

Last-Mile EV Fleets Can Save Up to 50% in Total Cost of Ownership by Adopting Wireless Charging

In July 2021 WiTricity set out to evaluate the relative total cost of ownership (TCO) of adopting and running an electric fleet for last-mile parcel delivery when those vehicles were charged with wireless charging versus plug-in charging. Ultimately, the hypothetical 200-van fleet running on two shifts saw a 50% savings in TCO by using wireless power transfer (WPT) built on technology developed by WiTricity.

Vehicle miles traveled, vehicle purchase price, and electric utility charges are the main factors in the lifetime cost of an EV truck for last-mile delivery. WiTricity's analysis showed that of those top three factors, electric utility charges could be cut in half through the use of WPT, with further significant savings gained in the installed cost of charging infrastructure, charger maintenance, and labor. The key is that wireless charging enables "opportunity charging" – the fleet can take full advantage of all depot time by charging while being loaded, serviced, as well as while being parked, rather than relying on discrete parking for tethered, plug-in charging. The bottom line: opportunity charging doubles the duration of charging operations and reduces peak electrical demand for the depot by half.

The analysis compared the use of 50kW plug-in charging v. 24kW wireless charging with the fleet running two 8-hour shifts, leaving 4 hours per shift for charging and depot operations. The model demonstrates how opportunity charging reduces exposure to demand charges by reducing peak loads, but also shows a reduced exposure to back-up energy generation infrastructure and operations costs.

The Key: Reducing Utility Demand

The dramatic savings in electricity costs come from opportunity charging vehicles in depot operations, which doubles the duration of the charging operations and thus does not rely on DC fast charging to keep the vans up and running. The logistics of running two shifts and 200 vans with plug-in charging would require the higher power solution to charge within the available time.

To understand how wireless charging can reduce peak loads and energy costs, it's important to understand how electric utility charges are structured. There are three components to utility charges for commercial customers:

1. Monthly meter fee, which is a set fee based on the rate class
2. Volumetric rate, which measures kilowatt hours (kWh), reflecting the cost of the energy from the supplier. The volumetric rate is generally priced as a commodity and is tiered. When the grid is stressed, as illustrated by recent events in Texas and California, primary generators (those with high capacity at low cost) run out of available capacity and secondary, less efficient generators get activated. These secondary generators come with a premium that is passed on to ratepayers.
3. Demand rate, typically expressed as capacity and delivery fees. Demand charges are essentially the compensation paid to the utility for maintaining the grid with sufficient capacity to energize a customer's needs at peak draw. This capacity may not be utilized for 99% of the time, but if demand spikes, the utility still needs to be able to deliver. Peak is generally determined as the average load during the highest 30-minute period in the billing period, though that can vary. It is not uncommon to encounter demand charges exceeding \$30/kW in US areas with higher population density, such as California, Colorado, and Massachusetts.

It's easy to see how flattening the peak load could drive substantial savings: 200 50kW plug-in chargers operating simultaneously would require a 10MW peak load. At a rate of \$30/kW, this would result in a monthly bill of \$300,000. In contrast, the peak load for 200 24kW wireless chargers would require a 5MW load, for a monthly bill of \$150,000. (Note, however, in the TCO model, WiTricity assumed a more conservative cost of \$15/kW as a US average. The costs for wireless charging would continue to be half that of the plug-in alternative.²⁾

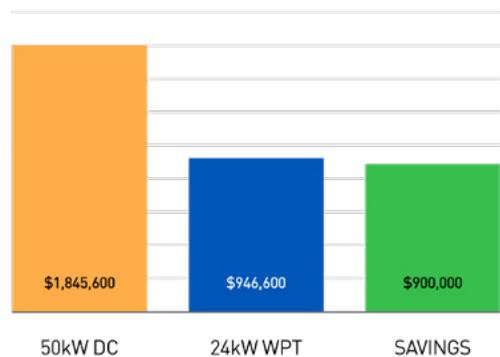
Reducing Energy Backup Generation Costs

WiTricity's model assumed that the delivery fleet must stay operational even during an electrical outage, and so the depot must invest in a backup energy source to keep the EV fleet powered. Given the focus on avoiding greenhouse gases in this particular hypothetical fleet, the model incorporated the costs of non-carbon emitting clean hydrogen powered micro-turbines. These systems can support a constant or intermittent load, and require minimal maintenance. Like the peak load calculations for the demand charges, the demand for power from the micro-turbines is similarly lessened through opportunity charging, resulting in savings of almost half. Of course, traditional diesel generators could also work, and the results would be proportionately similar.

Reducing Labor Costs

Electric vehicles that need to be plugged in to charge inherently need someone to do that plugging and unplugging. In addition, because humans are involved at each step of plugging and unplugging, WiTricity's model assumed that humans would be involved in each stage of the depot movement – roughly four "events" across each shift across the depot workflow: staging to loading, loading to staging, staging to cleaning/maintenance, cleaning/maintenance to staging. Each of these moves is

Utility Demand



Energy Backup

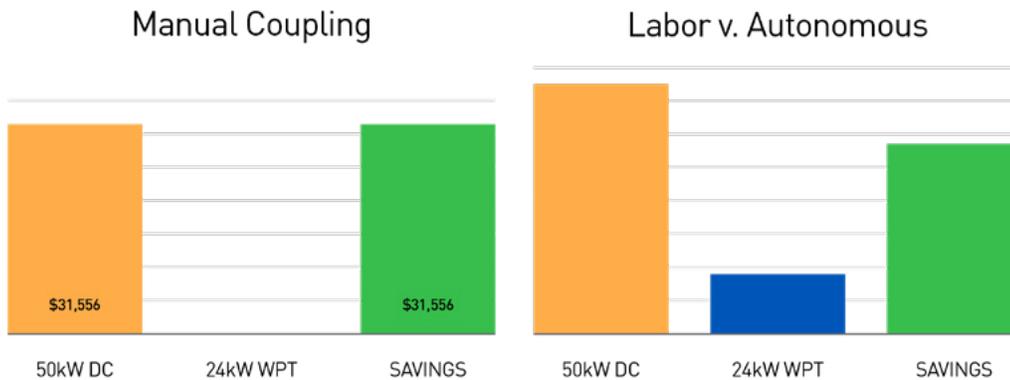


assumed to take an average of three minutes to jockey the vehicles from position to position, and requires walking or driving to the staging area space and back.

By contrast, new EVs being built and adopted for last-mile fleets are bursting with state-of-the-art technology, like advanced driver-assist systems and sensing. WiTricity's model assumes costs to enhance the functions of existing high-volume commercial driver assistance cameras, scanners, steering, brakes, and driveline equipment, all of which will reduce the amount of human intervention required for yard moves. Because no human intervention is required for opportunity charging connection or disconnection, a higher level of autonomy can be enabled. As a result, the yearly manual coupling labor costs drop from \$31K to virtually zero, and the autonomous vehicle movement within the depot versus human drivers results in a further savings of \$289K. Even without the addition of autonomy, of course, the labor cost reduction from not needed manual coupling would still be realized.

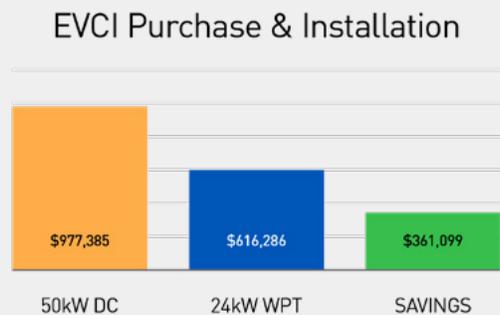
Maintenance

Wireless charging incurs very low maintenance because there are no serviceable parts, active cooling is not required, and there are no mechanical connectors that wear out or need replacement. In contrast, Level 3 plug-in charging stations require periodic inspection and maintenance given their active cooling systems, air filtration, and other components. The expense model includes bi-annual inspections and filter changes. In addition, the model assumes one cable and connector replacement over a ten-year serviceable life due to the frequency of use. (Note, the model does not include premature replacement due to drop damage, though this is a known issue.)



Charging Infrastructure Purchase and Installation

The costs for purchase were based on publicly available data on the wholesale costs of 50kW DC Fast Charging stations and WiTricity's own internal calculations on the costs of wireless charging infrastructure. Installation costs are more significant for the 50kW principally due to unit bulk and weight; these units require more robust foundations, anchoring systems, and labor to install.

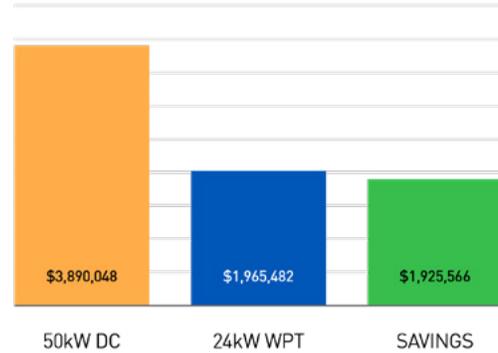


Conclusion

Last-mile fleets could achieve substantial savings as they adopt EVs through the use of wireless charging. In this example fleet, the overall savings were roughly 50% to the fleet. In addition to the savings, the use of wireless charging also puts less stress on the electrical grid and could offer additional benefits around health and safety by reducing trip and fall injuries. Above all else, the most dramatic savings come through the unique benefits of opportunity charging that wireless charging enables: vehicles can be charged in parallel with all depot operations, doubling the duration of charging and cutting peak load by half, and reducing labor costs as well.

This particular TCO model was based around the operational conditions of a specific fleet size, but WiTricity's wireless charging solutions can operate at a range of power levels to suit the specific conditions of your fleet. WiTricity has built a robust model that can be adapted to any fleet operation evaluating or using electric vehicles.

Total Cost Comparison



For more information about how WiTricity can help you accelerate cost savings in your electric fleet deployment, please contact CustomerCommunications@WiTricity.com

Appendix A: Underlying assumptions for this illustrative fleet

- 200 vehicles operate 2 per day returning to the depot for charging, maintenance and reloading
- Two-shift model is 8 hours leaving 4 hours per shift for charging and depot operations
- Vehicles are driven up to 150-160 miles per shift with an average efficiency of 1.88 miles per kWh
- Vehicles must accept not less than 80-86kWh during charging operations
- Loading and unloading will not be done by drivers so to increase efficiency of driver shifts
- Vehicles are moved to different locations while at the depot to be maintained and unloaded/loaded
- Make De-Make cycles on average take 15 seconds
- Vehicle entry and exit at the depot is primarily performed using the side or rear door
- Vehicle charging inlets are positioned at the driver's side front quarter panel
- Vehicles are equipped with systems that can sense surroundings, navigate and control vehicle speed
- Vehicle asset service life is rated at 150,000 miles or 1,500 charge/discharge cycles
- Vehicle service life in a two-shift model is 2.4 years with 4x replacement during EVCI service life
- CAPEX is expressed as total annual loan payments calculated at an interest rate of 5.5%
- Regularly occurring operational expenses are expressed as total annual costs
- Utility demand charges are based on the commonly encountered rate of \$15 per kW which varies based on utility and rate class
- EV charging infrastructure assumes a ten-year service life
- Non-regularly occurring expenses anticipated to be incurred over each asset's respective service life are expressed as amortized costs
- Factors of depreciation, tax deductions, tax credits, real estate savings, employee parking, employee benefits, employee injury, absenteeism, employee retention & training, repair costs due to employee negligence, e.g. drop damage, excess distribution facilities charges, utility lead times, insurance, security and eventual costs of equipment removal are omitted from the TCO analysis and require additional corporate operating or site-specific information to quantify
- Higher power chargers can introduce more up-front capital cost, extend installation time, and even limit depot site options due to the need for the utility to upgrade the local grid capacity and sub-station capacity to serve the depot's peak electrical demand needs.

¹ Certain utilities have established special rate structures for EV charging infrastructure. In the case of Connecticut, for example, the demand charge is adjusted to match the average demand charge incurred by non-EV related service customers with the same rate class as a means to accelerate the transition to EV-based transportation. This shifts the cost burden to taxpayers and are, in many cases, subject to annual reevaluation and extension by the public utility regulatory authority.

² Flattening the peak load would also impact the volumetric rate by lessening the stress on the primary generators, though again to be conservative, these data were not incorporated into the model.

About WiTricity: WiTricity is the global industry leader in wireless charging, powering a sustainable future of mobility that is electric and autonomous. WiTricity's patented magnetic resonance technology is being incorporated into global automakers' and Tier 1 suppliers' EV roadmaps and is the foundation of major global standards developed to support wide-scale adoption. Advancements like dynamic charging of moving vehicles, and the charging of autonomous robots and vehicles without human intervention all depend on WiTricity technology. See how WiTricity enables a magically simple, efficient charging experience.