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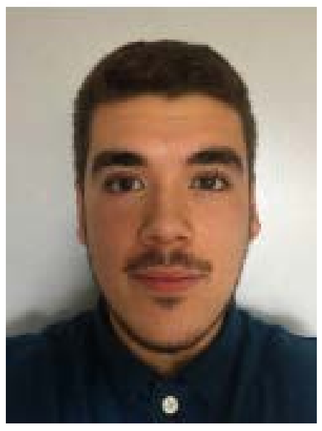

A Theoretical Deployment of an Electric Drivetrain on an Existing Delivery Vehicle

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Image of the Tesco van used for the drive cycle testing

Introduction

Global warming is becoming a grater concern as the amount of CO_2 increases. The transport industry contributes a considerable amount of CO_2 into the atmosphere. Light duty vehicles contribute 11.9% of the CO_2 produced in the transport industry. This is supported by pie chart below showing the amount of CO_2 each sector pollutes. This report investigates the impact of changing a standard diesel van to a electric van and the affect on CO_2 pollution. In this case, Tesco deliveries is tested due to its base to base operation which would prove ideal for to test the theory.

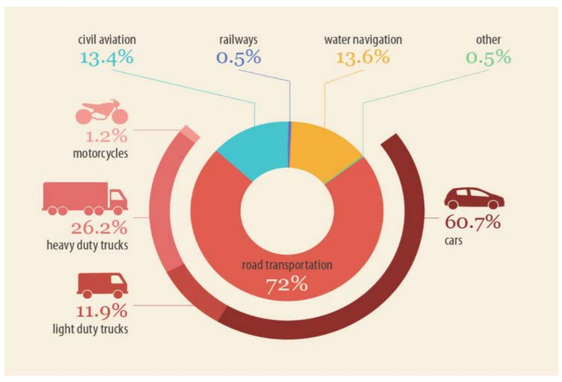


Image of the CO_2 emissions in the EU (European Parliament, 2019; Andrew & Peters, 2013)[1]

Project Aims

To ensure the project was going in the right direction, Project aims was created. Project aims is below:

- Identify the existing van output by conducting a drive cycle.
- Investigate and identify a suitable electric drivetrain.
- Identify and compare the CO_2 output of both diesel and electric drive train.

Methodology

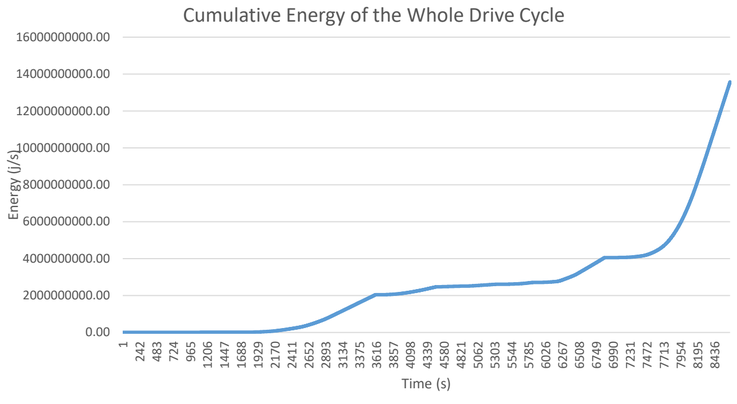
The drivetrain sizing and the CO_2 investigation is based on live data recorded from the Tesco van. The route selected is representative of the delivery types the vehicle undergoes e.g. long distance, multiple drops in close vicinity, gradients etc.

One of the main aspects of the drive cycle that was particularly calculated was the amount of energy it took to conduct all of the deliveries. This is mainly important to identify a adequate electric drive train.

Once the drive train was selected, the CO_2 output was investigated. This was done by multiplying the provided CO_2 output per Km (release from the manufacturer under NEDC test conditions) and the distance travelled. The validity of the test was questioned so the BSFC of the drive cycle was identified. These two methods revealed the amount of CO_2 the Diesel Tesco van emitted. For comparison, the electric CO_2 was identified by identifying the UK's energy pollution statistic. This was then multiplied with the amount of energy used throughout the run.

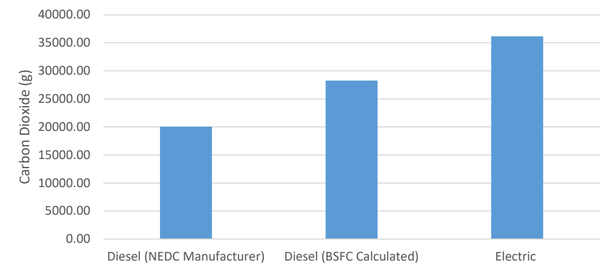
Results

The drive cycle data and calculations revealed the output of the standard van. This data includes maximum power, tractive effort and torque at the wheels and the flywheel. Additionally the cumulative energy is identified which is illustrated by graph 1 which shows that amount of energy used throughout the run. Using this data, a suitable drivetrain is identified. With efficiencies in mind, a suitable gearbox & differential, motor, motor controller, chiller unit and battery was selected that was adequate for the task.



Graph 1 of the Cumulative Energy Output of the Whole Drive Cycle

Once the system was selected, the CO_2 of the systems was compared. Using the drive cycle data, the CO_2 was calculated using the manufactures stated CO_2 emissions per km. It was revealed that the total amount of CO_2 emissions is 20,052.98 grams. This was validated by investigating the brake specific fuel consumption for each second which revealed to be 27,960.03 grams which is relatively similar. The electric system is calculated by using the UK's CO_2 emission per KWh of electricity which gives a total CO_2 amount of 36.175.40 grams. This is reflected in the bar chart below.



Bar Chart 1 specifying the CO_2 output of Diesel and Electric drivetrains

Conclusions

Looking at the data of the CO_2 shows that the standard vehicle pollutes between 25%-57% less CO_2 than the electric system. This is due to the amount of fossil fuels the UK government utilize to generate electricity. If the energy generation produced less co2 then the electric system would be ideal. Additionally, the comparison isn't accurate due to the diesel CO_2 production not being taking in account. In future tests and investigations, all of environmental impacts needs to be accurately compare the two systems.

References

[1]European Parliament, 2019. CO2 emissions from cars: facts and figures. [Online] Available at: https://www.europarl.europa.eu/news/en/headlines/society/20190313STO31218/co2-emissions-from-cars-facts-and-figures-infographics [Accessed 13 April 2020].

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