

The EEstor Energy Storage Unit (ESU) An Opportunity Analysis

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The Product and its Advantages

We are EEstor, one of the top 100 green companies according to the AlwaysOn Network¹, and are funded by Kleiner Perkins. Our product is a new supercapacitor that is better and cheaper than other energy storage units (ESUs). It stores 52kW of energy, weighs 336lb, and displaces 2005in³, allowing it to power an electric vehicle (EV) for 300 miles on a 4-6 minute charge.² We have patented the dielectric for the capacitor and its manufacturing process, which makes the capacitor light and inexpensive compared to other ESUs. Its expected price tag is \$2,100 in mass production.³ Though it is currently large and powerful, we can later modify it to extend applications to consumer electronics. With the current design, the most viable market to address would be that for powering EVs.

Due to skyrocketing oil prices, the demand for alternative energy vehicles has increased, as noted by the popularity of hybrid cars like the Prius and the success of electric vehicle company Tesla Motors. However, EVs are currently hindered by their limited range and long charging times. Our supercapacitor alleviates these problems by sustaining long drives and charging as quickly as filling up a gas tank. Unlike NiMH and Ni-Cd batteries, which take hours to charge and discharge at 5-10% and 1% per day respectively, the supercapacitor discharges at a rate of .1% per 30 days. The supercapacitor also contains no corrosive or hazardous materials and needs no maintenance, unlike some types of batteries which contain caustic and toxic components and may require deionization. It is also safer because it is non-explosive under impact.² Thus, these advantages remove the limitations that EVs currently face, and with an infrastructure that could serve as replacement gas stations, EVs could become widespread with an EEstor capacitor.

The Market and Customers

¹ "The GoingGreen 100 Winners." *Always On*. <http://alwayson.goingon.com/permalink/post/18632>

² A 4-6 minute charge would not be possible from standard household wiring. According to Dr. Alex Katamis of Exponent, Inc.'s Electrical and Semiconductor Practice, the necessary wiring would be unusually heavy-duty, but could be of a reasonable diameter for practical use.

³ [United States Patent 7,033,406](#). United States Patent Office. Retrieved on [2008-1-24](#).

The product would be integrated into a co-branded car between EEstor and a car manufacturer such as Honda that would best be aimed at those interested in hybrid and electric vehicles. “The world hybrid electric vehicle and electric vehicle (HEV/EV) battery market enjoyed a period of exceptional growth during 2006 and ...is expected to continue at a compound annual growth rate (CAGR) of 14.8 percent,”⁴ showing a growing market that will be receptive to the new technology. Also, as a proxy, the number of hybrids sold has increased every year⁵ and is now around 3% of all light-duty vehicles. Sales for previous years are shown in Exhibit 1. Trends in hybrid sales provide an initial indication of the size of the market we wish to enter.

However, EVs are not hybrids, and in order for them to cross the chasm, they need to be able to provide the convenience that customers have become accustomed to with traditional gas-powered vehicles. A car powered by an EEstor ultra capacitor would be able to provide this convenience through its long range and short charge time. The popularity of hybrid vehicles is a proxy for the market’s willingness to adopt a new technology that doesn’t pose a significant inconvenience

However, Toyota’s hybrid prices are roughly \$5,500 higher than standard models, but the average driver saves less than \$500 in gas per year. An EEstor-powered vehicle would save over \$1,000 per year in the fuel/electricity tradeoff. EEstor-powered vehicles would also cost less than hybrids because the capacitor is cheaper than hybrid batteries,⁶ and there would be no need for an additional gas engine. The bottom line is that a car powered by our capacitor would offer the same convenience as a hybrid at a lower price and with increased fuel savings. This means that our potential market would be larger than the current hybrid market, and we could dominate it. In a few years, we could hope to power 3% of light-duty vehicles sold in the U.S., the current size of the hybrid market, which would be roughly 180,000 vehicles per year.⁷ At a profit of \$500 per capacitor, the market would be worth \$90 million.

⁴ “World Hybrid Electric Vehicle and Electric Vehicle Battery Market.” Frost & Sullivan Research Service. <http://www.frost.com/prod/servlet/report-brochure.pag?id=N18B-01-00-00-00>

⁵ “Hybrids Post Strong US Sales in November; Up 82% Year-on-Year.” *Green Car Congress*. <http://www.greencarcongress.com/2007/12/hybrids-post-st.html>

⁶ “Behind the Hidden Costs of Hybrids.” <http://www.hybridcars.com/economics/hidden-costs.html>

⁷ Based on roughly 6 million light duty vehicles sold per year http://allcountries.org/uscensus/1279_motor_vehicle_factory_sales_and_retail.html

Partnerships

Bringing about a paradigm shift in the auto industry is not something that a startup can accomplish single-handedly. Success will require numerous partnerships in at least three areas: manufacturing, marketing and distribution, and charging infrastructure. Manufacturing would consist of a straightforward outsourcing partnership. This could take place domestically, or we could consider manufacturing in China to minimize costs.

Once the capacitor is manufactured, it needs to be put in cars which then must be sold. As a startup, we lack the capability manufacture automobiles. Thus, a strategic partnership with an automaker is necessary. The automaker would provide legitimacy through its name and marketing, a distribution network through its dealers, and the capability to produce the remainder of the vehicle.

The final type of partnership would be in setting up the infrastructure to charge the vehicles without which capacitor-powered cars would be virtually useless. The goal would be to partner with local utilities, municipalities, and businesses to roll out charging stations on local streets and in parking lots. Starbucks would be a specific yet non-exclusive target for this partnership. Not only do they have a nationwide presence, but we also feel that their customers are more likely to be among the early adopters of EEstor-powered vehicles. Partners would have to cover the cost of installing charging stations, and would then be able to profit from the markup on the electricity sold. Businesses like fast food establishments could also benefit from increased business that charging stations would bring. While tangential to our primary business of selling capacitors to car makers, the availability of this infrastructure is essential to maintaining the attractiveness of our product.

Competitors

In the last decade, many different means have come forth to replace our current gas motors; they include biofuels, lead acid batteries, lithium ions batteries and hybrids. Biofuels, however create a number of problems both economically and environmentally

and are unlikely to become mainstream.⁸ And our edge over hybrids has already been discussed.

The most promising battery technology of the electric vehicles (EV) industry thus far is the lithium ion battery. Tesla Motors has used the lithium ion batteries for their Roadster.⁹ However, three main factors have prevented the EV industry from being marketed outside dense cities and as a second car: a slow recharge time of 4 hours, a limited range of 220 miles and a hefty price tag of \$20,000.¹⁰

Risks

The barriers to entry for any EV company include technical risks, convenience issues and acceptance of the market. However, the EV market has become increasingly desirable considering governmental incentives, increased energy awareness, and steep gas prices. Naturally, many of the larger car companies have begun to produce pure EVs. Car companies need a durable, high capacity, fast charging battery to produce a desirable EV. The EEstor capacitor will help bring the EV to the average driver; and with solid intellectual property established, our only challenge after perfecting the technical aspects of our product is weaning consumers off gas.

Business Model

The primary aspect of the business model is our system of partnerships. One of which is the car company which also acts as our source of revenue. We aim to sell our product to major auto manufacturers that are currently planning to release pure electric vehicles in the next couple of years such as Toyota and Honda.

In the initial stages of research the principle expenses will be test materials, and set of assembly equipment. The main goal of the research will be to find the optimal design for the product components. This will involve assembling many capacitors for testing. Once a product is refined, then expenses will shift to manufacturing. Another expense involves supercapacitors being difficult to assemble. There is the possibility that

⁸ “Will the Current Biofuel Boom Go Bust?”
<http://www.nature.com/nbt/journal/v25/n5/full/nbt0507-491.html>

⁹ <http://www.teslamotors.com/>

¹⁰ “Will Lithium Ion Batteries Power the New Millennium?” <http://www.buchmann.ca/Article5-Page1.asp>

many capacitors may be damaged before they get to the test stage. Due to this variable, a logistical [Exhibit 2] model will be used in predicting how much test supplies are needed to become profitable. From this model we can estimate how much material to purchase. Once we reach the production stage there will be sound figures for how much material will be needed for manufacturing.

In order to get to profitability we will need enough funds to get through research to develop a product and then test it. It is estimated that that research will require \$3 million in series A funding, reliability testing will require another \$3 million of series B funding, and \$1.6 million in series C that will take us through initial manufacturing to market.¹¹ Upon market entry, we would expect to quickly displace hybrids as the preferred green vehicle. In addition to capturing this segment of the market, we would expect it to grow with our entry due to lower price and improved savings of EEestor powered vehicles. Given time for the market to adapt, we could profit upwards of \$90 million annually¹² while revolutionizing the automotive industry.

¹¹ Charlie Duncheon: Vice President of Sales and Marketing, Artificial Muscle Inc. March 2 2008, Sunnyvale, Ca

¹² As described in "Market and Customer" section.

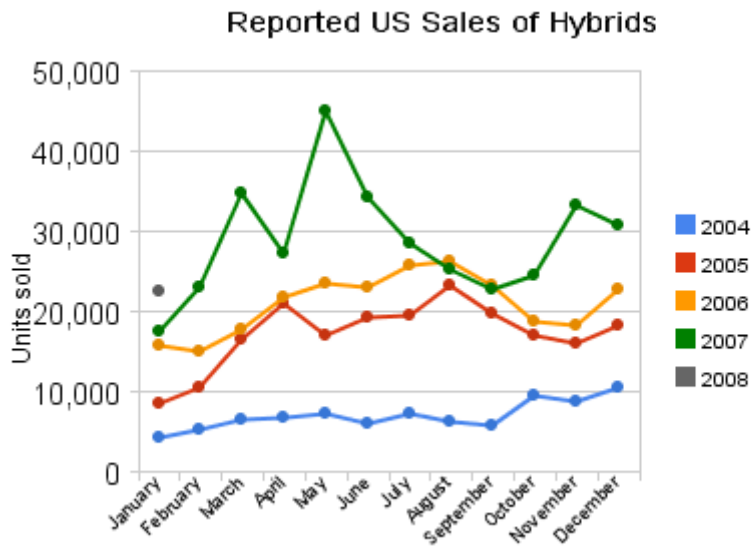


Exhibit 1. Sales of hybrids, excluding GM’s sales (which are unreported). Taken from “Reported US Sales of Hybrids Up 27.3% In January 2008.” *Green Car Congress*. <http://www.greencarcongress.com/2008/02/reported-us-sal.html>

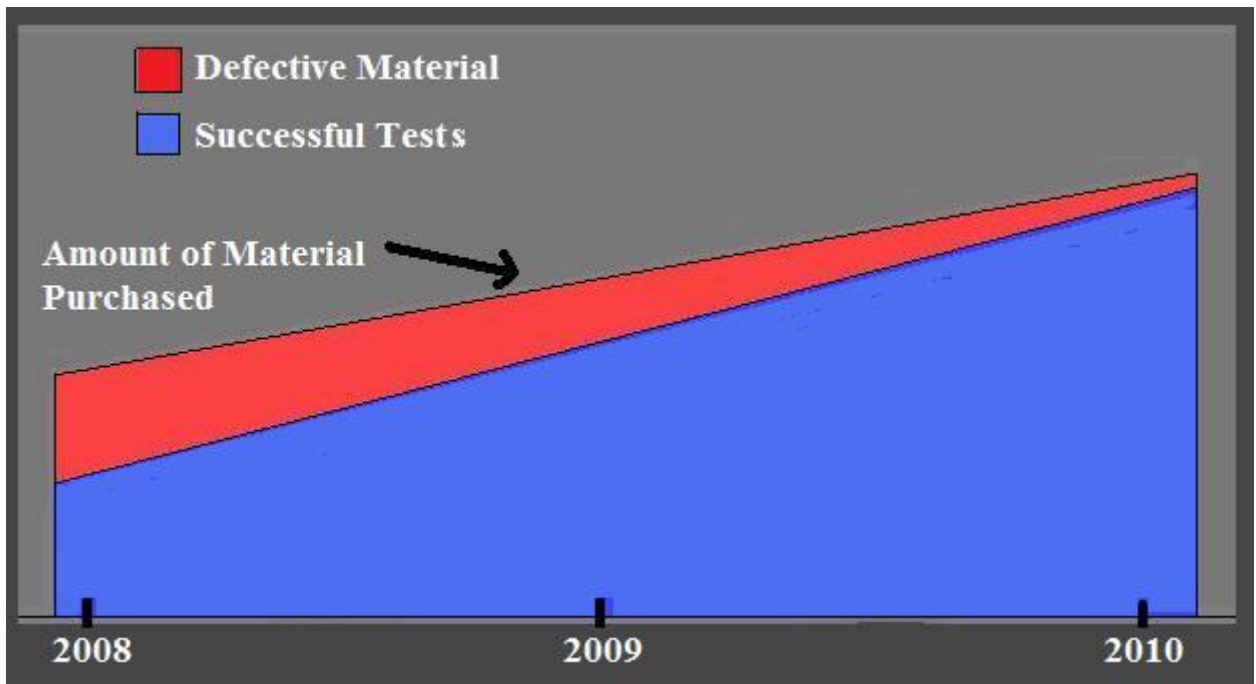


Exhibit 2. Logistics model for purchasing material through various testing phases.