Development of a carbon profile of paper-based gift cards manufactured by Optimum Card Solutions and comparison of carbon footprints of competing paper grades and gift cards

Prepared by Sustainable Paper Group, Inc.

Submitted to:

Optimum Card Solutions, LLC
855 S. Fiene Drive
Addison, IL 60101

August 1, 2023

DISCLAIMER:

The following report presents carbon footprint numbers for several types of products. Given the lack of publicly available data on many products, assumptions were made and are documented in the report. Several numbers are estimates and may differ from numbers which are based on measured data. It should be noted that the carbon footprint of a product can vary significantly based on variables within the life cycle of that product. The numbers reported here will change over time and with varying conditions.

CONTENTS

SUMMARY

This report presents the carbon footprint of the following products:

- Paper-based gift cards manufactured by Optimum Card Solutions using Invercote (made by Iggesund) as a paper base stock.
- Paper-based gift cards manufactured using the following paper grades: ImageMax by Neenah, Envi by Monadnock and Tango by Westrock.
- Gift cards made using virgin PVC resin.

The carbon footprint of the above paper grades and virgin PVC (prior to converting and printing) are also presented.

All reported numbers are based on publicly available data and assumptions which are documented in the report. It should be noted that there is a lack of data on product carbon footprints because many companies have not calculated or do not publicly report their carbon footprint or greenhouse gas emissions.

The CEPI Ten Toes Method[3] was used as a guideline for reporting the carbon footprint of paper. The carbon footprint of paper-based gift cards was calculated using the Greenhouse Gas Protocol[1] as well as Intergraf recommendations on CO2 emissions calculation in the printing industry.[2]

The carbon footprint of cards manufactured by Optimum Card Solutions in 2021 was 1,031 kg CO2e/MT of product. The key elements influencing this number are purchased electricity (56% of carbon footprint), paper (19%) and paper transportation (24%). One reason for high CO2e emissions of purchased electricity is that the local power grid uses a high percentage of fossil fuels as an energy source (64%). A more accurate measurement of power consumption by equipment type would be beneficial for better control and setting reduction targets.

Results show that gift cards manufactured by Optimum Card Solutions have the lowest carbon footprint when compared to their competitors. The numbers are shown below for one gift card and per metric ton of product.

Product	**Carbon Footprint (grams of CO2e per card)**	**Carbon Footprint (kg CO2e per metric tonne of product)**
Optimum Card Solutions paper gift card	4.7	1,031
Westrock Tango paper gift cards	9.2	2,021
Monadnock Envi paper gift cards	12.7	2,807
Neenah ImageMax paper gift cards	15.4	3,401
Gift cards made with virgin PVC	20	4,409

To put these numbers in context, the carbon footprint of 220 cards made by Optimum Card Solutions, or 1 kg of cards (1.031 kg CO2e) is less than the carbon footprint of 1 kg of apple pie (1.24 kg CO2e) and more than 1 kg of carrots (0.94 kg CO2e).

Due to its lower carbon footprint, Optimum Card Solutions can achieve significant savings in CO2e emissions over its competitors. For example, CO2e savings over an entire year of card production (412.7 metric tons of cards) can range between 400 and 1,000 metric tons of CO2e less than competing gift cards. This is equivalent to the carbon footprint of 1 passenger taking between 600 and 1,500 one-way flights from New York to Los Angeles (0.660 metric tons of CO2e per flight). Another equivalent would be taking between 85 and 215 typical passenger cars off the road for 1 year (i.e., based on CO2e emissions of 4.6 metric tons per average car - US EPA data).

The main reasons for the lower carbon footprint of Optimum Card Solutions gift cards are as follows:

- The use of Iggesund Invercote as a paper base stock. This sheet has one of the lowest carbon footprints in the pulp and paper industry at 195 kg CO2e per metric ton. In comparison, competing grades range from 878 to 1998 kg CO2e per metric ton due to more reliance on fossil fuels in the manufacturing life cycle. Iggesund can achieve a low number due to an energy-efficient mill and high use of renewable energy such as hydro and biomass power.

- Optimum Card Solutions uses a streamlined process where paper from the Iggesund mill is shipped directly to their printing facility in Addison, IL, and rolls are ready to use on the printing press. This avoids the carbon footprint of converting and laminating at a separate converting plant. Transportation by truck from the paper mill to a converter is also avoided.

- Optimum Card Solutions has a patented printing process which is energy and cost-efficient because it uses less equipment to produce gift cards, thanks to a fully integrated in-line process. All printing steps, embellishments, die cutting, mag stripe and personalization are carried out inline in a singular process and gift cards are completed from raw material to finished product in about 20 seconds on press.

- The traditional gift card manufacturing process used by other manufacturers includes several additional and separate steps such as:
    - Printer prints front of card
    - Printer prints back of card
    - Any embellishments (if needed) are applied to cards (foil, spot varnish, embossing, etc.)
    - Die cutting to CR80 size
    - Add magnetic stripe
    - Personalize cards with card number, PIN, encode mag-stripe and add security label

Publicly available data also shows that the environmental performance of Iggesund Invercote is superior to the Neenah (ImageMax), Monadnock (Envi) and Tango (Westrock) products. The key supporting evidence is the

Ecovadis ranking of Iggesund and the carbon footprint of the paper grades. Iggesund is also a more transparent company when it comes to making environmental and sustainability information publicly available (details in Appendix D).

Paper also has key environmental advantages over PVC:

- It is made from renewable wood fiber (from sustainably managed forests) or recycled fiber, as opposed to PVC plastic which is fossil-fuel based and non-renewable.
- The carbon footprint of paper is generally lower than the carbon footprint published for virgin PVC resin.
- The recyclability of paper reduces landfill waste. PVC is typically not recyclable in the mainstream recycling infrastructure. It is estimated that each year between 37,500 to 50,000 tons of PVC gift cards end up in landfills.
- Paper is biodegradable whereas plastic can take hundreds of years to break down into microplastics that can contain carcinogens, toxins, and heavy metals.

Given that more than 10 billion plastic gift cards are manufactured globally every year, the overall environmental impact of this volume of plastic is significant. Therefore, the use of paper-based gift cards with a low carbon footprint has clear environmental benefits.

INTRODUCTION

The objective of the project was to assist Optimum Card Solutions in its goal of acquiring information on the carbon footprint of its product and competing paper grades and gift cards.

The project included the following phases:

1 – Evaluating the carbon footprint of competing paper grades used to make paper-based gift cards (ImageMax by Neenah, Envi by Monadnock, Tango by Westrock) as well as other paper grades for which carbon footprint data was available. The scope of the carbon footprint is cradle-to-gate.[3]

2 – Calculating the carbon profile of paper-based gift cards manufactured by Optimum Card Solutions and its key competitors, including PVC cards.

In all cases the results will focus on fossil carbon and exclude biogenic carbon since this is a common method of reporting product carbon footprints. [4]

CARBON FOOTPRINT AND OVERALL ENVIRONMENTAL FOOTPRINT OF PAPER GRADES AND PVC

Optimum Card Solutions uses Iggesund Invercote (Solid Bleached Sulfate board 12 pt and 14 pt) as its preferred paper grade to manufacture paper-based gift cards. The three key competing North American paper suppliers (for paper-based gift cards) are:

- Neenah Paper (ImageMax grade)
- Monadnock Paper (Envi card stock)
- Westrock (Tango)

Carbon footprint and environmental data was collected for these four paper grades and PVC to compare their carbon footprint and other environmental attributes.

Iggesund Invercote

Iggesund publishes an annual Carbon Footprint and Environmental Declaration for its Invercote grade – see Appendix A. The carbon footprint is calculated based on the CEPI ten Toes Method which is a globally recognized guideline for product carbon footprint calculations.[5]

The carbon footprint of Invercote for 2021 was 195 kg CO2e per metric ton of board (excluding biogenic carbon). The table below shows the breakdown of the carbon footprint by key categories outlined in the CEPI method.

Fossil Carbon emissions	**CO_2 (kg/tonne board)**	**Percentage of total**	**GHG protocol scope**
Greenhouse emission from paperboard manufacturing facilites	44	22%	1
Greenhouse emission associated with purchased electricity	1	1%	2
Greenhouse emission from producing the wood fibres	19	9%	3
Greenhouse emission from producing other raw materials	110	57%	3
Greenhouse emission associated with transportation	21	11%	3
Carbon Footprint SUM	**195**	**100%**	

Neenah ImageMax

Neenah has several facilities that make coated specialty papers including laminated products. They are non-integrated and purchase market pulp in order to manufacture paper. The company has not calculated and/or made publicly available their product carbon footprint. However, estimates were made based on available data and are summarized below.

Data description	Kg CO2e per metric ton of product	GHG protocol scope	Source / Comments
GHG intensity for Neenah products	1,143	1 and 2	Neenah 2021 Sustainability Report[6,7]
US average carbon footprint for market pulp	855	3	Tomberlin et al., 2020[8]
Total carbon footprint	1,998		This estimate does not include scope 3 GHG emissions of producing wood fibres and other raw materials, and transportation of materials to the mill (which are typically included in a cradle-to gate carbon footprint calculation, such as the CEPI methodology used by Iggesund).

Based on the above, the carbon footprint for the average Neenah paper grade, including market pulp, is estimated to be 1,998 kgCO2e/MT.

More information on ImageMax can be found at: https://www.neenahpaper.com/brands/imagemax-papers

Monadnock Envi

Monadnock is a non-integrated mill facility and they purchase market pulp in order to manufacture paper.

The company has not calculated and/or made publicly available their product carbon footprint. However, based on information available in Monadnock's 2020 Environmental Reports and website, their paper carbon footprint was estimated and is summarized in the table below (see Appendix B for details).

Data description	Kg CO2e per metric ton of product	GHG protocol scope	Source / Comments
Scope 1 GHG emissions for Monadnock	699	1	Based on reported oil use.
Scope 2 GHG emissions for Monadnock	59	2	Based on on-site hydro consumption and purchased electricity use as well as the carbon intensity of the New Hampshire power grid.
US average carbon footprint for market pulp	855	3	Tomberlin et al., 2020
Total carbon footprint	1,613		This estimate does not include the scope 3 GHG emissions of producing wood fibres and other raw materials, and transportation of materials to the mill (which are typically included in a cradle-to gate carbon footprint calculation, such as the CEPI methodology used by Iggesund).

Based on the above, the carbon footprint for the average Neenah paper grade, including market pulp, is estimated to be 1,613 kgCO2e/MT.

More information on the Envi grade can be found at: https://mpm.com/product/paper-envi-card/

Tango

Tango paperboard (SBS) is produced by Westrock. The carbon footprint of Tango gift card stock was estimated to be 878 CO2e per metric ton of product based on data provided in the Westrock 2021 Sustainability Report as well as GHG emissions reported by the company on the US EPA GHG database. The table below summarizes the results.

Data description	**Kg CO2e per metric ton of product**	**GHG protocol scope**	**Source / Comments**
Scope 1 GHG emissions for the 3 Westrock mills producing SBS	878	1	USEPA GHG database
Scope 2 GHG emissions for the same mills	0	2	It is assumed that these mills are the largest Westrock mills and produce their own electricity using combined heat and power (CHP) systems. It is assumed that the three integrated mills producing Tango paperboard are self-sufficient in electricity and therefore have zero Scope 2 emissions.
Total	878		This estimate does not include GHG emissions of producing wood fibres and other raw materials, and transportation of materials to the mill (which are typically included in a cradle-to gate carbon footprint calculation, such as the CEPI methodology used by Iggesund).

A more detailed explanation of the calculations and rationale for the estimate are provided in Appendix C.

PVC

PVC (polyvinyl chloride) remains the most common substrate used to manufacture gift cards.

A recent study on the cradle-to-gate life cycle analysis of PVC resin[9] reported that the carbon footprint of virgin PVC is 2,095 kg CO2e per metric ton of product. It should be noted that recycled PVC or alternative bioplastics, which are also used for gift card manufacturing, are less carbon intensive than virgin PVC.

Comparison of Paper Environmental Attributes

Environmental attributes were compared for Neenah, Monadnock, Westrock and Iggesund paper grades (See

Appendix D).

The data shows that the environmental performance of Iggesund Invercote is superior to the Neenah, Monadnock and Westrock products. The key supporting evidence is the Ecovadis ranking and the carbon footprint. Iggesund is also a more transparent company when it comes to making environmental and sustainability information publicly available. Environmental declarations and performance data are lacking for Neenah, Monadnock and Westrock.

The main findings are detailed below:

- The Monadnock and Neenah products include recycled fiber content which could be an attractive feature to buyers, but it is unrelated to the overall environmental footprint of the product.
- The carbon footprint of Invercote is low given the high use of renewable energy at the Iggesund mill site and the absence of fossil fuels in the Swedish energy grid.
- Iggesund Invercote has an excellent Ecovadis ranking (Platinum), especially in the Environmental category (90%) (Appendix E). The Ecovadis Platinum score includes companies that rank in the top 1% globally for sustainability.
- Monadnock has an Ecovadis Gold ranking which covers companies that rank in the top 5 to 8%. However, Monadnock does not make their Ecovadis report and scores public.
- Neenah and Westrock do not participate in the Ecovadis ranking.
- All 4 companies provide certified products for FSC[10] relating to sustainable forest management and chain-of-custody certification. Iggesund also provides PEFC-certified product[11].
- Iggesund and Monadnock both have a certified ISO 14001 environmental management system. Neenah and Westrock do not.
- Iggesund is the only company having a certified ISO 50001 Energy Management System.
- Monadnock and Neenah are Green-e certified for renewable energy, but this does not relate to environmental performance.
- Monadnock offers carbon neutral products through the purchase of carbon offsets. This is also unrelated to environmental performance. Offsets can be purchased by any company.
- Both Green-e certification and carbon neutral products can be an attractive environmental attribute for buyers.

<u>Paper vs PVC</u>

Paper has key environmental advantages over PVC:

- It is made from renewable wood fiber (from sustainably managed forests) or recycled fiber, as opposed to PVC plastic which is fossil-fuel based and non-renewable.
- The carbon footprint of paper (Figure 1) is generally lower than the carbon footprint published for virgin PVC resin.[12]
- The recyclability of paper reduces landfill waste. PVC is typically not recyclable in the mainstream recycling

infrastructure.[13] It is estimated that each year between 37,500 to 50,000 tons of PVC gift cards end up in landfills.
- Paper is biodegradable whereas plastic can take hundreds of years to break down into microplastics that can contain carcinogens, toxins, and heavy metals.

Given that more than 10 billion plastic gift cards are manufactured globally every year, the overall environmental impact of this volume of plastic is significant.[14]

Product Carbon Footprint Benchmarking

A review of available carbon footprint data was conducted for cradle-to-gate, excluding biogenic carbon. In addition to the Iggesund, Monadnock, Neenah and Westrock data provided above, the following sources of data were identified:

- Carbon profiles for Billerudkorsnas board products
- Carbon profiles for UPM-Kymmene relevant grades (WFC)
- Euro Paper Sack research group study - Sack Kraft Paper
- Article – Life-cycle carbon footprint analysis of pulp and paper grades in the United States using production-line-based data and integration
- EU Graphical Papers carbon footprint average (CEPI)
- European average for carton products (ECMA carton product pool)
- EU Converted Carton Packaging carbon profile
- AFPA Printing and Writing grades LCA study
- Study on the carbon footprint of PVC

The carbon footprint data and links to all sources are provided in Appendix F. Figure 1 below summarizes the results of carbon footprint data. Globally, the data is limited because few pulp and paper companies have reported their product carbon footprint.

The data shows that the carbon footprint of paper can vary from 100 to 2,000 kg CO2e/MT of paper. Iggesund Invercote is the best performer in this data set (n=31), with a carbon footprint of 195 kg CO2e/MT. Neenah ImageMax (estimated at 1,998 kg CO2e/MT), Monadnock Envi (estimated at 1,613 kg CO2e/MT) and Westrock Tango (estimated at 878 kg CO2e/MT) have significantly higher carbon footprints, as do many other paper grades.

The carbon footprint of virgin PVC is higher than all reported paper grades, at 2,095 kg CO2e per metric ton of product.

It should be noted that carbon footprints were calculated using different methodologies and they cover different time periods. However, the benchmarking provides an estimate of the range of carbon footprints for relevant paper grades and PVC resin.

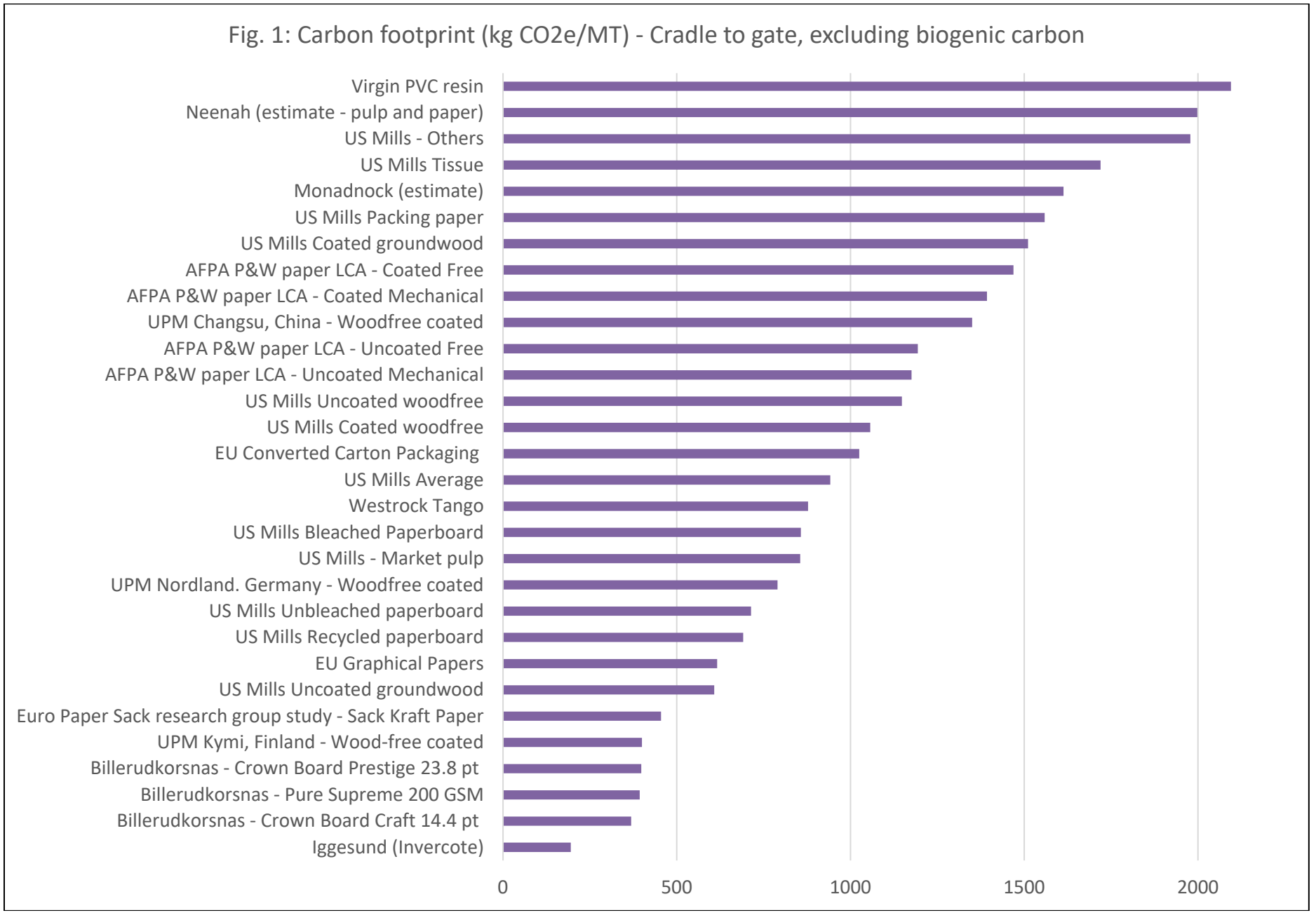


Fig. 1: Carbon footprint (kg CO2e/MT) - Cradle to gate, excluding biogenic carbon
Virgin PVC resin
Neenah (estimate - pulp and paper)
US Mills - Others
US Mills Tissue
Monadnock (estimate)
US Mills Packing paper
US Mills Coated groundwood
AFPA P&W paper LCA - Coated Free
AFPA P&W paper LCA - Coated Mechanical
UPM Changsu, China - Woodfree coated
AFPA P&W paper LCA - Uncoated Free
AFPA P&W paper LCA - Uncoated Mechanical
US Mills Uncoated woodfree
US Mills Coated woodfree
EU Converted Carton Packaging
US Mills Average
Westrock Tango
US Mills Bleached Paperboard
US Mills - Market pulp
UPM Nordland. Germany - Woodfree coated
US Mills Unbleached paperboard
US Mills Recycled paperboard
EU Graphical Papers
US Mills Uncoated groundwood
Euro Paper Sack research group study - Sack Kraft Paper
UPM Kymi, Finland - Wood-free coated
Billerudkorsnas - Crown Board Prestige 23.8 pt
Billerudkorsnas - Pure Supreme 200 GSM
Billerudkorsnas - Crown Board Craft 14.4 pt
Iggesund (Invercote)
0
500
1000
1500
2000

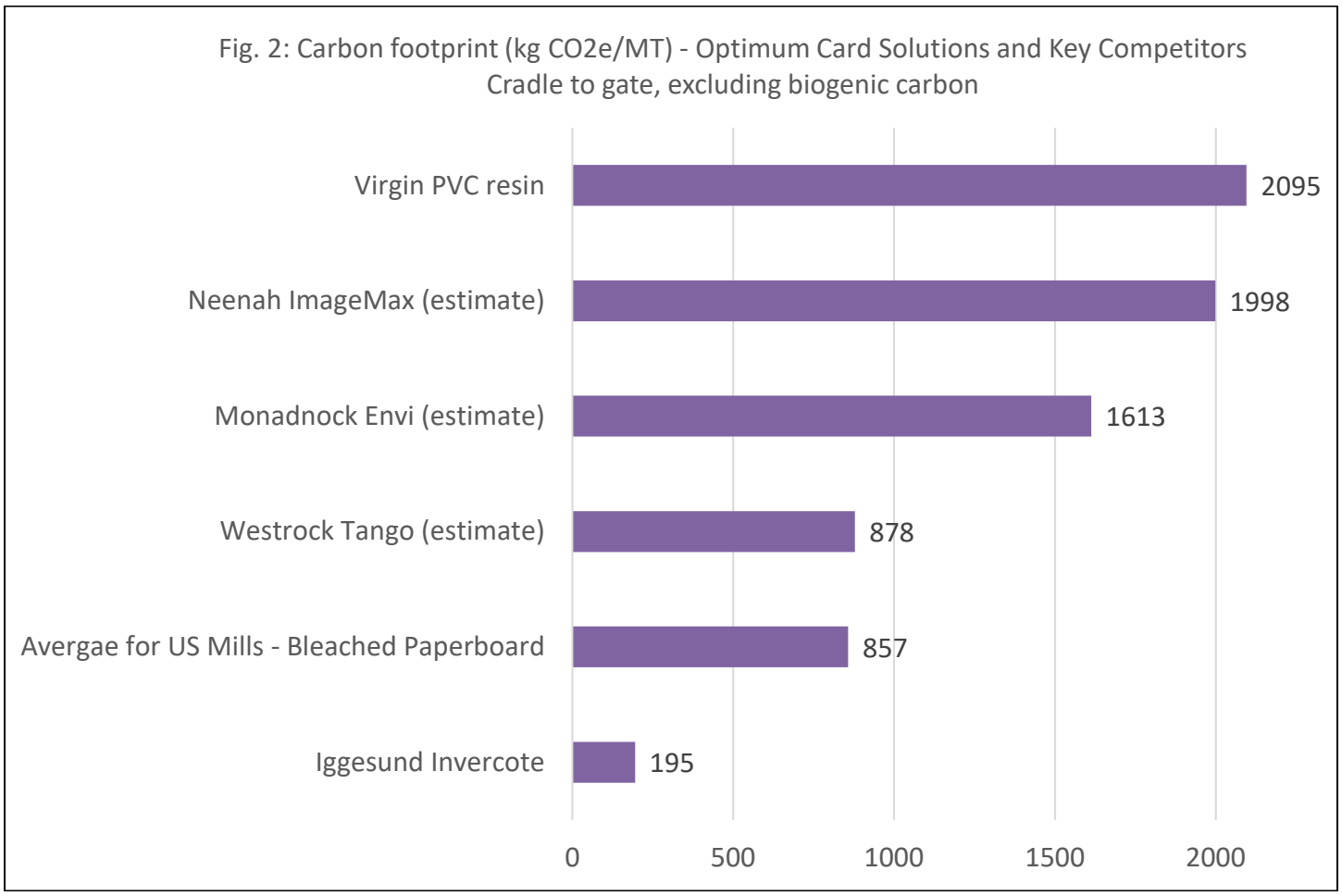


Fig. 2: Carbon footprint (kg CO2e/MT) - Optimum Card Solutions and Key Competitors
Cradle to gate, excluding biogenic carbon
Virgin PVC resin
2095
Neenah ImageMax (estimate)
1998
Monadnock Envi (estimate)
1613
Westrock Tango (estimate)
878
Avergae for US Mills - Bleached Paperboard
857
Iggesund Invercote
195
0
500
1000
1500
2000

CARBON PROFILE OF OPTIMUM CARD SOLUTIONS PAPER-BASED GIFT CARDS AND COMPETING GIFT CARDS

Optimum Card Solutions

Manufacturing Process

The card manufacturing process for Optimum Card Solutions can be summarized as follows:

- The Invercote grade is manufactured by Iggesund in Sweden. The rolls are cut to proper size by Iggesund and shipped to Philadelphia by ocean transport.
- In Philadelphia they are shipped to Desplaines, IL by full truckload (42,000 lb) where they are kept in a Midland Warehouse.
- Optimum cards orders batches of 10,000 to 12,000 lb to be shipped to their facility in Addison, IL ($^1/_4$ to ½ truckload).
- In 2021, Optimum Card Solutions operated 2 flexographic printing presses (13 inch and 10 inch). Each press manufactures cards and card carriers (see photos in Appendix G). The presses run 128 hours per 7-day week. The carriers do not undergo slitting or gluing and typically do not have a magstripe. However, the energy used to print a card and a carrier is assumed to be the same.

This is a streamlined and efficient process compared to the traditional process of manufacturing paper-based gift cards. The key points to note are summarized in the following table.

<table>
<tr><th>Manufacturing steps for paper-based gift card production</th><th>Optimum Card Solutions patented process</th><th>Traditional paper-based gift cards</th><th>Environmental benefits of Optimum Card Solutions process</th></tr>
<tr><td>Paper transportation from paper mill</td><td>Paper supply is cut to proper roll size by paper mill and shipped directly to Optimum Card Solutions</td><td>Paper rolls are shipped by the paper mill to a converter</td><td rowspan="4">Avoids transportation and processing by a converting facility. This reduces transportation, energy use and overall environmental impacts caused by converting and shipping.</td></tr>
<tr><td>Converter cuts rolls to proper size</td><td>NA</td><td>Yes</td></tr>
<tr><td>Converter combines two sheets and laminates/glues together to form finished sheet</td><td>NA</td><td>Yes</td></tr>
<tr><td>Finished sheets is shipped to printing facility</td><td>NA</td><td>Yes</td></tr>
<tr><td>Printer prints front of card</td><td rowspan="6">All printing steps, embellishments, die cutting, mag stripe and personalization are carried out inline in a singular process and gift cards are completed from raw material to finished product in about 20 second on press</td><td>Step 1 of traditional printing process</td><td rowspan="6">The Optimum Card Solutions patented process is energy and cost-efficient because it uses less equipment to produce gift cards, thanks to a fully integrated in-line process</td></tr>
<tr><td>Printer prints back of card</td><td>Step 2 of traditional process</td></tr>
<tr><td>Any embellishments (if needed) are applied to cards (foil, spot varnish, embossing, etc.)</td><td>Step 3</td></tr>
<tr><td>Die cutting to CR80 size</td><td>Step 4</td></tr>
<tr><td>Add magnetic stripe</td><td>Step 5</td></tr>
</table>

Manufacturing steps for paper-based gift card production	**Optimum Card Solutions patented process**	**Traditional paper-based gift cards**	**Environmental benefits of Optimum Card Solutions process**
Personalize cards with card number, PIN, encode mag-stripe and add security label		Step 6	

Data Collection and Methodology

Data covering the 2021 calendar year was collected and is provided in Appendix H.

The carbon footprint of paper-based gift cards manufactured by Optimum Card Solutions was calculated using the Greenhouse Gas Protocol, as developed by the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD)[15] as well as Intergraf recommendations on CO2 emissions calculation in the printing industry.[16]

Intergraf lists 13 key parameters which are normally responsible for most CO2 emissions that can be associated with printing activities on site, or in relation to the production of printed products (Appendix I). These parameters are assumed to cover about 95% of total CO2 emissions within the defined scope. The Intergraf recommendation does not include some parameters which are deemed to have a low relevance in relation to total emissions, in normal operation conditions. These represent a maximum of 5% of the defined scope for calculations, and are:

- Production of other materials like plate developing agents, fountain solution, gum, blankets and small supplies.
- Transport of other raw materials than the substrate.
- Transport and treatment of production waste and wastewater.
- Business travel by employees and visitors.
- Emissions from VOC's.

The following sources were also used as calculation tools and to obtain emissions factors:

- EPA emission factors for GHG Inventories (April 2022) - https://www.epa.gov/climateleadership/ghg-emission-factors-hub
- EPA (eGRID subregion RFCW 2021) - https://www.epa.gov/egrid
- USLCI factor - https://www.nrel.gov/lci/
- Ecoinvent database - https://ecoinvent.org/the-ecoinvent-database/
- Canadian Printing Ink Manufacturers Association - http://www.cpima.org/environmentalIssues.html
- Ecotransit - https://www.ecotransit.org/en/
- National Council for Air and Stream Improvement FEFPro Model - https://www.ncasi.org/resource/footprint-estimator-for-forest-products/

Results

This study covers the carbon footprint of the paper-based gift cards only, not the card carrier (see Appendix G for photos).

Appendix J provides the calculations for the carbon footprint of paper-based gift cards as well as supporting comments and references so that calculations can be verified and updated annually. Appendix K provides the carbon profile data sheets for the carbon footprint based on key elements of the product life cycle (as per Intergraf recommendations) and by Scope 1-3 greenhouse gas emissions.

The carbon footprint of cards manufactured by Optimum Card Solutions in 2021 is calculated as 1,031 kg CO2e/MT of product. The key elements influencing this number are listed below.

Activity or Item	**Carbon Footprint (kg CO2 / metric tonne)**	**% of total carbon footprint**	**Comments**
Purchased electricity	577.5	56%	This number is unusually high for a printing operation. A more accurate measure of power consumption is recommended for monitoring and setting reduction targets. Any reduction in electricity (per unit of production) will greatly reduce the overall carbon footprint
Iggesund Invercote	195	19%	This product has a low carbon footprint and is an ideal choice as a paper supply
Paper transportation - marine	123	12%	Any efforts to make transportation more efficient (per unit of paper) will help reduce the carbon footprint
Paper transportation - truck	119	12%	As above
All other items (remaining Scope 3 emissions)	16.2	1.6%	Not a significant impact on the total
Total	1,030.7	100%	

The carbon footprint above is equivalent to 4.7 grams of CO2e per card, since 200,000 gift cards produced by Optimum Card Solutions have an estimated weight of 1 short ton (2,000 lb).[17]

The highest contributor to the carbon footprint is the high electricity use by Optimum Card Solutions. One reason is that the Illinois power grid has a high percentage of fossil fuels used as an energy source (64%)[18] and this increases the carbon footprint. A more accurate measurement of power consumption by equipment type would be beneficial for better control and setting reduction targets.

These findings are also corroborated by the Integraf report which confirm that the bulk of CO2 emissions at a printing facility (Appendix I) are from the following:

- Production of substrate (paper, board)
- Purchased energy
- On-site fuel combustion
- Raw material transportation
- Production of inks and varnishes
- Supply chain energy use

Neenah

Manufacturing process

Gift cards made using the Neenah ImageMax grade follow the traditional method described earlier which consists of the following steps:

1. Paper is shipped from the Neenah mill to a converting/laminating plant. The plant used in this case is owned by Neenah (Mativ Holdings, Inc.) and located at 240 Water Street, Holyoke, MA 01040
2. Once laminated, the paper is shipped to a printing facility where cards are manufactured using a traditional process described earlier.

The printers receiving Neenah paper include the following:

- PLI - 1220 Trade Drive N. Las Vegas, NV 89030 - www.plicards.com
- Travel Tag - 5842 Carmen Avenue, Inver Grove Heights, MN 55076 - www.traveltags.com
- Westrock – MPS - 1500 Centre Circle, Downers Grove, IL 60515 - www.westrock.com
- Harvard Card - 111 N Baldwin Park Blvd., Bassett, CA 91746 - https://www.plicards.com/card-talk/pli-acquires-harvard-card-systems/

Data Collection and Results

The calculation of the carbon footprint of paper-based gift cards manufactured with Neenah ImageMax is presented Appendix J. Due to the lack of publicly available data, several assumptions were made and are detailed in the table below.

The carbon footprint of cards manufactured using Neenah ImageMax is estimated at 3,401 kg CO2e/MT. The key elements influencing this number are listed below.

Activity or Item	**Carbon Footprint (kg CO2 / metric tonne)**	**% of total carbon footprint**	**Comments**
Converting and laminating – Natural gas for heating	17	0.5%	The carbon footprint of natural gas used by the converter was assumed to be 0.5% of the total carbon footprint
Converting and laminating - electricity	338	10%	The carbon footprint of electricity use by the converter was assumed to be 10% of the total

Activity or Item	**Carbon Footprint (kg CO2 / metric tonne)**	**% of total carbon footprint**	**Comments**
			carbon footprint
Printer – natural gas for heating	8.6	0.25%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Printer - electricity	577.5	17%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Paper production	1998	59%	As calculated in this report for Neenah paper
Paper transportation	454	13.4%	All transport by truck at a rate of 0.0935 kg CO2e/mt-km. Transportation from the Neenah mill to the converter and then from the converter to 4 printers. An average distance was used for the 4 printers.
All other items (remaining Scope 3 emissions)	7.6	0.23%	Not a significant impact on the total
Total	3401	100%	

The carbon footprint above is equivalent to 15.4 grams of CO2e per card, based on the fact that 200,000 gift cards have an estimated weight of 1 short ton (2,000 lb).[17]

Monadnock

Manufacturing process

Gift cards made using the Monadnock Envi grade follow the traditional method described earlier which consists of the following steps:

1. Paper is shipped from the Monadnock mill (Claremont, NH) to a converting/laminating plant. The plant used in this case is owned by Neenah (Mativ Holdings, Inc.) and located at 240 Water Street, Holyoke, MA 01040
2. Once laminated, the paper is shipped to a printing facility where cards are manufactured using a traditional process described earlier.

The printers receiving Monadnock paper include the following:

- PLI - 1220 Trade Drive N. Las Vegas, NV 89030 - www.plicards.com
- Travel Tag - 5842 Carmen Avenue, Inver Grove Heights, MN 55076 - www.traveltags.com
- Westrock – MPS - 1500 Centre Circle, Downers Grove, IL 60515 - www.westrock.com
- Harvard Card - 111 N Baldwin Park Blvd., Bassett, CA 91746 - https://www.plicards.com/card-talk/pli-acquires-harvard-card-systems/

Data collection and Results

The carbon footprint of cards manufactured using Monadnock Envi is estimated at 2,807 kg CO2e/MT. The key elements influencing this number are listed below. Due to the lack of publicly available data, several assumptions were made and are detailed in the table below and in Appendix J.

Activity or Item	**Carbon Footprint (kg CO2 / metric tonne)**	**% of total carbon footprint**	**Comments**
Converting and laminating – Natural gas for heating	13.9	0.5%	The carbon footprint of natural gas used by the converter was assumed to be 0.5% of the total carbon footprint
Converting and laminating - electricity	281	10%	The carbon footprint of electricity use by the converter was assumed to be 10% of the total carbon footprint
Printer – natural gas for heating	8.6	0.3%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Printer - electricity	577.5	20.6%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Paper production	1613	57.5%	As calculated in this report for Monadnock paper
Paper transportation	306	10.9%	All transport by truck at a rate of 0.0935 kg CO2e/mt-km. Transportation from the Monadnock mill to the converter and then from the converter to 4 printers. An average distance was used for the 4 printers.
All other items (remaining Scope 3 emissions)	7.6	0.3%	Not a significant impact on the total
Total	2,807	100%	

The carbon footprint above is equivalent to 12.7 grams of CO2e per card, based on the fact that 200,000 gift cards have an estimated weight of 1 short ton (2,000 lb).[17]

Tango

Manufacturing process

Gift cards made using the Westrock Tango grade follow the traditional method described earlier which consists of the following steps:

1. Paper is shipped from Westrock to a converting/laminating plant in Greensboro, NC (Atlantic Packaging).
2. Once laminated, the paper is shipped to a printing facility where cards are manufactured using a traditional process described earlier.

The printers receiving Tango paper include the following:

- PLI - 1220 Trade Drive N. Las Vegas, NV 89030 - www.plicards.com
- Travel Tag - 5842 Carmen Avenue, Inver Grove Heights, MN 55076 - www.traveltags.com
- Westrock – MPS - 1500 Centre Circle, Downers Grove, IL 60515 - www.westrock.com
- Harvard Card - 111 N Baldwin Park Blvd., Bassett, CA 91746 - https://www.plicards.com/card-talk/pli-acquires-harvard-card-systems/

Data collection and Results

The carbon footprint of cards manufactured using Tango is estimated at 2,021 kg CO2e/MT. The key elements influencing this number are listed below. Due to the lack of publicly available data, several assumptions were made and are detailed in the table below and in Appendix J.

Activity or Item	**Carbon Footprint (kg CO2 / metric tonne)**	**% of total carbon footprint**	**Comments**
Converting and laminating – Natural gas for heating	9.3	0.5%	The carbon footprint of natural gas used by the converter was assumed to be 0.5% of the total carbon footprint
Converting and laminating - electricity	202	10%	The carbon footprint of electricity use by the converter was assumed to be 10% of the total carbon footprint
Printer – natural gas for heating	8.6	0.4%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Printer - electricity	577.5	28.6%	Assumed to be the same carbon footprint as for Optimum Card Solutions
Paper production	878	43.4	As calculated in this report for Tango paper
Paper transportation	338.5	16.8%	All transport by truck at a rate of 0.0935 kg CO2e/mt-km. Transportation from three Westrock mills producing SBS (average distance used) to the converter and then from the converter to 4 printers. An average distance was used for the 4 printers.
All other items (remaining Scope 3 emissions)	7.6	0.4%	Not a significant impact on the total
Total	2021	100%	

The carbon footprint above is equivalent to 9.2 grams of CO2e per card, based on the fact that 200,000 gift cards have an estimated weight of 1 short ton (2,000 lb).[17]

PVC Gift Cards

PVC cards are reported to have a carbon footprint ranging from 9 to 150 grams CO2e per card. The table

below shows data from several sources.

Type of PVC card	**Grams of CO2e per card**	**Scope**	**Link to Source**
Gift card	21	Not specified	https://www.greengiftcards.co.uk/news/top-9-benefits-going-green-your-gift-cards
Gift card	9.34 to 21	Production	https://shanericzu.files.wordpress.com/2017/10/kiind-environmental-impact.pdf
Gift card	58.53	Entire life cycle including production, packaging, transport, transaction, and incineration	https://shanericzu.files.wordpress.com/2017/10/kiind-environmental-impact.pdf
Credit card	20	Production	http://www.icma.com/ArticleArchives/CarbonFootprint_SE2-12.pdf
Credit card	150	Material (PVC), manufacturing, packaging, and transportation	https://www.thalesgroup.com/en/markets/digital-identity-and-security/banking-payment/cards/eco-friendly-credit-card/carbon-neutrality
ID-1 card	20 to 50	Production	http://www.icma.com/ArticleArchives/CarbonFootprint_SE2-12.pdf

For the purposes of this study, we have chosen a carbon footprint of 20 grams of CO2e per card. This number has been reported as representative to produce PVC gift cards. This is 4 times higher than the carbon footprint calculated for Optimum Card Solutions.

Benchmarking of Gift Card Carbon Footprint

Figure 3 below shows the carbon footprint per card of Optimum Card Solutions compared to its key competitors.

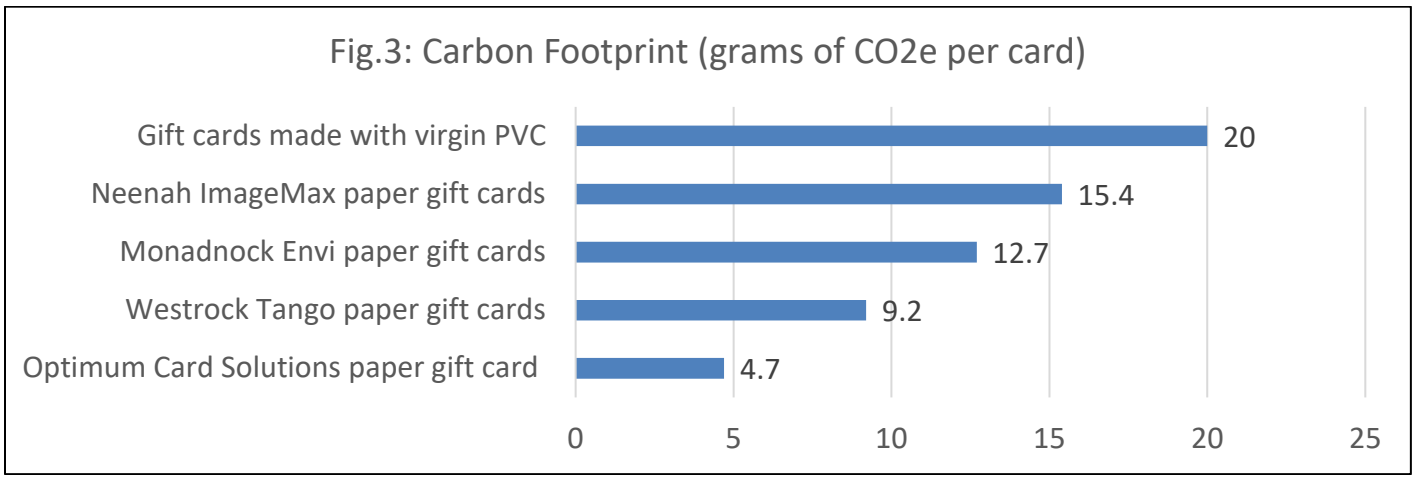
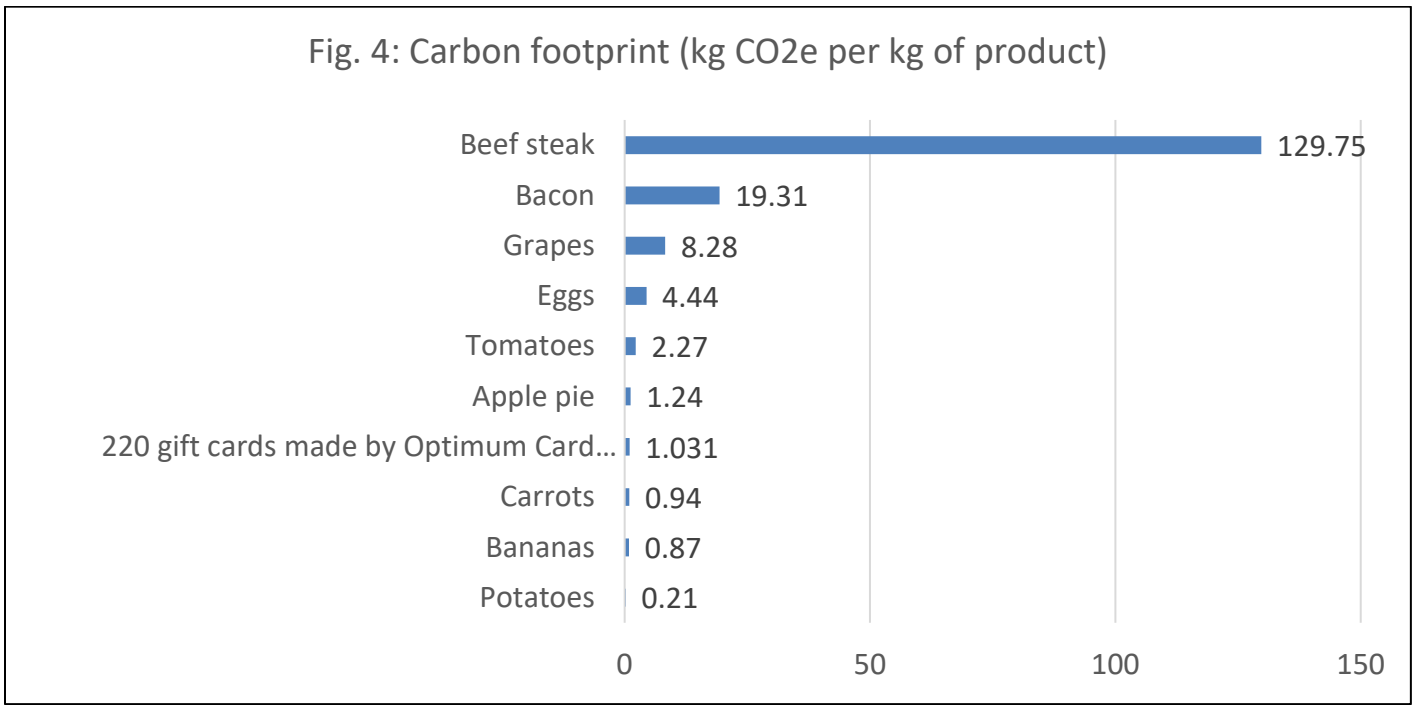


Figure 4 shows the carbon footprint of 220 gift cards made by Optimum Card Solutions (1 kg of cards) compared the carbon footprint of common food items.[19] The carbon footprint of 1 kg of gift cards (1.031 kg CO2e) is less than the carbon footprint of 1 kg of apple pie (1.24 kg CO2e) and more than 1 kg of carrots (0.94 kg CO2e).



Due to a lower carbon footprint, Optimum Card Solutions can achieve significant savings in CO2e emissions over its competitors (Figure 5). For example, CO2e savings over an entire year of card production (412.7 metric tons of cards) can range between 400 and 1,000 metric tons of CO2e less than competing gift cards. This is equivalent to the carbon footprint of 1 passenger taking between 600 and 1,500 one-way flights from New York to Los Angeles (0.660 metric tons of CO2e per flight)[20]. Another equivalent would be taking between 85 and 215 typical passenger cars off the road for 1 year (i.e., based on CO2e emissions of 4.6 metric tons per average car - US EPA data).

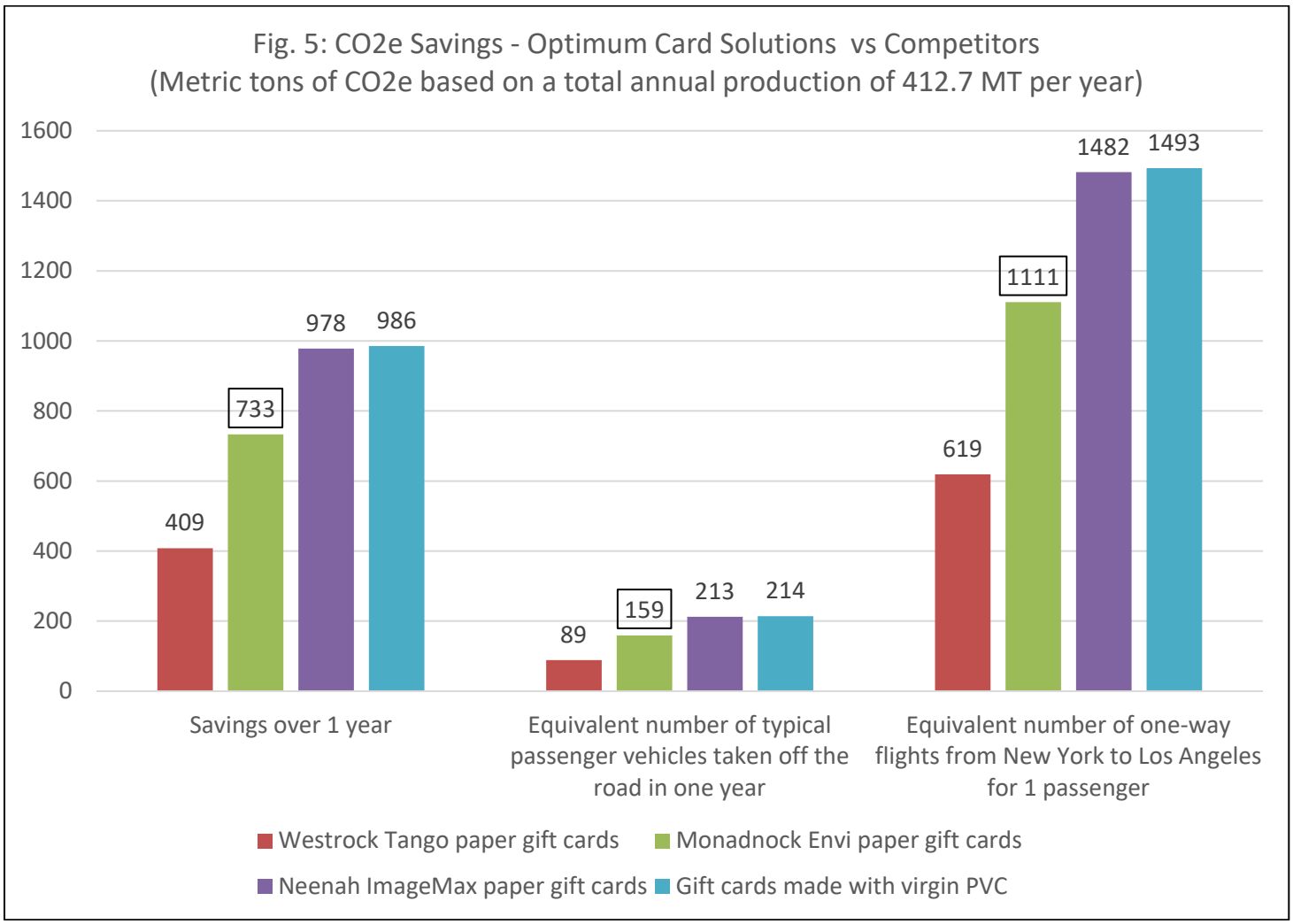


Fig. 5: CO2e Savings - Optimum Card Solutions vs Competitors
(Metric tons of CO2e based on a total annual production of 412.7 MT per year)
1600
1400
1200
1000
800
600
400
200
0
409
733
978
986
89
159
213
214
619
1111
1482
1493
Savings over 1 year
Equivalent number of typical passenger vehicles taken off the road in one year
Equivalent number of one-way flights from New York to Los Angeles for 1 passenger
Westrock Tango paper gift cards
Monadnock Envi paper gift cards
Neenah ImageMax paper gift cards
Gift cards made with virgin PVC

APPENDIX A – IGGESUND CARBON FOOTPRINT AND ENVIRONMENTAL PRODUCT DECLARATION

(Full report: https://www.iggesund.com/globalassets/alla/certificates/paperboard/environmental-declaration-invercote-pdf)

CARBON FOOTPRINT

Company	Holmen Iggesund Paperboard AB
Site	Iggesunds Bruk
Product	Invercote family
Period	2021-01-01 – 2021-12-31

Carbon Footprint Framework
Holmen Iggesund Paperboard calculates the Carbon Footprint of its products based on the guidelines given in the publication "Framework for the development of carbon footprints for paper and board products".
The framework is available at www.cepi.org
The carbon footprint is updated annually and based on figures from the previous year.

Fossil Carbon emissions	**CO_2 (kg/tonne board)**	**Percentage of total**	**GHG protocol scope**
Greenhouse emission from paperboard manufacturing facilites	44	22%	1
Greenhouse emission associated with purchased electricity	1	1%	2
Greenhouse emission from producing the wood fibres	19	9%	3
Greenhouse emission from producing other raw materials	110	57%	3
Greenhouse emission associated with transportation	21	11%	3
Carbon Footprint SUM	**195**	**100%**	

Biogenic Carbon uptake and storage	
Annual carbon storage in Holmen forest	545 kg CO_2/tonne board
Carbon stored in paperboard	1494 kg CO_2/tonne board

INVERCOTE!

Explanations and comments to Carbon Footprint calculations

Greenhouse emission from paperboard manufacturing facilites
Fossil CO_2 emissions from combustion of fossil fuels during pulp and paperboard production.

Greenhouse emission associated with purchased electricity
Fossil CO_2 emissions associated with purchased electricity.

Greenhouse emission from producing the wood fibres
Emissions from forest management and harvesting.

Greenhouse emission from producing other raw materials
Fossil CO_2 emissions from production of non-wood based raw materials and fuels.

Greenhouse emission associated with transportation
Emissions from transport of harvested wood and other raw materials. Transport to customer is not included as this varies strongly from case to case dependent on transport mode and distance. The emissions related to transport to customer can on request be calculated separately for specific cases.

Explanations and comments to Biogenic Carbon uptake and storage

Annual carbon storage in Holmen forest
Growing forests capture carbon. The quoted figure is calculated by dividing the net CO_2 capture in Holmen's own Forests by yearly tonnage produced of all Holmen products.

Carbon stored in paperboard
Biogenic carbon stored in the products.

APPENDIX B – ESTIMATE OF CARBON FOOTPRINT FOR MONADNOCK PAPER

- Use of oil is 52.9 gallons per ton (assumING short tons, since they use "metric tons" for CO2e)
- Assume #2 oil with an emission factor of 82.846 kg CO2e/GJ HHV and energy factor is 0.145 GJ HHV/gallon. This gives 52.9 x 0.145 x 82.846 = 635 kg CO2e/ton or 699 kg CO2e/MT for Scope 1 emissions.
- On-site hydro generation is 4,561 MWh per year, and total electricity use is 0.63 MWh/ton. If we divide 4,561 by 0.63 , we get 7248 tons, which must be less than full production The remainder probably comes from the New Hampshire grid, which has a carbon intensity of 442 kg CO2e/MWh.
- Assuming that the 12,500 tonnes of CO2e credits offset Scope 1 and 2 emissions and that the assumptions in 3 are correct, the total annual production is 16,500 tonnes. Based on this production, Scope 2 emissions = 59 kg CO2e/MT.
- Total Scope 1 + Scope 2 = 758 kg CO2e/MT
- The carbon footprint of purchased market pulp (US average = 855 kg CO2e/MT based on Tomberlin et al.) is also added since it is a major contributor.
- This bring the total estimated carbon footprint to 1,613 kg CO2e/MT

Oil use	52.9	gal/ST	
	58.2	gal/MT	
Oil energy factor	0.145	GJ HHV/gallon	
Oil emission factor	82.85	kg CO2e/GJ HHV	
Scope 1 Monadnock	**699**	**kg CO2e/MT paper**	
Hydroelectricity production	4561	MWh/year	
Electricity use	0.63	MWh/ST	
New Hampshire grid intensity	442	kg CO2e/MWh	
Wind credits purchased	12,500	MT CO2e/year	
Monadnock production	16,500	MT/year	(Input value until E25 = E13)
Absolute Scope 1 emissions	11,534	MT CO2e/year	
Emissions from NH grid electricity	966	MT CO2e/year	(Subtract Scope 1 absolute emissions from 12,500)
MWh from NH grid	2186		
Total MWh used	6747	MWh/year	
Back-calculation of electricity use	0.69	MWh/MT	
Scope 2 Monadnock	**59**	**kg CO2e/MT paper**	
Total Scope 1 and 2	**758**	**kg CO2e/MT paper**	
Scope 3 - US Average for Market Pulp	**855**	**kg CO2e/MT**	From Tomberlin et al. 2020[8]
Total incl. pulp	**1613**	**Kg CO2e/MT**	

The data below was available on Monadnock's website.

Targets

YEAR	2018	2019	2020
Mill Water, Gallons Per Gross Ton of Production	6,500	6,400	6,100
Oil, Gallons Per Gross Ton of Production	50	50	50
New Sustainable Products	Durable Tag	Astrolite PC 100 Velvet	Envi PC 100 Board
Outreach Frequency	8 Activities	10 Activities	12 Activities

YEAR	2018	2019	2020
ENERGY			
Electrical: kWH Used Per Gross Ton of Production	652	599	631*
Thermal: Oil Consumed YTD, Gallons Per Ton	52.5	52.5	52.9*
Total On-Site Hydroelectric Power Produced, kWH	6,399,600	4,507,800	4,561,000
Total On-Site Steam Power Produced, kWH	428,400	322,800	309,200
WATER			
Mill Water Use, Gallon Per Gross Ton of Production	6,913	6,769	6,973
WASTE			
Trash to Landfill Tons	42.5	52.8	45.2
Trash Recycled/Diverted Tons	597.4	626.2	618.9
EMISSIONS			
CO_{2eq} Offset with VERs Metric Tons	12,500	12,500	10,500

RECYCLED FIBER			
Percentage PWC to Gross Tons Produced	12.16%	9.79%	12.23%
EPN PCW IMPACT REDUCTIONS (papercalculator.org)			
Waste Avoided (Pounds)	160,000	160,000	170,000
BTUs Not Consumed (MM	20,700	19,200	21,000
Trees Still Standing	16,440,000	15,240,000	16,640,000
GHG CO_2 Not Produced (Pounds)	21,300,000	19,800,000	21,500,000
Wastewater Not Produced (Gal)	4,000,000	3,700,000	4,000,000
Retail Plastic Replacement Initiative (Pounds)	4,729,982	6,312,918	5,426,719*
Sustainable Product Development	Astrolite PC 100® Velvet	Envi® PC 100 Performance Board	Envi® PC 100 Card Envi® Durable Tag
Community Outreach & Education (frequency)	8	10	12

* *Reduced operations resulting from the COVID pandemic in 2020 adversely affected progress in impact reductions and budgeted sales of products to the retail sector.*

APPENDIX C: ESTIMATE OF TANGO CARBON FOOTPRINT (MANUFACTURED BY WESTROCK)

Tango paper board (SBS) is produced by Westrock. Westrock manufactures paperboard at several of its facilities, however the only mills making "Bleached Paperboard", according to their Annual Report 2022 are Covington, VA, Evadale, TX, and Demopolis AL (see Table below).

Table 1. Westrock production facilities 2022

Paperboard Mills - annual production capacity in thousands of tons

Location of Mill	Bleached Paperboard	Coated Natural Kraft	Coated Recycled Paperboard	Specialty Recycled Paperboard	Linerboard	Market Pulp	Total Capacity
Mahrt, AL		1,035					1,035
Covington, VA	950						950
Evadale, TX	385	95			180		660
Demopolis, AL	360					110	470
St. Paul, MN			170				170
Battle Creek, MI			160				160
Chattanooga, TN				140			140
Dallas, TX			127				127
Lynchburg, VA				121			121
Sheldon Springs, VT (Missisquoi Mill)			111				111
Stroudsburg, PA			80				80
Eaton, IN				64			64
Aurora, IL				32			32
Total Capacity (1)	1,695	1,130	648	357	180	110	4,120

(1) Our fiber sourcing for our paperboard mills is approximately 74% virgin and 26% recycled.

The production at our Lynchburg, VA mill is gypsum paperboard liner and the paper machine at this mill is owned by our Seven Hills joint venture. Our overall fiber sourcing for all of our mills is approximately 65% virgin and 35% recycled.

The Greenhouse Gas Summary Reports for each of these three mills are available on the US EPA GHG database[21], and Scope 1 emissions were obtained for 2021 (Table below).

Mill	**MT CO2e, 2021**	**MT product, 2022**	**Scope 1 intensity, kg CO2e/MT**
Covington, VA	1,245,559	950,000	1311
Evadale, TX	476,083	660,000	721
Demopolis, AL	104,961	470,000	223
Weighted Average	1,826,603	2,080,000	**878**

It is assumed that these mills are the largest Westrock mills and produce their own electricity using combined heat and power (CHP) systems, whereas many of the other mills use recycled fiber and don't have the same access to biomass power (p. 29 of Sustainability Report).

Westrock sold 5,829,426 MMBTU of electricity and steam in 2021 (p. 87), so it is assumed that the three integrated mills producing Tango paperboard are self-sufficient in electricity and therefore have zero Scope 2

emissions.
The total cradle-to-gate carbon footprint also includes some upstream (Scope 3) emissions, e.g. for bleach chemicals, wood harvesting and transportation to the mill.

Therefore, the carbon footprint for Tango gift card stock is estimated at:

Scope 1:	878 kg CO2e/MT
Scope 2:	0
Total:	878 kg CO2e/MT

APPENDIX D – COMPARISON OF ENVIRONMENTAL ATTRIBUTES FOR IGGESUND, NEENAH, MONADNOCK AND WESTROCK

Environmental Attribute	Iggesund Invercote	Neenah ImageMax	Monadnock Envi	Westrock Tango	Comments
Raw material	Wood pulp	30% PCW	Envi PC 100 card is 100% recycled	Wood pulp	
Caliper	12-14 pt	24-28 pt (610-711 microns)	14 to 28 pt	28 pt	
Energy source	Mostly biomass	Mostly natural gas	49% self generated and mostly from hydro	High use of biomass	
Grid energy source	Completely fossil free	Over 85% fossil fuels, including over 50% coal	Over 50% fossil fuels	Assumed low to high biomass source	The Swedish grid has a high percentage of hydro power
Environmental product declaration available	Yes	No	No	No	
Carbon Footprint (kg CO2e/tonne)	195	1998	758	878	Iggesund has an EPD and reported their carbon footprint (2021) using CEPI method - from cradle to mill gate. Tango, Envi and ImageMax numbers were calculated based on publicly available data - they are estimates.
Ecovadis overall score	Platinum ranking (79%)	Does not participate	Gold ranking (Score not reported)	Does not participate	The Ecovadis Platinum score covers companies that rank in the top 1% globally for sustainability (overall score between 78 and 100). The Gold ranking covers companies that rank in the top 5% (overall score between 70 and 77). For more, see: https://support.ecovadis.com/hc/en-us/articles/210460227-What-are-the-score-requirements-and-eligibility-criteria-for-EcoVadis-Medals-
Ecovadis Environmental Score	90	NA	NA	NA	
Forest certification	FSC, PEFC	FSC	FSC	FSC	
% certified fiber FSC	100	NA	NA	NA	
% certified fiber PEFC	100	NA	NA	NA	

Environmental Attribute	Iggesund Invercote	Neenah ImageMax	Monadnock Envi	Westrock Tango	Comments
Chain of custody certification	FSC and PEFC	FSC	FSC	FSC	
Environmental Management System	ISO 14001	No	ISO 14001	No	ISO 14001 is an international standard for designing and implementing an environmental management system (EMS). The requirements provide a framework and guidelines for creating a thorough EMS that is then audited and certified by accredited auditing firms.
Energy Management System	ISO 50001	No	No	No	ISO 50001 is a system for laying out energy management best practices in projects of all sizes and areas. The requirements provide a framework and guidelines for creating a thorough system that is then audited and certified by accredited auditing firms.
Green-e certified for renewable energy	No	Yes	Yes (wind power credits)	No	More on Green-e: https://www.green-e.org/
Carbon neutral products	No	No	Yes	No	Monadnock uses GHG Clean Projects Protocol (VERs). One hundred percent of Monadnock's papers are made with renewable wind-powered electricity that is certified by Green-e® (Third-party Certified Renewable Energy Certificates). This places Monadnock in the EPA 100% Green Power User group.

APPENDIX E – ECOVADIS REPORT FOR IGGESUND INVERCOTE

ecovadis

Sustainability Performance Overview - EcoVadis Rating Details

IGGESUND PAPERBOARD AB (IGGESUND SITE)

Sweden | Manufacture of pulp, paper and paperboard
Publication date: 10 Nov 2021
Valid until: 10 Nov 2022

PLATINUM Top 1% 2021 ecovadis Sustainability Rating

79 /100
99th percentile

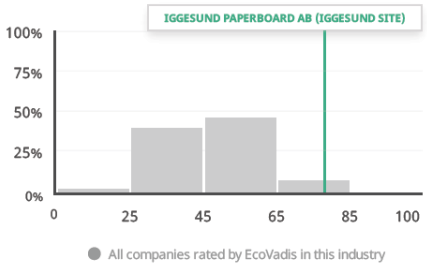
SUSTAINABILITY PERFORMANCE OVERVIEW

Score breakdown

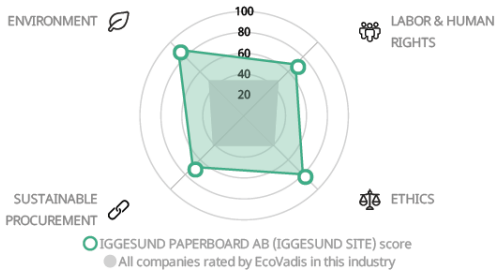
Sustainability performance: Insufficient | Partial | Moderate | Advanced | Outstanding | Average score

OVERALL SCORE	ENVIRONMENT	LABOR & HUMAN RIGHTS	ETHICS	SUSTAINABLE PROCUREMENT
79 /100	90 /100	70 /100	80 /100	70 /100
99th percentile	Weight	Weight	Weight	Weight

Overall score distribution



Theme score comparison



** You are receiving this score/medal based on the disclosed information and news resources available to EcoVadis at the time of assessment. Should any information or circumstances change materially during the period of the scorecard/medal validity, EcoVadis reserves the right to place the business' scorecard/medal on hold and, if considered appropriate, to re-assess and possibly issue a revised scorecard/medal.*

Document generated: 17 December 2021

ecovadis **Sustainability Performance Overview - EcoVadis Rating Details**

HIGHLIGHTS

Overall score

IGGESUND PAPERBOARD AB (IGGESUND SITE) is in the top **1%** of companies rated by EcoVadis in the Manufacture of pulp, paper and paperboard industry.

Environment

IGGESUND PAPERBOARD AB (IGGESUND SITE) is in the top **1%** of companies rated by EcoVadis in the Manufacture of pulp, paper and paperboard industry.

Labor & Human Rights

IGGESUND PAPERBOARD AB (IGGESUND SITE) is in the top **9%** of companies rated by EcoVadis in the Manufacture of pulp, paper and paperboard industry.

Sustainable Procurement

IGGESUND PAPERBOARD AB (IGGESUND SITE) is in the top **5%** of companies rated by EcoVadis in the Manufacture of pulp, paper and paperboard industry.

Ethics

IGGESUND PAPERBOARD AB (IGGESUND SITE) is in the top **1%** of companies rated by EcoVadis in the Manufacture of pulp, paper and paperboard industry.

Caps Lock Off

Document generated: 17 December 2021

APPENDIX F – CARBON FOOTPRINT DATA FOR SEVERAL PAPER GRADES AND PVC

Company / Paper Grade	Methodology	Year of data	Carbon footprint (kg CO2e/tonne)	Source
Iggesund	CEPI	2021	195	https://www.holmen.com/globalassets/alla/certificates/paperboard/environmental-declaration-invercote-pdf
Billerudkorsnas - Crown Board Craft 14.4 pt	International EPD system. LCA and PCR for processed paper and paperboard 2010:14 Version 2.11	2018	369	Data also available for 18.9 pt and 24.8 pt but numbers are similar. https://www.billerudkorsnas.com/globalassets/billerudkorsnas/our-offer/packaging-materials/cartonboard/crownboard-craft/epd---crownboard-craft.pdf
Billerudkorsnas - Pure Supreme 200 GSM	International EPD system. LCA and PCR for processed paper and paperboard 2010:14 Version 2.11	2015	393.3	Data also available for 160 and 175 GSM but numbers are similar. https://www.billerudkorsnas.com/globalassets/billerudkorsnas/sustainability/lca-and-epd/pure-supreme-epd.pdf
Billerudkorsnas - Crown Board Prestige 23.8 pt	International EPD system. LCA and PCR for processed paper and paperboard 2010:14 Version 2.11	2018	398	Data also available for 17.9 pt but numbers are similar. https://www.billerudkorsnas.com/globalassets/billerudkorsnas/our-offer/packaging-materials/cartonboard/crownboard-prestige/epd---crownboard-prestige.pdf
UPM Kymi, Finland - WFC	CEPI	2021	400	https://www.upm.com/responsibility/fundamentals/certificate-finder/?tag=185717&tag=184525
Euro Paper Sack research group study - Sack Kraft Paper	LCA	2018	455	https://www.eurosac.org/fileadmin/pdf/pdf_press_releases/2021_03_Fact_sheet_ESG__carbon_footprint_infographic.pdf
LCA - UCGW	ISO 14040	2018	608	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
EU Graphical Papers	CEPI	?	616	Data provided by CarbonCo
LCA - RPB	ISO 14040	2018	691	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
LCA - UBPB	ISO 14040	2018	714	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/

Company / Paper Grade	Methodology	Year of data	Carbon footprint (kg CO2e/tonne)	Source
UPM Nordland. Germany - WFC	CEPI	2021	790	https://www.upm.com/responsibility/fundamentals/certificate-finder/?tag=185717&tag=184525
LCA - MP	ISO 14040	2018	855	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
LCA – Bleached Paper Board	ISO 14040	2018	857	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
Westrock Tango	Estimate based on publicly available data	2021	878	See body of this report. Sources used include Westrock 2021 Sustainability report and US EPA GHG database.
LCA of US pulp and paper grades -US Total	ISO 14040	2018	942	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
European average for carton products (ECMA carton product pool)	CEPI	2009	964	https://www.osti.gov/etdeweb/servlets/purl/985454
EU Converted Carton Packaging	CEPI (2017) and CITPA (2018)	2017	1025	https://www.procarton.com/wp-content/uploads/2020/03/Carbon-Footprint-Report-2019.pdf
LCA -CWF	ISO 14040	2018	1057	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
Neenah - whole company (excluding market pulp)	Estimate based on publicly reported data from 2020 and 2021	2020 + 2021	1143	Estimate by SPG
LCA - UCWF	ISO 14040	2018	1148	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
AFPA P&W paper LCA - Uncoated Mechanical	LCA	2006-2007	1176	https://twosidesna.org/wp-content/uploads/sites/16/2018/05/Printing_and_Writing_Papers_-_Life-Cycle_Assessment_Summary_Report.pdf

Company / Paper Grade	Methodology	Year of data	Carbon footprint (kg CO2e/tonne)	Source
AFPA P&W paper LCA - Uncoated Free	LCA	2006-2007	1194	https://twosidesna.org/wp-content/uploads/sites/16/2018/05/Printing_and_Writing_Papers_-_Life-Cycle_Assessment_Summary_Report.pdf
UPM Changsu, China - WFC	CEPI	2021	1350	https://www.upm.com/responsibility/fundamentals/certificate-finder/?tag=185717&tag=184525
AFPA P&W paper LCA - Coated Mechanical	LCA	2006-2007	1393	https://twosidesna.org/wp-content/uploads/sites/16/2018/05/Printing_and_Writing_Papers_-_Life-Cycle_Assessment_Summary_Report.pdf
AFPA P&W paper LCA - Coated Free	LCA	2006-2007	1469	https://twosidesna.org/wp-content/uploads/sites/16/2018/05/Printing_and_Writing_Papers_-_Life-Cycle_Assessment_Summary_Report.pdf
LCA - CGW	ISO 14040	2018	1511	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
LCA - PP	ISO 14040	2018	1559	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
Monadnock	Estimate based on available data for 2020 (website and reports)	2020 data	1613	Estimate for Scope 1, 2 and Scope 3 (purchased pulp only).
LCA - Tissue	ISO 14040	2018	1720	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
LCA - Others	ISO 14040	2018	1978	https://bioresources.cnr.ncsu.edu/resources/life-cycle-carbon-footprint-analysis-of-pulp-and-paper-grades-in-the-united-states-using-production-line-based-data-and-integration/
Neenah - whole company (including market pulp)	Estimate based on publicly reported data from 2020 and 2021	2020 + 2021	1998	Estimate as per this report
LCA - PVC Resin	ISO 14044 – Cradle-to-gate	2015-2017	2095	Franklin Associates, 2021. Cradle-to-gate life cycle analysis of polyvinyl chloride (PVC) resin. Report submitted to the American Chemistry Council (ACC) Plastics Division, December 2021. file:///c:/users/phil%20riebel/downloads/cradle-to-gate-life-cycle-analysis-of-polyvinyl-pvc-resin.pdf

APPENDIX G: EXAMPLE OF CARDS AND CARRIERS

APPENDIX H: INFORMATION COLLECTED ON OPTIMUM CARD SOLUTIONS OPERATIONS AND PRINTING PROCESS FOR 2021

- Electricity use, MWh/year: 568,703 kwh
- Power consumption of the equipment used to manufacture the cards (from meter or equipment specifications) – see below.

	13-inch press	**10-inch press**
Press	12480 watts	12,480 watts
UV light	19.2 KW	6 KW
Blowers	12,688	12,880
Hot Stamp	8,050	7,500

- Any fuel use (e.g., heat from oil or natural gas): 6420 Therms (One therm is equal to 100,000 BTUs)
- Amount of water-based ink: Optimum Card Response: 9200 LBS
- Type of glue and amount: Optimum Card Response: 10,000 LBS. Safety Data Sheets were made available.
- Square footage of the entire facility: 32,000 sq ft
- Square footage of area used for card manufacturing: 1,500 sq ft.
- Square footage of area used for other purposes not included in this study: 18,250 sq ft.
- Total production of card and carriers:
    - Gift cards total: 91,000,000 and 200,000 cards = 1 short ton
        - 10” Press produces 35% or 31,850,000 cards
        - 13” Press produces 65% or 59,150,000 cards
    - Carriers total both presses: 17,768,500
        - Carriers on 10” Press (65%): 11,549,525
        - Carriers on 13” Press (35%): 6,176,975
- Carrier Size (finished): 4.50” x 5.25” (flat is 9.00” x 5.25”)
- Carrier Weight: 0.18 oz or 4 grams/each:
- Total production of all items: 149,909,100

APPENDIX I: FROM "INTERGRAF RECOMMENDATIONS ON C02 EMISSIONS CALCULATION IN THE PRINTING INDUSTRY – VERSION 2.1 – 2021"

INTERGRAF

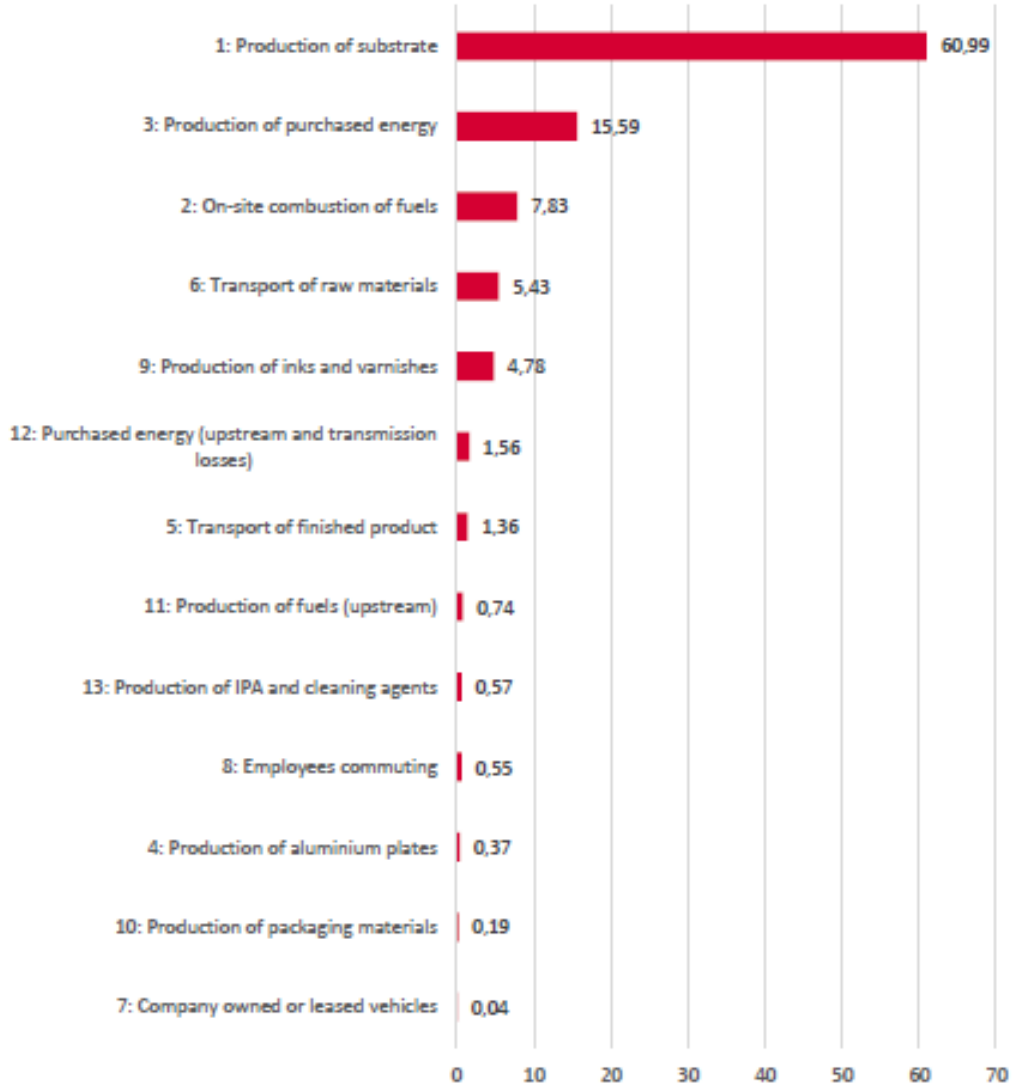
Top parameters for calculating CO2 emissions

No.	Parameter	Site/Product relevant	GHGP Scope
1.	**Production of substrate**	**Product**	**Scope 3**
Emissions from production of purchased substrate used for printing (e.g. paper and plastic).			
2.	**On-site combustion of fuels**	**Site**	**Scope 1**
Emissions from combustion of fuels in the company (direct emission) : *(Natural gas, fuel oils, LPG gas, coal and oils in inks and solvents)* Production of the combusted fuels are described under point K.			
3.	**Production of purchased energy**	**Site**	**Scope 2**
Emissions from production of purchased energy consumed in the company (indirect emission): *(Electricity, steam, district heating, compressed air, cooled water)* Production of the fuels used for energy production and transmission losses is described under point L.			
4.	**Production of plates, cylinders and other image carriers**	**Site**	**Scope 3**
Emissions from production of purchased offset plates, gravure cylinders or other image carriers.			
5.	**Transport of finished product**	**Product**	**Scope 3**
Emissions from transport of the finished product to the first point of delivery of the primary customer should be included in the calculation. Further transport (to point of sale or end-users) is to be accounted by customers, such as publishers. Production of the combusted fuels are described under point K.			
6.	**Transport of raw materials**	**Product**	**Scope 3**
Emissions from transport of substrates from the production of the material to the printer should be included. Transportation of other raw materials e.g. chemicals, printing plates and packaging materials can normally be left out due to low relevance. Production of the combusted fuels are described under point K.			
7.	**Company owned or leased vehicles**	**Site**	**Scope 1**
Emissions from combustion of fuels in company owned or leased vehicles (direct emission) including trucks, cars, landscaping equipment, fork lifts, etc. Production of the combusted fuels are described under point K.			
8.	**Employees commuting**	**Site**	**Scope 3**
Emissions from commuting by workers from the home to the work place should always be considered in calculations. The travelling of workers and the emissions deriving from it depends on the geographic location of the company and its employees. For some companies it can therefore be an important source of emissions, so it should be considered in calculation models. The travelling of visitors to the company is however not considered. Production of the combusted fuels are described under point K.			
9.	**Production of inks, varnishes, toners and cartridges**	**Product**	**Scope 3**
Emissions from production of purchased inks, varnishes, toners and cartridges.			
10.	**Production of packaging materials**	**Product**	**Scope 3**
Emissions from production of purchased packaging materials e.g. card and PE-plastic.			
11.	**Production of fuels (upstream)**	**Site**	**Scope 3**
Emissions from production and transportation of fuels for on-site combustion and transportation.			
12.	**Purchased energy (upstream and transmission losses)**	**Site**	**Scope 3**
Emissions from production and transportation of fuels for production of purchased energy. Transmission losses of purchased energy.			
13.	**Production of Isopropanol (IPA), or alternative fountain solutions additives, and cleaning agents**	**Site**	**Scope 3**
Emissions from production of purchased IPA and cleaning agents.			

4

INTERGRAF

SPECIFIC EXAMPLE of primary CO2/equivalent sources for a single PRINTING SITE INVESTIGATION on a yearly basis (%)

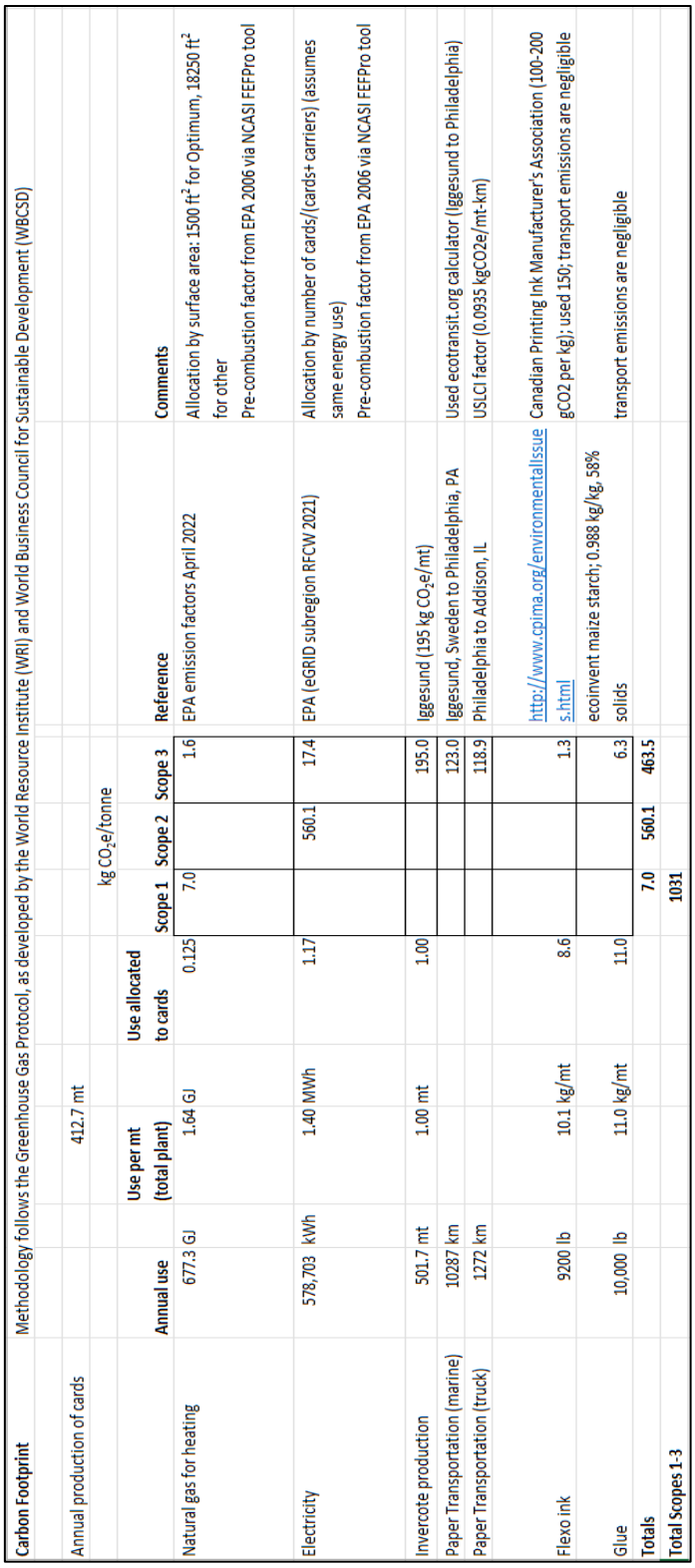


These values provide an illustrative example of proportions of CO_2 emissions, and should therefore not be interpreted as representative values for the European printing industry in general.

The company under investigation operates heatset printing facilities and produces magazines and advertising leaflets. It has in-house facilities for file content management, prepress, printing, finishing, and provides distribution services.

APPENDIX J: CALCULATION TABLE FOR THE CARBON FOOTPRINT OF PAPER-BASED GIFT CARDS

IGGESUND



Carbon Footprint	Methodology follows the Greenhouse Gas Protocol, as developed by the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD)									
Annual production of cards		412.7 mt								
					kg CO_2e/tonne					
	Annual use		Use per mt (total plant)	Use allocated to cards	Scope 1	Scope 2	Scope 3	Reference	Comments
Natural gas for heating	677.3	GJ	1.64 GJ	0.125	7.0		1.6	EPA emission factors April 2022	Allocation by surface area: 1500 ft^2 for Optimum, 18250 ft^2 for other Pre-combustion factor from EPA 2006 via NCASI FEFPro tool
Electricity	578,703	kWh	1.40 MWh	1.17		560.1	17.4	EPA (eGRID subregion RFCW 2021)	Allocation by number of cards/(cards+ carriers) (assumes same energy use) Pre-combustion factor from EPA 2006 via NCASI FEFPro tool
Invercote production	501.7	mt	1.00 mt	1.00			195.0	Iggesund (195 kg CO_2e/mt)	
Paper Transportation (marine)	10287	km					123.0	Iggesund, Sweden to Philadelphia, PA	Used ecotransit.org calculator (Iggesund to Philadelphia)
Paper Transportation (truck)	1272	km					118.9	Philadelphia to Addison, IL	USLCI factor (0.0935 kgCO2e/mt-km)
Flexo ink	9200	lb	10.1 kg/mt	8.6			1.3	http://www.cpima.org/environmentalissues.html	Canadian Printing Ink Manufacturer's Association (100-200 gCO2 per kg); used 150; transport emissions are negligible
Glue	10,000	lb	11.0 kg/mt	11.0			6.3	ecoinvent maize starch; 0.988 kg/kg, 58% solids	transport emissions are negligible
Totals					**7.0**	**560.1**	**463.5**		
Total Scopes 1-3					**1031**				

NEENAH

	Annual use		Use per mt (total plant)		Use allocated to cards	Scope 1	Scope 2	Scope 3	Total	% of total carbon footprint	Reference	Comments
						kg CO_2e/tonne						
Annual production of cards			412.7	mt								Assumed to be the same as OCS
Converting and laminating plant - Natural gas for heating									17.0	0.50%		It is assumed that this activity makes up 0.5% of total carbon footprint, slightly lower than for Optimum Card Solutions
Converting and laminating plant - Electricity									338.0	9.94%		It is assumed that this activity makes up 10% of the carbon footprint.
Printer - Natural gas for heating						6.98		1.6	8.6	0.25%		Assumed to be the same as for Optimum Card Solutions
Printer - Electricity									577.5	16.98%		Assumed to be the same as for Optimum Card Solutions
Paper production							1143	855.0	1998.0	58.75%		As calculated in this report.
Paper Transportation (mill to converter by truck)								163.3	163.3	4.80%	Google maps for distance (1746 km). Neenah, WI to Holyoke, MA	USLCI factor (0.0935 kgCO2e/mt-km)
Paper Transportation (converter to printer by truck)								290.9	290.9	8.55%	Google maps; average of 4 printer destinations (Holyoke MA to Las Vegas / Inver Grove Heights, MN / Downers Grove, IL / Bassett, CA (3,111 km)	USLCI factor (0.0935 kgCO2e/mt-km)
Ink								1.3	1.3	0.04%		Same data as for Optimum Card Solutions. Canadian Printing Ink Manufacturer's Association (100-200 gCO2 per kg); used 150; transport emissions are negligible
Glue								6.3	6.3	0.19%		Same data as for Optimum Card Solutions. Transport emissions are negligible.
Total									**3401**	100.00%		

MONADNOCK

	Annual use		Use per mt (total plant)		Use allocated to cards	Scope 1	Scope 2	Scope 3	Total	% of total carbon footprint	Reference	Comments
						kg CO_2e/tonne						
Annual production of cards			412.7	mt								Assumed to be the same as OCS
Converting and laminating plant - Natural gas for heating									13.9	0.50%		It is assumed that this activity makes up 0.5% of total carbon footprint, slightly lower than for Optimum Card Solutions
Converting and laminating plant - Electricity									281.0	10.01%		It is assumed that this activity makes up 10% of the carbon footprint.
Printer - Natural gas for heating						6.98		1.6	8.6	0.31%		Assumed to be the same as for Optimum Card Solutions
Printer - Electricity									577.5	20.57%		Assumed to be the same as for Optimum Card Solutions
Paper production						699	59	855.0	1613.0	57.46%		As calculated in this report.
Paper Transportation (mill to converter by truck)								14.7	14.7	0.52%	Google maps for distance (1746 km). Claremont, NH to Holyoke, MA (151 km)	USLCI factor (0.0935 kgCO2e/mt-km)
Paper Transportation (converter to printer by truck)								290.9	290.9	10.36%	Google maps; average of 4 printer destinations (Holyoke MA to Las Vegas / Inver Grove Heights, MN / Downers Grove, IL / Bassett, CA (3,111 km)	USLCI factor (0.0935 kgCO2e/mt-km)
Ink								1.3	1.3	0.05%		Same data as for Optimum Card Solutions. Canadian Printing Ink Manufacturer's Association (100-200 gCO2 per kg); used 150; transport emissions are negligible
Glue								6.3	6.3	0.22%		Same data as for Optimum Card Solutions. Transport emissions are negligible.
Total									**2807**	100.00%		

WESTROCK

	Annual use		Use per mt (total plant)		Use allocated to cards	Scope 1	Scope 2	Scope 3	Total	% of total carbon footprint	Reference	Comments
							kg CO_2e/tonne					
Annual production of cards			412.7	mt								Assumed to be the same as OCS
Converting and laminating plant - Natural gas for heating									9.3	0.5%		It is assumed that this activity makes up 0.5% of total carbon footprint, slightly lower than for Optimum Card Solutions
Converting and laminating plant - Electricity									202.0	10.0%		It is assumed that this activity makes up 10% of the carbon footprint.
Printer - Natural gas for heating						6.98		1.6	8.6	0.4%		Assumed to be the same as for Optimum Card Solutions
Printer - Electricity									577.5	28.6%		Assumed to be the same as for Optimum Card Solutions
Paper production						878	0		878.0	43.4%		As calculated in this report.
Paper Transportation (mill to converter by truck)								90.2	90.2	4.5%	Google maps for distance (965 km). An average distance from 3 Westrock mills (Covington, VA / Evadale, TX / Demopolis, AL) to their converter in Greensboro, NC.	USLCI factor (0.0935 kgCO2e/mt-km)
Paper Transportation (converter to printer by truck)								248.3	248.3	12.3%	Google maps; average of 4 destinations from converter to Greensboro, NC to 4 printers (Las Vegas / Inver Grove Heights, MN / Downers Grove, IL / Bassett, CA (2,655 km)	USLCI factor (0.0935 kgCO2e/mt-km)
Ink								1.3	1.3	0.1%		Same data as for Optimum Card Solutions. Canadian Printing Ink Manufacturer's Association (100-200 gCO2 per kg); used 150; transport emissions are negligible
Glue								6.3	6.3	0.3%		Same data as for Optimum Card Solutions. Transport emissions are negligible.
Total									**2021**	100.0%		

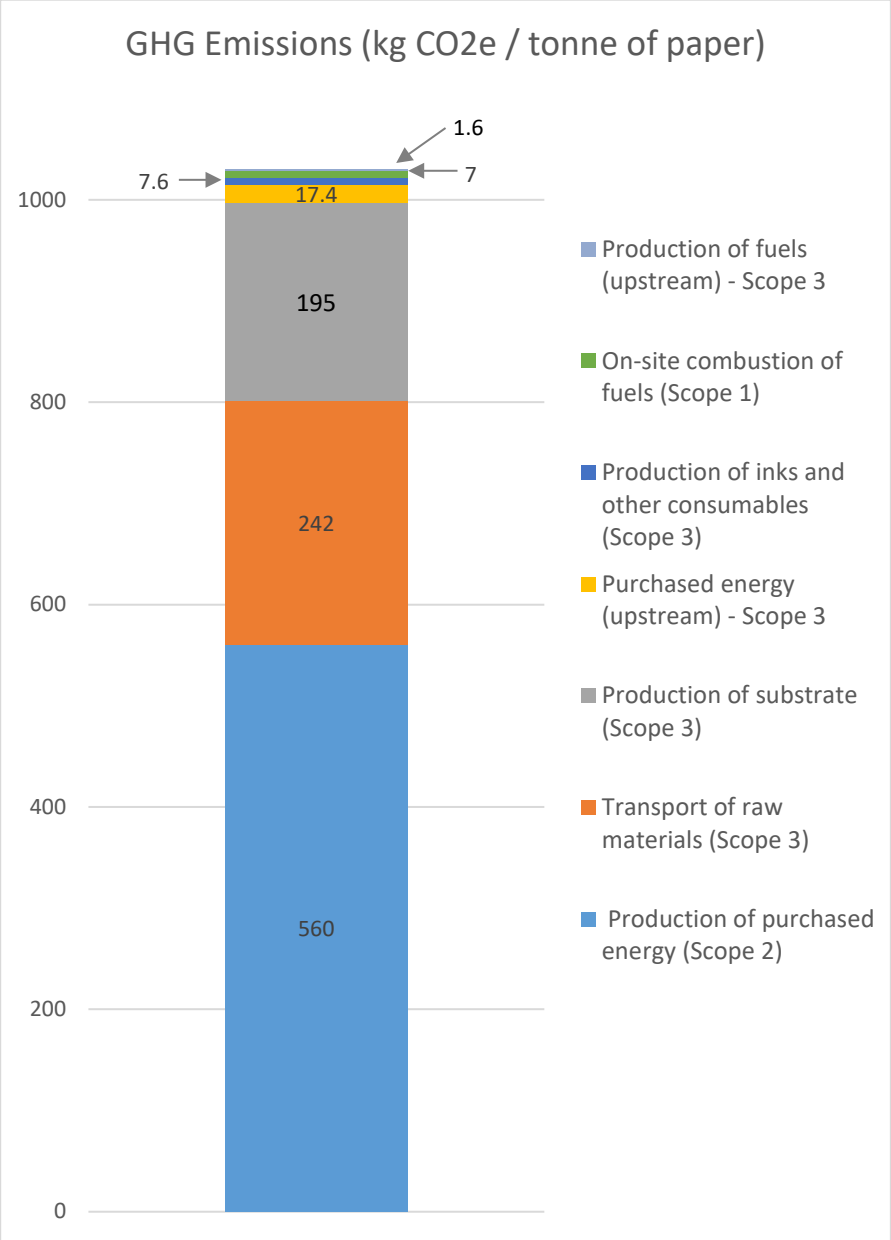
APPENDIX K: CARBON PROFILE DATA SHEETS – OPTIMUM CARD SOLUTIONS GIFT CARDS

CARBON FOOTPRINT

(According to key elements of the life cycle as per Intergraf recommendations)

Product	**Paper-based gift card manufactured by Optimum Card Solutions (WRI method)**
Site	**Addison, IL**
	Information gathered from 1.1. 2021 to 31.12.2021

- Optimum Card Solutions calculated the Carbon Footprint of its paper-based gift cards based on the Greenhouse Gas Protocol, as developed by the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD).
- The current fact sheet outlines key elements of the carbon footprint as per Intergraf recommendations (2021).
- The paper supply carbon footprint was provided by Iggesund and was calculated based on the CEPI Ten Toes method.
- The calculations are based on annual data and averages for the paper supply (Iggesund Invercote), paper transportation and relevant operations at the Optimum Card Solutions manufacturing facility in Addison, IL.
- GHG = greenhouse gas. Figures refer to emissions of CO_2 equivalents.



Key Elements of the Carbon Footprint (Intergraf, 2021)	**CO2 Equivalents (kg/tonne of paper)**	**Scope**
1. Production of substrate	195	3
2. On-site combustion of fuels	7	1
3. Production of purchased energy	560.1	2
4. Production of plates, cylinders, and other image carriers	Excluded	3
5. Transport of finished product	Excluded	3
6. Transport of raw materials	241.93	3
7. Company owned or leased vehicles	Excluded	1
8. Employee commuting	Excluded	3
9. Production of inks and other consumables	7.6	3
10. Production of packaging materials	Excluded	3
11. Production of fuels (upstream)	1.6	3
12. Purchased energy (upstream)	17.4	3
12. Production of isopropanol, or alternative fountain solutions, additives, and cleaning agents	Excluded	3
Carbon Footprint of paper-based gift cards manufactured by Optimum Card Solutions (cradle-to-gate)	**1030.6**	

Description of parameters

No.	**Parameter**	**GHGP Scope**
1.	**Production of substrate**	**Scope 3**
Emissions from production of purchased substrate used for printing (e.g., paper and plastic). This category includes the carbon footprint provided by Iggesund for their Invercote grade.		
2.	**On-site combustion of fuels**	**Scope 1**
Emissions from combustion of fuels in the company (direct emission): *(Natural gas, fuel oils, LPG gas, coal and oils in inks and* ***solvents).*** **This category includes the use of natural gas by Optimum Card Solutions.**		
3.	**Production of purchased energy**	**Scope 2**
Emissions from production of purchased energy consumed in the company (indirect emission): *(Electricity, steam, district heating, compressed air, cooled water).* This includes the electricity purchased by Optimum Cards Solutions.		
4.	**Production of plates, cylinders and other image carriers**	**Scope 3**
Emissions from production of purchased offset plates, gravure cylinders or other image carriers. This was excluded due to its low relevance in the study (less than 1%).		
5.	**Transport of finished product**	**Scope 3**
Emissions from the transport of the finished product to the first point of delivery of the primary customer should be included in the calculation. Further transport (to point of sale or end-users) is to be accounted by customers,		

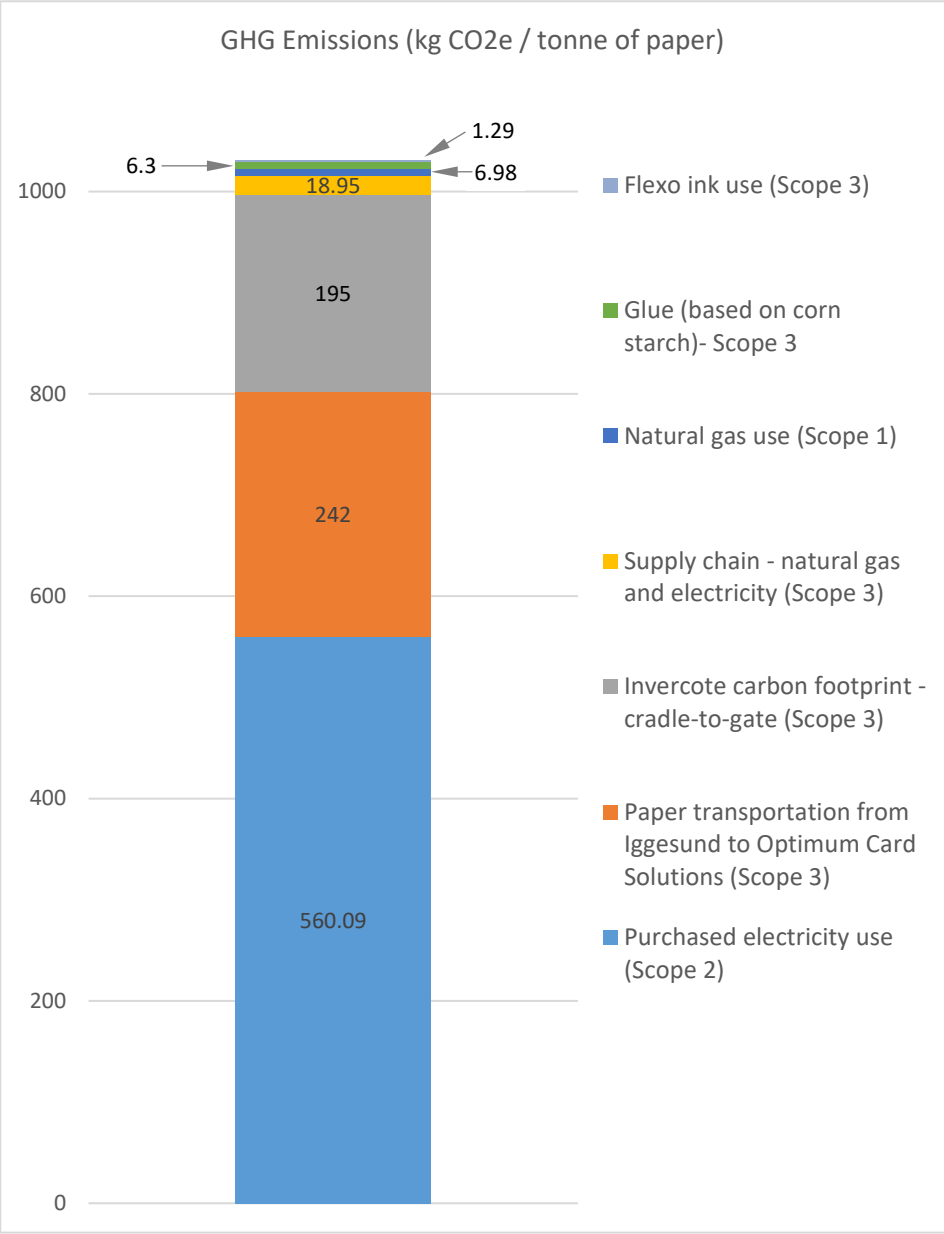
such as publishers. This was excluded because the study was cradle-to-gate and did not include delivery to customers.		
6.	**Transport of raw materials**	**Scope 3**
Emissions from the transport of substrates from the production of the material to the printer should be included. Transportation of other raw materials e.g., chemicals, printing plates and packaging materials can normally be left out due to low relevance. Transportation from the Iggesund mill in Sweden to Addison, Illinois by ship and truck was calculated.		
7.	**Company owned or leased vehicles**	**Scope 1**
Emissions from combustion of fuels in company owned or leased vehicles (direct emission) including trucks, cars, landscaping equipment, forklifts, etc. This category was not considered relevant due to its low contribution – less than 1%.		
8.	**Employees commuting**	**Scope 3**
Emissions from commuting by workers from home to the workplace were not considered due to its low relevance (less than 1% of the carbon footprint).		
9.	**Production of inks, varnishes, toners and cartridges**	**Scope 3**
Emissions from production of purchased inks, varnishes, toners, and cartridges. This was calculated.		
10.	**Production of packaging materials**	**Scope 3**
Emissions from production of purchased packaging materials e.g., card and PE-plastic. This category was excluded because the scope of the study was cradle-to-gate and did not exclude shipping to customers.		
11.	**Production of fuels (upstream)**	**Scope 3**
Emissions from production and transportation of fuels for on-site combustion and transportation. This was calculated.		
12.	**Purchased energy (upstream and transmission losses)**	**Scope 3**
Emissions from production and transportation of fuels for production of purchased energy. This was calculated. Transmission losses of purchased energy was not considered to be relevant.		
13.	**Production of Isopropanol (IPA), or alternative fountain solutions additives, and cleaning agents**	**Scope 3**
Emissions from production of purchased IPA and cleaning agents was not considered due to low relevance (less than 1% of the carbon footprint).		

CARBON FOOTPRINT

(According to Scope 1, 2 and 3 Greenhouse Gas Emissions)

Product	**Paper-based gift card manufactured by Optimum Card Solutions (WRI method)**
Site	**Addison, IL**
	Information gathered from 1.1. 2021 to 31.12.2021

- Optimum Card Solutions calculated the Carbon Footprint of its paper-based gift cards based on the Greenhouse Gas Protocol, as developed by the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD).
- The paper supply carbon footprint was provided by Iggesund and was calculated based on the CEPI Ten Toes method.
- The calculations are based on annual data and averages for the paper supply (Iggesund Invercote), paper transportation and relevant operations at the Optimum Card Solutions manufacturing facility in Addison, IL.
- GHG = greenhouse gas. Figures refer to emissions of CO_2 equivalents.



Elements of the Carbon Footprint	CO2 Equivalents (kg/tonne of paper)
Scope 1 - Direct Emissions	
Natural gas use (Optimum Card Solutions)	6.98
Total Scope 1	6.98
Scope 2 - Indirect Emissions	
Electricity use (Optimum Card Solutions)	560.09
Total Scope 2	560.09
Scope 3 - Supply Chain Emissions	
Natural gas (supply chain)	1.59
Electricity (supply chain)	17.36
Invercote carbon footprint - cradle-to-gate	195
Paper transportation (marine)	123
Paper transportation (truck)	118.93
Flexo ink use	1.29
Glue (based on corn starch)	6.3
Total Scope 3	**463.47**
Total Scope 1-3 - Carbon Footprint of paper-based gift card	**1030.6**

Explanations of the elements of the Carbon Footprint (based on Scope 1, 2 and 3)
Scope 1 – Direct Emissions
Natural gas use CO2 emissions from natural gas used by Optimum Card Solutions at their manufacturing site, specifically for the area used in card production.
Scope 2 – Indirect Emissions
Purchased electricity CO2 emissions due to the purchase of electricity by Optimum Card Solutions. These emissions are the result of fossil fuels used by local electricity providers to generate power. Estimated for the production of gift cards only, not carriers.
Scope 3 - Supply Chain Emissions
Natural gas and electricity (supply chain) Scope 3 emissions for natural gas and power are the upstream or "pre-combustion" emissions coming from extraction, processing, and transport of fuels.
Invercote carbon footprint - cradle-to-gate The carbon footprint of Invercote was provided by Iggesund and was calculated used the CEPI ten Toes methodology.
Paper transportation (marine and truck) CO2 emissions due to transport were calculated based on distance traveled and emission factors provided by the ecotransit.org calculator (Iggesund to Philadelphia) and the USLCI factor (0.0935 kgCO2e/mt-km)
Flexo ink use Ink manufacturing emissions are based on data provided by the Canadian Printing Ink Manufacturers. Transportation emissions are negligible.
Glue (based on corn starch) Glue manufacturing emissions are based on the ecoinvent database for maize starch. Transportation emissions are negligible.

FOOTNOTES AND REFERENCES

[1] https://www.wri.org/initiatives/greenhouse-gas-protocol

[2] https://www.intergraf.eu/communications/publications/item/331-intergraf-recommendations-on-co2-emissions-calculation-in-the-printing-industry

[3] Cradle-to-gate is an assessment of a partial product life cycle from resource extraction (cradle) to the factory gate (i.e., before the gift card is transported to the consumer). Cradle-to-gate assessments are often the basis for environmental product declarations (EPD).

[4] Biogenic carbon is carbon derived from biogenic (plant) sources excluding fossil carbon. Fossil carbon is carbon derived from fossil fuel or other fossil source.

[5] CEPI Framework for Carbon Footprints for Paper and Board Products. April 2017. https://www.cepi.org/wp-content/uploads/2021/02/ENV-17-035.pdf

[6] Scope 1 emissions covers the Green House Gas (GHG) emissions that a company makes directly — for example while running its boilers and vehicles. Scope 2 emissions are the emissions it makes indirectly – like when the electricity or energy it buys for heating and cooling buildings, is being produced on its behalf. Scope 3 emissions — are all the emissions associated that the organization is indirectly responsible for, up and down its value chain. For example, from buying products from its suppliers, and from its products when customers use them. Scope 3 emissions are typically large.

[7] https://www.neenah.com/sustainability/

[8] Tomberlin et al., 2020. Life Cycle carbon Footprint Analysis of Pulp and Paper Grades in the United States Using Production-line-based Data and Integration. Bioresources 15(2): 3899-3914. April 2020. https://www.researchgate.net/publication/340492627_Life_Cycle_Carbon_Footprint_Analysis_of_Pulp_and_Paper_Grades_in_the_United_States_Using_Production-line-based_Data_and_Integration

[9] Franklin Associates, 2021. Cradle-to-gate life cycle analysis of polyvinyl chloride (PVC) resin. Report submitted to the

American Chemistry Council (ACC) Plastics Division, December 2021. file:///c:/users/phil%20riebel/downloads/cradle-to-gate-life-cycle-analysis-of-polyvinyl-pvc-resin.pdf

[10] Forest Stewardship Council

[11] Program for the Endorsement of Forest Certification

[12] It should be noted that recycled PVC or alternative bioplastics, which are also used for gift card manufacturing, are reportedly less carbon intensive than virgin PVC.

[13] Prior to recycling, card users may need to remove the mag-stripe and other embellishments made to the paper gift card.

[14] https://www.greengiftcards.co.uk/news/top-9-benefits-going-green-your-gift-cards ; https://shanericzu.files.wordpress.com/2017/10/kiind-environmental-impact.pdf

[15] https://www.wri.org/initiatives/greenhouse-gas-protocol

[16] https://www.intergraf.eu/communications/publications/item/331-intergraf-recommendations-on-co2-emissions-calculation-in-the-printing-industry

[17] Information provided by Rich Olson at Optimum Card Solutions. 1 metric ton = 1.1023 short tons

[18] The numbers reported by eGRID RFCW (power grid used by Addison and Chicago) are the following: Coal 35.6%; Natural gas 27.7%; Nuclear 28.5%; Wind 5.2%; Hydro 1.1%; Other fossil-based 0.7%; Solar 0.3%; Biomass 0.1%; Other unknown 0.1%. The total amount of fossil fuel providing the electricity is 64%.

[19] https://ourworldindata.org/environmental-impacts-of-food

[20] https://co2.myclimate.org/en/flight_calculators/new

[21] https://www.epa.gov/ghgreporting/ghgrp-pulp-and-paper