

Major Project Questions

Project Title: A Theoretical Deployment of an Electric Driveline on an Existing Delivery Vehicle

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Question 1

You present some interesting data on CO₂ emissions to justify your study.

Figure 1. What happened in 1998-99 to cause such a shift?

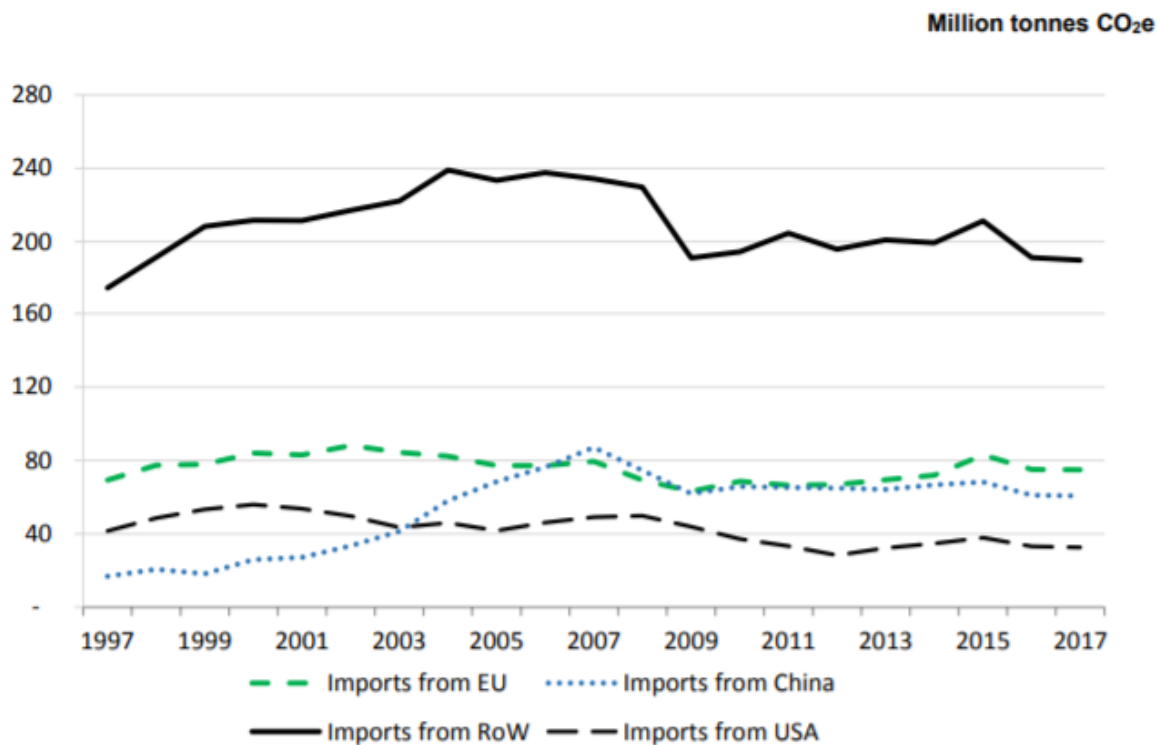
Figure 2 What transport makes up the 'green' other 0.5%?

Question 1 Response (maximum 200 words)

In figure 1, Shows an increase in CO₂ production in the majority of industries due to the increase in import and exportation of goods. This is supported in the following table where which shows the emissions of the importation of goods in several regions in the world. This matches the CO₂ emissions pattern of the sharp increase in CO₂ between 1998-1999.

(Department for Environment, Food and Rural Affairs, 2017)

Figure 3 Breakdown of consumption emissions by region of import 1997 to 2017



Department for Environment, Food and Rural Affairs, 2017.

On figure 2, the green section making up 0.5% of the CO₂ emissions is Bus and coach travel.

Question 2

Looking at figure 8 Cumulative energy for the whole run.
What is happening for the first 2015 second?
What does the annotation indicate?

Question 2 Response (maximum 200 words)

On figure 8 doesn't visually show the cumulative energy due to the size of the graph and the scale of the results. Additionally, the first section of the run is low in comparison of the rest of the run giving the illusion that there are no results.

The annotation was supposed to indicate the areas where energy can be recovered with an energy recovery system. I accidentally mislabelled the annotation. With the energy at that particular point illustrates a decrease in energy which would occur under braking which can be utilised to generate additional energy.

Question 3

Figure 12 shows the 'Sainsburys Ice Pack' system for transportation of frozen product.
Please explain how this works in conjunction with the Carrier Pulsor 350 unit.
Please explain the refrigeration power / energy comments 2,610wh?
How is this solution more efficient than the current Tesco system (assuming that vehicle is plugged in when in the depot)

Question 3 Response (maximum 200 words)

The ice pack system works by initially freezing an icepack in-store. The frozen icepack is then inserted added with the frozen items as well as an insulated jacket. The frozen arrangement is inserted in the chiller section of the van where the Carrier Pulsor 350 unit is utilised to chill the chiller. This decrease in the ambient temperature prolongs the time the icepack stays frozen

The listed Refrigeration energy is listed on the manufacturers website and to test the using for accuracy would mean a unit would need to be tested separately to identify an accurate energy output.

The Tesco system uses two compartments, a chiller and freezer. Naturally, it would consume more energy for both compartments to get to the required temperature. If the Tesco cooling method would be used on the electric system, then the energy draw would be higher than just using a single chiller system as identified in the document.

Question 4

You discuss the arrangement and capacity of the battery pack. How much 'spare' capacity have you chosen, what depth of discharge will you use, how will this effect battery health and life?

Question 4 Response (maximum 200 words)

It was revealed in the drive cycle that the energy used to complete was relatively high (125.92 kwh). The battery was selected with the minimum requirement in mind meaning that I have chosen the battery with additional capacity to so that the vehicle doesn't run out of charge to complete the run. The battery consisted of two banks of 13 Tesla modules giving a total of 26 batteryys and a capacity of 137.80 kwh. With this in mind, the depth of discharge of the battery based on the calculated drive cycle is 91.37%. By discharging the battery to this extent can cause stress the battery and cause the capacity to fade. It is typically recommended to discharge the battery to no more than 80% to avoided fade. These figures is reliant on the battery storage capacity and not the energy that can be restored. If an energy recovery system was factored in the energy usage, then the battery depth of discharge would be less.

Question 5

How did the mass of the batteries and electric driveline compare to the ICE and diesel fuel storage? Which mass(es) did you use for calculating the diesel used and the electric kwh used for the duty cycles?

Question 5 Response (maximum 200 words)

The mass of the batteries was identified to be 648kg, motor is 9.1kg and the controller is 5.7 kg so total the electric drivetrain 662.8kg. The dry weight of the Iveco 2.3 engine weighs 280kg. Additionally, the diesel tank can store 85 litters which can be multiplied by diesel weight per litter which is 0.832kg giving a tank weight of 70.7kg. The ICE drivetrain has a total weight of 350.7kg. This means that the electric system is 297.3kg more than the standard engine.

The mass of the drive cycle was based on the mass of the vehicle on the day of the drive cycle. Before starting, the weight is known due to driving licence weight restrictions of 3.5 ton. The mass of the vehicle is given to us at the start of each run and additionally the mass decrease for each drop is listed. The mass difference per drop is factored in the calculations so the rolling resistance can be accurate. I kept the drive cycle mass the same for the diesel and electric systems but in hindsight to maintain accuracy in the electric system drive cycle, the mass difference should have been factored in.

Bibliography

Department for Environment, Food and Rural Affairs, 2017. *UK's Carbon Footprint 1997 – 2017*, London: Department for Environment, Food and Rural Affairs.