AERODYNAMIC SOLAR ELECTRIC VEHICLES

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INTRODUCTION

Present day ICE engine vehicles have a low efficiency of about 25 percent and are composed of 200-300 parts requiring continuous maintenance and replacement. Electrical vehicles are replacing them with a smaller number of parts and simpler designs. Yet they suffer of limited cruising range, long battery recharging times and high prices. They are inefficient in that 60 percent of the energy expanded is used to displace the air, overcoming the drag, when it is needed to rotate the wheels.

Figure 1. Toyota Solar Powered Drive Prius PHV Prime can charge its batteries while the car is driving.

Increasing the range of electrical vehicle from the local 50-60 miles before needing a battery recharge to the 1,000 miles range requires minimizing their weight as well as their aerodynamic drag. In addition a solar EV (sEV) charges itself, simply being out in the sun.

Photovoltaic cells on the car's surface provides an emergency energy supply should a charging station is hard to locate. At a minimum level, it can keep, through air circulation, the temperature of the interior of the car at the ambient level.

Early solar cars were slow and impractical for day-to-day use. With breakthroughs in design and technology, today's solar EVs are not just efficient, but safe, reliable, comfortable, and fun. Non-solar EVs like the Nissan LEAF, BMW i3, and Audi e-tron are priced high, with significant weight and aerodynamic drag. They have limited range, and lower performance than the solar ones. The 2021 Nissan LEAF starts at $31,620 with only 149 miles of range; the 2021 BMW i3 starts at $44,450 for 153 miles of range; the 2021 Audi e-tron starts at $65,900 for 222 miles of range. The 2021 Chevrolet Bolt has 259 miles of range, and starting at $36,500.

Two companies have announced solar EVs: Aptera in San Diego, CA and Lightyear in Helmond, Netherlands. By controlling the weight of the vehicle, including that of the battery, they claim competitive prices to ICE Internal Combustion Engines vehicles.

Figure 2. Three-wheeled Aptera is licensed as a motorcycle. Top highway speed is 100 mph.

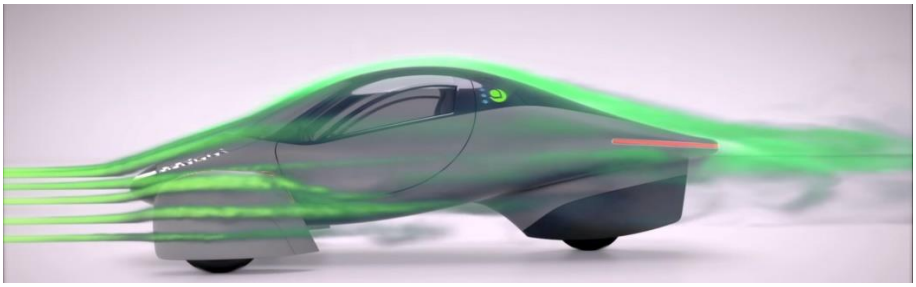

Figure 3. Aptera wind tunnel testing.

Figure 4. Solar panels on car’s hood, top and dashboard.

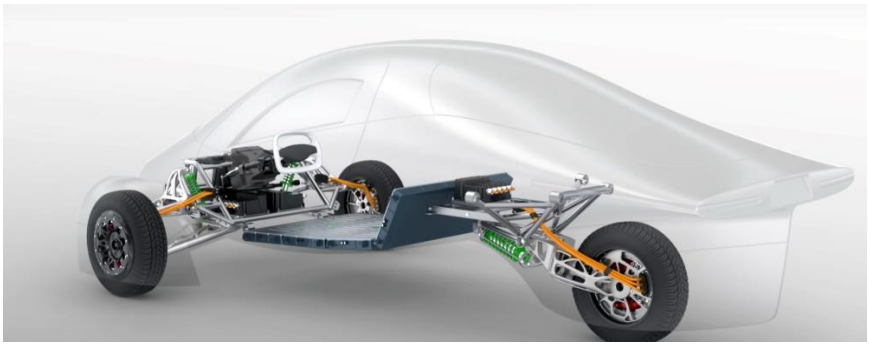

Figure 5. Composites chassis and battery emplacement.

APTERA VEHICLE

This three-wheeled design is designed to minimize the drag, hence using energy to rotate the wheels rather than overcoming air resistance. It claims up to 1,000 miles in range at a price of 25,000- 46,000 dollars. Meant for USA markets.

In the USA, 3,000 Apterae have been ordered for 2021 delivery, with the limited Paradigm and Paradigm+ editions selling out the very first day. A refundable $100 secures your place in line for a customizable Aptera. The car consists of 10 parts fitted at the assembly stage.

Over 30 square feet of upgradeable solar panels on the vehicle generate enough power to drive, on average, 25 miles a day throughout most of the USA, up to 45 miles a day in the southwest.

The base model has a 250-mile battery range, Never Charge solar array, and two in-wheel motors (front wheel drive) that produce a total of 134 HP and accelerates from 0 to 60 mph in 5.5 seconds. At $25,900, the Aptera compares very favorably to other EVs, not taking into account its tax incentives renewables benefits of about 7500 dollars of tax credits.

For more range, a $3,900 upgrades to a 400-mile battery range, matching the range of the much more expensive Tesla Model S Long Range Plus. $8,700 upgrades to a 600-mile battery range, more than any other EV offers. To out-drive any other vehicle on the market -- gas, electric, or hybrid -- $19,000 upgrades to an unheard-of 1,000 mile range.

Options for the Aptera include:

All-wheel drive, which brings the Aptera to 200 HP and 0-60 time down to 3.5 seconds ($2,500)

SafetyPilot, with Level 2 autonomy including adaptive cruise, lane keep, emergency braking, and facial tracking ($1,300)

Off-road kit, with more ground clearance and hardened wheel covers ($1,000)

Solar hood ($300) and/or solar rear hatch ($600), for more sun-powered miles

Enhanced audio, with subwoofer and an extra three channels of audio ($600)

Camping kit, with integrated tent and rear awning (yes, you can camp in the back! $600)

Pet kit ($300)

Climate control, driver display and 15" touchscreen are standard. All options are selectable with your reservation, and can be changed up until shortly before delivery when the order is finalized.

Figure 6. Lightyear One is a four-wheeled design.

Figure 7. Lightyear wind tunnel testing.

Figure .8 In-wheels independent electric motors provide an all-wheel capability.

LIGHTYEAR VEHICLE

The lightyear design has a range of 450 miles and a price tag of 150,000 Euros. It is meant for the European markets. Particularly Norway and Switzerland.

Lightyear One is covered with 1,000 solar panels, capable of adding on average over 20 miles a day of range throughout most of its target market. The base model has a 450-mile battery

range, exceeding that of even the Tesla Model S Long Range Plus. Four in-wheel motors (all-wheel drive) provide a total of just over 100 HP, saving weight and energy, with a 0 to 60 mph time of 10 seconds. This is a rather high value for an electric vehicle.

Priced at €150,000 (approximately $183,000 USD) plus taxes, standard features include a companion app, Apple CarPlay, Android Auto, a wireless charging pad, and armrests and cup. The company anticipates being able to lower that price for future models as the car catches on and they ramp up production.

DISCUSSION

Figure 9. Charging car batteries under a solar canopy during work hours.

An alternative to photovoltaic cells on cars, solar panels can be used for charging car batteries at work sites' parking spaces. This is for instance adopted at the Google campus in Mountain View, California.

The electrification of the transportation system is an ongoing process. The technology cannot be ignored since the cost of energy is zero. However it presents a capital cost issue in addition to a resource issue in the materials used such as Lithium, Cobalt, Copper and Nickel.