

Energy Technologies and Transportation for the Future

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Abstract: A major proportion of world's petroleum consumption goes into the transportation sector, which has caused tremendous environmental concerns. This has made the economies look beyond traditional source of energy (read hydrocarbons). Vehicles running on a single fuel have made the consumers globally, addicted to the gas stations, in turn discharging emissions. The central theme of the paper is, to examine the emerging energy paradigm, where the alternative energies will play a crucial role in the global energy mix, particularly in the transportation sector. The car companies launch bigger and increased horsepower SUVs that consumes more fuel, which gets more costlier. Thus, finding alternative energies becomes inevitable that promise practical, efficient and cheap transportation, facilitating hydrocarbon independence and reducing emissions. As a result, prototype or hybrid vehicles running on, gasoline, ethanol, hydrogen and fuel cells are being developed. However, the alternatives are an area of debate, linking biofuels (ethanol) to the global food crisis. The paper intends to address similar issues like, security and reliability of such technologies with improved engines and lighter body composites. The paper will also discuss the alternative energy generation and its availability to the people, where there are more hybrid vehicles on the road, with nowhere to fill the tanks.

Keywords: Hydrocarbons, Emissions, Alternatives, Hybrid, Fuel Cells.

Introduction

The world breath a sigh of relief, transitioning away from the traditions and saw the dawn of a new era in the energy industry, powered by the sun, wind or for that matter the food stuff. The global economic growth and development has been a result of the availability and advancement in the energy industry, due to new discoveries and advanced technology. Today, apart from the industrialized nations, many developing economies are expanding into economic realities. For this reason, energy has become a vital step to pursue the industrialization process forward, which has made the world, energy dependent. A large chunk of the world's energy is consumed by automobiles. The global transportation system is almost entirely fueled by oil. Thus, the non – renewable nature, soaring gas prices and shifting climate has pushed the economies to a new energy paradigm, where new technology and alternative energies will lead the global energy mix. However, an important note is, what the world is doing now, to keep the automobiles moving in the future.

The main objectives of the paper are: to look at the role of alternative energies in the transportation sector; to evaluate the future approach for transportation, that will reduce

dependence on oil and gas and reduce emissions; to review the new hybrid or fuel cell vehicles; and, to assess the fuel availability for the car of the future.

Methodology

The role and building up of alternative energies is going to be crucial in the coming time. However, the success of alternatives to be produced on a mass scale and solve the future issues of transport is a matter of investigation. The paper is an attempt in this regard. The paper is based on primary and secondary data, collected through publications, reports and working papers. The paper is based on scientific and environmental facts such as, climate change, and the changing global energy policies. Thus, the performance needs to be evaluated with reference to different alternative sources that will act as an efficient fuel for the future car. However, apparently, the failure of alternative sources to be implied on a commercial scale attributes to its weakness related to its fundamentals, i.e., availability, efficiency and security. Having examined the energy technologies and the alternative fuel, the paper will make an attempt to outline the fuel approach for the coming time.

Results / Conclusions

- The consumers want the alternatives to be practically efficient and to be available at affordable prices;
- The hybrid or the fuel cell vehicles are more risk prone, as their batteries are known to have caught fire. Hence, from the security perspective, unless its usage is safe, its difficult for the consumers to have faith in a recently developed technology;
- In a situation where there are more hybrid vehicles on the road, and nowhere to fill the tanks, the fuel stations should be seen as equally important and evolve together. Hence, prior to the building of alternative vehicle, alternative fuel should be in place;
- For a hybrid vehicle running on batteries, there should be charging stations which would be functional during nights, when there is less consumption traffic;
- The technological advancement and alternative fuel theory should not remain on papers as a policy recommendation, but be put to practice, allocating funds to the ongoing research;

- The automobile companies need to form a JV and work together to solve issues and introduce the new technologies in the markets for commercial use. This can be done with the launch of a few vehicles that would run on fuel cells, hydrogen gas or an electric motor;
- Developing alternatives such as ethanol from food products, will take away a large share of the global food requirement. This will raise the food prices and will affect the developing and the least developed nations more harshly;
- The global desire to pursue alternative energy is in co - relation of being environment friendly. Achieving this goal, will require a great amount of changes in the government policies and its assimilation pattern;
- To make the dream of an alternative fuel come true, the vehicle manufacturers should be able to sell their hybrids not in few numbers, but in billions;

Discussion

The non – renewable resource oil and natural gas, has been found at a few places on earth. “S. & Cent. America has the second largest proven reserves of oil with 198.9 (‘000 mb); Europe & Eurasia having 136.9 (‘000 mb) of oil and 2228.1 (tcf) of gas reserves; African proven reserves for oil and gas, stand at 127.7 (‘000 mb) & 521.2 (tcf); while, the Middle East has the largest oil and gas reserves which stand at 754.2 (‘000 mb) & 2690.4 (tcf)”¹. Apart from being a non – renewable resource, the extensive use of oil and gas that has already threatened the environment and has resulted in a major climate shift, putting ecology in a critical state. Melting glaciers, severe droughts, food scarcity and increasing poverty are all in a way effects of the greenhouse gases, released due to excessive use of oil and gas. And, as the global population grows, the energy demand continues to increase. A large percentage of this demand comes from the transportation sector. “.....energy consumption in the transportation sector grows from 27.2 quadrillion Btu in 2009 to 31.8 quadrillion Btu in 2035”². The past and projected demand can be seen in Fig. 1.

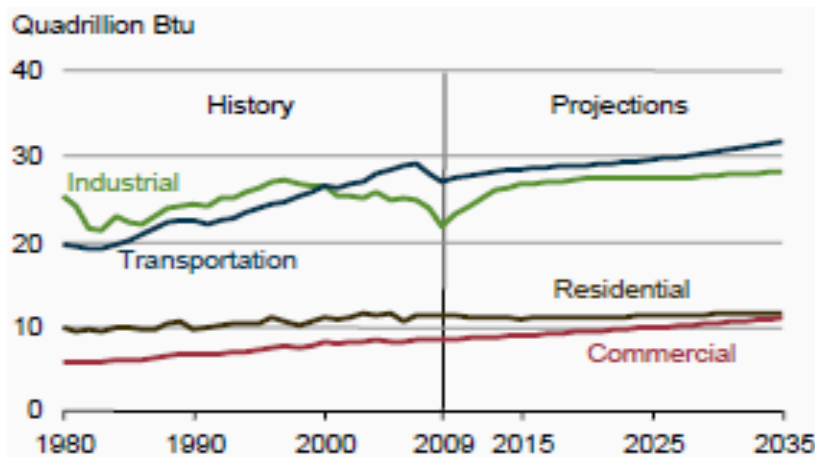


Fig. 1. Delivered energy consumption by sector (1980 – 2035)³

Vehicles, that are larger and have finer horsepower consumes more oil. This phenomenon is expected to augment, as the vehicles (car) sales and ownership is set to increase in the coming years. The non – renewable resource being consumed at an accelerating rate has made the world look beyond the traditional source. The over use of petroleum has led to the release of CO₂ and SO₂ emissions, changing the climatic patterns to an extent. Efforts are being made, to keep the vehicles moving in the future. Every possible technology is tried and tested to achieve a practical, efficient and a cheap transportation, and which will curb the global dependence on oil. By investing billions of dollars, automobile companies have made some progress in this direction. Prototype or hybrid vehicles running on, gasoline, ethanol, hydrogen and fuel cells are being developed.

Hydrogen Fuel Cell

Hydrogen is the most efficient fuel. “It does not need oxygen from the atmosphere to burn, which is an improvement over fossil fuels in saving the oxygen in our air supply. In fact, when hydrogen burns perfectly, nothing at all comes out of the tail pipe”⁴. Premier car companies such as Honda and Ford have taken a step in developing the technology. “Honda finally unveiled their new solar hydrogen solar station and all signs point to a dramatic success. The station is smaller than previous models and enables an electric car owner to refill their fuel cell overnight. The unit should easily fit into a homeowners’ garage taking up significantly less space than previous models”⁵. Previously, hydrogen as a fuel had gained a bad reputation when, “..... the Hindenburg disaster of 1937 finally convinced the world that hydrogen is not an acceptable lifting - gas for airships carrying people”⁶. Iceland is a classic example of renewable energy. “Iceland is the only country in the world which obtains 100 per

cent of its electricity and heat from renewable sources. 87 per cent of its electricity comes from hydro - power, and the remaining 13 per cent from geothermal power. Oil - powered fossil fuel power stations are only used as backups to the renewable sources”⁷.

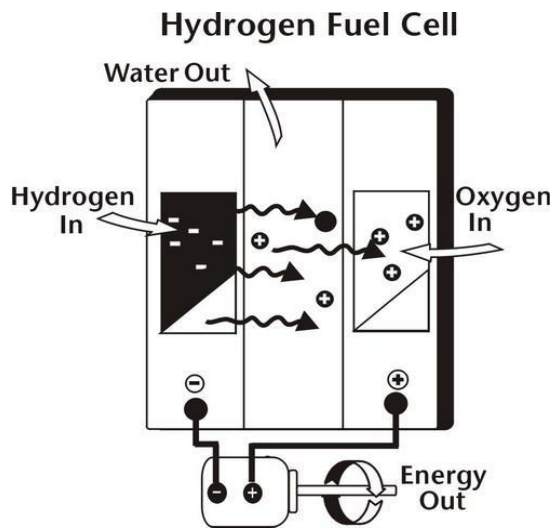
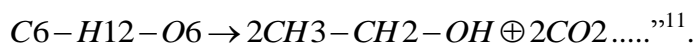


Fig. 2. Hydrogen Fuel Cell⁸

Fig. 2 describes how the hydrogen fuel cell car works. Hydrogen gas is combined with oxygen and fuel cells. Hydrogen and fuel cells generate electricity, moving the vehicle. Today, hydrogen is one of the most preferred alternatives for fossil fuels, emitting only water vapour. However, the technology is not ready and too expensive to be produced on a large scale. “.....hydrogen powered buses and cars currently cost up to four times more than petrol and diesel equivalents”⁹. This also questions the efficiency of the fuel cells, which might burst due to overheating.

Ethanol

Ethanol (grain alcohol) or E85 gets its name from “..... 85 per cent ethanol and 15 per cent conventional gasoline”¹⁰. “Ethanol has been made since ancient times by the fermentation of sugars. The fermentation reaction, represented by the simple equation



Carbon (6), hydrogen (12) and oxygen (6) atoms, gives C₂ - H₅ - OH or C₂ - H₆ - O or CH₃ - CH₂ - OH, i.e., Ethanol and a small amount (2 molecules) of carbon dioxide. “The US

leads the world in ethanol production (ahead of Brazil), with 7 billion gallons of cleaner, ethanol - blended gasoline used in 2007, about 12 per cent of fuel sales in the US. Most of it is E85 (85 per cent ethanol 15 per cent gasoline) or E10 (10 per cent ethanol 90 per cent gasoline), which most gasoline cars can use without engine conversion. Brazil, the world's ethanol fuel success story, produces four billion gallons of ethanol a year. All Brazilian fuel contains at least 24 per cent ethanol, and much of it is 100 per cent ethanol. Many other countries are implementing ethanol fuel programs”¹². The benefits of ethanol as a fuel are plenty. Most importantly, it's a cleaner fuel; releases lesser emissions as compared to petroleum; and, renewable in nature. Yet, Ethanol is not really a clean fuel. “.....combustion products of ethanol include formaldehyde and acetaldehyde, both known carcinogens; and that increased use of ethanol may also increase atmospheric levels of peroxyacetylnitrate (PAN)”¹³, a petrochemical pollutant. However, if Iceland has geothermal energy, many countries in the world have large sugarcane and corn fields. But, its energy intensive to extract fuel from corn or sugarcane, and is difficult to meet the energy and food demand at the same time. “.....the average price of corn has increased by some 60 per cent, soybeans by 76 per cent, wheat by 54 per cent, and rice by 104 per cent”¹⁴. The rising prices at alarming rates are caused due to increasing production of biofuels. The future trends and production of biofuels will affect the developing and the least developed nations more harshly. Therefore, research is on to make ethanol fuel out of ‘Cellulosic Biomass’, the waste part of the plant (wood chips, wheat straw, etc.).

Efficient Engine Technology

While, the fuel part remains a debatable issue, car technology or improved engines have also paced up. The old petrol engines have powered vehicles by using the chemical energy and convert it into a mechanical work. The combustion engines exhaust a large amount of oil in friction between the pistons and the cylinder and uses very little to actually move the vehicle. This process has to be reversed, to save that extra amount of fuel and use it for the right purpose. Many technologies are available today, that can enhance the vehicle performance and are fuel efficient. “‘Variable Valve Timing & Lift (VVT&L)’ increases 5 per cent engine efficiency. Valves control the flow of air and fuel, into the cylinders and exhaust out of them. When and how long the valves open (timing) and how much the valves move (lift) both affect engine efficiency. Optimum timing and lift settings are different for high and low engine speeds. ‘Cylinder Deactivation’ technology merely deactivates some of the engine's cylinders

when they are not needed. This temporarily turns a 8 - or 6 - cylinder engine into a 4 - or 3 - cylinder engine. It increases 7.5 per cent engine efficiency. ‘Integrated Starter / Generator’ (ISG) automatically turn the engine off when the vehicle comes to a stop and restart it instantaneously when the accelerator is pressed so that fuel isn't wasted for idling. It improves the engine efficiency by 8 per cent”¹⁵. In addition to improved engine efficiency, lighter body composites that would enhance the millage and use lesser fuel or the lithium batteries that have a larger density to store energy (“..... lithium - ion battery pack loses only about 5 per cent of its charge per month, compared to a 20 per cent loss per month for NiMH batteries”¹⁶), lighter and are recyclable, inturn releasing zero - emissions.

In the future, the world would not be able to avoid fatal crisis such as energy dependence and carbon emissions. There is a necessity to reduce the global dependence on petroleum, and for that there is a need to take collective actions. Building zero – emission vehicles such as the plug – in hybrids which can be charged directly from the electric socket at home or the Toyota Prius hybrid that has a gas tank, batteries and electric charge, has shown positive signs of transitioning away from hydrocarbons into an emissions – free environment in the future, however, there should be a change in the governmental policies and availability of right fuels.

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