

## What is the best device for reading in terms of CO<sub>2</sub>?

There are different environmental advantages between electronic devices and books. Once a book is produced its carbon footprint is set, but every time you buy a book you will add 2.7 kg of CO<sub>2</sub> to your carbon footprint (Wells *et al.*, 2012). Electronic devices on the other hand can store a vast amount of books, are responsible for high CO<sub>2</sub>-emissions during production, and (indirectly) produce CO<sub>2</sub> during their use. The amount of CO<sub>2</sub> produced by the electricity consumption is dependent on your electricity provider. The average in the Netherlands is 444 gram per kWh (NeoSave, 2012). So what's the best solution for the green student?

Let's assume that a student studies for 5 years and only follows courses. This is not entirely true, but during your thesis you will read a large number of papers, so let's assume it equals out. During a normal week you will read for one hour a day, for 6 days a week. During the study week you spend 7 hours reading for 6 days. Combined you spend 78 hours reading in a 8 week period. Follow this routine for 5 years and you will spend 1950 hours of your student life behind books / an e-reader (again, this assumption might not be entirely valid, but for books it doesn't matter how long you have opened them, and you are probably checking Facebook while you should be reading if you are using a tablet)

(In this analysis we mainly use Apple products for comparison, not because we like them so much, but because they have a relatively high share of the market. The Windows / Android market is shared by multiple companies)

### iPad:

An iPad uses 3.16 Watts (Apple, 2012), so if you multiply  $0.00316 * 0.444$  you'll see that an iPad produces 0.0014 kilo of CO<sub>2</sub> per hour of usage. Multiply this by the hours you'll spend reading and your iPad produces 2.74 kilo of CO<sub>2</sub> throughout your student career. During the production of the iPad 130 kg of CO<sub>2</sub> is released (Apple, 2012), making the total CO<sub>2</sub> emissions of an iPad 132.7 kg. CO<sub>2</sub>. (Of course with the exception of all the CO<sub>2</sub> you produce while playing candy crush).

### Desktop and laptop computers

Although you can get quite some work done on a tablet, you'll see most people using a desktop or laptop computer when you're taking a walk through the library. A laptop is built to replace a desktop on the road, so naturally you'd expect a laptop to use less power. An average notebook uses 12 Watts per hour, and an average desktop uses 84 Watts when you include the power consumption of the screen as well (EU Energy Star, 2013). Of course the power consumption is highly dependent on the way you use your laptop. If you're only reading a PDF your computer has to process less, but if you watch a movie, while toying with Photoshop your computer uses considerably more energy.

It depends how you use your computer whether you should include all the CO<sub>2</sub> produced in this small analysis that concerns reading. If you SPSS for your research it's hard to avoid the use of a computer. So you wouldn't only use it for reading.

An averaged sized laptop has a carbon footprint of 560 kg CO<sub>2</sub>, while the production of a desktop produces 380 kg CO<sub>2</sub> (Fujitsu, 2010). That might seem as a weird result, but you need to include the carbon footprint of a monitor as well, which would account for around the same footprint as a desktop. Unfortunately Green Office could not find any reliable numbers for computer monitors except for the 27 inch Mac screens (1040 kg) which is probably a bit larger than the common monitor and would be an unfair comparison.

If we assume that you use your computer half of the (useful study) time for reading and the other half for writing papers, SPSS, Photoshop etc. your laptop would produce  $560 \times 0.5 + 10.4 = 290.4$  kg of CO<sub>2</sub>. If we assume that a computer monitor has a carbon footprint comparable to two thirds of a computer, using a computer will cause  $380 \times 0.5 + 253 \times 0.5 + 72.7 = 389.2$  kg worth of CO<sub>2</sub> emissions.

### **Kindle:**

A Kindle uses considerable less energy than an iPad, 0.7 Watt, while its production produces more: 168 kg CO<sub>2</sub> (Ritch, 2009). The total CO<sub>2</sub> emissions of a Kindle are: 168.6 kg. One thing to keep in mind with dedicated e-readers is that they can't be used for anything else than reading. The iPad has the potential to replace your laptop, which would reduce your carbon footprint quite a bit. An e-reader on the other hand can only be used for reading.

### **Books:**

Electronic reading devices need servers to download the e-books from, and need energy to operate. Traditional books on the other hand can be enjoyed and shared as long and often as you like. But the more you buy, the higher your CO<sub>2</sub> footprint will be. Wells *et al.* (2012) estimate the CO<sub>2</sub> footprint of a book at 2.7 kg. Of course, these are normal books and students use books that are quite a bit bigger. So let's estimate the CO<sub>2</sub> footprint of a study book at 4.1 kg CO<sub>2</sub> (1.5 times a normal book). In your student career you'll need  $5 \times 5 \times 2 = 50$  books. Of course, you won't read as much during your thesis, but you'll probably print out quite a bit of papers and find other ways to waste some paper. Let's assume they count as heavy. Your book consumption will create 153.8 kg of emitted CO<sub>2</sub>.

### **Discussion and conclusion**

The iPad appears to be the winner, especially when it can replace a laptop or desktop computer. The digital contestants become even better when you only charge them at the university because the university uses green power (Wageningen UR, 2013). However, one has to keep in mind that a book does not require rare metals for its internal circuitry and battery. And did you know that the Dutch paper industry replaces every cut tree for at least another one (higher numbers are not uncommon) (Vouwkarton Platform Nederland, 2013; Doré, 2009), and that the recycling rate in the Netherlands for paper approaches 80% (Laurijssen *et al.*, 2010; Timmermans *et al.*, 2014)? So besides the CO<sub>2</sub> footprint you might want to consider other aspects of sustainability for making your choice in what method of reading you prefer.

## Sources

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