LEED v4.1 EPD Optimization Report

Prepared for:

3form Chroma Panels

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INTRODUCTION

This Optimization Report was prepared by the EPD Program Operator SCS Global Services, following the requirements in the LEED v4.1 Building Design and Construction guide[1]. This Optimization Report serves as documentation to demonstrate that the 2018 3form EPD for Chroma[2] panels meets the LEED v4.1 *MR Credit: Building Product Disclosure and Optimization Environmental Product Declarations* Option 2 credit for *Life Cycle Impact Reductions in Embodied Carbon*.

The LEED v4.1 credit for Building Product Disclosure and Optimization— Environmental Product Declarations, option 2 Life Cycle Impact Reductions in Embodied Carbon, recognizes products which have achieved "optimization". To qualify for optimization, a manufacturer-specific EPD must show reductions in potential environmental impacts. The amount of credit achieved depends on the amount of reductions in impact.

Credit Achievement Value	Required Reduction in Global Warming Potential	Required Reduction in Other LCIA Impact Categories
100%	Reduction in impact required	Not Required
150%	10% reduction required	Not Required
200%	20% reduction required	5% reduction in required in two additional impact categories[3]

In 2014, 3form registered a verified EPD for the Chroma panels with EPD Program Operator NSF Sustainability, and in 2018 the LCA was updated and the updated EPD was registered with SCS Global Services.

The original EPD registered with NSF Sustainability was based on an LCA using GaBi software. The LCA for the 2018 EPD was developed using SimaPro. To address issues with differences in LCA software and the incompatibility of comparisons made using these different tools, the 2014 EPD was recalculated using SimaPro, following the same PCR and modeling approach as the 2018 EPD.

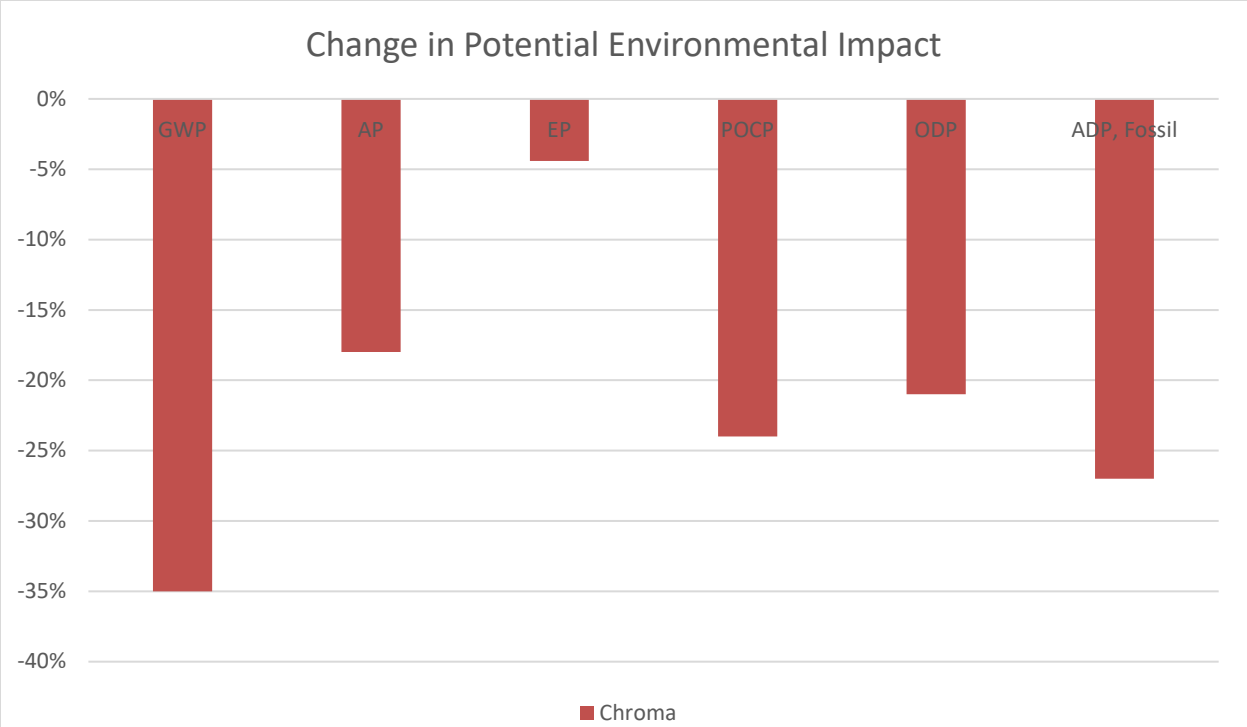
[1] LEED v4.1 Building Design and Construction. USGBC. July 19, 2019.
[2] Chroma Acrylic Resin Panels EPD. Valid April 9, 2018. SCS-EPD-04940.
https://www.scscertified.com/products/cert_pdfs/SCS-EPD-04940_3form_Chroma_040918.pdf
[3] Impact categories include: Ozone Depletion, Acidification, Eutrophication, Smog Formation, and Nonrenewable Energy Resource Depletion.

Table 1 shows a comparison of the LCA results based on the data to develop the 2014 EPD and 2018 EPD[4] for Chroma. The results for the 2014 EPD are modeled using the same software, same databases and equivalent assumptions as were used to develop the 2018 EPD. Results shown below are calculated on the same basis – one kg of panel product.

Table 1. Life Cycle Impact Assessment results for the 3form Chroma panel products. Results shown represent 2013 data, and are shown for 1 kg of product. Percent change from the product system results based on 2016 data are also shown. Results shown in green font represent decrease in the 2016 results.

Impact Category	Units	Value
Global warming potential, 100 year	kg CO_2 eq	8.2 -35%
Acidification potential	kg SO_2 eq	$3.7x10^{-2}$ -18%
Eutrophication potential	kg PO_4^{3-} eq	$4.8x10^{-3}$ -4.4%
Photochemical oxidation potential	kg C_2H_4 eq	$1.7x10^{-3}$ -24%
Ozone layer depletion potential	kg CFC-11 eq	$6.8x10^{-7}$ -21%
Abiotic depletion, fossil fuels	MJ	150 -27%

[4]Note - the 2014 EPDs are based on 2013 manufacturing data, and the 2018 EPDs are based on 2016 data.



GWP = Global Warming Potential	AP = Acidification Potential	EP = Eutrophication Potential
POCP = Photochemical Oxidation Creation Potential	ODP = Ozone layer depletion potential	ADP, Fossil = Abiotic depletion, fossil fuels

Figure 1. Percent change in potential environmental impact, comparing the 3form EPD for Chroma from 2013 to 2016. Bars extending into the negative range indicate reductions in environmental impact.

As shown in the above Figure 1, Chroma shows greater than 20% reduction in the indicator for global warming, as well as reductions in five additional categories. These reductions show that Chroma panels qualify for a 200% credit weighting factor under Option 2. A summary of the impact reductions and the additional credit achieved under Option 2 is shown in Table 2, below.

Table 2. Summary of the Optimization for the 3form Chroma panel products, and the Option 2 credit achievement value.

Product	Impact Reduction Achieved	Credit Achievement Value
Chroma	- 35% reduction in Global Warming. - Reductions achieved in five additional categories	200%

IMPACT REDUCTION NARRATIVE

Over the period under comparison (2013 to 2016), 3form implemented several new manufacturing practices which have reduced the environmental impacts for these products. These changes have included:

- Reduced resource use at the 3form facility (energy and water)
- Increased material use efficiency (reduced generation of waste scrap)
- For Chroma, the switch away from an extruded sheet to a cast sheet.

It is also important to note that the original EPD based on 2013 data used a different declared unit as the basis of reporting. For the initial EPD, results were reported as a production weighted average square meter of product. Use of a production-weighted area-based declared unit is problematic in this case because it does not represent an actual product, but is an average across the product line. This approach will change the basis of calculating results, due to year to year fluctuations in production related to customer preferences for particular size (thickness) products. For the current assessment, results are presented on the basis of 1 kg of product, which is not subject to the same variability based on product production.

Although the use phase is not included as part of the product system scope, the functional equivalence of the products is identical based on the manufacturer specifications, including the product performance, reference service life, product construction process, product use and maintenance and end-of-life. In addition, the same cut-off criteria are applied with respect to data quality as well as inclusion, or exclusion, of life cycle stages.

Another notable change for Chroma panels was the reduction in recycled content in the 2016 product data. However, it was discovered during the life cycle assessment that the change in sheet production from an extrusion process to a cast process had a significant reduction in many results, and offset the reduction in the use of recycled materials.

BACKGROUND

The LEED v4 Standard includes a credit[5] for EPDs of permanently installed products in a LEED project. This credit allows for up to two points:

- One point for a project which includes 20 products with manufacturer specific EPDs.
- A second point is available for EPDs which can show reductions (i.e., optimization)

[5] Building Product Disclosure and Optimization— Environmental Product Declarations. LEED v4. USGBC. 2013.

In January 2019, USGBC released guidance for LEED v4.1[6], which included new options and requirements for the LEED EPD credit. LEED v4.1 describes the requirements for EPDs to receive additional credit recognition under Option 2 for EPD Optimization. Option 2 rewards manufacturers with EPDs which can demonstrate a reduction in impacts over time.

Comparisons based on LCA represent the highest level of LCA because the outcome may affect the basis of a decision. LCA based comparisons require the greatest degree of care in ensuring that the two systems under comparison are treated equally and without bias. For example, parameters in LCA which need to be held constant for comparability to be achieved include:

- Equivalent Functional Unit
- Same background database
- Same LCA software
- Same Life Cycle Impact Assessment (LCIA) method(s)
- Parity of assumptions
- Same version of the Product Category Rule
- Equivalent data quality requirements.

An important factor which can influence comparability of EPDs is ensuring that the same Product Category Rule is used for each EPD. In the case of the original 3form EPDs, these were based on an earlier version of the PCR. Since that time, the PCR has been extensively revised including the reporting requirements, life cycle stages, and EPD format. The 3form 2018 EPDs are based on the most current version of the PCR, and the extensive changes which occurred to this particular PCR during the 3-year period are so extensive that EPDs created under the different versions would not be comparable. The analysis in this report is based on applying the same version of the PCR (most current).

The importance of achieving parity when comparing two EPDs has been explored and documented in research by others[7]. This research has shown that differences in software, databases, and assumptions can have significant effects (e.g., >10%) on the LCA results. The methods used to calculate results (LCIA) are also updated over time, and the same methodology must be used when attempting to compare LCAs or EPDs. The uncertainty which can be introduced by different LCA practitioners using different assumptions or tools must be minimized when attempting to demonstrate optimization of a manufacturing process.

SUMMARY OF RESULTS

Table 3 and Table 4 in the following section details the LCA results for Chroma for both the 2014 and 2018 EPD (based on 2013 and 2016 data, respectively). Each set of results is reported on an equivalent

[6] LEED v4.1 Building Design and Construction. USGBC. July 19, 2019.
[7] An Evaluation of the Variability Possible within a Single Environmental Product Declaration and Product Category Rule. Commissioned by BIFMA. April 28, 2014.

basis (1 kg of product), and all analyses are conducted using the same software, data sources, methods, modeling assumptions and are based on the same PCR requirements.

The original 2014 EPD for Chroma is based on 2013 data provided by 3form for their manufacturing processes. The original LCA was completed by PE International using GaBi software and GaBi LCI database. The EPD was prepared according to the applicable PCR and were registered with the NSF International EPD Program until the document reached the end of their validity period in 2017.

See Table 1 and Figure 1 for a summary comparison of the results based on the 2013 and 2016 3form data. Life Cycle Impact Assessment results are reported using the CML-IA[8] characterization methodology.

Table 3. Life Cycle Impact Assessment (LCIA) results for the 3form *Chroma* products. All values are rounded to two significant digits. Results are based on 2013 data. Results reported in MJ are calculated using lower heating values.

Impact category	Unit	Module A1 Sourcing/Extraction	Module A2 Transport	Module A3 Manufacturing	Total
Global Warming Potential (GWP-100)	kg CO_2 eq	6.4 79%	0.38 4.7%	1.4 17%	8.2 100%
Acidification Potential	kg SO_2 eq	$3.0x10^{-2}$ 81%	$2.3x10^{-3}$ 6.2%	$4.7x10^{-3}$ 13%	$3.7x10^{-2}$ 100%
Eutrophication Potential	kg PO_4^{3-} eq	$3.1x10^{-3}$ 64%	$5.7x10^{-4}$ 12%	$1.2x10^{-3}$ 24%	$4.8x10^{-3}$ 100%
Photochemical Ozone Creation Potential	kg C_2H_4 eq	$1.3x10^{-3}$ 80%	$8.3x10^{-5}$ 5.0%	$2.5x10^{-4}$ 15%	$1.7x10^{-3}$ 100%
Ozone Depletion Potential	kg CFC-11 eq	$5.1x10^{-7}$ 76%	$6.3x10^{-8}$ 9.3%	$1.0x10^{-7}$ 15%	$6.8x10^{-7}$ 100%
Abiotic Resource Depletion (Elements)	kg Sb eq	$2.9x10^{-6}$ 68%	$8.1x10^{-7}$ 19%	$5.6x10^{-7}$ 13%	$4.2x10^{-6}$ 100%
Abiotic Resource Depletion (Fossil)	MJ	130 84%	5.7 3.8%	18 12%	150 100%

Table 4. Life Cycle Impact Assessment (LCIA) results for the 3form *Chroma* products. All values are rounded to two significant digits. Results are based on 2016 data. Results reported in MJ are calculated using lower heating values.

Impact category	Unit	Module A1 Sourcing/Extraction	Module A2 Transport	Module A3 Manufacturing	Total
Global Warming Potential (GWP-100)	kg CO_2 eq	4.5 85%	0.28 5.3%	0.52 9.8%	5.3 100%
Acidification Potential	kg SO_2 eq	$2.6x10^{-2}$ 88%	$1.7x10^{-3}$ 5.7%	$1.9x10^{-3}$ 6.3%	$3.0x10^{-2}$ 100%
Eutrophication Potential	kg PO_4^{3-} eq	$3.6x10^{-3}$ 77%	$4.2x10^{-4}$ 9.1%	$6.2x10^{-4}$ 13%	$4.6x10^{-3}$ 100%
Photochemical Ozone Creation Potential	kg C_2H_4 eq	$1.1x10^{-3}$ 87%	$6.2x10^{-5}$ 4.9%	$1.0x10^{-4}$ 7.9%	$1.3x10^{-3}$ 100%
Ozone Depletion Potential	kg CFC-11 eq	$4.6x10^{-7}$ 86%	$4.7x10^{-8}$ 8.8%	$3.0x10^{-8}$ 5.6%	$5.4x10^{-7}$ 100%
Abiotic Resource Depletion (Elements)	kg Sb eq	$3.4x10^{-6}$ 81%	$6.0x10^{-7}$ 14%	$2.2x10^{-7}$ 5.1%	$4.2x10^{-6}$ 100%
Abiotic Resource Depletion (Fossil)	MJ	99 91%	4.2 3.9%	6.1 5.6%	110 100%

[8] CML 4.1 baseline, from Institute of Environmental Sciences Faculty of Science University of Leiden, Netherlands.

SUPPORTING TECHNICAL INFORMATION

The following is a summary of the data sources, software tools, and LCIA methods used for calculation of the 3form LCA. In all cases, equivalent assumptions were used in this Study for modeling of both the 2013 and 2016 3form data.

Background LCA Report:
Life Cycle Assessment of Varia Ecoresin, Chroma, Koda and Infinite Pressed Glass Panels. Final Report. September 2019.

Data Sources:
Ecoinvent v3.3
Plastics Europe

Software:
SimaPro, Version 8.3

LCIA Methodology:
CML-IA Baseline v4.2

Product Category Rule:
Construction Products and Construction Services. Version 2.2. The International EPD System