ENVIRONMENTAL PROFILES OF PAPER VS. ELECTRONIC UC-CEAS ANNUAL REPORTS

In 2010, the University of Cincinnati College of Engineering and Applied Sciences (UC-CEAS) created a new electronic format for the Annual Report that could be distributed through the college's website to replace the prior print version. In order to determine the environmental consequences of this decision, the college collaborated with the US EPA's Sustainable Technology Division to apply a technique called *life cycle assessment* (LCA) to determine the environmental impacts of both the prior print and new electronic versions of the report.

An LCA considers the direct and indirect environmental impacts of a product based on the function it provides. In this case this function was defined as the reading of 34,000 copies of the annual report by report recipients. In the first step of the LCA, the life cycle stages of each version of the UC-CEAS Annual Report were defined (Figure 1).

The design stage is shared between both versions of the report and includes conceptualizing, assembling of data, drafting of text, and layout of the report. For the print report, the design is emailed to the printer. The printer requires paper, inks, energy, etc. to print 34,000 reports. These reports are then sorted and labeled for mailing. The mail service then distributes the reports to the recipients, and the recipients read the reports under light before either disposing or recycling them. In the case of the electronic reports, following the design stage the electronic files are uploaded and stored on the college's web server. Recipients connect to the Internet and read the report on the college's website, at which time the files are downloaded to the recipients' computers.

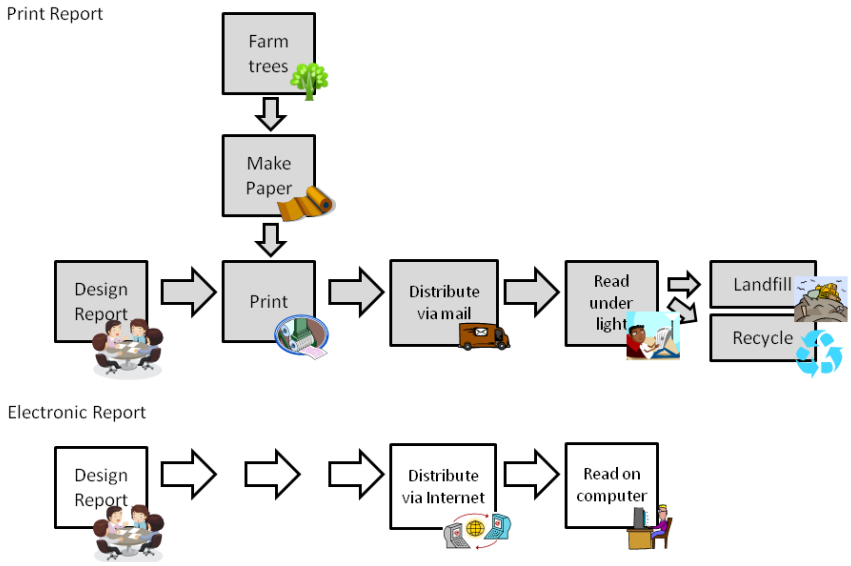

Figure 1. Life cycle diagrams of the print and electronic reports. Indirect stages of the life cycle are not shown here but are considered in the LCA.

The life cycle environmental impacts of these two alternative report formats were assessed using the U.S. Economic Input-Output Life Cycle Assessment (EIO-LCA) model which relates the purchases associated with each life cycle stage to the supply chain economic activity and associated environmental consequences throughout the U.S. economy. We provide results for carbon footprint, energy use, water use, and release of pollutants harmful to people and the environment.

The findings from this comparative LCA show that the electronic report has significant reductions in economic costs and environmental impacts in comparison with the print reports. The economic costs shared by all parties were reduced by approximately $41,000 over the life cycle. The environmental reductions include the approximate savings of:

- 33,000 lbs CO_2 equivalent greenhouse gases (reduction in carbon footprint)
- 72,000 kWh of energy
- 230,000 gallons of water
- 79% less pollutants toxic to human health
- 73% less pollutants toxic to ecosystems

These reductions occur primarily in the avoidance of the paper production and printing phase, as shown in the Figure 2 for greenhouse gases.

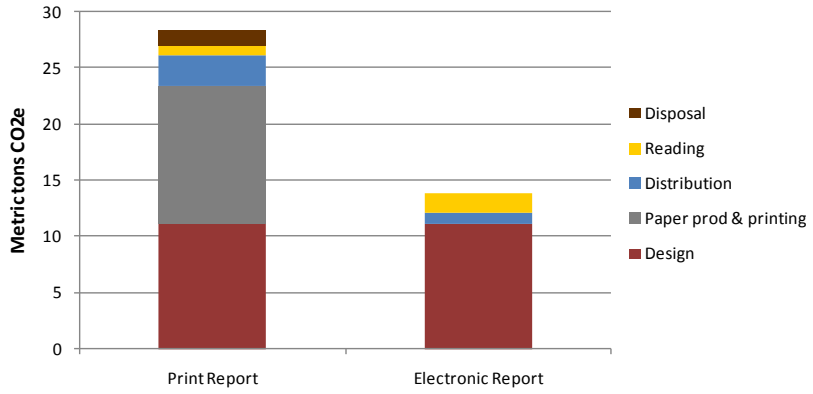

Figure 2. Greenhouse gas emissions by life cycle stage for 34,000 print and electronic reports.

The distribution phase for the electronic report results in fewer emissions than paper report distribution and the disposal phase is avoided for the electronic report. Only the use phase of the electronic report results in greater emissions than in the respective stage of the print report, but this increase is small in respect to the greenhouse gas emissions in other categories. Profiles of energy and water use by stage for the two report types also follow a similar pattern to that in Figure 2. Reductions in releases of toxic substances are even more substantial with the switch from print to electronic reports, because the majority of toxins are associated with the supply chains of paper production and printing.

This analysis assumes that readers of the electronic report do not print the report at home, which could potentially offset the reductions of environmental impacts. Recipients can further reduce the environmental impacts by reading the report on an electronic device that consumes less electricity, such as a notebook computer or e-reader.

This LCA shows that both forms of reports have environmental impacts, but that the impacts are substantially less for the electronic report, and that the electronic report also provides cost savings for UC-CEAS. It further points to the importance of considering all stages in the life cycle when considering environmental impacts, so that the benefits of changes to a product life cycle are seen in this broader context, and so that shifts in one stage are seen in context of the life cycle. The findings reveal that the UC-CEAS and the Annual Report recipients along with other parties directly contracted or indirectly involved in the life cycle each have a role in the environmental impacts and thus can each work to reduce their respective impacts to improve the sustainability of the report in the future.

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For more information:
Details and further analysis are available in a technical paper. Please contact the first author to request a copy of this paper.

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