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Electric cars

Electric cars: The wheel deal?

Ian Clifford says he's plugged into a new technology that will replace gas guzzlers.

By Andrew Nikiforuk



Last year, Ian Clifford, the CEO of Canadian electric-car company ZENN Motor Company Inc., got invited to 10 Downing Street in London. British Prime Minister Gordon Brown, of course, attended the private gathering, which focused on alternative modes of transport in a world increasingly rattled by carbon pollution, oil prices and the financial meltdown. It also showcased lots of electric vehicles, including the Indian-made Reva G-Wiz, the Mitsubishi i MiEV, and the sporty, but costly, Silicon Valley–engineered Tesla Roadster. Clifford’s own Zero Emission No Noise low-speed vehicle (into which comedian Rick Mercer once famously packed 20 cases of beer and which won a gold medal at the 2006 Michelin Challenge Bibendum) wasn’t at the event — but all the participants certainly knew about it.

Clifford, an earnest yet easygoing 46-year-old with the demeanor of a yoga instructor, gave his usual impassioned pitch about the coming revival of electric vehicles — or what he calls “guilt-free driving” — and renewable energy. “The writing is on the wall,” he says. “Industry has to shift, and ZENN is an enabler.” Still, after meeting Brown, Clifford couldn’t help but think: “It’s an honour to be here. But I’m sorry I’m not doing this at 24 Sussex Drive.”

That day may come, but the Toronto-born electric guru doesn’t expect any miracles in hydrocarbon-obsessed Ottawa anytime soon. No matter. Right now he’s too busy advocating for his ZENN brand — and for green solutions to oil-based problems in the United States, China and Europe. “I never imagined this when I started the company six years ago,” he says. “It’s crazy. I just shake my head.”

Clifford recently took his electric-car pitch to Jennifer Granholm, the governor of Michigan (scene of the auto industry's crash with reality), and to select U.S. senators and congressmen in Washington during President Barack Obama's inauguration. "It's was like someone drew back a great cloud over the city," he says of the historic event.

Clifford's popularity both in and out of the market place — ZENN (TSXV: [ZNN](#)) became a publicly traded company in 2006 — owes much to a unique business plan that just might transform the global automotive industry. It all boils down to a unique energy storage system (a so-called ultra capacitor) made by a very private Texas company, EESstor Inc. Clifford has proprietary rights to the technology in perpetuity for two-thirds of the world's car models (small and mid-size). And the device, he says, can make an electric car go as far as a gas guzzler (400 kilometres) on a single five-minute charge. "It could be really crazy," says Hugo Marsolais, director of the Quebec Advanced Transportation Institute. "How fast could they respond to demand, and what would be the best way to adapt the technology globally?"

But that's not all. Clifford really has his eye on 800 million cars already on the road. He wants to make them green with a ZENN conversion kit that replaces the combustion engine with both a ZENN electric drivetrain properly married to an EESstor storage unit. Mexico City's fleet of taxis, all on a Nissan platform, Clifford says, might make a good starting point. But he's more ambitious than that. "When I see the millionth electric car on the road, this thing will take on unstoppable momentum, and I will know I have been successful," he adds. And, yes, Clifford can envision electric planes. He also wants to change the world.

Not surprisingly, Clifford has some competition these days. Plans or designs for electric or hybrid vehicles, such as GM's much-hyped Chevy Volt, now dominate the automotive press. Even luxury carmakers such as Mercedes-Benz propose to diminish fossil-fuel use with plans for electric, hybrid and super-efficient diesel vehicles. The Israeli-born Shai Agassi, a high-tech entrepreneur just like Clifford, also has bold plans. With US\$200 million in startup capital, Agassi's Better Place company proposes to lease electric batteries to consumers (the most expensive component of any electric vehicle) and then set up a reliable network for recharging or replacing them. Israel, Denmark, Hawaii and the province of Ontario have all signed deals with Better Place in the hopes of keeping energy dollars at home by using local wind or solar sources to power green cars. Although Clifford shares Agassi's mission to end the petroleum fuel monopoly, he thinks that ZENN ultimately has a better plan: "It's all about the battery."

Mould-breakers rarely fit any stereotype, other than sharing some luck and being at the right place at the right time. And Clifford is definitely one of those. "I've always been intrigued by innovation and being at the edge," he says. At the age of 18, he got an opportunity to work alongside the great landscape photographer Ansel Adams in Yosemite and Big Sur, Calif. He then parlayed that "eye-opening" experience into a successful career as a commercial photographer. In 1995, Clifford caught the early Internet wave when he co-founded digIT Interactive, a firm that pioneered Internet marketing in Canada. With impeccable timing, he sold the successful firm to Quebecor for an undisclosed sum in 2000, just six months before the Internet boom went bust.

Clifford's aha moment with green energy occurred in downtown Toronto in 1995. After getting stuck in traffic and breathing smoggy air one sweltering afternoon, he decided to ditch his carbon-spewing

SUV for his “children’s sake.” After a fruitless search for a GM EV1, the famous electric car of the 1990s that became the subject of the documentary *Who Killed the Electric Car?*, Clifford settled on a Henney Kilowatt that ran on 800 pounds of lead-acid batteries. He bought his first electric vehicle from a former pilot in Connecticut, who drove a Henney in the body of an old Renault Dauphine to the airport every day for 35 years. Whenever Clifford parked the sleek-looking vehicle in downtown Toronto, 20 people would swarm the red apparition, exclaiming “What in the world is that?” Most then asked, “How do I get one?”

By now, Clifford had also delved into the surprisingly long and dramatic history of electric vehicles. A Scottish inventor, Robert Anderson, actually cobbled together the first electric carriage in the 1830s, and by the 1890s a variety of models travelled urban roads. Women, in particular, adored the vehicles. “They were like sitting parlours, where three or four women could talk and enjoy the quiet as they went shopping,” says Clifford. New York City even boasted an electric cab fleet in 1897, and nearly one-third of the cars in America’s major cities by 1900 were green machines powered by cumbersome lead-acid batteries. But the invention of the electric starter motor soon made the internal combustion engine even more female-friendly by disposing of the hand crank. Cheap oil, Henry Ford, and the promise of unlimited mobility ultimately spelled the death of the electric car.

Clifford discovered something extraordinary when his Henney broke down. He had to look in the Yellow Pages under Fork Lifts to find a repairman. That’s when he realized that “there were millions of electric vehicles being driven around in warehouses behind closed doors.” In other words, the technology hadn’t really died — it just went off road. Shortly afterward, Clifford and two associates started the Feel Good Cars Inc., which later morphed into ZENN. It bought old Renaults and sold them as refurbished electric cars. When just one appearance at the Canadian International AutoShow in Toronto resulted in 1,000 test-drive requests and 15 sales, Clifford realized that a cottage electric-car business was “unsustainable,” so he started to think about mass production.

Although SUVs still ruled the highways, Clifford adapted a French diesel Microcar in 2002 into a low-speed electric vehicle, the Zero Emission No Noise. It was small, used cheap lead-acid batteries and went 60 km on an eight-hour charge. One California website recently described the product as “a Canadian-made mini-mobile that looks like a Matchbox car, drives like a go-cart and saves money like bar soap.” A 40,000-square-foot manufacturing plant in Saint-Jérôme, Que., 70 km northwest of Montreal, now produces about three low-speeders a day.

All the media hoopla about the splashy Renaults brought Clifford to the attention of Dick Weir and Carl Nelson, two former hard-disc developers in Austin, Texas, both in their 60s. Since the 1990s, the pair had been trying to improve the storage capacity of electric batteries the same way hard discs had revolutionized the storage of data. Clifford, of course, now recognized that batteries for electric cars were generally expensive, toxic, and didn’t perform well in extreme temperatures. In fact, batteries remained the central obstacle to making electric cars market friendly. “Weir and Nelson talked to the Big Three, and then the phone rang,” says Clifford. His company was then one of the only makers of electric cars in North America. “It was serendipity,” Clifford says. “It was timing.”

Weir told Clifford that he was working on commercializing a unique energy-storage device that would make the electric car an affordable and flexible dream. He said his ultra capacitor (and, as a photographer, Clifford immediately knew that a commercial flash system was built around an ultra

capacitor) could hold a remarkable 52 kilowatt hours in a 300-pound unit. That's enough power to run an entire American household for nearly two days — or to drive more than 400 kilometres on a single charge.

Clifford found Weir's presentation so compelling that in 2004 he invested US\$2.5 million for an exclusive technology agreement with EEstor, and then another US\$2.5 million in 2007 as an equity investor. He now owns global rights to use the storage device in small and mid-sized vehicles in perpetuity, as well as a 3.8% equity share in EEstor that could climb to 10%. According to Clifford, Weir, a former U.S. navy pilot, developed the technology "to free America from its reliance on oil" and regards it "as a liberator."

Unlike many electric batteries based on the rare-earth metal lithium, the EEstor device is fashioned from an abundant non-toxic compound, barium titanate.

"It's even used as a lubricant for the drilling of oil wells," says Clifford wryly. Based on a ceramic-battery chemistry, the device can supply 10 times the energy density of lead-acid batteries at 1/10th the weight and volume. Although the Texas firm has not missed scientific verification milestones, it has taken more time between them to perfect commercialization procedures than anticipated. Clifford remains confident that the company will meet its commitment to deliver a factory-made device for his new 2009 CityZENN, a vehicle that will be as far-ranging as its gas-powered peers (and cost about as much). "When they deliver the product, it will be an ironclad. Dick is meticulous."

Critics, however, call EEstor's ultra capacitor "vapourware," because no one has yet seen the storage device at work. Early in the relationship, before doing his own research, Clifford admits that he initially had trouble believing that a commercial EEstor unit could honour its remarkable patent claims. At a Texas barbecue with Carl Nelson about seven years ago, Clifford blurted out, "Is this thing really going to work?" Nelson calmly replied, "Yes, absolutely it works." As Clifford today acknowledges, "There is always skepticism about disruptive technology."

The potential scale of the economic disruption is, well, mind-boggling. For starters, a state-of-the-art ultra capacitor would make electric vehicles feasible on a global scale — and possibly even end oil's reign as a transport fuel. EEstor also makes it possible to store electric power generated by wind or solar in a parked car. Vehicles equipped with electric-storage devices, as opposed to batteries, could charge up during off-peak hours and discharge energy into the grid when demand is high. (Willett Kempton, director of the Center for Carbon-free Power Integration at the University of Delaware, also considers using electric cars as a smart source of power for the grid.) In Denmark, wind power provides 20% of the nation's electrical needs, argues Clifford. But with a device like EEstor in every car, a national fleet of electric vehicles could potentially power 60% of the nation's demand by storing wind energy at night and discharging it into the grid during the day when the wind is not blowing. "That's the kind of thing we want to start talking about, a paradigm shift." He also argues that third- and fourth-generation storage devices — if they follow Moore's Law for microchips (the number of transistors on a chip will double every two years) — would make electric snowmobiles, boats and planes "entirely viable."

Canadian Business contacted Joseph Perry, a professor at Georgia Tech, for a reality check on barium titanate. He has both worked with the compound and published peer review articles on its electrical-

storage abilities. Perry notes that existing capacitors can charge and discharge quickly, but can't store a lot of juice. In contrast, batteries can hold a lot of volts, but charge slowly. A power device made on a mass scale that behaves like a battery but discharges like a capacitor, he says, would be "very attractive."

But like many skeptics, Perry notes that EESstor will have to overcome several critical challenges. Can its power model carry high charges without breaking down or shorting? Will the device become more difficult to charge over time, a problem known as saturation? Lastly, will its ceramic components, which tend to be brittle, hold up under the stress of discharging and recharging? According to EESstor, the device can take one million charges "without degrading, which is typical of ultra capacitors. It's reliable."

In his own lab, Perry has been able to increase the amount of electricity held on specially prepared sheets of barium titanate by a factor of three. EESstor claims it can improve that by a factor of 100 or higher. "If they are able to just get close to what they are saying, it would be a huge step," says Perry, who hastens to note that he is not surprised by EESstor's secrecy.

EESstor, which still has no functional website and is the subject of incessant Internet chatter (see <http://bariumtitanate.blogspot.com>), has recently collected some powerful investors and supporters. Morton Topfer, former vice-chairman of Dell Computer Corp., now sits on its board. Kleiner Perkins Caufield & Byers, the hot Silicon Valley venture capital firm that funded Google Inc. and attracted Al Gore as partner in 2007, has also invested millions in the company. In 2008, Lockheed Martin Corp., the world's No. 1 defense contractor, signed an exclusive agreement to use the EESstor device "for military and homeland security applications." Clifford quietly calls these developments "huge validations."

There have been other examples of truth-testing for ZENN. Rick McGraw, a 65-year-old self-described "serial entrepreneur" based in Toronto and the owner of two Honda dealerships, as well as a \$700-million trucking business, now chairs ZENN's board of directors. "When I first heard about ZENN, I thought they were nuts," says McGraw. "Then I got to understand and like it."

If EESstor can honour its performance claims, adds McGraw with the usual caveats, ZENN will be in for exciting times. "Somebody has got to do it," he says.

Analysts talk much the same way about what the future may hold. "The EESstor device, if it works, is a game changer in terms of potential," says Massimo Fiore at Montreal's Versant Partners Inc. "The question is, Will ZENN be bought up by a big manufacturer with access to lots of capital and lots of markets?"

Clifford, who clearly foresaw the revival of the electric car when others just saw ruin, plans on keeping his options open for the time being. But he has no doubt that electricity will soon fuel the economy — and an automobile renaissance. For starters, the energy efficiency of an electrical drivetrain surpasses a gas-powered counterpart by a factor of up to four. And a 2008 report by Environment America calculated that the United States could meet its entire energy needs with a 100-mile-square industrial solar thermal installation in the American southwest covering about 9% of Nevada. Other American studies have also shown that mass adoption of electric cars wouldn't strain the existing electrical grid. A 2007 study by the U.S. Department of Energy found that there is already

enough power to recharge more than 150 million electric vehicles to drive an average of 53 km per day. “In that scenario, you take the geopolitical power away from oil, and it doesn’t have a stranglehold anymore,” says Clifford.

Although it’s now legal to drive ZENN low-speed vehicles in 40 U.S. states, Canada hasn’t exactly rolled out the welcome mat. In fact, Transport Canada has largely regarded the electric car as a safety hazard — and Clifford still can’t legally drive one in Toronto. “It’s been a David and Goliath battle,” he says. But Clifford is now focused on the longer business strategy of putting a highway-capable ZENN on the road at the end of the year, as well as the promise of the ZENNergy drivetrain powered by an EESstor retrofit for existing carbon makers.

In fact, in between high-profile meetings with politicians and an upcoming gathering sponsored by *Forbes* magazine, Clifford is now getting very excited. “It all begs the question: What will happen to Nissan or GM or Ford if I can sell them exclusive parts and become the global dominant leader in electric-car solutions?”

The answer, as Clifford well knows, will all depend on timing, luck and a battery made in Texas.