William Yen – 109879163

Professor Stacey Suver

CSE 300

3 October 2016

An Electric Future

With rising levels of pollution and concern about climate change, people are looking for other ways to reduce their carbon footprint and be more environmentally aware. One of the biggest contributing factors to the rising pollution levels is CO_2 emissions from cars. Recently, car manufacturers have been taking a step towards becoming more environmentally friendly by researching and developing electricity powered vehicles. Companies like Chevrolet, Toyota, and Tesla are making electric vehicles not only more accessible, but also a more attractive option to consumers. A lot of research has been done over the past few decades, but electric vehicles have just started to rise in popularity. As a result, we need to be able to evaluate what we learned previously to make further advancements in technology in electric vehicles. Electric vehicles present a whole list of advantages over standard gasoline-powered vehicles, especially for car buyers looking to be more environmentally friendly.

The biggest advantage that electric vehicles (EVs) have over conventional gas-powered cars is that they use electricity, rather than gasoline. As a result, electric vehicles do not burn fossil fuels. In an article for the Salem Press Encyclopedia, Kaushik Ranjan, an associate professor at TERI University, notes that since electric vehicles do not need an internal combustion engine, they do not release anything from the exhaust, therefore do not cause pollution. However, even though the car itself does not require the burning of fossil fuels to run, Ranjan does not take into account of the costs to provide the electricity. Unless the energy comes

from a renewable resource, such as solar or wind power, it is inaccurate to say that electric cars do not contribute to pollution at all. In fact, some studies show that electric could emit even more pollutants than standard gasoline vehicles from sources other than the exhaust.

In a journal article in Science Magazine, Lave, Hendrickson, and McMichael discuss the environmental implications of electric cars. The journal article states that generating energy for recharging batteries as well as the manufacturing of the batteries causes considerable harm to the environment (993). However, the article fails to mention that the batteries in gas powered cars also use lead acid batteries to power the car. It's more accurate to say that manufacturing electric car batteries is just as harmful to the environment as internal combustion engine vehicle (ICEV) batteries. The article goes on to talk about other side effects of a rechargeable battery inside a car, such as increased weight. The weight of the car plays a big role in its fuel or energy efficiency and can also effect its emissions (994).

In a study done by Victor Timmers and Peter Achten from the University of Edinburgh, it was found that electric and hybrid vehicles actually worse for the environment and pollute more than gas-powered cars. Their research shows that the increased weight from electric cars releases a substantial amount of particulate matter from non-exhaustive sources, such as tire wear, brake wear, and road surface wear. Timmers and Achten compares 9 gas powered vehicles with an electric powered counterpart and found that as of 2016, the electric counterpart is about 24% heavier on average (12). While it is true that weight plays a major role in non-exhaustive emissions, it is not enough to claim that electric vehicles pollute more than internal combustion engine vehicles. Timmers and Achten only compares non-exhaustive emissions, but the total exhaustive and non-exhaustive emissions from ICEVs is greater than emissions from EVs. In fact, according to a report by the Union of Concerned Scientists, in a full life cycle of an electric

car, an electric car will emit almost half as much as an ICEV. Furthermore, some car manufacturers, like BMW, are implementing brake energy regeneration technology which can reduce particulate matter emissions and brake pad wear by up to 66% (Ranjan). Much of Timmers and Achten's research is based on current electric or hybrid cars, but new technology and research in electric cars is relatively new. Especially since weight plays a major role in the energy efficiency and range of a car, reducing the weight of EVs will be a major focus for car manufacturers.

Another point that Lave, Hendrickson, and McMichael make is that the price of buying an electric car does not justify its maintenance costs and environmental harm from manufacturing and driving the car. The article says that electric cars are a lot more expensive to manufacture and purchase. If we take a look at the current prices of EVs and their ICEV counterparts, we can see that this claim is definitely true. For example, the MSRP of a 2017 Ford Focus is around $16,000 while the 2017 Ford Focus Electric is around $30,000—almost two times the price (994). Furthermore, the heart of the electric car, the battery, is much costlier to replace than the car battery of an ICEV. Ranjan says that according to the International Energy Agency, at the current price estimate of battery prices, at $500/kWh, it would cost almost $35,000 to $40,000 to replace a 70kWh battery for a EV. However, Ranjan goes further and shows that even though the cost upfront and battery replacement costs are higher for electric vehicles, in the long run, the overall cost of an EV is much cheaper than an ICEV. In an analysis of gas refill costs versus battery charging costs, EVs came out ahead. Electricity prices are more stable compared to the fluctuating and generally more expensive gas prices. Over five years, a driver of an electric vehicle can expect to save up to $10,000 from not needing to refill gas. Furthermore, Ranjan's research on emerging rechargeable car battery technology refutes Lave,

Hendrickson, and McMichael's claim about EV maintenance costs. Ranjan uses Chevrolet as an example to show that car manufacturers are researching new technology to dramatically reduce prices and improve the lifespan of car batteries. Chevrolet announced that their newest Chevrolet Bolt will have a battery priced at only $145/kWh. A car battery may last 12 to 15 years and even if it dies, it can be replaced at prices that will only go down as EVs become more popular (Hootfman 13).

Lave, Hendrickson, and McMichael also go on to say that the biggest problem with EVs is that the range of an EV is not on par with ICEVs, especially with accessory power drains, like air conditioning and heating (995). However, this report was written in 1995. Since then, technology and research in batteries and electric cars has advanced far enough that this is not a problem for the average consumer. A study conducted by Jessika Trancik shows that even the least efficient electric vehicle out on the market right now is enough for the average consumer. She says, "Roughly 90 percent of the personal vehicles on the road daily could be replaced by a low-cost electric vehicle available on the market today, even if the cars can only charge overnight." If 90% of drivers today switched from ICEVs to EVs, the U.S. could potentially reduce up to 25% of its carbon footprint by 2025. It would be great if 90% of all drivers would be able to switch to electric cars without a problem, but it is hard to generalize the driving behaviors for 90% of all 100 million drivers in the U.S. The study's claim is only true if every driver drives the average amount. The claim does not account for days when energy consumption is higher, such as during vacations or when the air conditioner or heat is turned on higher than normal. However, the point of the claim still stands. For most people, an electric car is more than enough and especially with the advantages that come with owning one.

The advantages of electric vehicles outweigh its disadvantages compared to gas powered cars and making the switch is an essential step towards being an environmentally aware society. Even though there are many advantages of switching 90% of drivers to EVs, it comes at a steep cost. Not everyone has a driveway or a garage with an electric battery charger and even for those that do, they will not always have access to it. To be imagine a future of electric vehicles being the gas powered cars of today, the entire energy supply infrastructure will need to change to accommodate everyone. However, if we want a truly sustainable future, this is what we need to do.

Works Cited

Hooftman, Nils and Luis Oliviera. "Environmental Analysis Of Petrol, Diesel And Electric Passenger Cars In A Belgian Urban Setting." *Energies* (2016): 1-24. Web.

Lave, Lester B., Chris T. Hendrickson and Francis Clay McMichael. "Environmental Implications of Electric Cars." *Science* (1995): 993-995. Web.

Ranjan, Kaushik. "Electric Vehicles." January 2016. *Salem Press Encyclopedia.* Document. October 2016.

Timmers, Victor R.J.H and Peter A.J. Achten. "Non-exhaust PM emissions from electric vehicles." *Atmospheric Environment Volume 134* (2016): 10-17. Web.

Trancik, Jessika E., et al. "Potential for widespread electrification of personal vehicle travel in the United States." *Nature Energy* (2016). Web.