# The retrofitting resolution

## Converting ICE vehicles to EVs will create opportunities for electrical contractors

**By Maura Keller, *EA* Contributing Writer**

**Electric vehicles continue to make headlines as con**sumers evaluate the current environment surrounding this continuously evolving technology. And while EVs have certainly made a name for themselves within the consumer automotive marketplace, municipalities and other public transportation entities are evaluating the proper integration of EVs among bus fleets and other vehicles within the public sector. One avenue being explored is whether retrofitting existing internal combustion engine (ICE) vehicles to electric fits the bill.

According to Christopher Cedrone, EV account manager at JM Electrical, an electrical contractor in Boston, as EVs become a bigger player in both consumer and commercial vehicles, more and more municipalities and bus companies are exploring the avenue of retrofitting their vehicles with EV technology.

"Retrofitting ICE buses is a growing trend in the U.S.; however, overall, there are less than 1% of electric buses in use, including ones that have been converted," Cedrone says. That said, larger municipalities are exploring the benefits of retrofitting to their bottom line and the challenges to their operations.

*Christopher Cedrone, EV account manager at JM Electrical*

Tony Dagnachew, owner of Dagnachew Electric in Oceanside, N.Y., is a veteran electrician who has worked extensively on upgrading and fortifying the electrical infrastructure behind public transportation systems. As Dagnachew explains, in the U.S., retrofitting diesel buses to electric power is still more promise than practice.

Smaller municipalities and private school bus operators are testing it out, but larger agencies like New York's Metropolitan Transit Authority are pursuing full vehicle replacement.

"Why? Because retrofitting is complex, often costly, and difficult to scale. Still, the very fact that this discussion is happening shows how far the transportation sector has come in re-imagining its future," Dagnachew says.

To fully appreciate this shift, it's worth stepping back. As Dagnachew explains, a few decades ago, we were converting fleets to compressed natural gas and calling it a "win."

"Before that, streetcars ran on city streets, replaced by diesel buses as part of a national shift pushed by major industrial forces," Dagnachew says. "Before that, it was horse-drawn carriages and wooden wheels. Today, history is circling back. This time, it's electric, and the opportunities it's bringing are supercharged."

Of course, electric buses are not just buses. They're rolling power systems that are computer-driven, climate-controlled, high-voltage machines that need industrial-grade motors, fans, blowers, compressors, and gearboxes to perform safely and efficiently.

According to Dagnachew, they need more than wheels and windshield wipers; they need wattage, circuitry, LED lighting, and a crew of specialists to keep them running.

"This is what we've been training our workforce for and gearing up our business to tackle, just as they did when transitioning from wooden carriages to engines," Dagnachew says. "Which is why this transition is a call to action not just for public agencies, but for every electromechanical firm ready to step into the future."

### Challenges aplenty

Let's be honest: Retrofitting any vehicle with EV technology isn't a simple plug-and-play job. Retrofitting diesel buses for electric power is like trying to install jet engines on a propeller plane.

"You can do it, but not without a full system overhaul," Dagnachew says. "These buses need structural reinforcement, battery enclosures, upgraded brakes, rebalanced suspension, thermal management systems, and modern electrical architecture. And that's before we talk about grid compatibility and charger access."

What's more, as Dagnachew explains, retrofitting still depends on components that must meet modern industrial standards such as heavy-duty blowers to cool batteries, reliable fans and compressors for

onboard systems, and precision gearboxes to manage torque curves of high-RPM electric motors.

"These aren't hobby parts," Dagnachew says. "They're industrial-grade, and they must be engineered, installed, and serviced by experts."

The upside? Dagnachew believes this is a sunrise moment for skilled trades and electrical contractors.

"The transition to electrified fleets will put new tools in our hands and revitalize the industries that supply, repair, and install the backbone of electric propulsion," Dagnachew says. "This means, for our Brooklyn apprenticeship school for union members, students are already training with full-scale, real-world challenges from both on the job-training to in-class access to the latest technologies paired with transit infrastructure from control systems to railcars and grid components. We know what's coming, and we're preparing for it."

Cedrone agrees that the biggest challenges of retrofitting buses and other municipal vehicles include the engineering and precision to ensure compatibility of replacing key components with electric motors.

"Compared to a brand-new electric school bus, the savings could be as high as 80%," Cedrone says. "The benefits are faster electrification, reduced emissions, and reusing resources."

Ian Gardner, CEO of EVAI, a Cloud-based, AI-enabled platform for fleet electrification and management, adds that there are a number of companies offering these retrofit kits – and a bigger number that have gone bankrupt trying to make it work. He says retrofitting an existing ICE vehicle to make it an EV comes with a potential for many problems.

*Ian Gardner, CEO of EVAI*

"The conversion kits are imperfect, the maintenance and upkeep is high, you don't receive the intended benefits of a ground-up designed EV (except for GHG emissions reductions), and there is a very significant risk that the conversion kit provider goes out of business and parts are unavailable in the future," Gardner says. "The smarter strategy is to wait until the right point in the replacement and budgeting cycle and then do a detailed ground up total cost of ownership (TCO) analysis and implement a turnkey EV fleet solution that supports all of the different EV fleet ecosystem elements in concert to realize the intended benefits and ROI."

Gardner further explains that internal combustion engine vehicles have many systems and components designed for that type of propulsion. The chassis, HVAC and other support systems, 12 V system, springs and shock absorbers, tires, braking systems, etc. – all are optimized for the loads and stresses, and duty cycle of a combustion vehicle.

"EVs have a higher gross vehicle weight, greater torque, need regenerative braking and don't need many of the other systems associated with ICE," Gardner says. "Converting from an ICE to EV drivetrain will significantly increase downstream maintenance costs, downtime (waiting for parts and qualified service professionals to be available), and will shorten the useful life of the vehicle due to compatibility issues. It is cost-effective in the short-term versus the MSRP of a new EV; however, on a TCO basis, it is much more expensive."

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## Required regulations

From a regulatory standpoint, there are additional concerns with regard to the retrofitting process. As Cedrone explains, safety needs to be at the center of any regulatory framework. Retrofitting also needs to adhere to stringent safety standards of new vehicles.

"The replaced components such as brakes and electrical systems must meet standards and be certified for road use," Cedrone says. "Some of the biggest concerns are range and performance, limited federal funding (current federal funding only covers new EVs), warranty and maintenance, and the lack of standardization."

Right now, the rules for retrofitting are also murky. As Dagnachew explains, there's no federal standard for what a "safe and certified" converted EV bus looks like. That puts cities in a tough spot, especially when one incident can undermine public confidence in an entire program.

"Without uniform certification protocols, insurance protections, and data reporting mandates, retrofitting remains a legal and logistical risk for many agencies," Dagnachew says. "For companies in our industry, this should sound familiar. The lack of clear codes is exactly what delays innovation and market adoption. If you're selling or servicing generators, pumps, or compressors for industrial transit clients, you know that reliability, documentation, and warranty coverage are what close the deal with electrical contractors and procurement officers. The same will be true for electric transportation: manufacturers and retrofit vendors who want to earn trust must operate to the same standards that union shops have been delivering on for generations."

Gardner also points out that the reliability of the conversion technology and longevity of the technology provider are key concerns of the regulatory environment of EV retrofits.

"Do they have the balance sheet and staying power to remain in business for the useful life of the

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*An electric bus operated by New York's Metropolitan Transportation Authority undergoes recharging. The Authority says that 75 of its zero-emission buses are now on the road. Transportation agencies across the U.S. are exploring the feasibility of retrofitting internal-combustion-engine buses to electric.*
— New York's Metropolitan Transportation Authority photo

***EV RETROFITTING continued from previous page***

vehicle? Who are the service partners that will be able to support the converted vehicle?" Gardner says.

## What the future holds

For EV public transportation fleets to become more mainstream, the municipalities need more funding. Without it, municipalities cannot afford the significant cost of transitioning and retrofitting these vehicles.

"Further technological advancement in batteries regarding range and performance will also help," Cedrone says. "It will take some time for sure. But I do believe that with more funding, better technological advances, and with municipalities having a better understanding of the benefit to students and communities, it will be more embraced and will ultimately be the future of school transportation. Any way we can get more EVs on the road, the better we will all be in the long run. With that said, this will also require the need for more charging and continued investment in electrical infrastructure."

**Transitioning to electric transit means modernizing depots, upgrading the grid, and investing in the skilled workforce needed to keep it running**

In the short term, Dagnachew says retrofitting may be attractive to municipalities trying to stretch limited budgets or meet early emissions goals. But in the long run, full electrification is the more stable, scalable, and serviceable path. And as electric buses become more affordable, and federal funding more accessible, retrofit efforts will likely fade in favor of purpose-built vehicles.

"But make no mistake: Whether cities retrofit or replace, they will need industrial-scale components," Dagnachew says. "The air systems that support electric bus heating and cooling needs require high-efficiency blowers. The battery systems demand mission-critical fans to maintain safe operating temperatures. Powertrain support requires precision gearboxes. The move to EVs is reshaping the transit vehicle from the inside out, and that creates fresh demand for every company in the electromechanical supply chain."

Dagnachew says to think of this shift the same way you'd think of rewiring a factory. You don't just replace one machine, you rethink the floor plan. Transitioning to electric transit means modernizing depots, upgrading the grid, and investing in the skilled workforce needed to keep it running.

The Metropolitan Transportation Authority is North America's largest transportation network. According to a 2022 MTA study, the agency estimates that a full fleet transition will require between 328 and 458 megawatts of installed charging capacity system-wide.

"That's not just a few plugs in a wall, it's a grid-scale transformation," Dagnachew says. "Think transformers, smart panels, thermal sensors, and industrial-grade energy storage systems. The vehicles themselves will require even more precision. Electric motors will need cooling pumps. Air systems will rely on high-efficiency fans and compressors. Energy conversion systems will need rugged, repairable gearboxes. In every category, there will be growth. And where there is growth, there is opportunity for contractors, for suppliers, and for the apprentices coming up behind us. What's happening now with EV transit isn't just a new chapter, it's a new volume."

Dagnachew says the transition to electrified fleets is going to supercharge the demand for skilled tradespeople and the equipment that powers progress to move transit systems with electric motors, blowers, fans, compressors, gearboxes, and pumps.

"Whether you're selling them, building them, or installing them, you're part of what comes next," he says. **EA**