Office of Inspector General | United States Postal Service

RISC Report

Electric Delivery Vehicles and the Postal Service

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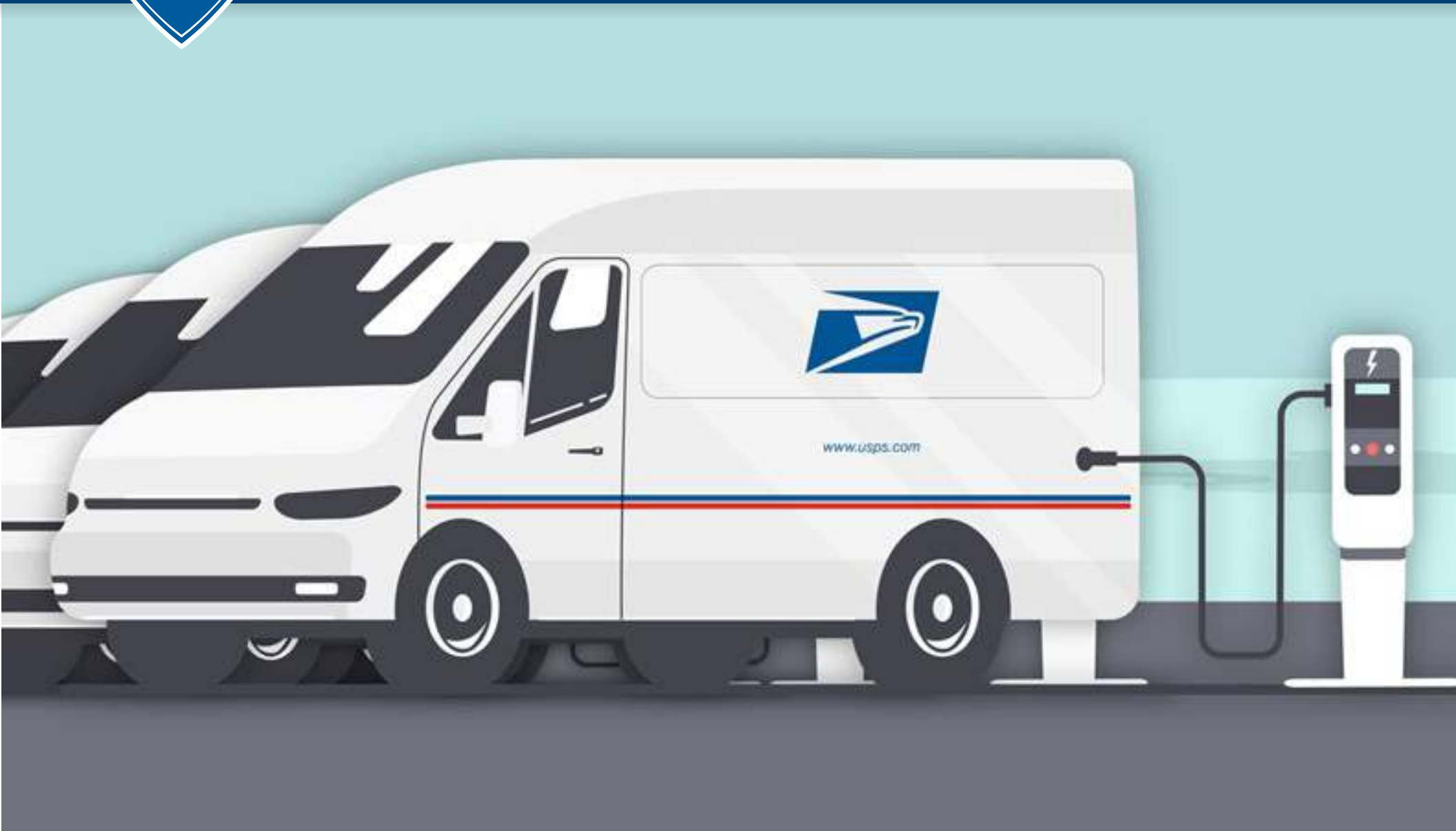

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Executive Summary

The U.S. Postal Service employs 217,000 delivery vehicles to deliver mail and parcels to more than 135 million addresses. Many of these vehicles are beyond their intended service life and expensive to operate and maintain. The Postal Service is at a critical inflection point for its aging fleet and is preparing to acquire and operate a new generation of delivery vehicles. In February 2021, USPS awarded a contract to produce and deploy 50,000 to 165,000 Next Generation Delivery Vehicles (NGDVs) over 10 years. The agency announced its intention to make at least 10 percent of its NGDVs electric but has not yet decided on the number of electric vehicles in its future fleet.

The U.S. Postal Service Office of Inspector General (OIG) sought to identify opportunities and challenges for the Postal Service in adopting electric delivery vehicles. In this white paper, we assessed the suitability of using electric vehicles as postal delivery vehicles. We analyzed the potential long-term cost savings of a new, electric delivery vehicle compared to a new, gas-powered vehicle. We also benchmarked the electric vehicle experiences of other federal agencies, foreign posts, and companies in the logistics and shipping sector.

We identified several clear benefits of adopting electric vehicles into the postal delivery fleet, including improved sustainability and environmental impacts. Electric vehicles are generally more mechanically reliable than gas-powered vehicles and would require less maintenance. Energy costs will be lower for electric vehicles, as using electricity to power an electric vehicle is cheaper than using gasoline.

Our research confirms that electric vehicle technology is generally capable of meeting the Postal Service's needs. Due to the diverse nature of postal delivery routes, however, there are multiple variables that could affect electric vehicle performance on specific routes. These factors include route length (as vehicles must return to a facility to recharge) and temperature (as batteries can suffer from reduced performance in extremely hot or cold climates).

The adoption of electric delivery vehicles could save the Postal Service money in the long term — at least for certain delivery routes. The OIG commissioned a total cost of ownership model to project the relevant costs of owning and operating a vehicle over its planned lifespan. The upfront cost of buying a new electric delivery vehicle is significantly higher than the cost of buying a new gasoline-powered vehicle. Electric vehicles also require the installation of chargers and related electrical infrastructure, which further adds to the upfront costs. Once the vehicle is purchased and the charger installed, electric vehicles are generally cheaper to operate because energy and maintenance costs are lower. The Postal Service may wish to prioritize electric vehicle implementation where there is the highest likelihood that electric vehicles would achieve cost savings over gasoline-powered vehicles. For example, longer routes — up to 70 miles — are more suited to electric vehicles because the agency saves money on each mile driven compared to gas-powered vehicles.

The Postal Service must make decisions about charging infrastructure that will influence the cost-effectiveness of implementing electric delivery vehicles at a given postal facility. Having a lower ratio of chargers to vehicles can cut down on upfront costs, but the agency must ensure that there are sufficient chargers available to meet a facility's needs. The type of charger is also important, as the cheapest variety of charger may be sufficient for vehicles that operate on shorter delivery routes and expend only a small portion of their battery's charge during the day.

As the Postal Service rolls out an electric fleet, good planning and communication with stakeholders will help avoid and overcome potential implementation challenges. These include challenges in implementing charging infrastructure across a diverse array of postal facilities and the potential strain that a large number of electric vehicles could place on local electric grids.

The upfront costs of vehicles and charging infrastructure are significant factors for the Postal Service as it determines the number of electric vehicles it will purchase in the future. External financial assistance would significantly change the cost-benefit analysis for the Postal Service. Congress is currently considering legislation that would help subsidize the purchase of electric vehicles and, in some areas, there will be incentives available to aid in the cost of installing charging infrastructure.

The Postal Service is poised to refresh its delivery fleet at a moment when electric vehicle technology is rapidly advancing. Battery ranges are improving, and battery costs are declining. The agency's decision to electrify a portion — or all — of its delivery fleet is a far-reaching decision that will impact its employees, operations, and services for decades to come.

Recently, on March 14, 2022, we received a congressional request to review the Postal Service's compliance with the National Environmental Policy Act (NEPA), among other issues, that are not addressed in this paper. The OIG will be doing additional work in response to that request.

Observations

Introduction

The U.S. Postal Service employs 217,000 delivery vehicles to deliver mail and parcels to more than 135 million addresses. For over 35 years, the Postal Service has used Long Life Vehicles (LLVs) as its primary delivery vehicles. LLVs went into service between 1986 and 1994 and were originally designated to have a lifespan of 24 years. Even the youngest LLVs are now far beyond their intended service life and are expensive to operate and maintain. To address this problem, the Postal Service is preparing to acquire and operate new Next Generation Delivery Vehicles (NGDVs). A portion of the NGDV fleet is likely to be electric. In deciding the extent to which it should electrify its delivery fleet, the agency is reprising its historic role as an innovator and pioneer in the American transportation sector.

From its beginnings, the Postal Service's efforts to deliver mail quickly and reliably have been a force for innovation in the American transportation sector. In the 1780s, the Post Office of the United States (as it was then known) drove the national adoption of stagecoaches — then a trailblazing technology — as a vital mode of transportation. In the 1830s, the agency was instrumental in promoting the expansion of the nation's railroads. In 1912, less than a decade after the Wright brothers' first flight, the Post Office Department began experimenting with mail flights and became a catalyst for the expansion of national air transportation. The agency began using electric vehicles for mail delivery as early as 1899, as shown in Figure 1. At various times in the second half of the 20th century, hundreds of electric delivery vehicles operated out of postal facilities, notably in Florida and California. In the 2000s and 2010s, the agency pilot tested different types of cutting-edge electric delivery vans and smaller vehicles. In the 2010s, the Postal Service piloted two-ton electric vans in several markets and partnered with five companies to test electric versions of its LLVs.

The electric portion of the current postal fleet is small. In 2017, the Postal Service began testing six electric left-hand drive passenger vehicles at three postal facilities in Northern Virginia for limited parcel deliveries. In 2018, 15 electric two-ton trucks began delivering mail at post offices in Fresno and Stockton, CA. The following year, the agency began operating electric terminal trucks in Richmond, CA. The Postal Service also installed electric vehicle charging infrastructure at six other facilities to support prototype electric vehicles.

FIGURE 1: ELECTRIC VEHICLE USED FOR RURAL FREE DELIVERY, CA. 1910

Source: National Postal Museum, Smithsonian Institution.

In February 2021, the Postal Service awarded a contract for the manufacture of NGDVs. This contract covers non-recurring engineering and tooling costs and allows the Postal Service to order between 50,000 and 165,000 NGDVs over a 10-year period. For more information on the new NGDV, see Figure 2.[1] The contract allows for four kinds of NGDVs: 2-wheel drive gasoline-powered, 4-wheel drive gasoline-powered, 2-wheel drive battery electric, and 4-wheel drive battery

1 The Postal Service also plans to acquire additional commercial off-the-shelf vehicles to supplement the NGDVs in cases where the parcel and mail volume is beyond the designed capacity of the NGDV. The contract with Oshkosh Defense stipulates that the supplier will provide between 50,000 and 165,000 NGDVs over 10 years. This contract is contingent on the completion of National Environmental Protection Act requirements related to the evaluation of the potential environmental impact of the NGDV program. There are 36,000 routes (most of them rural) that are served by carriers' personal vehicles and are thus not currently being considered for NGDV deployment.

FIGURE 2: NEXT GENERATION DELIVERY VEHICLES - FEATURES OF THE NEW NGDVS

NGDVs will incorporate upgrades such as larger cargo capacity, telematic data collection, and safety upgrades

Source: United States Postal Service, *Delivering for America*, 2021.

electric. USPS will make orders for new vehicles under the contract and can determine how many of each type it will request in each order. In addition, the supplier stated that it can later retrofit gasoline-powered NGDVs with electric powertrains (a term referring to the motor and drivetrain), potentially adding flexibility to the Postal Service's fleet electrification strategy.

In a January 2021 executive order, the Biden Administration declared a goal of electrifying the federal fleet.[2] The White House does not have authority over the postal fleet, but in February 2021, the Postal Service announced its intention to make at least a portion of its acquisitions electric vehicles. The upfront purchase cost of an electric vehicle is higher than the purchase cost of a gas-powered vehicle. For this reason, the Postal Service stated that it cannot afford to commit to a fleet that is more than 10 percent electric without external funding. Congress is considering legislation to provide this funding, but the Postal Service must begin making decisions about the proportion of electric vehicles in its future delivery fleet. It plans to submit the first order to the supplier in 2022.

On February 2, 2022, citing concerns about the environmental impact statement the Postal Service prepared for the planned NGDV acquisition, the Environmental Protection Agency asked USPS to submit a supplementary disclosure and recommended a public hearing to address environmental concerns related to the NGDV plan.[3] At the time this white paper was finalized, it was unclear whether these actions would delay the Postal Service's acquisition of new delivery vehicles. In addition, on March 14, 2022, we received a letter from Chairwoman Carolyn B. Maloney, House Committee on Oversight and Reform, Chairman Gerry Connolly, Subcommittee on Government Operations, and other members of Congress asking us to review the Postal Service's compliance with the National Environmental Policy Act (NEPA), among other issues that are not addressed in this paper. The OIG will be doing additional work in response to the congressional request. The scope of this paper did not include an assessment of the Postal Service's compliance with legal requirements related to environmental impact statements.

The objective of this white paper was to identify opportunities and challenges for the Postal Service in moving to an electric vehicle delivery fleet. Additionally, we assessed the suitability of using electric vehicles as postal delivery vehicles; analyzed the potential long-term cost savings of a new, electric delivery vehicle compared to a new, gas-powered vehicle; and benchmarked the electric vehicle experiences of other federal agencies, foreign posts, and companies in the logistics and shipping sector.

2 For more information on the executive order, see: the White House, "Executive Order on Tackling the Climate Crisis at Home and Abroad," January 27, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

3 For more information, see: Environmental Protection Agency letter to the Postal Service, February 2, 2002, https://context-cdn.washingtonpost.com/notes/prod/default/documents/cb839d93-acf3-4390-8106-508a98e25b48/note/2b41bc0f-ccdb-4107-b59c-afdbd475640c.#page=1 and USPS, "Environmental Impact Statement," December 2021, https://uspsngdveis.com/.

Suitability of Electric Vehicles for the Postal Service's Delivery Needs

Postal delivery vehicles must reliably serve addresses across the extensive postal network. Electric vehicle technology is generally capable of meeting the Postal Service's needs for delivery vehicles.

Requirements for Postal Delivery Vehicles

Postal delivery vehicles must provide consistent, dependable service across a diverse array of postal routes. They make frequent stops to deliver letters and parcels, with some vehicles averaging over 600 starts and stops per day.[4] This drive cycle can create significant maintenance demands for postal delivery vehicles. The average postal delivery vehicle drives around 7,000 miles per year, but some routes reach more than 20,000 miles per year. Delivery vehicles typically operate 301 days a year.[5] The average route length is around 24 miles, although two percent of delivery routes are 70 miles or longer.

In 2015, the Postal Service set out specific requirements for NGDVs. To be consistently reliable, each vehicle's body needed to last for 20 years and each powertrain (a term referring to a vehicle's motor and drivetrain) had to last for 150,000 miles. For NGDVs with electric powertrains, a vehicle should be able to fully charge its battery within eight hours and drive for at least 70 miles without recharging. This 70-mile range accounts for the need to power systems that go beyond simply moving the vehicle, including air conditioning, heating, defrosting, headlights, cameras, and sensors.

The OIG's research confirms that current electric vehicle technology can meet the Postal Service's requirements for delivery vehicles. For example, there are currently multiple off-the-shelf van-type (class 2b-3) vehicles on the market that are similar in size to a postal delivery vehicle and rated to reach at least 100 miles on a single charge.

Capabilities and Requirements of Electric Vehicles

While electric vehicles can meet the Postal Service's needs, several characteristics of this technology are relevant to the implementation of an electric delivery fleet.

Chargers and Related Infrastructure

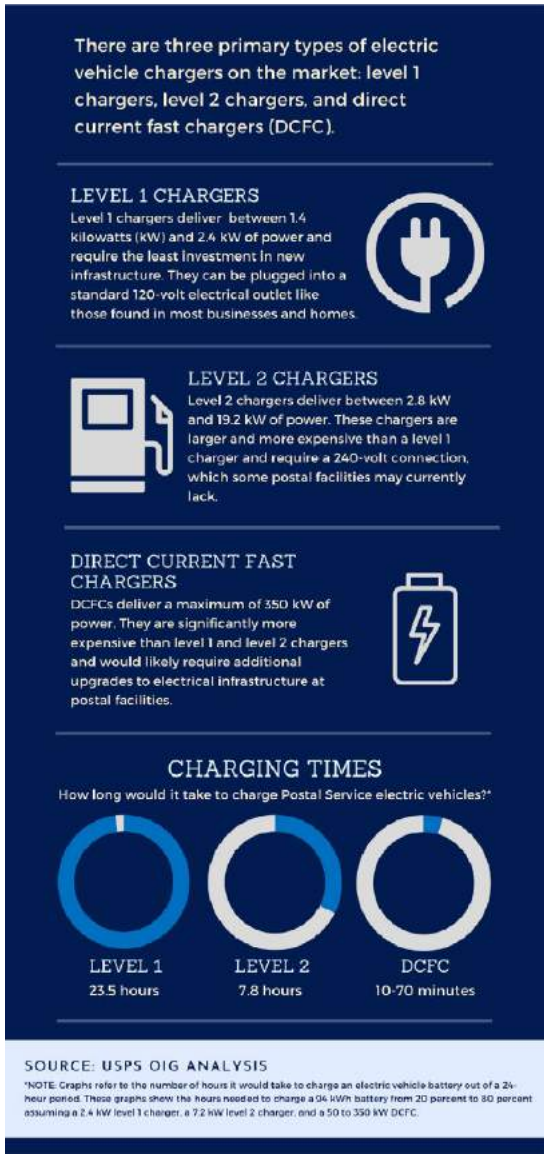
To adopt an electric delivery fleet, the Postal Service plans to install electric vehicle chargers at its facilities, specifically in the lots where most postal delivery vehicles park at night. There are three primary types of electric vehicle charging available on the market, each with different capabilities and costs. The charging port on an electric vehicle can generally accept a charge from any of the three technologies. Level 1 charging would require the least investment in new infrastructure but is the slowest, with vehicles needing 11 to 20 hours to fully charge.[6] Level 2 charging is more expensive than level 1 but can typically fully charge a battery within eight hours. Direct current fast charging is much faster but significantly more expensive to own and operate. For more details on chargers, see Figure 3.

Given the Postal Service's requirements, level 2 charging should be sufficient for postal delivery vehicles. This would allow all batteries to be fully charged during the 14 hours that a delivery vehicle generally sits in the lot (from 6:00 PM to 8:00 AM). For short routes that deplete only a small percentage of a battery, level 1 charging could be sufficient.[7]

The Postal Service estimated that an NGDV with an electric powertrain would deplete only 20 percent of battery capacity on an average route. Because of this relatively small depletion, it is possible that vehicles on many routes would not need to plug into a charger every night, meaning that postal facilities could host a smaller number of chargers than electric vehicles. In such cases, parking spaces

4 Frequent stopping may allow delivery vehicles to increase efficiency through regenerative braking, a standard feature in electric vehicles. This technology captures energy when a driver applies the brakes and uses that energy to recharge the battery. Research has yielded conflicting opinions about the extent to which this will benefit postal delivery vehicles, which make many stops but tend to drive at relatively low speeds.
5 Prior to 2021, there were 302 delivery days in a non-leap year. The adoption of the federal Juneteenth holiday in 2021 resulted in one fewer delivery day.
6 Exact charging times for any charging technology vary depending on the battery and the state of charge.
7 The Postal Service is assessing where it might utilize networked "smart" charging, also known as managed charging. This technology can manage the power levels of each individual charging station, prioritize the vehicles to be charged, and strategically supply power during times when electricity rates are cheaper. Smart charging increases the upfront installation costs and requires an additional service fee but can save money in the long run by reducing the daily costs of charging electric vehicles.

FIGURE 3: ELECTRIC VEHICLE CHARGERS



could be rotated so that each vehicle has access to a charger when necessary to replenish the battery.

Climate, Route Length, and Other Considerations

Due to the diverse nature of postal delivery routes, there are multiple variables that could affect electric vehicle performance on specific routes. For example, route length is an important consideration for the Postal Service. A fully charged battery has a finite range and will have to return to the lot to recharge before fully depleting. In practice, fleets should generally strive to have their vehicles remain above a 20 percent charge at all times, since allowing the charge to drop below that mark could reduce the life of a battery. To manage risk, a fleet may wish to increase that threshold so at least two days of charge are available in case of power outage or charger malfunction.

The 24-mile average length of a postal delivery route is well within the ability of current technology, but the longest routes may be more difficult for electric vehicles to serve. Of the roughly 177,000 routes served by Postal Service-owned delivery vehicles across the country, around 2,600 of these routes (1.5 percent of the total) may be poorly suited to electric vehicle deployment because they are longer than the specified 70-mile range of an electric NGDV. Routes that are shorter than 70 miles may also experience range limitations if they include hilly terrain, since acceleration up steep slopes can reduce the range of a fully charged battery.

Another variable is temperature, as batteries can suffer from reduced performance in extremely hot or cold climates. A battery will have the highest actual range when operating in 70-degree Fahrenheit weather. As external temperatures increase or decrease, the overall range of a fully charged battery is reduced. The primary reason for this is the need to use power-consuming heating or cooling systems to maintain a comfortable temperature for the occupants of a vehicle. The Postal Service has determined that locations with an average seasonal temperature that exceeds 94 degrees or dips below 15 degrees may be less suited to the use of electric vehicles, and the agency will accordingly give those locations lower priority when deciding where to implement NGDVs with electric powertrains. As technology improves and USPS accrues more experience, the agency may find that it can effectively deploy electric vehicles in more extreme climates.

A related issue is the reduction in the range of a fully charged battery as that battery ages. Factors such as prolonged exposure to high temperatures can increase the rate at which range degrades over time.[8]

There is also some uncertainty about the actual mileage range of even a new battery. Standard methods of range measurement have not yet been established in the industry, and due to variables, such as those listed above, advertised ranges can be misleading. For example, Rivian claimed the electric vehicles it built for Amazon would have a range of 120 to 150 miles, but testing revealed that ranges were often shorter than advertised, especially in adverse

8 For more information, see: Geotab, "The Geography of EV Charging," May 2020, https://www.geotab.com/geography-of-ev-charging/.

weather and terrain conditions.[9] In fact, interviews with private carriers revealed that the actual range of electric vehicles may be up to 40 to 50 percent less than manufacturers claimed.

For these reasons, it may be beneficial to ensure that all vehicles are running routes shorter than the rated range of the batteries. Doing so would reduce the risk that a vehicle battery fully depletes its charge while on its route. It should be noted that battery technology is evolving and improving, so current limitations could be less significant in the future.

Benefits of Adopting Electric Delivery Vehicles

There are several potential benefits to the Postal Service of adopting electric vehicles into the postal delivery fleet, including improved sustainability and environmental impact, lower operating costs on at least some delivery routes, reduced maintenance requirements, and more stable and predictable energy costs.

Sustainability and Environmental Impact

An electric delivery fleet would help achieve the Postal Service's sustainability goals and improve its environmental impact. Electric vehicles have no tailpipe emissions, and emissions from electricity generation facilities are expected to decrease as renewable energy production increases in the United States. According to Postal Service estimates, adoption of a fully electric NGDV fleet would roughly triple reductions in greenhouse gas emissions compared to a fleet that is only 10 percent electric.[10] In November 2021, USPS reported that six experimental electric vehicles in operation since 2017 accounted for a 52,770-pound reduction in greenhouse gas emissions compared to gas-powered vehicles. The Postal Service has set specific sustainability goals, including a 25 percent reduction in CO_2 emissions by fiscal year 2030 compared to fiscal year 2019.[11] The more the agency can replace gas-powered vehicles with electric vehicles, the easier it will be to achieve that goal.

Incorporating electric vehicles into the delivery fleet would reduce emissions, lower maintenance costs, and provide more stable and predictable energy costs.

A large order of electric delivery vehicles would also help fuel the growing electric vehicle market, accelerating a broader transition in the United States. The Biden Administration issued a report in June 2021 that presented electrification of the federal fleet as a strategy to stimulate demand for batteries and strengthen the supply chain. This report built upon a 2016 federal task force report stating that adoption of electric vehicles by USPS and other federal agencies would send a strong signal to the market, helping to drive the development of electric vehicle technology, boost the domestic supply chain, and support the installation of needed charging infrastructure.[12]

Reduced Maintenance Needs

Electric vehicles are generally more mechanically reliable than gas-powered vehicles and would require less scheduled maintenance and reduced maintenance costs. There are several reasons for this: the battery, motor, and associated electronics require little to no regular maintenance; there are fewer fluids (such as engine oil) to replace; brake wear is reduced due to regenerative braking; and there are fewer moving parts. It should be noted that NGDVs will have advanced technologies and systems that are not present in the current LLV fleet; because of this, both electric and gas-powered NGDVs will have some additional maintenance requirements compared to existing postal delivery vehicles.

9 Reuters, "Rivian's electric van for Amazon raises battery power doubts - The Information," November 19, 2021, https://www.reuters.com/technology/rivians-electric-van-amazon-raises-battery-power-doubts-information-2021-11-19/.

10 Comparison of emissions projections found in tables 4-6.2 and 4-6.5 in NGDV Environmental Impact Statement. See: USPS, "Environmental Impact Statement", December 2021, https://uspsngdveis.com/, pp. 4-23 and 4-25. Note that in February 2022 the Environmental Protection Agency cited concerns with this document and asked the Postal Service to submit a supplementary Environmental Impact Statement.

11 USPS sustainability goals can be found in: USPS, "2021 Annual Sustainability Report," 2021, https://about.usps.com/what/corporate-social-responsibility/sustainability/report/2021/usps-annual-sustainability-report.pdf.

12 For more information, see: the White House, "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth. 100-Day Reviews Under Executive Order 1407," June 2021 and Dorothy Robyn, "The Postal Service's $6 Billion Procurement of Its Next-Generation Mail Truck: What Would Ben Franklin Do?", Information Technology & Innovation Foundation, February 10, 2021, https://itif.org/publications/2021/02/10/postal-services-6-billion-procurement-its-next-generation-mail-truck-what.

Because electric delivery vehicles should not require additional maintenance work compared to gasoline vehicles, the number of employees at existing USPS vehicle maintenance facilities and commercial garages should be adequate for conducting maintenance on new delivery vehicles. The Postal Service stated that the deployment of new NGDVs, regardless of whether they are gasoline-powered or electric, would result in minimal or no changes to the total Postal Service vehicle maintenance workforce.

Lower and More Stable Energy Costs

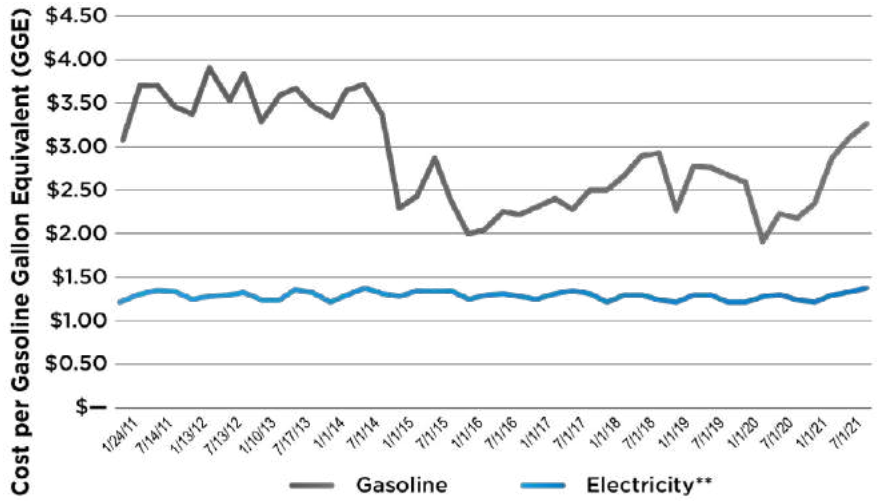
Energy costs will be lower for electric vehicles because using electricity to power a vehicle is cheaper than using gasoline, as shown in Figure 4. For example, USPS reported in November 2021 that six electric vehicles it had acquired in 2017 had reduced fuel consumption by 5,888 gallons and saved approximately $10,000 in fuel costs. Increased electricity use and reduction in gasoline consumption will also create more stability in the Postal Service's energy spending because electricity prices are, in the long term, more stable than petroleum prices. Since 2000, gasoline and other petroleum products have experienced significant price fluctuations. Electricity prices, on the other hand, tend to show only cyclical price variations from summer months to winter months.

The Cost of Electric Vehicles for the Postal Service

In addition to the benefits described above, adoption of electric delivery vehicles could save the Postal Service money in the long term — for certain delivery routes. The OIG commissioned a total cost of ownership model to project the relevant costs of owning and operating a vehicle over its planned lifespan.[13] This model calculates costs over 20 years based on inputs including the upfront cost of purchasing a new vehicle, the cost of fuel (gasoline or electricity), maintenance costs, charger installation costs, and miles driven per day. The model uses these inputs to project the ownership costs of an electric vehicle compared to a gasoline-powered vehicle.

In general, the upfront cost of buying a new electric vehicle is higher than the cost of buying a new gas-powered vehicle. Based on information from the Postal Service, our model assumes a new electric delivery vehicle would cost

FIGURE 4: AVERAGE RETAIL FUEL PRICES IN UNITED STATES, 2011-2021



Source: Department of Energy Alternative Fuels Data Center.
** Electricity prices are reduced by a factor of 3.54 because electric motors are 3.54 times more efficient than internal combustion engines.

[redacted] in 2023, while a new gas-powered vehicle would cost [redacted]. Electric vehicle adoption also requires investment in charging infrastructure, increasing the upfront cost.

Once the vehicle is purchased and the charger installed, an electric vehicle is generally cheaper to operate because fuel and maintenance costs are lower than for gas-powered vehicles. Depending on factors such as the specific characteristics of a delivery route and the charging infrastructure installed, the savings in operating costs for an electric vehicle may or may not be enough to overcome higher upfront costs over the total life of a vehicle. If the savings are enough to make owning an electric vehicle more cost effective than owning a gas-powered vehicle, our model allows us to identify a "breakeven" year when

13 The OIG contracted with ICF to produce this model.

the total cost of electric vehicle ownership drops below the cost of owning a gas-powered vehicle.

Projections Using the OIG Total Cost of Ownership Model

The OIG used the total cost of ownership model to explore how different route characteristics and other scenarios could affect the cost of electric delivery vehicle implementation.

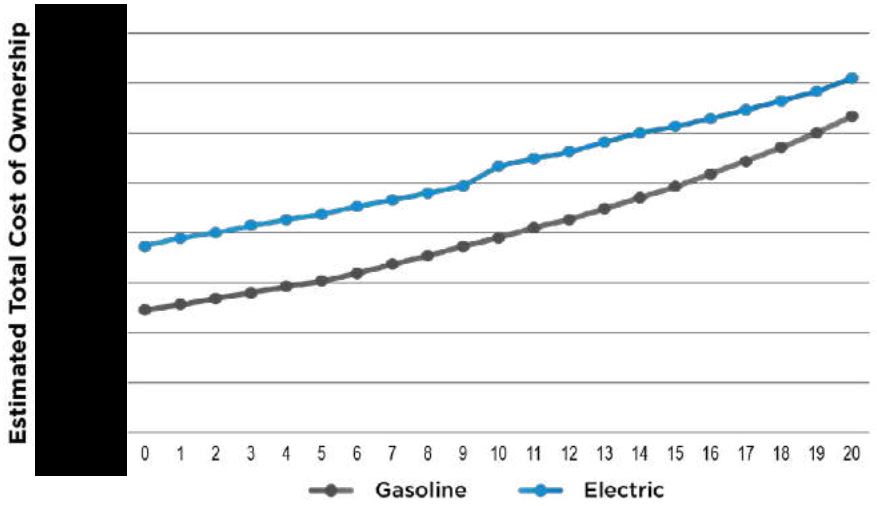
Baseline Projection

As a baseline, the OIG projected the total cost of ownership over 20 years if the Postal Service purchased 1,000 electric delivery vehicles in 2023 and installed 1,000 level 2 chargers to support those vehicles. We predicted operating costs using projected U.S. national average gasoline and electricity prices. The model estimated that an electric vehicle would cost around [redacted] over the vehicle lifetime, which is 11.0 percent higher than the projected [redacted] cost of a gasoline-powered delivery vehicle. In this case, there is no breakeven point over the 20-year period. There is an increase in the cost of an electric vehicle after 10 years of ownership indicating the point at which the Postal Service must pay to buy a new battery, as shown in Figure 5.[14]

Projecting the total cost of ownership requires making several assumptions; changing any of these input variables affects the model's output. The OIG's assumptions include that the Postal Service must pay for additional "make-ready" costs, a term that refers to the installation of electrical infrastructure necessary to enable operation of a charging station — essentially everything needed to connect a charger to the utility grid. We are assuming a five percent increase to charger installation costs to account for electrical upgrades. In reality, these costs will vary greatly among sites, but the OIG believes this assumption allows for a reasonable projection.[15]

FIGURE 5: 20-YEAR TOTAL COST OF OWNERSHIP PROJECTION — BASELINE MODEL

Estimated Average Per-Vehicle Payback Period: Annual Cumulative Cash Flow (Gasoline Vehicle Vs EV) (Discounted)



Source: USPS OIG.

Our baseline projection assumes an average delivery route length of 24 miles per day, and 301 operating days per year. The cost figures cited in this report are discounted using a 2.2 percent interest rate, a method of converting expected future benefits and costs into a present value.[16]

Potential Cost Savings on Higher Mileage Routes

Our model demonstrates that the total cost of deploying an electric vehicle instead of a gasoline vehicle over 20 years is closely tied to the length of a

14 The model includes a battery replacement after 10 years or 100,000 miles, whichever comes first. In practice, batteries will likely be replaced at different times depending on their health and usage. Some might need to be replaced prior to the 10-year mark, while others may be able to perform for more than 10 years.

15 In this projection, the OIG assumes that the charging infrastructure installed will not include managed "smart" chargers, which are more expensive than non-managed chargers but could allow the Postal Service to reduce its electricity costs. Managed charging will likely be appropriate for some postal facilities, but the OIG has not included this in its baseline projection to simplify the model.

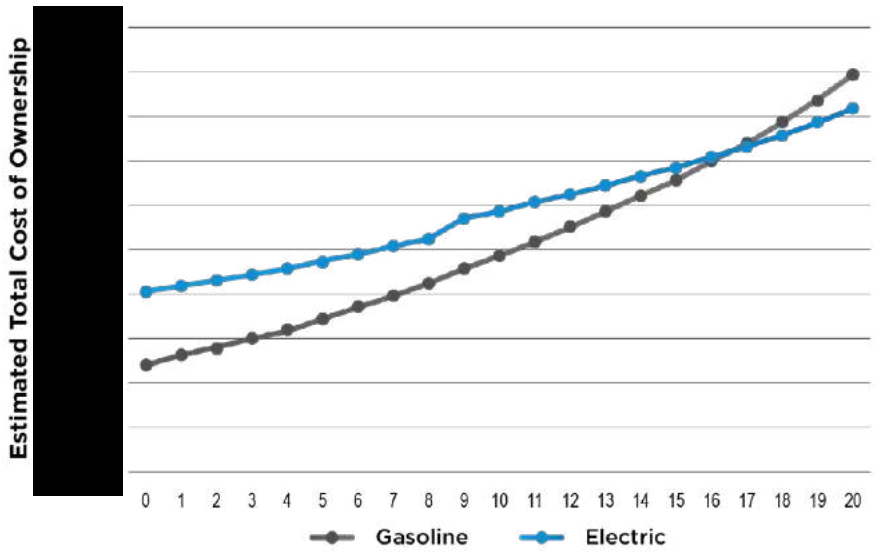
16 The discount rate is used in cost projections to account for the concept that the value of money or goods in the present is higher than the expected value of goods and financial returns in the future. The further a potential benefit or cost is in the future, the less its value. The discount rate is applied to anticipated costs and benefits of a project — in this case the NGDV — over the duration of the project to convert the value of a return in the future into today's value. See: "Cost-Benefit Analysis Methodology," Pan-American Health Organization, https://www.paho.org/disasters/dmdocuments/SHT_CostBenefitAnalysis.pdf.

delivery route. This is because electric vehicles have lower fuel and maintenance costs per mile and are therefore cheaper to drive. The longer the route, the more money saved. If the route is long enough, the cost savings will make up for the higher upfront costs of acquiring an electric vehicle and related charging infrastructure.

To test the impact of route length, we projected the total cost of ownership for a theoretical set of postal routes with an average length of 40 miles (higher than the national average of 24 miles) and kept all other inputs the same as in the above baseline scenario. For this example, see Figure 6. In this case, the cost of an electric vehicle over 20 years would be [redacted], 8.4 percent lower than the projected gas-powered vehicle cost of [redacted]. The model projects a breakeven point in year 17 of ownership.

FIGURE 6: 20-YEAR TOTAL COST OF OWNERSHIP PROJECTION — 40-MILE ROUTE

Estimated Average Per-Vehicle Payback Period: Annual Cumulative Cash Flow (Gasoline Vehicle Vs EV) (Discounted)



Source: USPS OIG.

Our projection suggests that there could be a strong financial case for deploying electric vehicles on longer postal delivery routes. For example, nine percent of USPS delivery routes are between 40 miles (the range in this example) and 70 miles long (the maximum range the Postal Service specified for electric vehicles); our model predicts that these routes would be good candidates for implementation of electric vehicles due to the likely cost savings for the Postal Service.

Geographic Variations in Energy Costs

The market in which the Postal Service deploys an electric vehicle can have a strong effect on the total cost of ownership over a vehicle's lifetime. This is due to variations in gasoline and electricity costs in different markets.

In California, where gas prices are the highest of any state, our model projects that a deployment of 1,000 electric vehicles in 2023 would cost the Postal Service 3.6 percent more over 20 years than the same number of gas-powered vehicles — an improvement over the 11.0 percent difference in our baseline projection. In Oklahoma, which has some of the country's lowest gas prices, the same number of electric vehicles would cost 12.2 percent more than gas-powered vehicles — a gap that is greater than our baseline projection.

Ratio of Chargers to Vehicles

A postal facility could possibly install fewer chargers than the number of electric vehicles it hosts. A smaller number of chargers could significantly reduce upfront costs. If a vehicle drives a relatively short route and only drains a small portion of its battery charge each day, that vehicle may not need to connect to a charger every night.

Our model demonstrates that a 1:1.5 charger-to-vehicle ratio would make electric vehicle adoption more affordable. For example, if the Postal Service adopted 1,000 delivery vehicles and installed 667 chargers instead of 1,000, the projected per vehicle cost of owning an electric vehicle for 20 years would drop from [redacted], a decrease of 6.3 percent. Given the large number of delivery vehicles that run very short routes and therefore might not require nightly charging, a 1:2 charger-to-vehicle ratio may be possible. Our model projects this

scenario would yield an almost identical cost per vehicle between an electric vehicle and a gasoline-powered one.[17]

The Postal Service is currently looking into the possibility of a 1:1.5 charger-to-vehicle ratio, but postal management stated that it prefers a 1:1 ratio because when outside temperatures are extreme, vehicles can use power from a charger to heat or cool the battery to ensure it does not reach a temperature that is dangerously low or high. The Postal Service also expressed an interest in ensuring that vehicles remain fully charged at all times to maximize operational flexibility.

Rotating vehicles and recharging them every other night (or even less frequently) could be the best strategy for maintaining optimal battery health and maximizing battery lifespan, as each charging cycle puts stress on a battery. For this reason, a lower charger-to-vehicle ratio would not only save infrastructure costs but also preserve battery performance and longevity by potentially extending battery life and delaying battery replacement costs.

Using Level 1 Chargers

Another consideration is the type of charger installed. For vehicles that run short routes, level 1 charging could be sufficient to replenish the battery overnight. Our modeling suggests that, if operationally feasible, installing some level 1 chargers instead of using exclusively level 2 chargers could make electric vehicle adoption more cost effective.

In our model, we projected a scenario where the Postal Service adopted 1,000 electric delivery vehicles and installed 500 level 2 chargers and 500 level 1 chargers (instead of 1,000 level 2 chargers). This drops the cost of ownership from [redacted] per vehicle to [redacted], a decrease of 8.5 percent. In this scenario, the cost of an electric vehicle is only 1.5 percent more than that of a gas-powered vehicle. However, postal management's position is that level 1 charging would not allow for the benefits of more advanced managed charging technology. For example, level 1 chargers would not be able to automatically draw power only during off-peak periods when electricity is less expensive.

The Postal Service's Model

The Postal Service has a fleet optimization model to gauge the appropriateness of different vehicles for postal delivery routes throughout the country. This model includes not only vehicle and infrastructure acquisition and operational costs, but also other factors such as parcel volume and the number of curbside stops. Unlike the OIG's total cost of ownership model, the USPS model accounts for whether commercial off-the-shelf vehicles would be the most appropriate vehicles for some postal routes. According to postal management, this model suggests that the optimal choice is currently to acquire a substantially gasoline-powered fleet. However, electric vehicles are predicted to be preferable to gas-powered vehicles in the future for an increasing number of routes due to declining costs.

The Postal Service's model differs from the OIG's model in its inputs and intended purpose, but both models suggest that electric vehicles could be cost-effective in specific circumstances. One important difference between the models is the Postal Service's higher assumed cost of charging infrastructure. The OIG model uses cost information from a variety of sources to project that the purchase and installation of level 2 chargers — including Postal Service funding of all make-ready costs — totals around $7,300 per charger. The Postal Service predicts a cost of $18,000 per charger based on previous experience installing chargers in 2017 and 2018 and on estimates it received for additional charger installation in 2018.

> It is important to install sufficient charging infrastructure to meet projected future needs and not only immediate needs.

Challenges in Adopting an Electric Postal Fleet

There are several issues that could complicate the Postal Service's implementation of an electric delivery fleet. Good planning and consistent communication with stakeholders can help overcome these challenges and ensure a smooth deployment.

17 The General Services Administration (GSA), the federal government agency that leases out the vehicles used in most federal government fleets (although not those of the Postal Service), has determined that agencies do not need a 1:1 ratio for vehicles that do not require a full charge every night.

Planning for Charging Infrastructure

The installation of chargers and related infrastructure presents several potential challenges to implementing an electric delivery fleet.

Charger Installation Challenges at Some Facilities

There may be issues and costs related to the installation of charging infrastructure at some postal facilities depending on several factors, including power availability, the layout of the facility, required upgrades, and other retrofitting needs.

There is a diverse range of more than 17,000 destination delivery units that may host new electric vehicles. Variations in how delivery vehicles park at different facilities could create logistical challenges in installing charging infrastructure. Some facilities may already be capable of supporting an electric fleet with minimal improvements because they have the necessary electrical equipment installed to power level 2 chargers. Other facilities may require retrofitting to provide the needed electrical power at the location where vehicles will charge. Running wire from electrical panels to charging stations requires work such as cutting trenches through parking lots, modifying existing canopies, or creating new overhead structures to bring electricity to a charger. Some buildings might require networked chargers, which use software to access online charging management tools, for separate electricity metering and billing. This equipment is more expensive to purchase and maintain than standard chargers. Smaller or leased properties, such as strip mall locations, may have limited space for charging infrastructure or require landlord approval for construction activities.[18]

A private carrier interviewed for this paper communicated that it is choosing to install overhead charging infrastructure. This frees up valuable space and provides the added benefit of being easily moved — an advantage for organizations such as USPS that lease some locations and whose fleets may need to be transferred to a different location in the future.

Local permitting processes can vary greatly across jurisdictions because they are usually regulated by local zoning and land use codes and can involve several municipal government offices. Permitting processes can slow down charging infrastructure installations and add to costs. Facilities that only have street parking for delivery vehicles will require additional permitting to allow charging in the public right-of-way.

In instances where logistics and installation costs are a major concern, another viable option could be to use level 1 or level 2 portable chargers that can be stored in vehicles. These units still would require access to the proper electrical outlets while a vehicle is parked but can offer a simplified infrastructure solution.[19]

Preparing for Future Needs and Communicating with Stakeholders

Interviewees emphasized that it is important to install sufficient charging infrastructure to meet projected future needs, not only immediate needs. This is because installing limited infrastructure and then upgrading or expanding at a later date will be more expensive than doing all necessary work upfront.

Representatives of two private carriers recommended engaging with charging service providers and local authorities as early as possible. Charging service providers, which organizations can contract to install and manage chargers and related infrastructure, may have limited experience working with large fleets. Talking with providers about the particulars of the electric fleet planned for a facility ensures that the provider is prepared to install the necessary equipment. Communicating with local authorities about planned electric vehicle implementation can help avoid problems in the permitting process.

Representatives from private carriers and federal agencies stressed the importance of early engagement with charging providers, utilities, and local authorities.

18 Postal management told the OIG that the agency can install charging infrastructure at both owned and leased facilities. The Postal Service maintains more than 25,300 leased spaces across the United States. See: U.S. Postal Service, "USPS Leased Facilities Reports," https://about.usps.com/who/legal/foia/leased-facilities.htm.

19 For a comparison of portable chargers, see: Tom Moloughney, "Portable Electric Car EV Charger Comparison: Which One's The Best?," *InsideEVs,* December 28, 2018, https://insideevs.com/news/341348/portable-electric-car-ev-charger-comparison-which-ones-the-best/.

Interviewees with knowledge of the electric vehicle sector said it was important to plan ahead and start work as soon as possible, including installing chargers well before electric vehicles are on the road or at facilities.

Electric Grid Issues

Adding many electric vehicles to a postal facility could significantly increase electricity demands and create potential capacity challenges for the local power grid. In Germany, for example, Deutsche Post DHL experienced this problem when it began operating an electric fleet at a facility and found that their vehicles had overtaxed the grid. An extensive acquisition of electric vehicles by the Postal Service could have the same effect unless the agency works with power utilities to prepare.[20]

To avoid grid problems, a best practice is for fleet managers or charging site hosts to communicate with the local utility early in the process and have a full power assessment of the site to anticipate expenses.

The Postal Service expressed it is currently communicating with a variety of stakeholders in the electric vehicle space, including utility companies. It is planning to discuss specific sites and requirements in early 2022 and complete grid assessments for specific markets.

Battery Replacement and Recycling

The batteries for NGDVs are specified to have a 10-year lifespan, which means the Postal Service plans to replace the battery halfway through an NGDV's 20-year lifespan. This raises the issue of what to do with the spent batteries, which are a source of hazardous waste.

Department of Energy representatives conveyed that 85 percent of an electric vehicle battery can currently be recycled. Postal management indicated they have completed preliminary research on battery recycling and stated that the agency will have more than a decade before it needs to have a large battery recycling program in place. The agency expressed optimism that the state of recycling technology will improve in the coming years.[21]

Training

Driver performance and driving style can have a significant effect on the efficiency and range of electric vehicles. To ensure the highest possible range and most efficient energy consumption, the Postal Service should properly train drivers to understand how to operate these vehicles.

Proper driver training can increase the operational range of electric vehicles.

The OIG's research clearly identified the importance of training. Deutsche Post DHL indicated its drivers initially had difficulty reaching the maximum operating range of their vehicles due to improper use of their heating and cooling systems, idling of engines while parked, and other issues. After training, drivers learned to precondition the vehicle by heating or cooling the cabin while the vehicle is still plugged in and to turn off the vehicles when stepping out to make deliveries. Drivers were then able to achieve much longer ranges. Another electric vehicle manufacturer reported seeing 10 to 15 percent increases in efficiency based solely on training.[22]

The Postal Service communicated that it is planning to create a training center devoted to the electric vehicle fleet. The contract with the NGDV supplier includes the development of training materials and implementation of a series of training courses. USPS will train District Driving Safety Instructors at the center, and these employees will in turn train carriers at their home facilities. Maintenance mechanics will also receive training to prepare them to work on the new vehicles.

20 For more information, see: Carter Boyle and Kory Sandven, "Preparing the Power Industry for USPS Fleet Electrification," Burns McDonnell, 2020, https://www.burnsmcd.com/insightsnews/1898/white-papers/preparing-power-ind-for-usps-fleet-electrification.

21 There may be creative options for repurposing batteries after they are used by delivery vehicles, as the batteries may still be able to hold some charge. Deutsche Post DHL, for example, is experimenting with using older vehicle batteries to capture solar power during the day. These batteries can then serve as buffer storage for solar power and as stationary chargers that can charge electric vehicles overnight. The University of California-San Diego has used older batteries in a similar way.

22 For more information, see: Chris Brown, "Heavy Payloads and Commercial EV Range - a Real-World Test," *Government Fleet,* March 29, 2021, https://www.government-fleet.com/10139840/heavy-payloads-and-commercial-ev-range-a-real-world-test.

Other Considerations for the Adoption of Electric Vehicles

There are several additional factors relevant to the Postal Service's implementation of electric delivery vehicles.

Potential Effect of Subsidies

The cost-benefit analysis for the Postal Service would change significantly if there were external funding to help it afford the higher upfront cost of electric vehicles and charging infrastructure. Such assistance is possible, as proposed legislation calls for partial Congressional funding of the Postal Service's acquisition of electric delivery vehicles.

The Postal Service stated that it could achieve full electrification if Congress provided $6.9 billion. A portion of this amount ($3 billion) would fund the differential acquisition costs between gas-powered vehicles and electric vehicles. The remaining $3.9 billion would fund charging infrastructure. In addition to NGDVs, the USPS electrification plan includes commercial off-the-shelf vehicles for routes where they may be less expensive to operate than NGDVs.

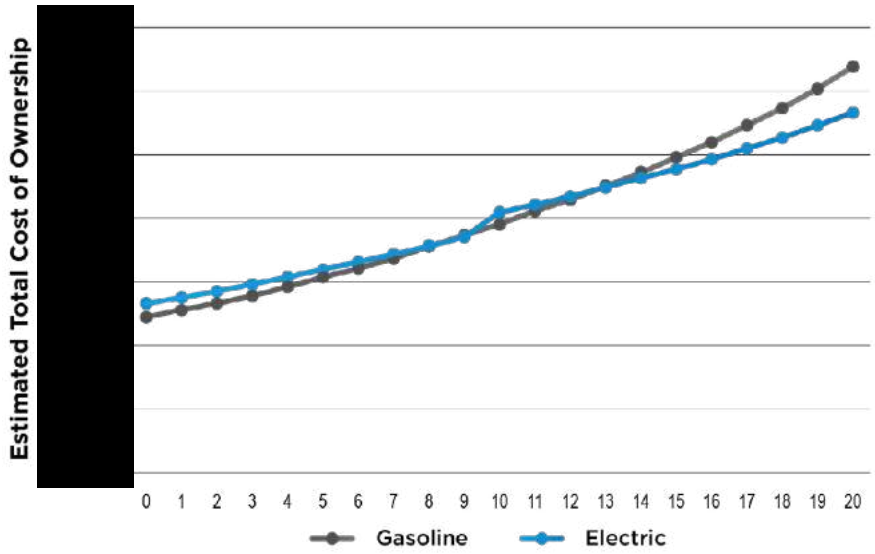
The OIG's total cost of ownership model demonstrates how the cost scenario would change for USPS if it were to receive outside funding to help purchase an electric fleet. If the subsidy covered the difference between the upfront cost of an electric delivery vehicle and a gas-powered vehicle (meaning the Postal Service would pay [redacted] in 2023 for an NGDV with an electric powertrain) and the cost of purchasing and installing charging infrastructure, electric vehicles would have an 11.0 percent lower total cost of ownership than gas-powered vehicles over a 20-year period, with a breakeven point in year 7, as shown in Figure 7.

Incentives for Installing Charging Infrastructure

There will be incentives available to the Postal Service to aid in the cost of installing charging infrastructure. Representatives of the Department of Energy's Federal Energy Management Program told the OIG that some electric utilities may help USPS pay for charging infrastructure and related infrastructure costs. Utilities offer these incentives because they stand to gain more revenue from the increased demand for electricity and want to encourage electric vehicle adoption.

FIGURE 7: 20-YEAR TOTAL COST OF OWNERSHIP PROJECTION — SUBSIDIES

Estimated Average Per-Vehicle Payback Period: Annual Cumulative Cash Flow (Gasoline Vehicles Vs EV) (Discounted)



Source: USPS OIG.

Some utilities offer make-ready infrastructure incentives to cover necessary upgrades between the utility's infrastructure and the actual chargers, including step-down transformers, electric service panels, conduits, wires, and other equipment. These make-ready costs are typically a large percentage (about 30 to 40 percent) of the capital costs of charger installation.[23]

Incentives would reduce the upfront costs of adopting an electric vehicle fleet. Interviewees recommended communicating with utilities from the beginning to understand available incentives. The Postal Service is currently assessing incentive offerings and associated requirements.

23 Chris Nelder and Emily Rogers, "Reducing EV Charging Infrastructure Costs," RMI, December 2019, https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/.

A related issue is the potential for the Postal Service to take advantage of subscription rates for electricity. This is a relatively new innovation in electricity pricing, but utilities in California have explored subscription charges to reduce demand charges for electric fleets.[24] For example, one utility offers two electric vehicle rate plans for business customers with on-site electric vehicle charging. These plans combine a customizable monthly subscription charge with a time-of-use rate to help fleets save money. The monthly subscription charge is chosen based on the maximum electricity consumption for chargers.[25] The Postal Service can benefit from identifying areas where subscription rates are available and could consider whether the potential cost savings make them especially well-suited to implementing electric delivery vehicles.

Prioritizing Implementation of Electric Vehicles

The Postal Service may benefit from prioritizing electric vehicle implementation where there is the highest likelihood that electric vehicles would achieve cost savings over gas-powered vehicles. For example, implementing electric vehicles at a delivery unit that has longer-than-average delivery routes in a state with higher gas prices could make economic sense for the agency. The OIG's total cost of ownership model projects that rolling out 1,000 electric vehicles on routes in California that have an average length of 30 miles (compared to the USPS national average of 24 miles) would yield a 4.9 percent cost reduction over 20 years compared to deploying gas-powered vehicles on the same routes.

There are also some sites that may be better suited for electric vehicle charging infrastructure installation than others. Locations that have a dedicated vehicle parking lot or depot are preferable to sites that rely on on-street parking. Sites with existing adequate electrical infrastructure to support charging are better suited for electric vehicle chargers, as it can be costly to retrofit parking spaces. Places that do not have any grid capacity constraints are better suited for electric vehicle charging as they do not require expensive power upgrades. Locations where the power utility offers incentives for installing charger infrastructure are more appealing for electric vehicle implementation. The Postal Service can consider these factors in prioritizing which facilities should receive electric vehicles in the early years of the NGDV rollout. Other sites may become more cost effective in later years as the cost of infrastructure may decrease.

Deployment of Electric Vehicles by Foreign Posts, U.S. Shipping and Logistics Companies, and the Federal Government

The Postal Service would not be the only delivery provider to use electric delivery vehicles — foreign posts and private companies have already begun acquiring and operating electric fleets. Some U.S. federal government agencies are also acquiring electric vehicles. These fleets are different from Postal Service delivery vehicles in significant ways, but their experiences may be informative for the Postal Service.

Foreign Posts

Germany's Deutsche Post DHL (DPDHL) and France's La Poste currently operate two of the largest electric delivery fleets in Europe. Both have experimented with electric vehicles for years, and both plan to continue electrifying their fleets to meet sustainability goals. These foreign posts process a mix of letters and packages different than that of the Postal Service, and their electric, van-size, left-hand drive vehicles are generally not used for curbside deliveries. In addition, gasoline prices in Germany and France are higher than in the United States.

Deutsche Post DHL

DPDHL plans to electrify 60 percent of its last-mile fleet by the end of 2030 and aims to achieve zero-emissions logistics by 2050. As of October 2021, more than 20 percent of its delivery vehicle fleet was already electric.[26] By 2025, the fleet

24 Herman K. Trabish, "PG&E, SCE, SDG&E pursue subscriptions, time-of-use rates to drive more California EVs," *Utility Dive,* January 23, 2019, https://www.utilitydive.com/news/pge-sce-sdge-pursue-subscriptions-time-of-use-rates-to-drive-more-cali/545907.

25 Pacific Gas & Electric, "Business Electric Vehicle (EV) rate plans," https://www.pge.com/en_US/small-medium-business/energy-alternatives/clean-vehicles/ev-charge-network/electric-vehicle-rate-plans.page.

26 According to an interview with a DPDHL representative, about 20,300 vehicles out of roughly 100,000 vehicles (including subcontractors) in its fleet were electric. This total did not include an additional 15,000 e-bicycles and e-trikes (three-wheeled electric powered cargo bikes).

is projected to include 37,000 electric vehicles, and DPDHL plans to purchase thousands of additional smaller electric vehicles.[27]

DPDHL's StreetScooter electric vans can travel up to 22 miles a day — similar to the average route length for USPS delivery vehicles — and have a lifespan of eight to 10 years.[28] DPDHL electric vehicles are used for mail and parcel services directly to customers rather than curbside deliveries. StreetScooter electric vehicles typically carry 100 to 120 parcels — and more during the holidays — but DPDHL has been interested in bigger payloads to accommodate the recent rise in parcel volume. Initial prototypes of the new StreetScooter Gigabox are projected to hold 240 parcels in its 12-cubic-meter compartment.[29]

Each StreetScooter electric vehicle has its own 3.7-kilowatt level 2 charger, which delivers only the amount of power needed to fully charge the vehicle overnight. For an example of a Deutsche Post DHL electric vehicle and its overhead charger, see Figure 8. Direct current fast chargers are available but are only used for larger trucks.

Installing charging infrastructure at DPDHL facilities can take six to eight months, but electrification can take as long as three years if it involves complications (such as a need to obtain approval from the local government). DPDHL had power grid issues when it first installed charging infrastructure but began deploying teams to depots to estimate seasonal energy demand. With this knowledge, DPDHL has employed a dynamic load balancing system to allocate the needed energy per vehicle, which avoids overextending the grid.

Figure 8: Deutsche Post DHL Electric Vehicle

Source: Deutsche Post AG.

La Poste

La Poste instituted a plan to begin replacing its vehicle fleet with electric vehicles when an eight-vehicle pilot in late 2005 proved to save money and deliver higher job satisfaction for drivers. The transition to electric vehicles was accelerated by government policies limiting access to cities for commercial vehicles with internal combustion engines. Almost 38,000 of La Poste's fleet of 90,000 vehicles were electric as of November 2021.

La Poste's electric fleet includes cars, bicycles, three-wheelers, and quads.[30] While the smaller vehicles are used in curbside deliveries for shorter distances

27 Automotive World, "Deutsche Post and DHL on the Road to Zero Emissions in Germany," *Automotive World,* April 22, 2021, https://www.automotiveworld.com/news-releases/deutsche-post-and-dhl-on-the-road-to-zero-emissions-in-germany/.

28 Deutsche Post DHL bought a startup called StreetScooter in 2014 when it was unable to find an original equipment manufacturer that was willing to build a vehicle for the post. DPDHL's electric vans include the StreetScooter WORK Box, the StreetScooter WORK L Box, and the new StreetScooter Gigabox. DPDHL sold StreetScooter's production rights to another company in January 2022.

29 Automotive World, "Deutsche Post and DHL on the Road to Zero Emissions in Germany," *Automotive World,* April 22, 2021, https://www.automotiveworld.com/news-releases/deutsche-post-and-dhl-on-the-road-to-zero-emissions-in-germany/.

30 Two-thirds of La Poste's bicycle mail carriers use e-bikes, which have a range of 12 miles, and whose electrical assistance can supply more than 80 percent of the power required to operate it. Electric tricycles are used to deliver and collect mail and small goods in city centers, suburbs, and rural areas. They have a range of 22 miles and can transport nearly twice as many letters and parcels as a scooter. Electric quads are used in cities, suburbs, and pedestrian areas closed to ICE vehicles. They have a range of 16 miles and can transport up to 330 pounds of mail and parcels and are poised to replace motorized two-wheelers and, in some cases, gasoline-powered four-wheelers.

(usually within cities), electric cars are used to deliver parcels and cover longer routes. La Poste's electric cars have a range of 44 miles and a load volume of three to four cubic meters. For examples of its fleet, see Figure 9.

Figure 9: La Poste Electric Vehicles

Source: La Poste-Vehiposte

La Poste made a large investment in chargers between 2000 and 2012 and is equipping every major city in France with charging stations. Electric delivery vehicles charge overnight, with one charger able to charge two to three vehicles at once. To optimize charging costs, a smart management system shifts electric consumption to off-peak hours.

Private U.S. Carriers

UPS has deployed hybrid and electric vehicles since 2000, and FedEx experimented with electric vehicles as early as 1994. Both FedEx and Amazon have pledged to be carbon-neutral by 2040, and UPS plans to be carbon-neutral by 2050. These carriers' vehicles generally drive longer distances between stops than the Postal Service's delivery vehicles, and the carriers generally do not require right-hand drive vehicles, which the Postal Service considers essential for curbside delivery. UPS, FedEx, and Amazon are all working with — and sometimes even investing in — electric vehicle manufacturers to assist in electrifying their delivery fleets. Currently, these private fleets still include a combination of gasoline- and diesel-powered vehicles.[31]

Amazon, for instance, has a 20 percent stake in Rivian, which plans to produce 10,000 custom-made electric vehicles for Amazon by the end of 2022 and an additional 100,000 vehicles by 2030. Amazon began testing Rivian's electric delivery vans in early February 2021.[32] UPS, which already had approximately 1,000 electric and hybrid electric vehicles in its fleet, announced a minority investment in Arrival, a UK-based company. UPS ordered 10,000 custom-built electric vehicles from Arrival for use in the UK, Europe, and North America.

FedEx is working with several different manufacturers and suppliers. FedEx received the first five out of a total of 500 electric vans from BrightDrop, a General Motors subsidiary, in December 2021. BrightDrop's EV600 has more than 600 cubic feet of cargo space and has a stated range of 250 miles.[33] At the same time, 35 FedEx Ground independent service providers have purchased 120 electric vehicles from another supplier. FedEx has also reserved 20 forthcoming electric semi-trucks from Tesla.

31 In 2018, for example, Amazon announced an order of 20,000 diesel Sprinter vans from Mercedes-Benz.

32 While Amazon has "exclusive rights to the delivery van for four years after Rivian provided the first batch," Rivian has recently stated it would "start taking orders for its electric delivery vans in 2022" and would "deliver them to fleet customers in early 2023." For more information, see: Steven Loveday, "Rivian All-Electric Amazon Delivery Vans Testing on Detroit Roads," *InsideEVs,* July 30, 2021, https://insideevs.com/news/523588/rivian-amazon-delivery-can-michigan/ and Sean O'Kane, "Rivian Will Start Selling Electric Vans to Non-Amazon Companies in 2023," *The Verge,* November 8, 2021, https://www.theverge.com/2021/11/8/22765853/rivian-fleet-sales-amazon-exclusivity-van-r1t-r1s.

33 For more information on FedEx's newest trucks, see: Caleb Miller, "FedEx Receives First Electric Vans from GM's BrightDrop Venture," *Car and Driver,* December 21, 2021, https://www.caranddriver.com/news/a38573183/fedex-electric-vans-general-motors/.

Carriers reported that electric vehicle deployment timelines were long, especially for vehicles that required customization. Interviewees recommended talking with manufacturers two to three years ahead of their expected deployment time.

Two carriers interviewed for this paper stated that they use level 2 chargers for overnight charging and one or two direct current fast chargers for emergency use. Both companies planned to utilize a ratio of one vehicle per charger. One company decided to use larger electric batteries than their modeling had initially suggested to ensure enough charge for a single day.

As one carrier began to deploy electric vehicles on its routes, it found it could minimize infrastructure costs by electrifying many vehicles at one facility rather than spreading vehicles across many sites. Another carrier deployed older trucks to shorter routes — such as routes in urban areas — to minimize maintenance costs and maximize potential cost savings for electric vehicles, which are more cost-effective on longer routes.

Federal Government Agencies

The General Services Administration's (GSA) fleet division supplies vehicles and infrastructure for the fleets of most federal agencies, although not that of the Postal Service. In 2020, GSA reported that there were more than 657,000 vehicles in the government fleet. Of these vehicles, 3,170 were electric (0.5 percent), and 29,052 were hybrids (4.4 percent).[34] Current federal electric vehicle fleets are primarily comprised of sedans and other light-duty vehicles. The federal fleet also includes electric buses and vans.

The Department of Energy and Department of Homeland Security have been early adopters of electric vehicles, and the National Park Service is experimenting with making its charging infrastructure available to the public. In general, most federal electric vehicles require level 1 and level 2 chargers and are either sold at auction after seven years or returned to their original equipment manufacturer at the end of their lease.

Conclusion

As the Postal Service prepares to acquire a new delivery fleet, electric vehicles may be a good option for deployment on many postal routes. Operating many of these vehicles would have important environmental benefits, decreasing the Postal Service's carbon emissions and encouraging growth in the electric vehicle market in the United States. The agency can, as it has in the past, take a leading role in advancing the adoption of new transportation technology. Foreign posts and private companies have already incorporated electric vehicles into their fleets, demonstrating that the technology is currently viable for a variety of uses. As the technology has evolved, there is no longer any question that electric vehicles can serve the functions necessary for postal delivery.

Postal management has acknowledged the benefits of electric vehicles and indicated a willingness to buy a large number if possible. The upfront costs of these vehicles and related charging infrastructure are a potential obstacle to acquiring them for the postal fleet. Congressional assistance for purchasing the vehicles may be possible; in addition, local incentives are available in some areas to help cover the costs of acquiring and installing chargers. Either of these forms of assistance would make the cost-benefit analysis of owning and operating electric vehicles more appealing for the Postal Service. It is important to note that electric vehicle technology is rapidly advancing, and current cost projections may look very different in a few years, strengthening the case for electric vehicle adoption.

The OIG's total cost of ownership model projects that electric vehicles are likely to be more affordable to own than gasoline-powered vehicles in certain cases, even in the absence of any financial incentives. There is considerable variation among delivery routes, and many factors (such as route length, local energy prices, and the ratio of chargers to vehicles) can make a route either more or less suitable to electric vehicle deployment. For the Postal Service, there is value in targeting the rollout of electric vehicles to specific locations.

34 For more information on these vehicles, see: Office of Governmentwide Policy, "Federal Fleet Open Data Visualization," https://d2d.gsa.gov/report/federal-fleet-open-data-visualization.

Summary of Management's Comments

Management noted that the OIG's analysis had many parallels with its own findings and conclusions but asserted some information in the white paper needed correction.

Management stated that the NGDV contract provisions had not been correctly reflected in the white paper. They assert that the contract is limited to supporting the non-recurring engineering and tooling development related to production of NGDVs and is actively in process. They also note that no delivery orders have been placed and that no delivery vehicles have been purchased yet.

Management asserted that the OIG incorrectly represented electric battery usage. Management believes the OIG's reference to 20 percent of a battery's charge being required for an average route accounts only for street mileage and not for other uses of battery power. Management also stated that the idea that some vehicles may not need to be charged every day is incorrect and based on an erroneous data point.

Management stated that the impact of the drive cycle of delivery vehicles is not assessed within the OIG's Total Cost of Ownership (TCO) modeling analysis, nor was it considered in the assessment of long-term maintenance requirements. They believe that characteristics of the postal delivery drive cycle make it challenging to compare their needs with those of other delivery providers.

Management asserted that the OIG does not acknowledge the important impact of battery conditioning and the value of keeping vehicles connected to dedicated chargers to keep battery temperature in the optimal range. They stated the OIG does not address how to maintain operational flexibility in the absence of fully charged vehicles. Management stated that the OIG was recommending a 50-50 ratio of level 1 and level 2 chargers without rationale. Management objected to the use of cost data for basic level 2 chargers in the TCO analysis and stated that the use of level 2 chargers eliminated the potential for the Postal Service to actively manage costs and to gain battery life benefits associated with smart chargers.

Management stated that the $7,300 hardware cost figure used by the OIG reflected the installed hardware costs alone and did not include the make-ready costs for comparison to Postal Service costs. They further stated that associated make-ready costs were significantly under-estimated and other comparable installation cost data were not provided in the white paper.

Lastly, Management requested incorporation of their response to the EPA letter where the OIG refers to and incorporates references to content from the EPA's letter.

See Appendix B for management's comments in their entirety.

Evaluation of Management's Comments

The OIG appreciates managements comments and provides the following response and/or clarification. Based on our responses, we have concluded the white paper does not require any further revisions.

Regarding postal management's assertion that the OIG's white paper inaccurately describes the NGDV contract's provisions, the OIG maintains our description is accurate. The description reflects the Postal Service's own statements about the NGDV contract, such as the February 2021 news release in which the Postal Service described it as a contract "to manufacture" new delivery vehicles and stated that the supplier "will assemble 50,000 to 165,000" of these vehicles. The distinction between a contract to fund the engineering and development necessary for the production of NGDVs and the actual orders for specific numbers of these vehicles is not substantive for the purposes of the OIG's white paper. The paper makes clear that the Postal Service has not yet submitted an order for production and delivery of any NGDVs.

Regarding management's comments related to battery usage, the OIG obtained that information from a document produced by the Postal Service. Specifically, the Postal Service's Environmental Impact Statement states: "The BEV NGDV would be expected to discharge around 20 percent of battery capacity under average conditions because of the low average delivery route mileage." The OIG acknowledges that many factors can affect the amount of battery charge depleted on a delivery route and believes the white paper clearly depicts those factors.

Regarding management's objection to the OIG's discussion of the potential for some delivery vehicles to not require daily charging, the Postal Service acknowledged this possibility in its Environmental Impact Statement: "This would limit battery degradation and may not require charging every day."[35]

Regarding management's assertion that the OIG's white paper and TCO model does not fully account for the unique conditions of postal delivery vehicles' drive cycle, the OIG believes its white paper acknowledges those unique conditions and explains that other delivery providers' fleets experience different conditions. The OIG's TCO model derives projections for the cost of owning and operating vehicles using, among other things, publicly available fuel and electricity cost projections and per-mile maintenance cost data for trucks and vans of similar size to postal delivery vehicles.

Regarding management's comments about battery conditioning, the types of electric vehicle chargers available, and the ratio of chargers to vehicles, the OIG emphasizes the white paper is intended to examine potential implementation considerations and inform discussion of these topics. The TCO model's projections involving factors like charger-to-vehicle ratios and charger mix are intended to demonstrate how those factors can affect TCO. They are not intended to recommend any particular set of choices. Management's criticisms of the OIG's recommendations are not applicable because the OIG does not make recommendations in this white paper. The white paper makes clear that its purpose is to explore the potential benefits to the Postal Service of adopting electric delivery vehicles and to raise possible challenges related to implementation. Further, the white paper acknowledges that the Postal Service has operational considerations that may impact its decisions on the proper number, type, and mix of chargers to deploy. Regarding management's specific concerns about battery conditioning, the OIG believes its white paper clearly states that battery conditioning may be a relevant factor in decisions about deployment of electric delivery vehicles. Management recognized that the OIG chose to use basic level 2 chargers in its baseline TCO projections rather than managed "smart" chargers. The paper states that managed charging will likely be appropriate for at least some postal facilities, but the OIG did not include smart chargers in its baseline projection to simplify the model.

Regarding management's concerns about the OIG's presentation of make-ready costs, it should be noted that make-ready costs for electrical work are included in the charger equipment and installation cost projections. It is therefore incorrect to state that the OIG's projections do not include make-ready costs. The OIG acknowledges that its projections of charger equipment and installation costs differ from the Postal Service's own estimates and that the Postal Service considers these to be underestimates.

Finally, regarding management's request that the OIG's white paper include information about the Postal Service's response to the EPA in sections where the OIG references the EPA, the OIG draws attention to the fact that the white paper's refences to the EPA's letter to the Postal Service include a link to the same source (https://uspsngdveis.com/) that management cites in its comments letter. The source is included in the footnotes as the "Environmental Impact Statement," which was the name of the document at the time the OIG's white paper was finalized. The name of the document has since changed to the "Record of Decision," but readers of the OIG's white paper can still access the Postal Service's response to the EPA's letter through the same link.

35 USPS, "Environmental Impact Statement", December 2021, https://uspsngdveis.com/documents/USPS%20NGDV%20Acquisitions%20NEPA%20Record%20of%20Decision_2.23.22.pdf, p. 3-2.

Appendices

Click on the appendix title below to navigate to the section content.

Appendix A: Additional Information

Objective(s), Scope, and Methodology

The objective of this white paper was to identify opportunities and challenges for the Postal Service in moving to an electric vehicle delivery fleet. Sub-objectives included: (a) assessing the suitability of using electric vehicles as postal delivery vehicles; (b) analyzing the potential long-term cost savings of a new, electric delivery vehicle compared to a new, gas-powered vehicle; and (c) benchmarking the electric vehicle experiences of other federal agencies, foreign posts, and companies in the logistics and shipping sector.

The scope of this white paper was to examine currently available electric vehicle technology. The OIG did not include speculation on what technology will be available to the Postal Service in the future. We focused on delivery vehicles that might replace long life vehicles (LLV) and not on other types of postal vehicles such as short-haul tractor-trailers.

To meet our objectives, the OIG conducted secondary research of academic studies, company reports, published books, and other relevant sources. In addition, the OIG conducted a total of nine interviews with persons familiar with the electric vehicle sector and/or the application of electric vehicles for postal, logistics, and shipping uses. The OIG also interviewed Postal Service personnel familiar with USPS's analysis and procurement process for electrifying the postal fleet. The full list of interviews follows:

- A professor at the Indiana University School of Public and Environmental Affairs;
- The Policy Director of Zero Emission Transportation Association;
- Representatives of the Department of Energy;
- The Director of the METRANS Transportation Consortium;
- The Vice President of Clean Ops Technology Center at Deutsche Post DHL;
- Representatives of the General Services Administration;
- The Program Manager of Technology Integration at the National Clean Fleets Partnership;
- A Procurement Analyst for GSA's Public Building Services;
- The Manager for Americas, Africa, and Middle East at La Poste;
- Representatives of two private carriers (via a contractor); and
- Postal Service personnel familiar with USPS's analysis and procurement process for electrifying the postal fleet.

In addition, the OIG contracted with ICF to build a Total Cost of Ownership model projecting the potential cost savings to the Postal Service of procuring and operating an electric delivery vehicle versus a gas-powered vehicle. ICF also prepared research notes and conducted interviews to supplement the OIG's research.

We conducted our research in accordance with the Council of the Inspectors General on Integrity and Efficiency's Quality Standards for Inspection and Evaluation. We discussed our observations and conclusions with management on February 15, 2022, and included their comments where appropriate.

Prior Coverage

Report Title	Objective	Report Number	Final Report Date	Monetary Impact
Delivery Vehicle Acquisition Strategy	To assess the U.S. Postal Service's acquisition strategy for delivery and collection vehicles.	19-002-R20	8/12/2020	$0

Appendix B: Management's Comments

UNITED STATES POSTAL SERVICE

March 7, 2022

JENNIFER MYKIJEWYCZ
DIRECTOR, OPERATIONS CENTRAL
RESEARCH AND INSIGHTS SOLUTION CENTER

SUBJECT: Management Response: Electric Delivery Vehicles and the Postal Service – White Paper (2021RISC012)

Thank you for the opportunity to review and comment on the Office of Inspector General's (OIG's) white paper: *Electric Delivery Vehicles and the Postal Service*.

The Postal Service is pleased to note that the OIG's independent analysis resulted in many parallels in the findings and conclusions that each of our organizations separately reached, and we are appreciative of our ongoing dialogue throughout the white paper development process. Several of the suggestions proposed align with work the Postal Service already has underway or completed in support of the NGDV program.

There are some items within the white paper that the Postal Service believes need to be corrected or further addressed within the document and recommendations. Each item was noted during the recent exit conference and in written summary of these key feedback points provided on the day of the conference. And while some items were acknowledged and addressed in the most recent white paper, several were not and may materially affect the outputs of the analysis and recommendations.

The Postal Service supplied a document with detailed comments throughout the white paper document accompanying the Management Response. Following is a high-level summary of the items that need to be corrected or perhaps revised in the white paper document.

- *NGDV Contract*: USPS' NGDV contract provisions have not been correctly reflected in the white paper document. Both the executive summary and page 2 of the document indicate that the Postal Service has issued a contract to "produce and deploy" or for the "manufacture of NGDVs". This is not fully correct. The Postal Service issued a contract for NGDVs in February 2021. The initial task order is limited to supporting the non-recurring engineering and tooling development, and is actively in process. The manufacturing and deployment of vehicles will occur once the USPS issues a delivery order against the master contract for vehicles. As of this date, no delivery orders for vehicles have been issued, nor have vehicles been purchased. Given the

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sensitivity of this issue, the Postal Service respectfully requests that the OIG correct this mischaracterization of the contract and its status.

- *Battery usage assessment*: the white paper incorrectly represents assertions regarding battery usage noted on page 5, stating that only 20 percent of the battery is required on an average route. This is incorrect and insufficient. As covered during discussion, the 20 percent figure is a representation of the battery usage required to support only the street mileage for an average route; however, this does not include "street time" where the vehicle is using energy, but not moving or accruing street miles. This value also ignores all the other vehicle systems that draw energy while the vehicle is in use. The 20 percent figure is NOT a reflection of battery usage requirements for day-to-day operations The energy needed for driving/route mileage and street time is expected to draw 40% of the battery vehicle demand on any given day. The remaining 60% of the daily battery usage is required to support HVAC systems (heating, AC, defrosting), and on-board accessory systems (such as blinkers, headlights, cameras and sensors, safety strobe lights, cabin controls, etc.). The 20 percent value represented on page 5 grossly under-represents the actual daily energy usage requirement. The paper further asserts that vehicles do not need to be charged every day, based on this erroneous data point, and purports that less chargers are required. This is also incorrect. The Postal Service respectfully requests that this erroneous information on battery demand and associated charging requirements be corrected.

- *USPS drive cycle*: the drive cycle for USPS delivery vehicles is very distinct from other vehicles and use cases. With 600 or more stop-and-starts given the requirements at each delivery point, and very short driving distances between stops, 6-7 days per week year-round, the drive cycle is much more demanding on vehicle systems, and results in greater maintenance requirements over time. No other service or delivery provider puts this kind of daily repetitive stress on their vehicles, so it is challenging to compare our needs with those of other providers. The white paper notes the USPS drive cycle on page 3, but its impact is not assessed within the OIG's Total Cost of Ownership (TCO) modeling analysis, nor was it considered in the assessment of long-term maintenance requirements. Though the model conclusions are directionally correct, it would be useful to note that the USPS drive cycle was not considered in the modeling outputs.

- *Charger ratios*: the white paper suggests that the Postal Service reduce vehicle-to-charger ratios to support reductions in installation costs. The Postal Service will work actively to moderate costs where possible; however, this recommendation ignores several key variables that should be corrected:

    - *Battery conditioning* – on page 5, the white paper specifically notes energy for cabin conditioning, but does not acknowledge the vital and perhaps more important impact of battery conditioning. By keeping vehicles connected to dedicated chargers, it is possible to keep the battery temperature in the optimal temperature range, thereby

prolonging battery life, without compromising battery range on the street. In climates where the temperatures regularly fall outside of the optimal range, decreasing the charger ratio compromises long-term battery life, and results in reductions in battery range on the street, both negative consequences of reducing the charger ratio.

- *Operational flexibility* – on page 12, the white paper acknowledges the Postal Service's need for flexible use of vehicles for changing operational demands, but does not address how to maintain this flexibility (or associated costs) in the absence of fully-charged vehicles.

- *Level 1 chargers* – on page 12, the white paper suggests a 50-50 ratio of L1 and L2 chargers, without rationale for the recommendation (but possibly a reflection of early and incorrect assertions of battery usage). The Postal Service's route-by-route assessment shows that a very small proportion of routes could be fully serviced daily with only L1 chargers.

- *Level 2 "basic" chargers* – the white paper notes its use of the cost data for *basic* level 2 chargers in the TCO analysis; however, neither L1 or L2 basic chargers have the ability to manage user authentication, the ability to manage charging across multiple vehicles within a given site, or the ability to manage peak electrical demand charges. Though both L1 and basic L2 options are cheaper to acquire than a Level 2 *smart* charger, they eliminate the potential for the Postal Service to actively manage these costs over the coming decades and associated battery life benefits of managed charging through smart chargers. The white paper does not point to other fleet applications or examples using basic chargers, so there is little supporting rationale for this recommendation beyond acquisition cost differentials.

- *"Make Ready" costs* – the white paper more or less correctly describes what is included in "make ready" costs – essentially all other site preparation costs needed to be able to plug in and operate the EVSE system. In the Postal Service's experience, these costs represent more than 60% of the costs associated with deploying charging systems. However, the $7,300 hardware cost noted on page 13 of the white paper reflects only the installed hardware costs alone, and does NOT include the make-ready costs for comparison to Postal Service costs. A Procurement IQ report (a market intelligence source for procurement professionals) on EV Charging Equipment from April 2021 shows the average cost of charging hardware and installation "at the post" is $7,455. This cost does *not* include the site prep and make-ready costs. The white paper significantly under-estimates these associated costs, and didn't provide other comparable installation cost data to support this conclusion, and it should therefore be corrected.

- *EPA references* – there are two sections of the white paper that refer to the EPA's recent letter to the Postal Service, on pages 3 and 7. The Postal Service requests that where the OIG refers to and incorporates references to content from the EPA, that the white paper incorporate the Postal Service's response to this letter, via the Record of Decision, found at this link: US POSTAL SERVICE (uspsngdveis.com)

We appreciate the opportunity for input, and look forward to receiving a copy of the OIG's TCO model.

E-SIGNED by SCOTT.R BOMBAUGH
on 2022-03-07 11:56:37 CST

Scott Bombaugh
Chief Technology Officer and Executive Vice President

cc: *Manager, Corporate Audit Response Management*

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1735 North Lynn Street
Arlington, VA 22209-2020
(703) 248-2100

For media inquiries, please email
press@uspsoig.gov or call 703-248-2100