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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:

Tesla Batteries:

Battery capacity degradation over time or distance traveled is one of the several main concerns in terms of electric cars. About 10 years ago, no one really knew how those new EVs would cope and some models were clearly underperforming (for various reasons). Taking a look at the official data from Tesla, which is extremely valuable because the company already has the most experience in terms of the number of all-electric cars sold globally.

Tesla says that its battery packs were designed to outlast the cars. The average usage of private passenger cars (ICE) in the U.S. is 17 years and roughly 200,000 miles (322,000 km). The mileage in Europe is lower - about 130,000 miles (209,000 km). So, we have the first indication that the batteries should last longer than that. Battery capacity is above 85% (on average) after 150,000-200,000 mile After selling more than 1 million electric cars, Tesla's battery degradation data shows that vehicles with mileage between 150,000-200,000 miles (241,000-322,000 km), on average, still have more than 85% of initial battery capacity the battery degradation is below 15%.

A group of Tesla owners on the Dutch-Belgian Tesla Forum are gathering data from over 350 Tesla vehicles across the world and frequently updating it in a public Google file located here: (https://docs.google.com/spreadsheets/d/t024bMoRiDPIDialGnuKPsg/edit#gid=0).

There is previously reported data, but they have since added many more vehicles and those vehicles have been driving a lot more – completing more battery cycles. The data clearly shows that for the first 50,000 miles (100,000 km), most Tesla battery packs will lose about 5% of their capacity, but after the 50,000-mile mark, the capacity levels off and it looks like it could be difficult to make a pack degrade by another 5%. The trend line currently suggests that the average battery pack could cycle through over 300,000 km (186,000) before coming close to 90% capacity.

When it relates to electric vehicles, battery degradation means the loss of battery capacity and range over time. It's one of the main concerns of new electric car buyers and it can vary greatly based on several factors like cell chemistry, battery management system, and usage. Tesla has historically been able to limit degradation to reasonable levels thanks to its robust battery management system. Real-world data showed that Tesla battery degradation was less than 10% after over 160,000 miles (257,500 km). Tesla interestingly used to not clearly cover battery capacity degradation in its warranty until it launched Model 3. With an update to its warranty earlier this year, Tesla now covers all battery capacity degradation in all its vehicles with a limit of 70% capacity for up to 8 years or 100,000 to 150,000 miles depending on the model. Based on the previously mentioned data, it looks like Tesla won't have to do too many battery replacements due to accelerated battery capacity degradation. However, some of Tesla's battery packs are known to perform better than others and the 90D, which is the one I have in this car, is known to be Tesla's worst battery pack for battery degradation. Tesla forums are full of Tesla Model S and Model X 90D owners reporting quicker battery capacity degradation compared to the average Tesla vehicle.

Public and Private Charging:

You can consider Level 1 charging as the default EV charging option. It works on all electric vehicles and at all places with a standard power outlet. Level 1 charging equipment is included with every EV. With Level 1 charging, all you do is plug your EV into a standard 120 volt AC wall outlet. This is the same kind of outlet you plug your laptop or phone charger into. Easy. The problem with Level 1 EV charging is that it's slow – very slow. They are typically powered at a measly 12 or 16 amps and provide just 2-6 miles of range per hour. Level 1 is the lowest charging option available and is often referred to as "trickle charging".

For faster charging, homeowners can upgrade to Level 2 chargers. These use a 240-volt power outlet, the same as those used by air conditioners or clothes dryers. Level 2 charging is a lot faster than Level 1 charging, providing 14 to 35 miles of range per hour by taking advantage of the circuit's higher amperage. These charging cords are traditionally sold as a separate add-on for your EV. Some homes might not have a 240-volt outlet, so you may need to work with an electrician to get one installed. You'll want to ensure that the circuit supports a high enough amperage to allow your charge to operate at its peak output to charge your car as fast as possible. For pretty much every EV brand except Tesla, Level 2 chargers use a J1772 port. Tesla has their own Level 2 charging port, however, all Tesla's come with a J1772 adaptor for charging. So, all EVs should be able to take advantage of most public Level 2 charging stations.

Unlike the first two options which use residential AC current, DC fast chargers (often called Level 3 chargers) use DC current. Because Level 3 chargers provide DC current, they bypass the on-board charger and directly charge the EV's battery. This allows for very fast charging speeds: they can provide 100 miles of range per hour or more. While Level 3 chargers are fast, manufacturers warn that you should not rely on them as your main charging source. The large amount of power that fast charging stations use can damage your EV battery's health, and potentially shorten its lifespan. It's recommended to only use fast-charging if you need it for long-distance travel or if you are pressed for time. Level 3 chargers are not feasible for home use, as they require special utility connections, hardware, wiring, and permits. They also have extremely high setup and energy costs. You'll only find Level 3 DC charging stations along highways or in other public areas.

In addition to the aforementioned Level 2 stations, the DOE says there are now 3,653 DC fast-charging stations in the U.S., 813 of which are for Teslas. But those numbers don't tell the whole story. First, knowing there's a station doesn't mean you know how many plugs are available; some may have a dozen plugs while others have just one or two. Second, vehicle connectivity is simply one aspect of public charging. After all, gas pumps will work with any car, but you still need to pay for the fuel. And that's where charging networks come in. The three biggest non-Tesla networks in the U.S. are operated by EVgo, ChargePoint, and Electrify America.

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. A consumer's willingness to pay for the Electric Vehicle and the costs to charge 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 action. The other alternative is to do nothing but build out more charging networks regardless of demand.

Elasticity of Demand:

Measuring the elasticity of demand for any good is a difficult process, with cars, however, this task becomes incredibly difficult. Cars typically only change prices with the release of the next year's model which can have anywhere from minor comfort and trim updates every year to major body and technology overhauls every three to five years. Because the price of a specific new vehicle only changes when a new model is released, it is difficult to track the change in price needed to calculate the elasticity. Even though we know the different quantities sold each year and the price, since each year is technically a different product, we are not able to compare across model years. It is also not practical to compare a vehicle of one model year to other versions of itself (e.g. base vs sport vs luxury) because each trim level is competing in slightly separate markets. A consumer looking to buy a base model vehicle of one brand is most likely compared to other brands' base models and not a sport or luxury model. Although it may be the case that one vehicle's luxury trim level is compared to a higher end vehicle's base model. Nevertheless, this has not stopped people from finding the elasticity of demand for both specific vehicles and vehicles by class.

Using standard and nested logit models, Qin (2014) estimates the elasticity of a compact internal combustion vehicle, such as the Jaguar XF, to be .022 within group and .0015 across group. The Jaguar XF itself has an own-elasticity of .0004 and a cross-elasticity of -6.22. Continuing with examining entry level luxury vehicle brands, we see within group elasticities as low as .429 for Audi and as high as 1.260 for Jaguar and as low as .0002 for Jaguar and high as .0017 for Mercedes-Benz and BMW across group (Qin, 2014). In 2019, (Xing et al., 2019) estimated the own-price elasticity for gasoline vehicles to be -2.761 and -2.751 for battery electric vehicles. When analysing just the Tesla Model S, they found an own-price elasticity of -2.37 and a cross-price elasticity average of .005 (Xing et al., 2019).

Willingness to Pay

Calculating willingness to pay, the maximum price at which a consumer will buy a product, like calculating elasticities, is a science. As when calculating elasticities, it is important to take into account the vehicle trim level, but also now associated costs such as fuel or electricity, fueling or charging station availability, and climate impact sensitivity. Tanaka et al. found that American consumers were willing to spend $49.8 for each percent decrease in fuel costs and $21.5 for every 10 miles added to the total range of the vehicle (Tanaka et al., 2014). For those consumers for whom carbon emissions were a concern, they were willing to pay $29.0 for each percent decrease in emissions. Because charging an electric vehicle takes considerably more time than fueling an internal combustion vehicle, the charge time must also be considered when calculating willingness to pay. Hidrue et al. found that consumers were willing to pay between $425 and $3250 per hour reduction in charging time and that to reduce a 50 mile recharge from 10 hours to one hour, consumers were willing to pay $5646. They suggest that range anxiety, long charging times, and higher entry prices were consumers' main concerns (Hidrue et al., 2011).

Asides on Willingness to Pay: Ownership Cost and Fuel Savings

As cemented in American culture as cars are, every car owner has a rough idea of how much maintenance and ownership costs will be before purchasing a new internal combustion engine vehicle. In late February of 2020, Investopedia did a brief overview of the least expensive way to own a Tesla Model S 85D, a middle of the line Model S. They found that at the end of five years, the cost of ownership is just over $100k (Page, 2020). Taking advantage of all available offers and calculating fuel and maintenance savings and selling the vehicle back to Tesla brought the five year cost to just under $44k which is about $730 per month (Page, 2020) The cost of purchasing a new Jaguar Xf is $72,950 on the sticker for a model most similar to a Tesla Model S 85D. According to Kelley Blue Book, the equivalent five year old Jaguar XF in good condition could be sold for between $30k and $35k. Assuming the best, the five year cost would be brought down to $38k for five years which is about $583 per month before gas and maintenance costs. A 2019 article on CleanTechnica compared Tesla Model 3 and Honda Civic costs over five years. Each vehicle was compared at three different equivalent trim levels. With as many as possible variables constant, the deciding factor was the cost of fuel vs electricity (Shahan, 2019). Across the five different comparisons of low, moderate, and high gas and electricity prices, they found that the five year ownership costs were roughly equivalent between the two vehicles (Shahan, 2019).

Asides on Willingness to Pay: Road Trip Time Comparisons (Trip time and distance measured with Google Maps)

For many people across the country, the ability to drive long distances to visit relatives for holidays, drive to school out of state, or simply like to vacation in far away places is of the utmost importance. For example, Gus drives back and forth between his home in Framingham, MA and his apartment near Florida Polytechnic University several times each year. Like an electric vehicle owner would, he meticulously plans out his route. Rather than optimizing charging times, Gus optimizes distance between gas stations and has a heavy bias towards BJ's, Costco, and Sam's Club gas stations. Because fueling time is negligible, he tries to get as far as possible between stops without running out of gas. Gus knows that he starts to get fuel anxiety at 315 miles, when his fuel needle is well below empty. His planned route from Lakeland to Framingham has five essential gas stops, with a sixth just before arriving home so that he has a full tank the next day. The average distance between gas stations is 221 miles with a maximum of 261 miles.

Using Tesla's trip builder, we can compare trips from Lakeland to Framingham with a Model 3 Performance which has a range of 315 miles, similar to Gus' maximum willing travel distance. The Tesla trip has 10 essential supercharger stops with an eleventh close to home, so that the two trips are as similar as possible. The average distance between superchargers is 130 miles with a maximum of 180 miles. Even though the Tesla stops more frequently to charge, Gus' trip is still 13 miles longer due to suboptimal routing towards his preferred gas stations. The Tesla's driving time is also shorter by roughly 18 minutes. The differences between the Tesla and gas trips constitute less than 1% of the total trips. This seems wrong, and it is because it does not take into account fueling or charging times. The Tesla trip builder estimates a total of 4.8 hours will be spent charging. Assuming a total time of five minutes per gas station that Gus stops at, that means that Gus' trip will take more than four hours less than the Tesla's trip.

The Tesla trip builder also estimates gas savings at $32. However, on closer inspection, we find that Gus has a lower dollar per mile driven and the gas savings are less than the $32 estimated. Assuming that the gas costs saved are directly related to charging times, we find that for each dollar saved we are spending nine minutes at a supercharger which comes out to $7.87 per hour. This is significantly less than the $425 per hour charging time found by Hidrue et al (2011). Until the cost savings per hour can meet the consumer's willingness to pay per hour charging, it does not make sense for consumers to choose a Tesla over a traditional gas vehicle for long trips.

Quantitative Analysis on Data from Users and Contextual Meaning:

To obtain more data on the numbers themselves, the team looked at some data provided by current Model 3 owners. For continuity purposes, the owners of the Model 3 have Long-Range Dual Motors, with 19" Sport Wheels, and have Autopilot (Tesla

Motors, 2020), all of which have factors on driving and utility for the driver. However, do note that the total value of the car is nearly $60,500 (Tesla Motors, 2020) and Tesla requires a down-payment of $1,000. In comparison, the average new vehicle in 2019 was roughly $40,000. More on these comparisons later.

The first set of data below was calculated and taken from John Kraus, one of the current Model 3 LR Dual Motor owners we spoke with. John's old data provides an interesting insight into the home charging prices in comparison to supercharger prices.

To completely fill-up the vehicle at home, he spends roughly $9.00. This charge has quite the contrast to what owners of combustion vehicles face per fill-up. Assuming that the average tank size of a car is 14 gallons (average between 12 and 16 gallon tanks) [RocketHQ, 2020), and that gas costs are currently anywhere between $2.00 a gallon to $3.50 (AAA Insurance, 2020), it could take a consumer between $28-$49 to completely fill their vehicle. This is nearly 3 - 5.4 times the amount an electric vehicle driver, who charges strictly at home, faces. The data is further broken down into subdivisions to see more insights.

Home charging

Miles per dollar	34.91
Dollars per mile	$0.0286
Average cost to add full rated miles (322)	$8.8887
Percent per hour	6.52
Miles per hour	20.24

However, these values significantly increase with the supercharging capability. Do note that a better value of the average cost to add full rated miles (322) should truly lie within the $16-$20 range. John's numbers are currently skewed as he calculated these values including the "free miles of charging" he earned from the use of Tesla's referral code program. Even using the maximum end of this range, an owner of the vehicle is not paying as much as they would if they have stayed with their electric vehicle. This data is also further broken down into subdivisions to see more insights.

Supercharging before reimbursement

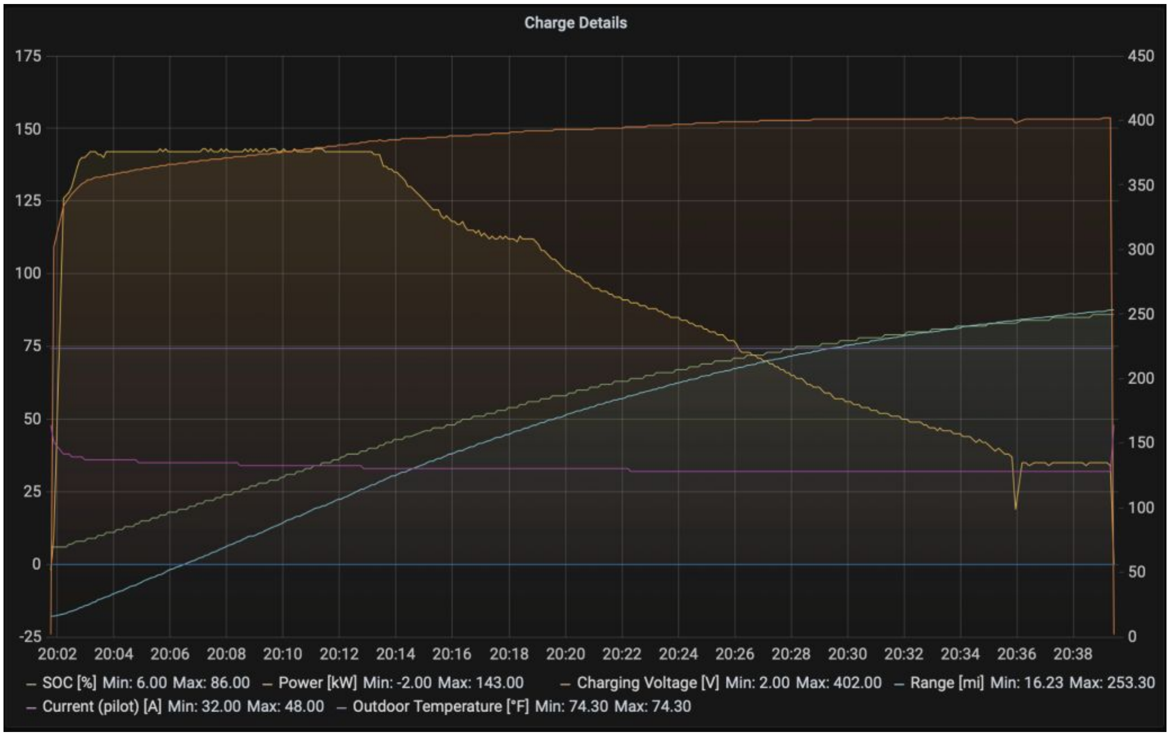
Miles per dollar	25.59
Dollars per mile	$0.0391
Average cost to add full rated miles (322)	$12.0259
Dollars per minute	$0.2455
Miles per minute	6.28

With this in mind, Trevor Mahlmann also shared his data in regards to his Tesla Model 3, named Cobalt. For Trevor, on average he is able to obtain a charge from 0-80% in roughly 6-6.5 hours at home. However, as mentioned in the Level 1 charging literature review, this amount of time is highly dependent on what kind of charger you buy. Average percentage gained per hour is roughly 10%. A different method in determining costs, in comparison to John, Trevor's costs per KwH $0.055/kWh as he bases it off of his value of time of use.

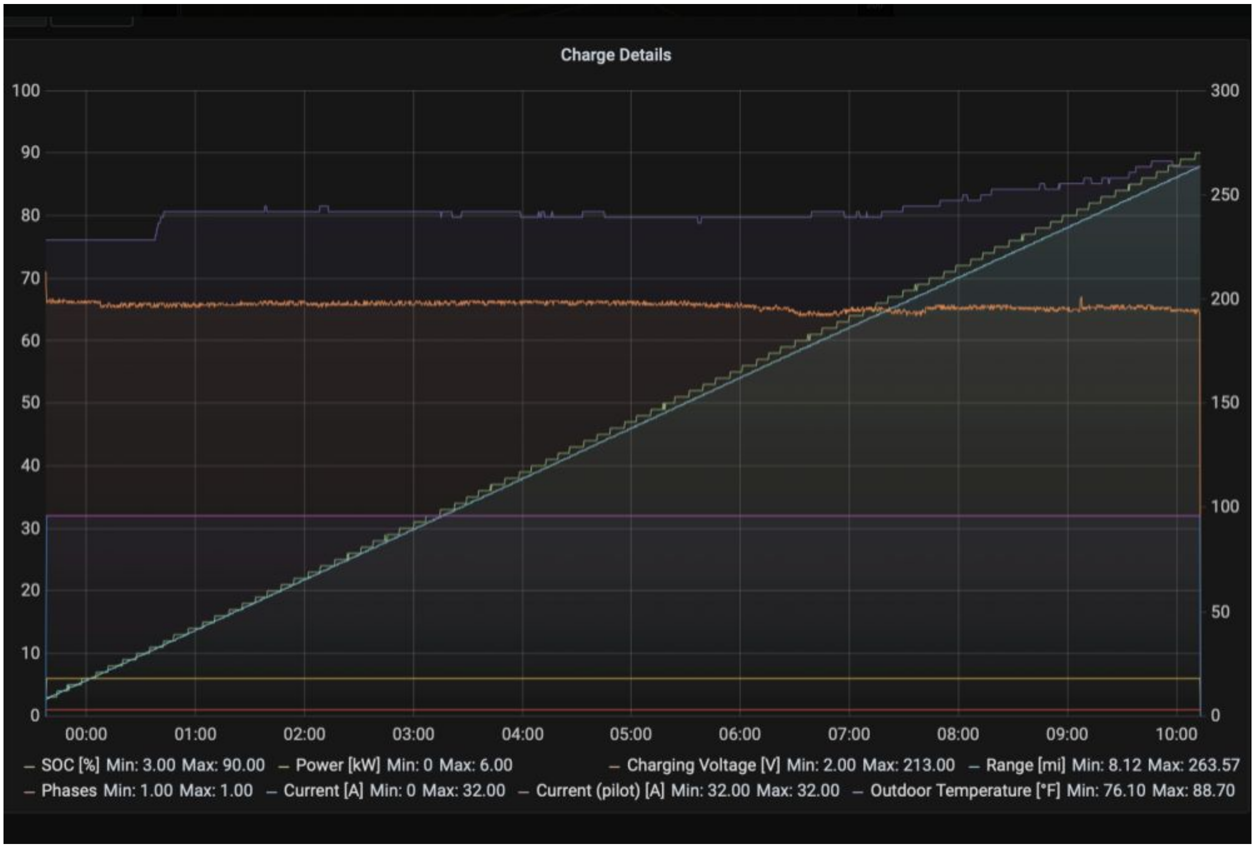
At home charging costs is roughly $4 for a full charge off-peak and roughly $20 for an on-peak charge. DCFC chargers are anywhere ~2-3 and 5-6 times the price of normal electricity. However, similar to John Kraus and Andrew Kaylor, these costs are justified due to the acknowledgement of the required infrastructure and that it is still cheaper than to fill-up a tank of gas.

There is a ~10% difference between the Level 2 charging network / KwH than at home, off peak. These prices become exponentially higher when comparing off-peak to DCFC, as it is roughly five to six times the cost. Off-peak is ~$0.05 / kWh and Supercharging is $0.25-0.30. The main reason for the increase in price? Speed.

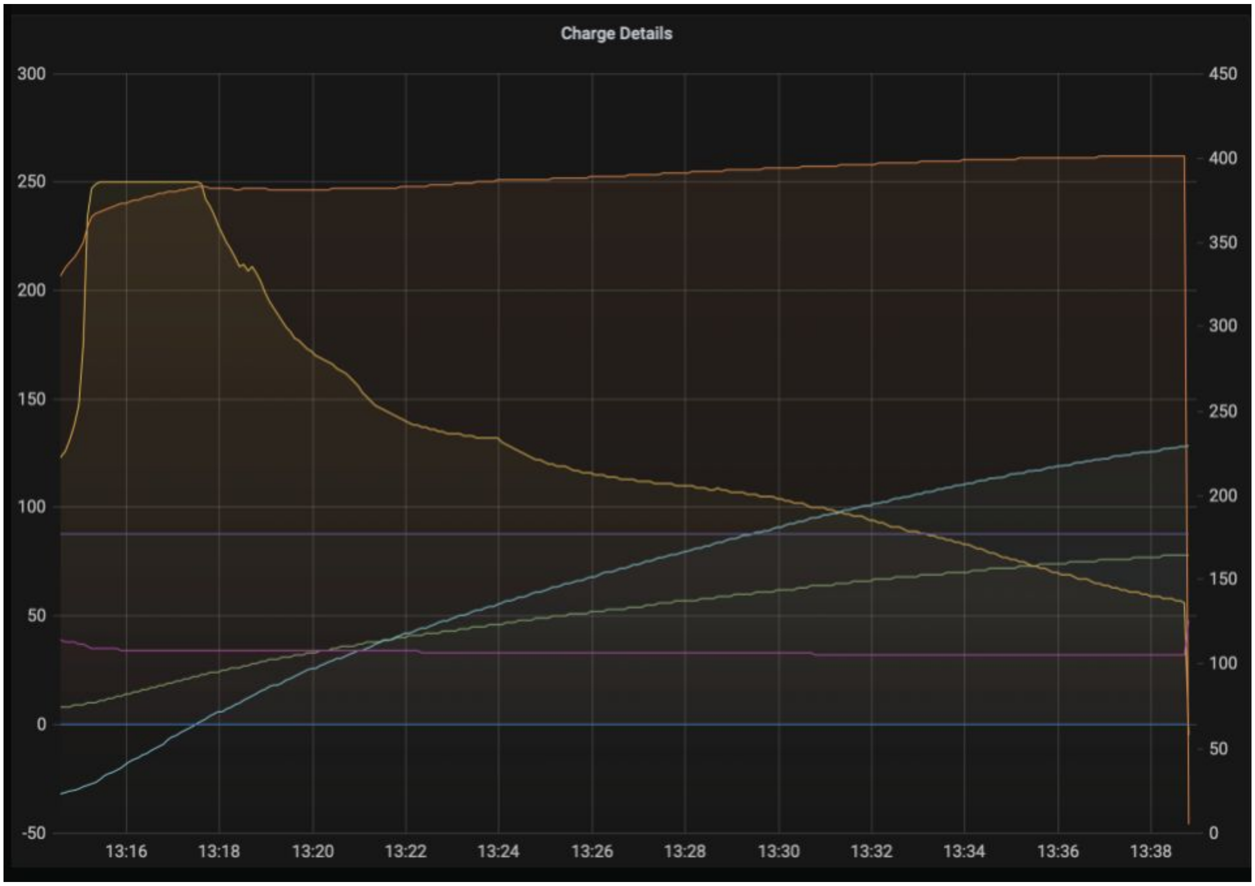
Supercharger networks are incredibly effective at providing consumers a very fast ability to recharge their vehicle. Tesla’s Version 3 Supercharger network can provide a vehicle 250 miles of range within nearly 20 minutes; Version 2 Supercharger Networks take just over 30 minutes of charging time. At home charging takes at least twelve times longer.



This graph depicts what is occurring to Trevor's vehicle under DCFC - Supercharging, V2 150kW during peak time at a charger. This is most likely equivalent to what we refer to as Level 2 charging. 250 miles are added within 36 minutes of plug-in. This means roughly seven miles of driving capability is added every minute of charge time. This is quite a decent rate of charge, but certainly takes a decent amount of time.



This graph depicts what is occurring to the vehicle under AC charging over roughly 10 hours at 6kWh. This is most equivalent to what we refer to as Level 1 charging, which often occurs overnight while the consumer is sleeping. 250 miles are added within 10 hours of plug-in. This means roughly 0.4167 miles of driving capability is added every minute of charge time. This is incredibly slow, however is the cheapest option for a consumer due to electricity rates being lower than supercharging rates.



This graph depicts what is occurring to the vehicle under DCFC Supercharging - V3 at 250kW. This is most equivalent to what we refer to as Level 3 charging, and is the fastest rate at which EV's can be charged today. 250 miles are added within minutes of plug-in. This means roughly 11.363 miles of driving capability is added every minute of charge time. DCFC Supercharging at the V3 stations, charging at 250kWh is significantly more expensive however is lightning fast compared to AC Level 1 charging.

Overall, the DCFC Supercharging - V3 at 250kW provides an incredible ability for the vehicle to recharge in a very faster manner. However, as mentioned, the rate at which the consumer must pay for this convenience is roughly five to six times higher than the cost of charging at home, at a very slow 6 KwH off-peak. For the consumer, the best way to charge, strictly monetarily speaking, is to solely charge at home, which is why nearly 80% of all EV owners do so. However, to minimize the amount of money spent and time charging, it is best to combine a mixture of at home charging and supercharger usage.

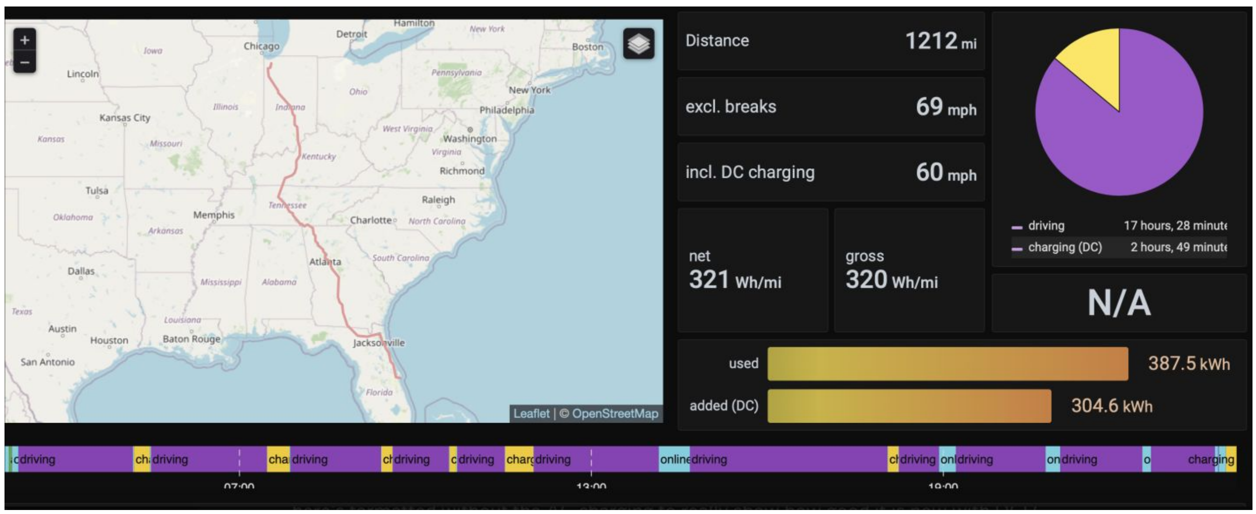
For the sake of argument, let us assume that the new Tesla is bought for $60,500, the charging costs for *charging only by the supercharger network* are $16 to obtain a fully charged vehicle, and has maintenance costs of $200 per year. In comparison, a new gas-powered vehicle is purchased for $40,000, has maintenance and repair costs of $600 per year (AAA Insurance, 2020) an average tank size of 12.5 gallons, has an average estimated miles per gallon of 20 mpg (enabling 250 miles per gallon), and gas costs $2.60 per gallon. Both scenarios have the consumer filling up their vehicle, with electricity and gas respectively, traveling 250 miles, and filling up once a week. It would take nearly 17 years for the price of the gas car to exceed the cost of the electric vehicle, should the consumer solely use the supercharger network at that rate, holding everything else constant. This was calculated by taking the initial cost of the vehicle plus the sum of maintenance costs and fill up costs each year. Excluding factors such as the Autopilot, Full-Service Driving Capabilities, and other perks of owning a Tesla, unless the consumer is wanting to keep the vehicle far past the average period a car is held for and about six years after the average lifespan of a vehicle, simply the costs of owning an electric vehicle do not make sense and cannot be justified by the money alone.

Initial Cost	Maintence Costs	Fillup Costs			20 mpg vehicle	250 miles	per week									
60500	200	832		1032	12.5 gallons per week											
40000	600	1690		2290	gas price of $2.60											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
61532	62564	63596	64628	65660	66692	67724	68756	69788	70820	71852	72884	73916	74948	75980	77012	78044
42290	44580	46870	49160	51450	53740	56030	58320	60610	62900	65190	67480	69770	72060	74350	76640	78930

The Myth of Range Anxiety - (hint: it's a lie):

According to John, Andrew, and Trevor, there is no thought of range anxiety or worry when comparing their Tesla's to their gas-powered vehicles. Being a Tesla customer means you have access to 3rd party charging plus the 20,000 stalls. Natively, Tesla's on screen display (OSD) will provide info on the quantity of public supervision chargers available real time. While the data reported on availability is highly accurate, some chargers do have issues and that's entirely understandable. However, Andrew mentioned that the speed and availability were very reasonably accurate enough to feel comfortable with planning his route. There is full-confidence in Tesla Superchargers being available for charging, but other networks much less so. A supercharger stall stands tall and Tesla signs the spots well to prevent people from parking there. Additionally, the charging network is almost seen as superior to a gas station because they put them frequently near good food options versus gas stations, so consumers can get bathrooms and also good food options /amenities, instead of nasty bathrooms and poorer food options in and near typical gas stations.

The only pitfall is that it can be challenging to determine wait times when charging was at full capacity, but this was not a frequent occurrence fortunately. Most stops are within 20 minutes, which is confirmed by the data above, just enough to make it to the next charging location. Charging while low is "better bang for the buck" as far as return on investment (ROI) on time investment goes; therefore the vehicle typically runs between 5-10% and 70% charge.



For instance, this is a track of Trevor's most recent road trip from Indiana. Out of the twenty hours it took to arrive, only roughly three hours were spent driving. This means about 85% of the entire drive was spent solely on the road - this is excellent! Trevor mentioned that when he made his stops, he was not solely just sitting there doing nothing; only roughly thirty minutes of that was true waiting time. The other time was time spent doing road trip activities like stretching his legs, using the restroom, eating, etc. Factoring in everything except thirty minutes, it is mentioned that only 0.025% of the trip was "wasted" due to having to stop and use a Supercharger.

Fundamentally, the concept of range anxiety for an electric vehicle is no different than that of a combustion engine. Those who claim otherwise have falsely made preconceived ideas, and if anything, more supercharger stations available should help reduce that anxiety.

Impacted Parties:

State	Lakeland County	Residents

Social Costs	**State**	**Lakeland County**	**Residents**
Costs For Charging Stations	50,000* 5,182 = 259,100,000	1000*1,628,000= 1,628,000 50,000* 22= 1,100,000 2,728,000 total	1,000
Cost to wait for charging	383,468 * 25.19= 9,659,558.92	41,009.32	25.19/per hour
Cost for an EV	0	0	60,000 +
Total	268,759,558	2,769,000	61,025.19-one time costs

Social Benefits	State	Lakeland County	Resident
Reduction in Carbon emissions	212 * 383,468= 81,295,216	212 *1628= 345,136	212
EV	60,000* 383,468 = 23 billion/5 years	60,000 * 1628 = 97,680,000	0
Eliminating purchase of gasoline	498*383,468 =190,967,064	1628*498= 810,744	498
Total	272,262,303	98,835,880	710/per year

We defined Q = # of cars

P = # of gas stations

Our first assumption is for P = we used the elasticity for gas gallons / station, which is -2.37. In determining the Number of gas stations in FL: 7,043, this gives us a total supply, as charging stations would be used in gas station lots. So with a ratio of 1:74 to users we we can determine the total amount of EV users in FL using the market ratio, which is 74 * 7,043 = 521,182 users in FL. With the average of 80% charge at home, we know that the total amount of users at home in FL will be , .8 * 521,182 = 416,945. Meaning that, for public stations, 104,236 users need the availability of public stations in FL. Looking at the lakeland county level, with 93 gas stations * 74 EV users, we can get an estimate of 6,882 total EV users possible in Lakeland. 6,882 * .8 = 5,505 users charge at home with 1,376 needing public charging stations.

Elasticity for gas = -2.37

Cost for using charging stations: .030 cents per mile

Sensitivity Analysis												
Assumptions	State	Lakeland				Users charging in public stations						
					11,008	20	40	80	93	120	140	160
charging stations public	104,236	1,376		Price	$20	160	320	640	744	960	1120	1280
Price/station	168	20			$17	100	200	400	465	600	700	800
Cost/station	136	12			$16	80	160	320	372	480	560	640
					$14	40	80	160	186	240	280	320
					$13	20	40	80	93	120	140	160
					$8	-80	-160	-320	-372	-480	-560	-640
					$6	-118	-236	-472	-548.7	-708	-826	-944

Conclusion:

Overall, there are varying options that the state and county can undertake. The demand for electric vehicles is taking the world and automobile market by storm as climate change becomes more prevalent. Tesla is incredibly exclusive due to the capability of the supercharger network and the requirements to charge at one of their stations. Consumers who are buying an Electric Vehicle, specifically a Tesla, at some point will be using the network. To aid in distilling range anxiety and reduce the amount of charging time, more superchargers must be built. Lakeland, and Florida Polytechnic in particular, is in a great location due to their geographical proximity to I-4, a route with lots of demand for vehicle usage. As the future evolves, Florida Polytechnic and Lakeland have the ability to become leaders at the forefront of this change and fight against climate change, as well as have their own Tesla Supercharger on campus. The costs for the county and state will increase, but these are offset what it benefits the consumer and the planet. Adding more superchargers enables the ability to grow the electric vehicle market and therefore meet future demand. It is best to invest now for the future's sake, rather than investing in the future.

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