



Comparative Study:

Electric Vehicles vs. Combustion Vehicles



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Abstract

In 2017, a study for Greenhouse emissions discovered that 82% of these emissions are Carbon Dioxide and its main cause is the production of gasoline and diesel for transportation. It's believed that Electric Vehicles may help to solve this problem in decreasing the amount of Carbon Dioxide in the atmosphere, for this reason this type of vehicle has been popularized. For this reason, a study on the Electric Vehicle, Kia Soul EV 2019 was made. We wanted to know the consumption of these types of vehicle, to be able to know if its cost effective for people and if it really helps to decrease the levels of CO₂. Some of the results we obtained, stated that in the year 2020 is not cost effective to own an Electric Vehicle but for 2017 and 2014 it was a viable option to own, since gasoline prices were to high. Due to the COVID-19 pandemic, we weren't able to do the CO₂ study, but we will execute it in the future.

Introduction

According to the Environmental Protection Agency in 2017, a study for Greenhouse gas emissions was made and it resulted that 82% of those emissions were carbon dioxide. This gas is naturally present in the atmosphere, but human necessities are increasing it. The main cause for this increase is the combustion of fossil fuels in transportation for the production of gasoline and diesel. For this reason, many scientists say that one of the options to reduce the amount of carbon dioxide in the atmosphere are Electric Vehicles. An electric vehicle is a “ground vehicle propelled by a motor that is powered by electrical energy from rechargeable batteries or other source onboard the vehicle, or from an external source in, on, or above the roadway.” (Anglin, 2016) The use of these types of vehicles has been more popularized since people started to comprehend the urge of climatic change and how it's affecting the planet Earth.

Objectives

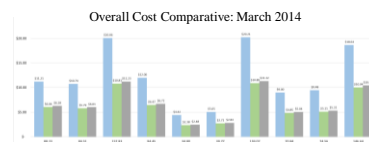
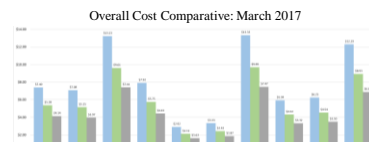
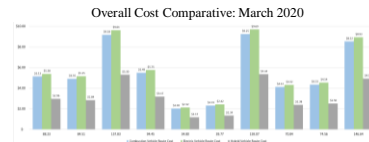
The purpose of this investigation is to study the alternatives in vehicular transportation. Also, to investigate the operation and types of electric vehicles like hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicles and fuel cell electric vehicles. Finally, to study the Kia Soul EV and compare the vehicle's performance against the manufacturer's specifications. For this investigation, the Polytechnic University of Puerto Rico will provide an electric vehicle to be studied.

Methodology

- Search for the manufacturer's data for the vehicles to be studied.
- Search for the cost of gasoline and how much is the kilowatt by hour for three different years.
- Map out the routes to be studied.
- Compute the cost per mile of each vehicle and the cost of each motor of the hybrid vehicle using manual formulas what will be presented in Microsoft Excel program
- Document data obtained.
- Compare and analyze the results obtained.
- Develop a conclusion based on the results obtained.
- Develop recommendations for the research based on the results obtained.
- Develop a list of aspects with potential improvement for the research.
- Final report development
- Poster development
- Final presentation



Data



Hybrid Vehicle: Electric and Gasoline Motor Cost Comparative
 March 2020

Route number	Round trip	Distance (mi)	Distance (mi)	Electric motor cost	Gasoline motor cost	Total motor cost
1	Home (Cales) to Plaza Las Americas (San Juan)	142	88.23	\$ 0.00	\$ 4.24	\$ 4.23
2	Home (Cales) to Plaza Las Americas (San Juan)	136	84.51	\$ 0.00	\$ 3.97	\$ 4.00
3	Home (Cales) to UPRM (Mayaguez)	294	187.78	\$ 0.00	\$ 7.43	\$ 7.50
4	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	152	94.45	\$ 0.10	\$ 4.43	\$ 4.53
5	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	56	34.80	\$ 0.04	\$ 1.43	\$ 1.47
6	Home (Cales) to Vega Baja Beach (Vega Baja)	64	39.77	\$ 0.02	\$ 1.29	\$ 1.30
7	Home (Cales) to El Yunque National Forest (Río Grande)	256	159.07	\$ 0.35	\$ 7.47	\$ 7.83
8	Home (Cales) to Cueva Ventana (Arecibo)	114	70.84	\$ 0.08	\$ 3.31	\$ 3.40
9	Home (Cales) to PUCPR (Ponce)	120	74.56	\$ 0.08	\$ 3.50	\$ 3.58
10	Home (Cales) to Palmas del Mar (Ponce)	236	146.64	\$ 0.15	\$ 6.88	\$ 7.03

Hybrid Vehicle: Electric and Gasoline Motor Cost Comparative
 March 2014

Route number	Round trip	Distance (mi)	Distance (mi)	Electric motor cost	Gasoline motor cost	Total motor cost
1	Home (Cales) to Plaza Las Americas (San Juan)	142	88.23	\$ 0.00	\$ 2.87	\$ 3.10
2	Home (Cales) to Plaza Las Americas (San Juan)	136	84.51	\$ 0.14	\$ 2.75	\$ 3.09
3	Home (Cales) to UPRM (Mayaguez)	294	187.78	\$ 0.20	\$ 6.14	\$ 6.34
4	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	152	94.45	\$ 0.15	\$ 3.07	\$ 3.22
5	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	56	34.80	\$ 0.06	\$ 1.33	\$ 1.39
6	Home (Cales) to Vega Baja Beach (Vega Baja)	64	39.77	\$ 0.07	\$ 1.23	\$ 1.30
7	Home (Cales) to El Yunque National Forest (Río Grande)	256	159.07	\$ 0.26	\$ 5.38	\$ 5.64
8	Home (Cales) to Cueva Ventana (Arecibo)	114	70.84	\$ 0.12	\$ 2.31	\$ 2.43
9	Home (Cales) to PUCPR (Ponce)	120	74.56	\$ 0.12	\$ 2.43	\$ 2.55
10	Home (Cales) to Palmas del Mar (Ponce)	236	146.64	\$ 0.24	\$ 4.77	\$ 5.01

Hybrid Vehicle: Electric and Gasoline Motor Cost Comparative
 March 2014

Route number	Round trip	Distance (mi)	Distance (mi)	Electric motor cost	Gasoline motor cost	Total motor cost
1	Home (Cales) to Plaza Las Americas (San Juan)	142	88.23	\$ 0.00	\$ 6.28	\$ 6.28
2	Home (Cales) to Plaza Las Americas (San Juan)	136	84.51	\$ 0.00	\$ 6.03	\$ 6.11
3	Home (Cales) to UPRM (Mayaguez)	294	187.78	\$ 0.18	\$ 11.23	\$ 11.41
4	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	152	94.45	\$ 0.11	\$ 6.12	\$ 6.23
5	Home (Cales) to Aeropuerto Luis Muñoz Marín (Carolina)	56	34.80	\$ 0.04	\$ 2.48	\$ 2.52
6	Home (Cales) to Vega Baja Beach (Vega Baja)	64	39.77	\$ 0.05	\$ 2.43	\$ 2.48
7	Home (Cales) to El Yunque National Forest (Río Grande)	256	159.07	\$ 0.18	\$ 11.34	\$ 11.52
8	Home (Cales) to Cueva Ventana (Arecibo)	114	70.84	\$ 0.08	\$ 5.00	\$ 5.12
9	Home (Cales) to PUCPR (Ponce)	120	74.56	\$ 0.08	\$ 5.31	\$ 5.39
10	Home (Cales) to Palmas del Mar (Ponce)	236	146.64	\$ 0.17	\$ 10.44	\$ 10.60

Analysis and Results

On 2020, the gasoline price was \$0.43 per liter and the kilowatt hour cost was \$0.23. The results for this study was that the electric vehicle the most expensive in consumption. On 2017, the gasoline price was \$0.62 per liter and the kilowatt hour cost was \$0.23. For this study it resulted that the combustion vehicle was the most expensive in consumption. Lastly, for 2014 the gasoline price was \$0.94 per liter and the kilowatt hour cost was \$0.26. In this study we obtained similar results as the year 2017, the combustion vehicle was the most expensive in consumption. For the year 2020, the electric motor cost ranged from \$0.04 to \$0.16 and the gasoline motor cost ranged from \$1.13 to \$5.14. On 2017, the electric motor cost ranged from \$0.04 to \$0.16 and the gasoline motor cost ranged from \$1.63 to \$7.47. Lastly, on 2014, the electric motor cost ranged from \$0.04 to \$0.18 and the gasoline motor cost ranged from \$2.48 to \$11.32.

Conclusion and Recommendations

Due to the COVID-19 pandemic conditions readjustment in the methodology had to be made, therefore theoretical data was used instead of experimental data. The pandemic changed gasoline prices drastically, in order to obtain a more real study, three years were used for the cost comparative.

What is the best option?

For 2020, the combustion vehicle.
 For 2017, the hybrid vehicle.
 For 2014, the electric vehicle.

For electric vehicle to be a viable option in PR:

- Promote more laws and incentives
- Build more charging stations

Future work

- Test drives on the proposed routes and calculate all the values using the experimental data, to compare them against the theoretical values calculated in this research.
- Study how much Carbon Dioxide emissions will be reduced using this vehicle.
- Study how many people would need to purchase this vehicle to be able to make a difference on the CO₂ emissions.

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