NRMCA Material Ingredient Reporting Guidance

Methodology and Guide to LEED v4 Material Ingredient Reporting

Version 1 | March 31, 2016

NRMCA
NATIONAL READY MIXED CONCRETE ASSOCIATION

Ready Mixed Concrete Research & Education Foundation

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Version 1 | March 31, 2016

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Contents

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Abbreviations

ASTM	American Society for Testing Materials
C2C	Cradle to Cradle Certified Products Program
C2CPII	Cradle to Cradle Products Innovation Institute
CASRN	Chemical Abstract Service Registration Number
CCRL	Cement and Concrete Reference Laboratory
CPA	Clean Production Action
GBCI	Green Building Certification Institute
GS	GreenScreen
HPD	Health Product Declaration
HPDC	Health Product Declaration Collaborative
LEED	Leadership in Energy and Environmental Design
MAP	Manufacturers Advisory Panel
MBDC	McDonough Braungart Design Consultants
MI	Manufacturers' Inventory
MR	Materials and Resources
MSDS	Material Safety Data Sheet
NRMCA	National Ready Mixed Concrete Association
PCR	Product Category Rules
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
RMCREF	Ready Mixed Concrete Research & Education Foundation
SCMs	Supplementary Cementitious Materials
SDS	Safety Data Sheet
SVHC	Substance of Very High Concern
USGBC	United States Green Building Council

Executive Summary

The new Materials and Resources credit in LEED v4: *Building Product Disclosure and Optimization — Material Ingredients* requires product manufacturers to report material and chemical ingredients if they are to help meet the requirements of the credit. USGBC provides guidance on several pathways for how manufacturers can report this information. This in turn raises the question of which is the most effective, efficient, and economical?

The National Ready Mixed Concrete Association (NRMCA), through the support of the Ready Mixed Concrete Research & Education Foundation (RMCREF), commissioned this study to determine which program is best for the ready mixed concrete industry.

The study has found that concrete producers can significantly contribute towards earning a project up to 2 points with the new credit. But if concrete producers are to deliver on this potential, they will have to obtain and report information on material ingredients and chemical constituents from their supply chain in an unprecedented way.

The study recommends that the Health Product Declaration and Health Product Declaration Builder v2 is currently the most practical and inexpensive pathway for the majority of concrete producers for establishing the necessary information for delivering on credit requirements.

Other schemes and compliance paths such as the Cradle to Cradle Certified Products Program, a GreenScreen Full Assessment Report, and a verified Manufacturers' Inventory Report, offer additional value, but this is proportional to their added costs.

The guidance in this report provides detail on each program and compares their pros and cons as they pertain to the unique characteristics of the concrete supply chain. This should allow concrete producers to choose a scheme that represents the best fit for themselves.

Study findings also identify opportunities for the NRMCA and its members to advise the scheme programs in areas where development is still necessary, and to ensure they produce pathways and tools that are meaningful and practical for manufacturers in the concrete industry.

How to Use this Guide

This guide is organized in the following way:

Section 1 provides the introduction and scope set forth by NRMCA that produced this guide.

Section 2 describes the evaluation criteria used in the research, as agreed with NRMCA for this work.

Section 3 sets the context and explains the background to the investigation conducted by explaining the LEED credit options and what qualifies as a product for LEED. This section highlights the particular opportunity for concrete to contribute to projects seeking LEED certification. It also explains what and why current ingredient information, such as safety data sheets, do not meet the requirement.

Section 4 summarizes the schemes named in the LEED credit and the associated programs that concrete producers should be aware of, namely, efforts to harmonize the schemes and tools, and to provide third-party verification. A detailed supplement of the various programs is available from NRMCA upon request.

Section 5 contains the recommendation and rationalization made to NRMCA and its members on how to demonstrate compliance with the LEED credit options. It also compares two of the compliance programs as well as the different versions of the one recommended.

Section 6 provides detailed instruction for concrete producers to carry out the recommendation. It explains what tools are required and provides a step-by-step guide shown graphically. This section also alerts producers to some common pitfalls to avoid.

Section 7 explains what elements of the LEED credit are still under development, and how this may impact the recommendations made in this report. This section offers a timeline of the anticipated changes, plus recommendations on what the NRMCA and individual members can do to stay ahead of them.

1 Introduction

The new Materials and Resources credit in LEED v4: *Building Product Disclosure and Optimization — Material Ingredients* will require product manufacturers to report material ingredients and chemical constituents if they are to help meet the requirements of this credit. LEED v4 references several options to earn a project up to 2 points. The options make reference to several methodologies and standards — Manufacturers' Inventory, GreenScreen, the Cradle to Cradle Certified Products Program, and Health Product Declarations — most of which are new concepts for the buildings industry.

Of the permanently installed building products 20 of them for the 1st point and 25% by cost for the 2nd point must participate and qualify in one of the referenced schemes. The credit limits the contribution of structure and enclosure to 30% of the qualifying products, also on a cost basis. Furthermore, additional weighting is given to locally sourced materials, and for attaining particular thresholds of certification within the standards.

Thus, as concrete is a major cost item and largely consists of local materials, it could potentially offer a one-stop shop for attaining a high contribution towards this credit. However, the many options and weighting factors within the credit bring about numerous possibilities for how concrete products could contribute most towards a project's achievement. It raises the question of which path is most effective, efficient, and economical.

1.1 A Guide for the Concrete Industry

A guide for concrete producers is essential to navigating the array of possibilities and mapping out a route that is sensitive to the particular ingredients in concrete, as well as the nature of its complex supply chain.

The options of the LEED v4 credit differ in many ways and selecting the optimal pathway should consider costs, time, ease in obtaining needed information, confidentiality protections, and public and professional relations implications for the individual supplier and the industry. Through comparing the options under these criteria this guide offers producers a navigational tool to select the optimal path to meet the LEED v4 material ingredients credit.

2 Evaluation Criteria Within this Guide

This guide is intended to help navigate producers through the array of possible pathways to contributing towards the LEED v4 credit on projects. It considers the particular ingredients in concrete and the nature of its complex supply chain. In arriving at the recommended routes, it has studied the options of the LEED v4 credit under the following criteria:

- Costs – in the form of program fee, necessary testing, third-party verification, and the amount of producer personnel engagement
- Time – as needed to obtain input data, test results, and a final document that qualifies for LEED v4 credit
- Intent – some of the standards are aimed at transparency of ingredients while others conduct a valuation of how healthy its ingredients rank relative to others
- Type and detail of information required – some options require more detailed reporting of ingredients than others. This guide lists the typical chemical constituents that would need to be reported under each option
- Nature of assessment – some are hazard assessments, others take into account exposure conditions during product use, and some also consider whether better alternatives exist. This guide notes the toxicity or health risks the options would likely identify, considering the chemical form of the ingredient in concrete during use
- Confidentiality of reported ingredients – the options differ in their allowances for portions of the ingredients to be kept confidential
- Infrastructure – some options are more established than others and thus have an existing protocol and case studies to reference, plus tools to aid product manufacturers, while others do not

In addition to the above, this guide for the concrete industry points out areas of potential risk. Some examples of potential risks include divulgence of proprietary formulations or other confidential information related to ingredient sourcing that offers market advantage and potential misinterpretation by the public of the hazardous nature of ingredients.

Through comparing the options under these criteria this guide offers producers a navigational tool to select the optimal path to meet the LEED v4 material ingredients credit.

3 Background – The Opportunity

3.1 The LEED v4 Material Ingredient Reporting Credit

Per the balloted and approved credit language of the *Building Product Disclosure and Optimization — Material Ingredients* within the Materials and Resources (MR) credit category of LEED v4, published by the US Green Building Council and publicly released in November 2012, the intent of the credit is as follows:

> To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved life-cycle impacts.

The credit offers up to 2 points within the MR category, and an additional 2 points within the Innovation in Design credits category for exemplary performance. (Note, a maximum of 5 points may be attained within the Innovation in Design category for the entire project so these points may not be available if the project team chooses to pursue other innovations that take all the slots).

Within this Disclosure and Optimization credit, the first option awards 1 point for disclosure and the second option awards another point for optimization. The credit was constructed with the intention that one would attain 1 point for disclosure and 2 points for both disclosure and optimization. Still, certain atypical projects could conceivably attain the second point and not the first. This structure is similar to two other new credits with the term Building Product Disclosure and Optimization in their credit titles which have similar point structures. There is one difference in this credit in that it offers a third option called Supply Chain Optimization. However, this option is not yet sufficiently defined to offer a viable path for manufacturers, so this guide will focus on the two options of Disclosure and Optimization. A summary of the different compliance paths and recognized programs is provided in Figure 1.

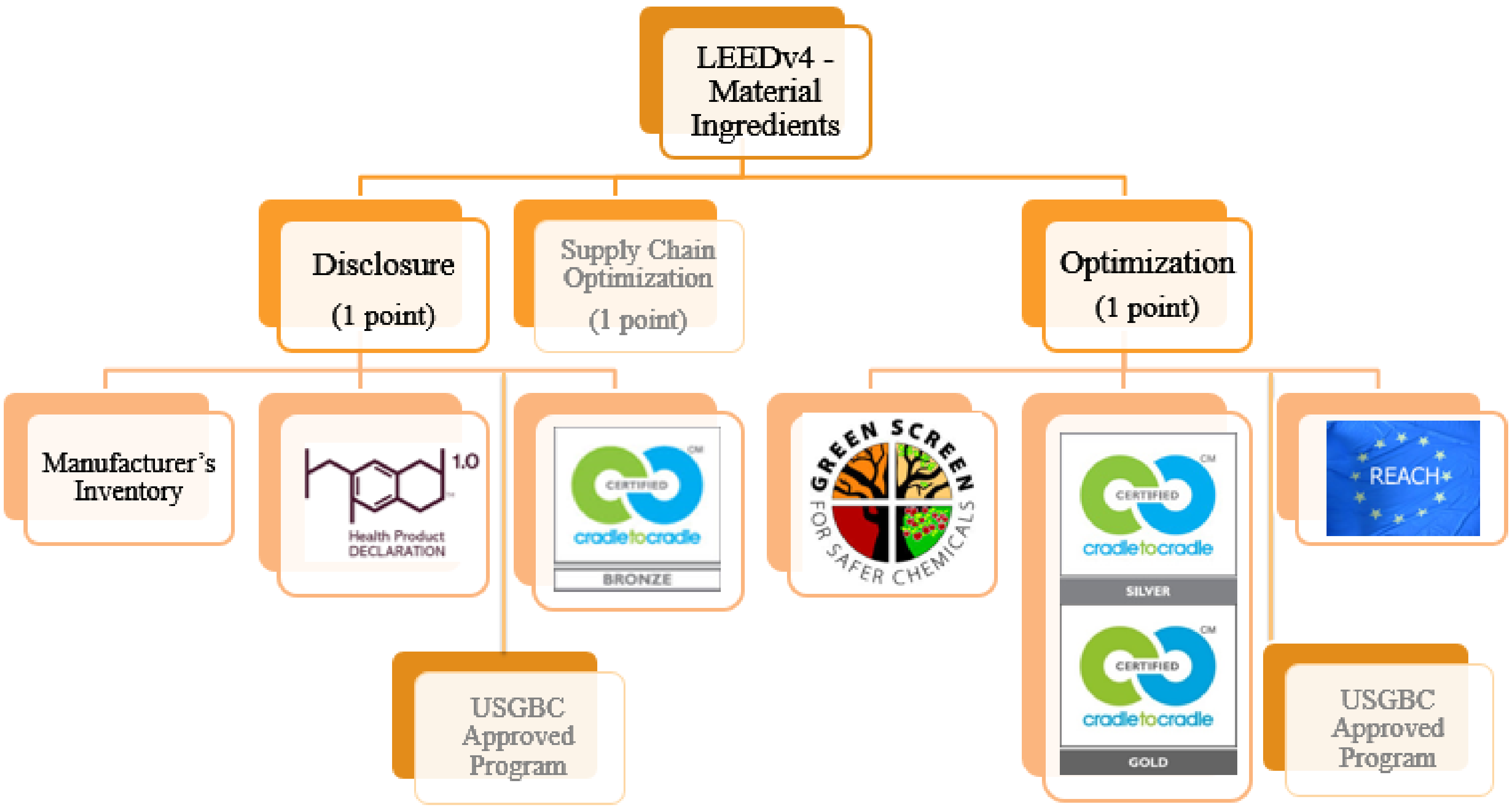

Figure 1: Pathways within the three options of the LEED v4 Material Ingredient credit

3.1.1 Achieving the Credit Through Disclosure

The disclosure credit is described in the LEED v4 Credit Library in the following way:

Option 1. Material Ingredient Reporting (1 point)

Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000ppm).

Manufacturer Inventory. The manufacturer has published complete content inventory for the product following these guidelines:

- A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN).
- Materials defined as trade secret or intellectual property may withhold the name and/or CASRN but must disclose role, amount, and GreenScreen benchmark, as defined in GreenScreen v1.2.

Health Product Declaration. The end-use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard.

Cradle to Cradle. The end-use product has been certified at the Cradle to Cradle v2 Basic level or Cradle to Cradle v3 Bronze level.

USGBC-approved program. Other USGBC-approved programs meeting the material ingredient reporting criteria.

Because the United States Green Building Council (USGBC) confirms that at this time they have not formally recognized any other USGBC-approved programs, other than those listed above, this study compares only the first three options of the Manufacturers' Inventory (MI), Health Product Declaration (HPD), and the Cradle to Cradle Certified Products Program (C2C).

3.1.2 Achieving the Credit Through Optimization

The optimization credit is described in the LEED v4 Credit Library in the following way:

Option 2. Material Ingredient Optimization (1 point)

Use products that document their material ingredient optimization using the paths below for at least 25%, by cost, of the total value of permanently installed products in the project.

GreenScreen v1.2 Benchmark. Products that have fully inventoried chemical ingredients to 100ppm that have no Benchmark-1 hazards:

- If any ingredients are assessed with the GreenScreen List Translator, value these products at 100% of cost.
- If all ingredients have undergone a full GreenScreen Assessment, value these products at 150% of cost.

Cradle to Cradle Certified. End-use products are certified Cradle to Cradle. Products will be valued as follows:

- Cradle to Cradle v2 Gold: 100% of cost
- Cradle to Cradle v2 Platinum: 150% of cost
- Cradle to Cradle v3 Silver: 100% of cost
- Cradle to Cradle v3 Gold or Platinum: 150% of cost

International Alternative Compliance Path – REACH Optimization. End-use products and materials that do not contain substances that meet REACH criteria for substances of very high concern. If the product contains no ingredients listed on the REACH Authorization or Candidate list, value at 100% of cost.

USGBC-approved program. Products that comply with USGBC-approved building product optimization criteria.

Again, because USGBC confirms that at this time they have not formally recognized another USGBC-approved program than those listed above, this study compares only the first three options of GreenScreen (GS), C2C, and registration, evaluation, authorization and restriction of chemicals (REACH).

3.2 Why an SDS is Not Enough

While the information on OSHA-mandated safety data sheets (SDS) can be useful in fulfilling the documentation requirements prescribed by the options in this credit, the SDS document itself will, for the majority of the time, not offer sufficient reporting to meet the requirements of the credit. Most SDS need only report certain hazardous chemical ingredients to 10,000ppm (or 1000ppm for highly hazardous substances) while Option 1 of the LEED credit requires an inventory of all ingredients to at least 1000ppm, and Option 2 requires an inventory to at least 100ppm.

Furthermore, SDS allow considerable masking of proprietary substances and chemical formulations. The LEED credit has provisions for protecting the precise formulations while it requires a content inventory and hazard disclosure that is more complete than the basic SDS.

Lastly, SDS documents are intended for occupational hazard safety and do not comprehensively address health hazards of product substances in use by consumers. The LEED credit aims to reduce the amount of hazardous substances within building products for the health of building occupants.

3.3 Potential Project Contribution

As Section 3.1 identifies, to earn the first point of the LEED credit, 20 of the permanently installed building products must meet the requirements of Option 1. To earn the second point, 25% by cost must meet the requirements of Option 2.

Furthermore, projects may attain two additional points in the Innovation in Design category through "exemplary performance" of particular credits as noted in the Reference Guide:

> Exemplary Performance
>
> Option 1. Purchase at least 40 permanently installed building products that meet the credit criteria.
>
> Option 2. Purchase at least 50%, by cost, of permanently installed building products that meet the credit criteria.

Up to 2 points may be attained through exemplary performance towards LEED certification on a project, so achieving exemplary performance through this credit means exemplary performance in other areas of the project will not also be awarded. Furthermore, considering the scarcity of other building products that meet the requirements of this credit, project teams will likely pursue other options for the 2 Innovation in Design points available through exemplary performance for some time.

For the second point, additional weighting is given to locally sourced materials through a "location valuation factor." Products and materials that are extracted, manufactured, and purchased within a 100 miles radius from the project can use twice their value towards the 25% by cost requirement. This distance may be measured as the crow flies, not by actual travel distance.

3.3.1 Definition of a Product

The LEED v4 Reference Guide provides the following definition of building products:

> Definitions
>
> product (permanently installed building product) an item that arrives on the project site either as a finished element ready for installation or as a

> component to another item assembled on-site. The product unit is defined by the functional requirement for use in the project; this includes the physical components and services needed to serve the intended function of the permanently installed building product.

Considering how concrete is a major cost item that largely consists of local materials, and that each specified mix counts as a separate building product, a ready mix producer could potentially offer a one-stop shop for attaining a major contribution towards the requirements of this credit, and maximize the points coming from structure and enclosure products of the project.

3.3.2 Limitations

Under Option 1, qualifying products must come from at least five different manufacturers.

Option 2 limits the contribution of structure and enclosure to 30% of the qualifying products.

According to the LEED v4 Reference Guide, for Option 2, projects in the U.S. may not use the REACH compliance path.

3.4 Credit Compliance Timeline

Currently, projects have the option to register under LEED v4 or under LEEDv3/2009. USGBC has stated that this option will remain available until at least October 31, 2016, when they plan to close new LEEDv3/2009 registrations.

Still, projects that register under LEEDv3/2009 may pursue the new LEED v4 credit, as well as others under the MR category, by way of pilot credits which count towards Innovation in Design points. According to the Pilot Credit Library, the requirements of *MRpc76 Material ingredient reporting* and *MRpc77 Material ingredient optimization* are identical to the LEED v4 credit provided in Section 3.1. Up to 4 of the 5 points available in the Innovation in Design category may come from pilot credits.[1]

Thus, concrete producers who attain the required documentation to meet the LEED v4 credit should inform the project teams of projects pursuing LEEDv3/2009 certification of this potential to earn immediate credit under the Innovation in Design category, as well as the benefit of familiarizing themselves with the significant changes in LEED v4 rating system.

Furthermore, projects registered to LEEDv3/2009 may swap out the entire MR credit category for the LEED v4 MR credits. USGBC currently offers some incentive to do this through bonus points at higher levels of credit achievement within the category.[2]

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[1] US Green Building Council, Pilot credit library, http://www.usgbc.org/pilotcredits.
[2] US Green Building Council, MR Credit Category Pilot ACP, http://www.usgbc.org/credits/new-construction-schools-new-construction-retail-new-construction/v2009/mrpc84.

3.5 Documentation Required of the LEED Project Team

The following table has been replicated from the LEED v4 Reference Guide:

Table 1: Documentation required by the LEED credit

Documentation	Option 1	Option 2
MR building product disclosure and optimization calculator or equivalent tracking tool	x	x
Documentation of chemical inventory through HPDs, C2C certification labels, manufacturers' lists of ingredients with GS assessment reports for confidential ingredients, or USGBC-approved programs (if applicable)	x	
Verification of ingredient optimization through C2C **certification labels, manufacturers' lists of ingredients with** GS **benchmarks listed for all ingredients, or manufacturers' declaration (for REACH), or USGBC-approved programs (if applicable)**		x

As on a typical LEED building project, the concrete producer should submit the specified documentation to the general contractor who will then compile and submit documentation per the LEED team coordinator's instructions for LEED project review and certification by the Green Building Certification Institute (GBCI).

As indicated in the LEED v4 Reference Guide, for Option 1, the project team must produce and submit the following to GBCI for review:

> Documentation of chemical inventory through HPDs, C2C certification labels, manufacturers' lists of ingredients with GS assessment reports for confidential ingredients, or USGBC-approved programs (if applicable)

For Option 2, the project team must produce and submit the following to GBCI for review:

> Verification of ingredient optimization through C2C certification labels, manufacturers' lists of ingredients with GS benchmarks listed for all ingredients, or manufacturers' declaration (for REACH), or USGBC-approved programs (if applicable)

For both options, the project team must also submit the MR building product disclosure and optimization calculator or equivalent tracking tool, available online and within LEED Online for all projects registered to LEED v3 or LEED v4.[3]

This tool helps to calculate the total points attained on a project for this credit, accounting for the different weightings for local sourcing, type of assessment or certification level within the applicable programs, and whether the product is part of structure and enclosure. Thus, the concrete producer ultimately needs to provide the following:

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[3] US Green Building Council, BPDO Calculator, http://www.usgbc.org/resources/bpdo-calculator.

- evidence of attaining Option 1 or both Option 1 and Option 2, as described above
- distances from project site to source of manufacture and source of extraction for each concrete mix.
- total cost of each concrete mix

The latter two items are similar to what has been needed for MRc5 of LEED NC v3/2009 and earlier.

3.6 Currently Qualifying Concrete Products

There are currently no ready mixed concrete products that offer documentation to qualify for the new Material Ingredients credit.

4 Program Comparison

4.1 Program Summaries

This study compared the six pathways currently acknowledged as acceptable for the LEED credit. Reasons for not including other programs that may academically qualify as a USGBC-approved program are given in Section 3.1.

Across the six pathways there are actually only four reference programs, since C2C is referenced twice (once in each option) and MI is purely a pathway and not an outside program.

A summary of the four referenced programs is provided below, followed by additional information on activities related to the programs.

4.1.1 Health Product Declaration

HPD is an open standard created by the Health Product Declaration Collaborative (HPDC) for the reporting of product contents and potential health hazards. Health hazards are identified using the Chemical Abstracts Service Registration Number (CASRN) unique to each chemical compound and the GreenScreen for Safer Chemicals (GreenScreen) methodology, which pulls from a defined set of Authoritative Lists used by toxicologists globally for chemical hazard identification.[4] More about GS is provided in its own section further below.

The HPD Builder is an online tool that "facilitates production of consistent HPDs in accordance with the HPD Standard." It provides step-by-step instructions that guide a registered user through filling out each field of the online HPD Builder input forms. This information is kept private until the user chooses to publish the form. The form becomes an HPD only when the user chooses to publish the data publicly.

Established in 2012, the HPDC is "a customer-led organization committed to the continuous improvement of the building industry's performance through transparency, openness and innovation in the product supply chain." The HPDC is supported by stakeholders representing segments all throughout the supply chain, from manufacturers to designers, to building owners, and more.[5] In particular, the HPDC established a Manufacturers Advisory Panel (MAP) in 2014 which is now comprised of 73 manufacturers who collectively provide regular input to the development of the HPD Standard and associated tools, such as the HPD Builder.[6]

4.1.2 Cradle to Cradle Certified™ Product Standard

Cradle to Cradle Product Certification is a multi-attribute certification standard for a variety of products, of which building products is a category, run by the Cradle

[4] Chemical Abstracts Service, www.cas.org/.
[5] http://www.hpd-collaborative.org/collaborative-communities (last accessed March 2015)
[6] HPD Collaborative, www.hpd-collaborative.org/.

to Cradle Products Innovation Institute (C2CPII). It includes a hazard assessment under the Material Health category, which is one of five total criteria categories and also includes Material Reutilization, Renewable Energy and Carbon Management, Water Stewardship, and Social Fairness. The final product certification level is based on the lowest level attained in each category, which can range from the lowest, Basic, to Bronze, Silver, Gold, or the highest, Platinum, with more stringent requirements added at every level in each category.

Under the Material Health Assessment of the C2C Protocol, a product must first comply with the standard's Banned List of Chemicals. Then materials are inventoried and evaluated, based on human health and environmental relevance criteria, by a C2C Accredited Assessor, typically a toxicologist. Through this, the material is placed into one of four categories: A, B, C, or X. An A represents little or no risk, and acceptable for use, while an X flags the material as high risk that should be phased out as soon as possible due to known or suspected carcinogens, endocrine disruptors, mutagens, reproductive toxins, teratogens, or other human health and environmental relevance criteria.[7] This assessment is based on hazard profiles and may also take into account the plausibility of exposure to the chemicals present at concentrations of 100ppm or above. The C2C program requires that the manufacturer develop an optimization plan to both substitute or remove chemicals rated an X from the product over time, and increase the percentage of assessed materials, if not already 100% assessed.

The principles of C2C follow the philosophy of the William McDonough and Michael Braungart, the former an architect and the latter a chemist. The partners formed McDonough Braungart Design Consultants (MBDC) and authored the book *Cradle to Cradle*, in which this philosophy has been described and popularized. Although MBDC created the "Cradle-to-Cradle Design Protocol" founded on the "Intelligent Products System" developed by Michael Braungart, C2CPII was created in 2010 as an independent certification body and now runs the C2C Certification program.[8]

4.1.3 GreenScreen

GreenScreen for Safer Chemicals is a method for comparative Chemical Hazard Assessment that can be used for identifying chemicals of high concern and safer alternatives. It is administered by Clean Production Action (CPA) and used by industry, government and NGOs to support product design and development, materials procurement, and as part of alternatives assessment to meet regulatory requirements. Based on its defined methodology, chemicals are categorized as Benchmark- 1, 2, 3 or 4, where Benchmark-4 signals a "Preferred" substance and Benchmark-1 signals a substance to "Avoid." This categorization involves assessment of chemical hazards on 18 human and environmental health endpoints. The method includes a screening tool — the GreenScreen List Translator — and a full assessment methodology.

[7] MBDC, www.mbdc.com/.
[8] Cradle to Cradle Products Innovation Institute, www.c2ccertified.org/product_certification.

The GreenScreen List Translator involves screening the chemical against the GreenScreen Specified Lists, a set of 34 authoritative lists mostly from governmental agencies which have reviewed scientific studies to associate chemicals with specific health endpoints. Inexpensive automated tools facilitate a quick look of chemicals against the List Translator.[9] The List Translator can only identify a chemical as a Likely Benchmark-1, Possible Benchmark-1, or Benchmark-Unknown.

Categorization of a chemical as a Benchmark-2 or higher requires a full GS assessment by a toxicologist. It starts with the List Translator but then extends to research and data collection from all relevant sources, including measured data from standardized tests and scientific literature and information derived from models and suitable chemical analogs. This is coupled with expert judgment to classify each hazard endpoint as ranging from Very High (vH) to Very Low (vL). Once the classifications are made for each endpoint, the profiler determines the level of confidence for each hazard classification. Then, following the GS benchmark assignment method, the profiler assigns the Benchmark category from 1 to 4 to the chemical. When a chemical is a GreenScreen Benchmark-1, it has hazard criteria that align with the definition of a substance of very high concern (SVHC) under REACH.

GS is applicable to single chemicals or more complex substances, and can also include consideration of feasible and relevant transformation products. Only certain numbers and types of data gaps are allowed for each Benchmark level, and it is possible that a Benchmark cannot be assigned at all if the data are insufficient. The methodology is freely available to the public, transparent, and peer-reviewed.

GS builds on the United States Environmental Protection Agency's Design for the Environment approach, the Organization for Economic Cooperation and Development test methods, Canada Domestic Substances List Methodology, the European Union's REACH program, the European Union's Classification, Labeling and Packaging Regulation, and other national and international precedents. It is used by businesses like Hewlett-Packard, governments like Washington State, and NGOs such as the Healthy Building Network in their Pharos Project. GS can also be used to support environmentally preferable product procurement tools including standards, scorecards, and ecolabels.

Manufactures have different options for using GS for the LEED v4 credit.

For the Disclosure credit, manufacturers can use an HPD (which includes screening using the GreenScreen List Translator) or complete a MI according to the LEED credit. For manufacturers who do not wish to disclose certain chemicals in their products, they can do a full GS assessment of those chemicals and report according to the LEED credit. The goal is to drive greater transparency in

[9] The Pharos Project, www.pharosproject.net. The Pharos Project's Chemical and Material Library provides CASRN and name lookup of chemicals and returns authoritative hazard listings and GreenScreen List Translator results. The HPD Builder also associates hazard and List Translator results as the while producing an HPD. HPD Collaborative, www.hpd-collaborative.org.

reporting and does not preclude the presence of Benchmark-1 chemicals in a product.

For Optimization there are two ways to demonstrate the absence of Benchmark-1 hazards. The simplest way is to use the GreenScreen List Translator, which involves screening the contents against a series of authoritative hazard lists. Products are valued at 100% of cost whose contents meet this screening. The second way is to use the full GS method, which involves a review of the science literature for evidence of the level of hazard. Products are valued at 150% of cost whose contents pass this more thorough assessment. For those manufacturers who are able to provide full ingredient transparency, it is straightforward to earn both the Disclosure and the Optimization credits (valued at 100% of cost) by using the HPD and the GreenScreen List Translator.

For those manufacturers who either need assistance tracking down chemical ingredient information from their supply chain or who are unable or averse to providing full ingredient transparency, a Licensed GreenScreen Profiler can serve as a valued third party to facilitate earning this credit by performing either GreenScreen List Translator screens or full GS assessments (valued at 150% of cost).

For more information, including a list of profilers and the GreenCircle Certified partnership program, go to: www.cleanproduction.org/Greenscreen.v1-2.php.

4.1.4 Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

This option basically offers a pathway whereby a product manufacturer can screen the chemicals in their product against lists of SVHC maintained by the European Chemicals Agency. Three lists are specifically mentioned in the Reference Guide: the Candidate List, Authorization List, and Restricted List.

It is important to note that this pathway uses these lists like Red Lists, which is not how they are used within REACH regulation. Also, these lists are not comprehensive lists of all SVHC. Since this path is not available to products for LEED projects within the US, this guidance document performs a very limited evaluation of REACH.[10]

4.2 Harmonization

As depicted in the program summaries, although the programs and pathways are listed independently, in reality there is much overlap and intermingling of the methodologies and documentation. For example, although the HPD is not named under Option 2, one can use an HPD to show evidence of GS evaluation for Optimization. Likewise, the basis for classification of substances as Benchmark-1 aligns with the definition of SVHC under REACH.

[10] European Chemicals Agency, Guidance, www.echa.europa.eu/support/guidance-on-reach-and-clp-implementation.

Recognizing that there would be benefits to manufacturers, designers, and programs if the programs could reduce redundancy in the inventory of product contents and their assessment protocols, the Healthy Building Network, HPDC, C2CPII and CPA launched an effort to harmonize across their programs. Initial phases of the harmonization project have been largely funded by grants from Google through the USGBC. The initial phase was a study comparing the technical aspects of the referenced programs. This Harmonization Opportunities Report[11] (and update[12]), included one other program, Declare, which is used for the Living Building Challenge rating system, and a building products hazard assessment tool, Pharos, which serves as the chemical and material hazard look-up engine behind the HPD Builder and supports the GreenScreen List Translator.

4.3 Third-Party Verification

Given the complexity of the LEED credit, and little precedence in attaining it, third-party verification of either the MI or HPD can offer notable value to manufacturers, essentially stamping the documentation with a seal of approval for the LEED reviewers to acknowledge. This can significantly streamline the LEED review process, improve confidence amongst project product specifiers and purchasers, and prevent improper documentation, especially between when products are selected for inclusion on the project in the design phase and when project teams receive LEED reviewer results after construction is complete.

Even with the HPD, because the HPD open standard was not produced solely for the LEED credit, one can use it to report as much or as little as desired. Thus, it is easy to create an HPD that does not qualify for LEED credit. See Section 6.4 for common pitfalls in ways that one can use the HPD but most likely not earn LEED credit. Thus, while not required by the LEED credit, using a third-party verifier may help ensure GBCI will accept the HPD submitted for review.

The other benefit of obtaining third-party verification is that consumers, and the producers themselves, can have increased trust in the information reported in the document which may have come solely from suppliers who do not ordinarily share their information in a way that producers can use for verification purposes.

The HPD program has started a program to develop an official protocol for verification by third-party verifiers. For a list of verifiers involved in this partnership, see Appendix A2. Additionally, GreenCircle offers LEED compliance verification of a Manufacturers' Inventory Report using GreenScreen.

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[11] Heine, et al., "Material Health Evaluation Programs Harmonization Opportunities Report," US Green Building Council, Washington DC, August 2013. http://www.usgbc.org/resources/material-health-evaluation-programs-harmonization-opportunities.

[12] Van Valkenburg, et al., "Material Health Evaluation Programs Harmonization Update: A report from the Material Health Harmonization Task Group," US Green Building Council, Washington DC, April 2015. http://www.usgbc.org/resources/material-health-evaluation-programs-harmonization-update-0.

CPA has produced the guidance document “How to Use GreenScreen® for LEED v4 Credit” which provides further detail. [13]

The verifiers interviewed for this guide report their costs in the range of $2,000-$5,000 per product family.[14] Note that the scope of verification varies across and within the different parties offering these services. For the most part, verification services are limited to a desk audit of documentation to verify compliance to the LEED requirements per the standards of the chosen documentation pathway. They do not include producing an inventory of ingredients, which, for the MI and HPD, still rests on the manufacturers and their supply chain.

[13] GreenScreen for Safer Chemicals, How to Use GreenScreen for LEED v4, http://www.greenscreenchemicals.org/practice/leed.

[14] Per conversations with Annie Bevan of GreenCircle Certified, LLC., 10/9/2015 and email correspondence with Paul Firth of UL Environment, 11/6/2015.

5 Study Recommendation

Based on the detailed program evaluation of the LEED v4 Material Ingredients credit and the requirements of all the applicable alternate pathways this study recommends:

Concrete producers can ***start*** with the Health Product Declaration v2.0 pathway as the means of offering the most economical, efficient, and effective method for engaging their supply chain for the information necessary to contribute to the LEED credit.

This recommendation is made based on the programs summarized in Section 4.

5.1 Why Begin with the HPD?

The recommendation to begin with the HPD is primarily based on how it performs against the following five key criteria:

1. assurance
2. time efficiency
3. cost
4. gateway to other programs
5. associative benefits

Each of these criteria is now considered in detail. The focus of the analysis is predominantly on the programs within Option 1 (HPD, MI and C2C) because Option 1 is a natural, albeit not mandatory, precursor to Option 2.

5.1.1 Assurance

The first reason for the recommendation to start with the HPD is that it is the most viable of the programs that offer a sufficient amount of assurance to the foremost goal of contributing to the LEED v4 credit. The three programs that offer this assurance are the HPD, C2C, and MI using GS. C2C admittedly offers greater assurance than the HPD because the requirement is much more straight forward. The product must simply attain a certain certification level. However, the cost of C2C makes it fairly unlikely for a ready mix producer to pursue, which is explained in a section about cost below. While the assurance with the HPD isn't as great as with C2C, the HPD Collaborative does provide users with a mark-up of exactly what is required of the HPD in order to qualify for the LEED v4 credit. When following this mark-up, the manufacturer can have fairly high confidence that the HPD will be accepted for contribution towards the LEED v4 credit.

Clean Production Action, in collaboration with Green Circle Certified, recently published "How to Use GreenScreen for LEED v4" a guidance document which manufacturers should study closely for producing an MI using GS. A third-party verified MI using Green Circle Certified generates a stamp on the MI that says "Verified for LEED v4 Material Ingredient Option 1" or "Verified for LEED v4 Material Ingredient credit Option 2." [15] No products have obtained this yet to prove a level of assurance as high as a C2C certificate, so currently the MI is somewhat on par with the HPD that follows the HPD markup. It is up to a concrete producer whether the cost of third-party verification — which is about a tenth to a quarter the cost of a full C2C, and at least four times the cost of an HPD using the Builder — is worth the increased assurance.

5.1.2 Time Efficiency

Time savings are primarily attributable to the HPD online tool, the HPD Builder. The Builder makes the process of filling out an HPD much easier, walking users through the input fields of the HPD form step by step. It provides instructions and definitions along the way, and offers overall assurance that a manufacturer has filled it out correctly.

5.1.3 Cost

Choosing the HPD is likely to be the most economical approach in part because there is no fee to use the HPD form and standard. There are only soft costs in the form of personnel time, and a nominal $500 fee for affiliate HPDC membership to use the HPD Builder. Because of the unique way the concrete industry is structured, the soft costs can be shared between producers and suppliers, which would be a more economical way to keep the costs to a minimum across the industry.

To better understand this, it helps to think of costs broken down into four sources: staff management time, staff investigative time, third-party fees, and testing. These are set out visually in Figure 2. All of these are included in C2C in its full service certification program. In the C2C program, a manufacturer is appointed a C2C assessor who obtains all the needed information up the product supply chain, which is included in the price. Additionally, the C2C assessor works with the manufacturer to create a plan to switch out or phase out any chemicals determined to necessitate replacement with safer chemicals. However, according to the C2C Market Report, the cost for typical cast-in-place concrete starts at around $10,000 (range published by C2C is $10,000-$25,000), for only the first mix.

[15] L. Heine, A. Bevan, A. Hunsicker, and M. Rossi, *How to Use GreenScreen for LEED v4*, Clean Production Action, October 2015. http://www.greenscreenchemicals.org/practice/leed.

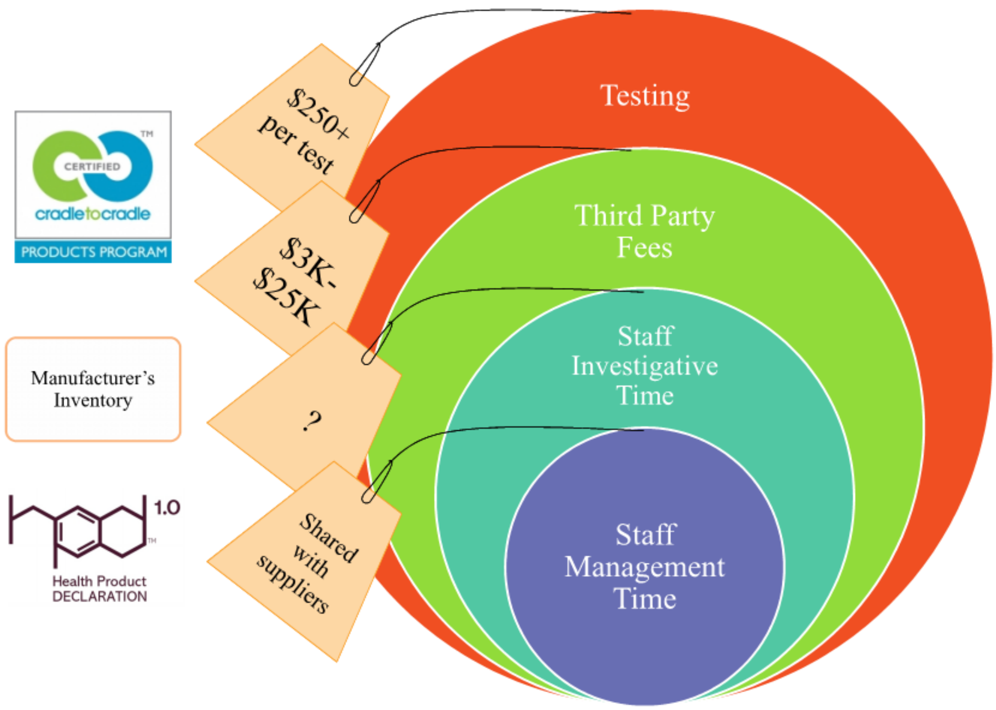

Figure 2: Buildup of services and costs between the programs.

In contrast, the HPD should only cost the fee to use the Builder, and the time of someone on staff, which can be shared with the suppliers of the various constituents of the concrete products. Ready mixed concrete is distinct in this aspect because a typical ready mix producer can produce hundreds, thousands, even tens of thousands of mixes from numerous different combinations of one to several of three primary *types* of products:

- the cement and supplementary cementitious materials (SCMs)
- the aggregate
- the chemical admixtures

It is realized that there are many more than three supply streams, and even more suppliers, but these three categories are distinct in how they relate to the HPD.

As illustrated in Figure 3, each mix can be thought of as simply a different recipe of a smaller number of products purchased from these three types of suppliers.

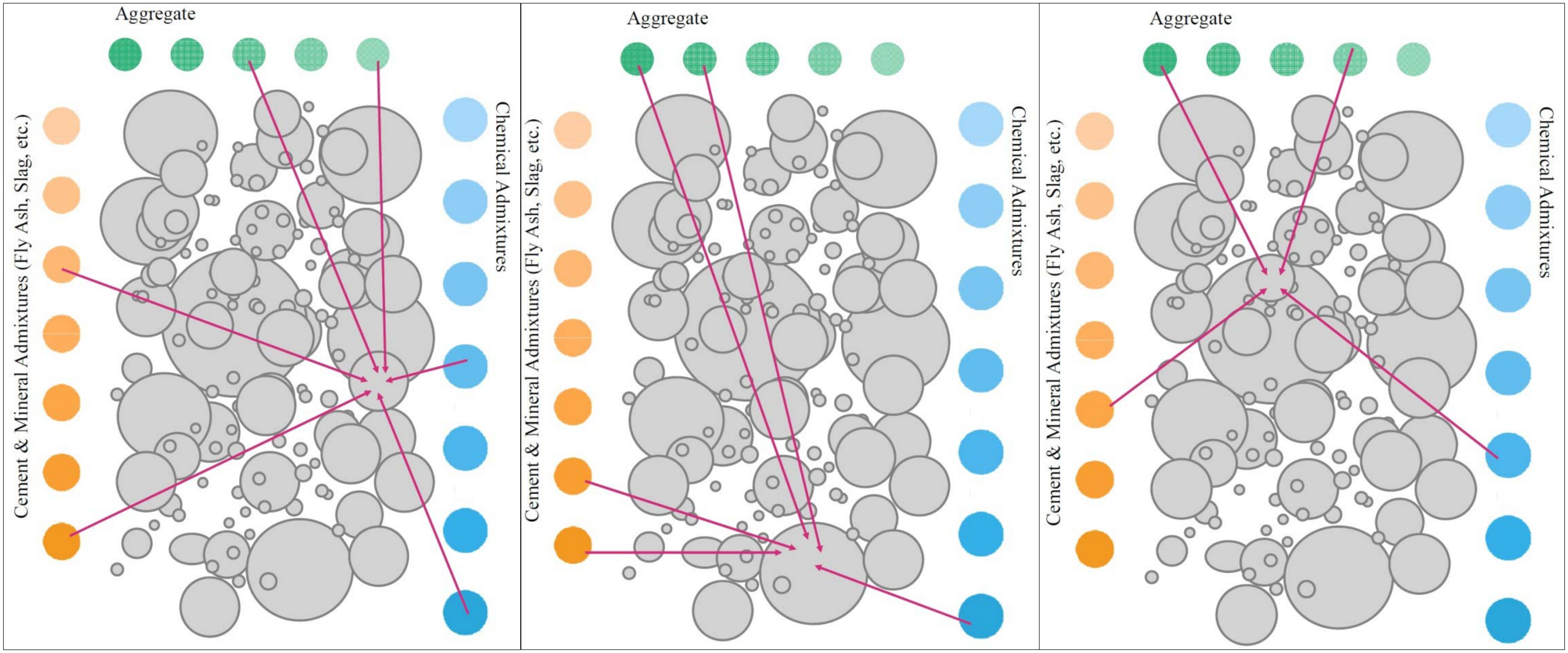

Figure 3: Simplified illustration of how a few products are typically combined to produce a numerous variety of unique concrete mixes. Each grey bubble represents a unique concrete mix, where the size of the bubble represents relative volume produced annually or historically by a single concrete producer.

Once this concept is recognized, it becomes the basis of how a producer will need to request and pull information from its suppliers into an HPD for the final concrete mix product. Functionally speaking, a producer can ask each of their suppliers to provide the necessary information for their HPDs and roll them into an HPD for the mix that uses those products.

This also forms the rationale for why attempting to generate a MI runs the risk of higher costs than an HPD, because producers could end up spending more time trying to individually guess at what is in the products of their suppliers. In the MI, a producer is completely on their own.

5.1.4 The HPD as a Gateway to Other Programs

Due in large part to the open standard intention of the HPD, and also due to the harmonization efforts incorporated in the HPD v2.0, the HPD is essentially the gateway to nearly all the other programs. The information you provide in an HPD can serve as a basis for all of the major programs that are currently included in the LEED credit — C2C, a GreenScreen Full Assessment, and even the REACH pathway — and two more which are currently seeking approval for inclusion as USGBC-Approved Programs — Declare and C2C's stand-alone Material Health Certificate; see Figure 4.

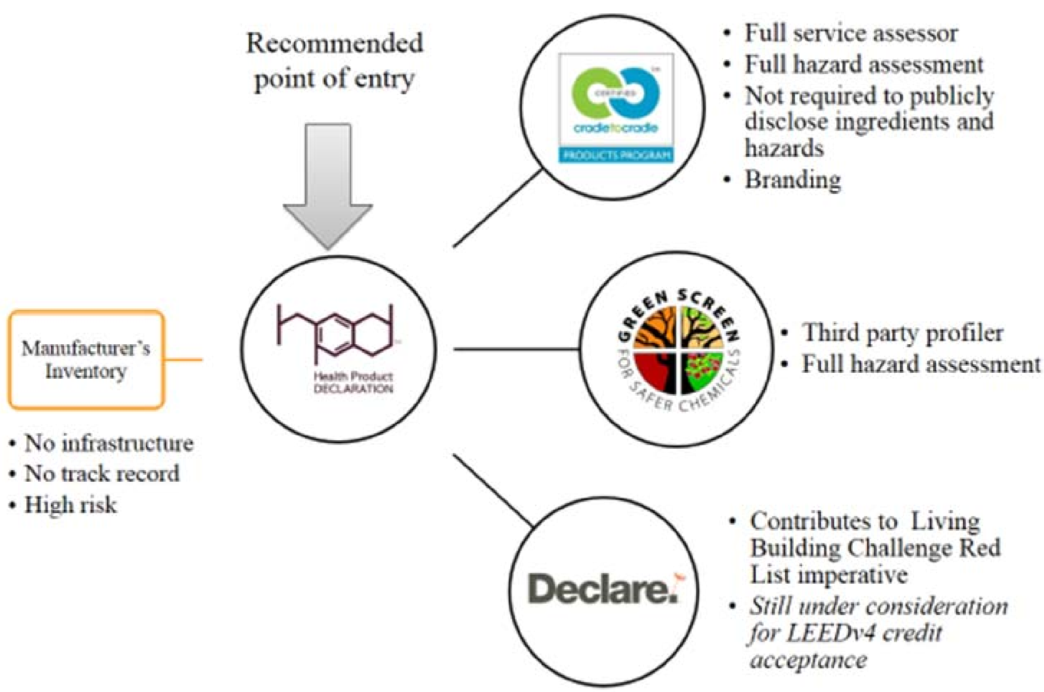

Figure 4: How the HPD is the gateway to other programs

Recalling that the first point is about disclosure and the second point is about optimization, all the programs to get the second point in the LEED credit require the disclosure that is found in Option 1 (an ingredient inventory and/or hazard screening). Thus, there is no wasted effort in doing an HPD if a manufacturer wishes to pursue a program or pathway for the second point as well, or decides later to use a different pathway for Option 1.

Figure 4 illustrates the HPD as the recommended point of entry that will enable pursuit of other programs, and highlights a few of the additional benefits offered by the other programs. The diagram also illustrates the relationship of the MI to the HPD and others. While MI may offer an elementary starting point, it must be noted that, aside from what is found in the LEED credit language, it offers no infrastructure and no track record. As well, for a product that does not have easily identifiable chemicals nor a completely vertically integrated supply chain, MI also has higher risk.

This risk has been recently begun to be addressed by emerging third-party verification programs of MIs (and HPDs). Still, there is no infrastructure to support supply chain engagement. These verifiers need to see the type of information a manufacturer would include in an HPD. The manufacturer still needs to perform the work required to obtain and show a complete set of information for the third-party to verify.

5.1.5 Associative Benefits

Lastly, producing an HPD shows participation in a movement and philosophy that can receive its own merits, even without meeting the LEED requirements. It has in a way become synonymous with "transparency."

To provide some history, following the release of HPD v1.0 in 2012, over 25 of the nation's top architecture firms (including SmithGroup, HDR, Cannon, HKS, ASG, and others) sent letters to manufacturers stating that they would give specific preference to products from manufacturers with HPDs. Some even spoke in the letters of removing products without HPDs from their library if HPDs were not available after a certain time frame.[16]

While these letters were controversial, the message was clear that prominent designers and specifiers were in strong support for HPDs. Following the letters, which were mostly issued in 2013, there was enormous market uptake of HPDs by 2014, and by February of 2015, nearly 1,000 HPDs were available. This generation of wide support in a very short time frame signifies that the HPD means something in and of itself.

Support for the HPDC remains strong into late 2015 and several new sponsors have joined since the release of version 1. This backing and the robust relationship with the MAP has enabled the development of version 2, which offers numerous improvements developed in response to needs voiced by the MAP.

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[16] GreenWizard, Transparency letters from Design and Construction Professionals, https://www.greenwizard.com/transparency/.

Accompanying the release of HPD v2.0, the HPDC has also added several other opportunities for stakeholder participation on various technical development committees. These committees address various issues of relevance to the concrete industry including Special Conditions, Supply Chain, and Education.

- Special Conditions – These are materials and substances for which, at present, disclosure is problematic in some respect. This subgroup will address the need for exceptions while best practices are emerging for rigorous application of disclosure rules.
- Supply Chain – This group will develop emerging best practices for dealing with complex supply chain issues such as secondary manufacturers, complex assemblies, proprietary information, and so forth.
- Education – This group will develop education materials for users, manufacturers, and parties in the HPD stakeholder network "ecosystem" to properly use HPDs and accelerate uptake in various industries.

It is recommended that the ready mixed concrete association and its members take advantage of these opportunities to become involved with the HPDC and have a direct voice to constructively effect future development of the HPD and its infrastructure.

5.2 HPD Compared to C2C

To date, concrete products have produced publicly available documentation by way of only two of the many pathways. This warrants a comparison of the two which are the HPD and C2C. The comparison is summarized in Figure 5.

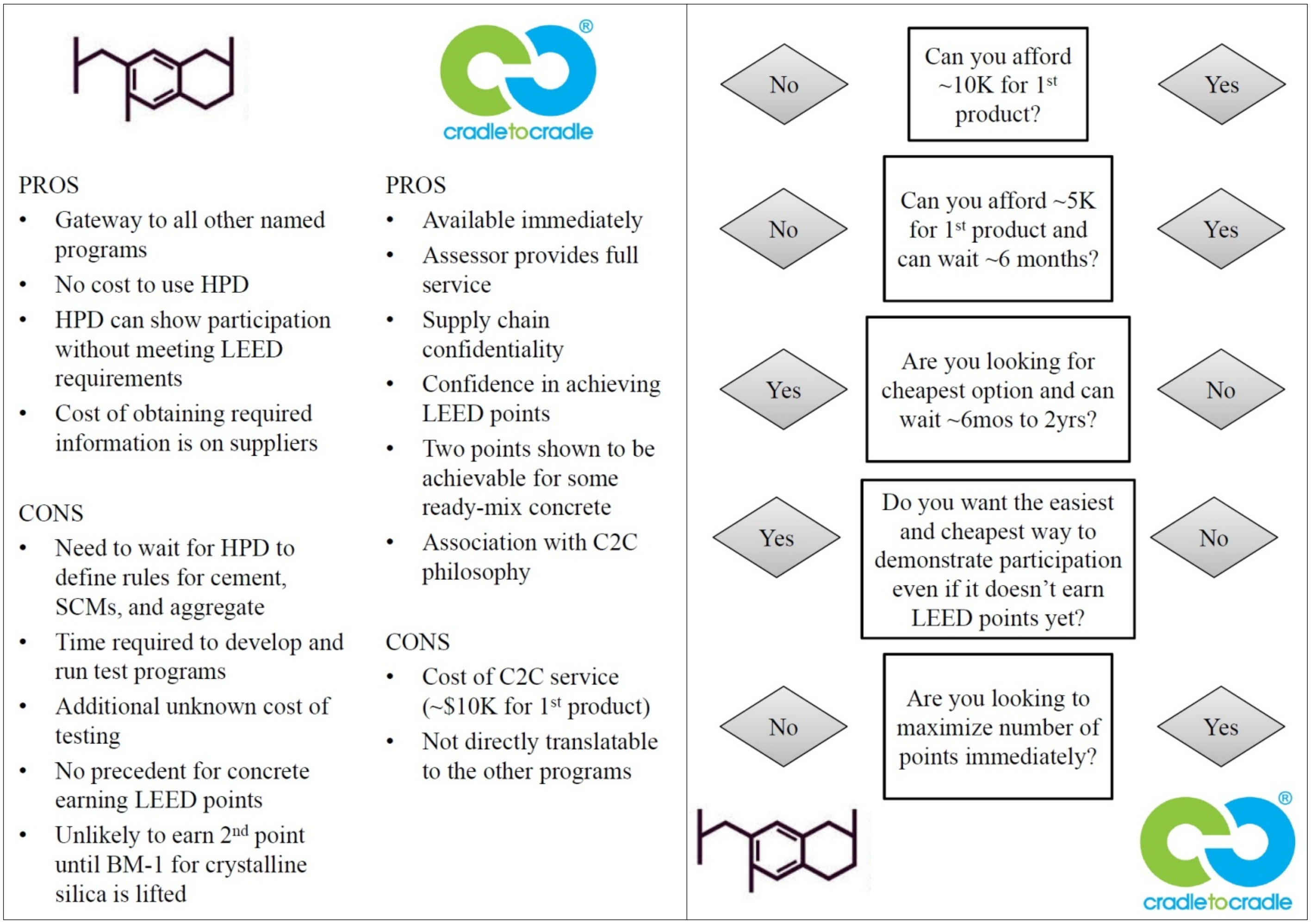

Figure 5: Comparison of HPD with C2D

C2C offers a unique and comprehensive service, plus unparalleled brand association, that justifies the additional cost for the manufacturers who find these offerings beneficial to their business. For the most part, however, the majority of concrete producers are not able to afford the cost of C2C. Note that this may change if USGBC approves the standalone Material Health Certification as an approved program for this credit. The standalone service has been approximated at half the cost of typical C2C certification for a typical concrete product.

5.3 HPD v2.0 Compared to HPD v1.0

Version 2 was designed with two main objectives:

1. Increase usability by both users and creators of HPDs.
2. Harmonize the HPD Open Standard specification with other standards and certifications used in the building industry that also relate to the reporting of product ingredients and health information.

The revision was developed to respond to lessons learned since the standard's launch in November 2012, with significant input from the Manufacturer's Advisory Panel, from designers and specifiers receiving HPDs, and from the work of the Harmonization Report. The changes involve both structural (formatting) and technical changes, and new terms and definitions.

Major changes from version 1 to version 2 are as follows:

- restructure of disclosure to reflect breakdown of products into homogeneous materials
- allowance for development of special conditions to address challenges in getting chemical level information on certain material types
- more precise definitions of types of disclosure
- separation of intentional ingredient disclosure thresholds from assessment of residuals and impurities
- enhanced notes sections to provide more opportunity to explain issues such as exposure
- redesign of the first page hazard summary
- clarification of content line item expectations for interactions and reaction products
- document simplification and language modifications based on users' perception/understanding of terms

Additionally, specific functional changes will enhance the HPD Builder.

For concrete products, there are four particularly critical and beneficial changes out of HPD v2.0:

1. Special Conditions
2. RFI-enabled HPD Database
3. Hazard vs. Risk Clarifications
4. Form-variants

5.3.1 Special Conditions

The HPDC has created a new category titled "Special Conditions" under version 2 for materials that pose inventory limitations at the chemical level. A preliminary list of materials that qualify as Special Conditions includes geologic material and recycled content. This is enormously helpful for aggregate and SCMs, and is explained in detail in their respective subsections under 6.3.

5.3.2 RFI-enabled HPD Builder and Database

The restructure of the HPD in v2 to group contents by homogeneous materials was done in part to better reflect the flow of materials from suppliers to manufacturers into final products and hence to facilitate engagement of the supply chain. By establishing a structure in which suppliers can provide and manage information for their products, the HPD can reduce the information management burden of disclosure on final manufacturers.

The HPD Builder for v2.0 will allow manufacturers to request that their suppliers use the HPD Builder to input and maintain the information for their supplied products which the manufacturer can then assemble into an HPD.

Preliminary plans for the new Builder indicate that suppliers will be able to specify which customers may use their input in the HPDs for their customers' products. The information the supplier provides will be restricted to use by these specified customers only, if the supplier so desires. Then when the customer goes to the HPD Builder to create an HPD for the final product, they will see a list of the materials and components available to them, accordingly. This creates a new path for suppliers to participate and make use of all the advantages of delivering the necessary information through the HPD Builder, without being forced to publish their information publicly.

5.3.3 Hazard vs. Risk Clarifications

The HPD v2.0 has new language clarifying the difference between hazards and risks so that users better understand the limitations of the HPD. Manufacturers are also encouraged to make use of an increased number of notes fields to explain their understanding of exposure considerations for contents indicated as hazardous and any appropriate risk management measures, and to advise on proper use of the HPD. These changes should help raise HPD user awareness of how concrete is able to bind up hazardous materials from entering the environment[17].

5.3.4 Form-Variants

One of the most problematic consequences of the HPD v1.0 was that the primary engine behind the Builder, the GreenScreen List Translator, is not able to recognize form-variants of chemical compounds and differentiate the associated hazard profiles. Its dependence on the CASRN constrains appreciation of other factors that make chemical compounds hazardous or not, such as exposure routes due to particle size, concentration, and whether they are bound (and therefore not respirable) or in an amorphous molecular state. This resulted in the HPD reporting GS classifications of Benchmark-1 for substances such as sand (crystalline silica) which is widely understood to pose low hazards when in the forms used within concrete. This limitation has prevented concrete products from attaining HPDs that would qualify for Option 2, which requires no Benchmark-1 ingredients.

The HPDC has been working diligently with CPA (also known as GreenScreen) to start to recognize form-variants by way of establishing Product Category Rules (PCR) so that HPD v2.0 may start to contain many of these advancements. CPA estimates that the development of PCRs will begin in 2016, when they would announce the protocol for convening subject matter experts according to product categories, to define the PCRs and establish rules for consistent evaluation of form-specific hazards under the GreenScreen framework.

[17] EPA 600/R-12/704 October 2012 | www.epa.gov/ord

While the HPD Builder awaits these amendments, it is recommended that concrete producers use the added notes fields to explain these exceptions and cite the Harmonization Report Update[18], which explicitly states the cases that should be recognized and not disqualify products from the second point in the LEED credit. These notes are intended for LEED project teams and LEED reviewers to have the means to make temporary exception and allow these products to contribute towards Option 2 if all other Option 2 requirements are met in the HPD. It is also recommended that, in this case, the concrete industry assist in education of the green buildings industry, and particularly the LEED reviewers and project teams seeking products that qualify for the LEED credit. See Section 7.4 for a listing of the specific opportunities the industry can take to enable meaningful development of the programs on form-variants and other complex issues.

A summary of how these changes impact the three types of concrete constituents is indicated in the simplified check list shown in Figure 6.

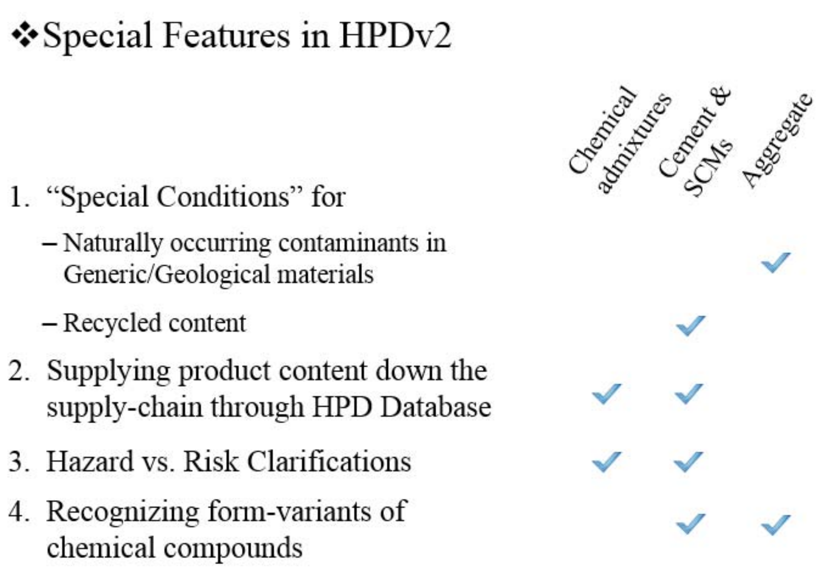

Figure 6: Special features in HPD v2.0 that apply to the constituents of concrete

All these improved features will enhance how ready mix will perform towards the LEED v4 credit and most are contained in version 2 of the HPD standard or HPD Builder. Thus, it is highly recommended that concrete producers use the HPD v2.0 and HPD Builder for v2.0 for achieving the LEED credit.

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[18] Van Valkenburg, et al., "Material Health Evaluation Programs Harmonization Update: A report from the Material Health Harmonization Task Group," US Green Building Council, Washington DC, April 2015. http://www.usgbc.org/resources/material-health-evaluation-programs-harmonization-update-0.

6 Process for Constructing an HPD

There are two principal tools needed for constructing an HPD. The first is the HPD markup for the LEED credit and the other is the HPD Builder.

6.1 HPD Markup for LEED Credit

The HPDC provides a markup of an HPD as a visual aid for meeting the LEED credit. On the markup, users can find what must be distinctly indicated and how, in order to meet the LEED credit. This markup has been presented, but not yet approved, by USGBC.

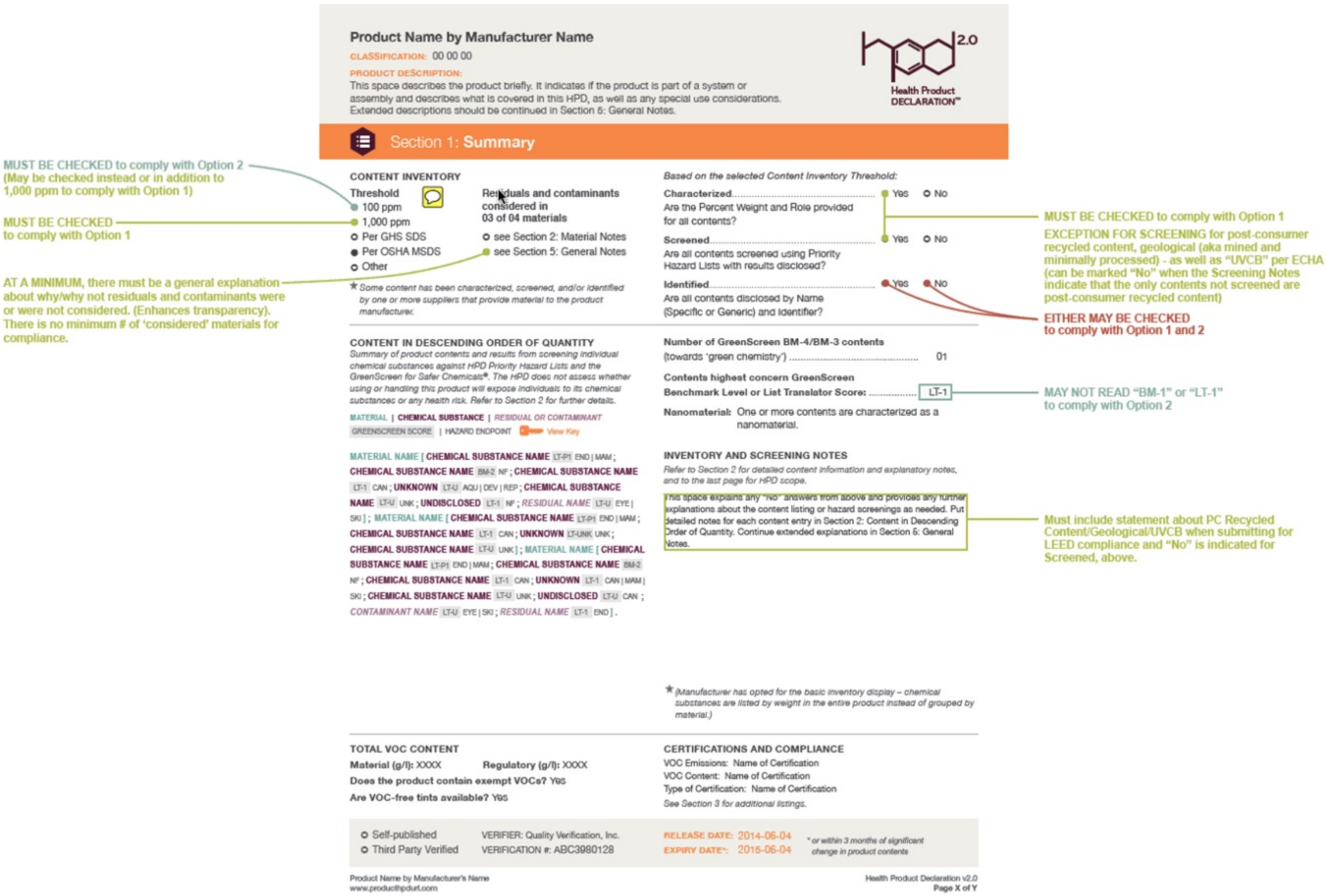


Figure 7: HPD v2.0 markup for LEED. A larger version of this graphic appears in Appendix A.

The HPDC also provides the following FAQ answer regarding use of the HPD for the LEED credit requirement:

> Option 1: HPD must include Full Disclosure of Known Hazards for all intentional ingredients and residuals disclosed at least to 1,000ppm. It also must include the Role and Percent Range for each line item.
>
> Option 2: HPD must include GS indicators for each intentional ingredient and residuals disclosed to 100ppm. No Benchmark-1 hazards may be

present in the product (use of GreenScreen List Translator valued at 100%; via full GS assessment valued at 150%).

While this summarizes the requirements, the markup provides more specifics. It is highly recommended that concrete producers download and follow the applicable version of the markup when attempting to generate HPDs for the LEED credit for the first time.

Another guidance document recently published that may be very useful is the "How to Use GreenScreen for LEED v4 Guide" by CPA and Green Circle Certified, LLC. This document covers the basics of GS specifically for the new LEED v4 credit, and numerous FAQs that apply equally to generating an HPD or MI using GS, since GS is embedded in the HPD.

6.2 HPD Builder

Constructing an HPD from within the HPD Builder offers the following advantages:

- low cost
- best way to do it right
- built-in guidance
- protection of confidential business information

By using the HPD Builder and built-in HPD Database, the ready mix producer can request that their particular suppliers provide the necessary information only for the most commonly used products, or the products used in specific mixes that need an HPD. These suppliers can then input the relevant information into the protected HPD Database, where it is kept confidential from the public, and can only be seen by the customers a supplier specifies. Another benefit is that there is no duplication of work for the supplier to provide information on the same products to multiple customers.

The Builder comes with $500 affiliate membership or $1,500 general membership to the HPDC.[19]

6.3 Constituents-Based Approach

As described in Section 5.1.3 on cost, the HPD system for requesting information from upstream suppliers and rolling it into an HPD complements the character of the concrete supply chain and industry participants very well.

Because a producer typically uses only a few well-known number of products to generate hundreds to tens of thousands of concrete mixes, the volume of information needed to populate the HPD Database, and thus generate an HPD, can be reduced by looking at only the primary constituents of concrete: the aggregate, cementitious materials, and chemical admixtures.

[19] Health Product Declaration Collaborative, https://builder.hpd-collaborative.org/user/auth/login.

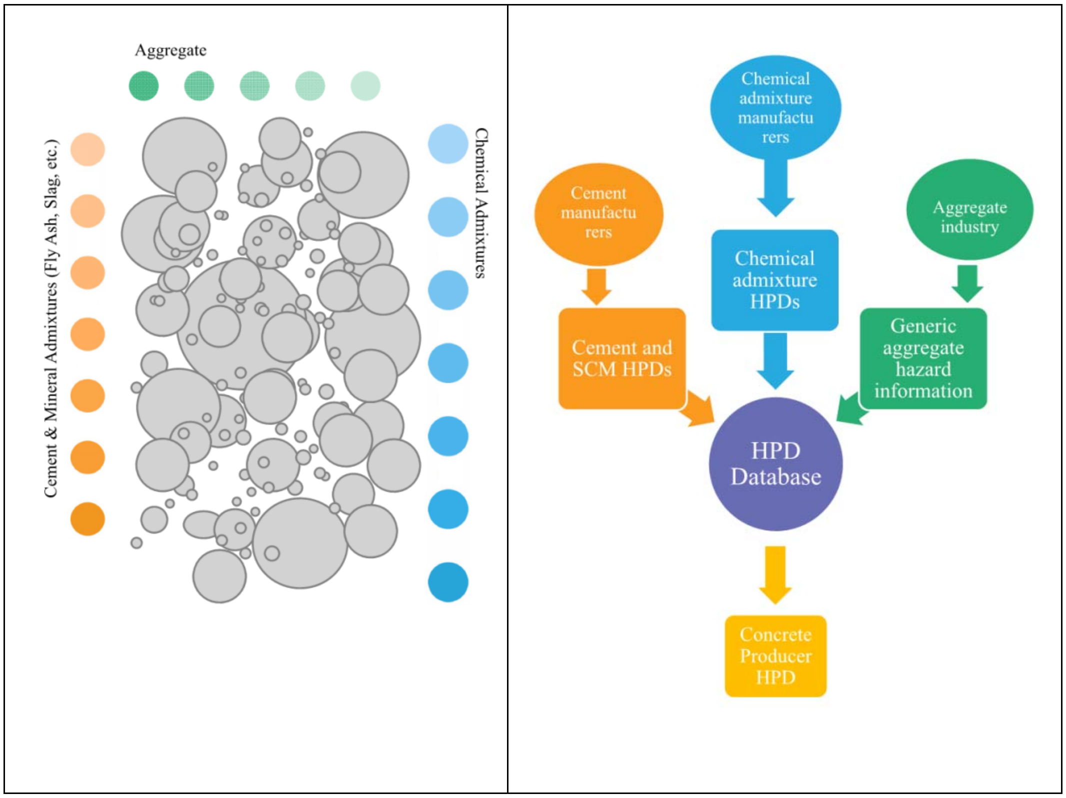


Figure 8: Constituents-based approach for producing HPDs

The process to produce HPDs is described further according to the three types of constituents in concrete, as they present different sets of issues that warrant different approaches. The following step-by-step outline addresses the three types in the following order:

1. chemical admixtures
2. cement and SCMs
3. aggregate

6.3.1 Chemical Admixtures

Concrete chemical admixtures are unique in that the manufacturer often knows the chemical compounds and appropriate CASRN to the level of the reporting threshold required (1000ppm or 100ppm). However, an admix manufacturer does not always know the complete set of chemical compounds because they are supplied by another company and only the hazardous ingredients are reported on an SDS. In this case, steps 1 and 2 will require some iterative refinement as admix suppliers obtain the necessary data from their suppliers.

In any case, this information is often sensitive intellectual property that must be kept confidential.

Figure 9 shows the four step approach to chemical admixture HPD creation recognizing the special circumstances of this component.

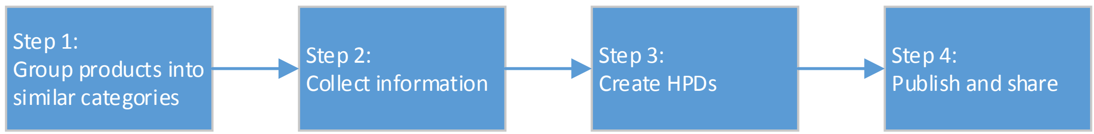


Figure 9: Constituents-based approach for producing HPDs for chemical admixtures

Step 1 – Group into product categories based on admix types and primary ingredients

It is recognized that admix manufacturers produce several dozens of unique products. To limit the number of HPDs that need to be produced, chemical admix manufacturers are recommended to group their products where they share the same function (e.g., American Society for Testing Materials [ASTM] type) and primary ingredients, as long as the range in chemical ingredient composition does not violate the rules of the HPD (which is +/-10% under HPD v1 and not anticipated to change for v2). For instance, a manufacturer may group together slightly different formulations of a viscosity modifying admixture into a single HPD information input whereas a group of polycarboxylate high-range water reducers will need to be separated from a group of lignin-based high-range water reducers.

Step 2 – Collect information on all intended ingredients and residuals to required reporting threshold

Intended ingredients, also known as ingredients, plus residuals must sum to 1000ppm when the claim of "measured to 1000ppm," has been chosen for the residuals reporting threshold per Option 1, and likewise to 100ppm for the claim to 100ppm for Option 2 of the LEED credit. The 1000ppm threshold is the disclosure level required for the first point in the LEED v4 credit whereas 100ppm is required for the second point.

Note that HPD version 1 did not set specific rules on the product constituents/components, but through the harmonization effort between the multiple schemes (see section 4.2) HPD v2.0 requires reporting of product constituents/components to the same thresholds as the parent product. This has a notable effect on chemical admix due to its low dose in the final product. Whereas in version 1 reporting the complete contents of admix may not have been required, in version 2 all admixtures that amount to over 0.1% of the concrete product will need to be reported to 1000ppm, for Option 1, or 0.01% and 100ppm for Option 2, respectively.

Step 3 – Create HPDs in the HPD Builder

Go to the HPD Builder here: https://builder.hpd-collaborative.org/user/auth/login.

If information is needed from suppliers, direct them to the HPD Builder as well.

Step 4 – Choose to publish full HPD or pass content to select producers

The admix manufacturer has a choice at the end of entering all the necessary information into the HPD Builder, to either publish an HPD for full visibility to all possible buyers, or to push content information to select concrete producers, e.g., their customers. Either way allows producers to automatically pull in chemical admix ingredient information into their concrete HPD. Note that the completed form may only be called an HPD if the information is made public.

6.3.2 Cement and Supplementary Cementitious Materials

Cement differs from the other constituent types in that it is not as precisely manufactured as chemical admixtures, as it is derived from firing natural materials in a kiln with a variety of fuels, and potentially mixing these with by-products from other industries. Yet quality control measures rigorously test cement for its chemical composition and restrict deviations from prescribed proportions. Thus, the primary chemical ingredients that amount to about 99.9% of cement are easily identified but trace elements and residuals create challenges; especially when incorporating materials containing recycled content, these can shift the proportion of known ingredients to very low levels.

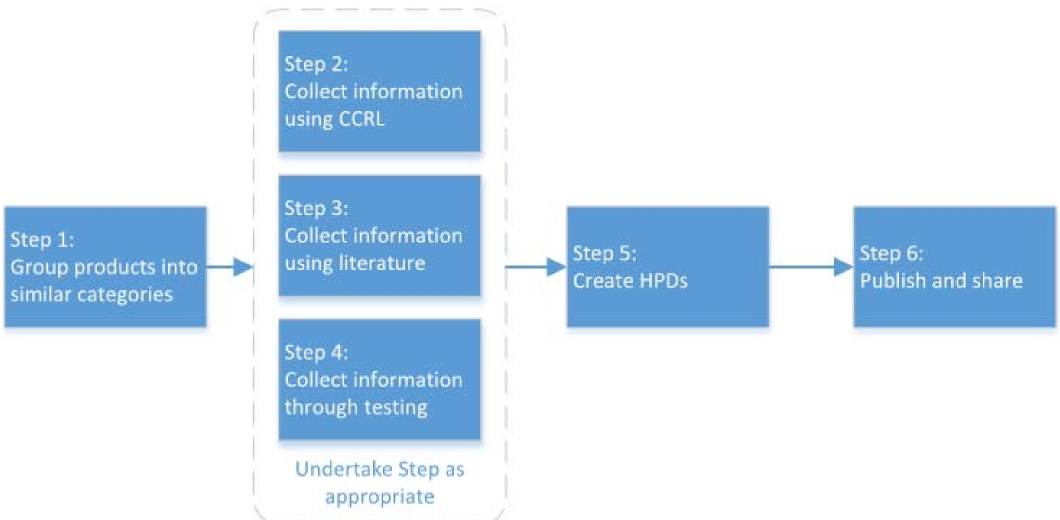


Figure 10: Constituents-based approach for producing HPDs for cement and supplementary cementitious materials

Figure 10 shows the six step approach to cement and supplementary cementitious materials HPD creation recognizing the special circumstances for this component

Step 1 – Group into product categories based on ASTM type, fuel used in kiln, and source region (see section 1)

The concrete producer should work with their cementitious material suppliers to group the supplied products into the different types of cement, cementitious blends, and supplementary cementitious materials, per ASTM types. These groups should then be further divided considering the fuels used in the kilns for fired products, or by source for SCMs, since these variations can affect the types of trace elements and residuals that appear over the required LEED reporting thresholds.

Note that in HPD v2.0, recycled content falls under the new Special Conditions classification. This was intended to offer manufacturers needed leeway, due to the impracticality of obtaining complete chemical composition information for this class of materials. The rules for Special Conditions are still in development by the HPDC. The plan is for a new technical subgroup to address these and post best practices to a new dynamic part of the HPDC website titled "Emerging Best Practices." This allows for faster creation of provisions since it does not depend on the more formal approval process involved in issuing new versions of the standard. It also offers an opportunity for ready mixed concrete suppliers and their various associations to participate in the development of solutions to these complex issues.

In any case, manufacturers should check with the Emerging Best Practices and follow the provisions stipulated, accordingly. Separating out the SCMs will allow concrete producers to proceed with producing HPDs for concrete mixes without recycled content, and then use the Emerging Best Practices with regard to recycled content as the provisions come online.

Emerging Best Practices for Special Conditions can be found at **http://www.hpd-collaborative.org/emerging-best-practices/.**

Step 2 – Use CCRL-based chemistry test reports for all intended ingredients

For pure Portland cement, manufacturers should be able to use the information provided by the Cement and Concrete Reference Laboratory (CCRL) chemistry test reports to identify the chemical compounds to nearly 99.9%.

CCRL Proficiency Sample Program

CCRL Portland Cement Chemical Proficiency Sample Nos. 159 & 160

Report Date: April 4, 2006

			Sample: 159		
TEST TITLE	UNIT	# of Labs	Average	S.D.	C.V.
Calcium Oxide, CaO	%	233	64.360	0.42	0.65
Tricalcium Silicate, C_3S	%	195	58.900	4.9	8.4
Silicon Dioxide, SiO_2	%	234	20.030	0.24	1.18
Dicalcium Silicate, C_2S	%	194	13.100	4.2	32.2
Tricalcium Aluminate, C_3A	%	199	10.100	0.3	3.1
Tetracalcium Aluminoferrite, C_4AF	%	196	6.000	0.2	2.5
Aluminum Oxide, Al_2O_3	%	231	5.100	0.12	2.25
Sulfur Trioxide, SO_3	%	233	3.680	0.12	3.17
Limestone Content	%	149	3.200	0.4	13.4
Loss on Ignition	%	234	2.650	0.07	2.8
Ferric Oxide, Fe_2O_3	%	232	1.990	0.05	2.25
Carbon Dioxide, CO_2	%	162	1.350	0.18	13.38
Magnesium Oxide, MgO	%	234	1.270	0.07	5.23
Free Calcium Oxide	%	183	1.070	0.2	18.94
Potassium Oxide, K_2O	%	225	0.510	0.01	2.5
Titanium Dioxide, TiO_2	%	174	0.260	0.01	4.32
Insoluble Residue	%	213	0.230	0.08	34.56
Phosphorus Pentoxide, P_2O_5	%	165	0.160	0	4.75
Sodium Oxide, Na_2O	%	220	0.120	0.027	22.089
Manganic Oxide, Mn_2O_3	%	124	0.030	0.002	5.827
Zinc Oxide, ZnO	%	65	0.015	0.004	24.497
Chromium Oxide, Cr_2O_3	%	65	0.007	0.004	46.858
Chloride, Cl	%	89	0.004	0.003	90.172
			100.74		

CCRL Proficiency Sample Program

CCRL Portland Cement Chemical Proficiency Sample Nos. 159 & 160

Report Date: April 4, 2006

			Sample: 159		
TEST TITLE	UNIT	# of Labs	Average	S.D.	C.V.
Calcium Oxide, CaO	%	45	64.360	0.42	0.65
Tricalcium Silicate, C_3S	%	34	59.000	5.0	8.0
Silicon Dioxide, SiO_2	%	45	20.030	0.24	1.18
Dicalcium Silicate, C_2S	%	35	13.000	4.0	32.0
Tricalcium Aluminate, C_3A	%	36	10.000	0	3.0
Tetracalcium Aluminoferrite, C_4AF	%	36	6.000	0.0	3.0
Aluminum Oxide, Al_2O_3	%	44	5.100	0.12	2.25
Sulfur Trioxide, SO_3	%	43	3.680	0.12	3.17
Loss on Ignition	%	29	3.000	0	3
Limestone Content	%	19	3.000	0	13.0
Ferric Oxide, Fe_2O_3	%	46	1.990	0.05	2.25
Magnesium Oxide, MgO	%	46	1.270	0.07	5.23
Free Calcium Oxide	%	20	1.000	0	19.0
Carbon Dioxide, CO_2	%	21	1.000	0	13.0
Potassium Oxide, K_2O	%	36	0.510	0.01	2.5
Sodium Oxide, Na_2O	%	34	0.000	0	22
Titanium Dioxide, TiO_2	%	17	0.000	0	4.0
Phosphorus Pentoxide, P_2O_5	%	19	0.000	0	5.0
Zinc Oxide, ZnO	%	7	0.000	0	24.0
Manganic Oxide, Mn_2O_3	%	17	0.000	0	6.0
Chloride, Cl	%	7	0.000	0	90.0
Insoluble Residue	%	22	0.000	0	35.0
Chromium Oxide, Cr_2O_3	%	5	0.000	0	47.0
			99.94		

CCRL Proficiency Sample Program

CCRL Portland Cement Chemical Proficiency Sample Nos. 159 & 160

Report Date: April 4, 2006

			Sample: 160		
TEST TITLE	UNIT	# of Labs	Average	S.D.	C.V.
Calcium Oxide, CaO	%	233	62.930	0.41	0.65
Tricalcium Silicate, C_3S	%	195	48.300	4.4	9.1
Silicon Dioxide, SiO_2	%	234	20.510	0.23	1.14
Dicalcium Silicate, C_2S	%	194	22.300	3.8	17.1
Tricalcium Aluminate, C_3A	%	199	7.500	0.3	4.2
Tetracalcium Aluminoferrite, C_4AF	%	196	11.000	0.2	1.8
Aluminum Oxide, Al_2O_3	%	231	5.120	0.11	2.23
Sulfur Trioxide, SO_3	%	233	3.160	0.09	2.82
Limestone Content	%	149	3.200	0.4	13.2
Loss on Ignition	%	234	2.480	0.08	3.22
Ferric Oxide, Fe_2O_3	%	232	3.620	0.06	1.63
Carbon Dioxide, CO_2	%	162	1.330	0.17	12.66
Magnesium Oxide, MgO	%	234	0.920	0.07	7.89
Free Calcium Oxide	%	183	1.140	0.21	18.3
Potassium Oxide, K_2O	%	225	0.750	0.02	2.41
Titanium Dioxide, TiO_2	%	174	0.230	0	4.12
Insoluble Residue	%	213	0.240	0.09	39.04
Phosphorus Pentoxide, P_2O_5	%	165	0.280	0.01	4.51
Sodium Oxide, Na_2O	%	220	0.065	0.027	40.744
Manganic Oxide, Mn_2O_3	%	124	0.110	0.003	2.263
Zinc Oxide, ZnO	%	65	0.012	0.004	29.842
Chromium Oxide, Cr_2O_3	%	65	0.010	0.004	43.167
Chloride, Cl	%	89	0.006	0.003	59.378
			100.92		

CCRL Proficiency Sample Program

CCRL Portland Cement Chemical Proficiency Sample Nos. 159 & 160

Report Date: April 4, 2006

			Sample: 160		
TEST TITLE	UNIT	# of Labs	Average	S.D.	C.V.
Calcium Oxide, CaO	%	45	62.930	0.41	0.65
Tricalcium Silicate, C_3S	%	34	48.000	4	9
Silicon Dioxide, SiO_2	%	45	20.510	0.23	1.14
Dicalcium Silicate, C_2S	%	35	22.000	4	17
Tricalcium Aluminate, C_3A	%	36	7.000	0	4
Tetracalcium Aluminoferrite, C_4AF	%	36	11.000	0	2
Aluminum Oxide, Al_2O_3	%	44	5.120	0.11	2.23
Sulfur Trioxide, SO_3	%	43	3.160	0.09	2.82
Loss on Ignition	%	29	2.000	0	3
Limestone Content	%	19	3.000	0	13
Ferric Oxide, Fe_2O_3	%	46	3.620	0.06	1.63
Magnesium Oxide, MgO	%	46	0.920	0.07	7.89
Free Calcium Oxide	%	20	1.000	0	18
Carbon Dioxide, CO_2	%	21	1.000	0	13
Potassium Oxide, K_2O	%	36	0.750	0.02	2.41
Sodium Oxide, Na_2O	%	34	0.000	0	41
Titanium Dioxide, TiO_2	%	17	0.000	0	4
Phosphorus Pentoxide, P_2O_5	%	19	0.000	0	5
Zinc Oxide, ZnO	%	7	0.000	0	30
Manganic Oxide, Mn_2O_3	%	17	0.000	0	2
Chloride, Cl	%	7	0.000	0	59
Insoluble Residue	%	22	0.000	0	39
Chromium Oxide, Cr_2O_3	%	5	0.000	0	43
			100.01		

Figure 11: Samples of CCRL Chemistry Test Reports. Summation on grey shaded column of averages added by Arup to show chemical compounds roughly sum to 100% for each sample.

Note that the CCRL reports list the phases within cement as well, which would double count the chemical compounds if included. The primary compounds that should be included in the HPD input are as follows:

- Calcium Oxide, CaO
- Silicon Dioxide, SiO_2
- Aluminum Oxide, Al_2O_3
- Sulfur Trioxide, SO_3
- Ferric Oxide, Fe_2O_3
- Carbon Dioxide, CO_2
- Magnesium Oxide, MgO
- Potassium Oxide, K_2O
- Titanium Dioxide, TiO_2
- Phosphorus Pentoxide, P_2O_5
- Sodium Oxide, Na_2O
- Manganic Oxide, Mn_2O_3
- Zinc Oxide, ZnO
- Chromium Oxide, Cr_2O_3
- Chloride, Cl

Two other standard ingredients listed in the standard CCRL test report that are not chemical compounds associable with CASRNs are limestone and insoluble residuals. Both of these fall under the new Special Condition of version 2. Manufacturers will be able to report limestone under the conditions for a geologic material, and “insoluble residuals” as a naturally occurring contaminant, and then follow the Emerging Best Practices, as well as the HPD v2.0 provisions for these stated by the HPD v2.0 Standard.

Step 3 – Use literature survey results for trace ingredients for all or most residuals (see section 4)

While the new Special Conditions term will appear in the HPD v2.0, the specific provisions for each material type may not appear within the Emerging Best Practices to the level of completeness a manufacturer will need to confidently complete an HPD. Where the provisions of the Special Conditions are not completely specified, manufacturers may propose an approach to the HPDC that meets the intent of the HPD, is appropriate to the unique characteristics of their ingredients, and enables participation of their industry. If accepted, these will appear on the Emerging Best Practices portion of the HPDC website.

One recommended approach is to list potential trace ingredients, or test for them, based on a literature survey and the C2C testing requirements. As an example, the following table was assembled from a PCA Minor Elements report, other studies, and C2C testing requirements.[20, 21]

[20] J. O., Bhatty, *Role of Minor Elements in Cement Manufacture and Use*, Research and Development Bulletin RD109T, Portland Cement Association, Skokie, Illinois, U.S.A., 1995.
[21] MBDC, *Cradle to Cradle® Certification Testing Requirements*, McDonough Braungart Design Chemistry, 2010.

Table 2: Example approach to propose as best practice to HPDC to address Special Conditions relevant to trace elements in cement and blended cements. The information in the Table is based on literature survey available from the CCRL database.

	By default	Cements that do not contain FGD gypsum	Cements that do not contain fly ash	Cements that were not fired with petroleum coke	Cements that do not contain FGD gypsum, fly ash, slag, nor were fired with petroleum coke, coal, used oil nor biosolids
Testing & Reporting requirements for 1st LEED point	Report the following as residuals at > 1000ppm: Co, Pb, and V, unless test results show measurements at < 1000 ppm. See below for required test methods.	Same as default.	Same as default, except no need to test for Co.	Same as default, except no need to test for V.	No testing necessary. Supply current CCRL certificate. Report standard chemicals list from CCRL database in HPD. No additional BM-1 residuals > 1000ppm to report.
Testing & Reporting requirements for 2nd LEED point	Report the following as residuals at > 100ppm: As, Cd, Co, Cr, Pb, Ni, Hg, Se, and V, unless test results show measurements at < 100 ppm. See below for required test methods.	Same as default, except no need to test for Hg content.	Same as default, except no need to test for Co and Se.	Same as default, except no need to test for Ni and V.	No testing necessary. Supply current CCRL certificate. Report standard chemicals list from CCRL database. No additional BM-1 residuals > 100ppm to report.

*** Inductively coupled plasma mass spectrometry (ICP-MS) or Atomic Emission Spectrometry (ICP-AES) to determine concentrations/presence of As, Cd, Cr, Co, Pb, Ni, Se and V.**
**** Cold vapor atomic absorption (CVAA) spectroscopy for direct Hg concentrations**

Step 4 – Conduct testing to collect information on residuals, if needed

It is evident that there is a need for a refresh on materials that have changed since the 1995 study report commissioned by PCA, as sources and proportions of SCMs such as fly ash and slag have since progressed. Kiln fuels have changed as well, such as the newer use of rubber tire derived fuels. If the Emerging Best Practices require testing to meet provisions for use, the concrete industry is encouraged to consider an industry-wide program to pool resources that can then be shared across the industry.

Step 5 - Create HPDs in HPD Builder

Go to the HPD Builder here: https://builder.hpd-collaborative.org/user/auth/login. Follow instructions on http://www.hpd-collaborative.org/emerging-best-practices/ for ingredients that qualify under Special Conditions.

If an industry-wide test program is not yet completed and is necessary for the HPD input, it is recommended that the industry request a temporary allowance from USGBC only for the unknown trace ingredients, where the LEED project teams can provide evidence that the allowances are traceable to participation in the testing program and proof that the testing program is to be initiated. Providing this type of evidence has precedent in many of the LEED credits, where points are readily awarded for evidence of commitment from the agents of authority when implementation is unfinished at the time of project documents submission for LEED credit.

Step 6 – Choose to publish full HPD or pass content to select producers

Same as for Chemical Admixtures, above. However, unlike admixtures, chemical content is not expected to need confidentiality protections, so it seems more likely that cementitious materials information can be published into an HPD and made available to the public.

6.3.3 Aggregate

Aggregate is again different from the other constituent types in that it is either geologic material that only undergoes mechanical processing (no changes in chemistry), or comes from crushed, previously used concrete. Unlike admixture and cementitious materials, the HPD information for this component type can most likely be handled by the concrete producers themselves.

Figure 12 shows the four step approach to HPD creation for aggregate materials recognizing the special circumstances of this component.

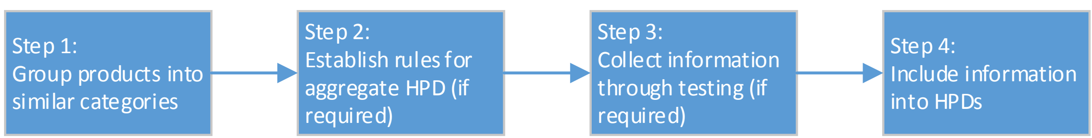


Figure 12: Constituents-based approach for producing HPDs for aggregate materials

Step 1 – Group into Product Categories based on role, source region, and expected contaminants

Natural sand, sand produced from crushing stone and virgin coarse aggregate will fall under the Special Conditions for geologic materials, whereas crushed concrete aggregate should qualify under recycled content. While all these materials will fall into the Special Conditions allowances, the HPD should list different materials separately. At a minimum, sand (crystalline silica), different types of crushed rock for coarse aggregate, aggregate from recycled sources, and aggregate with known contaminants should be listed as separate materials.

Step 2 – Dialogue with HPDC in development of rules for aggregate as generic ingredient, if needed.

Similar to the procedure for other components that fall under Special Conditions, the producer should follow the provisions stipulated in the HPD v2 standard for geologic materials and recycled content, accordingly.

Step 3 – Concrete Producers pull information into concrete HPDs
The last step of the process for aggregate is for the concrete producer to pull this information into each concrete HPD, alongside the information for chemical admixtures and cementitious materials. The ingredient amounts will need to sum to the required reporting threshold and meet other requirements indicated on the HPD markup for LEED before it can qualify for the LEED credit.

6.4 Common Pitfalls

HPDs have been published that do not meet the LEED v4 requirements. This section highlights some common mistakes that would cause LEED reviewers to reject the documentation for LEED project credit based on experience with HPD v1.0. Many of these would be common to the MI as well.

6.4.1 Chemicals versus Materials

The most common pitfall is using materials instead of chemical compounds to look up hazard profiles. While it is acceptable to list materials and follow the hazard screening exemptions that fall under special conditions, all other materials should list their chemical content and the hazards associated with their CASRN. Unfortunately, CASRNs exist for some concrete materials, such as Portland Cement, or polymeric admixtures, which makes this especially confusing. It is necessary on the HPD to list the individual chemical compounds that constitute a material, unless the material qualifies as a special condition.

6.4.2 Meeting Required Thresholds, Not Just to SDS

Because the HPD is an open standard that allows a variety of reporting thresholds, it is easy to forget that LEED has strict minimum requirements that exceed the SDS. On an HPD, a manufacturer can indicate a level of completeness to the extent of the SDS data available to manufacturers. However, LEED requires a minimum of 1000ppm and 100ppm levels of content reporting to meet the credit. This means manufacturers will need to ask their suppliers or others in their company operations to supply the information not found on SDS documents.

6.4.3 Special Conditions

Manufacturers need to follow the “emerging best practices” published on the HPDC site when they wish to use an allowance offered by the special conditions.[22] If the published one does not exist or poses extreme challenges for them, manufacturers are expected to propose a new or alternative best practice. It is not acceptable to simply indicate that the material falls under the special conditions list and do nothing else.[23]

[22] HPDC, Emerging Best Practices for Special Conditions, http://www.hpd-collaborative.org/emerging-best-practices/.
[23] Information about the Special Conditions Technical Sub Group, http://www.hpd-collaborative.org/technical-committee/

6.4.4 Omission of Residuals and Impurities

Known or suspected process residuals and feedstock impurities that exist in the final product above 1000ppm (or 100ppm for Option 2) must be reported for LEED. HPD version 1 required reporting of all known or suspected residuals. The new HPD version 2 only requires reporting on the procedure for gathering residual data and reporting of what is known. To use an HDP for LEED credit, however, still requires reporting all known or suspected residuals to the appropriate threshold (100ppm or 1000ppm).

6.4.5 Omission of Hazards Listing

The HPD allows masking of ingredient names and CASRNs, but not the hazards listing if it is a BM-1, LT-1, or LT-P1. Only the MI allows omission of the hazards listing if the CASRN is given. Use of the HPD Builder will prevent this mistake from happening.

6.4.6 Using Regulatory Hazard Lists versus GreenScreen

The HPD requires use of the GS methodology, which is built into the HPD Builder and Pharos. While there may be significant overlap with GS, manufacturers may not use other hazard lists as substitute for hazard reporting. Use of the HPD Builder will prevent this mistake from happening. Even with the MI, manufacturers who do not provide the CASRNs for all ingredients must use the hazards listing from GS.

7 Looking Ahead

7.1 Development of Other Programs and Pathways

Experience shows that LEED credits develop over time and this brings refinement, improvement, and potential opportunity. Two elements of the Material Ingredients credit were purposely left open for further development:

- Option 3 Supply Chain Optimization
- Other USGBC-Approved Programs

Please refer to Figure 1 pathways within the three options of the LEED v4 Material Ingredient credit to see how these two additional routes fit within the LEED credit. They are both now described below.

7.1.1 Option 3 Supply Chain Optimization

Option 3 is set up to offer an alternative to Option 2, worth one point. In other words, a manufacturer is expected to pursue Option 1 for 1 point, and may also pursue Option 2, Option 3, or a combination of Option 2 and Option 3 for a 2nd point.

Below is the prescribed, basic requirements of Option 3 exactly as it appears in the credit language. It can be seen that the same regional sourcing valuation factors and structure and enclosure contribution limitations of Option 2 apply to Option 3. Option 2 and Option 3 pathways may also be combined to reach the 25% requirement by cost.

Option 3. Supply Chain Optimization (1 point)

Use building products for at least 25%, by cost, of the total value of permanently installed products in the project that are as follows:

- Products are sourced from product manufacturers who engage in validated and robust safety, health, hazard, and risk programs which at a minimum document at least 99% (by weight) of the ingredients used to make the building product or building material, and
- Products are sourced from product manufacturers with independent third-party verification of their supply chain that at a minimum verifies the following:
  - Processes are in place to communicate and transparently prioritize chemical ingredients along the supply chain according to available hazard, exposure, and use information to identify those that require more detailed evaluation.
  - Processes are in place to identify, document, and communicate information on health, safety, and environmental characteristics of chemical ingredients.
  - Processes are in place to implement measures to manage the health, safety, and environmental hazard and risk of chemical ingredients.
  - Processes are in place to optimize health, safety, and environmental impacts when designing and improving chemical ingredients.
  - Processes are in place to communicate, receive, and evaluate chemical ingredient safety and stewardship information along the supply chain.
  - Safety and stewardship information about the chemical ingredients is publicly available from all points along the supply chain

USGBC acknowledges that the language is too ambiguous for manufacturers to implement. Thus, USGBC has convened the Supply Chain Optimization Working Group, tasked with creating the specific requirements for this third option. This working group began meeting in the latter half of 2014, and made its first program proposal to the LEED Steering Committee mid-2015. Following the presentation to the LEED Steering Committee, the working group was tasked to continue development in a direction that would increase stakeholder support and confidence in its viability within the marketplace.

This led to the publication of a clarifications guidance document in November 2015 which received unanimous consent of the Working Group[24,25]. If approved

[24] US Green Building Council (Developed by the Supply Chain Optimization Working Group), *LEED v4 MR credit Building Disclosure and Optimization – Materials Ingredients Option 3 Implementation Guidance*, November 10, 2015. http://www.usgbc.org/resources/leed-v4-mr-credit-building-disclosure-and-optimization-material-ingredients-option-3-imple

[25] Holowka, Taryn, “USGBC working group unanimously approves new guidance for LEED Materials & Resources Credit 4,” http://usgbc.org/articles/usgbc-working-group-unanimously-approves-new-guidance-leed-materials-resources-credit-4 (press release, last accessed Nov 15, 2015)

by the LEED Steering Committee, the USGBC guidance will need to enter a "field trial" period before going to scale. While the current clarifications won't be usable by the public until a field trial period has concluded, the NRMCA should consider participation in this trial portion of Option 3 development efforts.

The objective is to have sufficient specifics added to the requirements for a viable approach. However, in short, it is uncertain how long it will take for the Supply Chain Optimization Working Group to complete a set of requirements that are adopted into the credit.

7.1.2 Other USGBC-Approved Programs

To date, USGBC has not approved any other programs for this credit. The LEED Steering Committee (LSC) tasked USGBC staff with developing a process for on-boarding additional programs, in line with the Alternative Compliance Path development process outlined in the Foundations of LEED. The Materials and Resources Technical Advisory Group will review the programs that apply and make recommendations to LSC for approval. Announcements of approved programs will follow the quarterly addenda release cycle.

For the USGBC-Approved Programs, the task is to define explicit criteria for program evaluation and potential acceptance. In the meantime, several programs have approached USGBC expressing interest in becoming an approved program for either Option 1 or Option 2, or both.

Three of these are named in this guide because they have taken the extra step of contributing to the USGBC Material Health Harmonization effort, which increases their alignment with the named programs and, thus, their prospects for acceptance. Two of the three are interesting to concrete:

1. The first is the Declare Program of the International Living Futures Institute, which created and runs the Living Building Challenge, a different green building rating system.[26]
2. The second is the C2C Materials Health Assessment, which became available as a stand-alone service in 2015.[27]

The third, which is not applicable to ready mixed concrete, is the BIFMA level certification for furniture products. The future release of definition for these pathways may open up an even greater number of options for the concrete industry to consider.

[26] International Living Future Institute, Declare, www.declareproducts.com.
[27] Cradle to Cradle Products Innovation Institute, Material Health Certificate, http://www.c2ccertified.org/material-health-certificate.

7.2 Updates to Currently-Referenced Programs

As with the wider LEED rating system, credits need updating as referenced standards evolve. Besides the upcoming roll out of the HPD v2.0, some of the other programs are also in the middle of revising their standards.

The C2CPII began the process of revision towards v4 of the C2C standard in 2014, and is targeting completion in 2016. Most changes to the Material Health component of C2C appear to move the standard towards greater harmonization with other programs such as those that form the basis for GS. See the program summary in Section 4.1.3 for this list.

Concurrently, Clean Product Action has been working towards GreenScreen v1.3 and anticipates its imminent release. However, the changes entailed have less impact on concrete producers and more on the GS profiler and the Pharos tool. More impactful changes related to the form-specific hazards discussed in Section 1 are expected in GreenScreen v2.0 which is not expected to be out until mid-to-late 2016.

Program updates do not automatically receive recognition by USGBC for recognition as equivalent to the version referenced in LEED. Acceptance of version updates is first evaluated by USGBC staff and technical committees, and ultimately decided by the LEED Steering Committee, which then authorizes formal acknowledgement, typically in the form of LEED Addenda, issued quarterly.[28]

7.3 Program Development Timeline

The timeline in Figure 13 showing the key milestones has been created following the research conducted to date. It sets out upcoming key events that will likely impact how the concrete industry responds to the LEED credit going forward.

[28] US Green Building Council, Addenda database, http://www.usgbc.org/leed-interpretations.

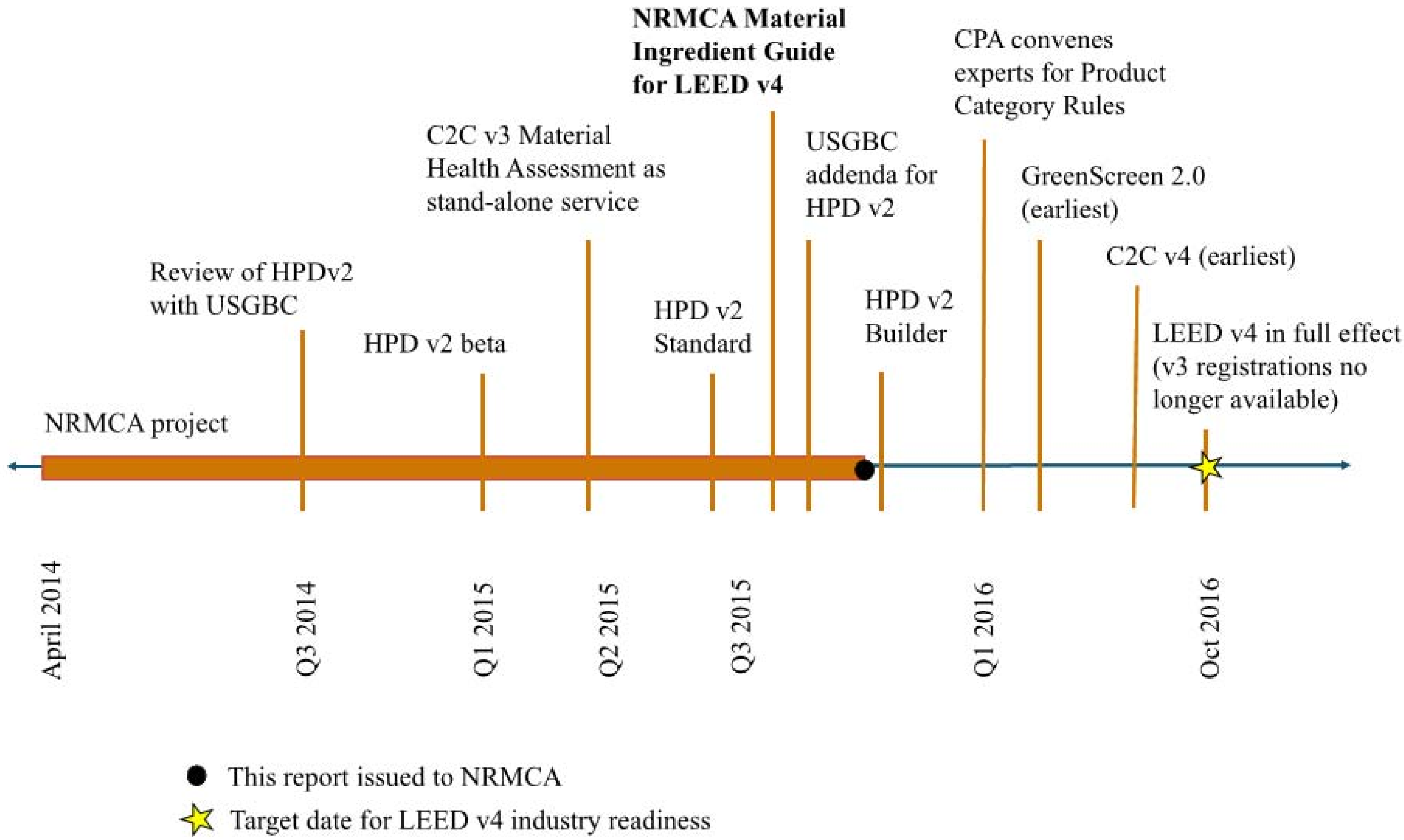


Figure 13: Timeline of upcoming changes to referenced programs (based on best available estimates provided to Arup).

7.4 Forward Program Development Recommendations

It is evident that the forward development of the described programs will have significant effect on how concrete can qualify for credit award. Therefore it is recommended that the NRMCA consider the following:

Keep abreast of the changes identified in this guide, and considers issuing an update to members after significant decisions have been made that affect the ready-mix concrete industry

Encourage its members to join the HPDC and its technical committees to take advantage of the opportunity to progress the Emerging Best Practices, and other items in need of development, in a direction that will make them feasible and meaningful for ready-mix concrete products

Similarly encourage members, or enable their own representatives, to take part in the product category rule development of GS (this recognizes that GS is foundational to nearly all the other programs)

Consider participation in pilot of Option 3: Supply Chain Optimization in accordance with the USGBC guidance document clarifications and recommendations

Examine whether there are opportunities to conduct industry-wide studies that collect information, test for specific ingredients, and/or assess hazards, if the USGBC and/or the referenced programs deem such activities necessary

Issue a set of briefing notes, webinar series, or other educational materials that distill the information provided in this report, and answer the most frequently asked questions from members in response to this report and the technical agenda

Appendix A: HPD Resources

The Appendix section includes two resources:

Appendix A1: HPD Form with LEED v4 MR Guidance – This section includes the pages included in the HPD Form, with details about filling out the form.

Appendix A2: HPD Verifiers – This section includes a list of organizations that may be able to assist with third-party HPD verification.

A1 HPD Form with LEED v4 MR Guidance

Product Name by Manufacturer Name

CLASSIFICATION: 00 00 00

PRODUCT DESCRIPTION:
This space describes the product briefly. It indicates if the product is part of a system or assembly and describes what is covered in this HPD, as well as any special use considerations. Extended descriptions should be continued in Section 5: General Notes.

hpd 2.0 Health Product DECLARATION™

Section 1: Summary

MUST BE CHECKED to comply with Option 2 (May be checked instead or in addition to 1,000 ppm to comply with Option 1)

MUST BE CHECKED to comply with Option 1

AT A MINIMUM, there must be a general explanation about why/why not residuals and contaminants were or were not considered. (Enhances transparency). There is no minimum # of 'considered' materials for compliance.

CONTENT INVENTORY

Threshold
- 100 ppm
- 1,000 ppm
- Per GHS SDS
- Per OSHA MSDS
- Other

Residuals and contaminants considered in
03 of 04 materials
- see Section 2: Material Notes
- see Section 5: General Notes

★ *Some content has been characterized, screened, and/or identified by one or more suppliers that provide material to the product manufacturer.*

Based on the selected Content Inventory Threshold:

Characterized .... Yes No
Are the Percent Weight and Role provided for all contents?

Screened .... Yes No
Are all contents screened using Priority Hazard Lists with results disclosed?

Identified .... Yes No
Are all contents disclosed by Name (Specific or Generic) and Identifier?

MUST BE CHECKED to comply with Option 1

EXCEPTION FOR SCREENING for post-consumer recycled content, geological (aka mined and minimally processed) - as well as "UVCB" per ECHA (can be marked "No" when the Screening Notes indicate that the only contents not screened are post-consumer recycled content)

EITHER MAY BE CHECKED to comply with Option 1 and 2

CONTENT IN DESCENDING ORDER OF QUANTITY

Summary of product contents and results from screening individual chemical substances against HPD Priority Hazard Lists and the GreenScreen for Safer Chemicals®. The HPD does not assess whether using or handling this product will expose individuals to its chemical substances or any health risk. Refer to Section 2 for further details.

MATERIAL | CHEMICAL SUBSTANCE | RESIDUAL OR CONTAMINANT
GREENSCREEN SCORE | HAZARD ENDPOINT View Key

MATERIAL NAME [CHEMICAL SUBSTANCE NAME LT-P1 END | MAM ; CHEMICAL SUBSTANCE NAME BM-2 NF ; CHEMICAL SUBSTANCE NAME LT-1 CAN ; UNKNOWN LT-U AQU | DEV | REP ; CHEMICAL SUBSTANCE NAME LT-U UNK ; UNDISCLOSED LT-1 NF ; RESIDUAL NAME LT-U EYE | SKI] ; MATERIAL NAME [CHEMICAL SUBSTANCE NAME LT-P1 END | MAM ; CHEMICAL SUBSTANCE NAME LT-1 CAN ; UNKNOWN LT-UNK UNK ; CHEMICAL SUBSTANCE NAME LT-U UNK] ; MATERIAL NAME [CHEMICAL SUBSTANCE NAME LT-P1 END | MAM ; CHEMICAL SUBSTANCE NAME BM-2 NF ; CHEMICAL SUBSTANCE NAME LT-1 CAN ; UNKNOWN LT-1 CAN | MAM | SKI ; CHEMICAL SUBSTANCE NAME LT-U UNK ; UNDISCLOSED LT-U CAN ; CONTAMINANT NAME LT-U EYE | SKI ; RESIDUAL NAME LT-1 END] .

Number of GreenScreen BM-4/BM-3 contents (towards 'green chemistry') 01

Contents highest concern GreenScreen Benchmark Level or List Translator Score: LT-1

MAY NOT READ "BM-1" or "LT-1" to comply with Option 2

Nanomaterial: One or more contents are characterized as a nanomaterial.

INVENTORY AND SCREENING NOTES

Refer to Section 2 for detailed content information and explanatory notes, and to the last page for HPD scope.

This space explains any "No" answers from above and provides any further explanations about the content listing or hazard screenings as needed. Put detailed notes for each content entry in Section 2: Content in Descending Order of Quantity. Continue extended explanations in Section 5: General Notes.

Must include statement about PC Recycled Content/Geological/UVCB when submitting for LEED compliance and "No" is indicated for Screened, above.

★ *(Manufacturer has opted for the basic inventory display – chemical substances are listed by weight in the entire product instead of grouped by material.)*

TOTAL VOC CONTENT

Material (g/l): XXXX **Regulatory (g/l):** XXXX

Does the product contain exempt VOCs? Yes

Are VOC-free tints available? Yes

CERTIFICATIONS AND COMPLIANCE

VOC Emissions: Name of Certification
VOC Content: Name of Certification
Type of Certification: Name of Certification
See Section 3 for additional listings.

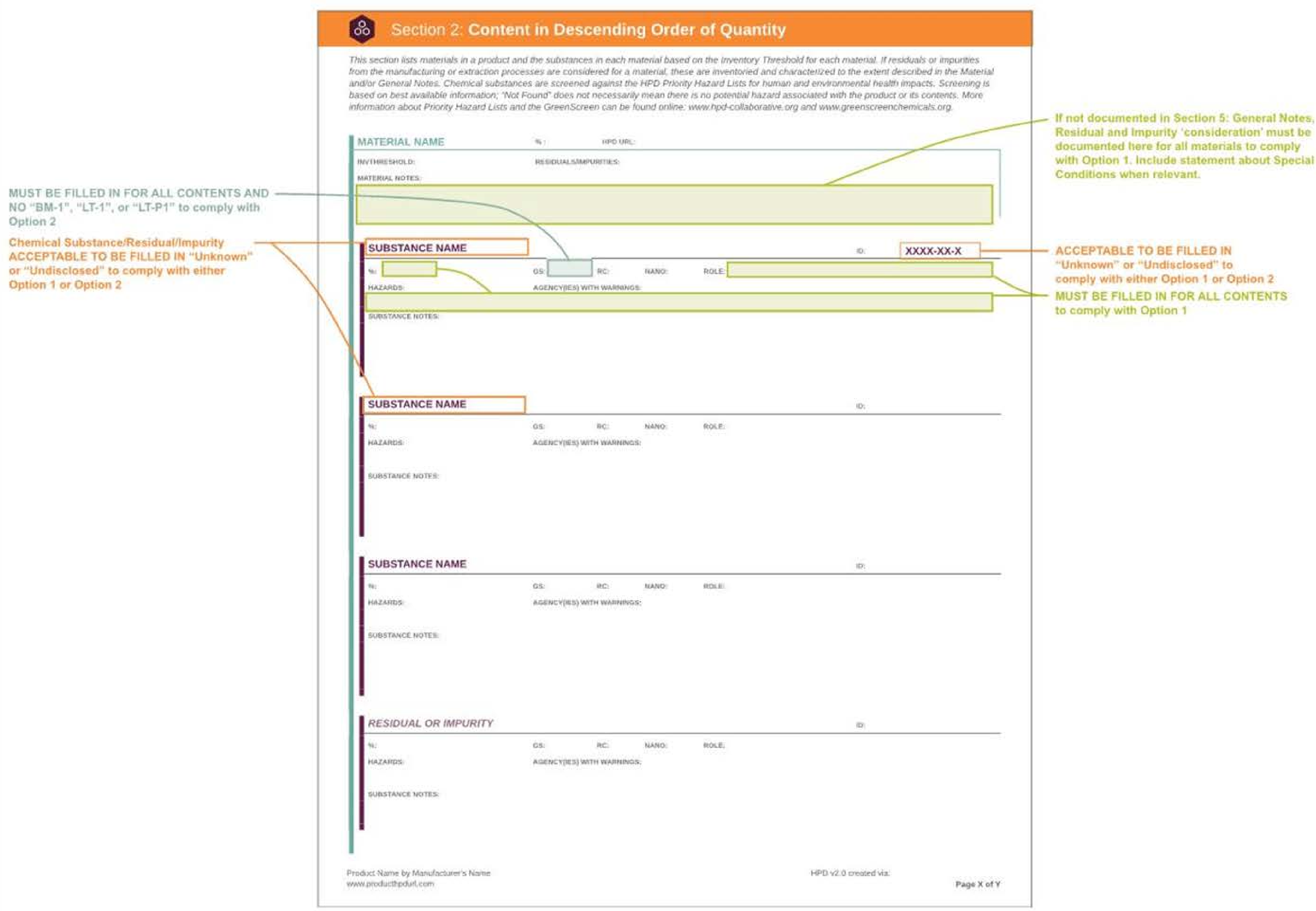
- Self-published
- Third Party Verified

VERIFIER: Quality Verification, Inc.
VERIFICATION #: ABC3980128

RELEASE DATE: 2014-06-04
EXPIRY DATE*: 2015-06-04
** or within 3 months of significant change in product contents*

Product Name by Manufacturer's Name
www.producthpdurl.com

Health Product Declaration v2.0
Page X of Y


Section 2: Content in Descending Order of Quantity
This section lists materials in a product and the substances in each material based on the Inventory Threshold for each material. If residuals or impurities from the manufacturing or extraction processes are considered for a material, these are inventoried and characterized to the extent described in the Material and/or General Notes. Chemical substances are screened against the HPD Priority Hazard Lists for human and environmental health impacts. Screening is based on best available information; "Not Found" does not necessarily mean there is no potential hazard associated with the product or its contents. More information about Priority Hazard Lists and the GreenScreen can be found online: www.hpd-collaborative.org and www.greenscreenchemicals.org.
MATERIAL NAME
%:
HPD URL:
INVTHRESHOLD:
RESIDUALS/IMPURITIES:
MATERIAL NOTES:
SUBSTANCE NAME
ID:
XXXX-XX-X
%:
GS:
RC:
NANO:
ROLE:
HAZARDS:
AGENCY(IES) WITH WARNINGS:
SUBSTANCE NOTES:
SUBSTANCE NAME
ID:
%:
GS:
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HAZARDS:
AGENCY(IES) WITH WARNINGS:
SUBSTANCE NOTES:
Product Name by Manufacturer's Name
www.producthpdurl.com
HPD v2.0 created via:
Page X of Y
MUST BE FILLED IN FOR ALL CONTENTS AND NO "BM-1", "LT-1", or "LT-P1" to comply with Option 2
Chemical Substance/Residual/Impurity ACCEPTABLE TO BE FILLED IN "Unknown" or "Undisclosed" to comply with either Option 1 or Option 2
If not documented in Section 5: General Notes, Residual and Impurity 'consideration' must be documented here for all materials to comply with Option 1. Include statement about Special Conditions when relevant.
ACCEPTABLE TO BE FILLED IN "Unknown" or "Undisclosed" to comply with either Option 1 or Option 2
MUST BE FILLED IN FOR ALL CONTENTS to comply with Option 1

Section 3: **Certifications and Compliance**

This section lists applicable certification and standards compliance information for VOC emissions and VOC content. Other types of health or environmental performance testing or certifications completed for the product may be provided.

VOC EMISSIONS Name of Certification or Compliance

CERTIFYING PARTY: ISSUE DATE: EXPIRY DATE: CERTIFIER OR LAB:

APPLICABLE FACILITIES:

CERTIFICATE URL:

CERTIFICATION AND COMPLIANCE NOTES:

TYPE OF CERTIFICATION Name of Certification or Compliance

CERTIFYING PARTY: ISSUE DATE: EXPIRY DATE: CERTIFIER OR LAB:

APPLICABLE FACILITIES:

CERTIFICATE URL:

CERTIFICATION AND COMPLIANCE NOTES:

Section 4: **Accessories**

This section lists related products or materials that the manufacturer requires or recommends for installation (such as adhesives or fasteners), maintenance, cleaning, or operations. For information relating to the contents of these related products, refer to their applicable Health Product Declarations, if available.

ACCESSORY PRODUCT OR MATERIAL NAME HPD URL:

CONDITION WHEN RECOMMENDED OR REQUIRED AND/OR OTHER NOTES:

Section 5: **General Notes**

If not documented in the Material Notes in Section 2, Residual and Impurity 'Consideration' must be documented here to comply with Option 1.

Product Name by Manufacturer's Name
www.producthpdurl.com

HPD v2.0 created via:

Page X of Y

A2 HPD Verifiers

While the HPDC has put their verification program on hold at this time, the following organizations were named in an announcement made Fall of 2013 about the initiation of an official third-party verification protocol for the HPD: [29]

- GreenCE
- GreenCircle
- NSF International
- PE International (now thinkstep)
- SCS Global Services
- ToxServices
- UL Environment

For updates, please check http://www.hpd-collaborative.org/hpd-1-faqs-3/.

[29] http://www.environmentalleader.com/2013/11/22/sustainability-assessment-firms-develop-hpd-third-party-verification/#ixzz3nRJunODr

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www.rmc-foundation.org

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