

An Exploration into the Environmental Impact of Duplex Versus Simplex Printing

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Abstract

In partnership with the administrative staff at the Indiana University Student Technology Centers, research was conducted on the environmental impact of duplex (double sided) versus simplex (single sided) printing based on energy consumption of the printing process, as well as that of the paper manufacturing process. Using a combination of controlled tests and statistical analysis it was observed that the amount of energy consumed per Kilowatt Hour (KWH) and the amount of time it took to print duplex was consistently higher than that incurred during the simplex test. The amount of energy consumed and the subsequent generation of greenhouse gases occurring in the paper making process, however, far outweighed the impact of the CO₂ associated with the KWH recorded. This is especially evident when extrapolated over an estimated number of pages consumed in an academic year at Indiana University Bloomington.

Introduction

As interest in sustainable solutions for fueling our cars, recycling batteries and sourcing local food become more prominent [1], we see an increased awareness of the role of technology plays in the consumption of natural resources. Many of the technologies we use daily, such as computer printers, have a greater impact than that readily apparent to the user. We know that printers use energy, but how much do they use? Is it more environmentally friendly to print double sided (duplex) or single sided (simplex)? Does duplex printing cause more mechanical failures than simplex printing? To determine the environmental impact of duplex versus simplex printing, we implemented a study in an environment known for high output printing – academia. This is the first component of a proposed, on-going study of printing practices, including future research to determine the impact of using recycled content in a high output environment.

Process

Tests were conducted on three different models of computers used at the Student technology labs across the Bloomington Campus: HP LaserJet P4515X, HP LaserJet 4350dtn, HP Laser Jet 8150 dn

Each test was timed (fig.1) & energy measured in Kilowatt hours using a Kill-A-Watt meter (fig.2). Total energy as well as incremental energy use was recorded.



Figure 1. Timing of a duplex test.



Figure 2. Kill A Watt meter during printer warm up state.

Data

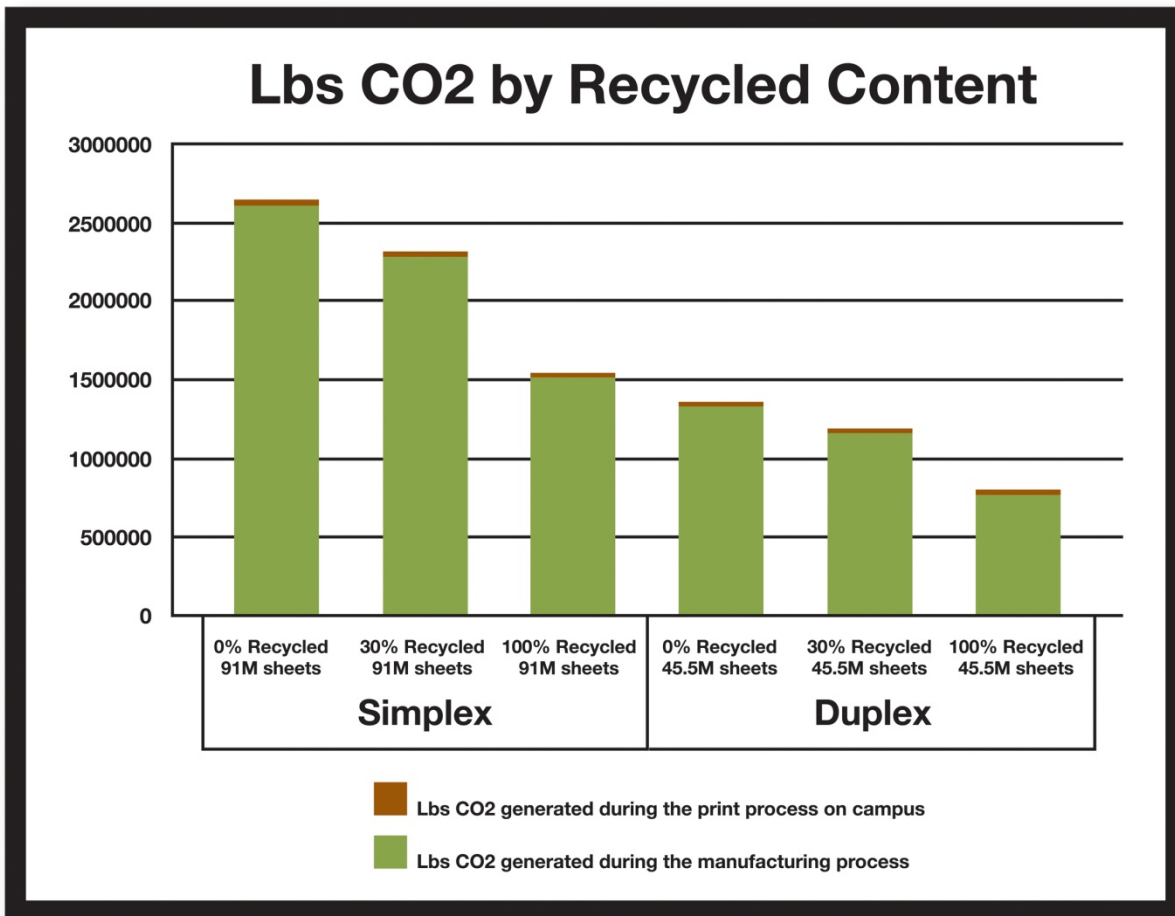
Total KWH is the cumulative energy used to print 500 images - 500 sheets via simplex & 250 double sided sheets via duplex. Total time to complete the test is presented in minutes, seconds, & hundredths of seconds. Printing duplex consistently took longer than simplex.

Duplex	HP LaserJet P4515X	HP LaserJet 4350dtn	HP Laser Jet 8150dn
Total KWH	0.14	0.12	0.21
Total Time	11:43.7	13:10.5	20:31.2
Simplex	HP LaserJet P4515X	HP LaserJet 4350dtn	HP Laser Jet 8150dn
Total KWH	0.11	0.11	0.18
Total Time	08:57.7	09:09.0	15:57.2

The data was used to determine the cost of energy consumed per sheet (calculated at \$.05 per KWH) and the pounds of CO2 generated per sheet.

Duplex	Average of 3 machines
Total KWH	0.1566667
KWH per page	0.0003133
Energy Cost per 500	0.0078333
Energy Cost per sheet	0.0000157
Energy in Tons CO2 per sheet	0.0000003
Energy in lbs of CO2 per sheet	0.0006103
Simplex	Average of 3 machines
Total KWH	0.1333333
KWH per page	0.0002667
Energy Cost per 500	0.0066667
Energy Cost per sheet	0.0000133
Energy in Tons Co2 per sheet	0.0000036
Energy in lbs of CO2 per sheet	0.0003057

The following graph shows the ratio of pounds CO2 generated in the papermaking process as compared to the printing process [2], calculated using conservative estimates of paper purchased by IUB in 2007 [3].



This chart shows the comparison of pounds CO2 produced by not only Simplex and Duplex, but also 0%, 30%, and 100% recycled paper content.

In rust, we see the amount of CO2 produced in the printing of 91 million Simplex or 45.5 million Duplex sheets. This amount is minimal to the amount of gas produced in the production of the paper itself, shown in green. These numbers show that the environmental impact of the combination of using duplexing and using recycled content paper can are by no means trivial.

Recommendations and Future Research

Preliminary research indicates that Indiana University can significantly decrease the carbon footprint of printing by setting equipment to duplex mode. The majority of this savings comes from the reduction of CO2 produced in the paper making process. Environmental benefits can also be gained through the use of recycled content paper. To more fully understand the impact of printing options, additional research will be needed:

- Monitoring of maintenance service on dedicated duplex and simplex machines.
- Calculation of carbon footprint of replacement parts based on maintenance records.
- Recycled paper study to determine impact of fiber infiltration of machine components.
- Financial comparison of practices.
- On-going support of campus wide print reduction campaign.

Conducting this research during the 2009-2010 academic year will allow IUB to consider changes that could affect paper vendor negotiations for the next fiscal cycle.

References

[1] Sustainability Coverage in a Variety of Media, retrieved July 31, 2009
<http://sustainability.publicradio.org/>

[2] Environmental impact estimates for paper production were made using the Environmental Defense Fund Paper Calculator. For more information visit <http://www.papercalculator.org>

[3] Hanks, K. (2008). Indiana University Sustainability Task Force Intern Summaries, retrieved July 20, 2009 <https://www.indiana.edu/~sustain/sustainabilityiu/summerfellows08/>