Material Health Evaluation Programs
Harmonization Opportunities Report

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Report of the Material Health Harmonization Task Group

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Executive Summary
While concern for the potential health impacts of the materials with which we construct buildings has always been an integral part of the US Green Building Council’s LEED® rating system, LEED v4 is raising the bar by including credits based on programs that evaluate material health more broadly than VOC emissions certification programs. Currently there is some confusion regarding each program’s methodology and whether or not they are consistent in their data requirements and in the signals they send to manufacturers and project teams.

To address this issue, Clean Production Action (CPA), the Cradle to Cradle Products Innovation Institute (C2CPII) and the Healthy Building Network (HBN) joined together in a Material Health Harmonization Task Group. The Task Group is charged to compare the leading product inventory and material health assessment programs for building materials and to identify similarities and differences in their methodologies. The goal of this project is to find opportunities to create synergies through harmonization and data sharing that will support implementation of the LEED v4 Material Ingredients credit and accelerate progress in the industry towards the manufacture of inherently safer products.

The Task Group analyzed information requirements of the product inventory and material health evaluation protocols in the following five programs (three of which are referenced in the LEED v4 Material Ingredients credit):

- C2CPII’s Cradle to Cradle CertifiedCM Product Standard (C2C)
- CPA’s GreenScreen® for Safer Chemicals (GS)
- HBN’s Pharos Chemical & Material Library & Building Product Library (BPL)
- HPD Collaborative’s (HPDC) Health Product Declaration (HPD)
- International Living Future Institute’s (ILFI) Declare

The analysis indicates that all of the programs define procedures for content inventory of product ingredients and list screening against certain health hazard and restricted substance lists. GS and C2C go further to define methodologies for full hazard assessment utilizing direct research into the scientific literature and modeling data. The C2C hazard assessment results are used towards assessment of material health as part of the C2C certification program. The results from the GS assessment procedure may be used independently and are also referenced in the Pharos BPL and the HPD.

The information collected by each program for product content inventorying, list screening analysis, and full assessment was compared and evaluated for the current state of alignment and potential for further harmonization and information sharing. The programs were also compared on how they verify and disclose collected information and how these requirements compare with the Globally Harmonized System (GHS) for Safety Data Sheets (SDS). The Task Group did not compare scoring protocols. The programs represent a diversity of approaches to material health evaluation and disclosure. Underlying the five programs, however, are many similarities in the inventory requirements, the use of lists for screening

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1 LEED v4 BD+C and ID+C MR Credit 4 - Building Product Disclosure and Optimization - Material Ingredients
2 The Health Product Declaration Collaborative was in development and not yet staffed when this Task Group was formed to undertake this project. Tom Lent who chaired the Pilot Committee which developed the HPD Standard provided the knowledge of the HPD for this report. Eden Brukman who is currently the Technical Director reviewed the report before publication and is now in consultation with the Task Force on ongoing harmonization work.
3 The reported information on Declare was derived from publicly available documents. Amanda Sturgeon of ILFI reviewed the final report and provided comments, but the Task Force takes final responsibility for the content of this report.
and the data used for hazard assessment. These underlying similarities can provide the basis for improving program efficiency through shared information and hazard data platforms and for consistency of signaling through further harmonization. The detailed results of the analysis of each program are presented in the body of this report.

**Content Inventory Methods**

There is significant overlap in the type of inventory information collected by each of the reviewed programs at the ingredient, homogeneous material and product levels. A substantial core set of primary ingredient information is required in common by all programs. Material and product level information requirements vary more by program. The Pharos system already collects much of the information required by each of the other programs and could be extended to the rest.

The overlap of program inventory requirements and the availability of an existing tool that already covers a significant portion of the data entry and some of the quality control and access control functionality required, indicate good potential to develop a shared inventory platform. A single data entry portal for product and material inventories could support each of the individual programs. The individual programs could further benefit from inter-program collaboration on strategies for inventory management and reporting of residual chemicals. The diversity of organizations involved, the diversity of information collected and analyzed, and the diversity of thresholds and disclosure protocols used in the programs will require careful data management and access control as well as broader stakeholder engagement to create a successful system that encompasses all of the programs and is used by all players.

**List Screening Methods**

Three of the five reviewed programs (GS, HPD & Pharos BPL) screen for chemical hazards using a similar set of hazard lists. The C2C protocol is less extensive with respect to the lists referenced but has similar screening needs and Declare also uses two of the lists covered by the other three programs presenting good opportunities for harmonizing this step. CPA established the GreenScreen List Translator as a uniquely defined set of lists and a first step towards a full GS assessment. The Pharos Chemical and Material Library (CML) database already supports the chemical hazard list screening needs of four of the programs (GS, HPD, Pharos BPL and Declare) and can be extended to accommodate C2C needs. All programs are interested in exploring harmonization of this step.

Concurrence of list screening protocols and availability of the existing Pharos list screening functionality indicates the feasibility of including automated hazard list screening in a shared assessment platform. Each of the reviewed programs could benefit from further research and discussion on screening lists to harmonize and improve coverage of relevant health endpoints.

**Full Hazard Assessment Methods**

GS and C2C, the two programs among those evaluated that conduct full hazard assessments, share approximately 80% of the chemical hazard endpoints in their assessment protocols. These endpoints include 13 hazard endpoints as defined in the Globally Harmonized System for Classification and Labeling (GHS) created by the United Nations, as well as five additional endpoints not covered by the GHS. Apparent differences between GS and C2C hazard endpoints are largely due to the way information is subdivided in the individual programs. A “lowest common denominator” approach to

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endpoint subdivision would allow for the sharing of information needed for endpoint classification across programs.

The overlap in chemical hazard information already collected by the two programs provides an opportunity for the development of a shared database to collect and communicate chemical hazard information in a consistent manner. A number of countries have created lists and databases of chemicals classified using GHS. However, the US has not. A shared database could draw on these country-specific GHS lists and databases, and also host information on non-GHS endpoints that is currently not publicly accessible. This database could provide a needed service to small and large, national and global companies who seek to align with best practices worldwide and create a basis for a unified community of practice for chemical hazard and material health Assessors/Profilers.

Conclusions
Based on the analysis of the product inventory and material health evaluation protocols and the degree of overlap already existing in each of the five programs, we conclude the following:

1. **Shared platforms for both product content inventory and chemical hazard analysis can be developed to create a comprehensive single portal of entry for manufacturers and a single repository for hazard classification data at both the list screening and the full assessment levels.** This would create synergies, reduce costs, increase the rigor of the scientific information used in full assessments through cross-organizational peer-review, and improve knowledge of product ingredients in support of optimization and transparency. Additionally, it will accelerate manufacturer participation by simplifying the entry point, eliminating redundancy, providing a clear progressive path toward optimization, and allowing for options depending on manufacturer goals and readiness. These shared platforms are possible because the programs share a significant common base of information. There is potential to define the lowest common denominator of information that can be shared between programs and to build a platform to allow for sharing and interoperability. Information unique to specific programs can and should be included in the platform to create a one-stop portal.

2. **While further harmonization will be highly valuable, the programs do not need to completely harmonize to take advantage of a shared platform.** In fact, their differences may serve different market needs such as manufacturer desire for:
   a. Transparency versus protection of confidential business information
   b. Self-disclosure and self-assessment versus use of third party Assessors/Profilers and verification
   c. Meeting LEED v4 requirements in the easiest way versus achieving other market benefits from meeting additional requirements specific to several of the programs.

Recommended Next Steps

- Immediately implement a memorandum of understanding between C2C and GS to encourage C2C Assessors to use pre-existing GS hazard assessments as data sources in C2C material health assessments.
- Expand participation in the Task Group by including representatives from all five programs and potentially others as relevant and feasible. Continue collaboration and discussions to further advance harmonization and strategies for interoperability, particularly for residuals in content inventory, specified hazard lists and data requirements and criteria for non-GHS endpoints.
- Design and build an online platform and database to share inventory and hazard and material health assessment information. Engage key stakeholders (e.g., Profilers/Assessors, manufacturers) in the design and development process to ensure that requirements are met.
1. Introduction

Concern with the potential health impact of the materials with which we construct buildings has always been an integral part of green building certifications such as the US Green Building Council’s LEED® rating system. Most programs have traditionally focused on the avoidance of exposure to volatile organic compounds (VOCs) with credits that reward the use of wet applied products with low VOC content and interior finishes that have been laboratory tested to ensure that VOC emissions are below acceptable levels. These programs have instigated significant improvements in product formulations.

VOC assessment approaches are limited, however, to addressing the impact of one set of ingredients that tend to volatilize (evaporate) and may be inhaled. Material ingredients may have health impacts through other pathways of exposure, such as dermal contact and dust mobilization, or at other stages in the material life cycle. Additionally there are other health effects of concern that are not well captured by VOC assessment approaches, such as endocrine disruption and cancer. These concerns have led to the development of evaluation programs that seek to complement the VOC assessment approach with broader material health assessments that encourage industry to move away from all hazardous ingredients, including semi- and non-volatile compounds, towards ingredients that are inherently safer.

The USGBC has reflected this development by including a new material health credit in the LEED v4\(^5\) that rewards projects for the use of building materials that A) inventory and report ingredients and B) optimize by using inherently safer chemicals.

The wide range of evaluation programs that address material health in the credit and beyond has led to confusion among manufacturers and project teams and to redundant and inefficient assessment work. To address this issue, Clean Production Action (CPA), the Cradle to Cradle Products Innovation Institute (C2CPII) and the Healthy Building Network (HBN) joined together in a Material Health Harmonization Task Group. The Task Group is charged to compare the leading product inventory and material health assessment programs for building materials and to identify similarities and differences in their methodologies. The goal of this project is to find opportunities to create synergies through harmonization and data sharing that will support implementation of the LEED v4 Material Ingredients credit and accelerate progress in the industry towards the manufacture of inherently safer products.

The Task Group analyzed the product inventory and material health evaluation protocols in the following five programs (four of which are referenced in the LEED v4 Material Ingredients credit):

- C2CPII’s Cradle to Cradle Certified\(^{(CM)}\) Product Standard (C2C)
- CPA’s GreenScreen for Safer Chemicals (GS)
- HBN’s Pharos Chemical & Material Library (CML) & Building Product Library (BPL)
- HPD Collaborative’s Health Product Declaration (HPD)
- International Living Future Institute’s (ILFI) Declare

The information collected by each program for product content inventorying, list screening analysis, and full hazard assessments was compared and evaluated for the current state of alignment and potential for further harmonization and information sharing. The programs were also compared on how they verify and disclose collected information and how these requirements compare with the Globally Harmonized

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\(^5\) All references to the “LEED v4 Material Ingredients credit” in the text refer to the LEED v4 credit entitled BD+C and ID+C MR Credit 4 Building Product Disclosure and Optimization -- Material Ingredients as described in the Ballot draft released in July 2013 and approved by membership vote in July 2013. http://www.usgbc.org/node/2616399?return=/credits/new-construction/v4-draft.
System (GHS) for Safety Data Sheets (SDS). The assessment does not address comparison of scoring protocols.

2. Overview of the Programs and Evaluation Steps

2.1. Evaluation Steps

As illustrated in Figure 1, the material or product evaluation process can be divided into three steps that represent a common structure among material health programs:

- **Content Inventory**: The ingredients of the material or product to be evaluated are identified and characterized along with certain material and product level information. Key factors in this step include how much of the product is required to be identified, what characteristics of the ingredients must be identified, engagement of the supply chain, how much of the resulting inventory is publicly disclosed, and whether the information is verified by a third party. Inventory analysis also may include research of the process chemistry and manufacturing site visits.

- **List Screening**: The ingredients are screened against preset lists of substances. Lists may include both restricted substance lists and authoritative and screening human and environmental health hazard lists. There are three levels of analysis that may be done with list screening:
  - Pass/fail screening of ingredients against a restricted substance list (a “red list”),
  - Identification of hazards from listings on specified hazard lists, and
  - Benchmarking of levels of concern from listings on specified hazard lists.

Some programs publicly disclose a material or product level evaluation from this screening step. Others use it only internally as a first step in the full hazard assessment.

- **Full Hazard Assessment**: In full hazard assessments, ingredients are individually researched to provide more information about health hazards than the screening lists alone provide and the information is used to guide material and product optimization. Full assessment goes beyond the use of hazard lists and includes research of the scientific literature as well as the use of modeling tools to assess health endpoints and environmental toxicity and fate issues. Public disclosure may include the underlying assessment data, rolled up assessments at the ingredient, material or product level, or a final score or certification level.
2.2. Summary of the Programs

All five of the programs undertake the first two evaluation steps (content inventory and list screening) but vary in whether and to what extent full assessment is included in the protocol and the types of disclosure and verification at each step. In particular, only two of the programs (GS and C2C) include defined methodologies for full hazard assessment. HPD and Pharos both utilize assessments from GS. The programs are summarized here according to the outline of evaluation steps described above (see Appendix 1 for more detailed descriptions of the programs):

- **Health Product Declaration (HPD)**\(^6\): The HPD is a disclosure format intended to provide a consistent publication standard for disclosure of the contents of materials and products, together with the potential health hazards of those ingredients.
  - **Content Inventory**: The HPD supports public disclosure of known content, including residuals, as well as VOC emissions testing and related certifications. The HPD allows for self-declared, second party, or third party declaration of ingredients.
  - **List Screening**: The ingredients are screened against a large set of authoritative hazard lists, defined by the GS List Translator (see below) with a few additions. If ingredients are included on these specified lists, the hazards must be public disclosed on the HPD and the List Translator score indicated.
  - **Full Hazard Assessment**: The HPD does not require full hazard assessments. However, the form provides the benchmark result of full GS assessments for public disclosure, if available.

- **Pharos**\(^7\): The Pharos Project is an online material selection tool that assesses occupant and

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\(^6\) Managed by the Health Product Declaration Collaborative http://www.hpdcollaborative.org/

\(^7\) Managed by the Healthy Building Network http://www.pharosproject.net/
manufacturing health hazards, sustainability of recycled and biobased content and renewable energy use in manufacturing. It includes a Chemical and Material Library (CML), which screens and assesses individual chemicals for direct hazard and process chemistry hazards, and a Building Product Library (BPL), which applies the CML assessment to product ingredients along with other environmental information.

- **Content Inventory:** Pharos supports public disclosure of known content, including residuals, as well as VOC emissions testing and related certifications. Self-declared information from the manufacturer is supplemented with research by HBN staff. HBN staff researches likely process chemistry for BPL ingredients to characterize likely residual ingredients that the final manufacturer may not disclose or know. HBN staff also assesses likelihood of exposure based on volatility and the location of ingredients in the product.

- **List Screening:** The ingredients are screened against a large set of specified hazard lists characterized in the CML, defined by the GS List Translator (see below) with a few additions. If ingredients are listed on these specified lists, the hazards are publicly disclosed in the BPL and the List Translator score is indicated. The hazard information is rolled up into a published ingredient level health hazard indicator and product level scores for several health hazard related attributes (VOC, toxic content and manufacturing toxics). The toxic content score may be modified by exposure considerations. The BPL also assesses several other environmental attributes.

- **Full Hazard Assessment:** Pharos staff does not undertake full hazard assessments. The Pharos BPL provides public disclosure of full GreenScreen assessments, if available.

- **GreenScreen (GS)**: GS is a chemical hazard assessment protocol used across many different industries and in state regulations to guide the assessment of the inherent hazards of chemical ingredients. It is free and publicly available. As indicated above it is incorporated into the HPD and Pharos.

  - **Content Inventory:** For GS assessments, manufacturers may engage a GS Profiler and full disclosure will be necessary. Public claims using the GS require either public disclosure of individual ingredient assessments or external verification.

  - **List Screening:** Ingredients are screened against a large set of authoritative and screening hazard lists, specified by the GS List Translator as a first step toward a full GS hazard assessment. The GS List Translator helps to populate a hazard table with hazard level indicators for each of a set of human and environmental health endpoints and environmental toxicity and fate indicators defined in the GS method. In particular, the List Translator helps to identify chemicals of possible concern.

  - **Full Assessment:** A full GS assessment includes evaluation of scientific literature, test data, expert judgment and use of modeling tools to assess and classify all of the health endpoints and environmental indicators. A benchmarking protocol uses the hazard classifications to assign one of four benchmarks based on levels of concern to the chemical overall. The GS may be used privately for internal assessment with no restrictions, but requires public disclosure of the analysis and supporting data as well as chemical identities to make a public claim using the GS.

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8 Managed by Clean Production Action http://www.cleanproduction.org/Greenscreen.php
• **Cradle to Cradle Certified (C2C)**: C2C is a certification standard for products in a variety of industries. It includes a hazard assessment protocol as part of the Material Health category. In addition to Material Health, products are evaluated and certified based on meeting criteria for Material Reutilization, Renewable Energy and Carbon Management, Water Stewardship, and Social Fairness.
  
  o **Content Inventory**: For C2C certification, a manufacturer must engage an accredited C2C Assessor that will use knowledge of industry and process chemistry, manufacturing site visits, and supplier interviews along with manufacturer declarations to verify a product’s content inventory. C2C requires disclosure of the identity of ingredients to the Assessor only.
  
  o **List Screening**: The ingredients are screened against C2C’s banned list of chemicals and a set of authoritative hazard lists, determined by the individual Assessor as an early step in making the assessment.
  
  o **Full Assessment**: A C2C Assessor evaluates scientific literature, test data, and uses modeling tools as well as expert judgment to assess hazard, exposure, and risk across all environmental and health endpoints. ‘Cyclability’ of the material is also considered as part of its material assessment process. A benchmarking protocol uses these data and the level achieved in the four other standard categories to assign a certification level to the product. At this time, public disclosure of the final certification level and level achieved in each of the five standard categories is not required, but is encouraged.

• **Declare**: The Declare program is a building product ingredient transparency and labeling program. Declare supports the selection of products for projects seeking to meet the Living Building Challenge (LBC) program. The Materials requirements of the program are focused on the avoidance of Red list chemicals and selection of regional materials.
  
  o **Content Inventory**: Declare requires a full public disclosure of ingredients and some key product characteristics based on a manufacturer’s self-declaration. A Health Product Declaration may be used as input with addition of some supplemental information.
  
  o **List Screening**: The ingredients are compared against the LBC Red List, LBC Exception List and two other governmental lists of chemicals of concern (EPA Action Plan list and the REACH SVHC Candidate list). The public disclosure includes a color-coding for these lists and indication of whether a product is permitted for use in an LBC project. The label also supplies some other Living Building Challenge related attributes.
  
  o **Full Hazard Assessment**: No further assessment is undertaken for the Declare label.

### 2.3. Relationship of the LEED Credit to Inventory, Screening & Assessment

In the LEED v4 Material Ingredients credit there are 3 options that could lead to up to 2 points.

**Option 1: Material ingredient reporting** (1 point) – This Option rewards products which have undergone the Content Inventory step as described above. The credit currently directly cites HPD and C2C and GS as programs through which project teams can obtain this credit. Products may contribute to the credit if they have published a Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard or if the product has been certified at the Cradle to Cradle v2 Basic level or v3 Bronze level. In addition, a Manufacturer Inventory compliance path involves material ingredient disclosure with an option to disclose the role, amount, and GS Benchmark (see 5.1.1

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9 Managed by the Cradle to Cradle Products Innovation Institute http://www.c2ccertified.org/
10 Managed by the International Living Future Institute http://www.declareproducts.com/
for description of GS Benchmark) for proprietary chemicals instead of the name and/or CASRN. Pharos BPL and Declare are not explicitly listed in the credit language but are programs which could potentially be used to demonstrate compliance with the credit.

Option 2: Material ingredient optimization (1 point) – This Option rewards products which have undergone the List Screening or Full Hazard Assessments steps as described above. The credit currently directly cites GS and C2C as criteria through which project teams can obtain the credit. Products may contribute towards the credit if the ingredients have no GS Benchmark 1 hazards as assessed with the GreenScreen List Translator and gain higher value towards the credit if they have undergone a full GreenScreen Assessment. Products may also contribute if they are certified Cradle to Cradle v2 Gold or v3 Silver and gain higher value towards the credit if they are certified v3 Gold or v2 or v3 Platinum. Pharos BPL and HPD are not explicitly listed in the credit language but are tools that may be used to document compliance with the GS List Translator or International Alternative Compliance paths of this Option.

Option 3: Product Manufacturer Supply Chain Optimization (1 point) - This Option addresses supply chain management rather than material ingredient reporting and optimization and therefore is not addressed in this report.

3. Content Inventory Step Analysis
This section identifies the core information that is required for all inventories in all programs, as well as additional information that is specific to one or more programs and provides a preliminary assessment of alignment. It also addresses the information source (who is providing the information), residuals, reporting thresholds/requirements (what needs to be reported and on what basis), and disclosure (what information needs to be communicated to whom).

3.1. Individual Ingredient, Material & Product Information
The type of information collected by the inventory programs generally falls into two or three categories. Certain information needs to be collected for each individual ingredient in a product or material (Table 1). Other information is collected on a whole product basis (Table 2). Additionally, for C2C and Pharos BPL, information is also collected at the homogenous materials level. The five programs share a core set of information required for individual ingredients (see Table 1 below). All programs require the collection of ingredient name, Chemical Abstract Service Registration Number (CASRN), and the percentage of the ingredient in the material or product by weight. In addition, all programs collect supplier name and contact information, although the HPD and Pharos BPL only collect it for components, not individual ingredients.

Harmonization of this core ingredient information collection will require alignment of definitions and how to handle content ranges and a number of other data collection protocol concerns. Each program faces certain challenges inherent to CASRNs such as when multiple CASRNs may apply to a single chemical or polymer that could be collaboratively addressed.

In addition to this core information on individual ingredients, the HPD, C2C, GS and Pharos collect information on function or role and whether an ingredient is a nanomaterial. GS is further developing their inventory protocol to identify specific nanomaterial characteristics, such as particle size and shape to assist in the assessment of nanomaterials.
There is variance among programs in the collection of other characteristics of ingredients and homogenous materials (Table 1) and products (Table 2), including some fields only required by a single program (not shown). Complete harmonization of use and definition of all product inventory information across all of the programs is not likely in the near future due to varying, program specific needs. There are, however, numerous opportunities for shared development of standards in the areas of overlap and sufficient parallels to make unified data entry advantageous with both shared core data entry and additional modules for program specific data entry.

| Table 1: Inventory data requirements by program – Ingredient & material level |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                               | HPD             | Pharos BPL      | Green Screen    | C2C             | Declare         |
| Core ingredient level elements shared by all programs |                 |                 |                 |                 |                 |
| Chemical name                 | X               | X               | X               | X               | X               |
| CASRN                         | X               | X               | X               | X               | X               |
| % by weight                   | X               | X               | X               | X               | X               |
| Supplier contact information  | Components only | Components only | X               | X               | X               |
| Program specific common elements shared by two or more programs and collected at the ingredient or homogenous material level |                 |                 |                 |                 |                 |
| Function/Role                 | X               | X               | X               | X               | X               |
| Nanomaterial form             | X               | X               | X               | X               |                 |
| Residual info                 | X               | X               | X               | X               |                 |
| Recycled content              | X               | X               |                 |                 |                 |
| Location in product           | X               | X               | X               |                 |                 |
| Material form related to hazard (e.g., fiber, particle size, etc.) | X               | X               | X               |                 |
| Renewable sourcing            |                 |                 |                 | X               | X               |
Furthermore, a preliminary comparison of specific data fields collected by GS, HPD, Pharos, Declare, and portions of the C2C program indicates that the Pharos system already is structured to gather the majority of the data required by the five programs (C2C field analysis is still underway). A lowest common denominator approach similar to that proposed for the full hazard assessment data categorization (see section 5.2 below) can facilitate inventory data collection that is portable between programs. A shared platform is clearly feasible and could substantially reduce the time required for data entry by manufacturers.

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<th>Table 2: Inventory data requirements by program – Product level</th>
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Program specific common elements shared by two or more programs

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3.2. Assemblies

Products can have a high degree of complexity and are sometimes composed of hundreds of individual materials and/or of multi-ingredient components that can be mixed and matched within a manufacturer’s product line. Several of the programs have addressed this issue.

C2C begins the inventory process by compiling a complete list of all homogeneous materials in a product (the Bill of Materials), rather than a list of individual chemical-level ingredients. Each homogenous material on the Bill of Materials then requires its own ingredients list.
The Pharos BPL inventory process includes provision for what it calls “Components” (comparable to C2C’s Bill of Materials), homogenous materials with their own ingredient lists. These may be nested in the BPL several levels deep to reflect supply chain relationships.

HPDs may be created for product components. The HPDC intends to develop an approved protocol for rolling up the ingredients and hazards from components into a parent product HPD. Pending that extension of the standard, however, all ingredients must be listed in the parent product HPD.

3.3. Harmonizing Inventory Data Collection
In order to allow for the transfer of information between different inventory programs and facilitate collection of this information within a shared platform, information needs to be collected in a standardized manner. The three main aspects that need to be considered in this regard are the information source (who declares), residuals and reporting thresholds/requirements (what needs to be reported and on what basis), and disclosure (what information needs to be reported to whom). The HPD Standard has well-defined guidelines on these three aspects that may serve as a template in harmonization. However, as discussed below, there is also a great deal of latitude in the options that can be chosen for each of these aspects. Not every HPD will be useful to every other inventory program. Programs will generally need to identify the level of the HPD Standard that meets their programmatic requirements.

To be useful as primary input to the Pharos BPL, a C2C or GS assessment, or a Declare label, an HPD will have to meet the HPD Standard “Full Disclosure of Intentional Ingredients” level of disclosure. The required level of residual disclosure is an issue the organizations need to discuss.

For manufacturers not ready or able to fully disclose product content, C2C Accredited Assessors could accept a Full Disclosure of Intentional Ingredients HPD under NDA and help the manufacturer publish an HPD that meets the “Full Disclosure of Known Hazards” level of disclosure (i.e. ingredient name and CASRN are not disclosed, but HPD-defined hazards and roles are published for each ingredient). This would meet the level of disclosure required in the LEED v4 Material Ingredients credit.

3.3.1. Information Sources
Declare relies solely on manufacturer declarations to obtain information regarding the chemical composition of materials or products. C2C requires Assessors to actively engage with the supply chain, conduct site visits to audit manufacturer declarations, and conduct industry research to assess the Bill of Materials against likely materials. Pharos’ BPL, GS and the HPD allow for and document different types of information sources. The BPL displays content information that is provided by manufacturers and suppliers along with potential ingredient lists for common components, which are developed by Pharos research staff, certifications of product content, and emissions tests by third parties. The HPD allows for self-declared, second party, or third party declaration of ingredients. See Table 3 for a visualization of these comparisons. This table also provides the Global Harmonized System of Classification and Labeling of Chemicals Safety Data Sheet (GHS SDS) requirements for comparison, as many manufacturers will be required to provide GHS SDSs for their products in the next few years. In general the evaluated programs start from similar data sources as GHS SDSs but are more rigorous in their requirements. Therefore information generated for these programs will be useful in generating SDSs as well. SDSs however, will often be inadequate for the data requirements of these programs.

In a shared system this wide diversity of information sources would either need to be harmonized or implemented in separate compliance paths with automatic safeguards that would ensure that any information transferred between programs meets program specific source criteria.
Table 3: Inventory Data Sources and Management

<table>
<thead>
<tr>
<th></th>
<th>HPD</th>
<th>Pharos BPL</th>
<th>Green Screen</th>
<th>C2C</th>
<th>Declare</th>
<th>GHS SDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer data submission path</strong></td>
<td>Manufacturer direct to user by standard format</td>
<td>Manufacturer to HBN</td>
<td>Manufacturer to third party Profiler</td>
<td>Manufacturer to third party Assessor</td>
<td>Manufacturer to ILFI</td>
<td>Manufacturer direct to user by standard format</td>
</tr>
<tr>
<td><strong>Current inventory data control</strong></td>
<td>HPDC publishes required standard format &amp; XLS template</td>
<td>Manufacturer or third party manages data</td>
<td>CPA provides recommended template. Third party Profiler collects and manages data</td>
<td>C2CPII recommends process and provides recommended template. Third party Assessor collects and manages data</td>
<td>ILFI collects and manages data</td>
<td>OSHA publishes format. Manufacturer manages data</td>
</tr>
<tr>
<td><strong>Additional information sources and validation</strong></td>
<td>Third party validation in planning</td>
<td>HBN does industry research + evaluates certifications</td>
<td>Third party Profiler does industry research</td>
<td>Third party Assessor does supply chain research + Industry research + site visits</td>
<td>ILFI does industry research to validate declarations. Considering third party validation</td>
<td>none</td>
</tr>
<tr>
<td><strong>List Screening</strong></td>
<td>By manufacturer if using XLS template or by third party if using third party database</td>
<td>By Owner (HBN)</td>
<td>By third party Profiler</td>
<td>By third party Assessor</td>
<td>By Owner (ILFI)</td>
<td>By manufacturer</td>
</tr>
</tbody>
</table>

3.3.2 Data Collection Control
The programs also differ in how centrally they manage the inventory data collection step, as well as the screening assessment steps (see Table 3).

Pharos BPL and Declare are the only integrated systems in which the program owner organizations (HBN and ILFI) directly collect the primary inventory information, provide quality control on the data entry and screen the product in house.

The HPDC publishes the HPD format, which provides strict requirements for how the format is to be completed, but does not do quality control or require manufacturer submission to a central organization at this time. HBN currently provides a service called the Pharos HPD Toolshed, which provides a comprehensive integrated service (the HPD Builder and Library) to create an HPD and report it out in one database. It includes links to the Pharos CML to automate associating health hazard information with the chemical ingredients. Other organizations may offer some or all of these services in time as well.
CPA and C2CPII publish guidance on inventory collection and management with strict requirements for thresholds. Data collection, screening, and assessment are undertaken by independent organizations referred to as Assessors (C2C) or Profilers (GS). Guidance is provided on inventory data collection but is not collected in a central database by the owner organization at this time.

For verified GS assessments, CPA receives and reviews GS full assessment reports generated by GS certified Profiler organizations that include all ingredient level data. For GS assessments that do not seek verification and/or are for use only for internal purposes and will not be used for public claims, only the Profiler and the manufacturer have access to and ownership of the GS assessment. C2CPII receives and reviews C2C assessment summary reports generated by C2C certified Assessor organizations that may have ingredient level data redacted.

Short of GS and C2CPII bringing the data flows in house, development and use of a shared inventory platform will require engaging the Assessors and Profilers for the two programs. Several of the Assessor/Profiler organizations already address both programs and are thus likely to have interest in consolidation assuming that an acceptable business model is developed.

### 3.3.3. Intentional Ingredients, Residuals, and Reporting Thresholds

Table 4 presents an overview of the different reporting thresholds and related requirements for the five programs. HPD, Pharos BPL, GS and Declare require the reporting of all intentional ingredients at any concentration to be considered fully disclosed. HPD and Declare have special allowances for proprietary materials but restrict reporting under those terms. The BPL uses Pharos staff research to fill gaps in disclosure by manufacturers. C2C requires the disclosure of all intentional ingredients present at 100 ppm by weight or more in homogenous materials that are themselves present at 100 ppm or more within a product for its highest certification levels (Gold and Platinum) and has lower reporting thresholds for lower certification levels. All of these programs have higher reporting requirements than the GHS which only requires reporting of intentional or residual ingredients down to 1% (0.1% for certain select hazards).

The programs have a variety of ways of handling the reporting of residual chemicals. GS generally requires residual reporting at 100 ppm but also defines “special case impurities,” that must be disclosed and assessed at any level. These special case impurities are potential chemicals of concern identified based upon their presence in feedstock or their role in process chemistry, such as the monomers and catalysts in polymers. In both cases this information is to be supplied based on an understanding of the process chemistry and supply chain.

C2C generally requires residual reporting at 100 ppm but also requires certain ingredients (process chemicals, toxic metals, organohalogens, and others) to be disclosed even if they are present at levels lower than 100 ppm in the material. C2C also requires analytical testing of recycled content to determine residuals in cases where the chemical composition of the material cannot be defined (i.e., post-consumer or post-industrial recycled content).

The BPL does not currently have explicit guidance for manufacturer reporting of residuals, but automatically adds assumptions about potential residuals through process chemistry. The HPD allows for a variety of reporting standards for residuals (measured to 100 ppm or 1000 ppm, reported by suppliers on MSDS, predicted from process chemistry, and “Other”).
Declare requires that the reported ingredients add up to at least 99% by weight of the final product. The Pharos BPL and the HPD require all intentionally added ingredients to be disclosed to be considered “complete.” The necessary percentage of assessed ingredients varies based on certification level in C2C.

These differences in reporting need to be carefully considered in order to allow the transfer of information among inventory programs.

All of these programs, with the exception of HPDs that are not fully disclosed or use the MSDS or lower level of residual disclosure, would meet the LEED V4 MRc4 Material Ingredients credit requirements.

| Table 4: Inventory data requirements by program - thresholds & requirements |
|-------------------------------------------------|-----------------|----------------|----------------|----------------|----------------|
| Reporting requirement for product                | HPD              | Pharos BPL    | Green Screen  | C2C            | Declare        | GHS SDS        |
| all intentionally added ingredients* to be considered fully disclosed | 100 ppm, 1000 ppm, predicted from process chemistry, as per MSDS (1,000 or 10,000 ppm) or calculated* | all intentionally added ingredients to be considered fully disclosed | all intentionally added ingredients | 75% to 100% at 100 ppm, varies by level** | all intentionally added ingredients to be “Red List Free” Must report >99% for others | Only hazardous ingredients >1% (>0.1% for select hazards***)

| Residual ingredient reporting threshold          | HPD              | Pharos BPL    | Green Screen  | C2C            | Declare        | GHS SDS        |
| HPD supports multiple levels: 100 ppm, 1000 ppm, predicted from process chemistry, as per MSDS (1,000 or 10,000 ppm) or calculated* | calculated from process chemistry | 100 ppm of chemical or material; special case impurities may be required at any level | 100 ppm of material (except process chemicals, toxic metals, organohalogens reported at any level) | 100 ppm of product | Same as above |

| Analytical testing requirement                   | Optional         | not specified  | not specified | For undefined recycled content | not specified | not specified |

* Residuals cannot sum to more than 1%. Ingredients beyond that level are considered intentionally added ingredients.

**for Bronze level 75% by weight and 100% by weight for Technological and Biological Nutrients, respectively; for Silver level 95% by weight and 100% by weight for Technological and Biological Nutrients, respectively; for Gold or Platinum level 100% by weight.

*** >0.1% for carcinogens, reproductive toxicants, mutagens and respiratory/skin sensitizers.
3.3.4. Content Inventory Disclosure

The meaning and requirements for disclosure differ considerably between the analyzed inventory programs. Table 5 presents an overview of these differences in disclosure.

The HPD recognizes two levels of “full disclosure” and also provides a structure for partial disclosures where full disclosure is not possible. The highest level of disclosure – “Full Disclosure of Intentional Ingredients” – requires that the identity of all ingredients is fully disclosed along with the hazards.

The second level of disclosure – Full Disclosure of Known Hazards – requires full hazard disclosure for each listed ingredient whether the identity of the ingredient is disclosed or not (see List Screening for details of the hazard disclosure protocol). This level is required in the LEED v4 Material Ingredients credit.

While an HPD can still be generated for a product without meeting either of these full disclosure requirements, to be considered “Complete” an HPD must include the reason for nondisclosure for each non-disclosed chemical and a timeline for disclosure.

<table>
<thead>
<tr>
<th>Table 5: Overview of ingredient &amp; hazard disclosure requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Role &amp; % by weight</strong></td>
</tr>
<tr>
<td>Publicly disclosed</td>
</tr>
<tr>
<td>Chemical ID (name+CAS#)</td>
</tr>
<tr>
<td>Optional at “Full Disclosure of Known Hazards” level*</td>
</tr>
<tr>
<td>Hazard disclosure</td>
</tr>
</tbody>
</table>

Legend for color code
- Full disclosure to public
- Partial public disclosure
- Disclosed only to Profiler/Assessor

* In HPD, if Chemical ID is not disclosed, known hazards must be disclosed and explanation for lack of disclosure must be provided with timeline for disclosure.
Pharos requires disclosure of all ingredients and hazards to be considered complete although some masking of exact formulas is allowed using ranges and common ingredients that may include more ingredients than are actually used in the product.

GS requires full public disclosure of chemical identity and hazards to make a public claim with the GS. There are no disclosure requirements for internal use of the GS.

C2C requires full disclosure to the Assessor who takes further steps to verify any content information provided based on industry knowledge and supplier interviews. To obtain this information, C2C Assessors routinely sign non-disclosure agreements with manufacturers and their suppliers that require them to keep some individual ingredient information confidential (at times even from the manufacturer). C2CPII receives information only at the material level and only the final level reached is publicly disclosed.

Declare requires full public disclosure of at least 99% of all ingredients. It does not require public disclosure of specific health hazards, only of whether the ingredients are included on the LBC Red List or Extended Red List.

4. List Screening Step Analysis
This section compares the hazard list screening methods used by the five programs to identify chemicals of known concern and in some cases assign preliminary benchmarks.

GS defines the GS List Translator which specifies thirty-six list categories of authoritative and screening hazard lists (which translates to 413 individual sublists) and assigns a hazard level (or range) for a health endpoint to each (see assessment section for more on this process). The lists are mostly governmental or government sanctioned authoritative body lists with a few derived from peer reviewed scientific literature to fill endpoint gaps in governmental lists. Screening by the GS List Translator can be used as a preliminary screening step to full hazard assessment, and is used to screen out chemicals that do not warrant the cost of the full assessment due to already meeting the worst rating (Benchmark 1) based on list screening alone. Results of this screening are displayed as part of the hazard table and must accompany any public claim using the GS.

The HPD and Pharos BPL both use the lists specified in the GS List Translator and add a small number of other lists. The HPD uses this to determine the health hazards that must be publicly displayed on an HPD and only requires hazard indicators from those lists that the GS List Translator assigns as equivalent to GS Benchmark 1. The Pharos BPL uses all of the GS List Translator lists as the basis of its public hazard display and to contribute to the published toxics scoring. Both the HPD and the Pharos BPL also include a key list that defines EPA priorities (the EPA Action Plans list), several global warming and ozone depletion lists from the EPA and European Community, and the San Antonio Statement on Chlorinated and Brominated Flame Retardants.

Declare uses one GS List Translator list (REACH SVHC) and one additional hazard list (EPA Action Plans) to highlight problematic chemicals in the published Declare label. Declare has its own restricted list (the Living Building Challenge Red List), which it uses along with a list of exceptions to determine which products are listed on the published label as acceptable for use in a Living Building Challenge project.

C2C also mandates the use of specific authoritative lists for each hazard endpoint as an initial step in hazard assessment. However, the set of lists which are explicitly covered in the standard is less extensive
than that used in the GS List Translator. Assessors are permitted to use additional hazard lists and information sources to speed the assessment process according to their internal procedures and professional judgment as long as they comply with the standard’s general hazard criteria. C2CPII is considering developing additional guidance on lists to be used and may specify GS List Translator to help inform that process.

Most of these lists are already supported by the Pharos CML tool.

<table>
<thead>
<tr>
<th>Table 6: Authoritative lists used in List Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Green Screen List Translator (GS LT) hazard lists</strong></td>
</tr>
<tr>
<td>HPD</td>
</tr>
<tr>
<td>All lists which are assessed by GS LT as Benchmark 1</td>
</tr>
<tr>
<td><strong>Additional hazard lists</strong></td>
</tr>
<tr>
<td><strong>Restricted Substance Lists (RSLs)</strong></td>
</tr>
<tr>
<td>BPL displays 12 RSLs but does not score them</td>
</tr>
</tbody>
</table>

ACGIH American Conference of Industrial Hygienists
BFR & CFR Brominated Flame Retardants & Chlorinated Flame Retardants
EC – European Community
EDCs - Endocrine Disrupting Chemicals
EPA (US Environmental Protection Agency
GWP – Global Warming Potential
ODS – Ozone Depleting Substances
REACH SVHC – Substances of Very High Concern
TLV – Threshold Limit Values

*Full assessment of overlap to be conducted.
**No specific hazard lists are required to be referenced by the international GHS protocol. Lists of chemicals and hazard warnings based on assessment under the GHS hazard classification scheme may be developed by individual countries and made part of the country’s regulatory implementation of the GHS. The EU, Japan, Korea and New Zealand have all created such lists which are also included in the Green Screen List Translator and the Pharos CML. There is, however, no universal "GHS list" that must be applied to all GHS implementation internationally nor are there any plans that we yet know of for development of a US version of a GHS hazard list.
5. Full Hazard Assessment Step Analysis

The purpose of this section is to identify similarities and differences and find opportunities for alignment in the chemical hazard assessment methods used in the GS and C2C programs since they are the only two with a full hazard assessment methodology as defined in section 3. Two of the other programs surveyed (Pharos Project and the HPD) use hazard metrics based on GS endpoints and GS List Translator and support disclosure of GS full hazard assessments. Declare does not currently include any form of hazard assessment beyond restricted substances list-screening (see section 4).

5.1. General Description of Hazard Assessment Schemes

5.1.1. GreenScreen

GS is a method to rank chemicals based on their inherent hazards to human health and environmental toxicity and fate. This is achieved by classifying the individual chemicals and their breakdown products for a large set of hazard endpoints and indicators and deriving an overall Benchmark score between 1 (worst) and 4 (best). For each hazard endpoint, 3 to 5 levels are used to classify the hazard intensity. All have low, medium, and high thresholds; some also have very low and/or very high. The GS method is then used to assess the overall Benchmark score, taking into consideration the interaction between persistence, bioaccumulation, and toxicity, as well as a higher weighting for certain chronic human health endpoints that frequently result in irreversible harm (e.g., Carcinogenicity, Mutagenicity, Endocrine Disruption and Reproductive and Developmental Toxicity are deemed to be of higher concern than Skin Irritation). The intent is to discriminate between chemical alternatives even in situations in which no inherently safe candidate may be available. The hazards or combination of hazards that result in Benchmark 1 scores align with national and international (EU, Canada and US) definitions of substances of very high concern. Chemicals retain their Benchmark score within a product or mixture as long as the chemical itself is unchanged in the product or mixture.

5.1.2. Cradle to Cradle Certified

The C2C chemical hazard rating scheme is part of the methods used to evaluate the Material Health of a product to determine whether it meets the requirements for C2C certification (the second aspect considered in evaluating Material Health, "cyclability", is separate from chemical hazard assessment and not reviewed here). The method evaluates the potential human health and environmental impacts of chemicals used in each of the materials in a product. This is achieved by rating the hazard of individual chemical ingredients across a large set of hazard endpoints and assigning ratings of either “red” (hazardous), “yellow” (potentially hazardous), “green” (safe), or “grey” (endpoint not applicable or insufficient information available) for each endpoint. The focus lies on identifying chemicals that can render materials unsafe and thus inconsistent with the C2C principles. Following the evaluation across individual hazard endpoints, chemicals are further evaluated for likelihood of exposure within the context of their material matrix and likely use scenarios, and then are assigned a chemical risk rating. There is currently no benchmark or rating for individual chemicals overall based on hazard only, just the individual hazard endpoint ratings and the overall chemical risk ratings.

5.1.2. Other Programs

The other programs evaluated as part of this analysis do not independently describe full hazard assessment methodologies as defined in section 3. Pharos and HPD both reference full assessments completed using the GS protocol. Declare does not include a full assessment component in its program. Pharos and HPD also address their list screening all of the GS indicators plus three of the additional environmental hazard endpoints (Terrestrial Toxicity, Ozone Depletion and Global Warming) that are part of a C2C hazard assessment, but not part of GS (see section 5.3).
5.2. Major Differences and Similarities between Hazard Assessment Schemes

The C2C method is limited to three hazard intensity levels, tends to assign the highest hazard score (“red”) more liberally than the “high” in GS, and does not generally differentiate between known and suspected toxicants (i.e., the hazard endpoint criteria for the highest hazard score (red) tend to be more conservative). The GS may distinguish between three to five hazard intensity levels depending on the endpoint and the levels of classification criteria available under Global Harmonized System of Classification and Labeling of Chemicals (GHS) developed by the United Nations\(^{11}\). Where there are more than three levels in GS, the top hazard levels usually map into the “red” hazard category in C2C (see detailed comparison of criteria and section 5.3.2 below). Additionally, the consideration of exposure by C2C in the derivation of overall risk ratings makes it impossible to compare overall benchmarks at the chemical or material level. In the C2C system, the same chemical may have different risk ratings depending on product use and potential for exposure. The GS scores do not depend on the application, since they are based on inherent hazard only.

While overall benchmark/risk ratings between the two methods are substantially different and difficult to compare, the criteria and data required to determine the hazard of individual chemicals across various hazard endpoints and indicators are much more comparable.

This is the reason that this report focuses first on aligning the individual hazard rating schemes rather than the overall chemical rating schemes of GS and C2C. Finding a common language and categorization scheme for hazard information would allow consistent storage and communication in a shared database even while the final benchmarking or rating of materials remains program specific.

Many similarities exist in the evaluation of chemical hazard at the hazard endpoint level. Both schemes are largely based on GHS, although both standards also include endpoints not covered by GHS.

Although the hazard endpoint names and criteria used by C2C and GS appear to be different at first glance, on deeper analysis the differences turn out to be primarily due to the manner in which the endpoint names and criteria are grouped. For example, defining the Oral Acute Toxicity of a chemical requires identical assessment to defining Acute Toxicity via the oral route -- the underlying information considered is the same. Table 7 illustrates a “lowest common denominator” scheme of subdividing information into distinct base level hazard indicator categories that are common to each program. In the discussion of “endpoints” below we refer to this lowest common denominator subdivision that includes 36 endpoints, unless otherwise stated. We also use the term “endpoint” broadly to refer to both hazard categories that would be considered hazard endpoints in the strict sense of the word (i.e., Acute Toxicity) and other information categories used in hazard assessment (i.e., environmental fate indicators such as Bioaccumulation and Persistence, and general categories such as Toxic Metals).

\(^{11}\) For more information the Globally Harmonized System for Classification and Labeling refer to the UN website at [http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/03e_part3.pdf](http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/03e_part3.pdf)
### Table 7: Endpoint comparison between GS, C2C, and GHS

<table>
<thead>
<tr>
<th>GS endpoints</th>
<th>C2C endpoints</th>
<th>GHS endpoints</th>
<th>Lowest common denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinogenicity</td>
<td>Carcinogenicity</td>
<td>Carcinogenicity</td>
<td>Carcinogenicity</td>
</tr>
<tr>
<td>Mutagenicity/Genotoxicity</td>
<td>Mutagenicity</td>
<td>Germ Cell Mutagenicity/Reproductive Toxicity</td>
<td>Mutagenicity/Genotoxicity</td>
</tr>
<tr>
<td>Neurotoxicity</td>
<td>Neurotoxicity</td>
<td>Neurotoxicity</td>
<td>Neurotoxicity</td>
</tr>
<tr>
<td>Endocrine Activity</td>
<td>Endocrine Disruption</td>
<td>Endocrine Disruption</td>
<td>Endocrine</td>
</tr>
<tr>
<td>Persistence</td>
<td>Persistence</td>
<td>Persistence</td>
<td>Persistence</td>
</tr>
<tr>
<td>Bioaccumulation Potential</td>
<td>Bioaccumulation</td>
<td>Bioaccumulation</td>
<td></td>
</tr>
<tr>
<td>Acute Aquatic Toxicity (Fish, Daphnia, Algae)</td>
<td>Acute Fish Toxicity</td>
<td>Acute Aquatic Toxicity (Fish, Daphnia, Algae)</td>
<td>Acute Fish Toxicity</td>
</tr>
<tr>
<td></td>
<td>Acute Daphnia Toxicity</td>
<td>Acute aquatic Toxicity (Fish, Daphnia, Algae)</td>
<td>Acute Algae Toxicity</td>
</tr>
<tr>
<td></td>
<td>Acute Algae Toxicity</td>
<td>Acute Algae Toxicity</td>
<td>Acute Algae Toxicity</td>
</tr>
<tr>
<td>Chronic Aquatic Toxicity (Fish, Daphnia, Algae)</td>
<td>Chronic Fish Toxicity</td>
<td>Chronic Aquatic Toxicity* (Fish, Daphnia, Algae)</td>
<td>Chronic Fish Toxicity</td>
</tr>
<tr>
<td></td>
<td>Chronic Daphnia Toxicity</td>
<td>Chronic Daphnia Toxicity</td>
<td>Chronic Daphnia Toxicity</td>
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<tr>
<td></td>
<td>Chronic Algae Toxicity</td>
<td>Chronic Algae Toxicity</td>
<td>Chronic Algae Toxicity</td>
</tr>
<tr>
<td>Reproductive Toxicity</td>
<td>Reproductive Toxicity (Repro+Dev)</td>
<td>Reproductive Toxicity (Repro+Dev)</td>
<td>Reproductive Toxicity</td>
</tr>
<tr>
<td>Developmental Toxicity</td>
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<td>Developmental Toxicity</td>
</tr>
<tr>
<td>Skin Sensitization</td>
<td>Skin and Respiratory Sensitization</td>
<td>Skin and Respiratory Sensitization</td>
<td>Skin Sensitization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Respiratory Sensitization</td>
</tr>
<tr>
<td>Skin Irritation</td>
<td>Skin, Eye, and Respiratory Corrosion/Irritation</td>
<td>Skin Corrosion/Irritation</td>
<td>Skin Irritation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eye Irritation</td>
</tr>
<tr>
<td>Acute Toxicity (Oral, dermal, inhalation)</td>
<td></td>
<td></td>
<td>Acute Oral Toxicity</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Acute Dermal Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Acute Inhalation Toxicity</td>
</tr>
<tr>
<td>Systemic Toxicity/Organ Effects</td>
<td>Oral Toxicity</td>
<td>Dermal Toxicity</td>
<td>Target Organ Oral Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inhalative Toxicity</td>
<td>Target Organ Dermal Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Target Organ Inhalation Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chronic/Repeated Oral Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chronic/Repeated Dermal Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chronic/Repeated Inhalation Toxicity</td>
</tr>
<tr>
<td>Flammability</td>
<td>Other (Human Health)</td>
<td>Other (Human Health)</td>
<td>Other Physical Properties, including Nano Properties</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other Environmental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Terrestrial, Avian, Bee Toxicity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Climal Relevance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ozone Depletion Potential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Global Warming Potential</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Organohalogenes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Toxic Metals</td>
</tr>
</tbody>
</table>

*Includes bioaccumulation in the determination of chronic aquatic toxicity categories

This diagram shows the lowest common denominator scheme of endpoint subdivision for compatibility with both programs. For the purpose of data gathering some endpoints (such as those pertaining to respiratory toxicity, flammability, and reactivity) may need to be further subdivided to account for different available metrics (i.e. form of the exposure: dust, mist, vapor, etc.).
There are 29 human and environmental endpoints that are used in both GS and C2C, plus seven endpoints that are each used in one of the programs, but are either optional or not addressed in the other program. The use of these 36 endpoints in GS and C2C are described in more detail below.

- Four human health endpoints and the two environmental fate indicators share the same high level hazard endpoint definitions and are used in both programs (top 6 rows in Table 7):
  - Carcinogenicity
  - Mutagenicity/Genotoxicity
  - Neurotoxicity
  - Endocrine (note this is called Endocrine Disruption in C2C and Endocrine Activity in GS)
  - Persistence
  - Bioaccumulation (called Bioaccumulation in C2C and Bioaccumulation Potential in GS)

- Of these endpoints that share the same high-level hazard endpoint definitions, four are not explicitly defined in the GHS (Neurotoxicity, Endocrine, Persistence, and Bioaccumulation).

- There are 21 other human and environmental health endpoints that are used in both GS and C2C although grouped differently (rows 7-27 in Table 7).

- Unlike the GHS, both GS and C2C also have at least one “Other” category into which additional human and environmental health information not addressed elsewhere may be assessed. For example, EDTA would get a “red” rating in C2C’s Other Environmental Health Hazards endpoint for its potential to mobilize toxic metals in aquatic environments. In C2C this is subdivided into two categories: “Other Human Health Hazard Endpoints” and “Other Environmental Health Hazard Endpoints”. Two physical hazard indicators included in GS may be captured in the C2C Other categories and one environmental health category in C2C may be captured in the GS Other category:
  - Flammability in GS addresses how easily a substance will burn or ignite, causing fire or combustion. This information is covered under “Other Human Health Hazard Endpoints” in C2C.
  - Reactivity in GS addresses the instability of the substance and liability to undergo strongly exothermic decomposition. This information is covered by “Other Human Health Hazard Endpoints” in C2C.
  - Terrestrial Toxicity in C2C includes information regarding the avian toxicity of a chemical (chronic/reproductive and acute for chicken and ducks) as well as toxicity to terrestrial invertebrates (chronic/reproductive and acute for earthworms, honeybees, and others). Terrestrial and other ecotoxicities may be added in GS under “Other”. The GHS does not include a classification scheme for terrestrial toxicity.

- There are two additional environmental health indicators in the lowest common denominator scheme that are used in C2C, that are not in GS:
  - Ozone Depletion Potential in C2C covers the potential of a compound to destroy ozone in the upper atmosphere and is completely list driven (chemical listed as Class I or II in the Montreal Protocol receive a “red” rating, all others a “green” rating). The GHS includes a classification scheme for ozone depletion but this is not a GS endpoint.
  - Global Warming Potential in C2C (under Climatic Relevance) accounts for the potential of a compound to contribute to climate change if released in the atmosphere. It is not included in GS or the GHS.

- Two chemical classes (Organohalogenes and Toxic Metals) are penalized in the C2C hazard rating scheme that are not directly addressed in GS. Chemical compounds are marked hazardous if they are halogenated and organic or contain toxic metal atoms. These chemical groups capture a large number of potentially hazardous chemicals and allow for a binary distinction of hazard. Halogenated organic compounds and compounds containing heavy metals
would need to be evaluated for hazard using the GS method rather than assuming hazard for all chemicals in the class.

In accordance with this lowest common denominator subdivision, 30 specific endpoints (excluding the more general “Other” endpoints) out of a total of 36 are covered by both GS and C2C (83%). Many of the apparent differences in the programs' endpoints are due to how the endpoints and criteria are defined for reporting purposes. The underlying data addressed by the 21 “lowest common denominator” endpoints (rows 7-27 in Table 7) are essentially the same because they are based on GHS:

- The six C2C aquatic toxicity endpoints (chronic and acute toxicity for each fish, daphnia, and algae) correspond to three subdivisions of the two GS chronic and acute aquatic toxicity endpoints (inclusive of data for fish, daphnia and algae). The GS subdivision of these endpoints matches that of the GHS. For all these endpoints there is a direct match between the information considered.
- Two C2C endpoints (Reproductive Toxicity, Sensitization of Skin and Airways) are further subdivided in the GS scheme. In GS, Reproductive Toxicity is separated into ‘Reproductive Toxicity’ and ‘Developmental Toxicity’ and ‘Sensitization of Skin and Airways’ is separated into ‘Sensitization of Skin’ and ‘Sensitization of Airways’. The C2C subdivision of these endpoints matches that of the GHS. For all these endpoints there is a direct match between the information considered.
- Another C2C endpoint (Skin, Eye, and Respiratory Corrosion/ Irritation) is subdivided into ‘Skin Irritation’ and ‘Eye Irritation in GS. The GS subdivision of these endpoints matches that of the GHS. There is a direct match between the information considered.
- Four C2C endpoints (Oral Toxicity, Dermal Toxicity, Inhalative Toxicity, Single Organ Toxicity) correspond to two GS endpoints (Acute Mammalian Toxicity, Systemic Toxicity/Organ Effects) in an overlapping fashion:
  - C2C divides these categories by exposure pathway (oral, dermal, or inhalative), while GS groups these by the kind of toxic effect (acute/lethal, single exposure non-lethal effects, repeated exposure non-lethal effects; with the latter two grouped into the Systemic Toxicity/Organ effects endpoint)
  - In C2C, the Single Organ Toxicity endpoint is listed as an independent endpoint, but in practice is subsumed to the three exposure pathways, similarly to acute and chronic toxicity.
  - The GS subdivision of these endpoints matches that of the GHS. For all these endpoints there is a direct match between the information considered.

5.3. Levels of Possible Alignment
A number of possibilities exist in aligning the GS and C2C chemical hazard rating schemes. At the highest level, information provided in pre-existing GS assessments could be used as data sources in C2C material health assessments with no modifications or method alignment. In the following sections, key possibilities are outlined along a spectrum of alignment depths starting from the most basic level of alignment and ending with complete alignment. These options are not exhaustive but are meant to provide a representative overview of plausible alignment strategies across the full spectrum of alignment depths.
5.3.1. Align Hazard Endpoint Categories for Shared Data Collection

Aligning the hazard indicators is key to reducing costs by ensuring that data collected for an assessment in one program can be easily reused for an assessment in the other program thus avoiding the costs associated with redundant research.

5.3.1.2. Shared categories

The most basic level of alignment would focus on improving the match between the 30 indicators that have comparable GS and C2C endpoints (see section 5.2). For six endpoints, direct correspondence already exists. For the remaining 24 endpoints, the same information is generally collected but made less transferable by being combined in different groupings. There may be further subdivision of hazard classification information based on exposure routes or aquatic species that differ between the two schemes. For example, C2C collects acute aquatic toxicity data for fish, daphnia and algae as separate endpoints while GS collects the same data for the three species but under the singular heading of acute aquatic toxicity (see Table 7). Data collected for acute aquatic toxicity at the species level reflects the lowest common denominator.

Much of the data used by GS and C2C assessments can be relatively easily made transferable without aligning hazard criteria. It would be sufficient to collect and store hazard data according to the “lowest common denominator” described earlier (i.e., endpoints would be subdivided according to the simplest scheme that creates no overlap between endpoints in either of the methodologies). Table 7 illustrates this lowest common denominator scheme for information collection and sharing, and also shows the corresponding GHS categories.

Specifically, this lowest common denominator scheme would require that aquatic toxicity information would be collected in at least six categories (as in C2C) with two sets of three categories corresponding to the two GS endpoints. Information on Reproductive Toxicity, Developmental Toxicity, Skin Sensitization, and Respiratory Sensitization would be collected in at least four categories (as in GS) corresponding to the two C2C endpoints (Reproductive/Developmental Toxicity & Sensitization of Skin and Airways). In the general toxicity categories, the subdivision of information would need to be finer than presently practiced in either of the schemes, since the three C2C endpoints (Oral Toxicity, Dermal Toxicity, Inhalative Toxicity) each partially correspond to both of the GS endpoints (Acute Mammalian Toxicity, Systemic Toxicity/Organ Effects). It would make sense to collect information in at least nine categories, subdivided by both exposure pathway (as in C2C) and toxicity type (as in GS).

5.3.1.2. Non-Shared Categories

There are currently three environmental health hazard endpoints (Terrestrial Toxicity, Ozone Depletion and Global Warming) and two other chemical class hazard indicators (Organohalogenes and Toxic Metals) in C2C with no directly comparable equivalent in GS. Aligning GS and C2C on this level would mean that one or both of the standards would have to either add or drop hazard endpoints in their current schemes. A dialogue about the reasons for inclusion or exclusion of the endpoints in question may be informative and help to improve both standards. However, this level of alignment is not essential for effective data sharing and it is feasible to include additional endpoint information that is not shared.

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12Single Organ Toxicity is not counted separately since it is in practice subsumed by Oral Toxicity, Dermal Toxicity, and Inhalative Toxicity in the C2C scheme.
5.3.2. Align Thresholds & Protocols for Shared Endpoint Hazard Assessment

After all of the endpoints which share the same underlying data have been aligned, the next step could be to align the criteria used within these endpoints to increase interoperability. This is complicated by the fact that the two systems use different numbers of levels in some cases. The C2C methodology distinguishes between three hazard levels for each hazard endpoint, while the GS methodology may have three, four, or five hazard levels depending on the endpoint. However short of totally aligning hazard criteria, it may be possible to map hazard criteria between the programs. For example, both GS very high and high for acute mammalian toxicity may map to C2C high.

The basis for mapping of hazard levels between programs is largely already in place since concentration cutoffs and other criteria in both standards are based on the GHS for most endpoints. Using GHS, the “lowest common denominator” of hazard criteria can be defined and used to support the relevant endpoints in GS and C2C. Endpoints fall generally into two categories, those for which the direct mapping of criteria is already possible and those for which clarification and changes in the criteria of one or both standards would be necessary for alignment.

5.3.2.1. Endpoints for Which Direct Mapping is Possible

For Carcinogenicity, Mutagenicity/Genotoxicity, and Reproductive/Developmental Toxicity, a direct mapping from GS to C2C hazard levels is already possible, based on GHS categories. However, GS considers additional non-GHS criteria in defining its “Moderate” hazard level for these three categories. A GHS-only database would thus yield “preliminary GS hazard ratings” for these three endpoints.

- Based on GHS categories, GS hazard levels “Moderate” and “High” map uniquely to C2C “red” hazard levels.
- It is unclear if GS “Low” assessed chemicals for these endpoints should be mapped to the C2C “yellow” or “green” category, as there are other non-GHS criteria (mostly list interpretations) that differ between the two standards.
- Since the difference between “yellow” and “green” in C2C doesn’t affect certification criteria, this gap could be filled with a decree of convention (i.e., amend or clarify the standard to reflect that GS “Low” ranked chemicals in these endpoints count as C2C “green” or “yellow”) without compromising the application of the C2C standard.

Other toxicity endpoints can be uniquely mapped from GS to C2C based on GHS criteria, provided that information is collected based on the lowest common denominator (as outlined in section 5.3.1):

- For endpoints of Acute Toxicity (Oral, Dermal, Inhalative)
  - GS hazard levels “High” and “Very High” map to C2C “red” hazard levels
  - GS “Moderate” maps to C2C “yellow”
  - GS “Low” maps to C2C “green” (it may need to be clarified by GS that for Inhalative Toxicity of gases, the most recent revision of the GHS criteria is to be used (20,000 ppm cutoff), rather than that of previous versions (5,000 ppm))

- For endpoints of Target Organ Single Exposure Toxicity
  - GS hazard level “Very High” maps to C2C “red” hazard levels
  - GS “High” maps to C2C “yellow”
  - GS “Moderate” and “Low” generally map to C2C “green” (same comment about cutoff value for gases)

- For endpoints of both Target Organ Repeated Exposure Toxicity and Acute/Chronic Aquatic Toxicity
GS hazard levels “High” and “Very High” map to C2C “red” hazard levels
○ GS “Moderate” maps to C2C “yellow”
○ GS “Low” maps to C2C “green”

For the Bioaccumulation endpoint, good correspondence between hazard levels exists, although these are not based on GHS criteria (GHS does not include Bioaccumulation, Persistence, or Endocrine Disruption).

● GS hazard levels “Very High”, “High”, and “Moderate” map to C2C “red”
● GS “Low” maps to C2C “yellow”
● GS “Very Low” maps to C2C “green”

5.3.2.2. Endpoints for Which Clarification or Changes in Criteria Would Be Necessary

For Neurotoxicity, Skin/Eye/Respiratory Irritation/Corrosion, and Skin/Respiratory Sensitization, it is difficult to say whether a direct mapping between hazard levels exists at present, since unlike GS, C2C is currently not explicit in its mapping of hazard levels to GHS guidelines. Similarly, for Endocrine Disruption/Activity, it is difficult to say whether a direct mapping between hazard levels exists at present, since this endpoint is not part of the GHS and the lists and criteria cited by the two standards seem to differ. In all of these cases, it should, however, be possible to agree on a mapping scheme since there is a direct correspondence in the intent of hazard evaluation in these endpoints. To reach such an agreement, the rationale behind the inclusion and exclusion of individual criteria and evidence cutoffs in the two standards should be discussed in detail for these endpoints.

For the Persistence endpoint, no direct mapping is currently possible since the half-life value cutoffs differ and hazard levels overlap between the two standards. This is further complicated by the additional differences in considering degradation in soil/sediment versus that in water. Table 8 shows the persistence criteria used by the two standards. It can be seen that currently only the GS “Very High” level could be mapped to C2C “red”, while the mapping between the remaining categories would be ambiguous unless cutoffs are aligned between the two standards.

<table>
<thead>
<tr>
<th>Table 8: Comparison between GS and C2C of half-life criteria in soil/sediment and water for the “Persistence” hazard endpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>half-life in soil/sed.</td>
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<tr>
<td>------------------------</td>
</tr>
<tr>
<td>GS</td>
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<tr>
<td>C2C</td>
</tr>
<tr>
<td>half-life in water</td>
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<tr>
<td>GS</td>
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<tr>
<td>C2C</td>
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</table>
5.3.3. **Align Hazard List Assessments for Shared List Screening**

Automation of hazard list screening can expedite initial screening by the Profiler or Assessor reducing assessment costs and allows manufacturers to do their own prescreening to identify problems and to focus their needs before entering into a paid assessment agreement.

Searching of hazard lists specified in the GS List Translator has already been automated using the Pharos CML to expedite initial screening. C2C also includes specific guidance on consulting lists to obtain first-level hazard ratings within each endpoint. In each category where hazard indicator alignment has been accomplished, screening list use can be reviewed and aligned for shared rapid screening using a common database. Since GS has more extensive documentation on the use of lists and a greater number of lists considered within most endpoints, this may mean that C2C would need to issue instructional guidance on the use of the GS List Translator or a narrower set of lists currently not explicitly covered. In any case, it would be useful to review the lists considered by both standards endpoint by endpoint to identify overlap, differences, and gaps in the cross-standard interpretation of hazard lists.

5.3.4. **Align Hazard Rating Levels for Consistent Signaling**

A further step of alignment subsuming the unique mapping described in section 5.3.2, would be a consistent mapping between GS and C2C hazard levels. For example, it could be agreed that GS hazard levels “High” and “very High” always translate to C2C “red” across all corresponding endpoints, GS “Moderate” could always correspond to C2C “yellow”, and GS “Low” and “Very Low” could always correspond to C2C “green” (note that the “very Low” hazard level only exists for Persistence and Bioaccumulation in GS). This would make more consistent signaling to industry of hazard priorities. Such an alignment would, however, require the modification of hazard level cutoffs in one or both of the standards, since the current alignment of hazard levels between GS and C2C differs between endpoints (see section 5.3.2). It would be helpful to have a discussion to establish why endpoint hazards viewed as “Moderate” in the GS scheme would currently be ranked by C2C as “red” for some endpoints (Carcinogenicity, Mutagenicity/Genotoxicity, Reproductive/Developmental Toxicity, and Bioaccumulation), “yellow” in others (categories of Acute Toxicity, Target Organ Single Exposure and Acute/Chronic Aquatic Toxicity), and “green” in others still (endpoints of Target Organ Single Exposure Toxicity). A consistent mapping scheme for the two standards may arise from such a discussion.

5.3.5. **Align Overall Hazard Benchmarks**

A higher step for consistent signaling to industry of hazard reduction priorities would be to align overall hazard benchmarks. C2C does not have an overall hazard rating for individual chemicals, only an overall individual chemical “risk” rating, which includes exposure considerations at the material level. For this level of alignment to occur, C2C would either have to adopt a scheme to assess the overall hazard of chemicals separate from and/or in addition to exposure, or drop exposure considerations from its assessment and switch to the full GS methodology for its evaluation of chemical hazard. Additionally, if alignment of overall hazard benchmarks is desired, the scoring of hazard endpoint data gaps and the evaluation of transformation products in the two standards would need to be compared and aligned.
6. Key Findings, Conclusions and Recommended Next Steps

6.1. Key Findings
The programs represent a diversity of approaches to material health evaluation and disclosure. Underlying the five programs, however, are many similarities in the requirements of inventory, the lists used for screening and the data used for hazard assessment. These underlying similarities can provide the basis for improving program efficiency through shared data platforms and for consistency of signaling through further harmonization.

Our key findings in each area are as follows:

- **Content Inventory:**
  - A substantial core set of primary ingredient information is required in common by all five programs.
  - One entry system (Pharos) already gathers a large majority of the information required by the five systems. A lowest common denominator approach similar to that proposed for the full hazard assessment data categorization can facilitate inventory data collection that is portable between programs.
  - The programs could benefit from collaborating on strategies to manage inventory and on procedures for reporting of residual chemicals.
  - A shared platform will require careful data management and access control as well as broader stakeholder engagement to create a successful system that encompasses all of the programs and is used by all players.

- **List Screening**
  - Three of the five programs (GS, HPD & Pharos BPL) screen for chemical hazards using a hazard lists primarily based on GS List Translator.
  - GS uses the GS List Translator as a first step toward a full GS assessment.
  - C2C also uses a set of lists, most of which overlap with lists in the GS List Translator and could be further informed by it. While list screening is not a key component of C2C, Assessors could benefit from use of the GS List Translator.
  - One database (Pharos CML) already supports most of the lists used by all five programs and could easily accommodate the others.

- **Full Hazard Assessment**
  - Two programs define full hazard assessment methodologies (GS and C2C). Two other programs (Pharos and HPD) include results of the GS assessments.
  - GS and C2C share approximately 80% of the chemical hazard endpoints in their assessment protocols, including a base of 13 hazard endpoints as defined by the GHS and five additional endpoints not currently addressed by GHS.
  - A shared database could be developed that would accommodate all of the data needs for both programs by utilizing a “lowest common denominator” approach to endpoint categorization.
  - Hazard assessments can be shared for many of the endpoints under current protocols as they are based upon a common approach using GHS criteria and levels. Some of the endpoints would require clarification or changes to the criteria of one or both programs to share.
6.2. Conclusions

Based on this analysis of the product inventory and material health evaluation protocols and the degree of overlap and alignment already existing in each of the five programs, we conclude the following:

- **Shared platforms for both product content inventory and chemical hazard analysis can be developed to create a comprehensive single portal of entry for manufacturers and a single repository for hazard classification data at both the list screening and the full assessment levels.** While some other countries have begun such efforts for hazard classification based on the GHS, the US has not. Additionally, a shared hazard database would draw on country-specific lists and databases, and host information on non-GHS endpoints that are currently not publicly accessible. This database could provide a needed service to companies who seek to align with best practices worldwide and create a basis for a unified community of practice for hazard assessments used by GS Profilers and C2C Material Health Assessors. In combination with a cross-program inventory platform, a shared hazard database would create synergies for Assessors and Profilers, reduce costs for manufacturers, increase the rigor of the scientific information used through cross-organizational peer-review, and improve knowledge of product ingredients in support of optimization and transparency. It would also accelerate manufacturer participation by simplifying the entry point, eliminating redundancy, providing a clear progressive path toward optimization, and allowing for options depending on their goals and readiness. These shared platforms are possible because the programs share a significant common base of information. There is potential to define the lowest common denominator of information that can be shared between programs and build a platform that allows sharing and interoperability. Information unique to specific programs can and should be included in the platform to create a one-stop portal.

- While complete harmonization could be highly valuable, the programs do not necessarily need to completely harmonize to take advantage of a shared platform. In fact, their differences may serve different market needs such as options to follow different pathways based on user desire for:
  - **Transparency versus protection of confidential business information.** Some manufacturers are comfortable disclosing their bills of materials and product constituents while others treat such information as proprietary.
  - **Self-disclosure and self-assessment versus use of third party Assessors/Profilers and verification.** Some manufacturers may have deep knowledge of the constituents in their materials and products while others do not. Some manufacturers may derive materials from suppliers who are not willing to disclose their formulations. Use of a third party may serve to protect proprietary information in certain unavoidable situations. And use of third-party verification may add credibility to the information provided.
  - **Fulfillment of LEED v4 requirements only versus more general market recognition.** Some manufacturers may seek to meet minimum requirements for one LEED credit while others may seek additional support for their product in the marketplace via product certification (C2C), certified third party hazard assessments (GS), full transparency of contents and production chemicals, their hazards and renewable characteristics (Pharos BPL) or by meeting Living Building Challenge (LBC) Materials Petal requirement.
6.3. Recommended Next Steps

In order to realize and accelerate the potential for these programs to facilitate the industry’s transition to safer materials we recommend the following:

- **Drive cross-organizational alignment:**
  - Immediately implement a memorandum of understanding between C2C and GS to encourage C2C Assessors to use pre-existing GS hazard assessments as data sources in C2C material health assessments.
  - Expand participation in the Task Group by including representatives from all five programs and potentially others as relevant and feasible. Continue collaboration and discussions to further advance harmonization and strategies for interoperability, particularly for residuals in content inventory, specified hazard lists and data requirements and criteria for non GHS endpoints.

- **Support continued harmonization discussions.** Suggested next topics for development to increase alignment and improve all programs include:
  - **Inventory:** compare systems for managing inventory data collection and assessing residuals for opportunities to improve and align programs.
  - **List screening:** assess lists identified in each program that are not referenced in the others for usefulness for each protocol.
  - **Full assessment:** Further develop and discuss mapping and alignment opportunities for hazard assessment and classification.

- **Support the development of a shared inventory platform** for use by all of the programs.

- **Support the development of a planning process for a shared hazard assessment database.**