Is There a Future for the Internal Combustion Engine?

By Klaus L. E. Kaiser, FCIC

You may recall, about 10 years ago, hydrogen-fuelled cars were to solve all our driving needs. They were supposed to be in car dealers' showrooms by 2001, ready "to drive away". Well, it did not happen, and lately, who has heard of hydrogen?

We are on to better things now, such as the "electric car" or is this another futile concept?

There are many people who wholeheartedly believe statements like, "successful application of new technologies such as fuel cells or electric vehicles will be the replacement of the current automotive fleets". This perception drives much of the current interest in hybrid and electric cars, both by manufacturers and consumers.

One of the reasons we like to think that electric cars will be the future seems to be the underlying assumption that electricity "is free" (or at least nearly so). And with "free" renewable electricity from wind power or photovoltaic cells, our new "smart [electricity] meters" will allow us to recharge any electric car battery "at the cost of a few pennies". Of course, at night, winds are commonly diminished and the sun rarely shines.

Unfortunately, the energy required to move a car is simply in orders of magnitude higher than what a typical household needs to run a few lights and small appliances — roughly one kW during part of the day. Very roughly again, one kW is close to one horsepower. So, if you drive a 150 hp car, you may use the equivalent of a 100+ households' electricity needs.

Of course, to "fill up" your car with the equivalent of, say 50 L of gasoline, you would also need approximately 500 kWh of electricity.

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Even at an "off-peak hour" rate of three c/kWh (proposed for Ontario), that is still $15, not just a few pennies.

Why else then does the electric car seem so appealing? In part, it seems to be the thought that it is cleaner, or "greener", i.e. has a smaller greenhouse gas (GHG) or carbon dioxide footprint. This is only true if the electricity to charge it is generated from sources other than fossil fuels (in North America presently about 50 percent). In terms of CO_2 emission, it makes no difference whether hydrocarbons are burned in an internal combustion engine, or in a (yet to be developed) fuel cell, or in a fossil-fuel-powered electricity generation station, the end products are the same, namely identical amounts of carbon dioxide and water.

Storing the electricity in a car is the really steep hurdle. You can see it in the battery costs: for a laptop computer, the cost of the battery alone is about $100, for a hybrid car $5,000, and for a full battery-powered car, such as the Tesla, close to $100,000. Such batteries also suffer from premature fatigue, loss of power on storage, and barely work at temperatures below freezing. In contrast, a car's gasoline tank is about $200. Solely from an energy storage cost perspective, gasoline is miles ahead.

The present (and foreseeable) storage capacity of even the best lithium ion batteries (0.5 MJ/kg) or the (yet to be commercially produced) super capacitors (1.2 MJ/kg) are only about 1/40th of that of an equal weight of common gasoline (48 MJ/kg). In other words, you would need a capacitor weight of about 1,600 kg to store the energy of 50 L gasoline. Therefore, also from a weight perspective, gasoline wins handily. Altogether, between the energy density, cost of storage devices, ease of handling, ability to use at low temperature, as well as other technical considerations fossil fuels, such as gasoline, are simply the energy carrier of choice.

This then leads to the question: how can we reduce GHG emissions and use the electric energy from wind and solar power installations and continue to keep gasoline as fuel for our internal combustion engine cars? The answer is surprisingly simple: by making gasoline!

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The best way to "store" electric power, generated, for example, from wind turbines or solar cells, is through its conversion to gasoline. This can easily be achieved by electrolysis of water to hydrogen, and the reaction of hydrogen with carbon dioxide to create gasoline-type hydrocarbons, a well-known process (Fischer-Tropsch synthesis). Furthermore, carbon dioxide is a large-scale waste product (at the tar sands plants in Alberta, for example). This kind of storage-process would require neither the development of new electric power storage technologies (e.g. super capacitors), or "electric" cars, or any different infrastructure to "fill up".

In fact, the same process of storing electricity could be used to make gasoline from limestone (essentially calcium carbonate), water and electric power. The remnants of 19th century lime kilns in southern Ontario are evidence to part of this process. Of course, at that time, the product of interest was the calcium oxide, not the carbon dioxide which escaped into the air. Perhaps we should look at it now as the future source for gasoline.

The internal combustion engine has served mankind well over a hundred years. While its energy efficiency is only about 25 percent, it is robust and works under all kinds of climatic conditions. It would be a worthwhile research goal to increase its efficiency. Despite that shortcoming though, unless novel electricity storage devices can be developed with an energy density similar to that of gasoline, and at a cost of about 1/100th of the present storage technology, the combustion engine does not need to fear its demise. ACCN

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