

PHOTO CAPTION: Suzuki Gran Vitara. PHEV Consortium-member Electrovaya is better known for its tablet computers, but it also developed a battery-powered version of the small, Suzuki SUV to demonstrate the energy and power of its advanced Superpolymer lithium batteries, which will be used in the consortium's plug-in hybrid drive system.

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Inside the PHEV Consortium

By Bill Moore

Part one of two part interview with members of the new Plug-In Hybrid Electric Vehicle Consortium.

The newly formed Plug-In Hybrid Electric Vehicle (PHEV) Consortium has set itself a pair of ambitious goals, according to David West, the director of marketing for [Raser Technologies](#). It wants to insure that plug-in hybrid technology costs no more than current automobiles and that consumers don't have to compromise on performance.

How they plan to accomplish both objectives will be interesting to watch, but by virtue of the fact that the four companies, which include Raser, [Pacific Gas & Electric](#), [Electrovaya](#) and [Maxwell Technologies](#), have established the consortium signals an important watershed in the PHEV movement.

Although no one has yet settled on a good marketing handle for the technology, the term "plug-in" seems to best describe how the vehicle is powered, at least partly. Current hybrids use gasoline and kinetic energy to keep their relatively small battery packs recharged. Plug-in or grid-chargeable hybrids utilize a much larger battery pack that is charged from the local electric power grid. That energy is used to propel the vehicle from 20-60 miles depending on the size and type of the battery used. Only a relative handful have actually been built, some by private owners and entrepreneurs and others by U.C. Davis students under the guidance of [Dr. Andy Frank](#). Beyond the 20 or 60 mile electric-only range, the hybrid's normal gasoline engine kicks in and the car reverts to normal gasoline-electric hybrid performance.

What the Consortium is seeking to do is move the concept to the next level of development by combining the key technologies provided by each consortium member. Raser Technologies would provide its high-power electric motor, while Canadian-based Electrovaya would team up with Maxwell to develop an ultracapacitor-lithium polymer hybrid battery.

Robert Tressler, with Maxwell, said that his company is excited about joining the consortium because it will enable his firm to provide "cutting edge" technology, as well as help influence how that technology finds its way into plug-in hybrids. In fact, all three manufacturers are offering state-of-the-arts products and designs which have only surfaced in the past several years.

"The imperatives in the consortium of providing both a cost-effective solution, as well as bridging the gap between theory and practicality is really critical in the long term", Tressler stated.

"Obviously, with the rise in fossil fuel cost and everyone paying north of \$65-70 a barrel for oil, the sensitivity and the ability for us to come to the marketplace with real options for consumers that don't effect them in a dramatic way in the pocketbook, but rather gives them some relief, is really exciting for us".

Speaking for Electrovaya, which did not have a representative available for the conference call, David West explained that its Superpolymer® lithium battery technology offers the potential to provide both the energy (range) and power (acceleration) needed to power plug-in hybrids, especially when paired with supercapacitors such as those manufactured by Maxwell.

Brian Stokes, representing PG&E, one of California's largest utilities, explained why his company joined the Consortium by noting that it's been active in various electric drive programs for some 15 years. It has a fleet of 13,000 vehicles and has implemented an environmental policy that requires it to "walk the talk". He believes in the need to offer consumers a no-cost or low-cost option that will help the utility's service area improve its air quality.

While there are only four members in the consortium, at the moment, West explained that it will be open to other EV-centric technology developers including other motor, electronics and battery manufacturers. The consortium also wants to eventually include automotive OEMs in what West calls Phase Two.

"The success of the consortium depends on the participating and leadership of an OEM. But our first task at hand is to make sure that we take to the table off-the-shelf, or available technologies that can get this car built, and demonstrate that they are ready to be built, in that the product is feasible.

"So, the first phase of the consortium is for the component suppliers to get together, make sure that we have enough components of what we call off-the-shelf or available already to be put into a proof-of-concept car... And get a lot of the work done to show that this is feasible and, thereby, attract OEMs to participate either with that design or take on some of the components that are presented through the consortium into their own designs to help accelerate that process".

West sees OEM participation as "critical and key" and he hopes that it will be only "a few short months" until one or more can be brought into the consortium.

Breaking the Mileage Barrier If and when a major OEM does decide to join the consortium, it will mark a major turn-around in automaker attitude, which has largely dismissed for years the concept of electric-motor dominate hybrids, along pure battery electric vehicles, which they tend to lump into the same uneconomic niche.

But what projects like those initiated by [Energy CS](#) and [CalCars](#) demonstrate -- not to mention the disappointing mileage numbers for the current batch of hybrids, the latest of which show virtually no improvement in fuel efficiency -- is that in order to break the current fuel economy barrier of 40-60 mpg (5.8 to 3.9 liters/100km), more of the vehicle's energy has to come from electricity.

The reason is simply.

An internal combustion engine is only 24-30 percent efficient, depending on whether its gasoline or diesel-fueled. In contrast, electric motors can be over 90% efficient. Batteries can have similar efficiencies. Even the oldest coal-fired electric power generator has an operating efficiency of 30-35 percent, while new, combined cycle gas turbines are 60 percent efficient. More of the primary energy generated through the electric power grid reaches the wheels than does that from gasoline or diesel fuel.

This is why the handful of plug-in prototypes on the road today can claim to get the *equivalent* of 120-160 mpg for the first 20-to-60 miles. Since 50 percent of Americans drive only about 25 miles a day, even a 20-mile range PHEV means they will be burning virtually no gasoline during

the week, while operating for pennies per mile on electricity, which comes from domestic energy sources, not imported oil.

"The only way to get to these numbers", West stated, "is to get past the combustion engine, to get towards electric motor-dominate solutions..."

What he sees for Phase One of the project is an e-motor dominate hybrid with an electric-only range of 20 miles, followed by one with a 50 mile battery range. The latter number would cover virtually 80 percent of all daily driving needs in America, while the former number would take care of half of all Americans, he said, referring to U.S. government data. The precise nature of the underlying hybrid architecture will be determined by the consortium.

Equivalent to 24 Cents Gallon

"What we think is very, very important about taking this next step is we go from very ethereal benefits, in order words a number on a mileage sticker on a car that claims 25 or 28, 30 or 40 miles per gallon to a car that actually doesn't turn on the combustion engine perhaps five days a week or seven days a week for many drivers... that allows them to drive without going to the gas station... It allows them... most significantly... to operate right here in Utah at 24 cents per equivalent gallon or in California [for] maybe 50 cents per equivalent gallon.

"In light of \$3-and-rising liquid fuel costs, the ability to get a lot of your driving done at 24 and 50 cents per equivalent gallon is a tremendous incentive, and we think it's perhaps the catalyst or critical mass that will allow consumers to really adopt hybrid cars in a broad way.

Both Stokes and West took pains to explain that the consortium isn't interested in creating an alternative car, but simply providing the components, either individually or as an integrated drive system that automakers can adapt to their product lines. The decision of what gets used and how rests with the OEM. The consortium wants to prove it's feasible and affordable to do.

"It provides a sensible transition from where we are now to where we need to be. That's really one of the things that's been missing from the plans here in the U.S. is how do we get to fuel cell vehicles? How do we get there from here? It's a realistic transition that makes economic sense, that gets us to a commercial or production-worthy design," West explained.

He added that its entirely possible that multiple vehicles may emerge from the consortium, each one demonstrating a different architecture -- series, parallel or a combination of both -- depending on OEM needs. He envisions the possibility of one carmaker using the consortium-developed drive system, while another uses only selected components. Above all, he believes the technology needs to adapt to consumer needs, not consumers adapt to the technology. He wants the free market to work its magic, letting consumers decide which approach works best.

Given there are hundreds of millions of cars and trucks on the road today, I asked if the consortium had given any thought to also investigating ways to create retrofit solutions that could be used to improve the fuel efficiency of the current fleet.

West responded that it's entirely possible that such solutions could emerge. He noted that it's possible today to install an electric motor in a vehicle's differential, as well as equipping small four cylinder cars with belt-driven starter-alternators to give the vehicle at least automatic stop/start capability to help save fuel wasted while idling.

He also added that the consortium wants to work with other organizations such as the California Cars Initiative, as well as with various leading academic institutions such as U.C. Davis and the University of Wisconsin at Madison, both of which have been actively involved for a decade in developing advanced e-drive components and systems.

[CONTINUED IN PART TWO...](#)