Gentleman Start Your Engines

By Shawn Stevenson, Source Water Specialist

The morning begins just like any other day; the dew on the grass and the sun rising in the east and continuing to seek the west. You grab your cup of java and out the door you go. As you strap on your seatbelt you hit the start button and instead of the guttural roar of your engine coming to life as in years past, there is only a faint hum. You pull out of the driveway and proceed down the street with only an inkling of vibration and faintly perceivable whine. Now this may seem like a futuristic dream, but it could be the near future of personal transportation as we know it.

Americans have always been identified with what they drive whether it is a diesel pickup with 650ft/lbs of torque or a lowered BMW riding on 20" wheels. To a certain extent our transportation is directly linked to the persona. Being an automotive enthusiastic culture the market has been in flux over the past decade and quandary has presented itself. Automakers are now offering vehicles with more horsepower than anytime in history. It is now possible to purchase a 500+ hp production vehicle from all of the top three American automakers and all have plans of exceeding 600hp within the coming year on at least one model. Buying trends of Sport Utility Vehicles (SUV) have far outsold fuel efficient sedans over the past ten years. At the other end of the marketing spectrum are fuel efficient models and hybrids. The automotive industry is aware that some time will be needed for the public to warm up to the idea of driving a primarily electric or alternate fuel vehicle; hence the introduction of a full size SUV models with innovative multi-mode hybrid packages as well as luxury sport sedans.

We will explore some of the possibilities from various angles; but be forewarned there are several detours down this road since so much of the technology is still in its infancy of development. As of late when an alternative fuel vehicle is mentioned many of us think of Biodiesel or Bioethanol burning vehicles. Biodiesel is biodegradable and non-toxic, and typically produces about 60% less net-lifecycle carbon dioxide emissions, as it is itself produced from atmospheric carbon dioxide via photosynthesis in plants. However, the smog forming hydrocarbon emissions are 35% greater, and the Nitrogen Oxide emissions are also greater than those from petroleum-based diesel; note that this figure can actually differ widely between fuels depending upon production and processing methods employed in their creation (*Wikepedia, 9-2007).*

Deemed the flex-fuel by Detroit automakers ethanol fuel is (ethyl alcohol), the same type of alcohol found in an alcoholic drink. Because it is easy to manufacture and process, and can be made from very common materials, such as sugar cane. Anhydrous ethanol (ethanol with less than 1% water) can be blended with gasoline in varying quantities up to pure ethanol (E100), and most gasoline style engines will operate well with mixtures of 10% ethanol (E10). Ethanol can be mass-produced by fermentation of sugar or by hydration of ethylene from petroleum and other sources (*Wikepedia, 11-2007).* Ethanol's increase in popularity across the globe is becoming apparent based on demand for the fuel and its derivatives. There has also been an influx of American manufactured vehicles that can burn the E85. Fuel mileage is slightly reduced compared to that of pure petroleum fuels but performance applications are increased based on the ability of internal combustion engines being able to run higher compression ratios.

Another fuel based option is hydrogen power; in an internal combustion engine hydrogen is burned in essentially the same method as typical gasoline burning cars. The other application is fuel-cell conversion where water and electricity are produced from a reaction of hydrogen and oxygen. Three products are generated from this reaction; water, heat, and electricity and the later can be used to power a motor. One perceived drawback is that hydrogen is not the source of energy but only a transporter or what is known as an energy carrier. On a large scale the need for power plants exists for this process. The other option is an in-cell vehicle where the conversion is self contained but packaging the raw hydrogen source is still not an efficient marketable reality.

Fuel prices affect everyone on the most basic monetary level. Even the alternative fuels are not cheap in comparison to petroleum based fuels and most are more expensive. Nobody wants to be limited by a set range distance and with gasoline or

diesel we have the ability to just keep filling up. But that freedom is still somewhat of an illusion since the typical range of most vehicles is between 250-400 miles between stations. The shift to a *perceived* more eco-friendly vehicle could be based on global awareness or cost savings at the pump; regardless of the personal motivation for purchasing a hybrid there are more choices of brand and type coming out.

Today's transportation marketplace is inundated with vehicles boasting higher miles per gallon ratings and alternative fuel types. However, a harsh reality is that sooner than later the need for a non-fossil fuel propelled vehicle is going to be a priority for consumers and manufacturers alike.

Hybrid manufacturers generally all have the same 6 concerns: durability, range, output, weight, cost, and safety. Currently the most common hybrid uses internal combustion to support and charge batteries. A battery stores and converts chemical energy to electricity. A rechargeable version does the reverse of this process as well as the prior. If we think of batteries in there simplest form, take for example a lemon. By inserting a steel nail in one end for the positive terminal and a copper nail in the opposite for the negative terminal the juice will act as the electrolyte and produce some voltage. Put several in series and enough energy will exist to run a digital clock or even a light emitting diode (LED). Currently the best selling hybrid on the market utilizes multi-cell batteries in series to create the necessary voltage; in this case the battery is a nickel metal hydride (NIMH). The configuration of the system is complex never letting the charge levels reach full or deplete past 65% in an effort to maintain longevity. So it really is never in a charge depleting mode such as a plug in style vehicle would be.

Traditional lead acid batteries are good voltage producers and are extremely cheap to manufacture but are also very heavy. Hence they are not a viable option based on their energy density; which is the output in voltage per kilogram. NIMH seems like a good option and is currently in the spotlight but requires large amounts of nickel. The prices of nickel have gone through the roof and this makes cost a genuine limiting factor of concern. There is however another battery type that has been around for years and many would associate with cameras and most recently rechargeable power tools. Lithium batteries have an energy density 30% greater than NIMH. Aside from hydrogen and helium; lithium is the lightest metal in the periodic table *(Simanaitis, R&T, 10-07*).

Although lithium power seems like the next logical progression there are some hurdles to overcome and the most major is upsizing the cell configurations to be durable enough to handle substantial reoccurring charging and discharging. Heat generation needs to be kept down to maintain safety since overheating lithium batteries can lead to fires. There are some lithium based upgrades offered for current hybrids and pending production models for next year.

The next generation expected from General Motors will be a plug in hybrid that will have charge depleting and charge sustaining modes and carries the name Volt. Its range will be approximately 40 miles in charge depletion mode and depending if a plug is available it will run on a gasoline variant power-plant to recharge the batteries to an acceptable level. Its release is expected some time in 2010 *(Simanaitis, R&T, 10-07*).

We have only been able to scratch the surface when it comes to transportation alternatives. For inner city living, public transportation is an option but it still carries with it the loss of some personal freedom. Alternative fuels such as Ethanol can supplement demand but as an individual source there are other costs; primarily the use of land for production of fuel instead of crops. Hydrogen could be a legitimate alternative but is decades away in terms of the technology. Electric cars are probably the most viable option, but there are many unknowns and some kinks to work out with battery technology. This is not to say that the future is grim, technology always seems to find a way and currently it is on the cusp. Just imagine a decade from now watching a NASCAR race with the pack ripping by on the front straight and all you hear is the whisper of displaced air from the aerodynamic bodywork!