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Benefit - Cost Analysis -

The Implementation of a Tesla Supercharger in Lakeland, Florida.

Abstract:

The purpose of this Benefit-Cost Analysis is to assess the feasibility of implementing Tesla charging stations and access the alternative options for local, city and state residents in Florida. In North America, most electric vehicles follow the same universal plug in style. These are more accurately put into three levels: Level 1 (120 volts AC), Level 2 (208-220 volts AC), and Level 3 DCFC (480 volts AC) charging.

Decision to be Analyzed & Literature Review:

Most EV manufacturers include a Level 1 EVC cord set so that no additional charging equipment is required. As a general rule, Level 1 recharging will add approximately four miles of travel per hour. Level 1 charging is the most common form of battery recharging and can typically recharge a EV's batteries overnight; however, a completely depleted EV battery could take up to 20 hours to completely recharge (Groover Combs et al, 2020).

Level 2 recharging will supply up to approximately 15 miles of travel for one hour of charging to vehicles with a 3.3 kW onboard charger, or 30 miles of travel for one hour of charging for vehicles with a 6.6kWh on-board charger. Level 2 EVC utilizes equipment specifically designed to provide accelerated recharging and requires professional electrical installation using a dedicated electrical circuit. Level 2 equipment is available for purchase online or from retailers that sell other residential appliances. A completely depleted EV battery could be recharged in approximately seven hours using a Level 2 charger (Groover Combs et al, 2020).

DCFC recharging will add approximately 80-100 miles of travel with 20-30 minutes of charging. The DCFC EVC converts AC to DC within the EVC equipment, bypassing the car's charger to provide high-power DC directly to the EV's traction batteries through the charging inlet on the vehicle .While the power supplied to EVs by all DCFCs is standardized, there is not uniform agreement on the connector that is used to connect the charger to the vehicle (Groover Combs et al, 2020).

One of the most revolutionary changes is that of Tesla's very own supercharging network, which represents a large market for both Electric Vehicles and a high demand for charging stations (US Department of Energy, November 2015). The increase in charging stations directly reflects consumer demand for Electric Vehicles.

An increase in the purchasement of Electric Vehicles, the demand for open charging stalls at the stations will also increase. Electric Vehicles and Charging Networks are complementary products. Therefore, as we see the gradual movement away from fossil fuels, electricity as a renewable energy source is increasing in usage and demand. This is furthered by states', like California, decision to move towards solely electric-based vehicles by the year 2035. Level 2 and DCFC chargers are going to see an exponential rise in demand due to more electric vehicles being in the market. More consumers are going to want their cars to be charged from these stations, and they will want it to be done incredibly fast. As a result, we will likely see an increase in DCFC chargers and their charging capabilities across the state.

One of the common reasons for choosing EV's is due to the price of gas versus the power consumption. Looking at the willingness to pay for an Electric vehicle, it would be in the range of $35 to $75 for a mile of added driving range and would pay more a decrease in charging time as well (*Willingness to pay…)*.

This factors into the demand for Tesla's charging stations and the ability to have a plugin that works at home for cars, as consumers are treated to more Electric vehicles in the market.

Alternatives to Public Charging Stations

The alternatives to having public charging stations involve having residential private charging stations, at home charging stations and renewable energy power charging stations, at home. The direction for public charging stations is to pay a per kilowatt charge and with Tesla, paying for the charge varies on the package and model year of purchase. For at home charging stations, the costs vary based on the age of the house and community and electrical wiring of the house, which can cost up to an additional $1,000 (Albrecht 2019).

In addition, the Governor of Florida, awarded 27 contracts to build charging stations along the I-95, I-4, I75 and I-295 highways (Calvan 2020). The state will use about $25 million of that settlement to build EV chargers at Florida's Turnpike service plazas. Based on another state level direction, California has instead imposed a mandate that the entire automotive industry in California transition to selling only EVs by 2035, effectively forcing the consumer market into a direction.

The other alternative is to do nothing but build out more charging networks regardless of demand.

(https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf#:~:text=The%20cost%20of%20a%20single,51%2C000%20for%20DC%20fast%20charging)

https://www.bizjournals.com/jacksonville/news/2020/03/27/florida-a-top-market-for-growth-in-electric.html - stats on chargers

Technical Plan:

Our technical plan will follow the steps from chapter 1:

1. Decide whose benefits and costs count, specifically standing.
2. Identify the impact categories, catalogue them and select metrics.
3. Predict the impacts quantitatively, we will say over 5 years.
4. Monetize these impacts over 5 years.
5. Discount benefits and costs to obtain present values.
6. Compute the net present value of each alternate.
7. Perform sensitivity analysis.
8. Make our Lakeland, Polytech Recommendation.

We plan to obtain our data from a group of sources attached in our references, and from States California, New York and Florida, and finally from universities that have done economic impact studies on EV charging stations.

Draft Analysis

Topic: The purpose of this Benefit-Cost Analysis is to assess the feasibility of implementing Tesla charging stations and access the alternative options for local, city and state residents in Florida.

Impacted Parties:

State	Lakeland County	Residents

Social Costs	**State**	**Lakeland County**	**Residents**
Construction Costs For Charging Stations			
Cost of conversion from gas v power			
Cost of a new work force for maintenance on EV			

Social Benefits	**State**	**Lakeland County**	**Residents**
Reduction in Carbon emissions			
EV sales			
Eliminating purchase of gasoline			

We defined Q = # of cars

P = # of gas stations

Our first assumption is for P = we used the elasticity for gas gallons / station.

Elasticity for gas = -.26

P= 9.2 million barrels nationally per day

Q = 13,358,246 cars in the State of Florida

Number of gas stations in FL: 7,043

Number of gas stations in Lakeland: 93

Number of existing electric charging stations in FL, this will be our equilibrium:

Number of electric charging stations in Lakeland: 22

Number of charging stations in FL: 5182

Number of gas stations with charging stations: 7

Cost for using charging stations: .10 KwH, kilowatts per hour

Cost to install a charging level 3 charging stations at home: $50,000

One of Gus' famous Author's Notes: I know that some of these numbers are wrong or mis-applied. I'm working on correcting them but need help from someone smarter than myself. Preferably someone who has taught or does teach QMB 3200 ~ Advanced Quantitative Methods. In addition, many of these assumptions are made under the guidance of Fermi Estimates.

The first two lines are currently the equilibrium 72,296 gas pumps (assuming each station has 8 pumps) and 14.442 million registered vehicles in the state of FL. Through pure conversion, and stating that 80% of those cars exclusively use in home-charging Level 1 capabilities, we have an equilibrium of 14,460 charging outlets required for Level 2/DCFC charging needs. At current point, there are 28,535 registered EV vehicles in the state by the total number of sales from 2011-2019, and 5,182 charging outlets in the state of FL. If we change the number of EV vehicles to the total number of vehicles registered, we can conclude that we are under-utilizing our current number of charging outlets because it projects more charging stations than our current equilibrium number of gas pumps. Thus a guardian-perspective could conclude that at this time it does not make sense to install new electric vehicle chargers. However, with the market shifting towards electric-vehicle utilization, a spender would find that it would be forward-thinking and in the best interest of Lakeland to place an EV Charging stall understanding that in the future there will be a greater need of charging ports available to the every-day EV consumer. Some may note that more electric vehicles would be sold if there were more chargers to reduce so-called “range anxiety”.

The costs of Level 1 chargers are incredibly minimal for installation. The average residential electricity rate in Lakeland is 10.58¢/kWh [https://www.electricitylocal.com/states/florida/lakeland/#:~:text=Residential%20electricity%20rates%20in%20Lakeland&text=The%20average%20residential%20electricity%20rate%20in%20Lakeland%20is%2010.58%C2%A2,rate%20of%2011.42%C2%A2%2FkWh.]

Our second assumption is related to the demand for public charging stations: Currently the estimated use of at home charging stations among hybrid or electric vehicles is 80%, meaning that 20% of all drivers can’t charge at home. But, in relation to time, we can use all drivers of vehicles if our time to charge is proportional to drivers needing a quick charge vs a full charge for their vehicles.

Our first objective is to prove that cost to install chargers + cost to change <= cost of gas in X time period.

Equation for objective 1:

(14.4m *.8 *$50) + (14460 chargers installed) + (average charging cost: $.1/ hour * 14.4m) <= (14.4m *$2.00/hr)

Bibliography:

Albrecht, Leslie. “You’ll Save Money on Gas with the Tesla Model 3, but You May End up Paying More Elsewhere.” *MarketWatch*, 1 Mar. 2019, https://www.marketwatch.com/story/youll-save-money-on-gas-with-a-tesla-but-also-consider-these-unique-expenses-2017-07-06.

April Groover Combs, FDACS OOE Doug Kettles, Central Florida Clean Cities Coalition Kaitlin Reed, Central Florida Clean Cities Coalition. *Florida’s Future EV Infrastructure & Infrastructure Models Interim Report For The Florida Electric Vehicle Roadmap*. Florida Division of Agriculture and Consumer Services, 30 June 2020, https://www.fdacs.gov/content/download/92160/file/FutureEV-Infrastructure-and-Infrastructure-Models-Interim-Report.pdf.

Calvan, Bobby Caina. “Florida to Install Charging Stations for Electric Vehicles.” *Sun-Sentinel*, South Florida Sun-Sentinel, 10 July 2020, https://www.sun-sentinel.com/news/politics/fl-ne-ap-desantis-charging-stations-20200711-ll3uh3gkmjcdtff4abnoazqk4q-story.html.

“Willingness to Pay for Electric Vehicles and Their Attributes.” *Resource and Energy Economics*, vol. 33, no. 3, North-Holland, Sept. 2011, pp. 686–705.

"Define the impacts and impacted parties, calculate the net benefits, and analyze which decision will make the most sense. Explain your work so someone unfamiliar with the topic can follow your calculation. Write this up as if it will be a section of your project report—because the final version of it will be."

- Impacts and impacted parties
- Net benefits
- Pick something and explain it