THE 'GREEN' CAR - CURE OR DISEASE?

The effect of green issues on the social, economic and design aspects of the automobile.

by

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INTRODUCTION

With recent publicity and legislation on the pollution caused by the automobile, manufacturers are being forced to reduce the levels of harmful emissions from car exhausts. This has resulted in a struggle to find the most viable solution to the problem in the shortest space of time. There have been several various approaches in the attempt to 'green' the car industry. These include the search for alternative power sources, improvements in fuel economy, improved engine designs and cleaner manufacturing techniques.

This thesis will examine how green issues have affected the car industry, what changes have occurred in recent years, and the implications that these changes will have on the automobile's social, economical and design aspects. Whether the automobile may have suffered rather than benefitted as a result of these changes will then be discussed.

While many scientists remain undecided as to what extent pollution from cars will affect the environment, this thesis asks, has the need for zero emissions taken undue priority over the quality of design and performance? While some scientists argue that the present rate of carbon dioxide emissions will cause the earth's temperature to rise by 5 degrees celsius, resulting in severe floods and droughts, others claim that the rise in temperatures will be of a much smaller, more acceptable level, and will have no great consequence on the environment.

With increasing pressure on the car industry to reduce the levels of pollution associated with automobiles, what direction should the industry take to meet new legislation and public approval? Many believe that the internal combustion engine's days are numbered and alternative fuels are the only true path to achieving a cleaner environment. Comparisons will be drawn between petrol cars and the alternatives to establish their potential as cleaner vehicles for the future.

The increasing 'green' trend in consumerism has also opened up great possibilities for financial gain in the car industry. To be 'green' is

now highly fashionable for both consumer and manufacturer. The motivation for the consequent changes in advertising campaigns will be examined.

Chapter I deals with the actual technical developments that have occurred in petrol cars, as a result of green issues. This includes, modifications to the automobile, such as the catalytic converter, improvements in engine designs, and further developments in fuel economy. How these developments compare with alternative fuels will also be addressed.

Chapter II discusses the search for alternative fuels and briefly examines some of the proposed alternatives. The advantages and disadvantages of each alternative are compared to those of petrol cars, and their feasibility questioned, particularly in relation to cost and performance. If reducing the levels of toxic emissions from car exhausts forces the consumer to accept inferior performance at a higher price, one must question the extent to which green issues should dictate automobile design?

Chapter III comments on the automobile's success and the car industry's rapid growth in the past century. The car has been a source of fun, freedom and personal enjoyment. Its success has grown with improvements in performance, speed and efficiency, and it is these same characteristics that are today being compromised, both by legislation and prevailing green trends in society. The automobile's role as status and virility symbol is also discussed, and the ability of the new, less powerful, environmentally friendly vehicle, to compare with the internal combustion engine is challenged.

The car's success however, has led to rapid growth in sales figures and increasing numbers of automobiles on the road, which will eventually cause extreme traffic congestion in urban areas. This chapter will examine some of the proposed solutions to this problem and analyse how, or if, they can be achieved.

Chapter IV investigates how the ever-increasing trend towards buying green products has allowed the car industry to exploit green issues. Many companies have jumped on the bandwagon in order to

promote an image of 'environmental awareness'. Examples of advertisements will be shown to illustrate this point. Volkswagen in particular, are among the forerunners in the establishment of a 'caring' image, especially through their 'Golf' advertising campaigns. This chapter will also address the concept of the 'green' car and will dispute its possible existence.

Chapter V addresses the economic factors relating to the 'greening' of the car industry. While many solutions have been offered in the attempt to reduce pollution levels, some may lose their feasibility due to some technical problem, or their social acceptability. Regardless of whether these criteria are met, the most important factor in a car's design is its ability to remain competitive with existing alternatives.

We cannot de-invent the automobile - it has become a vital necessity in our daily lives. Neither can we continue to pollute the environment at the present rate. A solution is required which can meet the demands of the environment, consumer and manufacturer without conceding the performance, efficiency and design aspects of the automobile.

Chapter I

Developments in Petrol Cars and Fossil Fuels

The present, there are 400 million cars on the road worldwide. The predicted figure for the year 2000 is 550 million. As the car is responsible for the majority of pollution in modern cities, changes must be made to delay any further increase in present pollution levels.

Petrol has been frowned upon as a hindrance to any form of cleaner society and many believe that alternative fuels can provide the only 'environmentally friendly' solutions. This is not necessarily true, at least not in the foreseeable future. Some developments in the design of the internal combustion engine have been more successful than the search for alternative fuels.

If manufacturers had initially concentrated their efforts on the research and development of the internal combustion engine, a successful solution might have been closer at hand than at present. This chapter discusses the developments that have taken place in the following areas;

-fossil fuels
-catalytic converter
-engine developments

Fossil Fuels

The burning of fossil fuels in car engines has been among the main contributing factors responsible for the present levels of air pollution in urban areas. Oil refineries and car manufacturers are constantly improving fuel quality and engine efficiency in the attempt to reduce emissions. Other concerns about the use of fossil fuels include the levels of potentially harmful substances emitted from the exhaust.

Concern about the use of lead in petrol grew with scientific evidence that lead seriously affected the intelligence of young children. This has not been directly linked to the quantities of lead in petrol. In

actual fact, most of the lead emitted from car exhausts is not an immediate danger to pedestrians' health as it falls to the ground and remains there as a fine powder. Unleaded fuel was introduced for the sole reason that leaded fuels could not be used in catalytic converters. It was never originally intended for use as a cleaner fuel as the lead removed was replaced with increased levels of benzene, a well known carcinogen. Unleaded fuel can only be regarded as cleaner when used in conjunction with a catalytic converter.

Before the introduction of the catalytic converter, diesel cars were considered by far the cleaner option. Their main drawback is the large quantity of particulates emitted from the exhaust. Apart from the visible damage caused by particulates, there is little scientific evidence of the extent to which they can effect the individual's health, although filters to remove particulates from the exhaust are currently being developed and may provide an adequate solution in the near future.

The Catalytic Converter

Although generally considered adequate for its purpose, the catalytic converter (fig. 1.1) has come under much scrutiny and discussion recently. By restricting the car's exhaust, the converter can reduce the car's performance, but because it significantly reduces the levels of carbon monoxide, hydro-carbons and oxides of nitrogen, it has now become standard equipment, in most countries, with each new car purchased. There are two basic types of converter;

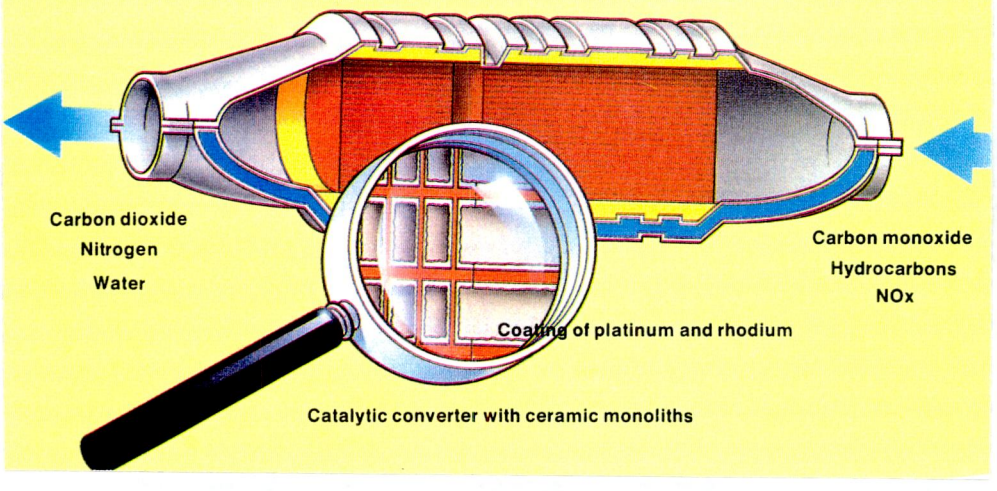


Fig. 1.1: Catalytic converter

1.Two-way converter

It can reduce emissions by up to 50%. In two-way converters, two reactions take place;

-carbon monoxide is oxidised to carbon dioxide

-hydrocarbons are oxidised to water and carbon dioxide

Oxides of nitrogen are not reduced.

2.Three-way converter

It can reduce emissions by up to 90% (when operating at peak efficiency). Apart from reducing carbon monoxide and hydrocarbons, it also reduces the level of nitrogen dioxide.
(Ahern, 1990, p.216)

Catalytic converters require certain conditions in which to operate efficiently, many of which can not always be achieved. Firstly, they require a sensor, to control the ratio of air to fuel. In older cars, that have converters fitted at a later stage, this sensor is not present, and therefore one cannot confirm that the converter is operating efficiently. They also require high temperatures in which to operate. On colder days, it may take five minutes or more to reach the required operating temperature. If the driver wishes to make a short journey, the converter becomes relatively useless.

Converters can also be very easily damaged, and if not properly maintained, will not operate to their full capabilities. In uncontrolled converters, there are no systems of displaying the converter's efficiency to the driver. If the engine performance improves due to converter inefficiency, then the incentive to have it correctly tuned will be lessened.

Many converters can cause a loss of power from the engine and an increase in fuel consumption. This, in turn, leads to increased carbon dioxide emissions, which although not as harmful as smog, contribute to global warming. An increase in fuel consumption also means an increase in cost for the consumer. As converters vary in price, from £300-£2,000, they will significantly increase the initial cost of automobiles. Their high cost is partly due to the use of platinum and

rhodium in their design (fig. 1.1). Platinum is more precious than gold and yet it is now a standard requirement in car exhausts.

The converter's life span is relatively short compared to the automobile's. It has been stated by many manufacturers that the converter's life span will 'most likely' stretch to the car's-provided it is not mistreated. Tests have shown however, that the average life span of a converter is approximately 30,000 miles, although in some cases it may stretch to 50,000 miles. When the converter reaches the end of its useful lifespan, the problem emerges that many companies have not made adequate provisions to recycle the precious metals used in each converter.

Apart from the cost factor and technical drawbacks, there have been reports of nausea, dizziness and even vomiting as a result of the odour from the catalysed exhaust leaking into the cabin.

It appears that the catalytic converter although somewhat successful in reducing smog levels, is not particularly beneficial to the automobile, its industry or the consumer. The general public are being forced to accept a very costly solution to the problem of emissions controls, which can only function effectively under limited conditions, has a shorter working life than most cars, is very easily damaged, and increases fuel consumption. The catalytic converter is detrimental to both driver and automobile. If used properly, it only serves to temporarily alleviate the smog problem until a more efficient solution can be found.

Engine Developments

Two-Stroke Engine

Research into two-stroke engines has been in progress for several years by the Australian company, Orbital. Although the two-stroke had a bad reputation for inefficiency and often emitted a vile, blue smoke from its exhaust, (as in the East German Trabant), its potential for reducing levels of oxides of nitrogen has been one of the main reasons for the new-found interest in its design.

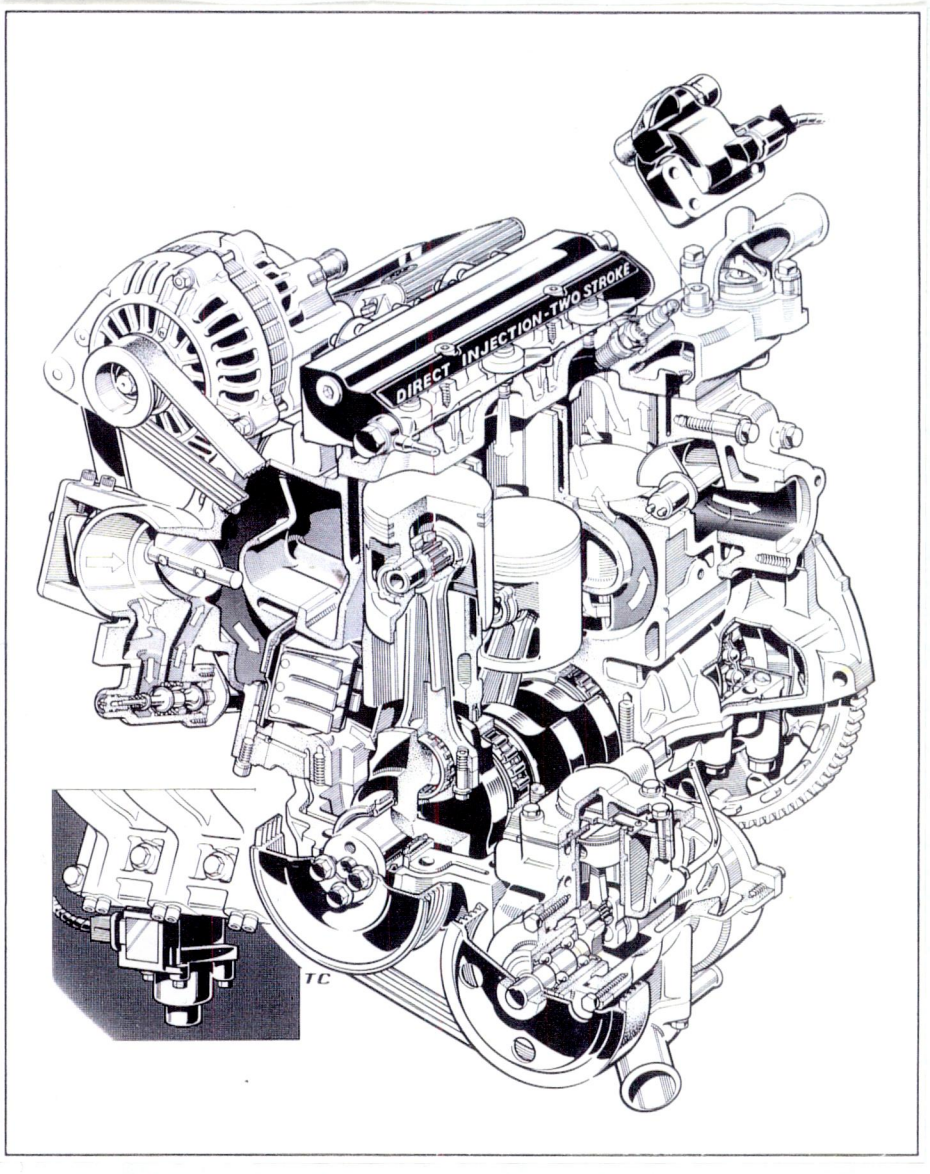


Fig 1.2 Two stroke engine - emits 5 times less oxides of nitrogen than four stroke engines

Development of two-stroke engines is far from complete. Orbital are Currently testing a new engine (fig. 1.2), Which they claim will meet the most stringent emission standards and will also cost less to manufacture than four-strokes due to a 50% reduction in parts.

If successfully developed, the potential benefits of the two-stroke engine are many. Its lower weight would increase the power-to-fuel ratio and its smaller size would allow for more significant design improvements (fig. 1.3).

Fig. 1.3 GM Prototype shows the packaging advantages of the two-stroke.

This General Motors prototype shows some improvements that can be possible with two-stroke engines. Apart from the a more spacious and comfortable cabin, the engine will require less maintenance due to the 50% reduction in parts. The car conveys a clean image through its uncomplicated design.

By the mid-90's, GM intend to have a two-stroke automobile on the market.

Saab's Trionic System

The Swedish car manufacturers Saab, have recently developed a new electronic engine management system which enables the car to clean the air as it drives. It has been reported that the new engine causes "less pollution running from New York to Los Angeles than a lawnmower cutting grass for two hours". (Nuttall, 1992, p.12)

The improved system is the result of a powerful electronic brain which can monitor and control engine combustion, to improve the way in which petrol is burnt.

Numerous tests have shown that the levels of hydrocarbons and oxides of nitrogen were much lower than those in the surrounding atmosphere. Its ability to reduce levels of carbon monoxide is limited to driving in congested traffic. As most cities suffer from traffic congestion, this solution may become more feasible in the near future.

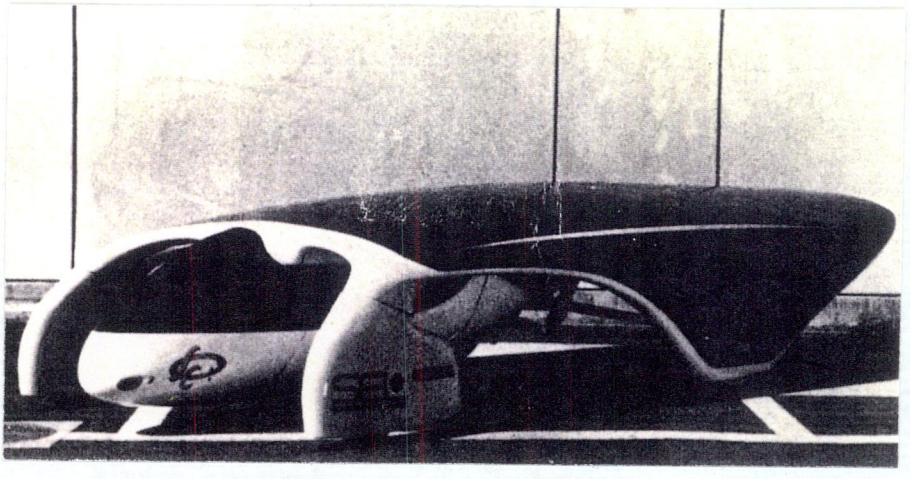
Chapter II
Alternative Fuels

The quest for an alternative fuel has now been undertaken by many car manufacturers. This is partly due to legislation on air pollution, and pressure from the general public. Also, car manufacturers are becoming increasingly aware of the need to prepare for a time when the earth's supply of fossil fuels has been depleted.

This quest has involved the exploration of several different alternatives which will be discussed in this chapter. Many of the solutions found, although perhaps innovative and interesting, have not been very practical or marketable for one reason or another. The following discussion analyses some of the proposed solutions and weighs up the advantages and disadvantages of each.

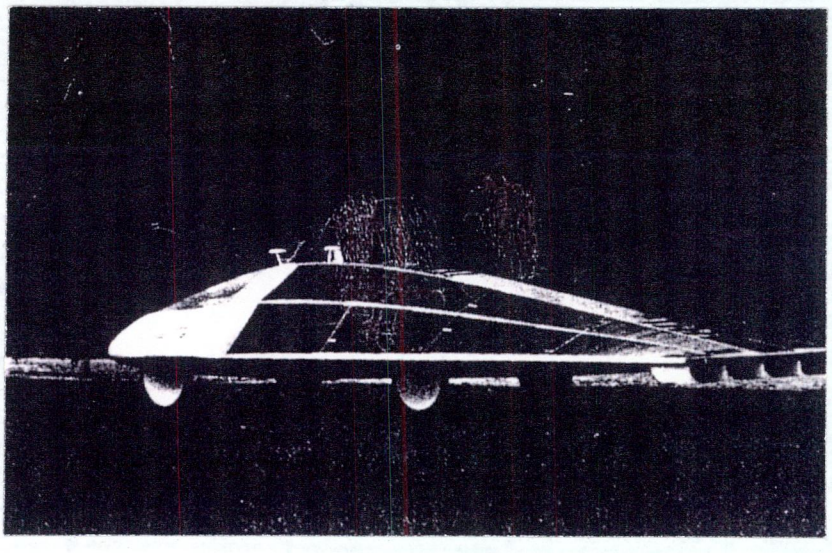
Solar Energy

The obvious drawback of the solar-powered vehicle is that it can only operate during daylight hours. However, relatively successful experiments with solar powered cars have taken place throughout the world. Various models were built, each requiring a very large surface area to obtain enough energy to power the vehicles. It can be clearly seen from the illustrations (fig. 2.1 and 2.2) how the designer's capabilities are limited by the restrictions of this still underdeveloped technology and the end result are bizarre forms which are unsuitable for use on modern roads. This is not only due to their appearance, but the minimal weight of the cars which is needed to improve their performance, would greatly increase the risk of injury to the driver were he to collide with a heavier, more powerful vehicle. Solar powered cars cannot presently compare with the performance of petrol cars. The average speed of the faster models was 65kmph. Much more research and development is required, before the solar powered car can become a practical option for the consumer.



Above: Fig 2.1 Mazda-SEL solar car. Below: GM's Sunraycer.

Hydrogen



The possibility of using hydrogen as an alternative fuel to petrol has been explored by Mazda. The end result has been the HR-X (fig. 2.3) which meets the strictest emissions regulations as the only end product from the exhaust is water. Due to hydrogen's flammable nature however, it causes many problems for designers and manufacturers in meeting safety requirements. Its potential as an environmentally friendly fuel is questionable as it requires large amounts of generated electricity (to divide water into oxygen and hydrogen). If used on a large scale water emissions from the exhaust can have an adverse effect on the climate.

Fig. 2.3 Mazda HR-X:Fuelled with hydrogen

Methanol

Methanol has been widely considered a likely alternative to petrol, especially in the United States where both have been successfully combined in the same engine. Others have frowned upon methanol as a 'misguided notion'. There are many who doubt its potential to significantly reduce emission levels. Like many other alternatives, its technical drawbacks include a reduction, both in performance and range. Methanol is also corrosive to steel which, in turn, limits the vehicle's manufacturing possibilities.

Fig. 2.4 Audi Duo:Gasoline-electric hybrid

Hybrid

The petrol/electric hybrid combines an internal combustion engine with battery. It has generally been considered by car manufacturers to be among the more practical of developments. Volkswagen/Audi group have adapted their Golf and have also produced the Audi Duo (fig. 2.4). However, because it is powered by electricity, combined with either diesel or petrol, two engines are used alternately to operate the vehicle. This greatly increases the car's weight and can considerably reduce its performance and fuel efficiency. A car of this size usually offers a large loading capacity. In the Duo this is reduced due to the area required by the secondary power plant. However incorporating the hybrid technology into a standard bodyshell, provides a more conventional alternative and therefore increases consumer acceptance.

Electricity

The modern electric vehicle is widely considered to be the most likely alternative to petrol. The technology used nowadays however, has not greatly advanced from the electric vehicles that were in operation 100 years ago. The same electric vehicles became obsolete, due to their inferiority to the internal combustion engine. The only reason for their manufacture in the late twentieth century is because of government legislation. This has led to a regression rather than a progression in the automobile's development.

Although the electric car has many advantages (it is clean, silent, and does not draw from the earth's limited supply of fossil fuels), it also has many drawbacks. Apart from its limited speed and range, the electric car only makes sense if the electricity used, comes from clean forms of energy (as opposed to the burning of fossil fuels).

Table 8.2: CO_2 emission of Golf Diesel and Electric Golf

Vehicle	**Golf Diesel**	**Electro Golf**			
Raw materials	**Crude oil**	**Crude oil**	**Nat. gas**	**Hard coal**	**Brown coal**
Primary energy consumption in kWh per 100 km	78	82	73	79	82
CO_2-emission factor in g/kWh	290	290	190	330	400
CO_2-emission in g/km	226	238	139	261	328

Source: Volkswagen

Fig. 2.5 The above table shows how electric vehicles can produce more carbon dioxide than a diesel engine.

Volkswagen have tested their battery operated Golf, and the equivalent diesel version to establish levels of carbon dioxide emissions. The table (fig. 2.5), shows how electric vehicles can sometimes produce more carbon dioxide when the energy required is obtained from fossil fuels such as coals or crude oil. In Germany, the majority of electricity is generated from brown coal. Therefore, any attempts to manufacture

an electric vehicle in Germany would defeat the purpose of an environment friendly vehicle.

Most of the present designs are powered by lead-acid batteries which are extremely inefficient, and must be replaced every two to three years, the cost of which varies from £1,500 to £9,000. Because of these problems, other types of batteries are currently being researched, but they too have their drawbacks. To begin with, most batteries require high starting and operating temperatures (between 250-600C). The sodium-sulphur battery is highly corrosive, while the nickel-cadmium battery poses recycling problems, considerably reducing its 'green' attractiveness. For the moment, the highly inefficient lead-acid battery remains the best option.

Other disadvantages of the electric car include the length of time required to recharge the battery which in many cases can take up to eight hours or longer. This can deny the owner spontaneous use of the vehicle in case of emergencies for example. Some batteries however, can be partially recharged in much shorter periods of time.

The initial cost of purchase for an electric car is estimated to be on average, 20-40% higher than present cars on the market. The Volkswagen Golf CityStromer (whose range is limited to 81km) is priced at £23,750 while the Jetta is even more unrealistically priced at £42,400. These high prices are mainly due to the cost of the batteries. The initial cost of purchase and subsequent battery replacements should effectively deter even the 'greenest' of consumers. The high cost is also due to low production numbers, to a certain extent creating a 'catch 22' situation.

It has often been stated that the electric car shall be purchased by multi-car families and will be a novelty item for those who wish to portray a certain 'green' image. The consumer who buys an electric car will most likely already own at least one other car which he or she will use for longer journeys, thus, to a certain extent defeating the purpose of the zero emissions vehicle.

The electric car's novelty will also be increased due to the unusual design of many models. Their shape must be altered to accommodate the large batteries and electric motor. The weight and size are also important considerations. Due to the limited power of lead-acid batteries', these features must be kept to a minimum.

The Renault Zoom (fig. 2.6) has been considered a very feasible commuter vehicle for use in Paris (70% of the electricity in France comes from 'clean' nuclear energy). The Zoom is designed to make a strong statement about the owner, and appeal to the 'green' consumer. It is intended for use as a commuter vehicle, and as such, will be most commonly used in congested traffic. To overcome this undesirable feature of many electric cars, the Zoom attempts to portray an image of fun.

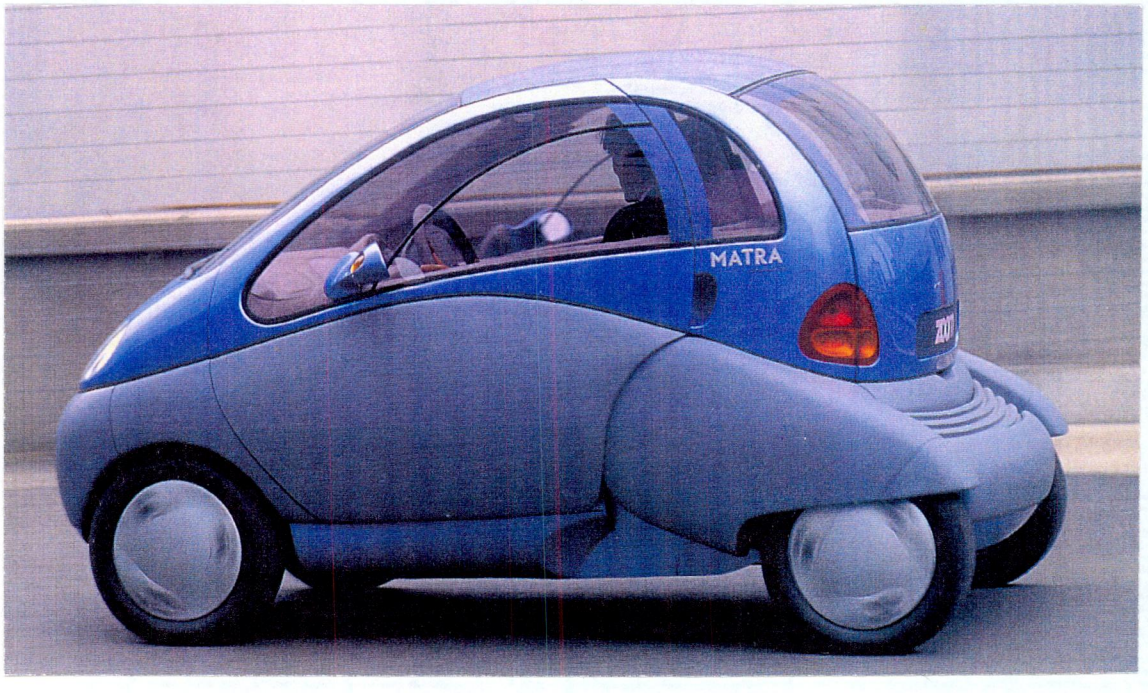


Fig. 2.6 Renault Zoom:Its futuristic shape belies the antiquated technology that lies beneath the surface

Fig. 2.7 GM Impact:Will be available in the mid-nineties.

The car's maximum speed is limited to 75mph and its urban range is 90 miles, which is quite acceptable for use in cities. At a constant 30mph its range can extend to 160 miles, which although impressive for an electric vehicle, cannot always be guaranteed.

General Motor's Impact (fig. 2.7), by its aerodynamic styling, is obviously aimed at the fast car market. Although designed to look powerful, the Impact's capabilities are not much greater than the Zoom. Intended to go into production in the mid-nineties, it is actually less practical than the Zoom, as its ability to reach faster speeds is achieved by compromising its range.

Biofuels - Ethanol and Rapeseed Oil

Experiments conducted with rapeseed oil in diesel engines have shown that the level of toxic emissions was similar and even greater in variety than those of petrol. The smell from the exhaust has been described as comparable to 'stale cooking fat'. To operate efficiently, rapeseed oil requires a modified engine design. Plans to manufacture such an engine are under way in Ireland. Two acres are all that is needed to supply an engine for one year. To provide enough fuel to supply all the country's needs however, would require vast acreage of land, most of which is presently needed for agricultural purposes.

Ethanol, being a crop fuel, shares the same problem. 100% pure ethanol can successfully reduce emission levels with only slight engine modifications. However, shortages of land on which to grow the crops and certain economic factors would make this unfeasible. One of the main environmental benefits from these fuels is that the carbon dioxide emitted from the exhaust is equivalent to that absorbed by the crops during photosynthesis.

Performance

Whatever the choice of fuel, it must compete with existing fossil fuels in terms of performance, cost and safety. Many of the proposed alternatives considerably affect the vehicles performance by limiting its range, speed or efficiency.

Solar powered cars, although drawing from the cleanest energy source, can still only achieve mediocre speeds and cannot be operated in darkness without a system for storing energy. Other options such as methanol, ethanol and electricity limit both the performance and range of the vehicle. A reduction in power (especially in the case of electric and solar-powered vehicles) requires that the weight of the vehicle be reduced to increase the power-to-weight ratio. In one sense, to reduce the amount of fast cars on the road may also reduce the accident figures. On the other hand, the driver of a lighter vehicle is at greater risk of injury if an accident occurs thus reducing the car's appeal to the consumer.

The electric automobile is probably the most feasible option for use in cities. It is presently more suited to driving in congested traffic than existing cars and although more costly to run, would substantially reduce local pollution. A breakthrough in battery technology is still awaited however, not only to improve the electric car's performance, but to reduce the cost of this expensive commodity.

Chapter III

The Automobile and Society

Success of the Automobile

After the Second World War, worldwide sales figures for motor- vehicles increased dramatically from approximately 50 million cars in 1945 to 320 million in 1980. During this time the smog problem had become an issue, particularly in cities like Los Angeles and Tokyo. Still, this did not affect car sales to a significant extent, and as a result, car manufacturers did not feel obliged to alter their designs to help control the levels of pollution. The car owner seemed quite content to drive a vehicle which emitted carbon monoxide, hydro-carbons and other poisonous gases into the atmosphere. Although cars run on petrol have their drawbacks, much of what has been achieved today would not have been possible without the internal combustion engine.

One might ask how this smelly, noisy alternative to steam-powered and electric vehicles captured the hearts and imagination of every generation for the past 100 years? In the early decades of this century, steam-powered and electric cars lost favour, due to lower average speeds of 20 to 30 mph, whereas cars run on petrol were reaching 50mph and higher. In the twenties and thirties, people simply wanted to drive faster cars, regardless of the noise or foul fumes. Nothing much has changed today. The element of speed fascinates everybody. It can be both exhilarating and completely terrifying. At the turn of the century, it was new and exciting. The petrol car made it possible for the individual to personally experience this new phenomenon. Apart from the excitement value, speed also gave the car owner a great feeling of power. In' Sex, Drink and Fast Cars', Stephen Bayley remarks;

> Perhaps the single most significant aspect of man's relationship with his car is the element of power...
> A fast car has reserves of power.
>
> (Bayley, 1986, p.7)

The feeling of power can not only be obtained by the speed at which the car is moving, but also from the engine's roar - a feature which is given great consideration in the automobile's design. The electric car, being silent in operation, loses this important quality and perhaps this loss may have been among the reasons for its decline early this century.

"The very suggestion of power has in itself a strong erotic content". (Bayley, pg.7, '86). The car's role as a symbol for both sexual prowess and status has certainly helped to boost the automobile sales figures. For many years, we have been aware of the erotic content of cars. Driving a car is not simply a means of getting from A to B. It is also regarded as a complete sensual experience.

In Japan for example, the senses of sight, smell, sound and touch are important factors in the automobile's design. The same consideration is given to the smell of the interior, or the sound of a closing door, as the car's actual performance and mechanical functions.

Our dependence on the automobile stems from a much greater need than transportation. Any attempt to de-invent the modern car would be akin to the castration of the entire male population. Apart from the psychological benefits of owning a powerful car, the internal combustion engine is a cheap, durable, compact, versatile, reasonably efficient source of power. Obviously, to the consumer, these design aspects take priority over environmental issues.

The Decline in the Automobile's Popularity

In recent years however, the car's popularity has decreased. This is not only due to the prevalent green trend in consumerism, but also the prevailing economic climate. The modern automobile is capable of reaching high speeds and has often been frowned upon for being a dangerous mode of transport. In 1979, when car sales had reached their highest figure ever, the number of motor-vehicle-related fatalities was 255,212. With increasing traffic congestion in urban

areas, the risk of accidents will increase even further and the automobile's image will suffer as a result.

While safety has become a more important factor of design and more of a selling point in automobile advertising, many road accidents could have been prevented by improved road designs, better street lighting and improvements in driver education and awareness. One must bear in mind that any machine is potentially dangerous if not used properly and it cannot be guaranteed that a car will always be driven by a sensible, or sober driver. Because car accidents cannot be prevented, it becomes the designers task to reduce the possibility of injury to a minimum.

Fast cars have come under much criticism for being unnecessary and only serve to encourage people to break speed limits and drive dangerously whereas in fact, a car that is capable of 170mph will be a lot more efficient to drive at 60mph than a car whose maximum speed is 120mph, because its engine is not using its full potential. Therefore it can brake quite easily at 60mph if necessary. Chances are, that a faster car will also have more in-built safety devices. Also, rapid acceleration to fast speeds allows drivers to instantly avoid dangers.

Also, if driving at fast speeds is considered by some to be very dangerous, why are the accident statistics for motorways and German autobahns much lower than most other roads? The idea that fast cars are dangerous, is a common misconception. Powerful cars are, when not abused, probably the safest vehicles on the road.

Because many of the proposed alternatives to petrol compromise on power and efficiency, the resulting cars will be much lighter and in many cases, smaller, to compensate for the loss of performance. This will damage the handling characteristics of the car and also increase the driver's risk of injury in the case of an accident. The Swedish company, Volvo, who are widely perceived to be among the safest manufacturers worldwide, have a reputation for large automobiles.

Safety issues were not always given as much consideration as they are today. With increasing traffic congestion, the standard of safety features in modern automobiles must be exemplary. Smaller,

lighter vehicles will be less desirable to the consumer due to the inferior safety aspects of the design.

The Role of the Car in Society

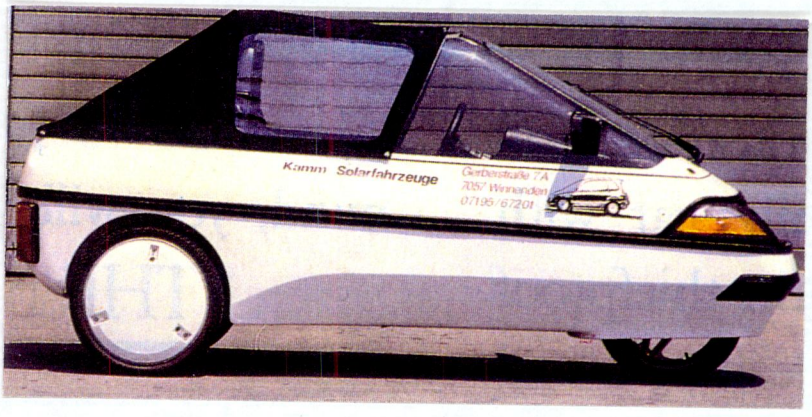
The car's invention has played an important role in the shaping of our modern environment. Quite literally, were it not for motor vehicles, our cities and towns would look quite different than what they do today. Automobiles have dictated the design of cities for almost a century, and yet proposals have been made to completely eliminate the private motor-vehicle from city centres to reduce air pollution and preserve the infrastructure. Such an act, apart from costing millions, would greatly restrict the mobility of many private car owners and force them to use public transport. The case for the removal of cars from the city centre is that accessibility is more desirable than mobility. Even the most well developed of public transport systems cannot give the same access, or variety of destinations as the private car. By restricting the private motor-vehicle owner's mobility, one might argue that thousands of people are being denied their right to the freedom of travel. Business in city centres would also be affected, as the flow of people into and out of the city would be more controlled and reduced in number.

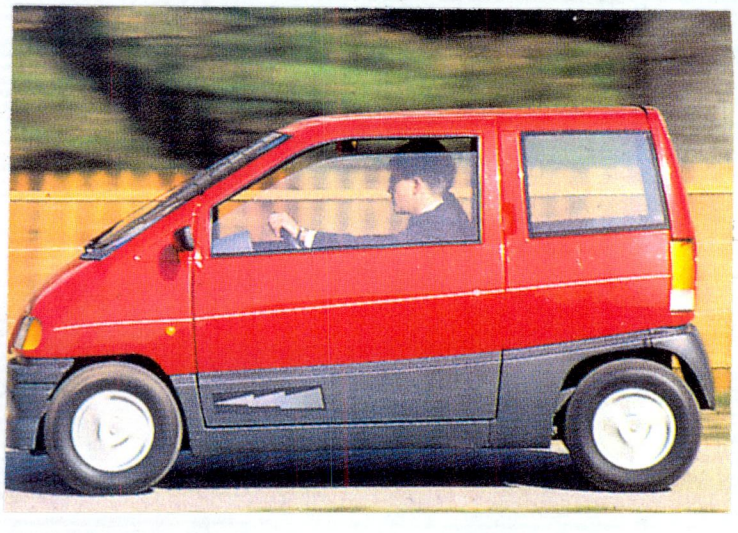
The automobile has changed our way of life. It has become a necessary part of day-to-day existence for many people and cannot simply be removed, replaced or de-invented. Industry has depended on the internal combustion engine for speedy deliveries of heavy loads over great distances. The automobile industry's enormous success could not have existed without the invention of the internal combustion engine. The oil and steel industries have also benefitted greatly from its production. Because of its speed, efficiency and versatility, it has given many people great personal freedom, mobility and enjoyment. The car has inspired writers, moviemakers and artists, each drawn to the dynamism, symbolism and power that emanate from the automobile. Over the past 100 years, the car has become firmly rooted in our culture, not only in function but also in form.

Because car manufacturers are now pressurised into finding new sources of power (as opposed to petrol), car designs may radically change to accommodate this new technology. The Renault Zoom, discussed earlier, is one example of how cars may look in the near future - portraying an image of fun as opposed to power. A radical shift in the automobile's appearance might dislocate much of the imagery which has contributed to the car's success.

The following examples (fig. 3.1) clearly show how the limitations of electric vehicles extend far beyond the technical aspects of the design. Gone is the sweeping engine bay, which contained the powerful heart of the machine. The long, low, sleek vehicle is replaced by shorter, higher forms and in some cases, the presence of aerodynamics seems non-existent.

If the modern automobile symbolises male sexual potency, to replace the existing, high performance powerful cars with less well developed technology and imagery would have a damaging effect, not only on the design of the motor vehicle, but also on the male ego.





Top: Fig. 3.1: El-Trans Mini-el-city (Denmark). Middle: Fig. 3.2: Penguin 4 (Germany). Bottom: Fig. 3.3: AMSOC Electric car (Italy).

Chapter IV

Exploitation of the Green Issue

Following poor media coverage and increasing green trends in consumerism, many car manufacturers saw the potential for financial gain through presenting their products and themselves, as environmentally aware. In the race to corner the 'green' section of the market, the need for presenting a 'green' image has apparently taken priority over actual changes in design.

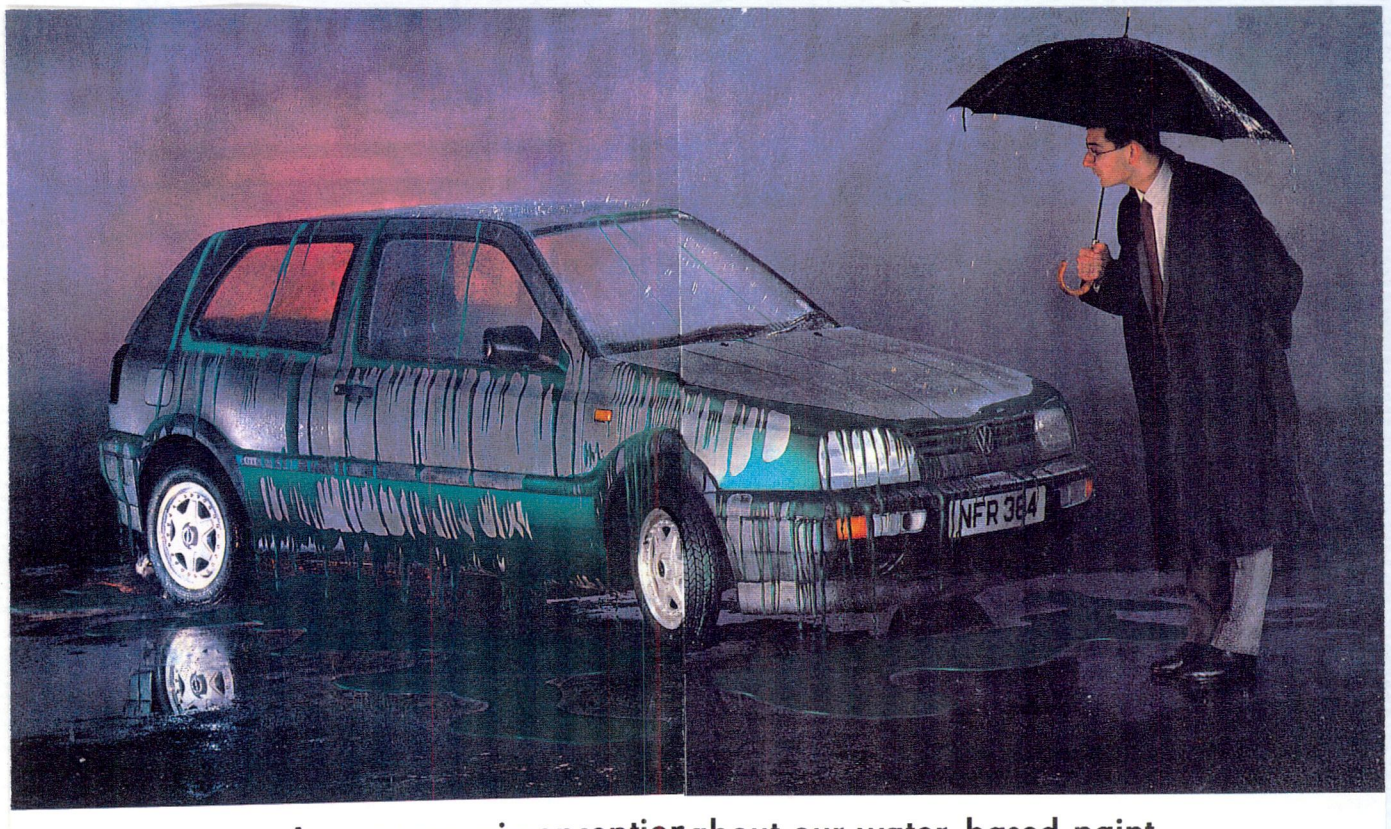
> "At Volkswagen, environment friendly vehicle design and production is as much a matter of course today as the objective of making a decisive contribution to the development of ecological transport systems. That is not a matter of faith, but an indication that we are aware of our great responsibility for a healthy environment and a future worth living."
>
> (Goeudevert, 1991, p.2)

This statement typifies the comments being made by car manufacturers, both to preserve their image and their sales figures. The term 'environmental awareness' has been commonly exploited by the car industry in an attempt to present their products as environmentally friendly machines.

To promote a car as being 'green' is a contradiction. The car, by its design, is completely incompatible with green issues. Car manufacture is based on heavy industry which is inherently linked to pollution. No amount of packaging or imagery can change that fact. Pollution has always been an inescapable part of progress, dating right back to the industrial revolution. Regardless of whether a car is run on petrol, electricity or solar power, it will still require a substantial amount of energy to run, or large amounts of raw materials to be mined from the earth's resource supply.

The German manufacturers Volkswagen, have one of the best reputations for 'greening' their cars. This is mainly due to their intensive advertising campaigns, emphasising what 'improvements' they have made, in their quest for the 'environment friendly' automobile. The following are some examples of advertisements for the 'Golf' which show strong emphasis on environmental issues.

In the following advertisement (fig. 4.1) printed in 'Car' magazine, May 1992, the emphasis is solely on the fact that the level of solvents used in the priming, painting and waxing processes has been dramatically reduced. The 1991 VW Golf promotional brochure states more specifically, that the paint process has been reduced to a 'maximum of five stages'. Three years earlier, Audi, a subsidiary of Volkswagen, in their promotion of the Audi 80, placed emphasis on the car's 'rustproof' characteristics (fig. 4.2) which were mainly due to the car's '27 stage paint process'. Many car manufacturers gradually changed their marketing strategies from selling the performance aspects of the car to promoting its 'greenness' when green issues were becoming fashionable.



A common misconception about our water-based paint.

When the idea was first mooted, even we had our doubts.

But the boffins at Volkswagen are an obstinate lot.

Ten years and 1,700 million deutschmarks later, their persistence has paid off (thank heavens).

Not only is the paint on our new Golf free of toxic solvents like lead and cadmium.

It's as deep and lustrous as ever it was.

And not a run in sight. Rain or no rain.

Of course, environmentalists might be tempted to say, why stop at the paint?

We didn't.

The primer is water-thinned. So, too, are the filler coats.

And though the clear finish we finally apply contains a measure of solvent, the level is comfortingly low.

That said, it can never be low enough. Which is why we make up for it in other ways.

Those 320 kilos of wax we flood through every Volkswagen bodyshell? Solvent-free.

The wax skin that protects every new Volkswagen on its journey from factory to showroom? Solvent-free.

In today's climate, did you expect any less of us?

The new Golf.

Fig. 4.1: VW Golf advertisement

THE AUDI 80.

The submarine will rust before the Audi.

Audi

If you happen to be in the market for a new submarine, don't worry. It's unlikely to fall apart over the next couple of years.

We'd just like to point out that the steel body of an Audi 80 enjoys a level of protection not given to your average sub.

In fact, it offers a level of protection not given to any other saloon car.

For a start, the steel body of the Audi is made of steel that's been 100% galvanised on both sides.

This protects the car in two ways.

Firstly, the layer of zinc is itself highly resistant to corrosion and physically protects the steel.

Then, should the paintwork be chipped and the steel exposed, the zinc will oxidise to form a protective coating.

It heals in exactly the same way that a cut heals.

In addition, the seams on the doors, bonnet and boot lid are bonded with PVC and the body cavities are filled with wax.

Only then does the car undergo its 27 stage paint process.

How else do you think we can offer a 10 year anti-corrosion warranty?

VORSPRUNG DURCH TECHNIK.

Fig. 4.2: Audi 80 advertisement

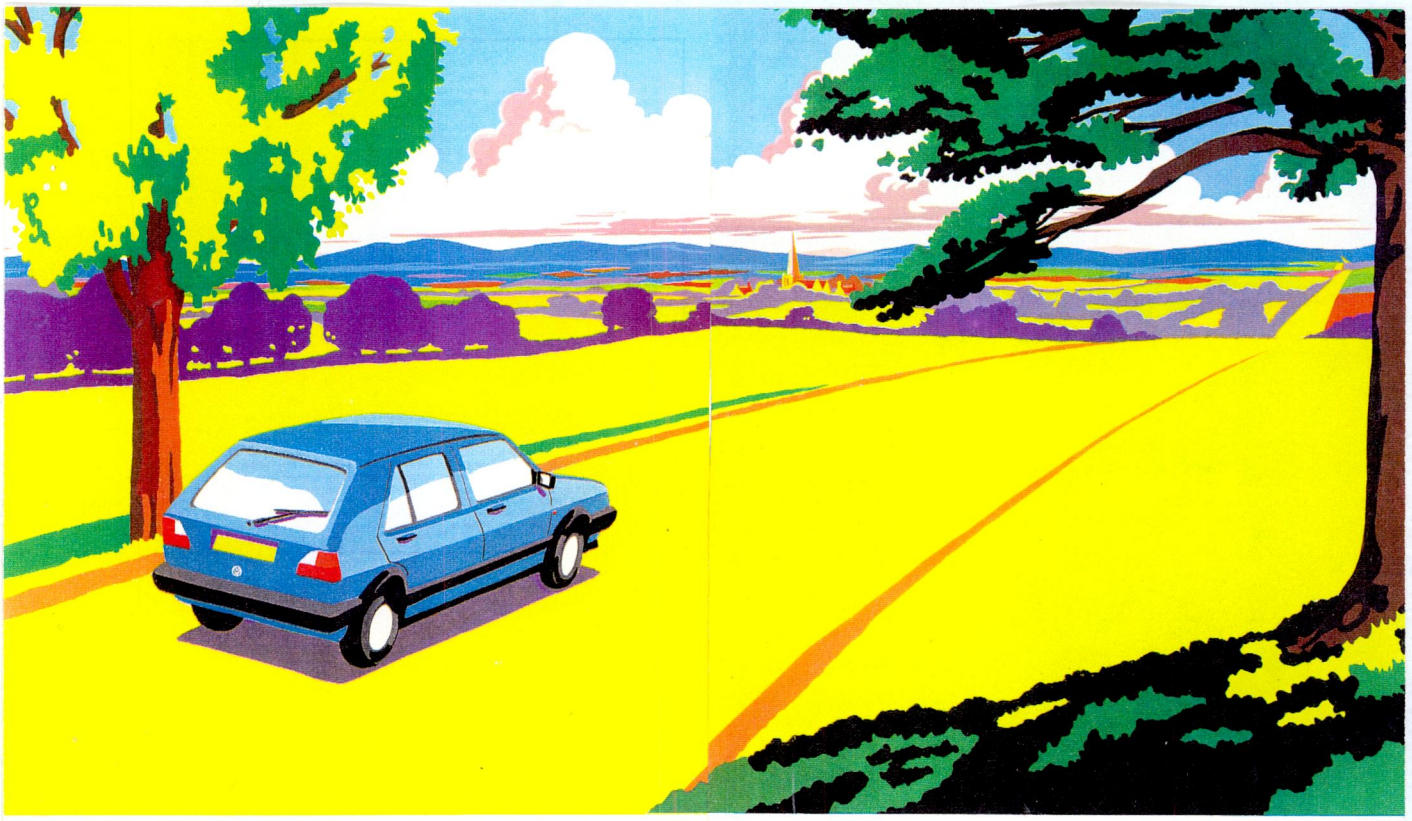
Volkswagen's marketing strategy for the Golf now concentrates solely on the environmental aspects of the design and to a certain extent, safety issues, yet practically ignores aspects such as rustproofing and performance. Taking the entire automobile into consideration, the paint processes referred to in the advertisement are very minor aspects of the design, yet Volkswagen have used this single improvement in an attempt to convey the entire car as an environmentally friendly vehicle. Car manufacturers are also prone to stressing the fact that the decision to incorporate a catalytic converter onto all their new cars stems from an environmental awareness rather than government legislation.

This exploitation of green issues is now widespread throughout the car industry. The following examples demonstrate how images and words are manipulated both blatantly and in a more subtle manner. Fig. 4.3 places more emphasis on Audi's 'environmental awareness' than the actual benefits of the catalytic converter through the use of image and wordplay. Fig. 4.4 also uses wordplay to combine the element of high performance with an 'environmentally friendly' automobile. Though these advertisements portray environmental awareness in car design, they explicitly misguide the consumer.

The exploitation of natural imagery is a recurring theme in advertising in the attempt to present the car as a green machine (fig. 4.5). Again, the Golf is presented as a clean car, not through the use of words, but by its depiction in a bright, sunny environment - subtly implying that the car will have no adverse affects on the environment.

Fig. 4.3 Audi advertisement

Fig. 4.4: Peugeot 205 advertisement



What better day to test our new 4-wheel drive.

Blue skies up above. Firm and dry underfoot. Everywhere sweetness and light.

Has Volkswagen's first-ever 4-wheel drive stumbled into the wrong ad?

Or is there more here than meets the eye? There is indeed.

With the Golf Syncro, you don't engage a thing. And what you don't engage, you don't have to disengage. In other words, the system is permanent.

Nothing new in that, you may think.

Until you consider the way *in which* it is permanent. It's there when you need it and not when you don't.

If you're bowling along on a perfect Summer's day (remember those?), the Syncro behaves just like front-wheel drive.

But at the first sign of 'slip' (any of the 215 days a year it rains in this country, for example) into play it comes.

Thinking for itself.

It literally senses the precise amount of power each wheel needs for maximum traction at any given moment.

Then adjusts automatically. And imperceptibly. All you feel is confident and relaxed.

The fact is, the Syncro gives you the best of all worlds.

In normal conditions, it performs like any other Golf.

While in sticky conditions, it's even less likely to come unstuck. **Golf Syncro**

FOR PRICES AND BROCHURES CONTACT VOLKSWAGEN INFORMATION SERVICE D22, YEOMANS DRIVE, BLAKELANDS, MILTON KEYNES, MK14 5AN. TEL: [illegible] FLEET SALES: [illegible] EXPORT SALES 01-486 8411

Fig. 4.5 Volkswagen Golf advertisement

Other developments in the design of automobiles include the introduction of recyclable plastics and components, a fact also well advertised by car manufacturers, in particular, Volkswagen. The use of recyclable plastics can only become feasible if a proper recycling facility is set up (at great financial expense to car manufacturers). A more direct approach is to simply re-use old parts, a method which has been undertaken by Volkswagen since 1947 (fig. 4.6 and 4.7) Although more economical and environmentally friendly than the use of recyclable plastics or reduction of CFC's, it is not advertised for fear that the idea of incorporating older engines into new cars will not appeal to the consumer and might affect sales figures. The 'greening' of automobiles does not stem from an environmental awareness, but rather a need to make a profit.

While manufacturers continue to advertise their cars as 'green' products, many of the developments advertised do not tackle the more urgent issues such as emissions levels, both on a local and global scale. Although reduction of CFC's in the manufacturing process and the use of recyclable plastics will, to a certain extent, benefit the environment, the majority of pollution problems caused by the car industry still remain unsolved.

Through its attempts to clean up its act, the car industry has made several changes which actually disimprove the design of automobiles rather than improve them. The catalytic converter is one example - minimising the use of paint is another.

The car industry and green issues have little in common, despite attempts by car manufacturers to tell us otherwise. Their conspicuous attempts to present the automobile as a green product have only tarnished the industry's and the automobile's image even further. The car, by its design can never become a genuinely green product.

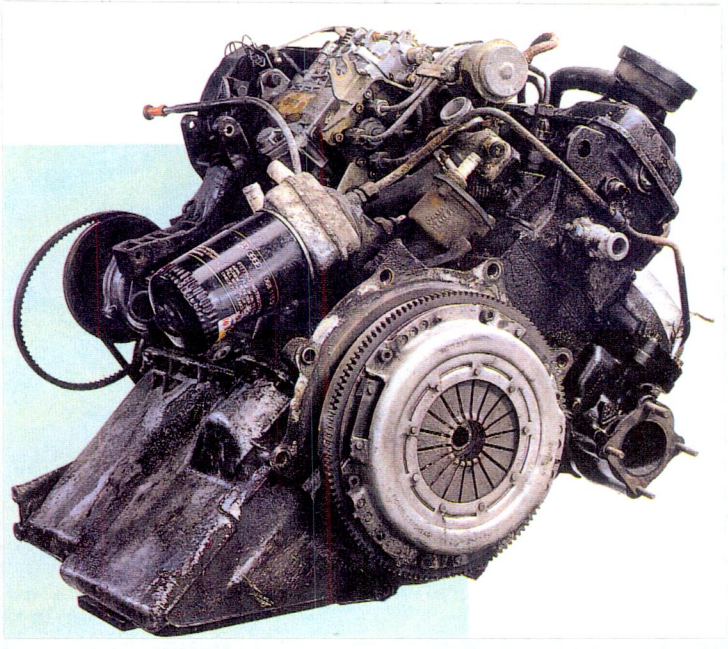


Fig. 4.6 Old Volkswagen engine

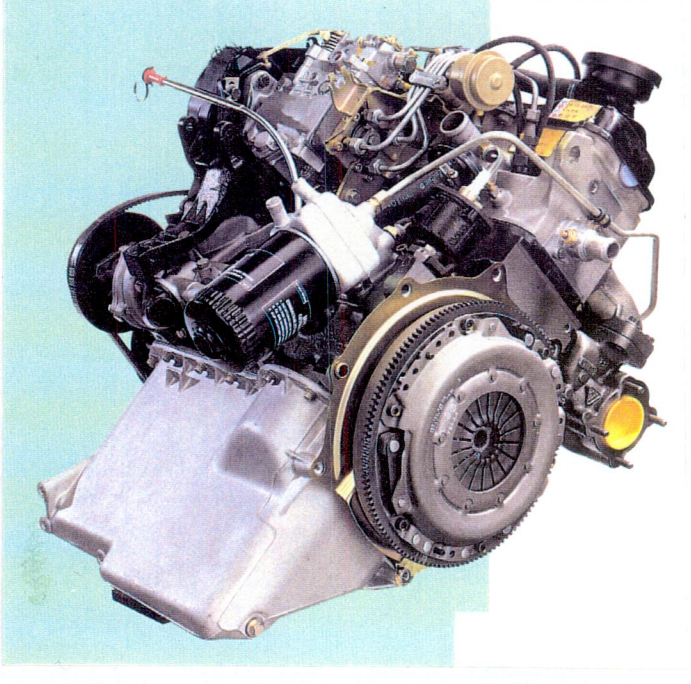


Fig. 4.7 Reconditioned Volkswagen engine

Chapter Five
Economic Factors

Taking into consideration the related industries, such as mining, electronics and oil refining, the car industry is among the largest in the world. The employment figures alone, are countless. An approximate figure, for the United States, established in 1979, indicated that almost one in every ten people was employed in a motor-vehicle-related occupation.

There has been a growing awareness of the economic significance of a healthy automobile industry. This is mainly due to its connection with the oil industry and the fact that much of the world's economy rests on the stability of this industry. Although the natural supply of petroleum is limited, and the car industry will be forced to find another power source, a premature switch from petrol to alternative fuels would have a damaging effect on the oil industry and the economy in general.

The depletion of the earth's natural supply of petroleum does not necessarily mean an end to the internal combustion engine, as certain alternatives, such as methanol and ethanol extracted from sugar cane, can be directly substituted for petrol with little or no modifications to the engine.

An experiment was conducted in Brazil in 1975 to assess the economic feasibility of ethanol for use in car engines. Brazil was suited to the experiment as it was one of the world's largest sugar producing countries and had a plentiful surplus of land, which meant that initial investment would be significantly reduced. Low sugar prices also gave farmers greater incentive to grow cane for ethanol. At one stage, there were 500,000 ethanol-powered cars on the road in Brazil. However, due to cutbacks in subsidies to farmers who grew the cane, the price of ethanol increased, which resulted in a switch back to petrol.

A similar project is currently taking place in Ireland, except the chosen fuel is rape seed oil (or Bio-Diesel). Like Brazil, the venture's success will depend on government subsidies to farmers to grow the crops.

However, the economic feasibility of the alternatives is the main deciding factor as to whether or not they can be mass-produced. Most of the alternative fuels would be too costly to consider on a large scale. Of the proposed options, the battery-powered vehicle could become very feasible if a breakthrough in technology occurs which would lower the cost of the batteries but this is unlikely to happen in the near future.

The reality of the situation is that car manufacturers are not prepared to abandon petrol as their main power source - to do so would mean certain financial disaster. The cost of research and development alone is tremendous which is why car manufacturers such as Volkswagen, will only incorporate recyclable plastics or solvent free paints into their designs, provided they can remain profitable.

At present, many alternatives to petrol cannot compete with current oil prices and as a result, are too costly to manufacturers to mass produce. While petroleum reserves diminish however, the cost of petrol will rise, creating an economic climate whereby other alternatives to petrol may become highly competitive. This is not likely to occur until well into the 21st century and in the meantime, fuel economy is constantly being improved to give oil supplies a longer life span.

Conclusion

The effect of green issues on the car industry has seen great activity in car design in recent years, as car companies research and develop various alternative fuels. Most of the proposed alternatives however, simply cannot compete with existing cars either on an economic or technological level. Designers are attempting to accomplish to much too soon, and the results in some cases are mere prototypes, destined only for the car showroom to await the promised breakthrough in technology. Paddy Corcoran, managing director of Fiat Ireland has stated that "the real technological advantage within our industry tends to be evolutionary rather than revolutionary." (Corcoran, 1992, pg.40)

The technology of internal combustion has steadly evolved over the past century which is the reason for its superiority. In comparison, research into the alternatives is still in its infancy, often due to oil companies efforts to suppress new developments. To find solutions for the problems associated with alternative fuels will take years of expensive research and development.

However while many manufacturers are being sidetracked into researching alternatives and other companies are more concerned with conveying a green image than the actual greening process, the real breakthrough has occurred in the internal combustion engine. If SAAB continue to develop their engine managment systems, and further improvments are achieved with two stroke engines, it seems possible that the current argument for alternative fuels will be partially eliminated (for the short term at least). Improvements in fuel economy also stand in favour of the engine management systems and the two stroke engine. Also a redeveloped internal combustion engine, unlike electric powerplants, does not detract from the sexual fascination of existing cars.

However, diminishing oil supplies will eventually cause the price to increase, creating an economic climate whereby certain alternatives such as ethanol or rapeseed oil can become competitive.

The ideal solution would be a direct substitute for petrol, that would require little or no engine modification, and effect performance as little as possible.

Even if a direct replacement for petrol is successfully introduced, the engine management system's technology will still be needed and current manufacturing techniques will need minimal modification. The direct replacement fuel still does not solve the emissions problem, yet the drawbacks will be much less than those of the alternative technologies. One must also recognise that pollution and progress have shared a symbiotic relationship ever since the advent of the industrial revolution. Pollution in the twentieth century is the price of development. As scientists are still undecided as to what extent pollution from cars will affect the environment, it is difficult to quantify permissible levels. Therefore do we have to decide on a permissable level of development also? If so, how do we develop a zero emissions vehicle? If the alternatives are still inadequate, as this thesis contends, then we can only strive to improve the internal combustion engine to bridge the gap until such time as the alternative technologies provide a viable option.

What is needed is a system which can meet the strictest of emission requirements, without compromising on performance, efficiency and design. It should satisfy the needs of the environment, consumer, manufacturer and the economy in general.

BIBLIOGRAPHY

BAYLEY, Stephen, Sex Drink and Fast Cars - The Creation And Consumption of Images, London, Faber and Faber, 1986.

GOEUDEVERT, Daniel, Corporate Task Environmental Protection, Wolfsburg, VAG, 1991.

NIEUWENHVIS, Peter, Green Car Guide, London, Green Print, 1992.

SEIDLER, Victor J., Rediscovering Masculinity- Reason Language and Sexuality, London, Routledge, 1989.

WISE, David Burgess, The Motor Car- An Illustrated International History, New York, Orbis, 1977.

PERIODICALS

AHERN, Brian,"Catalytic Converters", Consumer Choice, July 1990, pp216-218. London.

BENNETT, George, "Two Strokes May Power Your Car in The 90s",Car, April 1990,pp 124-127. London.

CAREY, John, "On The Sunny Side Of The Street", Autocar And Motor, Vol.186, no.11, 12 December 1990, pp40-43.

CORCORAN, Paddy, "Any Colour As Long As Its Green," Auto Ireland,1992, p40.

HAMILTON, Andrew, "Volkswagen Golf Nominated European Car Of The Year", Auto Ireland, Vol.22 no. 9, p4. Dublin.

HARVEY, Michael, "Short Circuit", Autocar and Motor, 7 October 1992, pp 46-47, vol; 194, no.2. London.

HORRELL, Paul,"Pole Vault",Car, October 1992, pp 100-103.

KACHER, Georg, "VW Golf Umweltdeisel", Car, April 1990, p72. London.

LEHMANN, Hans, "Renault Electric Show Car Shrinks To Park", Car, October 1992, p12. London.

McCARTHY, "Two Stroke Could Be Engine Of Future", Auto Ireland, September 1992, p20. Dublin.

McKENZIE, Debora, "Europe Threatens Court Action Over Germanys Clean Cars" This Week, Vol.35, no.5, January 26 1991, p20.

NUTALL, Nick, "Brainy Car Clears Up Air As It Drives", London Times, December 12, 1992, p12.

NUTALL, Nick, "Dirty Air Cleaned In The Engine", London Times, October 21 , p12.

VAUGHN, Green Cars May Hit The Road", Newsweek, June 8, 1992, p38.