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Top Trends Shaping the World of Electric Vehicles

2011 & *Beyond*

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EV WORLD.COM

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Renewable Energy - Facts and Fantasies

EXECUTIVE SUMMARY

There is plenty of reporting about the past and present of the migration to electric vehicles. We've had our delays and bankruptcies, OEMs dragging their heels, promising technologies that failed to materialize, and repressive neighborhood EV legislation. On the other hand, we've had fantastic triumphs: huge rounds of financing for a certain few start-ups, breakthroughs in battery chemistry, and dozens of OEMs – some that seemed least likely to do so – running like the devil and making terrific progress in the EV product launch plans.

But that's the present. You can read all about it on EVWorld – for free. Want to know what the future holds?

That's why you bought this report. You have more than an idle curiosity about where this is all going. You're more than vaguely aware that some people are going to get quite rich as we replace the 800 million internal combustion engines on our roads with alternate power trains, especially PHEVs, BEVs, and fuel-cell vehicles. As in all celebrity divorce cases, lots of dollars change hands. And this is by far the largest "divorce" in the history of business on Earth: the separation of Big Auto from Big Oil.

So in these pages, I've laid out my predictions -- with whatever degree of precision I feel is appropriate -- in the EV space over the coming year or two.

This is the first EV industry outlook that EV World has published. Originally, the purpose was to identify 'winners' and 'losers' in the industry as seen from

our perspective, after having monitored it for more than a decade, during which time we have seen technologies, vehicles and companies come and go, all expectantly hoping to ride the wave of a new transportation paradigm. Most have been aspiring start-ups run by an eclectic group of visionaries, technocrats, entrepreneurs and, yes, a few crackpots. The losers lost often because they were under-funded, poorly managed, or just victims of the times. They had the right product at the wrong time. The wrong product at the right time. Or the wrong product at the wrong time. And truth be told, even the mighty have stumbled, including the largest car company in the world. The road to an EV world winds through a mine field littered with the remains of long forgotten predecessors dating back a century or more. Those that have survived what I refer to in my book, Electrifying Ride as the "Lost Decade" from 1999-2008 have done so by focusing with laser precision on a particular niche, working assiduously within that niche, while avoiding, by astute management, just plain luck, or, more likely, a combination of both, the kinds of disastrous business decisions that imploded others.

Outlook 2011 doesn't attempt to pick winners or losers largely because such an exercise presumes a level of insight and business acumen that EV World lacks. Instead, the objective is to summarize where the industry is with respect to automotive-based electric-drive vehicles in North America; and in that summary may lie clues to the future fate of the industry at large and the individual players within it. Subsequent editions may look at other markets such as Europe, Africa and the Middle East, Southeast Asia and the Asia Pacific Rim, as well as technology subsets therein.

A key reason for adopting a more circumspect view of the future of the industry has much to do with 2007 best seller, The Black Swan - The Impact of the Highly Improbable, by Nassim Taleb, the main lesson of which is that we live in a world shaped by the unexpected, what Lebanonese-born Taleb calls "Extremistan," where Gaussian curves are irrelevant and economic forecasting models useless. Two recent cases in point: the self-immolation of a Tuni-

Bill Moore at the
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sian fruit seller literally and figuratively igniting turmoil across the Arab world, and the 9.0 earthquake off the main Japanese island of Honshu. Both of these highly improbable events -- a 9.0 earthquake is considered a once-in-a-thousand year occurrence -- will forever reshape the world as we know it. Precisely how it will, we simply have no way of knowing. The unfolding nuclear disaster in Fukushima may spell the end of fission-based nuclear power and the ascendency of a wide-range of distributed energy systems: wind, solar, geothermal, hydrokinetic; maybe even exotics like cold fusion or zero point energy, pick your moniker. Certainly, energy efficiency will become even more central to our future, and that will directly impact our transportation system, especially as oil prices continue their wild fluctuations and fission-based nuclear power looks less attractive economically, politically, and environmentally. This may bode well for energy storage, which is vital to compensating for the intermittency of renewable energy sources, be they utility-scale wind farms or residential-scale solar photovoltaics. Investments in energy storage may result not only in improvements in energy density and system durability and reliability, but also possible cost reductions, though supply bottlenecks and competition could mitigate potential savings with utilities and ESS manufacturers bidding against automotive manufacturers for cells. In the wake of Fukushima, the much-worried "battery glut" of 2017 may become the "battery shortage" instead, unless some other unexpected Black Swan event jolts the world off into yet another entirely unexpected direction: a breakthrough in fusion power or the appearance of proven, scalable energy extraction from the vacuum (zero point energy).

Since Black Swans -- be they good or bad -- are by their very definition impossible to foresee, much less predict; the best we can hope for is to understand where we are at the moment and keep as many options open as feasible, societally and technologically-speaking.

PAST IS PROLOGUE

Late last year, on schedule and as promised, General Motors and Nissan began series production of the Chevrolet Volt and LEAF electric cars respectively, but there the similarities end. Having relinquished, at least in North America, its title as maker of the then-world's most advanced electric car, the EV1, the company abandoned what senior management considered an unprofitable venture. It recalled some 1,500 of the sports car-like two-seaters it had built that were in the hands of both fleets and private owners, including a substantial number of Hollywood notables, and with few exceptions, crushed the battery-powered roadsters, stacking the remains like cord wood, essentially absolving the corporation of any future liabilities. Publicly at GM, electric vehicles were now dead and buried somewhere in the Arizona desert.

General Motors, however, wasn't the only major carmaker obligated by California lawmakers to invest time, talent and resources into "zero emission vehicles" or ZEVs.

Under the terms of what became known as the Memorandum of Understanding (MOU) with the State of California, Nissan, too, had been required to field a small number of electric cars, deploying two distinctly different models: the Hypermini and the Altra, the latter, a station wagon-like crossover vehicle. Both were powered, for the first time, by lithium ion batteries. Although beset by early technological problems with its highly reactive, but energetic lithium cobalt chemistry, Nissan effectively trail-blazed the shift away from the then-prevalent nickel metal hydride battery chemistry to more promising lithium-based batteries.

When California's Air Resource's Board, under political pressure from carmakers, dealers and even the George W. Bush White House, agreed to allow auto manufacturers to substitute fuel cell vehicles for battery electric models, they threw open the gate for a virtual stampede away from battery electric vehicles or BEVs. The half dozen large carmakers impacted by California's so-called Zero Emission Vehicle mandate began similar recalls and lease terminations. By 2004, few of the original wave of electric cars, pickups, minivans and sport utility vehicles were left on the road; the exception being a handful of first-generation Toyota RAV4 EVs and Ford Ranger EVs in consumer hands, mainly in California. Many of those vehicles are still on the road.

With the widely successful introduction of Toyota's second generation Prius in late 2003, momentum clearly shifted to gasoline-electric hybrids. While not a popular seller, Honda's little two-seat Insight was rated yearly the most fuel-efficient car in the United States. Ford was working feverishly on its own hybrid using a parallel hybrid architecture similar to that in the Prius. General Motors offered a mild hybrid version of its popular Chevy/GMC half-ton pickup, though without much sales success. A similar mild hybrid program at its now-shuttered Saturn division, didn't fair much better.

Prior to its short-lived merger with Daimler, Chrysler had developed an all-electric version of its popular minivan. Some 300 were built and subse-

quently withdrawn from service, as the Auburn Hills, Michigan company merged with Germany's Daimler. During that time, Chrysler explored a number of approaches, finally rolling out, briefly, a hybrid electric version of its Dodge Durango sport utility vehicle. Its subsequent 'divorce' from Daimler and souring financials, caused it to terminate all of its electric vehicle programs, including dissolving its EV development team.

With its own EV program on hold and looking for a low-cost way to enter the hybrid car market, Nissan was the only large Japanese OEM to take Toyota up on its offer to license what it calls its Hybrid Synergy Drive (HSD), putting it in the Nissan Altima Hybrid sedan. For all intents and purposes, as far as the general public was concerned, battery electrics were a dead letter by mid-decade. The future was -- and may still be -- fuel cells. They just needed to resolve a 'few' issues. By 2010, General Motors promised, commercial fuel cell cars would be a reality. And they became that... sort of.

Quietly, privately, however, the dream of a battery electric car lived on, both at GM and Nissan, it turns out; and a couple tiny start-ups.

Inspired by the work of AC Propulsion, the small California R&D house whose founders had done much of the original development work on what would become GM's EV1 -- then called the Impact -- two different sets of entrepreneurs rolled out a pair of lithium-powered electric sports cars. The first to debut was the $400,000, custom-made Fetish, developed by Venturi Automobiles, based in the Principality of Monaco. An early concept version made its public appearance at the 2002 Salon International de l'Auto in Geneva. The pre-production prototype, using technology originally licensed from AC Propulsion, made its official debut at the 2004 Paris auto show.

While a significant step towards a new generation of electric cars, the Fetish was viewed more as an exotic curiosity than the harbinger of change. It would be a second group, Tesla Motors, based in Silicon Valley that would capture

the media limelight in North America. Incorporated in 2003 by Martin Eberhard and Marc Tarpenning, Tesla -- named in honor of the late 19th, early 20th century inventor Nikola Tesla -- rolled out to the media in July 2006 its Lotus Elise-based Roadster, also powered by technology licensed from AC Propulsion. Besides its exhilarating performance -- zero-to-60 mph in under 4 seconds -- and 200+ miles of range per charge, the two-seat Roadster was one-quarter the price of the Fetish and its creators were aiming for "mass production," hoping the success of the Roadster would pave the way to future, lower-priced models. It would subsequently announce development of the Model S, all-battery electric sport sedan with room for five. That car, the company predicted, would sell for under $60,000, with yet a third, even lower priced model to follow. Time magazine awarded the Roadster its "Invention of the Year" in 2006.

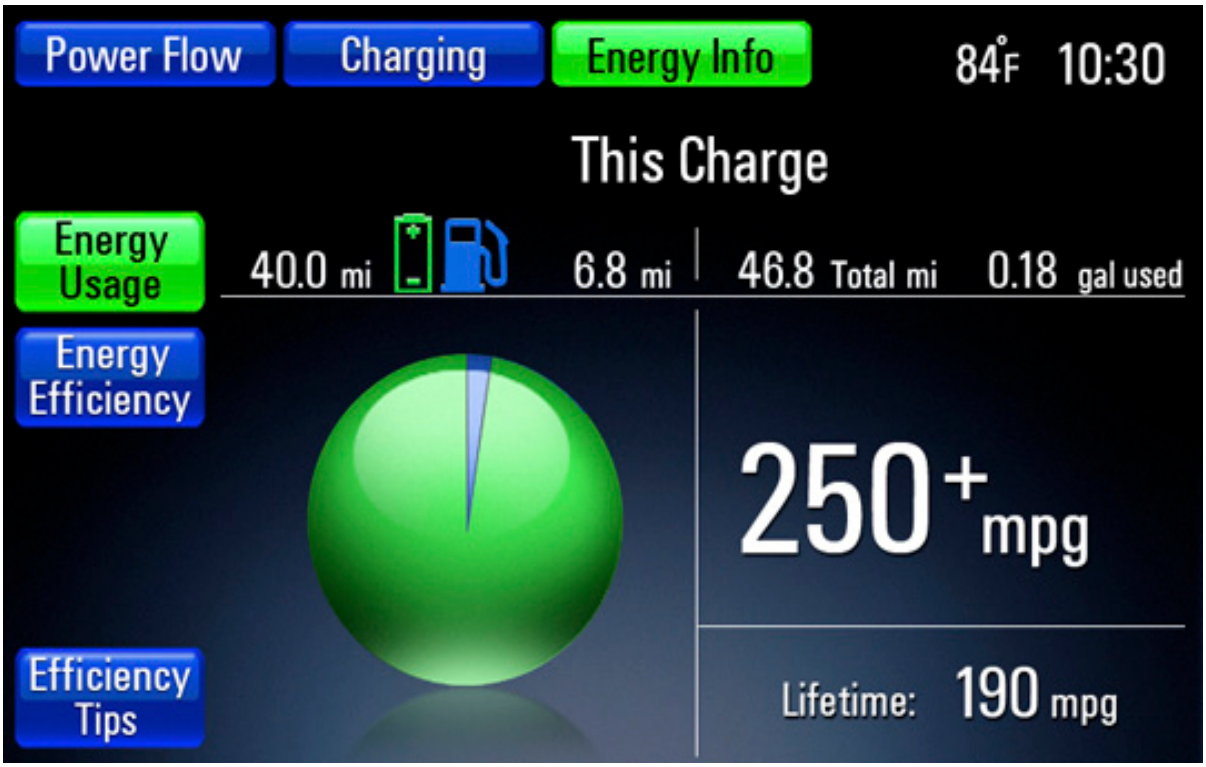
The media hoopla surrounding Tesla wasn't lost on GM's then-Chairman of North American Development Robert Lutz, whose job it was to breathe styling and performance excitement into General Motor's product line. While most of his previous efforts at Chrysler, where he was instrumental in developing the Plymouth Prowler and Dodge Viper, concentrated on low-volume, high performance vehicles, he came to GM with the personal vision of picking up where the EV1 left off. In the spring of 2006, before the official debut of the Tesla Roadster, a GM executive privately confided to EV World that "the electric car isn't dead at GM." The following January, at the 2007 North American International Auto Show in Detroit, the company unveiled the Chevrolet Volt concept car, an extended-range electric vehicle (EREV) then promoted as having 40 miles of electric driving range, at which point it would become a hybrid with several hundred additional miles of gasoline-powered range. The muscular-looking concept car created a media sensation, so much so that GM announced that it would put the car into development with production slated to begin in November 2010; a target they subsequently did meet.

Over at the Renault Nissan Alliance, two key personalities teamed up: Alliance

Chairman Carlos Ghosn and Project Better Place founder Shai Agassi. It was the Israeli-born Agassi's vision to create an electric car network modeled after cellular telephone services, selling miles instead of minutes to plan participants. A key component of that concept was an electric car whose batteries could be exchanged within minutes, allowing cars to travel distances comparable to gasoline models. That vision coincided with Ghosn's growing belief that electric cars would become an increasingly important segment in a world of expanding mobility demands, especially in the developing world with its growing mega cities. Ghosn predicted in 2008 that by 2020, electric cars would capture 10 percent of the global market. He saw in Agassi's plan a viable pathway towards volume production of electric vehicles. On January 21, 2008, the Alliance and Better Place announced they had reached an agreement with the government of Israel that would enable Agassi to introduce his EV service network; the first of several to follow, including Denmark and Australia. Renault would provide the vehicles, which would incorporate Agassi's required rapid battery exchange capability, and Better Place would oversee installation of the charging network that would consist of as many as 500,000 charging stations and an unspecified number of automated battery exchange installations, strategically placed around Israel, enabling travel from one end of the country to the other without stopping for lengthy recharges. Giving Agassi's plan the credibility it needed was an initial investment of $100 million in venture capital, a sum that would then grow to $200 million from one of Israel's richest businessmen, Idan Ofer, head of the Israel Corporation. For his part, Ghosn would bring to bear the engineering expertise of both Nissan and Renault, using the latter's Fluence sedan as the platform for Agassi's rapid battery exchange concept. Production has now commenced at the Oyak Renault Otomobil Fabrikaları A.Ş plant in Bursa, Turkey. At the 2009 Frankfurt, Germany auto show, Better Place announced placement of an order for 100,000 Renault electric cars, plus 100,000 charging stations from Flextronics. Today it remains the largest single order for electric cars in history.

While the Renault side of the Alliance would focus on its traditionally strong

markets in and around Europe, Nissan would capitalize on their joint engineering efforts by developing the LEAF, an all-electric car based on a model known as the Versa in North America and Tiida in Japan. However, it would not incorporate the rapid battery exchange capabilities of the Fluence, given the lack of a supporting network of quick drop stations similar to those planned for Israel and Denmark. It would incorporate Nissan's pioneering lithium ion battery efforts over the last decade, bringing in the cost of the 24 kWh battery pack at an estimated US$16,000; enabling it to offer the five-passenger LEAF for $32,780 in the United States. While initial production of the LEAF is being done in Japan, the company is building a facility in Tennessee to manufacture both the car and its battery pack in the USA. It is also planning in two years time to assemble models for the European market at its plant in Sunderland, England. In early February 2011, 67 LEAF EVs arrived at the Port of Tyne, England. Those cars are slated to go on sale in Britain in March 2011 for £28,350. They qualify for the UK government's £5,000 incentive grant. In the United States, the LEAF qualifies for a $5,000 federal tax credit, as well as an additional $5,000 in California. Other states offer similar incentives. Nissan reports that its first production run of 10,000 vehicles is sold out.



INDUSTRY STATE-OF-CHARGE

P.S.R.
Probable Success Rating

2011 may come to be considered the watershed year for the electric vehicle revolution. Clearly, a confluence of many forces geopolitical, social, and technical are coming together in a way they have never done so in the century since the introduction of the automobile. From ever-escalating -- and wildly fluctuating -- energy prices driven by growing global demand and production constraints, to dramatic improvements in energy storage technology and control electronics, the chances of the success of the electric vehicle may be the best they have ever been.

There remain, however, significant uncertainties: consumer acceptance being perhaps the most daunting, followed by technological unknowns; how durable, how safe, how dependable are these advanced batteries? On the consumer side, price sensitivity and unfamiliarity with the advantages of electric propulsion systems compared to more familiar IC engine vehicles, are likely to

be the primary drag on the adoption of EVs globally. Complicating the picture are the offerings themselves. There are few choices at the moment: two sedans in North America (LEAF, Volt) and a small sports car. The introduction of the Fisker Karma will add a third sedan, and the availability of the TH!NK city, doubles the number of city-class EV offerings to two.

While all of the current offerings are superior in every way to those rolled out nearly fifteen years ago, their success commercially -- and that of their underlying suppliers (drive systems, batteries, etc.) -- remains uncertain. Will today's offerings succeed, as they must, financially; especially in light of short-term government incentives? Do they offer a compelling enough case economically and, perhaps more importantly, emotionally to justify the purchase? Finally, are the company's themselves technically, financially, and managerially-capable of supporting their products going forward? An eight year, 100,000 mile warranty is worthless if the company no longer exists.

Bearing all these factors in mind, EV World created a simple "state-of-charge" score for evaluating the viability (probable success rating) of today's product offerings, Using the metaphor of a battery charging (or discharging), our SOC scoring offers five "levels of charge" as follows:

- 1 bar: Strong concerns
- 2 bars: Some reservations
- 3 bars: 50/50 chance of success
- 4 bars: Moderate chance of success
- 5 bars: Excellent chance of success

The selection of a specific SOC, with respect to each company's product, is largely based on subjective judgement and not on any measurable qualitative or quantitative analysis of either the product or the company's management. The key question is, will it sell? If it does and the company can make money doing so, then the company will be a success.

PRESENT FUTURE TENSE

While both the Volt and the LEAF are off to what might be best described as tentative starts given the state of the economy globally and events in Japan, other companies are bringing product to market as well. What follows is a summary of those efforts to date, listed in alphabetical order, concluding with our perspective on their SOC.

- BYD
- CHEVROLET
- CODA
- FISKER
- MITSUBISHI
- NISSAN
- SMART
- TESLA
- THINK
- VENTURI
- WHEEGO

BYD

Based in Shenzhen, China, near Hong Kong, BYD also plans to sell electric-drive cars in North America, offering initially one plug-in hybrid model (F3DM), an all-electric crossover (e6), and an all-electric transit bus (K9), which may become its largest seller based on a September 2010 agreement with Hunan Province to purchase 1,000 of the buses. The agreement was announced during the much publicized visit by Berkshire Hathaway leaders Warren Buffett and Charles Munger, along with Microsoft founder Bill Gates. Originally launched in December 2009, BYD's first electric-drive vehicle, the "Dual-Mode" F3DM beat GM's Volt to market by nearly a year, but sales to date are reported to be slow in the interval. The company responded in July of 2010 by nearly cutting the price of the car in half from RMB 169,000 (US$24,800) to RMB 89,900 (US$13,400) through the extension of a RMB 50,000 subsidy from the central government in Beijing and another RMB 30,000 subsidy from the Shenzhen provincial government. It also introduced an "updated low-carbon" model in March 2010 that incorporates a solar panel integrated into the vehicle's roof to provide some modest battery trickle charg-

ing, likely for its 12 volt accessory battery. The company also appointed 30 new dealers in 2010 to handle F3DM sales across China.

With an eye towards eventual sales in the United States, BYD established its North American headquarters in Los Angeles, California and provided the city's Housing Authority (HACLA) with ten F3DMs. Early published reports describe the car as meeting expectations in terms of electric range and fuel savings. It is currently servicing those vehicles through a shared facility in Glendale, California. It reports also having set up 10 dealerships in the USA to date.

PROBABLE SUCCESS RATING

3

The e6 is an all-electric, five-door vehicle said to have a driving range per charge in excess of 200 miles. The first version that debuted at the 2009 North American International Auto Show in Detroit featured intrusive bumps and humps in the passenger cabin from the vehicle's 60kWh lithium ferro-phosphate battery pack. Fifty e6's accumulated more than 600,000 km (372,000 mi) in a taxi demonstration program in Shenzhen as of September 2010. In January 2011, the company announced it would retail in America -- before government incentives -- for US$35,000.

The 12 meter long, 6 ton K9 all-electric bus is reported to have a range of 300 km (186 mi), recharge to 50% state-of-charge (SOC) in 20 minutes, and be fully charged in six hours. EV World has been advised that BYD will again participate in the annual Berkshire Hathaway shareholder convention in May 2011 in Omaha, Nebraska; and will bring the K9 for display and demonstrations, perhaps in part to alleviate potential BRK shareholder anxiety in the wake of confidential, but Wikileak-ed U.S. State Department cables said to paint an unflattering portrait of a company that copied competitor designs, and skimped on product quality and safety.

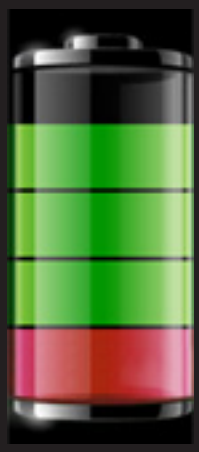
CHEVROLET

GM began delivery in mid-December 2010 of its pace-setting Extended-Range Electric Vehicle. According to GM, through February 2011, it produced 1,800 units, just over half of which have been sold to retail customers. The company remains committed to its original plan to manufacture 10,000 units in 2011, while increasing the launch markets from an initial seven in 2011, to all 50 states by the end of 2011.

As of late March, it is being reported that Volt production may be impacted by the situation in Japan where its transmission is manufactured. This is the same transmission that created a stir when it was revealed that there was, under certain driving loads, some mechanical interaction between the engine/generator and electric drive motors that improved the cars performance by an estimated additional 10 percent, a brouhaha that quickly blew over. Subsequent early driver experiences have demonstrated electric driving efficiencies equivalent to more than 100 mpg, with gasoline consumption in hybrid mode in the 30-35 mpg range. Overall fuel (electric and gasoline) economy is seeing averages

well in excess of 70 mpge. Costs per mile demand largely on local utility rates: the lower the per kilowatt hour rate, the better, with some California drivers paying the equivalent to what they would have if they had been using gasoline alone. This is compensated for by the fact that when in EV-mode, the car is running on domestically-produced energy, not imported oil. In 2010 and early 2011, Volt garnered numerous 'Car of the Year' accolades from the likes of Motor Trend, Automobile, Green Car, the North American International Auto Show and others.

PROBABLE SUCCESS RATING



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PHOTOS:

PREVIOUS: Retired airline pilot James Brazell takes delivery of first Chevrolet Volt sold to a retail customer. RIGHT: GM Hamtramck plant manager Teri Quigley escorts President Barak Obama on tour of Detroit Hamtramck production plant where Volts are built.

CODA

Coda Automotive is a 2009 spin-off of Miles Electric, founded in 2004 by Miles Rubin; whose original business model was the importation of Chinese-made EVs as FMVSS 500 qualified low-speed vehicles, bypassing the need for DOT crash certification. Limited to a top speed of no more than 25 mph on roads with posted speed limits of 35 mph or less, two basic models were marketed primarily to fleets.

Coda effectively broke its visible ties with Miles Electric in 2009, seeking to introduce a fully-capable highway-speed electric sedan based on the Hafei Saibao III, a Chinese-made, gasoline engine-powered model designed by Pininfarina in Italy and originally manufactured by Hafei Motor, now owned by Chang'an Motors. The plan is for Coda to provide the vehicle specifications and sales/service support in North America with manufacture of the all-electric version of the four-door, five passenger sedan to be done in China. The electric drive system would come from UQM, a Colorado-based e-drive specialist, while the battery pack would be supplied by Lishen Power Batteries,

PROBABLE SUCCESS RATING

2

which is majority owned by China National Offshore Oil. In 2010, Lishen and Coda announced a joint venture to assemble battery packs at a future plant site in Ohio.

To date, the company has raised some $200M in capital from four separate rounds: series B for $24M in 2009, series C for $58M in 2010, and the latest round for $76M from Harbinger Capital Partners and Riverstone Holdings, llc. In 2010, the company's CEO, Kevin Czinger left and has been replaced by former GM China executive Philip Murtaugh. Deliveries of the US$44,900 car is now slated to begin in Q3 of 2011. Coda hopes to sell between 10,000-14,000 vehicles in the first twelve months after its initial launch. In October 2010, Enterprise Rent-a-Car announced it would order 100 cars for its fleet. Hertz followed in December with a similar announcement, but for an un-specified number of vehicles. Beyond this, the company has talked about sales starting in Hawaii, though the exact marketing plan still appears to be evolving.

FISKER

Six months before Tesla announced its Model S, Anaheim, California-based Fisker Automotive introduced its Karma electric hybrid (plug-in) at the 2008 Detroit auto show. Founded the year before by famed Aston Martin designer Henrik Fisker, in partnerships with Bernhard Koehler and Quantum Technologies, the 4-seat Karma would be the first "luxury" electric hybrid, utilizing a Quantum-developed drive train with batteries provided by A123 Systems. Priced now at US$95,600, the Karma will have an electric range of up to 50 miles. In series hybrid mode, similar to the Volt, the car can travel another 250 miles. Unlike the Volt, production of the car has been entirely outsourced, according to Wikipedia, with an aluminum frame supplied by Norsk Hydro, the interior by Magna International, and initial assembly in Finland. Production is slated to begin late March 2011 with first deliveries to customers planned to follow in April. As of late winter 2011, reports are that the company has in hand some 3,000 pre-orders. In early 2009, it announced it had signed up

PROBABLE SUCCESS RATING

3

some 32 dealers in 17 states. The number of dealers and importers is now estimated at 50 in North America, Europe, Asia and South America. As part of the Obama Administration's 2009 American Recover and Reinvestment Act stimulus program, Fisker obtained a federal loan of $528 million, $359 million of it to help underwrite the development and eventual production of a follow-on model code-named Project NINA that is pegged to be priced at $47,000 in late 2012. The car will be manufactured at the former General Motors Box-wood plant in Delaware.

MITSUBISHI

Mitsubishi introduced the electric version of its 'i' Kei car (light automobile) at the 2007 Tokyo auto show, partnering with Japanese utilities to demonstrate its fleet operation capabilities. In July 2009, it began domestic market sales, while quietly introducing the car into a host of potential markets in Asia-Pacific, Europe and North America, eventually partnering with PSA Peugeot/Citroen on rebadged versions known as the ion and C-Zero, respectively. As of late 2010, 15 months after beginning serial production, Mitsubishi has delivered 5000 vehicles, 3,000 in Japan. The car seats four adults, is propelled by a rear-mounted 47kW (63 hp) permanent-magnet motor, powered by a 16kWh, 330V lithium-ion battery pack mounter under the passenger cabin. Range is estimated at 80 miles on the EU combined mode driving cycle. Top speed is 130 km/hr (80 mph). Recharge time at Level II (240V, 13A) is 6 hours. Direct DC (3-phase) to 80% SOC is 30 minutes. In 2010, the company announced it would develop a model designed for the North American market, dubbing it the "i." Slightly wider than the original model and priced "around US$30,000" before applicable credits and/or incentives, U.S. sales are slated

PROBABLE SUCCESS RATING

4

to begin in November 2011 on the West Coast, extending to the East Coast in 2012. The car is also available in the United Kingdom, Hong Kong, Australia and Costa Rica. Mitsubishi has also placed it in demonstration programs from Spain to New Zealand.

NISSAN

Just one day prior to the 9.0 earthquake that struck offshore of the main Japanese island of Honsu, 600 Nissan LEAF electric cars left for North America, escaping the tsunami that destroyed some 1,300 premium line Infiniti automobiles, as well as another 1,000 newly manufactured Nissan automobiles sitting dockside in the port city of Hitachi, Irabaki Prefecture. Those 600 LEAFs likely represent the largest single shipment to date of Nissan's centerpiece electric car platform, which has been, since production began in late 2010, slow to deliver vehicles to the estimated 300,000 'hand-raisers' in North America, alone; many of whom have put down $99 deposits. Reports from Japan indicate that as of the end of January 2011, some 1,100 cars have been shipped with just over 100 delivered to customers in the United States prior to the shipment of the lucky 600.

PROBABLE SUCCESS RATING

4

Part of the reason for the slow delivery rate may have to do with the value of the Yen, which was steadily rising against the U.S. dollar prior to the earthquake, making the LEAF increasingly more expensive for Nissan to sell outside Japan. While the company announced that it anticipated being able to produce 4,000 a month by the end of March, 2011, the aftermath of the earthquake, tsunami and power cuts now plaguing Japan, will likely disrupt that schedule, especially since the Oppama plant where the car is assembled is just south and west of the larger Tokyo metro area. While not directly affected by radioactive fallout from Fukushima Dai'ichi, nonetheless it was one of those shuttered by Nissan in the wake of the disaster. When production is resumed the focus will be on parts production only for overseas and repair markets. Officially, first production run for 2011 is sold out.

One of the primary ways of avoiding the trap of fluctuating international currency values, as well as potential supply disruptions is to manufacture vehicles in the destination country, and towards this end and with respect to the LEAF, Nissan is building the capacity to assemble the electric car, along with its battery pack, at its plant in Smyrna, Tennessee. It will also be assembling the car at its plant in the Northeast of England, and the battery pack at a new plant now under construction in Portugal. The resulting cars will be sold in Europe. Deliveries of Japan-assembled LEAFs begun in the United Kingdom in late March 2011.

SMART

When Nicolas Hayek set out to develop the "Swatchmobile" in 1991, he intended to give it a hybrid-electric drivetrain. Eventually the car that would become know as the 'smart' and developed in collaboration first with Volkswagen and then Daimler-Benz AG, would be powered by conventional gasoline and diesel engines when it launched in 1998 as the City Coupe and adding in 2000 the City Cabrio. Not only did the smart become an iconic vehicle in Europe where owners appreciated its diminutive size and good fuel economy, but it also became, with the rise of China to an economic power, one of the most copied vehicles on the planet.

Since its initial appearance, a number of groups have sought to give it an electric pulse, including Atlanta-based e-Motion, Zytek in the UK, Wavecrest in Michigan, and Hybrid Technologies in North Carolina. Apart from hand-built

PROBABLE SUCCESS RATING

3

conversions, little came of these efforts. In 2007, Daimler announced it would introduce 100 electric smarts in London, with a number operated by police. In 2009, the program would be extended to include other regions of the country, with the company promising to start serial production in 2010.
In the spring of that year, it rolled out the first limited production version of the car in New York City, calling it the smartED for "electric drive." Through its smart USA partner, the company plans to place 250 of the electric cars with various groups and individual consumers at a lease price of US$545 a month. Its 30 kW motor and 16.5 kWh lithium-ion battery pack offers an estimated range up to 98 miles. Top speed is 130km/hr (80 mph).

Reports began circulating in March 2011 that a third generation version of the smartED will go into larger volume production in 2012. Besides the smartED, the company unveiled a pair of electric two-wheelers in 2010 at the Paris auto show: an electric-assist bicycle and motor scooter as part of a strategy to offer a range of electric mobility options for urban commuters. At this writing, no decisions have been made to commercially produce the vehicles.

TELSA

As of its March 2011 10-K filing with the Security and Exchange Commission (SEC) Tesla Motors reports it has sold more than 1,500 roadsters in 31 countries. Its network of retail sales and service stores totaled 16 by the end of 2010. The company further reports that once its supply of contracted 2,400 Lotus Elise "gliders" are "exhausted" sometime in the 2012 time frame, it will evaluate whether or not to order further platforms, suggesting that the fate of the Roadster remains somewhat in question beyond 2012.

Instead, the company is shifting its development efforts towards the introduction of the Model S, which increased R&D expenses from $73.3 million in 2009 to $93 million in 2010. In October 2010, it completed the $48.5 million acquisition of the former NUMMI plant in Fremont, California where it intends to manufacture the Model S and "future vehicles," the first of which will

PROBABLE SUCCESS RATING

3

be the Tesla Model X, the 10-K noting however, that the company will need to raise additional capital to pursue it's development. It is aiming for a mid-2012 launch of Model S production. The company will offer three versions of the vehicle, each model offering increased driving range at a commensurate price. The base line model with up to 160-mile range will sell for US$57,400. The next model, with a range up to 230-miles, will sticker for $67,400. The top-of-the-line 300-mile model will go for US$77,400. Additionally, the company has contracts to provide 1,800 battery packs and chargers to Daimler for their smartED electric car initiative, as well as providing assistance in developing an electric version of the Mecedes-Benz A-Class sedan. It also has a contract worth up to $69 million to provide engineering prototypes of Toyotas RAV4 sport utility vehicle. Work on that project is expected to continue through 2011.

THINK

The Norwegian-based company produces a two-passenger electric car, primarily intended for urban and suburban environments, with most of its sales to date occurring in Northern Europe. European production takes place in Finland, and battery options include EnerDel 23 kWh lithium-ion and 24 kWh FZ Sonick ZEBRA (sodium nickel-chloride). The vehicle has a top speed of 110km/hr (68 mph) and an approximate range of up to 160 km (100 miles) per charge.

The company is 48% owned by U.S.A.-based Ener1, Inc., which is also the holding company parent of EnerDel, one of Think's two battery suppliers. The company has not released sales figures for its European operations, where vehicles have been placed in service in Norway, The Netherlands and Austria. In late 2010, the company shipped 300 partially-assembled vehicles to its Think North America facility near Elkhart, Indiana, with the objective being to use those vehicles to train employees how to assemble them in anticipation of pro-

PROBABLE SUCCESS RATING

3

ducing complete vehicles for the U.S. market. Those vehicles were assembled in early 2011 and 15 where delivered to the State of Indiana and allocated to some of its state parks. Subsequently, all of the vehicles have been recalled three times for various assembly issues from incorrectly installed seat belts to heaters not working properly. Additionally, Think Global recently asked both EnerDel and FZ Sonick to temporarily curtail battery deliveries to enable it to realign its inventory, presumably due to slower than anticipated sales.

VENTURI

Venturi Automobiles, which arguably helped catalyze the rebirth of interest in electric cars with the debut of the Fetish, achieved its own set of milestones. A Venturi-powered Citroen Berlingo, equipped with a trio of ZEBRA sodium nickel-chloride batteries, successfully drove, unassisted, from Shanghai, China to Paris, France through the spring and early summer of 2010. The company is manufacturing, in partnership with PSA Peugeot/Citroen, a similar version of this vehicle for La Poste, the French postal service; The initial order for 500 vehicles has subsequently been increased to 1,500. Production is now underway at its new MVE facility in Sablé-sur-Sarthe, France. During 2010, the company also acquired the assets of Voxan, a bankrupt French motorcycle manufacturer, and is considering development of electric motorcycles. Additionally, in partnership with Ohio State University's Center for Automotive Research (CAR), a Venturi-sponsored team set the land speed record for electric vehicles in 2010 with the re-christened Venturi Jamais achieving a record top

PROBABLE SUCCESS RATING

3

speed of 515 km/hr. (pictured here).

At the 2011 North American International Auto Show, the company officially announced the launch of Venturi North America, whose mission is to explore avenues by which to extend the company's brand and technology to this side of the Atlantic. Headquartered in Columbus Ohio, home of OSU, its CEO is long-time automotive industry veteran John W. Pohill.

WHEEGO

PROBABLE SUCCESS RATING

2

Continuing the trend of importing Chinese-made platforms, converted either overseas or locally to electric-drive, Altanta, Georgia headquartered Wheego Electric Cars, Inc. is moving, starting in March 2011, from the low-speed to highway-rated category with the introduction of its LiFe model powered by lithium batteries and base-priced at US$32,995. The company claims the LiFe model consists of 80% U.S.-sourced parts. Adding transportation charges of $1000.00 and minus the $7,500 federal tax credit, the price of the car stickers out to $26,495. An air conditioning option adds $1,995. The company advertises the car as having a range of 100 miles on its 30 kWh, 260 Amp Hour (AH) lithium ferro-phosphate battery pack. Top speed for the two-seater, yet another Chinese clone of the smart, is 65 mph.

According to the Atlanta Journal-Constitution, the company sold some 300 of its low-speed Whip models. It hopes to sell 2,500 of the LiFe version in 2011. In addition to the federal tax incentive, the State of Georgia offers an addition-

ELECTRIC LOGISTICS

- BALQON
- BREMACH
- FORD
- NAVISTAR
- SMITH

BALQON

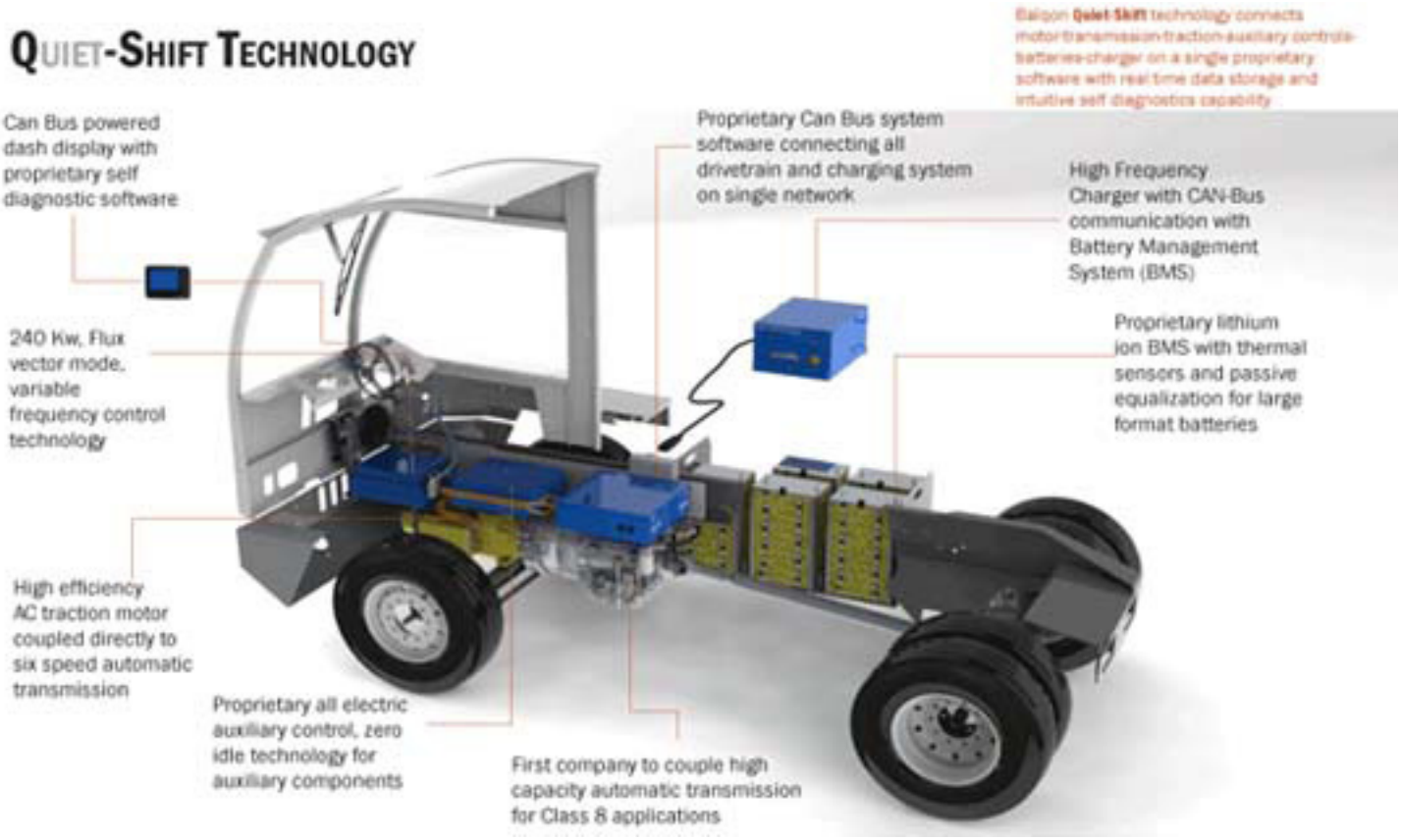
Harbor City, California-based Balqon manufactures a trio of heavy-duty electric trucks: two models designed for handling shipping containers within and around dock facilities, and one model that could be considered competitive with both Smith and Navistar/Modec trucks. The Nautilus E20 model is capable of operating over an 8-hour shift or up to 95 miles (unloaded) while hauling up to 60,000 lbs of containerized cargo at a top speed of 25 mph. It is intended strictly for dockside drayage operations. The Nautilus E30 can operate on-road, but top speed is limited to 45 mph. It is capable of moving up to 30 tons of containerized cargo. Maximum range is 150 miles. The M150 Mule is also an on-road vehicle with a standard cab-over, two passenger-wide cabin. It is able to transport 7 tons up to 90 miles. Range unloaded is up to 150 miles. Top speed is unspecified.

In December 2010, the company raised $5 million in investment capital, and

PROBABLE SUCCESS RATING

3

one month later it received an order worth $15.9m for electric drivetrains for export to China, signaling the company's movement into electric vehicle system sales that include e-drives, battery modules and flux vector motor controllers; the latter which it acquired in 2010 with the IP acquisition of Electric Motorsports, LLC, Cincinnati, Ohio. Its stand-alone drive system is for integration into inner city transit buses both domestic and overseas. The largest single customer to date has been the City of Los Angeles of Nautilus-class trucks for use at the Port of Los Angeles.



BREMACH

PROBABLE SUCCESS RATING

2

Founded in Italy by the merger of Fratelli Brenna and Aeronautics Macchi in Italy in the late 1960s, the company manufactures an all-wheel drive truck called the T-Rex. Its U.S. distributor - Bremach USA (Chino, California) - has developed an all-electric version of the T-Rex, which it is currently looking to market. The company has developed a unique 200kW (150kW continuous), 110V "low voltage" drive system that it claims can climb up to a 45 degree incline.

FORD

Azure Dynamics finds itself in the unique position of being the official electric vehicle integrator for Ford Motor Company on its Turkish-built Transit Connect van. Originally undertaken by Smith Electric in England, Ford turned to Azure Dynamics when Smith found itself unable to continue development of the program, focusing its efforts on its larger Newton lorry and Edison light van platforms.

Azure Dynamics is the official manufacturer of record, purchasing Transit Connect gliders that are shipped from Turkey to Baltimore, Maryland where they are then trucked to AM General in Livonia, Michigan for "uplifting" with AZD drive and control electronics, and Johnson Control Saft lithium batteries. The 28 kWh pack provides the popular panel van with between 50-80 miles of range depending on accessory usage, climate and road conditions. Top speed is 75 mph. At present, some 30 vehicles are in operation with test fleets in both North America and Europe. Those fleets include AT&T, Johnson Controls,

PROBABLE SUCCESS RATING

4

Xcel Energy, New York Power Authority, Florida Power and Light, and Southern California Edison. The company currently has the capacity to produce 700 vehicles annually, but reports it can ramp this up as necessary. The vehicle carries a dual warranty with Ford responsible for the basic vehicle and AZD, the e-drive system. The EV version is distributed through Ford's national dealer network. Pricing in the U.S.A. is in the mid-$50's. The vehicle will also be available in Canada once the final approval process is completed with Transport Canada. It also qualifies for the U.S. federal government's $7,500 tax credit. Full production commences in April 2011.

MODEC

Modec, like Smith, originates in England, which has a long history of electrically-propelled work vehicles, the largest single category being retail dairy delivery (milk floats). Launched in 2004 by Lord "Jamie" Borwick, the 5th Baron Borwick, the company began production of its delivery van alternative to the Smith Newton in 2007, delivering vehicles to a host of high-profile companies including Tesco, UPS and FedEx in the U.K. It established dealerships in The Netherlands, Ireland, France, Spain, Germany, Denmark, Switzerland, and the USA, the latter being taken over by Navistar International Corporation, through which it agreed, via a Joint Venture, to manufacture the vehicle under the Navistar e-Star name. President Obama was on hand for the rollout in 2009 of the first e-Star at a reopened RV plant in Indiana. In February 2011, the company announced that UPS had increased its Modec fleet to 20 operating in London, with an additional six in Germany.

On March 4, 2011, the company officially entered "Administration," the British

PROBABLE SUCCESS RATING

2

equivalent of Chapter 11 bankruptcy in the United States, with the company reportedly some £40m in debt, due in part, it has been reported to the global economic recession that drastically reduced customer orders. Efforts are currently underway to find a buyer for the firm in order to keep it in England.

ADDENDUM:

While Navistar has failed to respond to inquiries on the status of the e-Star program, it appears from recent announcements that they intend to continue to pursue sales of the vehicle in the United States, and presumably manufacture.

SMITH

In 2011, Smith Electric Vehicles was acquired by its U. S.-based associate, Smith Electric Vehicles US (SEVUS), for an undisclosed sum. Smith UK's parent company, Tanfield Group, will retain a 49% share of merged entity, with headquarters located in Kansas City, Missouri. The U.S.-based facility, located on the grounds of Kansas City International Airport, currently produces the Newton delivery vehicle, available in three GVW classes: 16,535 lbs., 23,148 lbs., and 26,455 lbs. Range of all three weight classes is advertised to be in excess of 100 miles per charge. Because it is intended primarily for urban delivery, its top speed is 50 mph. Energy is stored in Lithium-ion Iron Phosphate batteries, with the drivetrain warranted for 60 months. In the spring of 2010, the company received an additional $22 million U.S. Energy Department grant, bringing the total grant funding to $32 million. The funds are to be used to offset development of future commercial electric vehicles and to allow Smith to operate demonstration programs in various regions for the purpose of data collection. The company also announced in 2010 that it would estab-

PROBABLE SUCCESS RATING

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lish as many as 20 regional assembly plants across the United States, the goal of which is to "provide Smith's customers with comprehensive local factory-based service and support," according to a company press release. Late in 2010, the company announced the U.S. Marine Corps acquired a pair of Newton vehicles for Camp Pendleton, California, revising the vehicle's top speed to 55 mph and range "from 50 to 120 miles on a single charge…" As a privately held company, SEVUS is not required to release financial information.

However, the fact that no new sales have been announced since the December 2010 Marine Corps announcement suggests that sales for it, like Navistar/Modec have been lackluster. Visits by President Obama to both Navistar and Smith have raised their profiles, though that hasn't necessarily translated in to substantial sales.

X-PRIZE

Founded in 2005, the goal of the Automotive X Prize was to encourage the development of a commercially-producible passenger vehicle with energy equivalence of 100 miles per gallon. As the program developed, additional criteria emerged, including producing less than 200 grams of carbon dioxide per mile (124g/km). Additionally, the entered vehicle must have features expected on any modern automobile: enclosed passenger cabin with windows and windshield, operating windshield wipers and washer, seat belt, lighting, turn signals, rear view mirrors, etc. Each vehicle had to be able to maintain 65 mph on a four percent grade, and safely be able to accelerate from 40 to 60 mph in less than nine seconds. Eventually two classes emerged once teams began to enter vehicles: Mainstream and Alternative, the latter allowing much wider range of innovation.

Eventually, 111 teams registered and paid the entry fee by late October 2009. A series of competitive stages followed an initial design judgment period that looked at questions of safety, manufacturability, emissions and business plan. Teams vetted past this screening

stage moved onto a series of increasingly demanding competitive stages, held primarily at Michigan International Speedway through the spring and summer of 2010.

By the time the competitors reached the validation stage, conducted at the EPA labs in Ann Arbor, Michigan and Argonne National Labs outside Chicago, Illinois, only a handful of vehicles remained. The winner of the Mainstream class was Edison2 Very Light Car, powered by a small ethanol-fueled internal combustion engine. Its owners took home $5 million of the $10 million prize. The Alternative class was divided between tying entries: Li-ion Motors' Wave II and X-Tracer from Switzerland, the former a side-by-side design, the latter, tandem seating. A sister vehicle, driven by another Swiss team would complete a 27,000 km around-the-world rally in February 2011, both entirely powered by electric drive systems. Li-ion Motors and X-Tracer split $5 million in prize money between them.

What came out of the Automotive X Prize as winners were largely unconventional designs, the practicality and consumer acceptance of which remain open to debate.

CONVERSIONS

Are They Now Moot?

During the "lost decade" from the demise of the Memorandum of Understanding between the top six car makers (Chrysler, Ford, General Motors, Honda, Nissan, and Toyota) and the State of California, when nearly all of the several thousand electric cars on lease in the state to fleets and private owners were terminated, the cars recalled, and most disposed of by their manufacturers, a small subset of hobbyists and small businesses continued to invest time, effort and money in converting conventional gasoline engine vehicles to electric drive. While not as sophisticated as the large OEM products, they enabled their owners, along with their friends, neighbors and relatives to experience electron-powered mobility. Ford, GM and the U.S. Energy Department, helped encourage similar developments at the University level through a series of technology challenges: Future Car, Future Truck, Challenge X, EcoCar; all centered around converting conventional cars (SUVs and Crossovers, of late) to various types of electric-drive systems; serving as a "farm club" for both future automotive engineers and technological innovation.

The announcements by General Motors (Chevrolet Volt), Nissan (LEAF), and Ford (Focus-class EVs) that they would be offering e-drive vehicles, has had the effect of dampening consumer interest in conversions, with the exception of hobbyists and racing enthusiasts for whom there are few OEM-built options: in particular light-duty trucks in the Chevrolet S-10 and Ford Ranger category. That segment of the EV market continues to survive, though because it is dependent on small business suppliers, product availability and order fulfillment often lag, stalling project completion.

In the "commercial" conversion arena, two players stand out, though others could be mentioned: AMP and Rapid Electric Vehicles, the former based in Cincinnati, OH, the

latter in the Vancouver, British Columbia area.

Starting with the now defunct Saturn Sky and Pontiac Solstice sports cars, AMP has developed a respected all electric drive system that it has now adapted to the Chevrolet Equinox. In addition to orders for several by the city of Akron's electric utility, it has also been tapped to provide vehicles for a consortium of energy providers in Iceland. AMP's battery-powered Saturn Sky was entered in the Progressive Insurance Automotive X Prize competition making it up to the Knockout round.

Rapid Electric Vehicles specializes in fleet conversions of Ford F150 medium-duty pickups for fleets. Based in Vancouver, British Columbia in Canada, it has tapped into a pool of engineering talent originally pulled together by Ballard Fuel Cells in its early-to-mid 2000s heyday. The company has developed what it calls 'bi-directional' charging that enables electrical energy flow both into the vehicle's 25 kWh Valence battery, as well as back into the grid -- sufficient power to run many American homes for several days. However, the target market is organizations, both private and public, that have need for portable power sources for run on-site construction equipment or provide emergency back-up electricity.

The company's customers include Honeywell Aerospace, Burlington Hydro and the City of Santa Monica in California.

PHASE II EVs

The Next Wave of Electric-drive Vehicles

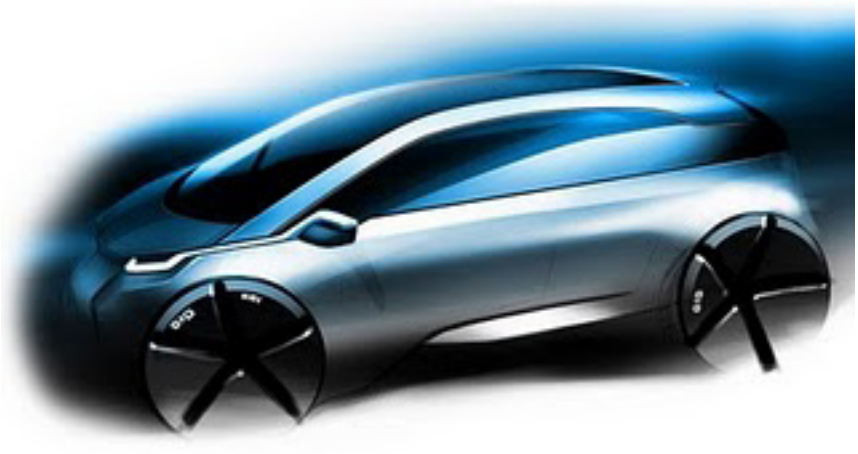
From the plethora of public announcements coming from nearly every significant car company on the planet, we could find ourselves awash in electric-drive vehicle options beyond the 2012 horizon.

In 2010, Deutsche Bank found, during their research, some 160 electric-drive vehicle programs in the "development pipeline." Among these are the following...


Blue.
blue-e-motion

BMW

i-Series electric car sub-brand that will initially include a city-class vehicle called the i-3, and a sport model known as the i-8. The cars will make extensive use of carbon fiber materials to reduce weight and improve range and performance.



CHRYSLER

After emerging from bankruptcy, the Auburn Hills, Michigan carmaker finds itself controlled by Fiat of Italy. As a result, its vehicle development programs are focused on small IC engines and vehicle platforms; with virtually no hybrid or electric-drive programs in the works, with the exception of a battery version of the Fiat 500 minicar, tentatively slated for North American sales in 2012.

DAIMLER

No longer 'married' to Chrysler, the makers of the Mercedes-Benz line of luxury cars continues its dalliance with electric vehicles ranging from conventional hybrids to pure electric to hydrogen fuel cells. It has taken a stake in Tesla Motors, hiring the California firm to assist in engineering battery packs, while collaborating with BYD in China and Renault in Europe on future electric drive vehicles to replace the current Smart and compete with BMW's announced i-Series EVs.

FORD

The company introduced a pair of electric vehicles: the all-electric Focus EV, based on its new C-Max vehicle platform; and the Ford Energi electric hybrid, again using the C-Max, but incorporating a gasoline engine for range extension. Both vehicles will be built on the same production line as Ford's conventionally-powered Focus models, giving Ford the ability to adjust production to as demand arises.

GM

In Europe, the company will not only offer the Chevy Volt, but also its European cousin, the Vauxhaul/Opel Ampera. It also announced commencement of two new electric vehicle programs: an EREV Cadillac SRX and a "multi-purpose" minivan-like vehicle, both to be powered similar to the Volt. The company is also experimenting with all-electric vehicles; both programs -- Korea and Germany -- centered on battery electric versions of the Chevrolet Cruze. GM also continues development of its fuel cell program, announcing in late 2010 that it would assist in helping build out a hydrogen refueling system in Hawaii.

HONDA

Essentially the last holdout opposed to developing pure battery electric cars ('the batteries aren't ready'), Japan's third largest automotive manufacturer, came about -- to turn a nautical phrase -- and announced that it too would be offering, for starters, an all-electric version of the popular Fit, examples of which will be loaned to several California entities, including the City of Torrance, Google, Inc., and Stanford University. At the same time, it announced that it would be debuting an electric hybrid (PHEV 15) version of the Accord in 2012. The company's motorcycle division is also conducting demonstration trials of an all-electric motor scooter in Japan.

HYUNDAI

The Korean carmaker introduced its first hybrid in 2011, the Sonota Hybrid, but like Daimler and GM, continues to see a future in fuel cell vehicles, announcing in October 2010 that it would produce 2,000 fuel cell sedans between 2012 and 2014, with 400 to be rolled out in the USA. On the plug-in electric front, the company admitted that it has an "active EV program," but has given no timetable as to when and what type of vehicle might appear, other than the handful of prototype demonstrators its testing in Korea.

TATA

Indian industrial giant Tata began production of an electric version of its Vista subcompact car in England. It plans to initially produce 1,100 cars for the UK market which is offering incentives up to £5,000. It has also shown in the recent past an all-electric version of its Nano in Europe, though an introduction schedule has not been announced.

TOYOTA

Long the preeminent manufacturer of hybrid vehicles, led by the market pacesetter Prius, Japan's leading car company announced that it will be bringing to the consumer market a plug-in version of the Prius with an electric range up to 12 miles (<20 km). Additionally in 2011 it created the Prius 'family', introducing two new Prius-based models, the station wagon-like 'V' and the compact city-class 'C', the former to go on sale -- depending on the recovery of the Japanese auto supply market in the wake of the March 11, 2011 earthquake, tsunami and resultant infrastructure damage and power shortages. It also plans to introduce a battery version of its iQ microcar in 2012, with an initial target sales of 50,000 units. Along with the iQ electric, the company contracted with Tesla Motors to deliver a pair of prototype electric versions of its RAV4 sport utility vehicle; the first unit of which was displayed at the 2011 North American International Auto Show in Detroit in January. Toyota says it plans to have the vehicle "market ready" by 2012, which isn't a promise that it will, in fact, be produced in any quantity. Perceived demand will drive that decision.

VOLKSWAGEN

Early in 2011, the Wolfsburg automaker debuted its XL-1 electric hybrid concept car at the Qatar Motor Show. VW's press release boosted its combined-cycle fuel economy equivalent to 313 mpg in EV-mode The 800cc diesel engine powering the super-efficient two-seater will be used, according to news reports, in the forthcoming Up Hybrid, a Golf-life minicar, that will also be offered as an all-electric model, both supposedly appearing in the 2014 time frame, along with a battery version of the Golf. The company is also collaborating in China, like Daimler, but in this case with SAIC Motor Corp. and FAW Group Corp, to develop an electric car for the Chinese market.

2012 & BEYOND

EV Trends Going Forward

While it isn't yet entirely clear what kind of consumer acceptance awaits these and the other scores of electric-drive vehicles appearing in the coming years, certain trends are starting to manifest, which will affect the speed and rate of adoption.

MILD HYBRIDS

In sheer terms of economic impact -- or "bang for the buck," the use of relatively inexpensive Belt Alternator Starter or BAS systems offer both manufacturers and consumers the most affordable way to immediately improve overall fuel economy. Technically not hybrids in the strictest sense of the word, these systems which allow engines to be started and stopped automatically, reducing wasted fuel during engine idle, resulting in an estimated 15-20% improvement in fuel economy at a cost of about $400 per vehicle, compared to $4000 for a full hybrid. The payback period can be less than 24 months.

FLEET ACQUISITIONS

General Electric announced in 2010 that it would purchase up to 25,000 electric-drive vehicles over the next half decade, fifty percent of those vehicles being Chevrolet Volts. Other corporate fleets, principally rental car firms, including Hertz, Enterprise and Budget all announced in 2010 orders for electric cars from GM, Nissan and Coda in both North America and Europe.

CORPORATE NETWORKS

In sheer During the ill-fated Memorandum of Understanding of the mid-to-late 1990's in California, retailer Costco set the example for installing electric car charging stations, using them more as a public relation's tool then to attract the relatively few EV owners driving the EV1s and Honda EV Plus electric cars at that time. During the current wave of electric car excitement, various public and private entities are re-exploring investment in public charging infrastructure for very similar reasons. Two of the more interesting are the Cracker Barrel chain of family restaurants in Tennessee and the Buf-

falo Wild Wings bar and grills in Florida, which have announced they will be installing electric vehicle service equipment (EVSE) at their respective franchises, effectively creating, in Cracker Barrel's case, an Interstate EV charging corridor in the eastern half of the state.

The first electric utility to deploy its own public charging system is NRG's Reliant Energy in Houston, Texas, where the company is installing 150 public charging stations, primarily for the use of its customers who sign-up for the $49 a month eVgo program. EVSEs will be installed at Walgreen drug stores, HEB/Central Market stores, and Best Buy. The success of the eVgo program could serve as a model for other utilities wanting to sell more than just whole power.

URBAN MARKETS

Increasingly, carmakers are concentrating more of their research and development resources toward better understanding urban markets, especially megacity/megaplex ones rapidly developing from Brazil to Cairo to Tehran and Shenzhen. They note that now 50% of the world's population live in giant, sprawling, congested megacities with populations of 10 million and more. Conventional automobiles are out of place in these population-dense organisms. Mobility is still a necessity, but new approaches are desperately called for: better public transit; small, pollution-free or nearly-so vehicles. The system needs to be safe, convenient and affordable. OEMs are coming up with novel answers: GM's ENV, Renault's Twizy, Toyota's i-Real, Honda's 3-RC. While unconventional in every sense, they nonetheless offer a fresh perspective on urban mobility in the 21st century.

EV MARKETING

Electric-drive cars are clearly a paradigm change for manufacturers and consumers, and whether or not they can be sold using methods, techniques and outlets that have been refined over the last century to move petroleum-powered automobiles remains an open question. Case in point: in Japan, Mitsubishi is exploring the viability of selling its i-MiEV electric car through an appliance store chain, not through their regular automotive dealership network. In the United States, several Best Buy stores have sought to sell electric two-wheelers, with marginal success to date. Tesla opted to open its own network of boutique stores in high profile locations.

In its February 2011 report to the California Air Resources Board, the International Council on Clean Transportation (ICCT) identified several "second wave incentives" that might need to be employed to attract customers beyond the initial "early adopters" to electric-drive vehicles, including loan of conventional vehicles when needed and customer trials beyond the usual dealership test drive or the "take-it-home-overnight" sales strategy period. Other informational and motivational sales techniques likely will be needed to encourage the next wave of potential customers.

Some strategies currently being employed include national "road tours" where carmakers or vested interest groups arrange to have their vehicles appear on display and be available for media and/or public test drives. In March 2011, General Electric launched its seven city EV Experience Tour, working with General Motors, Ford, Toyota, Navistar, Smith Electric Vehicles, Mitsubishi, Coda, Smart, THINK and others; stopping in San Francisco, Seattle, Los Angeles, San Diego, Austin, New York City and Washington, D.C. Tesla pursued this same strategy, as has General Motors, going so far as to loan its Equinox fuel cell electric vehicle to drivers across America (with access to hydrogen fuel stations, of course) to drive the car for several weeks as part of its Project Driveway initiative. Having experienced driving a state-of-the-art FCEV, many didn't want to give them back to GM.

RALLIES AND RACING: Since the appearance of the first automobiles, racing and rallies have served as an important marketing, as well as technology perfecting, tool for carmakers. In the last two years, there has been a resurgence of EV-centric competitions from the Brighton-to-London Eco-Rally to the TTXGP electric motorcycle race series, held both in Europe and North America in 2010. 2011 will see the inauguration of the EV Cup race series in Europe.

ENDURANCE TESTS: 2010 witnessed three electric vehicle-centric tests of endurance. A two-person team supported by Venturi Automobiles drove unassisted from Shanghai, China to Paris, France. A British team drove from Alaska to the tip of South America in an electric car. Three electric vehicles, one an Australian-built automobile, the others two-wheeled motorcycles/scooters, literally circumnavigated the globe, traveling an amazing 28,000 km in just 80 travel days.

The objective of all these endeavors is to raise the visibility of electric vehicles and to demonstrate their viability.

BLACKS SWANS TO GRAY

Nassim Taleb, the author of 'The Black Swan: The Impact of the Highly Improbable' explains that while paradigm-changing events are unpredictable, like a 9.0 earthquake, the negative effects can be somewhat mitigated, or turned into what he calls 'gray swans.' He writes, "Remember that for an event to be a Black Swan, it does not just have to be rare, or just wild; it has to be unexpected, has to lie outside our tunnel of possibilities. You must be a sucker for it. As it happens, many rare events can yield their structure to us: it is not easy to compute their probability, but it is easy to get a general idea about the possibility of their occurrence. We can turn Black Swans into Gray Swans, so to speak, reducing their effect. A person aware of the possibilities of such events can come to belong to the non-sucker variety."

So what might be the 'gray swans' that could impact the EV world? They could be technological, political, sociological, or economic. On the technological side, we could see energy storage breakthroughs or setbacks. Lithium could be supplanted by manganese or zinc or *unobtainium*. China could completely turn off the supply of refined rare earth elements, either deliberately or through political upheaval. We could discover that despite the supposed economics of scale, battery prices stubbornly refuse to come down, restricting the sale of electric cars to the environmentally-conscious affluent. Or a short cut is found to producing biofuels that are directly secreted by engineered bacteria, eliminating the need for classic fermentation and use of precious food crops, enabling IC engines to continue their dominance for decades to come. These are just some of the improbabilities that could radically alter the trajectory of our world

Taleb's point is that the wider your view of possibilities -- and 'impossibilities' -- the less likely you are to be surprised by the seemingly improbable ones, the real paradigm-shifters. Of course, this perspective goes beyond the still tiny world of EVs, especially in a globalized economy, but bear it in mind when trying to figure out where the industry is headed, and who might be the winners or the losers; it may help you maintain your footing when the ground unexpectedly turns to Jello beneath you.

POSTSCRIPT

By Craig Shields

I have a great deal of fond respect for Bill Moore, and I hope the reader has fully absorbed the value of the information he's provided above. In particular, I hope readers will find a way to turn this information into cash; I certainly plan to myself. There are an unlimited number of business directions that are suggested by these trends, with implications for EV start-ups, traditional OEMs, supply chain partners, charging infrastructure players, battery suppliers, utilities, etc. – both in the US and around the globe.

Before we conclude here, however, I would like to provide my own assessment of the market, and the trends that I see for the coming 12 months.

Craig's Forecast – Concept #1 – Keep Your Eye on France

In 2011, a few countries will begin to lead the way to EV adoption. McKinsey likes the US, followed by Germany, France, and China. While I respect McKinsey generally, and like what I see here in the US, I'm betting on France to set the pace in this industry, with its:

- Clean power (so EVs make a real difference)
- Top-down public sector backing in all aspects (especially charging infrastructure)
- Aggressive investments from the private sector
- Active solicitation of business relationships with partners worldwide
- Sophisticated/enlightened citizenry that prides itself in leadership
- Smaller footprint (less than 1/10th the size of the continental US)

Craig's Forecast – Concept #2 – Rapid and Smooth EV Adoption Curve

Many other influences will come together which collectively will cause the adoption of EVs generally to outpace expectations. One of the most obvious is declines in manufacturers' costs (and thus prices) to the end customer. This is due to the fact that the powertrains of EVs – to a far greater degree than ICEs – are built on technology, which can be expected to follow Moore's Law (Gordon's, not Bill's), which theorizes an exponential increase in the value of technology and a corresponding decrease in its cost. In particular, battery prices will continue to come down, making the EV adoption curve much faster and less painful than most people predicted. Of course, the degree to which this will happen in the remaining months of 2011 has a limit.

Craig's Forecast – Concept #3 – New EV Concepts

The success of this market will spawn a great number of new ideas for commuter transportation (e-scooters, enclosed e-bikes, tandems, etc.) bolstered by investor support from people wanting to ride on the coattails of this whole EV phenomenon. I've seen some truly incredible business plans from entrepreneurs in this space.

Craig's Forecast – Concept #4 – Say Goodbye to the Remaining "Me-Too" Start-Ups

The commitment of the traditional auto OEMs will kill off all start-ups except those with solid niche strategies. Companies that did not follow the advice that I gave them on this matter a few years ago are doomed.

Industry observer Bill Weaver is particularly tough on Coda, writing:

"2011 will mark the year that their investors finally decide that they've written their last check to capitalize a company that has no future whatsoever – one whose only real product is a myriad of delays, excuses, and the ceaseless, frantic shuffling of fatuous, self-absorbed executives."

Wow, the guy cuts like a knife. This may be unkind, but he's certainly right that Coda has a credibility problem with which it must deal. To build an effective position with dealers and customers at this point will take some bold steps if they are to avoid joining some of the others that have gone by the wayside.

Regardless of what happens with Coda, I predict that this industry bloodletting will be accelerated by a surprise announcement from Toyota, who will cease resting on the laurels of the Prius, and make a real commitment to the BEV market. Toyota's current plans for the plug-in Prius are such a yawn that I have to feel a company with this much prowess (and investable capital) will come up with a far more exciting idea.

Whatever happens there, it is certain that Nissan, with the LEAF, the first mass-produced BEV, will work hard to capitalize on its early lead, but Honda, Ford, BMW, Mitsubishi, etc. will all be running hard to co-dominate the car and small truck EV market. All other OEMs who expect to be around in 2020 will make BEV announcements in 2011.

Craig's Forecast – Concept #5 – Heightened Awareness of and Interest in Renewable Energy

The success of this market will also drive further the public interest in renewable energy, as the question "where does the power come from?" will enter some people's minds who never thought about this before. Of course, the events in the Gulf of Mexico and in Japan have further turned a spotlight on the disregard we have with the respect to the safety of our energy production.

This, in turn, will put pressure on legislators to create a fair and level playing field for clean energy, as the public, for the first time, will come to grips with the utter stupidity of the US position on energy:

• We have no energy policy, much less a federal RPS (renewable portfolio standard).

• We offer only lip service in COP meetings like Copenhagen and Cancun.
• We subsidize oil and coal at 12 times the rate we do renewables.
• We scrupulously ignore the numerous externalities of fossil fuels (e.g., long-term environmental damage, lung disease, etc.).
• We feign concern about the national debt we're leaving to our children, while borrowing an incremental $1 billion per day to buy foreign oil and sending it to regimes that are openly hostile to the US and its interests.
• We act like we're concerned about unemployment, while ignoring the fact that the migration to clean energy will create three new jobs for every one that is lost.
• We warmly embrace the behavior of an oil industry that employs 7000 lobbyists, whose only job is extracting favors from Congress, better enabling it to profit from human misery, now and into the foreseeable future.

2011 will be the year that the public awakens and realizes how completely outrageous all this is, and begins to raise its voice in protest.

As the 2012 presidential election moves closer, these issues will steadily ratchet upward in importance, to the point that every credible candidate will have a sane and workable (even if disingenuous) position on the subject.

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