

Alternative Fuel Vehicles

a report by SUHRID PALSULE

Guide: Prof. Ramachandran

Approval Sheet

The Industrial Design special project titled

‘Exploration of Alternative Fuel Vehicles ’

By
Suhrid K. Palsule
08613803

is approved as a partial fulfillment of requirements for Masters in Design
degree in Industrial Design Centre.

Project guide:.....



Introduction

1. Introduction
2. Synchronic
 - India
 - Abroad
3. Clean technology
5. Conclusion





Introduction

The Automobile:

Considered among the greatest influences of the 20th century, it has today reached an iconic status and are now an indisputable part of our lives.

Over 600,000,000 passenger cars travel the streets and roads of the world today. There is no doubt that mankind has benefited hugely from the use of this technology, but that progress has come at a price. Vehicles have had a huge impact on us and our environment, and most of it is not good. Today, every school-going kid is familiar with the terms air/noise pollution, global warming, ozone depletion etc. We now see vehicles as a prime issue to be dealt with, as our lives get more dependent on them each day.

This is an indicator of the magnitude/urgency of the problem at hand.

Steps are being taken to slow down the negative impact caused by auto's on the environment. This report documents the 'clean car' race and its significance.





AIR POLLUTION

In case of cars and all motorized vehicles, the amount of pollution caused in this category is phenomenally higher than any other single source/ activity/ product.

“Air pollution is an umbrella term that refers to the loss of air quality, due to human activities/ practices”. Mobile or vehicular pollution, as mentioned before is a major contributor to the overall air quality problem- Up to 14% of all greenhouse gas emissions are from transportation fuels. And half of a million people die every year from these particle emissions.

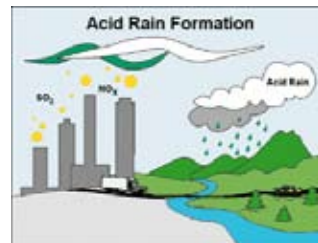
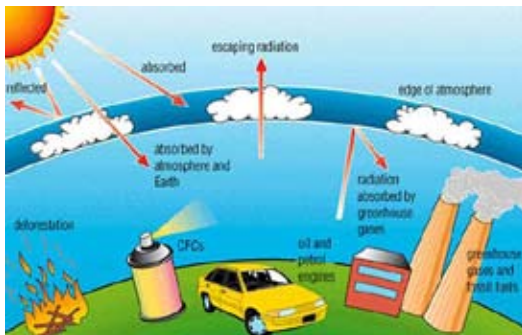
The term pollution also has sub-categories in it. Some of the most predominant forms of air pollution are;

1.Smog: Smog = smoke + fog.

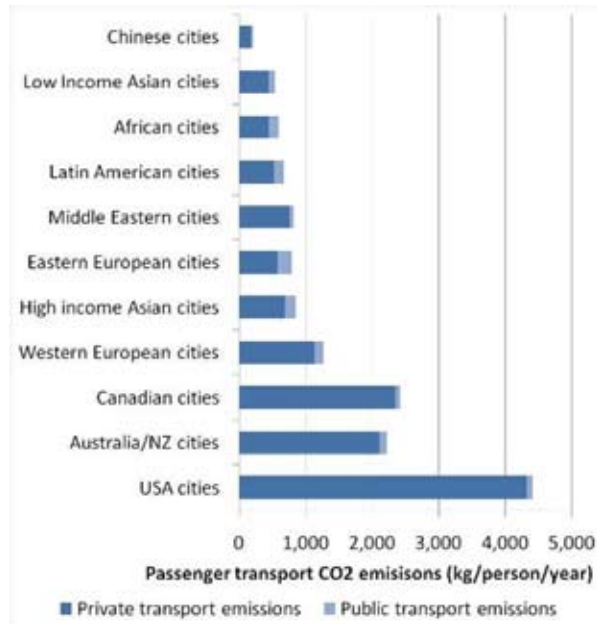
- In 1950s, photochemical smog was first described.
- It forms when sunlight hits various pollutants [nitrogen oxides (NO_x) and volatile organic compounds (VOCs)] in the air and forms a mix of inimical chemicals that can be very dangerous.

2.Acid Rain: Acid rain is rain or any other form of precipitation that is unusually acidic, i.e. elevated levels of hydrogen ions (low pH). It has harmful effects on plants, aquatic animals, and infrastructure. Acid rain is mostly caused by emissions of compounds of sulfur, nitrogen, and carbon (all by-products of vehicular activity) which react with the water molecules in the atmosphere to produce acids.

3.The Greenhouse effect: The greenhouse effect is the heating of the surface of a planet or moon due to the presence of an atmosphere containing gases that absorb and emit infrared radiation. Global warming is a direct consequence of this.

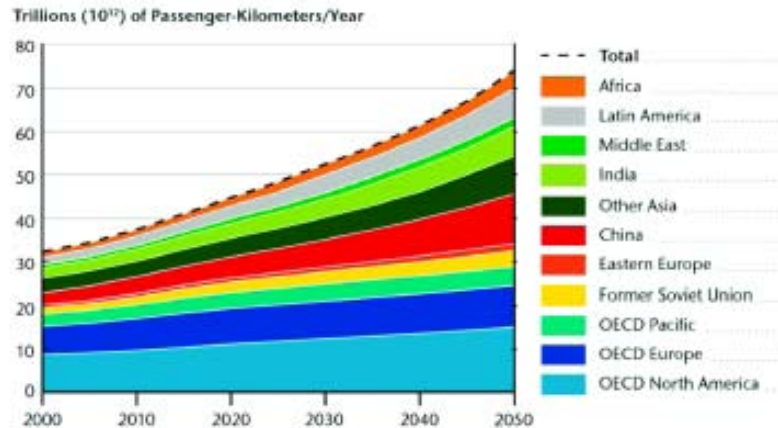


Why pollution is bad; (Problems of air pollution)



- Slowly ruins people's lungs to an extent as great as that of cigarettes.
- human body has difficulty defending itself against the harms of smog- Smog can cause chest pains, coughing, and throat irritation
- Other illnesses such as colds and pneumonia can also be brought on by exposure to smog.
- People with asthma problems are under an even greater threat. Even minor exposure to smog may cause these people to get asthma attacks.
- Agriculture is also hurt by air pollution. Soybeans, wheat, tomatoes, peanuts, lettuce, and cotton are all subject to infection when exposed to it.

Personal transport activity by region



Environmental Impact of cars;

The graph 1 shows the distance travelled by vehicles in the world and graph 2 shows the CO₂ emissions from vehicles, by category.

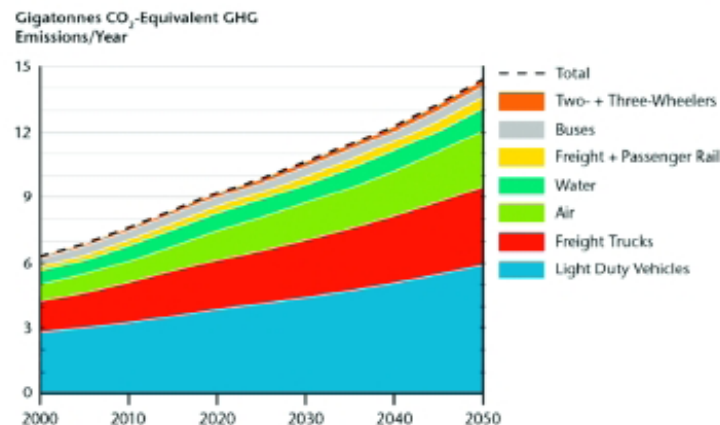
AIR POLLUTION

- CO₂ : one of the major sources of carbon dioxide emissions - it is the most important of the greenhouse gases which are widely believed to cause global climate change.
- NO_x, SO_x : Oxides formed at high temp and pressure
- Particulate matter: remnants of combustion such as ash

NOISE POLLUTION

- Noise: Traffic noise is a great nuisance, especially around busy roads.

Transport-related well-to-wheels CO₂ emissions by mode, 2000-2050



OTHER

- Production: Impacts from the production and scrapping of vehicles: eg. disposing of worn tyres, Lead in batteries, etc. can have considerable implications for the sustainable use of natural resources.
- road infrastructure impacts biodiversity and the physical environment
- vehicle collisions with wildlife also amount to a substantial dent on the ecological balance
- Effect of contaminated water running-off roads.



Prevention

Car Pollution Menace must be curbed:

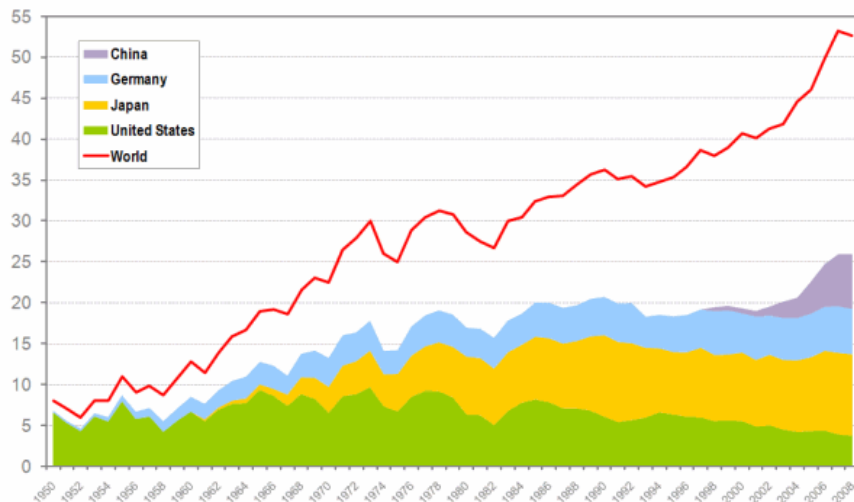
MODERN AWARENESS (early steps)

1952: The Great Smog of London killed at least 8000 people. This massive event prompted some of the first major modern environmental legislation, The Clean Air Act of 1956.

mid-1950s and early 1970s : Pollution began to draw major public attention in the United States, and Congress passed the Noise Control Act, the Clean Air Act, the Clean Water Act and the National Environmental Policy Act.

CAR SALES:

According to the “Global Auto Report” by the research arm of Scotiabank global new car sales will gain momentum in 2010 after an initial recovery in 2009 which could, they say, lead to record sales in 2011. In 2009, China surpassed the US as the world’s biggest car market, with sales surging by more than 40 per cent to 7.3 million units in 2009, with an additional 20 per cent growth expected in 2010 to almost 9 million vehicles, whilst in India, car sales also reached a record 1.4 million units in 2009.





Diachronic analysis: Alternative Fuels and Hybrids Have a Long History

- alternative fuels like ethanol and biodiesel are as old as the automobile itself. Also the hybrid was 'invented' over a century ago.
- Henry Ford advocated both recycling and renewable resources like agricultural products. The Model T was actually designed to run on ethyl alcohol, or ethanol, produced from corn. However, by the time the Model T appeared in 1905, gasoline was readily available, albeit from general stores, carriage shops, blacksmiths and liverys, which was not the case with ethanol.
- By 1920, the gasoline pumps were found throughout the country. Automobiles and trucks were in widespread use long before the gasoline infrastructure was equally widespread.
- From 1920 to 1924, the Standard Oil Company marketed a blend of 25-percent ethanol and 75-percent gasoline (it would be called E25 today) in the Baltimore area, but high corn prices combined with storage and transportation difficulties terminated the project.
- During the 1930s, more than 2,000 service stations in the Midwest sold ethanol made from corn, as gasohol. Gasohol could not compete with cheaper gasoline and the plant closed in the 1940s.
- another gasohol, a blend of 10-percent ethanol and 90-percent gasoline (E10) that appeared during the 1979 fuel crisis.

- In the 1890s, Rudolf Diesel ran his first diesel engine on peanut oil that today would be called biodiesel. He believed diesel engines would operate on a variety of vegetable oils. But petroleum-based diesel fuel was cheap and readily available, so it quickly became the diesel fuel of choice.
- By the late 1890s, electric vehicles (EV) were well developed in comparison to those powered by gasoline and steam.
- The years between 1898 and 1912 were the high point of electric vehicles in America.
- In 1905, 86-percent of the cars sold in the U.S. were powered by gasoline; electric and steam each captured about 7-percent of the market, the most in all EV history.



Green car history

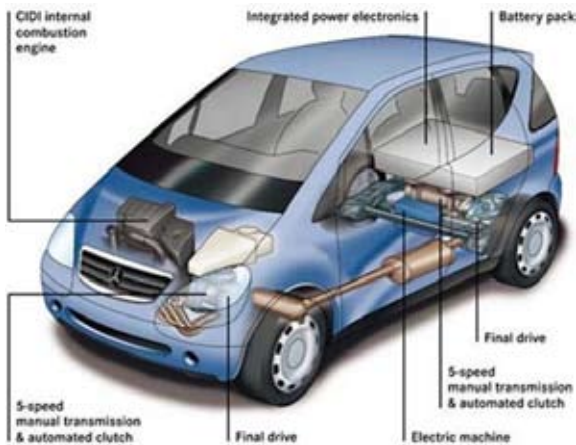
How did it all begin for green cars?

During the infancy of motoring, as the horse and carriage was originally phased out, many manufacturers believed that steam was the future for cars as it had been for locomotives. One of the most prolific manufacturers of this era was the Stanley Motor Carriage Company, which produced the Stanley Steamer from 1896-1924.

Between 1832 and 1839, the first crude electric carriage was invented and electric cars soon began to flourish in Europe due to the fact that they ran quieter and smoother than other cars. By 1890 America too had jumped on to the electric car bandwagon and cars built by AL Ryker and William Morrison earned notable recognition.

It was also prior to the turn of the twentieth century that electric cars broke through as commercial vehicles, making their debut as a fleet of New York taxis in 1897.

The peak for electric vehicles



The Detroit Electric Coupe was one of the most popular models of the early twentieth century and was even famously driven by the wife of Henry Ford. It was capable of travelling 80 miles on a single charge and could reach a steady speed of 20mph.

Indeed there were many electric models that earned widespread recognition around the turn of the twentieth century when sales briefly surpassed petroleum alternatives.

However, when Henry Ford began mass-producing petroleum cars beginning with the Model T in 1907, the writing was on the wall for the electric vehicle. They cost half as much and their capabilities far surpassed those of any green cars on the market - they could travel further and could achieve faster speeds. Electric cars effectively died out for several decades.

An alternative to petrol

Diesel engines were designed and patented in 1893 by Rudolph Diesel, but weren't placed into passenger cars until 1933 when Citroën introduced the Rosalie - the world's first commercially available diesel engine.

The concept was quickly expanded by General Motors in 1934. By 1936, Mercedes Benz began building the 260D - the world's first production diesel car. Peugeot followed suit by introducing

a diesel edition of the 402 in the same year and at last a popular alternative to petrol was established.

1960s revival of green cars:

Green motoring was reborn in the late 1950s and early 1960s thanks to a number of popular models.

First came the Vespa 400, produced from 1956-1961, which sold more than 28,000 models and was the only car produced by the established motorbike company. Then the memorable Messerschmitt KR200 arrived, built between 1957 and 1964, which featured a single-cylinder two-stroke engine.

Several cars with small engines took the spotlight in the 1960s including the Austin Healey Sprite and from 1959 onwards arguably the most famous small car of them all, the Mini.

Electric cars also enjoyed a mini-revival and in 1966, GM introduced the Electrovan. For the most part however, it was one and two-cylinder engines that were the most environmentally friendly and in 1970, the Bond Bug was introduced as a precursor to the Reliant Robin.



Oil crisis creates electric car concept boom

The 1973 oil crisis led to renewed interest in alternative fuels. Once again electric cars took centre stage, but for the most part their futuristic designs and limited capabilities meant they failed to grasp mainstream interest.

There were many hits and misses during this period, including the Electraction Tropicana, built in 1977, and the Zagato Zele which turned its manufacturers' reputation for producing beautiful, lightweight cars on its head with its high and square-cornered design.

1980s and 1990s: green cars get serious

In the 1980s, attempts to develop the green car concept reached new heights. In Switzerland for example, there was an annual race for solar-powered vehicles called the Tour de Sol. This ran from 1985-1995.

In 1991, BMW created a pair of battery powered E1 concepts that failed to get past the concept stage. In the same year, the Citroen Citela was born with a range of 130 miles and top speeds of 70mph. It was seen as the car of the future but relied on assistance from the electricity companies who were not so forthcoming.

Many other concepts came and went including the Fiat Downtown and the Peugeot 106 Electric - the latter actually obtaining some success in its native country of France. GM also introduced its first purpose-built electric vehicle, the EV1, from 1996-1999.





A green car millennium

Since the turn of the millennium the concept of green cars has expanded at a phenomenal rate. No longer are green cars a vision of the future - they are very much part of the present. This is thanks in part to the expansion of hybrid cars, which effectively plug the gap between electric cars and conventional vehicles. By combining a rechargeable energy storage system (RESS) and a fuel powered source to gain propulsion they are more economical and better for the environment than petroleum alternatives. Popular models include the Toyota Camry, which was once acclaimed as the top-selling passenger vehicle in America, and the Toyota Prius which in 2007 was the number-one selling hybrid vehicle world-wide. The concept has even been introduced into larger vehicles such as the Lexus RX400h, an off-roader. The Volkswagen BlueMotion Polo, which became available in 2007, cut CO2 emissions even further.

Hydrogen fuelled cars arrived in 2006 through the BMW 7 Series, while the Ford Airstream was introduced in 2007 with a lithium battery that was topped up by a hydrogen fuel cell. Electric cars advanced too and the Venturi Fetish, capable of travelling from 0-60mph in under five seconds, broke the mould of clunky and slow electric models. The likes of the G-Whiz also exploded in popularity thanks in part to its exemption from London congestion charges. With other legitimate incentives to go green in

the form of lower road tax, potentially lower car insurance premiums and of course more economical driving, this latest chapter in the history of green cars is the most significant and successful to date.

Epilogue

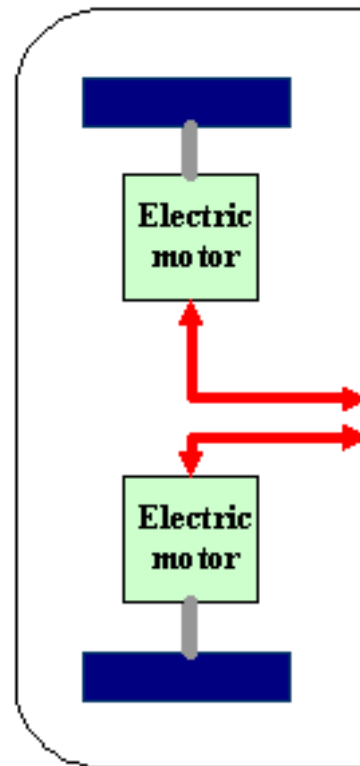
Who killed the electric car?

'Who Killed the Electric Car' is a documentary which unfolds a complex set of events around the development and demise of the modern electric car.

- The narrative begins to unfold with a brief history of the first electric cars created in the early twentieth century. These electric vehicles were killed off nearly 100 years ago as gas/petroleum powered internal combustion engine (ICE) cars became cheaper. In 1996, electric cars began to appear on roads all over California. They were quiet and fast, produced no exhaust and ran without gasoline..... Ten years later, these futuristic cars were almost completely gone. The movie continues to reveal what the various suspects did to kill the reality of the electric car, and the efforts of EV supporters to save them. Oil companies stood to lose enormous profits if EV sales took off and they colluded with others to kill the electric car.

Why electricity didn't work;

- The simplistic answer often given is the invention of the electric starter by Charles "Boss" Kettering, which first appeared on the 1912 Cadillac. In reality, it was the cheap gasoline-powered car, most notably Henry Ford's Model T and the establishment of an infrastructure to keep them running down the road.
- In the early 1900's electricity was still a novelty and also expensive. Electricity was not standardized. Much of rural America would not be electrified until the 1930s and even as late as 1945. Unlike gasoline cars that could go anywhere, electrics were pretty much confined to urban areas.
- Further, limiting the electrics popularity was their high cost, they rarely improved to match that of the gasoline car, and relatively low top speeds.
- By the mid-1930s, electric vehicle production essentially ceased.
- One of Dr. Porsche's first designs, the 1900 Porsche-Lohner, had electric drive motors built into the front wheel hubs with a gasoline engine supplying power. The Owen-Magnetic of the 1920s was an electric car with a gasoline engine driving a generator that supplied power to an 'electric' transmission.
- Fuel cell-powered vehicles are much more recent. GM developed the Electrovan in 1966. This pioneering concept vehicle demonstrated a propulsion system using electrical power developed by hydrogen and oxygen combined with potassium hydroxide. There was no need to charge and no petroleum fuel.





Synchronic analysis

1. Clean car scene in India

REVA: Reva car is the Indian face of AF cars. It was launched in 2001. Reva introduced Energy Management system (EMS) which diagnoses and rectifies the problem of over discharging and helps in better maintenance. To counter the general perception amongst people that electric vehicles are not safe, the Reva has incorporated safety features like the steel space frame, side impact beams, dent-proof ABS body panels, a low voltage system, and a dual-braking system. The Reva is offered in three variants — Standard (non-a/c), Air-conditioned and Classe. Priced at Rs 3.1 lakh (on-road) for the base variant and Rs 4.05 lakh for the Classe variant, the Reva is not exactly very affordable. The non air-conditioned base variant has a driving range of 80 km on a full charge, while the other two air-conditioned variants will give you about 60 km. Cute and super compact Reva which comfortably seat two adults and two kids offered in six colours. Reva has received investments worth USD 20 million recently from Global Environment Fund. The Reva is an electric car completely designed and manufactured in India!

o The Reva NXG is the latest offering from the company - It features fuel cell technology.

o Specs;

- ☐ 37 kW AC induction motor
- ☐ sodium nickel chloride batteries
- ☐ independent four-wheel suspension
- ☐ top speed of 120 km/h
- ☐ high endurance - 200 km/charge

<http://www.hindu.com/2005/04/17/stories/2005041702461300.htm> <http://www.theautochannel.com/news/2009/09/25/478975.1-lg.jpg>

2. India's Tata Motors reveals electric car prototype;

- Tata Motors unveiled an electric version of the Indica hatchback, with plans to make it available in Norway in 2009 and India in 2010.
- plans for an electric car called the Ace are also under-way
- Claims of a 175 kilometers (110 miles) range on a full charge of its two battery packs, which takes about 8 hours.
- The company is also exploring other technology, such as the compressed-air powered OneCAT for India's market



Others:

Toyota electric-petrol Prius and Honda Motor Company's Insight hybrid car and the FCX fuel-cell vehicle.

Daimler-chrysler has been working on biodiesel powered Mercedes.

Indian players:

Mahindra says hybrid SUV to be launched soon . In January mahindra has launched biodiesel powered Arjun tractors and Bolero.

Tata plans on bringing out a range of green vehicles in the near future.



Others:

There are many regional players in this industry. Now, this industry has attracted major players too.

- Mahindra eco mobiles a subsidiary of M&M has launched "Bijlee" a 10 seater available only in selected markets.
- Scooters India, a lucknow based company has been offering 8 seater (including driver).(claims the charge range as 80km at a speed of 30-35km/hr).
- Major cycle makers such as Hero cycles (Hero Honda group) has collaborated with UK based Ultra motor has launched a series of bikes in January 2007. (Max speed 25 kph. and run for about 45-50 kmrange).Price Rs 15,000 to Rs 20,000 and the electric scooters in the range of Rs 24,000 to Rs 28,000.
- Atlas has launched an e-bike priced at Rs 17,000.
- Ludhiana based Avon Cycles and Chennai based TI cycle has also launched e-bikes.

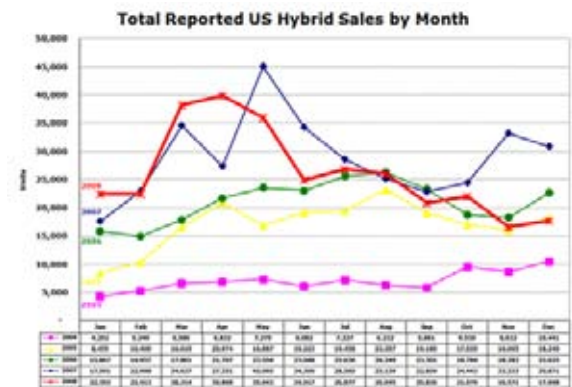




	Location	Products	Features	Price
Indus – division of Electrotherm	Gujrat based company-	two scooterettes and four bike models	motor power in the range of 200-250W, compact dimension, less weight, 75kg payload, top speed of 25km/hr, range/charge mileage of 75km, Charge duration required is 6 – 8hrs	Rs 13,999 and Rs 23,249.
EKO vehicle	a Bangalore based company	EKO cosmic –I scooter and EGO bike.	Battery weighs 28kgs, life of 12000–5000kms., rapid charger charges the bike at 10 – 15 minutes, max speed 40km/hr, five colours, exported to many countries.	
Ace motors	Pune based	e-bike (electric bike) - majority of the components imported from Changtong E Bike Company Ltd., China	a load-carrying capacity of 100-140 kg., 220 km range, 6 – 8 hours charging at 220 volts for full range, maximum speed is 25 km/hr	priced at Rs 26,500.



ford fusion hybrid
air powered car
honda civic hybrid
VW blue-motion technologies





CLEAN TECH:

Types of fuels;

- Gasoline
- Diesel
- Biodiesel
- CNG, LNG
- Electricity
- Ethanol (E85), Methanol(M85)
- Hydrogen
- LPG
- Fuel cells



Better technologies; Enable cars to give better performance and achieve efficiencies that seemed impossible only a few years ago.

Eg. - Volkswagen Blumotion Technology

- The Polo BlueMotion: the first five-seater in 2006 to reduce fuel consumption below 4.0 liters per 100 kilometers
- Touareg: Average fuel consumption: less than 9.0 liters per 100 kilometers. CO2 emissions: <210 g/km.
- Passat BlueMotion: a new common rail TDI (81 kW / 110 PS) delivers pioneering 4.9 liter average fuel consumption and CO2 emissions of just 128 g/km (Wagon: 129 g/km), range of over 1,400 kilometers on ONE TANK of fuel. This car is already being sold.





CNG: Compressed natural gas (CNG) is the most common fuel used in vehicles while liquified natural gas (LNG), which is stored under such low temperatures that the gas liquifies, is often preferred as an alternative to diesel especially in heavy long-distance trucks because of its high energy content and the comparatively less space required to carry the liquid.

- environmental benefits: Is composed mostly of methane which is a relatively clean-burning fuel producing, on combustion, less carbon dioxide and harmful ozone-forming hydrocarbons than petroleum-based fuels. Dedicated natural gas engines emit about 90 per cent less carbon monoxide, 85 per cent less ozone-forming hydrocarbons and virtually no particulates, as compared to petrol or diesel-fuelled vehicles.

- no evaporative emissions from the heated engine or emissions during fueling, which can account for close to 40 per cent of hydrocarbon emissions in petroleum-based vehicles.

- Natural gas is also among the safest fuels on the road today. Also, it is stored in overground tanks, eliminating problems of leakages in underground storage tanks.

- Natural gas is 30 to 50 per cent cheaper than petrol and considerably cheaper than diesel

- United States of America Biofuel Production

- United states produces more ethanol than any other country

- Corn is the main crop grown to support the ethanol biofuel industry

- As of September 2007, the United States had 126 ethanol plants with a total production capacity of more than 23.1 billion litres (6.1 billion gallons) per year

- The United States has another 71 plants under constructions which will produce an additional 19.3 billion litres (5.1 billion gallons) per year

- The ethanol industry used 27% of the national corn crop in 2007



What is Biofuel?

- Biofuel refers to any solid, liquid or gas fuel that has been derived from plant biomass.

There is presently two main types of biofuels being produced:

1. Biodiesel

Made by separating glycerin from animal and vegetable oils to form methyl esters

Use rapeseed, soybean, canola, coconut, palm, and jatropha nut oil

Commonly use blends of 20% biodiesel, 80% diesel

2. Ethanol

Made by fermenting sugars (starches) into alcohols

Use sugarcane, corn, sugar beets and sweet sorghum

In Europe use E10 - 10% ethanol, 90% petroleum

- Biodiesel and Ethanol are in very different stages of their life cycles

1. Ethanol first began in the 1980's and is now beginning to enter the second phase of the life cycle

2. Biodiesel is relatively new, only began to take off in North America in the late 1990's, and is still in the first phase of its life cycle, with minimal research conducted on the second phase

Source: <http://www.imf.org/external/pubs/ft/weo/2007/02/pdf/text.pdf>





Photodisc

Final comments;

Beginnings: sustainable culture of india - One has grown up hearing about adversities of pollution- situation already out of hand- preservation of the environment, ecology was hep - energy crisis became the next buzzword- hit home when oil prices skyrocketed recently – Copenhagen summit, Darfur, | Alternate fuels are the way to go..

Facts: disastrous effect of oil emissions on the environ – social, politico-economic scene- energy independence- alternate fuels is the only way out- options India has –

Summary;

Why gasoline must go;

- 1.The whole market is deflated. Oil cos. Running at a loss
- 2.Despite that, oil is still expensive, peak oil prodn. Point is behind us. It will only become more expensive now. The economy will die otherwise.
- 3.Govt. subsidies take a big chunk out of the govt.s pocket

Energy independence: is extremely importance as the source/s of oil are unreliable and non-permanent.

India market:

There are various options when one thinks about using alternate fuels. Some of them are listed below;

Naturally occurring gases- CNG, LPG, Biogas

Bio fuels- ethanol, biodiesel

Synthetic fuels- biomass to liquid blends (H + CNG blend ; 20:80)

Reformulated conventional fuel: RFG, LDO- light diesel oil.

Advantage of using alt. fuel (namely CNG) –

- 1.Adulteration hostile
- 2.Cheap (1/3rd the price of gasoline)
- 3.Environmentally friendlier
- 4.Energy security

Corporate incentives for promoting/ developing alt. tech.

- 1.Ability to meet stringent emission norms
- 2.Cheaper cost of manufacturing
- 3.Indirect advantages: company reputation, brand image

Note on H + CNG; Problem with CNG – low on ‘C’ emission due to complete combustion, but high on NO_x emissions, which are harmful too. Best fuel – hydrogen (H). No C content at all. But highly inflammable, hence risky. Therefore, H + CNG offers the best compromise. H reduces NO_x emissions and H content speeds up the burning, making it more efficient, speeding up the process.

We have large deposits of natural gas in the KG basin near Hyderabad.

Problems with promoting alternate fuels;

1. There is a problem of establishing an infrastructure network: too many diff. technologies currently exist. No one solution seems financially assuring.
2. Public awareness regarding alt. fuels and their significance
3. Misinformation by the petrol and diesel lobbies and the international oil market, in general.

Energy density; following is a comparison of volume of fuel needed to supply the same amount of energy. This is very important as it directly affects the space consumed by the fuel storage chamber inside the vehicle.

1 Gasoline = 5 CNG = 20 Hydrogen

Relevance of alternate fuels and vehicles for designers:

Future thoughts: transportation evolution;

Walking-human power- horse, cattle(animal power),chariots, carriages- coal/steam cars, electric cars- gasoline cars-alternates

Sail powered land vehicles

“Sustainable Mobility is the ability to meet society’s need to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future.”



References

<http://www.worldometers.info/cars/>

www.SustainableMobility.org

<http://www.doverdelawarethinktank.org/consortium.html> - \

<http://www.alternative-energy-news.info/technology/transportation/>

<http://www.earthcars.com/views/index>

<http://www.ers.usda.gov/AmberWaves/November07/Features/Biofuels.htm>

<http://www.earthcars.com/views/index>

<http://www.energyplanet.info/Transportation/>

<http://www.cleanfleetreport.com/>

<http://green.autoblog.com/>

http://www.youtube.com/view_play_list?p=A0B6E8AC705D7A56

<http://www.energyplanet.info/Transportation>

http://en.wikipedia.org/wiki/Ozone_depletion