

# Journal of Interdisciplinary Science Topics

---

## The Global Importance of Zero-Emission Vehicles

Elizabeth O'Meara

*Honours Integrated Science, McMaster University*

05/04/2019

### Abstract

This paper discusses the effect that zero-emission vehicles, such as the Tesla model 3, could have first in the reduction of CO<sub>2</sub> emissions in the UK and then its global potential. This paper only investigates the CO<sub>2</sub> emissions released by vehicles when being driven, and disregards those which are produced during production of the vehicle, and when charging a Tesla. Given the average CO<sub>2</sub> emissions per car, the number of registered cars in the UK, and the average annual mileage per vehicle, it is found that the entirety of the registered cars in the UK produces 48.6 million imperial tons of CO<sub>2</sub> each year. In comparing this value to those of countries which account for large percentages of the global CO<sub>2</sub> emissions, such as the United States and China, 511 million and 1.4 billion imperial tons respectively, it is evident that replacing all vehicles with a zero-emission vehicle such as the Tesla model 3 has great potential for the global reduction of annual CO<sub>2</sub> emissions.

---

### Introduction

As global warming becomes an increasingly dangerous issue across the globe, it is crucial that adjustments are made to reduce greenhouse gas and CO<sub>2</sub> emissions by country. In the UK, the transportation sector represents 34% of CO<sub>2</sub> emissions alone [1]. In reducing the CO<sub>2</sub> emissions released per car, this would in turn drastically reduce the CO<sub>2</sub> of the whole country.

In 2009, Tesla revealed the first ever premium all-electric sedan, the model S [2]. Although the government provides a £3500 rebate for those who purchase electric vehicles [3], the model S being valued at £70,000 minimum, was not achievable by the general public [4]. However, with the recent release of the model 3, valued at \$35,000 USD approximately £27,000, the purchase is much more achievable. This paper first investigates the effect of replacing all cars in the UK with the newly released Tesla model 3 on the CO<sub>2</sub> emissions in the UK, then compares this figure to those of countries which represent large percentages of the world's CO<sub>2</sub> emissions.

### Methods and Assumptions

This paper will make the following assumptions:

- Solely the CO<sub>2</sub> emissions of the vehicles in the UK will be considered, neglecting the

emissions released during the production of the vehicle and when charging a Tesla, thus only considering those released when driving the vehicle.

- Since the data for the CO<sub>2</sub> emissions released per vehicle is not available, the average value of 122.1 gkm<sup>-1</sup> will be used to estimate the total amount of emissions in a year [5]. As this value is dependent on distance travelled, the average annual mileage of 7800 miles (approximately 12,552 km) per car will be used [6].
- With the reduced price of the Tesla model 3, it is assumed that all cars in the UK could realistically be replaced with the model 3.

Considering these assumptions, it is possible to calculate the amount of emissions released by the cars in the UK and compare this reduction to that of countries representing large percentages of global CO<sub>2</sub> production.

### Results

In 2017, 32.2 million cars were registered in the UK [7]. With the assumption that the average mass of CO<sub>2</sub> emissions per car, dependent on distance travelled,  $m_d$ , is 122.1 gkm<sup>-1</sup>, and an average annual mileage,  $d$ , of 7800 miles (approximately 12,552 km)

the total annual mass of CO<sub>2</sub> emissions per car,  $m$ , can be calculated using equation 1:

$$m = m_a d. \quad (1)$$

Using equation 1, it is found that each car in the UK will produce  $1.53 \times 10^3$  kg of CO<sub>2</sub> in a single year.

Next the total emissions released annually,  $m_T$ , can be calculated using the total number of cars in the UK,  $N$ , and the previously calculated total annual CO<sub>2</sub> emissions per car,  $m$ , in equation 2:

$$m_T = mN. \quad (2)$$

Using equation 2, the total CO<sub>2</sub> emissions released annually was calculated as  $4.93 \times 10^{10}$  kg, or 48.6 million imperial tons. Using the data for the total CO<sub>2</sub> emissions in the UK of 389.75 metric tons (approximately 383.59 imperial tons), this then represents an approximate annual reduction of 13% [8]. This value is lower than the previously stated figure of 34% as that figure represented the emissions for all transportation while these calculations were based solely on cars.

### Discussion

By replacing every car in the UK with a zero-emission vehicle, for the purposes of this paper the Tesla model 3, it would result in a reduction of 48.6 million imperial tons (approximately 13%) of the country's annual CO<sub>2</sub> emissions. Although, on a global scale, this reduction may seem negligible, it is important to consider the potential for larger countries such as the United States or China, where they represent 13% and 28% of the global CO<sub>2</sub> emissions respectively [8].

Using similar methods as above for the number of registered cars, annual mileage and average CO<sub>2</sub> emissions of vehicles, it is found that with

112,864,228 registered cars, and average emissions of 4.6 metric tons (4.53 imperial tons) of CO<sub>2</sub> per car per year there would be a reduction of approximately 511 million imperial tons (approximately 10%) in the United States [9, 10]. With approximately 310 million registered cars and using the average CO<sub>2</sub> emissions per car of 4.6 metric tons per year there would be a reduction of 1.4 billion imperial tons (approximately 14%) in China [9, 11].

With these figures, it is evident that zero-emission vehicles, like the model 3, are of great importance when it comes to the global reduction of annual CO<sub>2</sub> emissions.

As Tesla has recently released a reduced-price SUV, the model Y, and has begun designing an electric lorry, further investigation has the potential to show the impact of not only replacing all cars with zero-emission vehicles, but also SUVs and lorries [12, 13]. Furthermore, with further investigation, the emissions released in the production of the average CO<sub>2</sub> releasing vehicle can be compared to those released when producing a Tesla. This comparison could further investigate the pros and cons relating to the replacement of all vehicles with zero-emission vehicles.

### Conclusion

This paper aimed to indicate the importance of the implementation of zero-emission vehicles, like the Tesla model 3, which is a recently released, more affordable, zero-emission vehicle, first in the UK, and then globally. It was found that replacing every car in the UK would result in a reduction of 48.6 million imperial tons of CO<sub>2</sub> emissions each year. Although this figure is small in the grand scheme of things, if the same replacements were to be made globally, zero-emission vehicles show great promise in reducing CO<sub>2</sub> emissions on a global scale.

### References

- [1] Department for Business, Energy and Industrial Strategy (2018). *2017 UK Greenhouse Gas Emissions, Provisional Figures*. Department for Business, Energy and Industrial Strategy [online] Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/695930/2017\\_Provisional\\_Emissions\\_statistics\\_2.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/695930/2017_Provisional_Emissions_statistics_2.pdf) [Accessed 6<sup>th</sup> March 2019].
- [2] Tesla (2019). *About Tesla | Tesla*. [online] Available at: [https://www.tesla.com/en\\_GB/about](https://www.tesla.com/en_GB/about) [Accessed 6<sup>th</sup> March 2019].

- [3] GOV.UK. (2018). *Low-emission vehicles eligible for a plug-in grant*. [online] GOV.UK. Available at: <https://www.gov.uk/plug-in-car-van-grants> [Accessed 6<sup>th</sup> March 2019].
- [4] Tesla (2019). *Model S | Tesla UK*. [online] Available at: [https://www.tesla.com/en\\_GB/models](https://www.tesla.com/en_GB/models) [Accessed 6<sup>th</sup> March 2019].
- [5] Topham, G. (2018). *CO<sub>2</sub> emissions from average UK new car rise for first time since 2000*. The Guardian [online] Available at: <https://www.theguardian.com/business/2018/feb/27/co2-emissions-from-average-uk-new-car-rise-for-first-time-since-2000> [Accessed 6<sup>th</sup> March 2019].
- [6] RAC Foundation (2019). *Mobility | General facts and figures about roads and road use*. [online] Available at <https://www.racfoundation.org/motoring-faqs/mobility> [Accessed 6<sup>th</sup> March 2019].
- [7] GOV.UK. (2018). *Cars (VEH02) | Statistical Data Set*. Data on all licensed and registered cars, produced by Department for Transport [online] GOV.UK. Available at: <https://www.gov.uk/government/statistical-data-sets/veh02-licensed-cars> [Accessed 6<sup>th</sup> March 2019].
- [8] Union of Concerned Scientists (2018). *Each Country's Share of CO<sub>2</sub> Emissions*. [online] Union of Concerned Scientists. Available at: <https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html> [Accessed 6<sup>th</sup> March 2019].
- [9] US EPA (2016). *Greenhouse Gas Emissions from a Typical Passenger Vehicle*. United States Environmental Protection Agency. [online] Available at: <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle> [Accessed 6<sup>th</sup> March 2019].
- [10] US Department of Transportation (2017). *Table MV-1 - Highway Statistics 2015*. Policy and Governmental Affairs, Office of Highway Policy Information. US Department of Transportation, Federal Highway Administration. [online] Available at: <https://www.fhwa.dot.gov/policyinformation/statistics/2015/mv1.cfm> [Accessed 6<sup>th</sup> March 2019].
- [11] Money Control (2018). *China has 310 million registered vehicles, 385 million drivers in 2017*. [online] Money Control. Available at: <https://www.moneycontrol.com/news/world/china-has-310-million-registered-vehicles-385-million-drivers-in-2017-2483729.html> [Accessed 6<sup>th</sup> March 2019].
- [12] Tesla (2019). *Model Y | Tesla UK*. [online] Available at: [https://www.tesla.com/en\\_GB/modely](https://www.tesla.com/en_GB/modely) [Accessed 18<sup>th</sup> March 2019].
- [13] Tesla (2019). *Semi | Tesla UK*. [online] Available at: [https://www.tesla.com/en\\_GB/semi?redirect=no](https://www.tesla.com/en_GB/semi?redirect=no) [Accessed 18<sup>th</sup> March 2019].