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Life Cycle Assessment of Paper Products: Part Two — The Impact of Methodology on the Life Cycle Analysis of Paper Products

This brief provides an overview of how Sappi defines the boundaries of analysis and methodology for studying the carbon footprint of pulp and printing papers manufactured at our North American operations. Readers will gain insights to some of the benefits and limitations to using Life Cycle Assessment (LCA). Ultimately our aim is to help other companies make the right decisions to help reduce the carbon footprint within their own supply chains.

LCA can be used to help paper buyers make good decisions about paper selection – but it can also lead to false conclusions and bad decisions when implemented improperly. With the growth of environmentally conscious consumers, many companies have used LCA as a basis for making environmental marketing claims. With the recent publication of the Federal Trade Commission (FTC) Green Guides (1), we urge marketers to use caution in taking this approach, and to use only well-defined, product-specific results for generating claims.

This is part two of a three-part series. For results of product level analysis at our Somerset Mill, we encourage readers to download eQ Insights Volume 4.3, "The Carbon Footprint of Sappi's Somerset Mill and the Impact of Recycled Fiber" (2).

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1 Introduction

At Sappi, our primary objective for using life cycle analysis is to study the carbon footprint of the pulp and printing papers manufactured at our paper mills. Our aim is to benchmark our operations and identify opportunities for further improvements. We also set out to understand the impact of various purchased pulp inputs, including purchased kraft pulp and deinked pulp (recycled fiber).

There have been a multitude of LCA studies conducted to investigate various papermaking processes and products. With disparate results and conclusions, many stakeholders within the industry are confused. For example, in 2009, the Association of Magazine Media (MPA) commissioned a review of five LCA studies on magazines, with a specific focus on greenhouse gas (GHG) emissions, also referred to as carbon footprint. Results of the selected studies indicated that the carbon footprint for magazines printed on paper ranged from 1.14 to 5.32 tons of CO_2 equivalents (eq) per ton of magazines (3). In analyzing the studies, the MPA found that there were vast differences in methodology (how each study was conducted), which confounded the ability to quantify an average carbon footprint or to compare differences between individual titles. The team working on the project concluded that the

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magazine publishing industry needed to standardize its LCA methodology to allow for comparisons within the industry and for benchmarking improvements over time.

Building on the efforts of the MPA, Sappi sought to adopt a methodology that would deliver meaningful results for our own use as well as inform our customers in a clear and concise manner.

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The Importance of Product-Specific Analysis

In 2011, the National Council for Air and Stream Improvement (NCASI) published a review of the existing knowledge on LCA and paper recycling. After evaluating 99 published studies, they concluded that "...the existing knowledge does not allow for general conclusions to be made regarding the overall environmental superiority of the use of recycled or virgin fiber for paper production"(4).

In 2012, the FTC released its revised *Guides for the Use of Environmental Marketing Claims*, commonly referred to as the "Green Guides". Development and enforcement of the guidelines is intended to protect consumers from misleading claims by helping marketers ensure their products' environmental claims are true. In its summary of the newly issued Green Guides, the FTC warns marketers:

"Claiming 'Green, made with recycled content' may be deceptive if the environmental costs of using recycled content outweigh the environmental benefits of using it"(5).

In short, it is imperative that marketers seek out product-specific environmental data from suppliers in order to make truthful claims that can be substantiated.

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Background

In *eQ Insights* 4.1, we described the background of LCA, which is an approach for understanding various environmental impacts over the full life cycle of a product or service (6). Process steps are identified for each stage in the product life cycle. The inputs (materials and energy) and outputs (products, emissions and pollutants) are determined for each step, and then are organized into environmental impact categories (e.g., global warming).

Methodology factors that can significantly impact the results of a specific product LCA include the source of the data, the boundaries of the study, and the recycling allocation method. Each of these factors is discussed further below.

Data source:

- Primary data, that is data collected from the manufacturer, is the best and most reliable for analysis. Industry average data is excellent for benchmarking one industry compared to another, and for tracking industry performance over time; however, it does not represent an individual product, mill or company. Some facilities will perform significantly below average and others will perform better than average on any given impact category.
- Carbon emission factors are used to calculate the greenhouse gas emissions arising from an activity such as combustion of a fuel or the manufacture of a product. For example, direct emissions (Scope 1) are determined based on amounts of fuel combusted multiplied by the emission factor for each fuel type. Companies that incorporate materials into a product or service must rely on other sources of emission factor information. According to the Greenhouse Gas Protocol, examples of emission factor sources include life cycle databases such as ecoinvent (7) and the US LCI Database (8), published product inventory reports, government agencies, industry associations, company-developed factors, and peer-reviewed literature. The emission factors that populate these data sources can vary in their methodology of calculation, geographic focus, update frequency and the rigor of their independent review (9).

The boundaries (or scope) of the study:

- A **gate-to-gate** analysis is essentially reflective of only the mill's direct impact and does not reflect other aspects of the supply chain. For greenhouse gas emissions in particular, a gate-to-gate analysis would be limited to direct emissions from fuels burned at the mill, emissions from other operations such as the lime kiln and any on-site landfill, as well as emissions associated with purchased power. The upside to a gate-to-gate analysis is that all mills should have good primary data. However, the mill's performance is only one step in a product's life cycle.
- In a **cradle-to-gate** analysis, the scope of the study is expanded to include all significant material and energy inputs to the mill. For papermaking this includes wood, fuels, pulping and bleaching chemicals, as well as paper additives used for fillers and coatings. Manufacturers can rely on purchasing records to identify actual usages of materials and can use either their suppliers' primary emission factor data or industry average data to determine environmental impacts of purchased materials.
- Complexity increases significantly with a **cradle-to-grave study**. Typically, multiple assumptions have to be made about transportation, distribution, use and disposal; ultimately, studies become more subject to criticism on key assumptions. One example of the methodology choices a practitioner has to make is in how to handle the impacts of the "end of life" choices for a given product, i.e., whether consumers discard products or whether the products are collected for recycling. Additional assumptions must be made as to the ultimate fate of waste, whether incinerated (sometimes resulting in energy generation), or sent to a landfill. If a product is destined for a landfill, assumptions must be made regarding whether the landfill captures methane, and so on.

Allocation Methods:

In LCA work, environmental burdens must often be split between various products and processes. These allocations occur at various stages across the life cycle (material acquisition, manufacturing, distribution, use, and end-of-life).

There are several methods for allocating the environmental burdens of material acquisition and manufacturing (up to the mill gate) or distribution, use and end-of-life (downstream from the mill gate). The two most often used in studies of paper are the **cut-off method** and the number of subsequent uses method. The cut-off method assigns only the burdens directly caused by the product being studied. So in the case of paper, a portion of the impacts associated with harvesting trees and virgin pulping, for example, are not allocated downstream to recycled fiber, whose impact cycle begins with waste paper collection. This method is simpler to apply but is sometimes criticized for ignoring the relation between recycling and virgin fiber. In the **number of subsequent uses method**, a portion of the impact of the virgin production is shared with the subsequent uses of the material. Because recycled fiber cannot exist without virgin fiber, to many practitioners it seems "more fair" to share the burden of virgin manufacturing with the recycled fiber. However, this approach requires making an assumption about the number of subsequent uses and is sometimes criticized as a means to benefit virgin manufacturing.

For the purposes of Sappi's analysis, we opted to use a cradle-to-gate analysis and the cut-off method. In doing so, we are able to utilize our mill-specific consumption of materials and energy (primary data) and a straightforward means of assigning environmental burdens. In other words, we are not allocating burdens outside of the boundaries of the mill. Nor are we making assumptions about the use and end-of-life of our products.

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The Impact of Allocation Methods on Life Cycle Analysis Results

Adopting different recycling allocation methodology can lead to different results and conclusions, even when analyzing the same performance data. In fact, the selection of end-of-life methodology can influence desired results and help drive certain behaviors.

In 2009, Nicholson et al. (10) studied how end-of-life allocation methods affect material selection decisions. The authors concluded that the choice of methodology can have a significant impact on LCA results and can change the order of material preference. They also found that the results change at different rates for different materials, e.g., the impact on steel is different than the impact on paper.

In 2010, Sappi commissioned a study by Dr. Richard Venditti of North Carolina State University (11). On our behalf, Dr. Venditti explored the effect of different LCA methodologies for determining carbon footprints of paper products, in particular the way in which recycling is treated. This project included an in-depth review of the following LCA studies on paper products:

1. Paper Task Force *White Paper No. 3. Lifecycle Environmental Comparison: Virgin Paper and Recycled Paper-Based Systems* (12). This study included an LCA of printing and packaging paper materials with two separate systems: a) virgin paper and disposal, and b) production of recycled paper and infinite recycling.

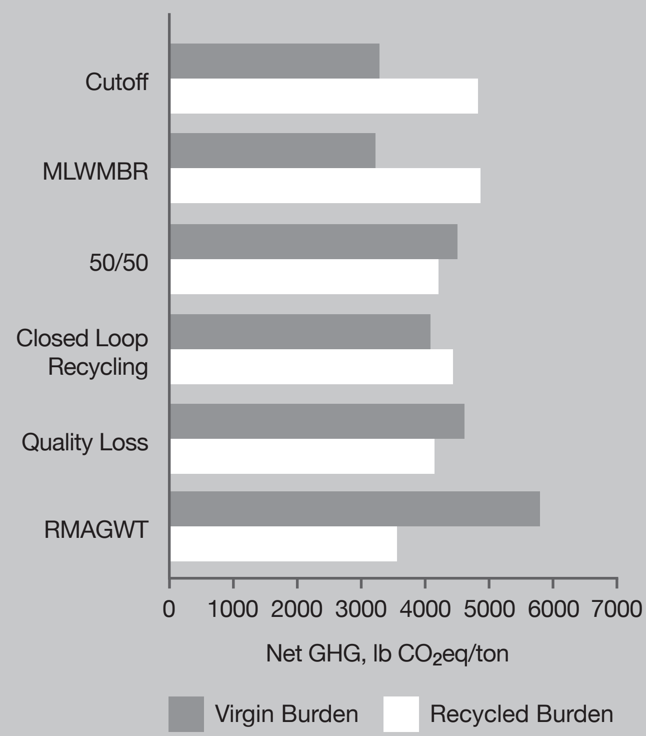
2. The Heinz Center. *Following the Paper Trail: The Impact of Magazine and Dimensional Lumber Production on Greenhouse Gas Emissions: A Case Study* (13). This study performed a partial LCA on *Time* and *InStyle* magazines, focusing only on the carbon footprint.

3. National Council for Air and Stream Improvement, Inc. "Life Cycle Assessment of North American printing and writing paper products", which included an LCA on printing and writing grades (14).

Figure 1 shows the carbon footprint results Dr. Venditti calculated when applying different recycling allocation methods to the data for copy paper published by the Paper Task Force (12). Each pair of data shows the greenhouse gas emissions calculated for virgin and recycled paper based on different allocation methods. The results show that when using the same set of performance data, the different allocation methods will dictate whether virgin production or recycled fiber production is found to have a lower environmental impact.

Comparison of Recycling Allocation Methods

Figure 1



NCASI scientists have also studied this issue and in 2012 published the results of their analysis of the impact of different open-loop recycling allocation methods on the results of LCA and carbon footprint studies. This report explains, examines and compares various open-loop recycling allocation methods and is a useful resource when selecting a method appropriate for a paper product LCA or carbon footprint analysis. They also conclude that "…the choice of one allocation procedure over another can have a significant effect on the results of an LCA"(15).

Again, as noted in the previous section, by defining the boundary for Sappi's analysis as the gate of our mill operations, we are eliminating the impact of end-of-life methodologies in our assessment. Our choices of boundaries and allocation methodologies allow for clear insights to the performance of our material and energy usage up to finished product at the mill gate.

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Focusing on Greenhouse Gas (GHG) Emissions

Public concerns about climate change—coupled with recent economic conditions—keep energy and greenhouse gas emissions top of mind for stakeholders within the pulp and paper industry. While GHG emissions are currently not regulated within the U.S., we believe it is important to understand and manage greenhouse gas risks to ensure long-term success in a competitive business environment. To fully comprehend impacts and risks, Sappi's LCA must extend beyond our operations to other elements of our supply chain.

GHG emissions can also be considered a *de facto* metric for monitoring fossil fuel usage. Thus with a single indicator it is possible to understand the use of non-renewable resources for energy and the potential global warming effect of a product or process.

The investment community has long considered GHG emissions a material issue and as such the Securities and Exchange Commission and ASTM International have released guidance documents on reporting GHG emissions (16, 17). The rapid growth and breadth of participation in the Carbon Disclosure Project (CDP) provides further evidence that for many groups GHG emissions are the single most important environmental attribute (18). In 2012, the number of responding companies grew to 4,112; Investor Signatories (that is, financial institutions that are CDP members) reached 655, representing $78 trillion in assets (19).

Eventually, Sappi may expand life cycle assessment efforts beyond GHG emissions and include additional environmental indicators and impacts, but we have no plans to do so in the near term.

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Beyond Scope 1 and Scope 2 Reporting

The Greenhouse Gas Protocol is the most recognized and widely used international accounting tool for understanding, quantifying and managing GHG emissions (9). The protocol established definitions for the different emissions sources to enable a consistent reporting structure. They define three scopes of measurement and reporting:

Scope 1: Direct GHG emissions from sources owned and controlled by a company

Scope 2: Indirect GHG emissions from the purchase of electricity or steam

Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, outsourced activities, waste disposal, etc.

Sappi has participated in the Carbon Disclosure Project since 2007 and has monitored Scope 1 and 2 emissions prior to disclosure since 2000. However, we have only recently embarked on Scope 3 measurement and reporting. In expanding the scope of our analysis, we are able to better assess risk factors within our supply chain and are also able to fully quantify the impact of various pulp sources, including kraft pulp and deinked pulp (recycled fiber) purchased from other suppliers.

In Sappi's eQ Tool (www.sappi.com/eQTool), we enable users to make comparisons of our Scope 1 and 2 emissions as compared to industry average. However, these calculations have not reflected the impact of recycled content (a Scope 3 element) and users do not see a difference in emissions associated with a 100% virgin product as compared to one containing recycled content. To most accurately assess the impact of recycled fiber, we set out to fully understand methodologies for determining carbon footprints of paper products, in particular the way in which recycling and the use of recycled fiber is treated.

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Our Selection of the FEFPro™ Tool

NCASI developed the Footprint Estimator for Forest Products (20) to better enable forest products companies to calculate the GHG emissions of a product, manufacturing site, company or sector in a way that also includes Scope 3 emissions. FEFPro™'s calculations are based on methods in the IPCC National Accounting Guidelines (21), the WRI/WBCSD GHG Protocol and Calculation Tools (9), ISO standards (22) and other government-sanctioned reporting programs and registries in the U.S. and Canada.

To evaluate and establish competency with FEFPro™ as a GHG emissions, or carbon footprint calculation tool, we worked with Dr. Venditti to develop FEFPro™ models for integrated kraft mills. He used data from the NCASI study *Life Cycle Assessment of North American Printing and Writing Paper Products* (14), and compared the FEFPro™ results with those from the study which were calculated using SimaPro™, an internationally recognized and widely used LCA software tool. Dr. Venditti stated, "The percent difference in results between the two methods indicates that the FEFPro™ model produces essentially the same result for the given inputs."

In short, we were able to use two different modeling tools to assure ourselves that we had mastered competency and that FEFPro™ delivered meaningful and accurate results. This tool is available to American Forest and Paper Association (AF&PA), Forest Products Association of Canada (FPAC) and NCASI members for free, and as such provides a viable platform for generating comparative results.

FEFPro™ does not include the calculations to assess the impacts of land use change. In other words, if either deforestation or afforestation (increasing forested land) is occurring, this would not be captured in results. FEFPro™ users can perform these calculations offline and enter them into the FEFPro™ worksheet dedicated to capturing these results. For mills procuring from sustainably managed forests it is assumed that carbon storage is maintained. Results of U.S. forest inventory studies support this assumption. The U.S. Department of Agriculture Forest Service reports that forest area has been relatively stable since 1910; that "over the past 50 years, net growth has consistently exceeded removal" and the growing stock volume per acre (forest density) continues to rise (23). In other words, not incorporating land use changes is a conservative estimate and may well lead to over-reporting the actual emissions associated with paper and wood products manufactured in the U.S.

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Conclusion

With the increase of environmentally conscious consumers, many companies use life cycle assessment as a basis of making marketing claims. As stipulated in the FTC Green Guides, environmental marketing claims must be truthful and substantiated. We urge marketers to seek out product-specific data from suppliers.

In order to provide data for Sappi products, we researched the impact of allocation methodologies, and have selected the FEFPro™ tool for modeling the cradle-to-gate carbon footprint of our products. For results of product-level analysis at our Somerset Mill, we encourage readers to download *eQ Insights* volume 4.3, "The Carbon Footprint of Sappi's Somerset Mill: A cradle-to-gate analysis showing the impact of recycled fiber".

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We invite you to share your thoughts so that we can all benefit from innovative thinking and best practices. For questions and comments on this document, please email us at eQ@sappi.com.

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