A3_5 Fifty Shades of CO$_2$

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November 18, 2019

Abstract

In this article we consider the environmental effects if the *Fifty Shades of Grey* series had not been published. We investigate the number of trees required to produce all the books sold and relate this to the amount of carbon that could have been stored had these trees remained in place since date of publishing. Using this we found the amount of CO$_2$ that could have been stored in these trees to be 179,200 tonnes. This is a negligible amount when compared to road transport and power station emissions for just one day.

Introduction

The *Fifty Shades of Grey* series by E.L James is one of the fastest selling book series of all time, selling a total of 150 million copies worldwide [1]. However, they are also considered by many critics to be one of the worst written books of all time. We will therefore be considering the environmental impact of the publication of these books by determining how much carbon could have been captured if the trees used in the publication process had continued to grow.

Theory and Results

One of the biggest contributors to climate change is carbon dioxide (CO$_2$), which is captured by trees as they grow. To determine how much CO$_2$ is captured by each tree we first need to determine how many trees were used to produce the trilogy. Using experimental methods (weighing various novels), we determined the weight of a standard page to be 7.7×10^{-4} $\pm 5 \times 10^{-4}$ kg and the number of pages in each *Fifty Shades of Grey* book to be 550, assuming all books contained the same number of pages. In equation (1), M_p is the mass of one page, N_p is the number of pages in the trilogy, N_B is the number of books sold, and M_t is the mass of paper produced per tree [2]. We can determine the number of trees, N_T, used to produce 150 million copies of the books, which we found to be 1.69 million.

$$N_T = \frac{M_p N_p N_B}{M_t} \qquad (1)$$

The paper making process uses a combination of both softwood and hardwood trees which are harvested when they reach a height of 12 m and a diameter of 0.2 m [2]. Two of the commonly used softwood and hardwood trees are Pine and Birch respectively [3], and we assume that the number of trees is split evenly between both species.

The amount of carbon stored within a tree is 50% the dry mass of the tree [4], therefore by determining the mass of carbon held by each tree during its lifetime we can then determine how much carbon a tree takes in each year. This is done by using equation (2), where r is the radius of the tree, h is the height of the tree, and the densities, ρ, of Birch and Pine are 0.67×10^3 and 0.51×10^3 kgm^{-3} respectively [5]. We find that the mass of carbon, M, stored for a single Birch

tree is 127.3 kg and 96.9 kg for a single Pine tree.

$$M = \frac{1}{2}\pi r^2 h \rho \qquad (2)$$

We then need to determine the age of the trees at 12 m before they were harvested by looking at their respective growth rates which were found to be 0.4 m per year for a Birch [6] and 0.5 m per year for a Pine [7], giving an age at harvest of 30 and 24 years respectively. Dividing the mass of carbon per tree by these values gives the rate of carbon taken in by an individual tree per year, which was found to be 4.24 kg year^{-1} for Birch and 4.03 kg year^{-1} for Pine.

The final installment in the *Fifty Shades of Grey* trilogy was first published in 2012. For ease we will take this date to be the date that all the trees used in publication were harvested, giving a time since harvest of seven years, at the time of writing. Using this value we can calculate the amount of carbon that could have been captured by these trees over the seven years since publication for all 1.69 million trees. This results in a total of 48,900 tonnes of carbon that could have been stored. With the addition of the mass of oxygen to this value, and assuming all the carbon stored resulted from the processing of CO_2, we find that 179,200 tonnes of CO_2 could have been captured had these books not been published.
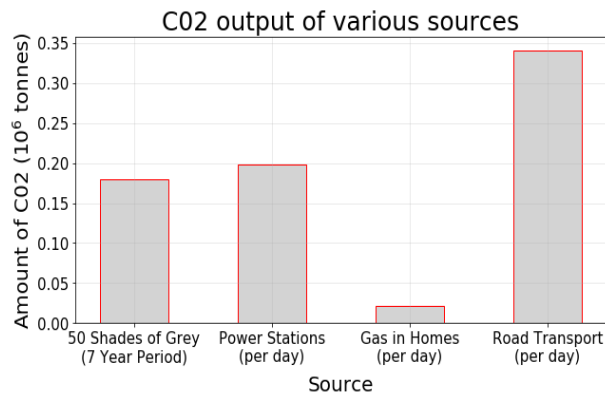

Figure 1: Comparison of the CO_2 emissions from various UK sources (2017) [8].

Discussion

From Figure 1 we can see that the amount of CO_2 that would have been captured over the seven year period if the trees had not been har-

vested is rather insignificant. For example, the value found for the trees over seven years is 91% that of all the emissions from all UK power stations in one day, and 53% that of the UK road transport emissions for one day. The comparison shown in Figure 1 suggests that the effect the production of the *Fifty Shades of Grey* book series had on the environment is relatively small and therefore would not be a major contributor to global warming. However this estimated value of CO_2 has not taken into account the carbon footprint included in the transportation and manufacture of these books, which may greatly affect the overall CO_2 budget. This could be investigated in a future paper.

Conclusion

We found the amount of CO_2 that could have been captured if the books had not been published to be 179,200 tonnes, and that this is negligible when compared to the emissions of power stations and cars for a shorter time period. Therefore we cannot use environmental factors as a reason for these books not being printed.

References

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