ENVIRONMENTAL PERFORMANCE OF SUGAR SHEET PAPER

FINAL REPORT

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SOCIAL PRINT PAPER™

TRUCOST

Credits

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About Trucost

Trucost helps companies and investors to achieve success by understanding environmental issues in business terms. Our data-driven insights enable organizations to manage risks and identify opportunities for growth.

We are the world's leading experts in quantifying and valuing the environmental impacts of operations, supply chains, products and financial assets. By putting a monetary value on pollution and resource use, we integrate natural capital into business and investment decisions.

With offices in Europe, the US and Asia, Trucost works with businesses worldwide to increase revenues, improve communications, meet marketplace expectations and comply with regulatory requirements.

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PROJECT SCOPE

Trucost was engaged by Social Print Paper to quantify the environmental performance of Sugar Sheet paper and answer the following questions:

- What are the greenhouse gas (GHG) emissions associated with the production of Sugar Sheet paper and how do they compare with conventional, wood-derived virgin and recycled paper (30% and 100%)?
- How many trees are saved using Sugar Sheet paper, when compared with the production of conventional, wood-derived virgin and recycled paper (30% and 100%)?

Trucost utilized a combination of Life Cycle Analysis (LCA) methodology and the Environmental Paper Network (EPN) Calculator, along with data from the paper mill and peer-reviewed databases to answer these research questions.

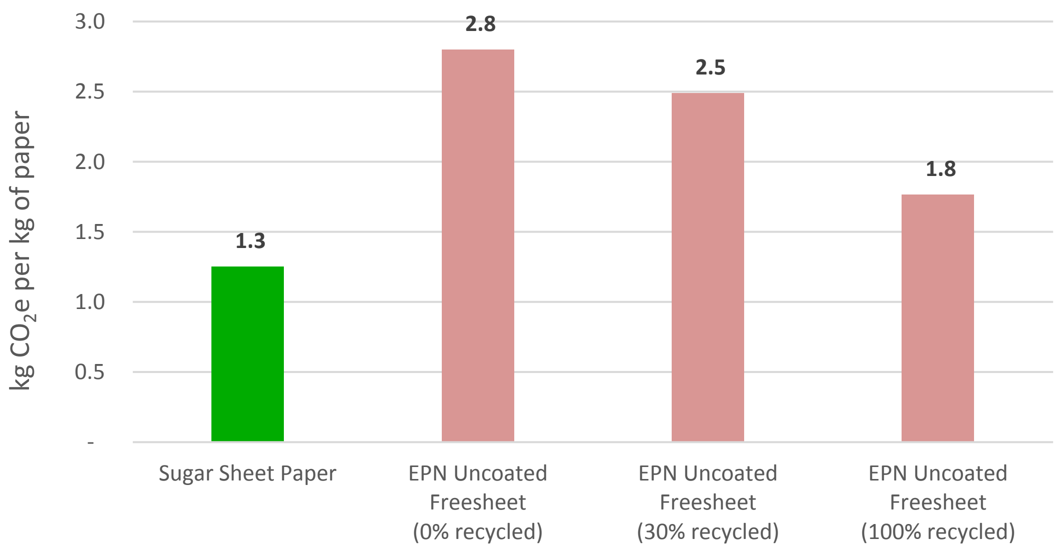
KEY FINDINGS

GHG Emissions

On average, the GHG footprint of Sugar Sheet paper is 1.3 kg CO_2e per kg of paper across its entire life cycle, from sourcing and transport of agricultural waste to its end-of-life disposal. Therefore, the GHG emissions associated with the production of Sugar Sheet paper are:

- **55% lower** than uncoated **wood-derived** paper with no recycled content
- **50% lower** than uncoated **wood-derived** paper with 30% recycled content
- **29% lower** than uncoated **wood-derived** paper made entirely from recycled pulp

FIGURE 1: GHG EMISSIONS FOOTPRINT COMPARISON



Tree Consumption

Since wood is not used as a raw material in Sugar Sheet paper, one kg of product requires no wood. This compares with 3.6 kg of wood per kg of virgin uncoated freesheet and 2.7 kg of wood per kg of uncoated freesheet for 30% recycled paper. Based on average levels of wood density per tree, as sourced from EPN, 1 tonne of Sugar Sheet saves 26 trees compared to the baseline (0% recycled uncoated freesheet).

FIGURE 2: WOOD USE COMPARISON

PAPER PRODUCT	QUANTITY OF WOOD (KG WOOD PER KG OF PAPER)	NUMBER OF TREES PER TONNE OF PAPER
Uncoated freesheet, 0% recycled	3.6	26
Uncoated freesheet, 30% recycled	2.7	19
Uncoated freesheet, 100% recycled	0	0
Sugar Sheet	0	0

CONCLUSION

The results illustrate that Sugar Sheet paper has substantially lower GHG emissions and wood consumption associated with its life cycle than conventional, wood-derived uncoated freesheet alternatives.

INTRODUCTION

In 2013, Social Print Paper introduced a wide selection of 'agripapers'—paper products derived from agricultural waste, to further reduce the environmental impact of their operations and demonstrate their commitment to sustainable production methods. Utilizing waste by-products from agricultural activities is intended to reduce the overall environmental impact of paper production, in terms of raw material use (substituting wood use, for example) and wider impacts (avoided greenhouse gas emissions, for example).

Trucost was engaged by Social Print Paper to quantify the environmental performance of its Sugar Sheet paper and answer the following questions:

- What are the greenhouse gas (GHG) emissions associated with the production of Sugar Sheet paper and how do they compare with conventional, wood-derived virgin and recycled paper (30% and 100%)?
- How many trees are saved using Sugar Sheet paper, when compared with the production of conventional, wood-derived virgin and recycled paper (30% and 100%)?

Trucost utilized data from the paper mill and internationally recognized, peer-reviewed databases to construct a cradle-to-grave Life Cycle Analysis (LCA) model to evaluate Sugar Sheet paper, which is sourced from agricultural sugarcane waste, known as 'bagasse.' Conventionally sourced and produced paper metrics were obtained from the Environmental Paper Network (EPN) Calculator. The EPN Calculator uses industry average data for different grades of paper. Any marketing claims about Sugar Sheet paper should specifically reference these industry averages and the EPN Calculator. The complete analysis methodology is available in the Appendix. The following table summarizes the project scope.

FIGURE 3: SCOPE AND BOUNDARY

Intended audience	Customers and external stakeholders
Purpose	Social Print Paper wants to measure and quantify the environmental performance of Sugar Sheet paper over its full life cycle and compare that performance to conventional paper in the EPN calculator. The aim of the study is to communicate the environmental benefits of Sugar Sheet.
Coverage of the study	The LCA scope is cradle-to-grave. The functional unit is one kilogram of paper. The paper is manufactured in Latin America and sold in North America. The scope and functional unit were chosen to be comparable with the EPN calculator. The key performance indicators that were analyzed are GHG emissions and wood used.
Data collection	Trucost collected data from the paper mill. The study includes both primary data and secondary LCA data. A gap analysis identifies the source of each input.

KEY FINDINGS

GREENHOUSE GAS EMISSIONS

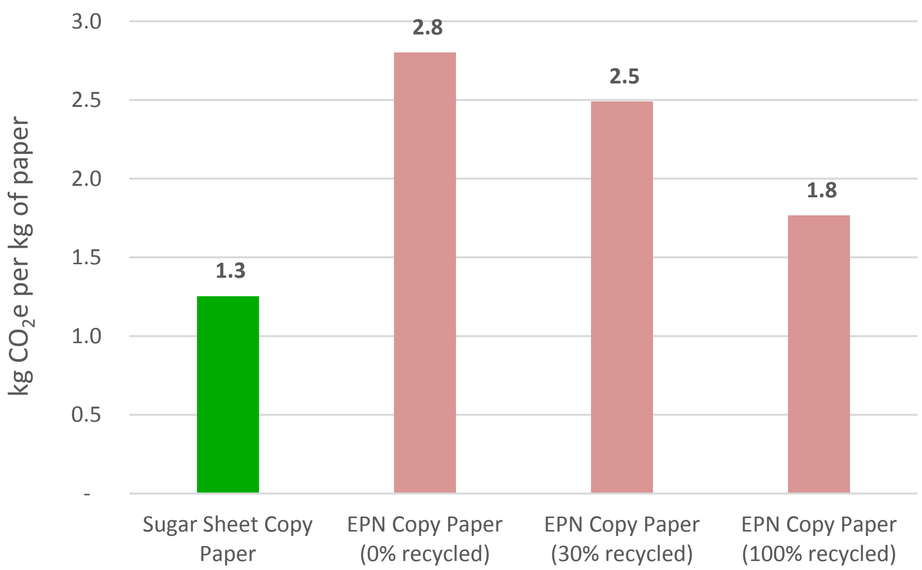
The research question for comparative GHG emissions was the following:

- What are the GHG emissions associated with the production of Sugar Sheet paper and how do they compare with conventional, wood-derived virgin and recycled paper (30% and 100%)?

On average, the GHG footprint of Sugar Sheet paper is 1.3 kg CO_2e per kg of paper across its entire life cycle, from sourcing and transport of agricultural waste to its end-of-life disposal. This compares with 2.8 kg CO_2e per kg of paper for an uncoated wood-derived paper with no recycled content, 2.5 kg CO_2e per kg of paper for uncoated wood-derived paper with 30% recycled content, and 1.8 kg CO_2e per kg of paper for uncoated wood-derived paper with 100% recycled content. Therefore, the GHG emissions associated with the production of Sugar Sheet paper are:

- **55% lower** than uncoated **wood-derived** paper with no recycled content
- **50% lower** than uncoated **wood-derived** paper with 30% recycled content
- **29% lower** than uncoated **wood-derived** paper made entirely from recycled pulp

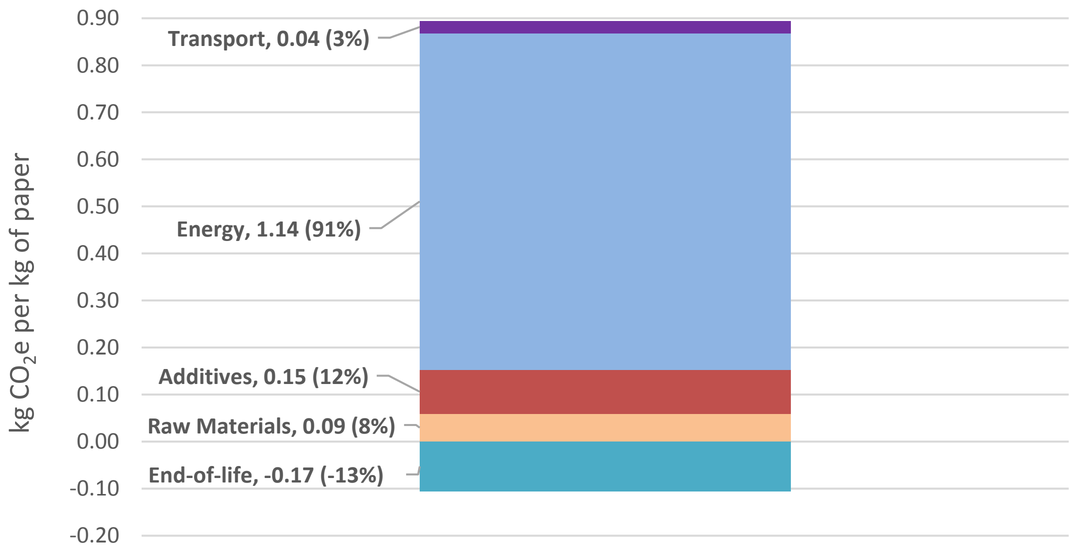
FIGURE 4: GHG EMISSIONS FOOTPRINT COMPARISON



While there are uncertainties associated with calculating and comparing the Sugar Sheet LCA data with the environmental data in the EPN calculator (for more detail on these, please see the Appendix), the results demonstrate that Sugar Sheet products have lower GHG emissions than paper with or without recycled content. The following graph details the breakdown of the GHG footprint of Sugar Sheet paper across its life cycle stages, based on the Trucost LCA model and findings.

The EPN calculator does not disaggregate the results into individual manufacturing stages due to its modeling algorithm. Accordingly, there are uncertainties involved in the process. These uncertainties are detailed in the methodological overview and data gap assessment section of this report.

FIGURE 5: GHG FOOTPRINT OF SUGAR SHEET BY LIFE CYCLE STAGE (KG CO_2E PER KG OF PAPER)



Energy consumption—in the form of coal, fuel oil, diesel and biomass—accounts for 91% of the total GHG footprint of Sugar Sheet products, or 1.14 kg CO_2e per kg of paper. The largest contributor is coal use, which contributes 48% of the total fuel and energy emissions. Biomass use represents 47% of emissions from fuel and energy. Fuel oil and diesel are far smaller contributors at 5% and 0.2%, respectively. The methodological overview section reviews the allocation method applied.

The end-of-life stage has a positive impact on the GHG footprint, primarily due to avoided emissions from waste to landfill via recycling, either by generating energy from waste incineration with energy recovery or new paper raw material.

TREE CONSUMPTION

The research question for comparative tree consumption was the following:

- How many trees are saved using Sugar Sheet paper, when compared with the production of conventional, wood-derived virgin and recycled paper (30% and 100%)?

Since wood is not used as a raw material in Sugar Sheet paper, one kg of product requires no wood. This compares with 3.6 kg of wood per kg of virgin uncoated freesheet and 2.7 kg of wood per kg of uncoated freesheet for 30% recycled paper. The case of 100% recycled paper assumes that no additional wood is consumed in the manufacturing process. Based on average levels of wood density per tree, as sourced from EPN, 1 tonne of Sugar Sheet saves 26 trees compared to the baseline (0% recycled uncoated freesheet).

FIGURE 6: WOOD USE COMPARISON

PAPER PRODUCT	QUANTITY OF WOOD (KG WOOD PER KG OF PAPER)	NUMBER OF TREES PER TONNE OF PAPER
Uncoated freesheet, 0% recycled	3.6	26
Uncoated freesheet, 30% recycled	2.7	19
Uncoated freesheet, 100% recycled	0	0
Sugar Sheet	0	0

CONCLUSION

The results illustrate that Sugar Sheet paper has substantially lower GHG emissions and wood consumption associated with its life cycle than conventional, wood-derived uncoated freesheet alternatives, even when 100% recycled alternatives are considered.

APPENDIX: METHODOLOGY

Trucost conducted a life cycle assessment of Sugar Sheet paper in accordance with the ISO 14044 International Standard on Environmental Management: Life Cycle Assessment, and the WRI Life Cycle Standard. The assessment compares the cradle-to-grave impacts of one kg of Sugar Sheet paper to one kg of conventional virgin and recycled uncoated freesheet (30% and 100%). The team structured the analysis through the following steps:

- Definition and characterization of impact categories
- Definition of the life cycle boundary
- Assignment of LCI results to the selected impact categories
- Calculation of category indicator results

IMPACT CATEGORIES

Two primary impact categories were defined in the context of this study:

- GHG emissions, in terms of kg of CO_2 equivalent per kg of paper
- Wood use, in terms of kg of wood and number of trees per kg of paper

These impact categories represented the key areas of focus for the client regarding environmental improvement through the use of Sugar Sheet paper over conventional uncoated freesheet.

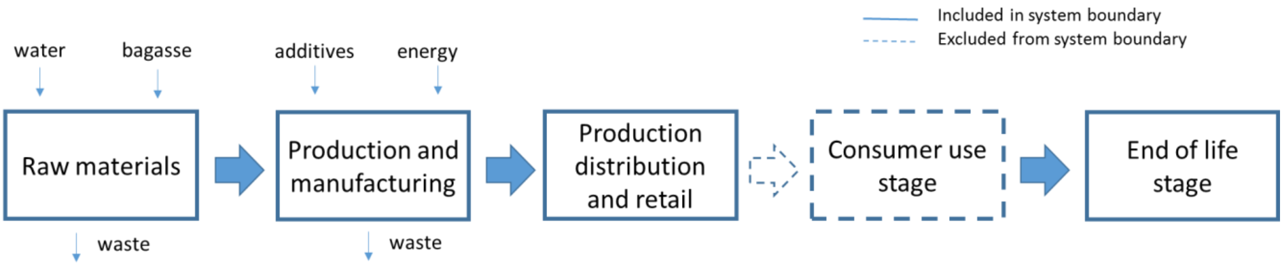
LIFE CYCLE BOUNDARY

Trucost undertook a comprehensive cradle-to-grave life cycle analysis of Sugar Sheet paper. The boundary of a product's life cycle is determined by defining the life cycle is determined by defining the life cycle stages, as described by the WRI Life Cycle Standard. These stages are:

- Stage 1: Raw material acquisition and pre-processing
- Stage 2: Production and manufacturing
- Stage 3: Product distribution and retail
- Stage 4: Consumer use stage
- Stage 5: End-of-life stage

The process map below outlines the cradle-to-grave processes and life cycle stages within the LCA scope.

FIGURE A1: CRADLE-TO-GRAVE SCOPE



Primary data were provided by the paper mill including total annual consumption of bagasse as the raw material input, consumption of various additives and total energy consumption by sources. Total annual Sugar Sheet output was used to scale these data and provide a unit consumption value per kg of paper production. Similarly, transport distance and mode data were provided and used to calculate transportation distances and associated fuel consumption per unit of product. Finally, total volumes of waste paper were provided and a similar scaling approach applied to establish a per-unit amount.

When reviewing secondary research, environmental impact data for the various paper types were classified based on the stages above. This placement provided clarity for making comparisons among the various life cycle processes for Sugar Sheet paper versus conventional, wood-derived uncoated freesheet and gave context to the papers' impacts throughout their life cycles.

This exercise also highlighted some of the distinctions of Sugar Sheet paper in comparison to conventional wood-derived paper. There are reduced impacts in the raw materials stage since 100% of the raw material inputs were assumed to be sourced from the waste agricultural product bagasse. More detail on this key assumption and others underlying the boundary of the analysis are outlined in the table below.

TABLE A1: GENERAL ASSUMPTIONS

PARAMETER	MODELING DISCUSSION
Impacts from raw materials	Impacts from raw material use were assumed to be reduced for Sugar Sheet paper since the key raw material (bagasse) is an agricultural waste product which would otherwise be disposed. For example, in Mexico, recycled paper is the principal feedstock in paper mills (rather than wood pulp), accounting for about 75% of raw material use.[1] According to the paper mill, Sugar Sheet paper is sourced from 100% waste materials.[2]
Electricity mix	Manufacturing electricity was assumed to be sourced from the local grid rather than on-site generation sources. The paper mill provided a range of fuel consumption data alongside electricity consumption so these data are assumed to be distinct. If the electricity were sourced from a local, undisclosed source (for example, on-site renewable energy) this would have implications for the overall GHG intensity of the production process—beneficial, if renewable or low-carbon energy is sourced; detrimental, if non-renewable or high-carbon energy is sourced.
End-of-life routes	End-of-life routes were assumed to be consistent with those of the EPN calculator for comparison; specifically 74% recycling, 21% going to landfill and 5% going to incineration. This is largely consistent with other estimates; USEPA data points to average paper recycling rates of around 65%,[3] while the European Union had an average recycling rate of 72% in 2014.[4]

1 BN Americas (2006) Paper, Cardboard Recycling Industry Ranked 4th in World. Available from: http://www.bnamericas.com/news/waterandwaste/Paper,_cardboard_recycling_industry_ranked_4th_in_world [Last accessed March 24, 2017]

2 Royal Printers (2017) Print Without Forests: Paper That Tells a Story. Available from: http://www.royalprinters.com/why-royal/print-without-forests/ [Last accessed March 24, 2017]

3 USEPA (2016). Wastes - Resource Conservation - Common Wastes & Materials - Paper Recycling. Available from: https://archive.epa.gov/wastes/conserve/materials/paper/web/html/basic_info/html [Last accessed March 24, 2017]

4 European Recovered Paper Council (2015) Recycling Monitoring Report 2014. Available from: http://www.paperrecovery.org/uploads/Modules/Publications/Final_MonitoringReport2014.pdf [Last accessed March 24, 2017]

ASSIGNMENT OF LCIA RESULTS TO IMPACT CATEGORIES

Following the development of the impact indicators and the development of per-unit resource consumption using the paper mill's data, Trucost entered these values into the SimaPro 3.0 software. Trucost then undertook the life cycle analysis of Sugar Sheet paper using the widely-applied ReCiPe Midpoint H V.1.12 methodology.

Trucost used an impact indicators framework to map the life cycle impacts to the different stages in the product life cycle, which produced estimates of unit values (kg CO_2e). Wood use for Sugar Sheet paper was zero (0), as this was not utilized as a raw material input. Trucost sourced figures for comparative uncoated freesheet from the Environmental Paper Network Calculator, which yielded comparative GHG and wood use category impacts under different recycled content rates.

CALCULATION OF CATEGORY INDICATOR RESULTS

Trucost collected the SimaPro outputs for cumulative kg CO_2e emissions per kg of paper for Sugar Sheet paper. Trucost compared these values against per-unit GHG impacts for EPN uncoated freesheet paper and calculated the percentage change in GHG emissions per kg of product.

DATA SOURCES AND ASSUMPTIONS FOR INPUTS

The table below presents Trucost's data sources and assumptions for each input within the LCA model.

TABLE A2: DATA SOURCES AND ASSUMPTIONS

INPUT	DATA SOURCE	REGION	ASSUMPTIONS
Bagasse processing from sugarcane at sugar refinery	Paper mill	Country of paper manufacture	Transport, freight, lorry
Maize starch	Ecoinvent 3	World	Starch used as an additive is derived from maize; Transport, freight, transoceanic tanker
Hydrogen Peroxide	Ecoinvent 3	World	Transport, freight, lorry
Chlorine dioxide	Ecoinvent 3	World	Transport, freight, lorry
Lime	Ecoinvent 3	World	Transport, freight, lorry
Sodium Hydroxide	Ecoinvent 3	World	Transport, freight, lorry
Limestone	Ecoinvent 3	World	Transport, freight, lorry, crushed
Optical brightener agent	Ecoinvent 3	World	Transport, freight, lorry
Retention agent	Ecoinvent 3	World	Transport, freight, lorry
Alkylketene dimer sizing agent	Ecoinvent 3	World	Transport, freight, lorry
Electricity mix	Ecoinvent 3	Country of paper manufacture	Grid-mix

INPUT	DATA SOURCE	REGION	ASSUMPTIONS
Electricity, coal burning	Ecoinvent 3	World	Electricity generation from coal based on generic data, adapted the quantity of coal used in the process with client specific data
Biomass	Ecoinvent 3	World	No Transport
Fuel Oil	Ecoinvent 3	World	No transport
Diesel	Ecoinvent 3	World	No transport
Transport	Social Print Paper, Ecoinvent 3	World	Lorry freight transport by size defined by client. Shipping data per km were also provided.
End-of-life split among incineration, landfill and recycling	EPN, based on USEPA 2009	United States	21% landfill, 5% incinerated, 74% recycled
End-of-life emissions and credits	EPN, based on USEPA 2009, NASCI 2004, DEFRA 2012	United States	Assumptions made around degradation rates, landfill gas capture and energy generation, waste-to-energy generation, material higher heating value, greenhouse gas emissions from electricity grid, emissions from transportation / sorting/ operations

LEGAL STATEMENT

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