Driving down fuel usage: MIT spinout fits gas-guzzlers with electric powertrains, cutting gas consumption

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Shown here are XL Hybrids' electric powertrain components (in brown) that attach to traditional gas and oil powertrains. These components include the traction motor (nearest the front), the drive motor (on the side), and the lithium-ion battery (at the rear). Credit: XL Hybrids

Despite their potential to reduce carbon dioxide (CO_2) emissions and fuel consumption, electric and hybrid cars and trucks struggled for years to find a solid customer base. Much of the reason came down to cost and convenience: Electric car batteries are expensive, and charging them requires plug-in infrastructure that's still sparse in the United States.

Now MIT spinout XL Hybrids is upfitting (and retrofitting) gas and diesel commercial vans and trucks with fuel-saving "add-on" electric

powertrains whose batteries are charged through energy generated by braking.

According to tests conducted by the startup, the $8,000 system—which has been incorporated into hundreds of vans in the commercial fleets of Coca-Cola and FedEx, among others—can provide a 20 percent reduction in fuel consumption and CO2 emissions.

"The goal is to reduce oil consumption with cost-effective electric drive technology, where fleets don't need additional infrastructure and don't need a large battery," says Tod Hynes '02, co-founding president of XL Hybrids and a lecturer at the MIT Sloan School of Management.

The system's powertrain includes an electric traction motor, a lithium-ion battery, advanced power converters, and other connecting components that attach to the powertrains of traditional General Motors and Ford cargo, delivery, and shuttle vans, as well as cutaway trucks.

When the vehicles brake, a process known as "regenerative braking" captures the kinetic energy (usually dissipated as heat through friction) and converts it into electricity that charges the battery—which, in turn, releases the energy to the electric motor during acceleration.

Custom software reads the driver's braking habits and optimizes the system. The startup also collects operational data from the vehicles to inform fleet managers of the best vehicles for the technology—usually ones traveling in the stop-and-go traffic of urban areas.

Over the past year, XL Hybrids—co-founded by Clay Siegert SM '09 and Justin Ashton GM '08, who Hynes met through MIT's entrepreneurial network—has seen its revenue grow twentyfold.

Last month, *Fast Company* ranked the startup No. 35 on its list of the

world's 50 most innovative companies, and third in energy-specific companies, trailing only Tesla Motors and General Electric. This week, the company was named an Energy Innovation Pioneer by the global analytics company IHS at CERAWeek, a leading international energy conference.

Benefits by the numbers

Hybrids themselves have been around for decades, and other companies have started retrofitting vehicles with electric powertrains.

But XL Hybrids' innovation comes from targeting commercial fleet vehicles with "a good value proposition all around," Hynes says—offering low-cost equipment, quick installation, savings on gas and oil, and easy integration.

"At the end of the day, it's about making the economics work to compete against the price of fuel," Hynes says, adding, "We're able to do a lot with a little."

Electric or hybrid fleet vehicles traditionally run on large batteries—sometimes more than 100 kilowatt-hours (kWh) in capacity—that cost upward of $40,000. XL Hybrids installs small, 1.8-kWh lithium-ion batteries that provide a 20 percent fuel savings, Hynes says.

To determine the extent of the savings, XL Hybrids conducted a dynamometer test, which involves running a vehicle on treadmill-like rollers to estimate fuel mileage in urban driving. They first ran a 5-ton vehicle through the test without XL Hybrids' system and then with the system, observing a 21 percent savings.

With this savings, companies can expect to save 4,000 gallons of fuel

over the life of an XL Hybrids system, Hynes says. Since the system costs $8,000, companies essentially pay $2 for each gallon saved. "Why pay $3 or $4 for a gallon, when you can pay $2 to save a gallon?" Hynes says.

Additional benefits to the system, Hynes says, include reducing brake wear and maintenance, and the time employees spend filling up at gas stations. Also, downsizing engines: An XL Hybrids electric motor adds torque to an existing powertrain, meaning a customer can reduce the size of the engine from, say, a 6-liter to a 4.8-liter, and get better acceleration—which can save hundreds or thousands of dollars upfront, Hynes says.

"When a fleet customer looks at the numbers, they want to see benefits based on fuel savings and engine downsizing," Hynes says. "These other benefits are just gravy."

While the system can be added as a retrofit, it's generally installed as part of the modifications that most commercial fleet vehicles go through. This ease of integration helps set the company apart from the competition, Hynes says.

"The vehicles literally roll of the line and go to facilities where they'll be modified anyway," he says. "Manufacturers don't need to change their manufacturing processes."

Renewed energy

For Hynes, the path to entrepreneurship, alternative energy, and XL Hybrids revolves around his alma mater.

As an MIT undergraduate in management in the late 1990s and early 2000s, Hynes became "very passionate about startups." With the Internet

boom in full swing, he co-founded a couple of dot-coms, but began viewing "climate change and energy as the real challenges of my generation."

After graduating, he co-founded the consulting and engineering services firm Strategic Energy Systems with two MIT alumni before taking a position as director of alternative energy at Citizens Energy in Boston.

Over five years, a few things came together: Alternative energy became a focus at MIT, which had launched, among other things, the MIT Energy Club (2004) and the MIT Energy Initiative (2006)—both of which Hynes became involved with. "I got more engaged with MIT as MIT got more engaged with energy," he says.

At the same time, across the nation, clean energy ventures became much more profitable: For example, the wind industry grew from a $500 million industry to a $15 billion industry in five years.

But Hynes noticed that the nation didn't have an electricity problem. "It has an oil problem," he says. "We're very dependent on oil: We rely on imports, and more than 95 percent of transportation fuel is oil."

So he quit his job in 2008, with the aim of starting a company to cut oil consumption. With rising innovations in batteries and advanced power inverters and motors, Hynes "backed into a technological solution" with retrofitted electric powertrains.

Reconnecting with former mentor Bill Aulet, now managing director of the Martin Trust Center for MIT Entrepreneurship, Hynes put the final pieces into place.

Hynes and Aulet co-founded MIT's Clean Energy Prize in 2008; via the competition, Hynes met Ashton, his XL Hybrids co-founder. Through

Aulet, he then met Siegert, a supply chain and logistics expert who had already founded a few startups.

The trio began "grinding away" in a garage in Somerville, Mass., conducting early trials on the Ford Crown Victoria and tweaking the specs. In 2011, they relocated to their current headquarters in Brighton, Mass., where they have ramped up production and are expanding their technology to fit different makes and models.

"A benefit of the design is we can make slight modifications to the system and incorporate it onto other vehicle makes and models, and rapidly scale across the industry," Hynes says.

Coming full circle, Hynes now teaches at MIT, helping to walk students through the process of launching alternative-energy startups. Back on campus, he says the energy landscape has certainly expanded since he was an undergraduate—and even since he started XL Hybrids.

"MIT has done a tremendous job at becoming a world center for energy innovation," he says.

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