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A Financial and Environmental Impact Analysis on the Implementation of Electric Vehicles for the Washington County, Arkansas Sheriff's Department

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by

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Introduction

The importance of renewable energy has become a dominant conversation regarding the future of energy needs. As the penetration of electric vehicles increases in the market, it could be only a matter of time before they become a standard. This raises the question as to whether it is economically feasible to predominantly rely on renewable energy sources for the future and implement new technologies within typical practices.

Hybrid vehicles have been common in the marketplace since the introduction of the Toyota Prius, but what is the difference between Hybrid and Electric vehicles? A hybrid vehicle is defined as a combination of both an internal combustion engine and an electric motor which work together to power the vehicle. The hybrid can use the electric motor, the internal combustion engine, or both in conjunction; it all depends on the work the vehicle is performing. For instance, when the hybrid is in heavy traffic the battery can recharge when the vehicle brakes which contributes to its better and cleaner mileage versus its traditional counterparts. Hybrid vehicles are designed to handle "stop-and-go" traffic and light accelerations but when driving changes to a highway setting, the electric engine cannot handle the higher speeds required (JD Power). Therefore, hybrid vehicles are comparable to traditional vehicles in terms of highway mileage. The electric motor is unequipped to cope with such change.

Electric vehicles are the opposite of traditional vehicles. Different from the traditional internal combustion engine, they are run solely on an electric motor and a substantial battery pack. The battery will rely on charges to produce a range that the vehicle can cover. One of the main benefits that we can see with electric vehicles is that routine maintenance such as oil changes are no longer required which contributes to their decreasing maintenance costs (JD Power).

In January 2021, the Biden Administration signed into effect an Executive Order that will impact the Federal fleet of vehicles. His administration plans to incorporate "net zero emission" electric vehicles and gave little else in terms of specifications (Wayland). It is also important to note that the current requirements of 50% of a vehicle's parts must be American, and this standard must be increased as the new initiative becomes practice. The hope is that this model will percolate through state and local governments for official vehicles.

The administration has "inspired" manufacturer General Motors to fulfil this promise of renewable energy. GM encompasses the brands Chevrolet, GMC, Cadillac, and Buick. In the 20th century through the early 21st, GM was a prominent manufacturer and developed a culture of innovation through automobiles (Britannica). This rich history is no surprise as to why they have shown interest in this initiative and have begun their research and development towards participation.

Since the Biden administration has provided implication that the hope is for state and local governments to adopt net zero emission federal vehicles, it is important to see how this might work for a county in a rural area of Arkansas. Applying this real possibility to the local Sheriff's department will aim to create a case either for the implementation of electric vehicles or prove to show that it is not a feasible solution.

This research will compare the financial advantages and disadvantages of this order along with the possible environmental impact that this solution can attribute to. Focusing on the example of Washington County as my basis for scalability and application to other counties in the United States that have similar demographics.

Significance and Motivation

The world is changing rapidly, and new technologies are frequently emerging. There is a strong emphasis on climate change and the effects of pollution that contribute to this growing concern. The use of electric vehicles aims to eliminate the need for fossil fuels, mainly gasoline, for the everyday functions of society. By examining the impact of traditional transportation methods used by local police, we can see whether there will be a significant enough contribution to the reduction of harmful environmental factors compared to the total landed cost of implementing electric vehicles to the standard fleet.

As renewable energy technologies advance, it is only natural that current technologies adapt. The growing popularity of renewable energy and the "green culture" has created pressure on governments and localities to increase the implementation of energy efficient technologies and programs aimed at reducing carbon emissions and footprint.

Research Hypothesis

This research is poised to defend whether it is, or is not, economically feasible to implement electric vehicles into the fleet of Washington County Sheriff's Department within the next 5 years and if it will create enough of a positive environmental impact to do so.

Methodology

Through the analysis of multiple resources on electric vehicles, the environmental impact of current vehicles, the financial impact on the department, and interviews with a representative from the Washington County, Arkansas Sheriff's department, a comprehensive analysis of the scope and scalability of the implementation of electric vehicles into the fleet will be created.

Current Position of Department

Below is an interview conducted with Captain Kenneth (Kenny) Yates from the Washington County Sheriff's Department. This interview details the current state of the department pertaining to their financial constraints and logistic operations. His responses are direct quotes and are bolded.

- How much do you spend on average on fueling costs? **These costs vary from year to year depending on the current and yearly cost per gallon of fuel. In our 2021 budget, we have $252,000.00 budgeted to pay for fuel, oils and lubricants. We typically spend approximately $216,000.00 on fuel.**
- How many miles are you driving per shift? **Typically, a patrol deputy drive approximately 28,000-30,000 miles per year. There are several factors that dictate the number of miles driven. Call volume, weather, number of days off for an officer and obviously COVID has played a big part on miles driven.**
- What is the shift length/when do shifts change? **The patrol division works several different shifts. Some work 12-hour shifts (7-7), some work 8 hour shifts (6am-2pm and 10am-6pm) and some work a 10-hour power shift. The variety of shift hours gives adequate coverages during peak hours and higher call volume times.**
- Do you anticipate any "defunding" with this administration? **I don't anticipate any defunding of law enforcement in our area in correlation with recent media coverage. What we are facing and have been for the last several years are mandatory budget cuts by our governing body. It is common practice for governing bodies to expect law enforcement to do "more" with "less".**

- How many cars will be replaced in the next 5 years? **The patrol division on average purchases 4 new units per year, so in the next 5 years we will replace approximately 20 patrol vehicles.**
- Is it more cost effective to have patrol cars and then have fitted (specifically modified for police activity use versus public market stock vehicles) vehicles come for arrests? **No, it would not be. It would require double the amount of cars and personnel to operate them.**
- How many vehicles are in your current fleet? **We have 44 vehicles outfitted for the patrol division.** What is the breakdown of models? **6 pickup trucks and 38 Tahoes.[1]**
- Do you make any money back on these vehicles during resale? **Vehicles that are no longer dependable enough for patrol work are traded in on used vehicles used by our criminal investigative division.**

[1]A Chevrolet Tahoe is the most common vehicle used by the department and is currently not outfitted for electric standards. There are no current plans for Chevrolet to enter the electric vehicle industry as of March 2021. This would require a complete overhaul of the fleet by phasing it out incrementally over the next 5 years. With their current financial position, the Washington County Sheriff's Department will be unable to meet the 50% requirement of electric vehicles by the end of this time constraint.

Vehicle Comparison

This section will examine the differences between vehicles and model types in relation to their energy consumption, pricing, and differentiating features.

Tesla

Tesla has a large range in their product line, each with different specifications and ideal uses. As of February 2021, the lowest priced model is the *Tesla Model 3* costing about $38,190 with an estimated range of 263 miles (Lin). This vehicle is without upgrades such as all-wheel drive and is not considered long range. The best fit model for implementation would be the *Tesla Model X Long Range* that boasts a 360-mile range for $91,190 including all-wheel drive; the option for increasing seat capacity is available for upgraded charges as well. Currently there are multiple Tesla supercharger locations across NWA, mainly in Benton County, but very limited options in Washington County. There is also an application for hosting a supercharger, Tesla states that in order to apply you must work with a licensed electrician for an estimate and then they will help with installation oversight and implementation (Tesla). It is also worth noting that they ask to "*Please design your quote based off of the installation of two or more Tesla Wall Connectors. They must each have a dedicated 208/240v 60A circuit breaker* (Tesla)." Charging with a supercharger will take approximately 15 minutes based on recorded data displayed on the Tesla website, and it is not necessary to charge above 80% of battery capacity except in rare cases.

One major concern with the Tesla models would be the ground clearance and accessibility to power sources outside of the larger cities in the county. Washington County is "rural" based on US census data achieving ⅗ markers for rural considerations (USDA). Tesla is most suitable for urban landscapes and would likely be unable to accommodate the county at large. Another concern relating to design again would be the capability to be retrofitted with modifications. Tesla can be modified based on seat number as

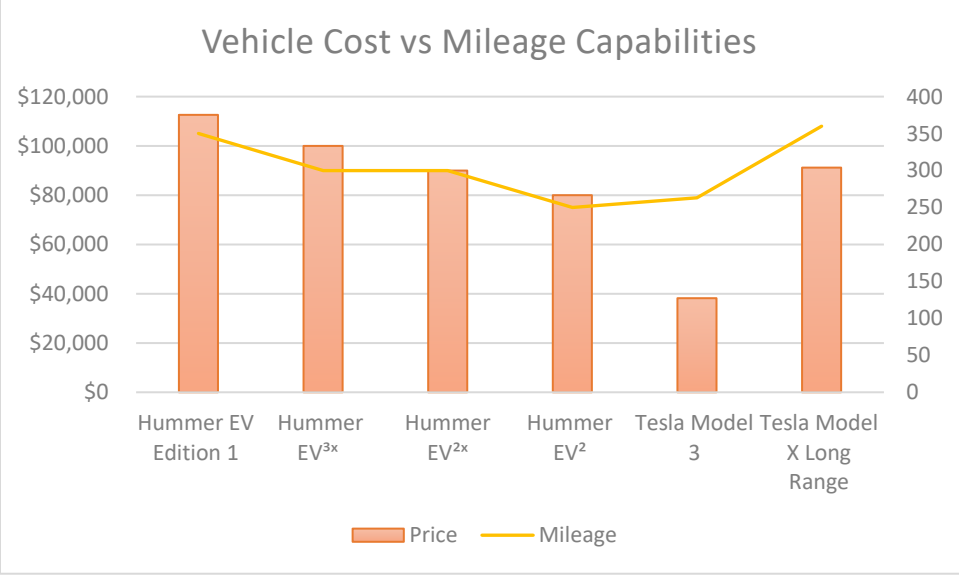
displayed on their website, (for an increased charge) but there is little to suggest they could do a complete redesign to include all necessary outfitting. The front of the cabin is already fitted with a large tablet which would serve to act as the laptop system in most police vehicles, but there would need to be extensive overhaul of the luxury vehicle to make the back cabin functional for transporting detainees - any additional changes to the vehicle would increase the purchase cost.

GM

GM currently manufactures the Tahoe and as of March 2021 they do not have an electric version of either the Chevrolet Tahoe or the GMC Yukon. However, the most feasible option for an electric SUV/ Pickup would be the Hummer EV. It is unclear whether each vehicle is all wheel drive or 4-wheel drive, but there is a feature on the Hummer EV that allows individual 4-wheel steering to accommodate off-road or rural conditions (GMC).

The current cost of the *Hummer EV Edition 1* is approximately $112,595 for the model set to come out in Fall of 2021. There is currently no space available to make a reservation for this model, but over the next 3 years a total of 4 models will be available in varying prices. In Fall of 2022, the *Hummer EV^{3x} is* set to roll out at $99,995 with an estimated range of over 300 miles. The *Hummer EV^{2x}* will arrive in spring 2023 and cost approximately $89,995 with only 2 motors still giving a range of over 300 miles. Lastly, in spring 2024 the *Hummer EV^{2}* will be released to the public for $79,995 boasting an economic option with 2 motors and a 250+ mile range (GMC).

Depending on the charger, a level 1 charger will provide 2-4 miles per hour, a level 2 charger provides 4-7 miles per hour, and a public DC charger will provide 60-100 miles per charge. The level 1 and 2 chargers are available for home use. The purchase of a personal charger would be required for the department when vehicles are not in use so that they remain secure versus leaving them at dealerships or in parking lots for more than 15 minutes (GMC).



Energy Consumption

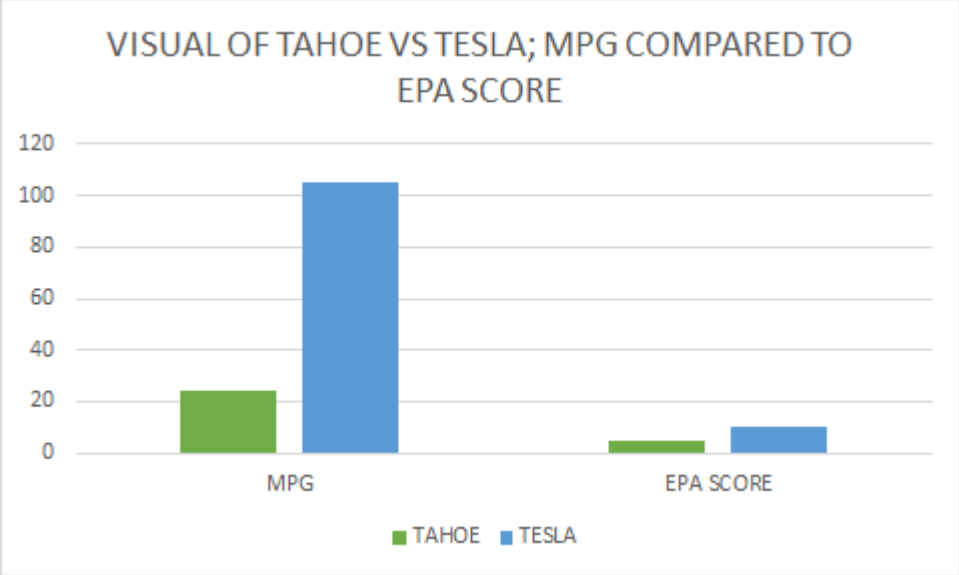
One of the main draws to electric vehicles is the reduction of carbon emissions that are harmful to the environment. By examining the potential difference in emissions from the current

vehicle usage to the expected future vehicles, the impacts can be observed as significant or insignificant.

According to the EPA, there is a score assigned as a rating to vehicles based upon their miles per gallon (MPG). By using the information provided by their website, it is concluded that the "rating reflects vehicle tailpipe emissions of carbon dioxide (CO2), the most prevalent greenhouse gas (GHG). CO2 emissions typically constitute 99% of the tailpipe emissions of greenhouse gases (EPA)." The scale is in intervals 1-10, with 10 being the highest and most "clean".

It is estimated that up to 60% of energy created in the United States comes from natural gas and coal (EIA). By relying on fossil fuels to keep the energy grid running and electric companies supplying electricity, we are not truly changing the root of the problem… only placing a band-aid on it. If there are more electric vehicles relying on fossil fueled charging stations, then it doesn't make much difference. Increasing the number of vehicles dependent on an electric charge will increase the demand for electricity in the home and charging stations, thus increasing the dependence and consumption of fossil fuels.

One major concern is the uncertainty in electricity costs as they can spike during peak hours and if you're charging during this time, it could cost upwards of $8 per gallon theoretically. Each electric company sets their own rates and surge pricing times, so finding a true cost of recharging versus filling up becomes more difficult (Edmunds). When, where, and how long you plan to charge will affect the overall financial impact and could increase "fueling" expenses compared to traditional gasoline.



Tahoe

Carbon Emission: Currently the Tahoe has a 21/28 MPG city and highway distribution, averaging a 24.5 MPG earning. As this is the most popular vehicle in the department, we will use this as our baseline for carbon emissions comparisons. The rating given to the Tahoe by using model years 2018/2019 is a 5 (EPA).

Tesla

Carbon Emission: The model X has a 109/101 MPG city and highway distribution, averaging a 105 MPG earning. This is the largest Tesla model and is considered the SUV offering. This Tesla model receives a 10 for the carbon emissions rating (EPA).

GM

Carbon Emission: The Hummer has an extensive line of vehicles to be released over the next 3 years, and the ranges span from 200 miles to over 350 on a single charge (GMC). Since this is a newer vehicle and will not be released until Fall 2021, true statistics are not available, only manufacturer information.

Limitations of Research

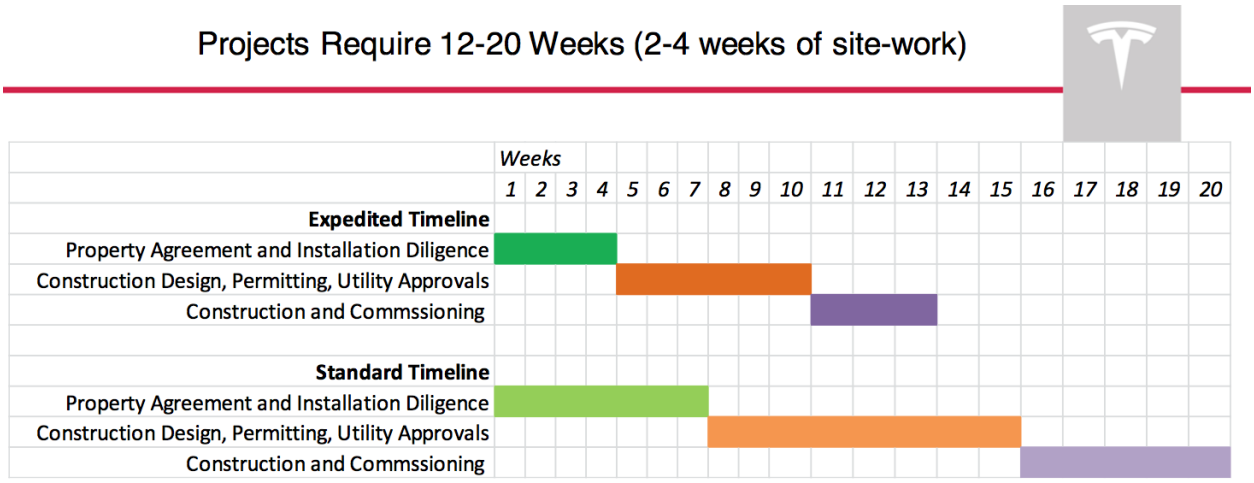
Research is limited by the access of information relating to the financials of the Sheriff's department and what they choose to share with the public. Application to other populations could be drastically different based on the conditions of their environment and economic restrictions; what might be conditional in a primarily rural Northwest Arkansas will have no impact in a metropolitan area such as Los Angeles.

Conclusion

Most commercial chargers are located at dealerships across the county that would provide a quick fix, but for a long-term solution the Sheriff's office would need to purchase a high-capacity charger to provide the most benefit. This of course would create uncertainty and risk when quick response times are required and there is no backup energy source besides the battery range. This would be an additional cost to incur at about $1,900 per charger plus installation (HomeAdvisor), on the conservative end. The high cost of vehicles is a large concern as most traditional fleet vehicles (based on consumer pricing) are around $50,000 compared to over $110,000 for an electric vehicle SUV. While we can see small decreases in overall maintenance costs like the elimination of oil changes, this does not eliminate the cost for all vehicles in the fleet. At 50% capacity of fleet vehicles being electric, the estimated savings from reduced maintenance would at maximum be $126,000 per year. Each purchase of electric vehicle would account for at least $91,000 (without modifications) of those newly allocated funds and based on purchase history of replacing 4 vehicles per year, there would need to be $238,000 more in savings to justify the purchase of electric vehicles. Infrastructure costs and increased electricity charges would also have to be considered.

Based on the evidence presented above, it is not feasible to implement electric vehicles in a large, rural county public office such as the Washington County Sheriff's Office.

Application



[2]A project implementation timeline from Tesla for the implementation of a supercharger

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