Chemical Footprint Project (CFP) Chemicals of High Concern (CoHCs) Reference List v.3.0:

Technical Fact Sheet

December 3, 2024

The *Chemical Footprint Project (CFP) Chemicals of High Concern (CoHCs) Reference List, v.3.0* is a broad-based resource for identifying known CoHCs to human health and the environment. Companies use the Reference List to: identify CoHCs contained in products and packaging, and used in manufacturing processes, supply chains, and maintenance of facilities (for example, used for cleaning offices); set goals for reducing their chemical footprints; and identify, track, and measure reductions in their chemical footprint.

Clean Production Action's definition of a CFP CoHC aligns with the European Union (EU) REACH regulation definition of a substance of very high concern (SVHC),[1] GreenScreen® for Safer Chemicals' Benchmark 1 criteria,[2] and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).[3] A CFP CoHC is: "a carcinogen, mutagen, or developmental/reproductive toxicant; persistent, bioaccumulative, and toxic substance (PBT); very persistent and very bioaccumulative (vPvB); or any other chemical for which there is scientific evidence of probable serious effects to human health or the environment that give rise to an equivalent level of concern—such as endocrine disruption or neurotoxicity—or a chemical whose breakdown products result in a CoHC that meets any of the above criteria."

Version 3.0 of the Reference List, updates version 2.0 of the CFP CoHC Reference List, which was released in 2018. Version 2.0 was based on chemicals with a hazard score of GreenScreen® List Translator-1 (LT-1).

The newly released version 3.0:

- Adds publicly available GreenScreen® Benchmark-1 (BM-1) chemicals
- Updates the list of GreenScreen List Translator-1 (LT-1) chemicals
- Adds chemicals from 19 chemical classes
- Adds an expanded list of Per- and Polyfluoroalkyl Substances (PFAS)
- Revises URLs for the Authoritative Source Lists

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[1] SVHCs are defined in Article 57 of Regulation (EC) No 1907/2006 ("the REACH Regulation"). See European Chemicals Agency (ECHA), "Proposals to identify Substances of Very High Concern previous consultations," accessed November 9, 2024, https://echa.europa.eu/proposals-to-identify-substances-of-very-high-concern-previous-consultations.

[2] Shari Franjevic, Mark Rossi, Amy Hunsicker, and Michelle Wilhelm Turner, GreenScreen® for Safer Chemicals Hazard Assessment Guidance, version 1.4, Clean Production Action, accessed November 9, 2024, https://www.greenscreenchemicals.org/images/ee_images/uploads/resources/GreenScreen_Guidance_v1_4_2018_01_Final.pdf.

[3] See https://unece.org/about-ghs (accessed November 9, 2024).

See below for details on each of these updates.

CFP CoHC Reference List Guidance

The technical guidance below provides background information for each Worksheet 1, 2, 3, and 4 contained in the CFP CoHCs Reference List v.3.0 file. Chemicals included in Worksheets 1, 2, and 3 are considered CoHCs.

Worksheet 1: GreenScreen BM-1+LT-1s

This list of CoHCs contains a comprehensive list of chemicals that have been assessed and/or screened using the method "GreenScreen® for Safer Chemicals Hazard Assessment Guidance" and have received a GreenScreen Benchmark-1 (BM-1) score and/or a GreenScreen List Translator-1 (LT-1) score.[4]

What is a GreenScreen Benchmark-1 (BM-1)?

GreenScreen Benchmark scores are assigned based on a full GreenScreen assessment of a chemical by a Licensed GreenScreen Profiler[5] which includes a comprehensive review of all available information including 1) measured data from toxicological studies in the scientific literature, 2) estimated data from suitable analogs and models, and 3) hazard lists associated with the GreenScreen List Translator.

The Benchmark score is determined by analyzing specific combinations of hazard classifications for 18 human health and environmental hazard endpoints included in GreenScreen (See figure below for the Benchmark-1 Criteria). The Benchmark criteria were developed to reflect hazard concerns that have been established by governments nationally and internationally. An important value of GreenScreen is that Benchmark-1, "Avoid - Chemical of High Concern", clearly defines the criteria for chemicals of high concern to human health and the environment consistent with global regulations like REACH.

Group I Human includes Carcinogenicity, Mutagenicity/Genotoxicity, Reproductive Toxicity, Developmental Toxicity (incl. Developmental Neurotoxicity), and Endocrine Activity. **Group II Human** includes Acute Mammalian Toxicity, Systemic Toxicity/Organ Effects-Single Exposure, Neurotoxicity-Single Exposure, Eye Irritation and Skin Irritation. **Group II* Human** includes Systemic Toxicity/Organ Effects-Repeated Exposure, Neurotoxicity-Repeated Exposure, Respiratory Sensitization, and Skin Sensitization. Immune System Effects are included in Systemic Toxicity/Organ Effects. **Ecotoxicity** includes Acute Aquatic Toxicity and Chronic Aquatic Toxicity.

[4] See GreenScreen Method documents: https://www.greenscreenchemicals.org/assess/method
[5] See list of Licensed GreenScreen Profilers: https://www.greenscreenchemicals.org/assess/profilers

What is a GreenScreen List Translator-1 (LT-1)?

A List Translator score of "LT-1" means the hazard classification(s) across 18 human health and environmental hazard endpoints for a given chemical meet one or more of the GreenScreen Benchmark-1 criteria (see figure above), and this information is based on Authoritative lists from the GreenScreen Specified Lists (see Worksheet 4 - Authoritative Source Lists).

An LT-1 score is based on clear agreement among Authoritative lists that the substance is a CoHC and may be considered equivalent to a GreenScreen Benchmark-1.

The LT-1 chemicals list in Worksheet 1 was generated using one of Clean Production Action's Licensed GreenScreen List Translator™ Automators' tools, the Pharos tool by Habitable (formerly Healthy Building Network).[6]

Worksheet 2: Chemical Classes

This list of CoHCs contains a comprehensive list of chemicals based on known chemical classes of concern. Using this method of identifying CoHCs is a protective and efficient method of hazard evaluation based on shared structural similarities of chemicals within a class, which often translates to similarities in the inherent hazards. Targeting classes of chemicals for removal can help prevent regrettable substitutions when one chemical is replaced by a structurally similar chemical that will end up having similar hazardous effects.[7]

The CFP CoHC Reference list includes the following 19 chemical classes:

1. Alkylphenols and alkylphenol ethoxylates
2. Azo dyes and azo colorants
3. Benzophenones
4. Bisphenols
5. Cyclic Volatile Methyl Siloxanes (D4, D5, D6)
6. Formaldehyde releasers
7. Halogenated organic compounds
8. Ortho-phthalates
9. Ozone depleting substances (ODS)
10. Parabens
11. Per- and polyfluoroalkyl substances (PFAS)
12. Antimony and compounds
13. Arsenic and compounds
14. Cadmium and compounds
15. Chromium VI and compounds
16. Cobalt and compounds
17. Lead and compounds
18. Mercury and compounds
19. Organotin compounds

Below are the definitions and explanations for these 19 chemicals classes.

[6] https://pharos.habitablefuture.org
[7] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9835214/

1. Alkylphenols (APs) and alkylphenol ethoxylates (APEOs)

- Alkylphenols (APs) are chemical compounds that consist of one or more alkyl chains bound to a phenol. Phenol consists of an aromatic ring and a hydroxyl group. An alkyl chain is an acyclic saturated hydrocarbon (consisting of hydrogen and carbon atoms arranged in a tree structure in which all carbon-carbon bonds are single) with the general formula CnH2n+1. Alkylphenol ethoxylates (APEOs) are derivatives of alkylphenols prepared by a chemical reaction between ethylene oxide and an alkylphenol, resulting in an ethoxylated chain with the general formula -(OC2H4) n OH replacing the hydroxyl group.[8]
- APs and APEOs as a class are persistent, bioaccumulative, and toxic to aquatic organisms and likely endocrine disruptors (estrogenic) that affect fertility and development. APEOs breakdown into APs, which are also toxic, but more stable and persistent that APEOs. APEOs are often used as surfactants, while APs are used as intermediates in the production of resins, plastics, and adhesives.[9]
- Chemical group members for alkylphenols and alkylphenol ethoxylates were sourced from Habitable's Pharos database.

2. Azo dyes and azo colorants

- "Azo dyes and pigments are colourants that incorporate one or several azo groups (-N=N-) bound with aromatic compounds. Thousands of azo dyes exist, but only those that degrade to form the listed cleavable amines are restricted."[10]
- Azo dyes which breakdown to form aromatic amines through reductive cleavage are substances of concern for being carcinogenic, skin and eye irritants, respiratory irritants or toxic to the aquatic environment. Azo dyes themselves can be mutagenic due to their nitro group– with reproductive and developmental toxicity.
- Chemical group members for azo dyes and azo colorants were sourced from Habitable's Pharos database, which includes chemicals identified by CompTox and ECHA.

3. Benzophenones

- Benzophenones are organic compounds containing a ketone attached to two phenyl groups.[11]
- Many of the chemicals in this class are persistent, bioaccumulative, and toxic. They cause endocrine disruption and organ toxicity, especially liver hypertrophy, as well as skin irritation. CA Prop 65 classifies benzophenone (CAS: 119-61-9) itself as a potential carcinogen. Benzophenones are widely used (mainly to prevent UV damage) in flavorings and fragrances, in plastics and adhesives, as well as pharmaceutical manufacturing (NIH NLM).
- Chemical group members for benzophenones were sourced from the GreenScreen Certified Standard for Single-Use Food Service Ware & Thermal Paper restricted substances list. This list is a combination of the 1) Safer Materials in Food Packaging, Safer Made, March 2019, and 2) Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food.[12]

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[8] Alkylphenols and alkylphenol ethoxylate definition, GreenScreen Certified for Single-Use Food Service Ware & Thermal Paper, Version 1.2, September 2023

[9] See also ZDHC Guidance Sheet: https://mrsl-30.roadmaptozero.com/guidancesheethtml?sheet=29

[10] Azo dyes and azocolourant definition from the ZDHC MRSL v3.1

[11] IARC definition

[12] See Table A5: RSL Reference List for Benzophenones, page 47 of the GreenScreen Certified for Single-Use Food Service Ware & Thermal Paper, Version 1.2, September 2023

4. Bisphenols

- Any chemical compound with the following characteristics:
    1. All chemical compounds with a Tanimoto Coefficient of 0.9-1.0 (compared to Bisphenol-A CASRN 80-05-7) are restricted. [Note: Tanimoto Coefficient as calculated using EPA's CompTox Dashboard].
    2. Any chemical compound with a Tanimoto Coefficient of 0.8-0.9 is restricted until there are publicly available, valid in vitro or in vivo hazard data that enable evaluation of estrogen and androgen receptor agonism and antagonism. If a compound does not have significant endocrine disrupting potential, it is not included.
    3. Chemical compounds with a Tanimoto Coefficient <0.8 shall be considered restricted if the compound: a) Has demonstrated endocrine disrupting potential (estrogen and/or androgen receptor agonism and/or antagonism) and is used as a functional substitute for BPA, or b) Is detected in environmental media or human biomonitoring studies and it is used as a functional substitute for BPA and publicly available hazard data to evaluate endocrine disrupting potential (estrogen and/or androgen receptor agonism and/or antagonism) are lacking.[13]
- Bisphenol A (BPA) is on the EU REACH restricted substances list as well as on the California Proposition 65 list for developmental and reproductive toxicity for women.
- Chemical group members for bisphenols were sourced from Habitable's Pharos database.

5. Cyclic volatile methyl siloxanes (D4, D5, D6)

- Cyclosiloxanes are members of the family of silicone materials that have repeating units of silicone (Si) and oxygen (O) atoms in a closed loop, giving it a cyclic structure. Cyclic volatile methyl siloxanes (cVMS) are a subset of this class that are restricted based on their hazard profiles.[14]
- Cyclic volatile methyl siloxanes D4, D5, and D6 are persistent, bioaccumulative, and toxic – particularly to the endocrine and reproductive systems. These are part of the REACH candidate list of substances of very high concern.
- Chemicals included in this class are:
    - Dodecamethylcyclohexasiloxane (D6), CASRN 540-97-6
    - Decamethylcyclopentasiloxane (D5), CASRN 541-02-6
    - Octamethylcyclotetrasiloxane (D4), CASRN 556-67-2

6. Formaldehyde releasers

- Formaldehyde releasers are defined as chemicals that release formaldehyde (CAS 50-00-0) over time. These chemicals are restricted under REACH because of the potential to release formaldehyde, which is a known carcinogen and sensitizing agent (National Toxicology Program, CA Prop 65). Formaldehyde also has high hazard for systemic toxicity, neurotoxicity, skin and eye irritation, respiratory sensitization, and aquatic toxicity.
- Formaldehyde releasers and formaldehyde itself are commonly found in textile and leather processing, coatings, and in fertilizer production.

[13] See Definition for BPA analogs, page 4, of the GreenScreen Certified for Single-Use Food Service Ware & Thermal Paper, Version 1.2, September 2023.
[14] Definition from Toxic Free Future

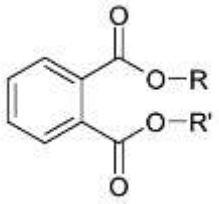
- Chemical group members for Formaldehyde Releasers were sourced from ECHA Investigation Report: Formaldehyde and Formaldehyde Releasers.

7. Halogenated Organic Compounds (Organohalogens)

- Organohalogens are defined as chemicals containing one or more halogen atoms (typically chlorine, bromine, fluorine, or iodine) bound to a carbon atom.
- All organohalogens are included on this list because as a class, they are extremely persistent and bioaccumulative, with a wide range of human health hazards including reproductive toxicity, neurotoxicity, immunotoxicity, endocrine disruption, and carcinogenic effects. Organohalogens include PFAS, many ozone depleting substances, and other known environmental contaminants such as DDTs (insecticides), polychlorinated biphenyls, and chlorinated or brominated dioxins.
- Chemical group members for organohalogens were sourced from Habitable's Pharos database. Sources for the Pharos chemical group include PubChem structural searches, the EPA ToxCast Inventory, the California Safer Consumer Products List, the California Biomonitoring list and Environment Canada. This list can also be found in the GreenScreen Certified Standard for Cleaners and Degreasers in Manufacturing.

8. Ortho-phthalates

- Phthalates are a benzene derivative family formed by the esterification of phthalic acid.[15]
- Dialkyl ortho-phthalates (or phthalate esters) are a subclass of phthalates, with the general chemical structure shown below, where each R group only contains hydrogen and carbon either in a linear or branched chain or cyclic chain.[16]
- Dialkyl ortho-phthalates are known for being endocrine disruptors (especially testosterone), as well as having reproductive and developmental toxicity. These also bioaccumulate in aquatic systems.
- Phthalates are most used in making PVC plastics as well as printing inks, personal care products, and coatings (ZDHC).



- Chemical group members for Ortho-phthalates were sourced from Habitable's Pharos database.
- Chemical group members for ortho-phthalates were compiled using the ortho-phthalates approved for use in food contact materials by US FDA, or EU (EU No 10/2011), or those being used under the FDA GRAS process.[17,18]

[15]Definition from the NIH, https://pubchem.ncbi.nlm.nih.gov/compound/Phthalate
[16] Adapted from USEPA Phthalates Action Plan 2012
[17] U.S. Food and Drug Administration, Phthalates in Food Packaging and Food Contact Applications
[18] COMMISSION REGULATION (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food

9. Ozone Depleting Substances (ODS)

- "A compound that contributes to stratospheric ozone depletion. ODS include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, hydrobromofluorocarbons, chlorobromomethane, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone."[19]
- Chemical group members for ozone depleting substances were sourced from the GreenScreen Certified for Cleaners & Degreasers in Manufacturing restricted substances list for ozone depleting substances, which was created from the Apple Regulated Substances Specification.[20]

10. Parabens

- "Parabens are a family of alkyl esters of para-hydroxybenzoic acid. Different parabens differ in the chemical substitutions in the para position of the benzene ring." [21]
- The class of parabens has been flagged for being estrogenic endocrine disruptors, having reproductive and developmental toxicity, and for their link to skin and breast cancers. Parabens are widely found in personal care products, clothing and textiles, and household cleaning products.[22]
- Chemical group members for parabens were sourced from Habitable's Pharos database. This list can also be found in the GreenScreen Certified Standard for Single-Use Food Service Ware & Thermal Paper restricted substances list for parabens.[23]

11. Per- and polyfluoroalkyl substances (PFAS)

- Per- and polyfluoroalkyl substances are a class of organic chemicals containing at least one fully fluorinated carbon atom. The definition of PFAS used by CFP is "A class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom."[24]
- PFAS are extremely persistent and bioaccumulative. They have been linked to higher cholesterol and liver damage, obesity, thyroid toxicity, reproductive toxicity during fertility and pregnancy (hypertension and preeclampsia), and immunotoxicity. They have also been linked to increased cancer risk – specifically testicular, kidney and prostate. Research has shown that short chain as well as long chain PFAS have these toxic effects.
- PFAS are widely used for their heat, water, and grease resistance properties as coatings on cookware, fabrics and textiles, as well as being used as a chemical additive in a range of products from firefighting foam to cosmetics.

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[19] Definition from the U.S. EPA under the Montreal Protocol: https://www.epa.gov/ozone-layer-protection/ozone-depleting-substances.

[20] See Table A1: RSL Reference List for Ozone Depleting Substances, page 19 of the GreenScreen Certified for Cleaners & Degreaser in Manufacturing, Version 1.0, September 2021

[21] See Definition for Parabens, page 4, of the GreenScreen Certified for Single-Use Food Service Ware & Thermal Paper, Version 1.2, September 2023. Originally from Environment Canada.

[22] See https://biomonitoring.ca.gov/sites/default/files/downloads/ParabensFactSheet.pdf

[23] See Table A4: RSL Reference List for Parabens, page 49 of the GreenScreen Certified for Single-Use Food Service Ware & Thermal Paper, Version 1.2, September 2023

[24] SB 5135, Safer Products for WA ACT; http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Senate%20Passed%20Legislature/5135-S.PL.pdf?q=20210811124919, accessed 4/17/23

- Chemical group members for PFAS were sourced from the USEPA CompTox Database list of per- and polyfluoroalkyl substances.[25]

12-19. Heavy metals and their compounds: Antimony, Arsenic, Cadmium, Chromium VI, Cobalt, Lead, Mercury, and Organotins

- Heavy metals and their compounds have a wide range of health impacts including: neurotoxicity of central and peripheral nervous systems, carcinogenicity, reproductive and developmental toxicity. Many are also linked to kidney and gastrointestinal toxicity through oral exposure, immunotoxicity, and reproductive and developmental toxicity. In the environment they bioaccumulate and are toxic to the aquatic environment.
- Lead is perhaps the most well-known toxicant for its effects on multiple body systems, and its effects on children's brain and central nervous system developments.
- Heavy metals are widely found in products and used in manufacturing operations and supply chains, including pigments and dyes, impurities in metal alloys, and in the manufacture of PVC.
- Chemical group members for heavy metals and their compounds were sourced from Habitable's Pharos database.

Worksheet 3: U.S. Environmental Protection Agency, List of Per- and Polyfluoroalkyl Substances (PFAS) from CompTox Database

Companies are encouraged to set robust elimination goals for PFAS inputs to its products, manufacturing operations, and/or packaging.

The list of PFAS chemicals in the CFP CoHCs Reference List was assembled from the USEPA CompTox Database and contains ~16,000 chemicals.

Worksheet 4: Authoritative Source Lists

The GreenScreen List Translator™ provides a "list of lists" approach to quickly identify chemicals of high concern. This Worksheet provides source information for the Authoritative lists used to identify GreenScreen List Translator LT-1s in the CFP CoHC Reference List. Authoritative Lists include results from hazard assessments by authoritative scientific bodies convened by international, national and state governmental agencies, intergovernmental agencies and NGOs, often as part of government regulatory processes. An LT-1 score is based on clear agreement among Authoritative lists that the substance is a CoHC and may be considered equivalent to a GreenScreen Benchmark-1.

[25]The CFP PFAS Reference List is a combination of the CompTox PFASSTRUCTV5 (version August 2022, https://comptox.epa.gov/dashboard/chemical-lists/PFASSTRUCT) and PFASDEV2 (version August 8, 2021, https://comptox.epa.gov/dashboard/chemical-lists/PFASDEV) accessed in October 2023. These lists are periodically updated and replace the retired PFASMASTER list which was last updated in August 2021.