U. S. POSTAL SERVICE
OFFICE OF INSPECTOR GENERAL

U. S. Postal Service

Electrification of Delivery Vehicles

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EXECUTIVE SUMMARY

With a large geographically dispersed vehicle fleet and short delivery routes, the Postal Service makes a particularly interesting national laboratory for testing technological advancements of electric vehicles (EVs) sought by the President through the Department of Energy (DOE). The Office of the Inspector General (OIG) conducted this study on the feasibility of EVs[1] in the Postal Service in response to a request from Congressman José E. Serrano, Chairman, Subcommittee on Financial Services and General Government, Committee on Appropriations. The primary objective of the study was to assess the operational and economic feasibility of moving the Postal Service's delivery fleet to electric vehicles. In summary, use of electric vehicles for Postal Service deliveries is operationally feasible and could provide a valuable opportunity for the nation to test EV technology. Due to the Postal Service's current financial distress, government funds and vehicle to grid (V2G) revenue would likely be needed to make this transition economically feasible.

Operational Feasibility of Electric Vehicles

An EV is an alternative fuel automobile that uses an electric motor for propulsion, in place of more common propulsion methods such as the internal combustion engine. EVs are commonly powered by on-board battery packs, and as such, are referred to as battery electric vehicles.

Our evaluation determined that broad use of EVs in the Postal Service delivery fleet would be operationally feasible. Current EV technology would work well with the average mail delivery driving distance of approximately 18 miles per day. Previous delivery operations tests under favorable environmental conditions within California have shown that the EV performance levels were adequate for mail delivery ranges of up to 40 miles a day and battery technology has advanced considerably since then resulting in significantly increased driving distance ranges. Only about 3 percent of the delivery fleet has driving distances that exceed that daily distance.

Because the government is currently making investments to advance battery technology, we suggest the Postal Service phase in any electrification of its fleet so it can capture future benefits before broad implementation. One area that should be further explored is how effectively EVs operate under adverse environmental conditions, such as very low winter temperatures.

[1] One type of EV is the Battery Electric Vehicle. We focused on Battery Electric Vehicle purchases in this paper because battery ranges cover the vast majority of delivery routes.

Opportunity to Demonstrate Vehicle to Grid Technology

V2G technology establishes a system in which battery stored electricity or capacity can be sold to power wholesalers when electric vehicles are "plugged-in" or not in use for mail delivery. Alternatively, when vehicle batteries need to be fully charged, electricity from the power grid can charge the battery. Since most of the Postal Service's 146,000 delivery vehicles are parked from approximately 5:00 p.m. to 8:00 a.m., the agency could use their batteries as grid regulators when they are plugged into the grid. This would stabilize the electrical grid and, as a result, wholesalers who coordinate the movement of electricity would be willing to pay fees for regulation services.

Currently, about 20 percent of the Postal Service delivery fleet is in an area which offers V2G. Our discussions with industry leaders during this project indicate that in the next 2 to 5 years, there will be additional opportunities for V2G in other areas of the country as stimulus funding encourages this type of smart grid application. As such, the Postal Service should test and deploy EVs in geographical areas that offer V2G.

Economic Feasibility of Electric Vehicles

The Postal Service's difficult financial condition requires it to prioritize limited capital funds available. The Postal Service expects capital investments to generate a high return and have a short payback period – at least thirty percent and fewer than three years, respectively. We measured four economic scenarios for using electric vehicles in delivery operations. One of the four scenarios offers an opportunity to generate a high return in a short period. In this scenario, electrification of the Postal Service delivery vehicles can occur if the agency obtains significant federal government funds. The other scenarios become economically attractive if technology costs decline, additional funds are obtained, or the Postal Service's financial situation improves.

Chart 1 provides the economic outcomes for purchasing[2] 3,000 delivery vehicles. It shows that without assistance or V2G revenue the Postal Service would not realize its required rate of return. If, however, the upfront capital cost is overcome by participation in DOE-funded demonstration programs and V2G revenue is captured, the return increases to 63.2 percent with the agency breaking even within the first 2 years that EVs are in operation.[3] Funding specifically targeting Postal Service mail delivery vehicles would likely be necessary to create an economic environment that provides incentives for the Postal Service to move into a leadership position with EV technology.

[2] We assumed the Postal Service's approach would be to purchase new electric vehicles rather than convert existing delivery vehicles to electricity, due to the age of the delivery vehicles.
[3] We estimated $15,500 is eligible for DoE funding (50 percent of total costs less battery costs).

Chart 1. Economic Outcomes – 3, 000 Vehicles

Decision Year	0	1	2	3	4	5	6	7	8	9	10	Total
Postal Service Purchases and Maintains Vehicles, Without Government Funds or Grid Revenue [4] Payback > 10 Years IRR = -1%	($76.4)	$8.6	$8.7	$8.8	$8.9	($10.1)	$9.1	$9.3	$9.4	$9.5	$9.6	-($4.5)
Postal Service Purchases and Maintains Vehicles, Without Government Funds But Generates Grid Revenue Payback = 5 .6 Years IRR = 15.3%	($69.5)	$15.5	$15.6	$15.7	$15.8	($3.2)	$16.1	$16.2	$16.3	$16.4	$16.6	$71.6
Postal Service Purchases and Maintains Vehicles With Available DoE Program Grants Payback = 5.5 Years IRR = 19.9%	($29.9)	$8.6	$8.7	$8.8	$8.9	($10.1)	$9.1	$9.3	$9.4	$9.5	$9.6	$42
Postal Service Purchases and Maintains Vehicles with Grid Revenue, and DoE Program Grant Payback < 2 Years IRR = 63.2%	($23.0)	$15.5	$15.6	$15.7	$15.8	($3.2)	$16.1	$16.2	$16.3	$16.4	$16.6	$118
Decision Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**

****The internal rate of return (IRR) is a rate of return used in capital budgeting to measure and compare the profitability of investments.**

[4] Dollars in millions.

I. BACKGROUND

EVs have been around for more than 100 years but have not become part of mainstream transportation because of cost and distance limitations. Today, EV technology offers promising opportunities to not only save on gasoline costs but also to manage recharging of electrical fleets remotely and reduce maintenance costs and carbon footprints while generating revenue from the power grid.

Postal Service Current Fleet

The U.S. Postal Service's current fleet of more than 219,000 vehicles includes approximately 146,000 delivery vehicles,[5] the vast majority called long-life vehicles (LLVs). LLVs were produced as early as 1987 and average about 10 miles per gallon.[6] The vehicles are right-hand drive, because drivers deliver numerous mailpieces to curbside mailboxes, typically driving in the direction of prevailing traffic.

Illustration 1 – Long-Life Vehicle

The age of Postal Service delivery vehicles range from 8 to 22 years.

Electric Vehicles

Our analysis focused on EVs that use electric motors and motor controllers instead of internal combustion engines for propulsion.[7] These vehicles use chemical energy stored in rechargeable battery packs to power the motor.

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[5] LLVs and Flex Fuel Vehicles.

[6] LLVs combine a purpose-built aluminum body built by Grumman, a General Motors chassis based on a Chevrolet S-10 pickup truck, and either a 2.2-liter engine or a 2.5-liter piston engine.

[7] Other configurations use both electric motors and an internal combustion engine (hybrids) and are not considered pure EVs because they also consume some fuel.

II. Operational Feasibility of EVs for the Postal Service

We studied the operational feasibility of current EV technology and found that large-scale use of an electric fleet of delivery vehicles within the Postal Service is feasible. A key aspect of the Postal Service's delivery fleet that makes it a good candidate for EV technology is the relatively short delivery routes that average approximately 18 miles a day. Additionally, delivery routes have regimented operating hours and centralized base locations. The stability of the operational workhours means Postal Service vehicles will be delivering mail during peak load on the electrical grid[8] and can charge at the lowest rates during off-peak hours. The delivery vehicles also require stop-and-go driving at low speeds which creates excellent opportunities for regenerative breaking to recapture energy.[9] The Postal Service delivery vehicles currently attain approximately 10 miles per gallon on average, making fuel a large expense for the Postal Service.

Previous Postal Service demonstrations of EVs have been successful. In 1995,[10] the Postal Service tested the feasibility of achieving maximum cost effectiveness for six converted electric LLVs in Merrifield, VA and Torrance, CA. The agency collected and analyzed 8 months of data and found the electric engine had a distribution of power comparable to a typical internal combustion engine with a multi-speed transmission. In another demonstration conducted in 2001 using 500 Ford EVs,[11] Southern California Edison conducted baseline performance and accelerated reliability tests for the Postal Service. The EVs met Postal Service specifications for all requirements except meeting a 50-mile distance requirement. Actual ranges achieved were up to 42 miles.

The following sections detail the most critical considerations in our analysis and identify issues that need further study during the early stages of an EV deployment.

Batteries and Charging

The battery is the single most important contributor to the cost and performance of electric vehicles, thus, it offers the greatest challenge in a large-scale EV deployment. As such, we focus much attention on the range, cost, life, warranty issues, and environmental limitations of vehicle batteries. Batteries are manufactured and priced by kilowatt hour (KWh) size and a 20 KWh battery provides about 40 miles of driving distance for electrical vehicles.

[8] Periods in a day when energy customers use maximum amounts of electricity, such as, 5:00 p.m. to10:00 p.m.
[9] Regenerative braking is a mechanism that reduces vehicle speed by converting kinetic energy into a storable form. The recaptured energy is stored for future use or fed back into a power system for use by other vehicles.
[10] *Feasibility Demonstration of an Electric Postal Delivery Vehicle*, August 1995, Section 3.
[11] *Demonstration and Evaluation of USPS Electric Carrier Route Vehicles*, December 2001, Section IV – Pg. 24.

Range Current battery technologies vary in range and cost but meet the average daily driving distance of 18 miles for mail delivery operations (see Chart 2 below for the driving distances of the delivery fleet). Further, 96 percent of driving distances are less than 40 miles per day. Electric vehicle battery companies indicate they are able to produce batteries with up to a 40-mile range and can provide range extenders if needed.

Chart 2 – Distance Ranges for Delivery Vehicles

Miles Per Day	*Delivery Vehicle Count*	*Percent of Count*
0-4	1,733	1.18%
5-9	22,379	15.27%
10-14	40,920	27.92%
15-19	36,232	24.72%
20-24	21,977	14.99%
25-29	10,486	7.15%
30-34	4,909	3.35%
35-39	2,429	1.66%
40-44	1,461	1.00%
45-50	892	0.61%
>50	2,442	1.67%
Unknown	706	0.48%
Total	146,566	100%

Source: Automated Vehicle Utilization System October 2008-April 2009

Cost Nickel Metal Hydride and Lithium Ion are two types of batteries used in EVs, with costs ranging up to $1,500 per KWh. Manufacturers indicated that battery prices may come down over the next 2 years. We note the DOE has funded research to advance battery performance and lower costs.

Environmental Conditions/Battery Life Environmental conditions — namely temperatures and terrain — could affect performance and additional testing is needed to determine possible impacts on performance within the Postal Service fleet. For example, extreme weather conditions may affect battery life and the distance a vehicle may drive. According to Idaho National Laboratories, temperatures of 68 to 104 degrees Fahrenheit (F) are the optimal operating temperature range. Testing by Canada Post identified performance degradation at around -4 degrees F. Battery manufacturers indicated limited battery performance as low as -22 degrees F. Temperature management systems are available to control some environmental impact on batteries; however, these systems draw energy and will affect the distance expected from the batteries. Postal Service testing of these extremes would identify geographic limitations and further reinforces a phased-in deployment approach.

Warranty Issues Battery warranties vary among vendors and there is no consensus on how long or how much of the battery is covered under warranty. As such, standards are still evolving including those covering the impact of V2G on battery life. For example, some manufacturers cover the entire battery under warranty while other manufacturers' warranties require the purchaser of the battery to follow operating guidelines for warranty coverage. The Postal Service would have to ensure battery warranties would address the risk of premature battery replacement and any possible effects of V2G technology to maximize expected returns.

Grade/Load As it pertains to terrain, battery performance degrades with the degree of incline in which the vehicle is used. Previous operational tests the Postal Service conducted indicated EV performance met requirements, including gradeability, set at a 25 degree incline with maximum payload. The individual routes would need to be evaluated to ensure they don't exceed gradeability.

Charging Electrical wholesalers indicated that sufficient power exists to charge electrical vehicles during non-peak demand periods. As such, Postal Service facilities would incur little or no additional power infrastructure costs. Limited analyses of several facilities supporting delivery operations corroborate the assertion that facilities are able to support electric vehicle loads during off-peak hours. However, management at each delivery installation would need to verify this assertion.

Electric Vehicle Purchase Considerations

The current LLV provides a platform specifically designed for the unique character of postal delivery services. Further, this platform has been adapted and optimized through many years of use. One option for the Postal Service would be to convert the current LLV fleet to EVs. However, the age of the current fleet (see Chart 3) would likely result in continuing increases in maintenance cost to remain operational and eventual replacement costs are expected during an EV investment period.[12]

Chart 3 – Age of Delivery Fleet

Vehicle Year	*Count*	*Percent of Total*	*Age/Years*	*Remaining Life (24 Years Purchased Life)*
87	6,818	4.65%	22	2
88	17,060	11.64%	21	3
89	17,232	11.76%	20	4
90	17,222	11.75%	19	5
91	17,716	12.09%	18	6
92	17,785	12.13%	17	7
93	18,121	12.36%	16	8
94	16,889	11.52%	15	9
00	8,170	5.57%	9	15
01	9,553	6.52%	8	16
Total	146,566	100%		

Source: Vehicle Management Accounting System

[12] *Carrier Route Vehicle Fleet – Renewal/Replacement Alternatives*, Booz Allen Hamilton, September 2005.

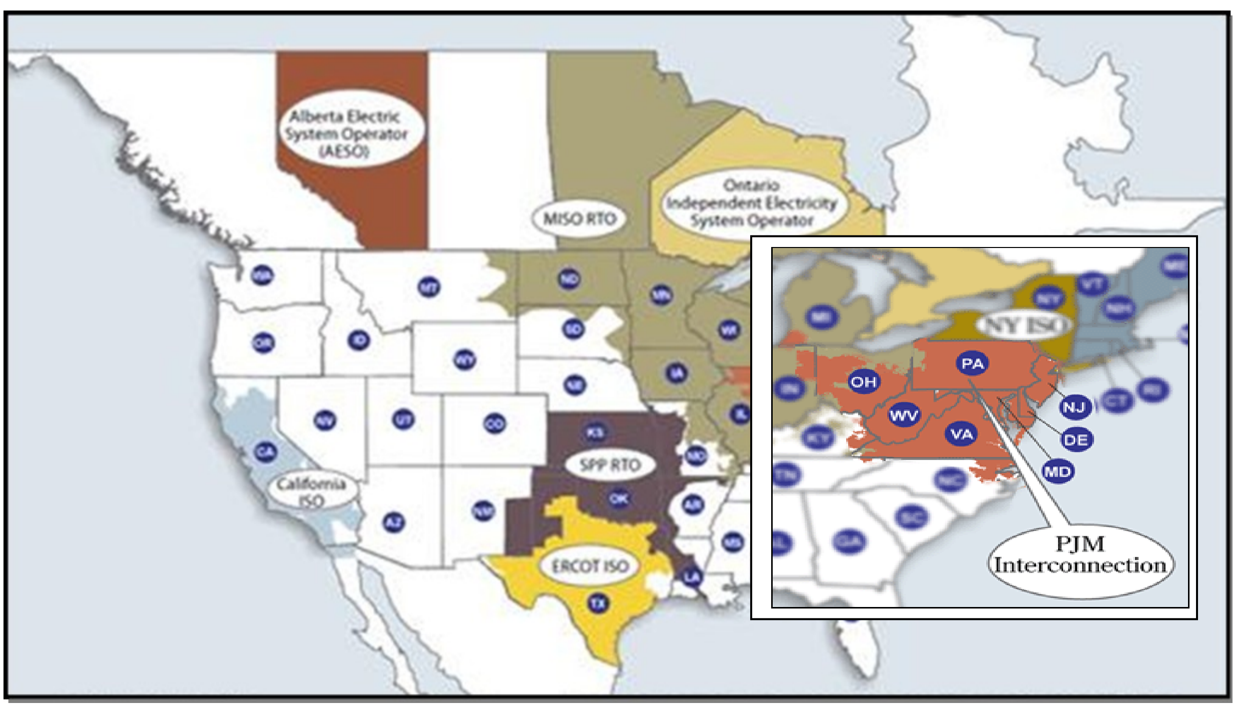
In comparison, purchasing a new EV from the outset would assure better performance in advance and would more closely align with the vehicles that EV manufacturers may be developing for general use. However, the Postal Service would need to determine whether the interior space in a new EV is suitable for mail delivery or would require alterations.

Vehicle to Grid Technology

V2G describes a system in which stored battery electricity or capacity can be sold to power wholesalers when electric vehicles are "plugged-in" or not in use for mail delivery. Alternatively, when vehicle batteries need to be fully charged, they can draw electricity from the power grid. Since most Postal Service vehicles are parked from approximately 5:00 p.m. to 8:00 a.m., the agency could use their batteries as regulators when they are plugged into the grid. Regulation helps balance minor electrical variations on the grid by correcting short-term changes in electricity use that might affect the stability of the power system. It helps match generation and load and adjusts generation output to maintain the desired frequency. As a result, wholesalers who coordinate the movement of electricity are willing to pay fees for regulation services.

The investment in EVs could present some unique revenue opportunities for the Postal Service as an early adopter of V2G technology. As presented in Illustration 2, there are a number of Regional Transmission Organizations. According to one operator, PJM Interconnection (PJM), if the Postal Service invests in EVs, it would be able to generate revenue by using battery capacity to level the electric load on its grid. Specifically, organizations would pay the Postal Service for allowing EV batteries to regulate minor fluctuations on the power grid. The Postal Service receives payments whether or not its batteries are called upon to download or upload a small amount of power.

Illustration 2. Regional Transmission



To generate grid revenue in PJM's territory, the Postal Service or an aggregator must provide, at a minimum, 67 vehicles with 1 megawatt (MW) of capacity within the grid. In PJM's territory, the Postal Service uses 30,060 LLVs to deliver mail. Chart 4 shows potential vehicle to grid revenue in PJM's territory.

Chart 4 – Revenue Opportunities Associated with Vehicle to Grid

Number of Vehicles	*Mega Watt Hour*	*Potential Annual Revenue*
67	1	$154,657
1,000	15	$2,308,320
3,000	45	$6,924,960
30,060	451	$69,388,099

Although annual V2G revenue ($2,308 per vehicle) would help defray costs of EVs in the PJM territory, other energy companies[13] indicated that V2G technology is in the research phases and would not be available for another 2 years. As such, the Postal Service should test and deploy EVs in geographical areas that offer V2G and negotiate revenue contracts accordingly.

[13] New York Independent System Operator (ISO), Midwest ISO, Southern California Edison.

III. Economic Feasibility for the Postal Service

Even with the technology advances of recent years for electric vehicles, the initial investment costs to purchase new EVs would be sizable. The Postal Service is currently in the midst of an economic crisis and does not have capital funds easily accessible to spend on such an endeavor. Thus, without extensive funding by the federal government or private entity partners, it is not currently economically feasible for the Postal Service to do a broad fleet purchase.

However, there are potential funding options that may be available for demonstrating the application of new energy saving technologies. Additionally, if the Postal Service could incorporate the use of V2G technology into an electrification effort, opportunities exist to offset these costs. This section explores a limited economic analysis of a smaller scale purchase effort. The final section of the paper explores possible funding options for the Postal Service or its partners.

Economic Impact of Purchasing 3,000 Vehicles

Because battery technology is rapidly evolving and about 6,800 LLVs are approaching the end of their service life, we believe it would be prudent for the Postal Service to phase in a limited number of EVs. This would determine whether purchasing a large fleet is possible and whether V2G opportunities are realistic to pursue. Additionally, investment requirements for a limited deployment would be lower and perhaps easier to address through grants or partnerships with industry.

Our modeling assumed a pilot investment in 3,000 EVs and, generally, the results are scalable if a larger test is desired. We analyzed four different scenarios for a purchase of existing LLVs to assess economic feasibility. Only one of these scenario meets the Postal Service's investment requirement for a high return and short payback period. In this scenario, the Postal Service would need to obtain outside funding. A summarized cash flow for this scenario is presented at the end of this section in Chart 5 and a detailed cash flow statement is provided in Appendix B.

Modeling Assumptions

The primary factors used in this economic analysis include net costs for EV purchase, operating variances, costs for charging stations, V2G revenue, and LLV replacement cost avoidance. Based on the work performed, as outlined in Appendix A, we believe that these assumptions are reasonable at this time, although future developments or breakthroughs in the EV and battery fields could impact them.

Net Costs for EV Purchase

Generally, the purchase price for a new EV is optimal when there is a commitment for a large order. In this case, the median price vehicle manufacturers provided was $40,000 per EV. Our assumption in the economic analysis is that the Postal Service could use possible government funds to assist in the purchase effort. To demonstrate the benefits of a smart grid, DOE grants provide funding for 50 percent of program costs not including battery costs. We estimated $15,500 per vehicle would be eligible for government funding. As such, net capital requirements for acquiring 3,000 EVs are estimated at $73.5 million.

Operating Variances

Operating variances are expected to provide an additional $75.2 million over 10 years. Operating variances include maintenance, fuel, replacement battery, and training and contingency factors.

Maintenance Reductions

In FY 2008, the Postal Service spent about $400 million to maintain its fleet of delivery vehicles. In our analysis, we assumed the agency could reduce current maintenance costs up to 50 percent by transitioning to EVs.[14]

Projected Fuel Savings

Industry information indicates that a reasonable assumption for gasoline costs per vehicle mile into the future would be approximately 33 cents per mile (using a rate of $3.27 a gallon) and electric costs per mile would be 5 cents — a difference of approximately 28 cents. Our analysis for a full year indicates that about $1,500 in savings per vehicle per year is possible if gasoline prices are in the $3-$4 a gallon range.

[14] This is based on Southern California Edison realizing a 50 percent maintenance reduction for its electrical vehicle fleet.

Replacement Battery Costs

Because battery life has not yet been fully tested in the Postal Service environment, we assumed a battery warranty that would cover 5 years of use, and a resulting battery replacement after 5 years, in our 10 year costing analysis. The total cost for replacing batteries is $19.1 million. As battery technology improves, costs are expected to decrease and life and range are expected to increase.

Training and Contingencies

We included $750,000 for the cost of training maintenance personnel. We also included a 3 percent factor (or $127,000) for unexpected operational contingencies.

Charging Stations

Because there is not enough capacity to charge all vehicles simultaneously at some Postal Service facilities, smart charging systems will be required to stage and monitor charging throughout the off-peak hours in those facilities. The net cost for 3,000 smart charging stations, installation, and training is about $16.8 million. The technology for charging stations is likely to improve which could result in reduced costs.

V2G Revenue

We used the data we received from PJM Interconnection to estimate the revenue potential for implementation of V2G technology in our modeling for the 3,000 test vehicles. For the V2G segment of the analysis we assumed the Postal Service would generate $76.1 million in revenue over the life of the investment. The Postal Service would need to work with PJM to assure commitment to the revenue period.

LLV Replacement Costs Avoided

We offset the EV purchase price by a replacement cost of $19,000 as the life of current delivery vehicles are expiring. A 2005 study of delivery vehicle replacement conducted for the Postal Service by an outside management consulting firm concluded that replacing the current LLV as soon as possible was the most cost effective and environmentally friendly option.

Chart 5 – Economic Outcome for the Purchase of 3,000 Battery Electric Vehicles Government Funding and Grid Revenue Realized

EV Purchase – 3,000 Vehicles		Total – Years 0-10	Upfront Capital Requirement
All-Battery (EV)			
Total purchase cost	-	$120,000,000	$120,000,000
Government Funding	+	$46,500,000	
Net Purchase Cost to Postal Service	=	$73,500,000	
Operating Variances			
Projected Fuel Savings	+	$43,254,274	
Maintenance Savings	+	$51,937,894	
Replacement Battery - *Year 5*	-	$19,106,233	
Training and Contingencies	-	$877,174	$750,000
Subtotal Operating Variances	=	$75,208,762	
Charging Stations			
Net installation Cost to Postal Service	-	$16,500,000	$16,500,000
Training	-	$250,000	$250,000
Subtotal Charging Stations	=	$16,750,000	
V2G Revenue	+	$76,164,000	
Net Cash Flow Over 10 Years	=	$61,122,762	
LLV Replacement Cost Avoidance	+	$57,000,000	
Net Amount	=	$118,122,762	$137,500,000
Present Value[15]		$70,537,585	
Internal Rate of Return		**63.2%**	

[15] Discounted at 7 percent – cost of capital plus risk factor.

IV. Postal Service as a National Laboratory for Electric Vehicle Testing

In March 2009, President Barack Obama toured a California electric car plant and announced a $2 billion grant program to develop electric vehicles. He stated, "we can remain one of the world's leading importers of foreign oil, or we can make the investments that will allow us to become the world's leading exporter of renewable energy. We can let climate change continue to go unchecked, or we can help stem it. We can let the jobs of tomorrow be created abroad, or we can create those jobs right here in America and lay the foundation for our lasting prosperity."

The Postal Service could serve as a national laboratory for testing of electric vehicles. Its position in the market place as well as its expansive delivery network provides a unique opportunity to test electric vehicles. Several factors make the Postal Service fleet an interesting national laboratory, including:

- A large vehicle fleet that is geographically dispersed for relatively short mail delivery routes. The delivery fleet is aging and the Postal Service will have to replace them to avoid excessive maintenance costs.
- High potential economic value due to off-peak charging requirements and current low miles per gallon vehicles.
- Experience with electrical vehicles in operations.

The Postal Service owns and operates the largest civilian vehicle fleet in the world including approximately 146,000 vehicles used for mail delivery. The Postal Service reaches every household in geographically diverse regions which provides for testing in many different climate and terrain conditions. Additionally, the Postal Service has a facility in most communities and EVs used as mail delivery vehicles would have high visibility in the communities they serve.

Other possible broader benefits could include creation of jobs, building strategic partnerships among industry leaders, leveraging possible emission trading changes, and influencing industry standards.

- Creation of jobs – Although there is limited quantifiable data on job creation for an investment in EVs, American electric vehicle manufacturers would likely have to expand U.S. capacities to accomplish a large purchase effort. One major American automobile manufacturer has indicated they would retool an idle plant if the Postal Service decides to order new EVs.
- Partnerships – Automobile manufacturers have worked with the Postal Service on electric, natural gas, and flex fuel vehicles and are working with the Postal Service on other testing efforts such as building hydrogen cell vehicles. These manufacturers have expressed an interest in partnering with the Postal Service to

produce new electric vehicles. Additionally, battery manufacturers are interested in working with the Postal Service to equip the EVs with batteries. The battery manufacturers indicated that firm commitments would enable them to increase their production capacities. Utility companies are also interested in working with the Postal Service to further vehicle to grid capabilities.

- Emissions Trading – Emissions trading is an innovative approach to reducing pollution. The government sets an overall cap on emissions and creates allowances, or limited authorizations, to emit up to the level of the cap. Entities are free to buy or sell allowances or bank them to use in future years. Entities comply with the program by holding enough allowances to cover their emissions. If entities emit more than their emission cap, they can purchase allowances to cover the excess. One bill before Congress would impose trading limitations on emissions of greenhouse gases that contribute to climate change. The Energy Act of 2009[16] targets greenhouse gas reductions by phasing in emissions caps. Each covered entity would receive emission "allowances" worth 1 ton of carbon dioxide and could trade them. Legislation may qualify the Postal Service as a covered entity to participate in selling credits if electric vehicles reduced carbon tons below the established baseline.
- Industry Standards – Currently, V2G technologies do not have industry standards. The Society of Automotive Engineers is working on a vehicle to grid standards process and the National Institute of Science and Technology has a group that is working on smart grid technologies. Postal Service testing of V2G could advance industry standards.

[16] H.R. 2454, American Clean Energy Security Act of 2009.

V. Funding

One of the main challenges impacting project funding is the Postal Service's financial outlook. For fiscal year 2009, the Postal Service is currently looking at a shortfall of approximately $7 billion, sharply limiting its capital spending and its ability to make any substantial investment in EVs. Given this constraint, we researched possible available funding sources that could support an EV purchase. Our proposal assumes an initial capital requirement of about $138 million.

There are currently no funding options specifically tailored for electrifying Postal Service vehicles. If available, tailored funding could pay for all vehicles and initial supporting costs and provide for a significant return on investment. If tailored funding is not available, there are other sources the Postal Service might use to supplement and/or offset an EV investment and pay for infrastructure costs. However, one constraint required for obtaining federal funds in the current environment involves selecting an appropriate potential partner and competing for funding. Potential partners who could attract funding at this time might include manufacturers of elements of alternative vehicles or third parties such as universities.

Specifically we noted the "stimulus bill", the American Reinvestment and Recovery Act of 2009, is the source that most people would point to as the source for funding energy projects at this time. The energy funding in the stimulus bill (approximately $37 billion) was significantly greater than the annual DOE budget.

Within the stimulus bill, there are three potential sources of funding:

- Funding for alternative transportation technologies and fleets;
- Loan guarantees for investment in battery technology and demonstration; and
- Grants for development of technology associated with the smart grid.

There also may be a new Energy Act passed in 2009. The policy debates concerning the regulation of carbon emissions have captured much of the attention around this bill. However, more broadly, the Energy Act of 2009 (which has only passed the House of Representatives at this point) seeks to sharpen the focus of energy policy onto electrification. Development of EVs will be a centerpiece of this new policy if passed.

At present, the DOE funding opportunity available is as follows:

Opportunity: Recovery Act - Smart Grid Demonstrations

Reference number: DE-FOA-0000036

Issue date: 06/25/2009

Response due: 08/26/2009

Award: Approximately $615,000,000 in federal funds is expected to be available for new awards under this announcement. Funds are available for individual agencies of up to $100 million for smart grid demonstrations and $50 million for utility load shifting.

The DOE, Office of Electricity Delivery and Energy Reliability, issued this competitive Funding Opportunity Announcement for Smart Grid Demonstrations from funds made available by The American Recovery and Reinvestment Act of 2009. Smart Grid projects include regionally unique demonstrations to verify smart grid technology viability, quantify smart grid costs and benefits, and validate new smart grid business models at a scale that can be readily adapted and replicated around the country.

Projects to demonstrate energy storage technologies include battery storage for utility load shifting, wind farm diurnal operations, ramping control, frequency regulation services, distributed energy storage, compressed air energy storage, and demonstration of promising energy storage technologies.

The cost share must be at least 50 percent of the total allowable costs for demonstration and commercial application projects. DOE anticipates making awards with project periods of 3 to 5 years.

Other Sources of Funding

The leading state in providing incentives for supporting an electric vehicle program is California, although there are other states that have provided incentives as well. The state of Washington has been prominent in this respect and New York State is a third example. Michigan and Pennsylvania might represent other examples of state support programs. One of the aspects of the current evolving energy conservation program that makes it dynamic are State Energy Conservation Programs and the Energy Conservation Block Grant programs. Taken together, these programs represent approximately $12 billion in funding that states are currently applying for. There is a great deal of discretion in these programs and activities such as infrastructure support and training might qualify under some programs.

APPENDIX A: WORK PERFORMED AND ADDITIONAL STUDIES IN THIS AREA

Work Performed

In conducting this review, we analyzed the Postal Service's vehicle operational data, information provided by academia, and relevant industry data; and considered subject matter expert viewpoints. Specifically, we:

- Contracted with subject matter experts to review the current state of EVs and key issues that would impact the Postal Service if they use them.
- Interviewed subject matter experts from the DOE and Federal Energy Regulatory Commission. We also interviewed experts on EV and battery technology from Idaho National Laboratory and the Universities of Delaware and Texas.
- Contacted original equipment manufacturers and purchase companies to identify costs and capabilities.
- Contacted organizations in the energy industry to identify capabilities and opportunities associated with V2G applications.
- Conducted surveys with battery manufacturers to identify types of batteries produced, performance, and manufacturing capability.
- Analyzed Postal Service data to assess the impact of EV loads on the facility infrastructure and operational impact.

Other Studies in this Area

In October 2008, the Government Accountability Office (GAO) issued a report[17] that concluded federal agencies had mixed results in meeting the energy reduction targets for fleets in FY 2007. In June 2009, a subsequent GAO report[18] stated that agencies will face challenges related to cost, availability, planning, and federal requirements when considering incorporation plug-ins into the federal fleet.

In May 2009, Michael Ravnitzky of the Postal Regulatory Commission issued a report[19] concluding that electrification of the Postal Service fleet should be an integral part of the nation's energy goals. According to the report, most daily mail delivery routes are short,

[17] *Federal Energy Management: Agencies Are Acquiring Alternative Fuel Vehicles but Face Challenges in Meeting Other Fleet Objectives*, GAO-09-75R, October 2008.
[18] *Federal Energy and Fleet Management: Plug-in Vehicles Offer Potential Benefits, but High Costs and Limited Information Could Hinder Integration into the Federal Fleet*, GAO-09-493, June 2009.
[19] *Electric Drive Vehicles for Mail Delivery: Identifying Key Issues*, Michael Ravnitzky – Postal Regulatory Commission, May 2009

repetitive, and well-defined and include many stops, making the Postal Service delivery fleet a prime application for electric drive vehicles. Also, the electrification of the Postal Service fleet could significantly reduce gasoline and maintenance expenses while reducing the fleet's carbon footprint. Furthermore, the Postal Service could earn substantial revenue in the wholesale electric markets by aggregating and offering on the wholesale electric market access to ancillary electric power from the vehicle batteries. Off-peak charging, grid operator control, and the availability of aggregated storage capacity work together to enhance the ability of the nation's electrical grid to incorporate renewable sources of electricity.[20]

[20] Sources like wind and solar power.

APPENDIX B: CASH FLOW SCENARIO – 3,000 VEHICLES

Postal Service Purchases and Maintains Vehicles with Grid Revenue and DOE Program Grant

	Phase 1 : Vehicle Purchase	Phase 2: Operational Test			Phase 3: Planning Fleet Transition	Phase 4: Transition Procurement					
Calendar Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EV Purchase--3,000 Vehicles											
All-Battery (EV)											
Units Purchased	3,000										
1. Investment (Outlay of cash)											
Purchase cost per LLV	$40,000										
Government Funding per Vehicle	$15,500										
Total purchase cost	$120,000,000										
Government Funding	$46,500,000										
Net Purchase Cost to Postal Service	$73,500,000										
2. Expense Investment	$0										
None for LLV or EV											
3. Operating Variances (EV operating costs compared to LLV operating costs)											
a. Energy											
Purchased Electricity to charge Batteries ($0.10/kWh in 2009)	$344,966	$698,210	$712,174	$726,418	$735,135	$743,956	$752,884	$761,919	$771,062	$780,314	$789,678
Decrease in Gasoline use ($3.27/gal in 2008)	$2,283,147	$4,621,090	$4,676,543	$4,732,662	$4,789,454	$4,846,927	$4,905,090	$4,963,951	$5,023,519	$5,083,801	$5,144,806
b. Spare Parts-decrease of 50% from 2008 $1,455/vehicle	$1,110,981	$2,241,959	$2,262,137	$2,282,496	$2,303,039	$2,323,766	$2,344,680	$2,365,782	$2,387,074	$2,408,558	$2,430,235
c. Maintenance Labor-decrease of 50% from 2008 $1,531/vehicle	$1,189,959	$2,422,757	$2,466,366	$2,510,761	$2,555,954	$2,601,962	$2,648,797	$2,696,475	$2,745,012	$2,794,422	$2,844,722
4. Replacement Battery in year 5 at $6,000 each						$19,106,233					
5. Training development and delivery											
Mechanics Course	$750,000										
Operators course	$0										
6. Contingency 3% of Energy, Spare Parts and Labor	$127,174										
Subtotal Operating Variances	$70,138,052	$8,587,596	$8,692,872	$8,799,501	$8,913,312	$10,077,535	$9,145,683	$9,264,290	$9,384,543	$9,506,466	$9,630,085
per vehicle	$23,379	$2,863	$2,898	$2,933	$2,971	$3,359	$3,049	$3,088	$3,128	$3,169	$3,210

		Phase 1 : Vehicle Purchase	Phase 2: Operational Test			Phase 3: Planning Fleet Transition	Phase 4: Transition Procurement					
Calendar Year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EV Purchase--3,000 Vehicles												
Site and VMF Charging Stations												
Install stations for 3,000 additional vehicles		3,000										
1. Investment (Outlay of cash)												
Instillation cost per unit		$5,500										
Government Funding per Vehicle		$0										
Total installation cost		$16,500,000										
Government Funding		$0										
Net installation Cost to Postal Service		$16,500,000										
2. Expense Investment		$0										
None for LLV or Charging Stations												
3. Operating Variances (charging station operating costs compared to LLV operating costs)												
1. Training Charger Station Course		$250,000										
2. Contingency 3% of Energy, Spare Parts and Labor		$0										
Subtotal Charging Stations		$16,750,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
V2G Revenue												
Average yearly revenue per unit	$ 2,308	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000	$6,924,000
Cash Flow for Purchase of 3,000 vehicles		$79,964,052	$15,511,596	$15,616,872	$15,723,501	$15,837,312	$3,153,535	$16,069,683	$16,188,290	$16,308,543	$16,430,466	$16,554,085
Replacement Cost/Per Unit	$19,000											
LLV Replacement Cost		$57,000,000										
Net Economic Impact		$22,964,052	$15,511,596	$15,616,872	$15,723,501	$15,837,312	$3,153,535	$16,069,683	$16,188,290	$16,308,543	$16,430,466	$16,554,085
Present Value at 7%		$70,537,585										
Present Value at 6%		$75,711,385										
Present Value at 5%		$81,336,526										
Present Value at 3.5% (Cost of Capital)		$90,726,387										
Internal Rate of Return		**63.2%**										