The Future of Communication Engineering: The Case of Vehicle-to-Grid Hybrid Cars, Plug-In Hybrids, and Electric Cars

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***Abstract*---** Vehicle-to-Grid (V2G) hybrid cars constitute systems whereby plug-in electric vehicles such as plug-in hybrids (PHEV) and electric cars (BEV) engage in communications with power grids for purposes of selling demand response services by either throttling their charging rate or returning electricity. Indeed, V2G has been observed to be used in gridable vehicles (PHEV and BEV) with grid capacity [1-3]. With power generated from various sources that include renewable sources of energy (such as hydro, solar, and wind power) and thermal power plants, it (power) flows in a unidirectional manner into the system before being distributed through the grid.

***Keywords*---** Plug-In Hybrids, Electric Cars, Hybrid Cars, Hydrogen Economy.

I. INTRODUCTION

As such, the power aids in charging electric vehicles at home, at dedicated charging stations, and in the workplace. In turn, batteries powers of electric vehicles aid in feeding systems at the time of peak demand and the eventuality is an allowance of two-way flow systems between the electric vehicle and the grid.

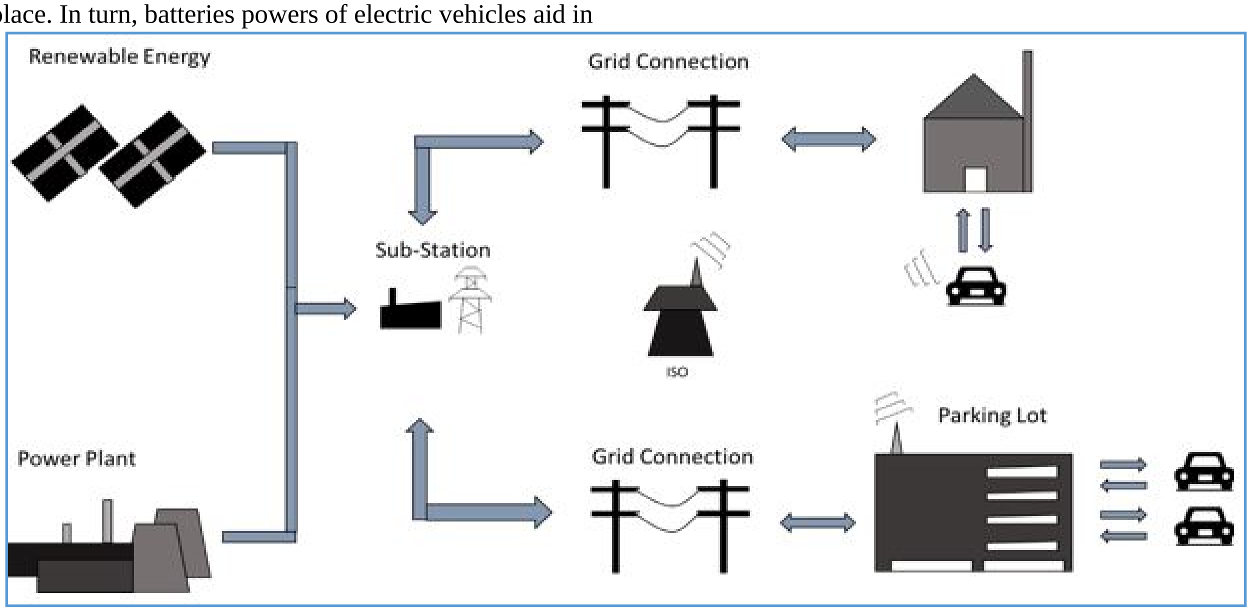


Figure 1 - How V2G Works [1]

Plug-In Hybrids: the plug-in hybrid electric vehicles (PHEVs) combine diesel and gasoline engines with electric motors and large rechargeable batteries. As such, PHEVs deviate from the conventional hybrids in such a way that they can be plugged-in and recharged via outlets. The eventuality is that PHEVs are capable of driving extended distances through a sole reliance on electricity. In situations where batteries are emptied, conventional engines in PHEVs turn on, making the PHEVs to operate as conventional and non-plug-in hybrids. It is further notable that two common modes of PHEVs exist. On the one hand, all-electric PHEVs imply that the battery and the motor provide the car's energy in entirety. On the other hand, hybrid PHEVs implies that both gasoline and electricity are used. With ranges varying from 10 to 40 miles, PHEVs have been observed to typically start up in all-electric modes up to the point where battery packs are depleted.

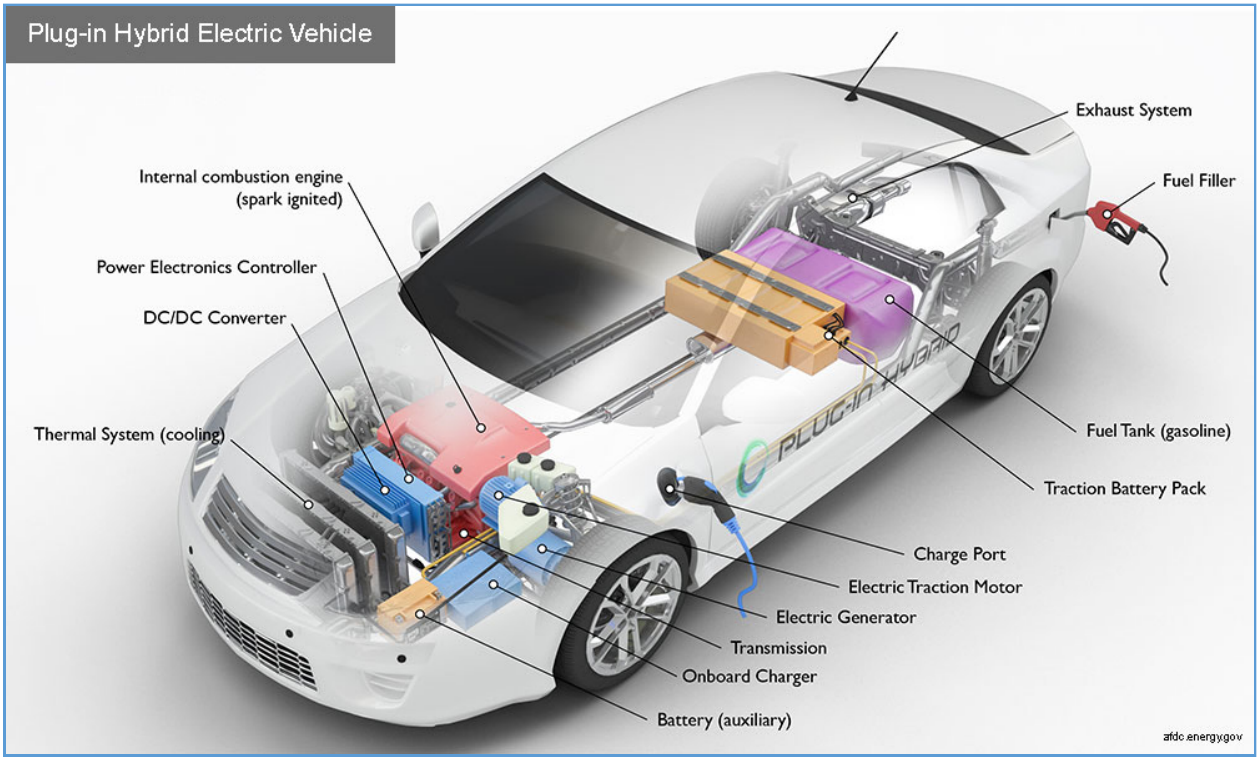


Figure 2 - How Plug-In Hybrids Work [3]

Electric Cars: These cars are propelled by one or more electric motors. Hence, electric cars have rechargeable batteries or alternative energy storage devices storing electrical energy. Through electric motors, the cars are given instant torques that lead to the creation of smooth and strong accelerations [4].

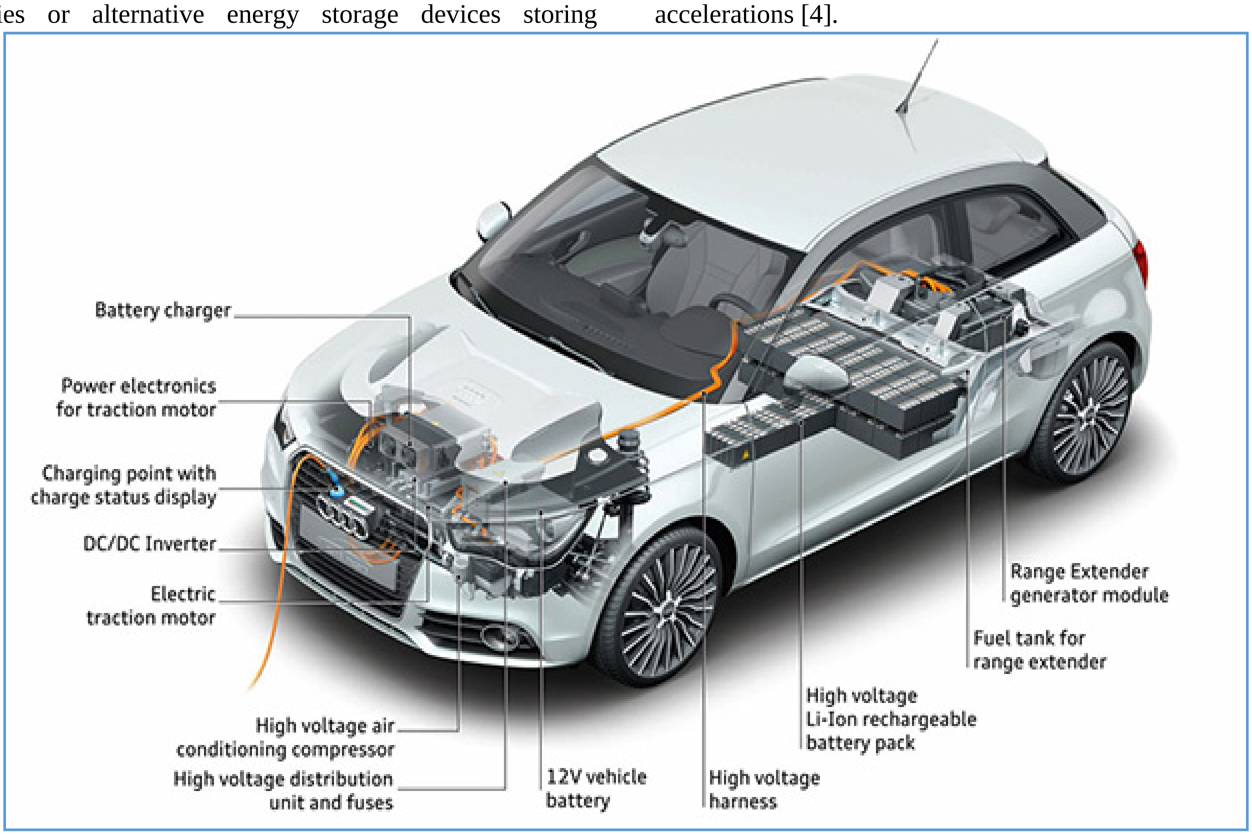


Figure 3 - How an Electric Car Works [5]

II. SECONDARY DATA RESULTS

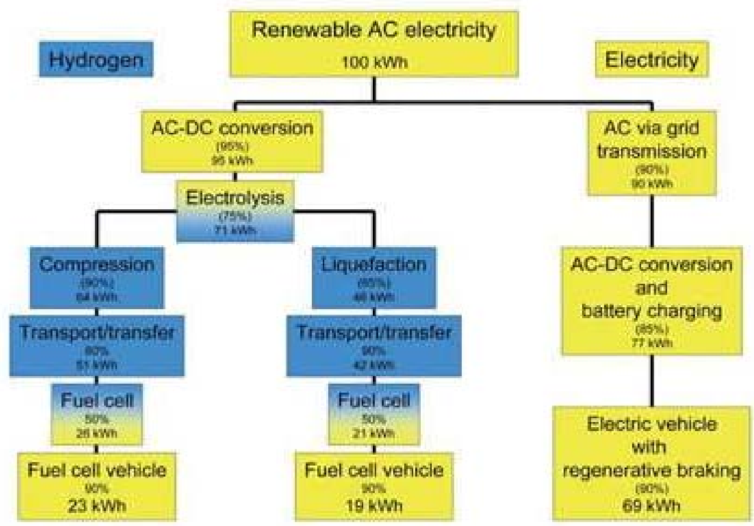
Vehicle-to-Grid (V2G) Hybrid Cars	▪ V2G hybrid cars have been found to offer active power regulation and reactive power support ▪ Similarly, the vehicles pose the merits of current harmonic filtering, load balancing, and the tracking of variable renewable energy sources ▪ Trickle-down effects include ancillary services such as spinning reserve and frequency and voltage control	Demerits include: ▪ The need for intensive communication between the grid and the vehicle ▪ Battery degradation ▪ Effects on infrastructure changes and grid distribution equipment (that makes it costly) ▪ Technical, cultural, political and social obstacles
Plug-In Hybrids	❖ Environmental friendliness because the vehicles run cleaner with better mileages ❖ Twin-powered engines with gasoline engines and electric motors imply that the vehicles cut fuel consumption, fostering energy conservation [4] ❖ Financial benefits due to many credit supports and incentives , often linked to lower annual tax bills and exemption from congestion charges ❖ Conservation of natural resources due to reduced dependence on fossil fuels ❖ Regenerative braking systems aid in recharging batteries ❖ Built from light material and require less energy, saving the same [6]	❖ Powered by two engines, they are associated with low or less power when compared to gas-powered engines ❖ Suitable for city driving at the expense of distances requiring speed and acceleration ❖ High purchase and maintenance costs due to the challenges faced by mechanics while repairing ❖ High voltages pose risks of electrocution, hampering rescue efforts [5]
Electric Cars	✓ Electric cars are associated with higher efficiency that reaches 400 to 600 percent over internal combustion engines ✓ The cars are also environment-friendly due to significant reductions in pollution, with the cars getting power from batteries, the sun, or the wind (renewable sources) ✓ Additional merits include safety, compactness, quietness, convenience, and durability	Disadvantages include: ✓ Limited range with some demanding re-fueling after only 100 miles ✓ Time wastage due to the need for frequent re-fueling and/or battery recharging ✓ Electric cars are also expensive to buy, with some stretching to $50,000

III. PROSPECTS

Rapid changes have been documented to characterise the current state of the automotive industry, a pace perceived to be quicker than that which has been witnessed in the last 20 years [4]. It has also been observed that there is a major shift towards increased fuel economy and green technologies [7]. Indeed, these trends are found to be driven by both consumer demand and regulations. Similarly, a majority of the consumers have been documented to prefer cars that offer much better technological experiences; often likened to iPhones and iPads. The eventuality is that the adoption of electric cars among consumers continues to exceed that of hybrids; with the trend projected to accelerate in future due to improvements in the charging infrastructure; besides advancement in manufacturing and battery performance towards the delivery of more affordable electric cars whose driving ranges may be longer. As such, the next five to ten years will witness every car sale offer an electric vehicle, V2G, or plug-in hybrid vehicle variant. Similarly, it has been project ted that a dramatic increase in these technologies' adoption rate will be witnessed due to the greater role played by markets in regions such as India and China [7]. Despite the observation that manufacturing remains challenging, the scaling up of the automobile industry is likely to attract much room for people to identify techniques of reducing battery manufacturing costs and other provisions at the heart of these car (including power electronics and motors), a trend that will attract the increasing adoption of these categories of technology-driven vehicles.

IV. THE HYDROGEN ECONOMY

In most of the existing literature, it has been observed that the hydrogen economy is hype. Specifically, a hydrogen economy has been perceived as that which is wasteful. Opposing groups argue that the large energy amount required in isolating hydrogen from natural compounds (such as biomass, natural gas, and water), package the resultant light gas via liquefaction or compression, and transfer the energy carrier to users implies that the amount of energy lost upon converting it to useful electricity with fuel cells yields only 25 percent for practical utilisation [2]. Indeed, this value remains unacceptable in terms of running the economy towards future sustainability. Hence, only niche applications that include spacecraft and submarines may use hydrogen. With these adversities, the electron economy has been proposed. In this economy, most of the energy is likely to be distributed using the shortest routes in the existing infrastructures and with the highest efficiency. Such an economy would imply that the efficiency remains unaffected by wasteful conversions from physical to chemical and, later, to physical energy. The eventuality would be a transportation of the sustainable "green" energy to consumers; providing electricity's power for communication, light, heat, comfortable temperature in buildings, and cars [2].



This chart compares the useful transport energy requirements for a vehicle powered from a hydrogen process (left) vs. electricity (right). Image Credit: Ulf Bossel.

Figure 4 - The Hydrogen Economy Illustrated [2]

V. Summary

Sweden forms one of the several countries poised to adopt the "green" hydrogen economy. Specifically, about 30 power-to-gas pilot plants have been reported in the region and Sweden's Gothenburg remains imperative to note. The International Vision for Hydrogen and Fuel Cells documents further that its objective lies in the facilitation and acceleration of the transition to efficient and clean mobility and energy systems using hydrogen and fuel cell technologies. Partner countries that have committed to collaborating towards advancing the commercialisation of hydrogen and fuel cell economies include Australia, Austria, Brazil, Canada, China, France, and Germany. Others include India, Italy, Iceland, Japan, the Republic of Korea, Netherlands, and Norway. Additional countries entail the Russian Federation, the UK, and the Republic of South Korea. The U.S. Department of Energy has also tapped groups of high-tech firms for funding that amounts to $35 million with the intention of helping the hydrogen economy operate optimally. Thus, it can be inferred that collaboration between the public and private sectors in the U.S. forms another key step towards assuring a hydrogen economy in relation to sustainable development. Systems that use ammonia have also been sought as platforms for compressing hydrogen gas. Specifically, funding has been extended to firms such as SAFCell and Bettergy Corp. to establish alternative ways of whittling complex processes of the energy-intensive and expensive separation methods down into a single process demanding one device. An energy-efficient reactor is also being developed by a team from the University of South Carolina with a low-cost catalyst perceived to separate ammonia from hydrogen during decomposition. Fuel cells that generate electricity directly from ammonia have also been developed by teams from the University of Delaware and Materials and Systems Research, Inc. The eventuality is that a continue quest towards research and development in the wake of collaboration between the public and private sectors and funding from relevant authorities (such as the U.S. Department of Energy) forms major steps that have been taken towards achieving a hydrogen economy.

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