Section IV — Assessing Chemicals with GreenScreen List Translator™

23. INTRODUCTION

A GreenScreen List Translator assessment is a streamlined chemical hazard assessment based on review of GreenScreen Specified Lists only. Authoritative and screening hazard lists can be very informative as a preliminary step to quickly identify known chemicals of high concern and to prioritize chemicals for further review. GreenScreen List Translator consolidates over 40 primary authoritative and screening sources and hundreds of sub-lists that include national and international regulatory and hazard lists, influential NGO lists of chemicals of concern (screening lists), lists from authoritative scientific bodies, European Risk and Hazard Phrases and chemical hazard classifications by countries using the Globally Harmonized System of Classification and Labelling of Chemicals.

All of the GreenScreen Specified Lists (Annex 11) used in GreenScreen have been compiled and subsequently mapped to hazard endpoints and hazard levels and published in the GreenScreen List Translator Map (Annex 12) and in the GreenScreen Chemical Hazard Criteria (Annex 1).

23.1 Method Limitations

GreenScreen List Translator only includes a review for presence or absence of a chemical on the GreenScreen Specified Lists. Since only a small fraction of chemicals in commerce have been reviewed by the organizations that publish these lists, a chemical's absence from a list does NOT mean that the chemical has a low hazard profile. A score of LT-UNK indicates a chemical was present on a GreenScreen Specified List, but the information contained within the list did not result in a clear mapping to a LT-1 or LT-P1 score. Thus, more research is needed to determine its hazard profile and whether it is a chemical of high concern.

GreenScreen List Translator does not include a data gap analysis. As such, a chemical with less data available may receive a more favorable score than a chemical that has been well studied and characterized. However, the risk of using the chemical of unknown hazard may be higher than using a chemical of known hazard depending on the hazard profile of the chemical.

GreenScreen List Translator does not include assessment of environmental transformation products, such as by-products of microbial action in sediment or waste treatment, chemical transformation in surface waters, or photochemical reactions in the atmosphere. A thoughtful follow-on process will consider the ramifications of this limitation.

To identify safer alternatives and make high impact choices, it is recommended to use a more comprehensive assessment leading to a GreenScreen Benchmark score.

24. LIST TRANSLATOR RESOURCES

While a GreenScreen List Translator assessment is included as one portion of the more comprehensive GreenScreen assessment, it can also be used as a standalone tool to screen for known chemicals of high concern in products. In addition to this guidance, the following resources[8] are needed to complete a List Translator assessment:

24.1 Annex 11 – GreenScreen Specified Lists,

24.2 Annex 12 – GreenScreen List Translator™ Map

25. USES AND APPLICATIONS OF GREENSCREEN LIST TRANSLATOR

Using GreenScreen List Translator can be a first step toward a GreenScreen assessment and an affordable way to expedite the process of assessing the hazards of chemicals found in products. While it cannot substitute for a comprehensive GreenScreen assessment, there are still a variety of practical uses:

1) rapidly identifying LT-1 (Likely Benchmark-1) and LT-P1 (Possible Benchmark-1) chemicals when conducting an alternatives assessment,
2) earning LEED credit,[9]
3) prioritizing chemicals for further review and/or phase-out,
4) meeting client specifications for eliminating chemicals of very high concern,
5) assisting in regulatory and non-regulatory standard compliance, and
6) communicating materials goals and criteria to suppliers.

26. PROCESS OVERVIEW

GreenScreen List Translator maps GreenScreen Specified Lists to hazard endpoints, hazard levels and List Translator scores. The GreenScreen List Translator Map in Annex 12 documents this mapping, and is not a database of scores for specific chemicals (i.e. by CASRN). See Section 32 for automated tools that provide List Translator scores for chemicals of interest. The following table provides an overview of steps to evaluate chemicals using GreenScreen List Translator.

TABLE 4. **Quick Steps to Conduct a GreenScreen List Translator Assessment**

Step 1	Determine chemicals to assess
Step 2	Search GreenScreen Specified Lists (automated or manual search)
Step 3	Assess and classify hazards
Step 4	Determine List Translator score
Step 5	Report results: 1. List Translator score for each ingredient 2. List Translator Hazard Summary Table & lists 3. Resolution of any LT-P1 results

8 http://greenscreenchemicals.org/method/method-documents, accessed 12/15/17.
9 http://greenscreenchemicals.org/practice/leed, accessed 12/15/17.

27. STEP 1 – DETERMINE CHEMICALS TO ASSESS

The guidance in this Section IV applies to conducting a GreenScreen List Translator assessment for a single chemical identified by a CASRN.

28. STEP 2 – SEARCH GREENSCREEN SPECIFIED LISTS

The GreenScreen Specified Lists in Annex 11 contain web links to each list. Check each list for the presence of a chemical of interest. If a chemical is found on a list, compile the name(s) of the list(s) and the related list endpoint category. The GreenScreen Chemical Hazard Criteria in Annex 1 or the GreenScreen List Translator Map in Annex 12 can be used to determine which hazard endpoint(s) relate to the listing. This will be needed in later steps.

28.1 Individual versus Multiple Hazard Lists

In most GreenScreen Specified Lists, the listing category is specific to a single hazard endpoint. For example, several agencies have lists of carcinogens. While these carcinogens may also express other toxic properties, the source lists specifically address the individual Carcinogenicity endpoint. Chemicals with data for individual hazard endpoints will normally be assigned a hazard level such as very High, High, Moderate, or Low (See sub-section 29).

Some lists, however, address multiple hazard endpoints (e.g., lists of Persistent-Bioaccumulative-Toxic (PBT) chemicals or their equivalents). “Multiple Endpoints” are also indicated for many GHS classifications of Reproductive Toxicity. For an example, UNEP and EU GHS classifications often combine reproductive toxicity effects and developmental toxicity effects into a single endpoint called “Reproductive Toxicity.”

28.2 Authoritative versus Screening Lists

Authoritative Lists include results from hazard assessments by recognized experts, often as part of government regulatory processes. These results are considered to be highly reliable and should only be changed when new data or special circumstances clearly indicate that a new hazard level is warranted. Intervention of a Licensed GreenScreen Profiler or CPA’s Consulting Toxicologist would be required to validate such a change.

Screening Lists result in a classification with a lower level of confidence because at least one of the following is true of the list. It was:

1) developed using a less comprehensive review,
2) compiled by an organization that is not considered to be authoritative,
3) developed using predominantly or exclusively estimated data, or
4) developed to identify chemicals for further review and/or testing.

Regulatory prioritization screening lists are an example (e.g., Canada’s Domestic Substances List (DSL)). In the DSL program, quantitative structure-activity relationship models were used to fill in gaps in hazard data. These types of models have inherent error bounds and cannot produce results with the same reliability as good quality experimental data. See Table 5.

28.3 A-Sublists and B-Sublists

1) A-Sublists include data that give clear, focused hazard levels. Two situations occur:
   a. One hazard endpoint with only one possible hazard level (e.g., a US CDC occupational carcinogen can only lead to the result "High Concern" for Carcinogenicity), or
   b. A hazard classification with only one possible List Translator score (e.g., a chemical on the U.S. EPA Priority PBT list) will receive an LT-1. No other score is possible for substances on this list.
2) B-Sublists include data that cannot be captured in a single hazard level or single hazard endpoint. For example:
   a. The G&L list identifies neurotoxic chemicals; however, no assessment of the potency of the substances or severity of the effects is offered. Presence on the G&L list is therefore classified as a range of possible hazard levels, from very High to Moderate.
   b. Current UNEP and EU GHS classification schemes combine reproductive and developmental toxicity into a single endpoint. As such, an indication of hazard cannot always be separated into either Reproductive (R) or Developmental (D) Toxicity effects. Chemicals on these hazard lists may not translate into the individual R and D endpoints and instead be assessed against "Multiple" criteria that combine R and D.

TABLE 5. **Categorization of GreenScreen Specified Lists**

List Type	Description	Possible Combinations
Authoritative Lists	Authoritative lists are generated by recognized experts, often as part of a government regulatory process to identify chemicals and known associated hazards. These lists are considered to be of high reliability and should only be changed when new data or special circumstances clearly indicate that a new level-of-concern is warranted. Intervention of a Licensed GreenScreen Profiler or CPA's Consulting Toxicologist would be required to validate such a change.	Authoritative A*
		Authoritative B**
Screening Lists	Screening Lists result in a classification with a lower level of confidence because at least one of the following is true of the list. It was: 1. developed using a less comprehensive review, 2. compiled by an organization that is not considered to be authoritative, 3. developed using predominantly or exclusively estimated data, or 4. developed to identify chemicals for further review and/or testing.	Screening A*
		Screening B**

* A Sublists: This category in the list translates directly to one of the following: 1) a single hazard classification for a single GreenScreen Hazard Endpoint, or 2) a single Benchmark.

** B Sublists: Categories that meet one or more of the following: 1) This category in the list incorporates a single GreenScreen Hazard Endpoint and does not translate directly to a single Hazard Classification or Benchmark; AND/OR 2) This category in the list refers to more than one GreenScreen Hazard Endpoint; AND/OR 3) This category in the list specifies that the hazard is associated with a specific form of the substance or a specific exposure route.

28.4 Trumping rules

The GreenScreen Specified Lists carry inherent weighting based on the organization that publishes the list as well as the process used to develop the list. These factors are captured in the list type as explained in the list definitions in Table 5 above. When a specific hazard endpoint for a given chemical is found on more than one GreenScreen Specified List, one of the lists will drive the hazard classification by taking precedence over the other list(s).

The rules for selecting which list takes precedence over the other lists are depicted in Table 6 below. When the chemical shows up on more than one list for the same hazard endpoint, find the first list type in Column 1 and the second list type in Row 1. The rule found in the cell at the intersection of the two list types determines which list will control the hazard classification. Repeat this process for each hazard endpoint for which the chemical of interest appeared on more than one list.

For example, if one list is an Authoritative B list and the second is a Screening A list, then the Authoritative B list will "trump" the Screening A list and drive the hazard classification for the hazard endpoint. When a chemical shows up on more than two lists, the same procedure is used iteratively, beginning with the first two lists.

When a list results in a hazard range that spans only two hazard levels (e.g., H or M) as seen in the "Display in Hazard Box" column of the List Translator, use the highest end of the range (e.g., H) to determine whether a given list is most conservative. If the list results in a hazard range that spans more than two hazard levels, the hazard is classified as UNK. When a list results in a hazard level of UNK, the list is not used in the "trumping" process described above. However, if it is the only list for the hazard endpoint, place UNK in the Hazard Summary Table for that hazard endpoint.

TABLE 6. **Trumping Rules for GreenScreen Specified Lists**

	Column 1	Column 2	Column 3	Column 4	Column 5
Row 1		Authoritative A	Authoritative B	Screening A	Screening B
Row 2	Authoritative A	Most Convervative	Most Conservative	Authoritative A	Authoritative A
Row 3	Authoritative B		Most Conservative	Authoritative B	Authoritative B
Row 4	Screening A			Most Conservative	Most Conservative
Row 5	Screening B				Most Conservative

29. STEP 3 – ASSESS AND CLASSIFY HAZARDS – LIST TRANSLATOR

29.1 The hazard classification step in a List Translator assessment is based on hazard lists (i.e., GreenScreen Specified Lists) only. The GreenScreen List Translator method does not include data requirements to achieve a given List Translator score; however, GreenScreen assessments do have strict minimum data requirements for each Benchmark score.

29.2 The GreenScreen List Translator Map specifies the hazard endpoint(s) and hazard level(s) associated with each listing on a GreenScreen Specified List, as well as the List Translator score associated with each listing. The hazard levels are described in Table 7.

TABLE 7. **Description of Hazard Levels for List Translator**

Hazard Level Classification*	
vH	Very High Concern
H	High Concern
M	Moderate Concern
L	Low Concern
vL	Very Low Concern
(BLANK)	The chemical was not found on any of the authoritative or screening lists associated with GreenScreen
Range	A range may be reported for chemicals found on "B" lists. B lists sometimes include a level of uncertainty and may benefit from additional research to confirm a more specific hazard classification level

* **Bold** font indicates result was derived from an Authoritative A list; *Italics* font indicates result was derived from Authoritative B, Screening A, or Screening B lists

29.3 Document Hazard Levels

In the Hazard Summary Table (See example in Table 8), indicate the hazard level assigned to each hazard endpoint. Display the hazard level in the Hazard Summary Table as it appears in the "Display in Hazard Box" column of the List Translator Map for the list that is driving the hazard score. The hazard levels and ranges in the List Translator Map were determined as follows:

1) Where a hazard range spans only 2 levels (e.g., H or M), the range is displayed in the Hazard Summary Table.
2) Where a hazard range spans more than 2 levels (e.g., H, M, or L), UNK is displayed in the Hazard Summary Table.
3) When a CASRN is found on a multiple endpoint list, "Mult" is displayed in the Multiple hazard box in the Hazard Summary Table. (See sub-section 28.1 – Individual versus Multiple Hazard Lists).

TABLE 8. **Example List Translator Hazard Summary Table**

Group I Human					Group II and II* Human								Ecotex		Fate		Physical		Multiple
C	M	R	D	E	AT	ST		N		SnS*	SnR*	IrS	IrE	AA	CA	P	B	Rx	F	
						SINGLE	REPEATED*	SINGLE	REPEATED*											
			M or L	*H or M*	L	*vH*	*H*	*M*	*M or L*			*M*	**H**			*vH or H*			*H*	*Mult*

Glossary of GreenScreen® Hazard Endpoint Abbreviations

AA Acute Aquatic Toxicity
AT Acute Mammalian Toxicity
B Bioaccumulation
C Carcinogenicity
CA Chronic Aquatic Toxicity
D Developmental Toxicity
E Endocrine Activity
F Flammability
IrE Eye Irritation
IrS Skin Irritation
M Mutagenicity and Genotoxicity
N Neurotoxicity
P Persistence
R Reproductive Toxicity
Rx Reactivity
SnS Sensitization (Skin)
SnR Respiratory Sensitization
ST Systemic/Organ Toxicity

* *Repeated exposure*

30. STEP 4 – DETERMINE LIST TRANSLATOR SCORE

30.1 List Translator Score Description

Use List Translator score nomenclature only, and not GreenScreen Benchmark nomenclature, to communicate results from a GreenScreen List Translator assessment. There are only 3 possible List Translator scores. List Translator scores begin with LT (i.e., LT-1, LT-P1, LT-UNK) to clearly distinguish the scores from GreenScreen Benchmark scores. See Table 9 for List Translator scoring nomenclature and how each List Translator score is related to GreenScreen Benchmark scores.

Results reported as LT-P1 may be resolved by performing further research on the hazard endpoint(s) driving the LT-P1 score. Using this approach, there are only two possible resolved scores, either LT-1 or LT-UNK. See Table 9 for two approaches to resolve LT-P1 scores.

GreenScreen List Translator cannot be used to verify that a chemical is safe or even to say that it is safer than a Benchmark-1. A chemical that receives a List Translator score of LT-UNK may be a safer chemical; however, it may also be a chemical that has not been evaluated by the organizations publishing GreenScreen Specified Lists, or it may be a chemical that has not been well tested and has minimal data available (unknown hazard). Due to the more comprehensive nature of GreenScreen assessments, Benchmark scores always trump List Translator scores.

TABLE 9. **List Translator versus Benchmark Scores**

List Translator Score	GreenScreen Benchmark Equivalent	Derivation	Exceptions/Resolution
LT-1	Likely Benchmark-1	An LT-1 score is based on clear agreement among Authoritative lists that the substance is a Chemical of High Concern and may be considered equivalent to a GreenScreen Benchmark-1.	EXCEPTIONS: chemicals that are hazardous due to form-specific issues (e.g., silica, TiO2). RESOLUTION: The solution is to fully characterize the form (e.g., particle-size distribution, purity, etc.), and obtain a GreenScreen assessment to determine a Benchmark score.
LT-P1	Possible Benchmark-1	Frequently this means that the chemical appears on a list that does not translate directly to a single Benchmark score and Benchmark-1 is included in the range of possible Benchmark scores.	EXCEPTIONS: none RESOLUTION: It is an option to resolve LT-P1 scores to further support decision-making.[10] There are two ways to do so: 1. Evaluate only the Hazard Endpoints driving the LT-P1 score using guidance in Section I. (e.g., P, B and T): a. If it meets Benchmark-1 criteria, assign a score of LT-1. b. If it does not meet Benchmark-1 criteria, assign a score of LT-UNK. 2. Perform a GreenScreen assessment and report the final Benchmark score.
LT-UNK	Unknown Benchmark	LT-UNK ("unknown") indicates that a chemical is present on a GreenScreen Specified List but that there is insufficient information to classify the hazard as LT-1 or LT-P1. The LT-UNK score or the absence of a chemical on hazard lists does not mean it is safe. It may mean the chemical has not been reviewed by the body publishing the list or that the chemical has not yet been well tested.	A GreenScreen assessment would need to be performed to determine the Benchmark score of the chemical.

30.2 Assign a List Translator score

Assign each chemical a List Translator score based on the combination of the hazard levels and hazard endpoints as reported in the List Translator Hazard Summary Table. First determine a List Translator score based on individual endpoint hazard lists, then determine a List Translator score based on multiple endpoint lists. Assign the most conservative List Translator score.

To determine a List Translator score based on individual endpoint hazard lists, compare the Hazard Summary Table to the LT-1 criteria in Table 10 below. You can use Table 10 as a worksheet to determine whether one or more of the List Translator scoring criteria are met. If a hazard range spans only 2 hazard levels (e.g., H or M), use the most conservative hazard value (e.g., H) for scoring. When the hazard level is specified as UNK for a hazard endpoint(s), do NOT use the hazard endpoint(s) to assign a "Yes" for any scoring criteria.

10 Resolving LT-P1 scores is required for Option 2 of the LEED v4 Optimization credit (http://www.greenscreenchemicals.org/practice/leed), accessed 12/15/17.

TABLE 10. **List Translator Scoring Algorithm**

LT-1 Criteria	Answer (Y or N)	List Type(s)	Hazard Endpoint(s)
a. High Toxicity (Group I)			
b. High P **AND** High B **AND** very High Toxicity (Ecotox or Group II) **OR** High Toxicity (Group I or II*)			
c. very High P **AND** very High B			
d. very High P **AND** very High Toxicity (Ecotox or Group II) **OR** High Toxicity (Group I or II*)			
e. very High B **AND** very High Toxicity (Ecotox or Group II) **OR** High Toxicity (Group I or II*)]			

Human Health Group I: Carcinogenicity (C), Mutagenicity & Genotoxicity (M), Reproductive Toxicity (R), Developmental Toxicity including Neurodevelopmental Toxicity (D), and Endocrine Activity (E)

Human Health Group II: Acute Toxicity (AT), Systemic Toxicity & Organ Effects (ST-single), Neurotoxicity (N-single), Skin Irritation (IrS), and Eye Irritation (IrE)

Human Health Group II*: Systemic Toxicity & Organ Effects* Repeated Exposure (ST-repeated, Neurotoxicity – Repeated Exposure (N-repeated), Skin Sensitization (SnS) and Respiratory Sensitization (SnR)

Environmental Toxicity & Fate (Ecotox): Acute Aquatic Toxicity (AA), Chronic Aquatic Toxicity (CA), Other Ecotoxicity studies when available, Persistence (P), Bioaccumulation (B)

Physical Hazards: Reactivity (Rx), and Flammability (F)

30.2.1 Step 4a: LT-1 Criterion (a)

1) If one or more combinations of hazard endpoint and hazard level meet LT-1 Criterion (a), and the hazard level in at least one of those combinations is based on an Authoritative A list, the chemical score is LT-1. This is true even if other hazard levels are based on Authoritative B or Screening lists, as the most conservative listing (i.e. Authoritative A) drives the final score.
2) If one or more combinations of hazard endpoint and hazard level meet LT-1 Criterion (a), and all hazard levels are based on either Screening lists or Authoritative B lists, the chemical score is LT-P1.

30.2.2 Step 4b: LT-1 Criteria (b) through (e)

1) If the combination of hazard endpoints and hazard levels in the Hazard Summary Table results in meeting Criterion (b), (c), (d), or (e), and all are based on Authoritative A lists, the score is LT-1.
2) If the combination of hazard endpoints and hazard levels used to meet Criterion (b), (c), (d), or (e) were based on both Authoritative AND Screening lists, the score will be LT-P1.
3) If the combination of hazard endpoints and hazard levels used to meet Criterion (b), (c), (d), or (e) were all based on Screening A or B lists, the score will be LT-P1.

30.2.3 Step 4c: Multiple endpoint hazard lists

To assign a List Translator score from a multiple endpoint hazard list, use the List Translator score provided in the GreenScreen List Translator Map (Annex 12). Do not use the LT-1 criteria in Table 10. A List Translator score has already been assigned in Annex 12 based on an in-depth review of the underlying source list criteria and endpoints and application of the List Translator scoring criteria above. If the chemical is found on more than one multiple endpoint hazard list, assign the most conservative List Translator score.

30.2.4 Step 4d: Assign a final List Translator score

Determine the final score for the chemical of interest based on the information from steps 4a-4c above by selecting the most conservative score. For example, if you assigned a score of LT-1 based on step 4a, an LT-UNK based on step 4b, and an LT-P1 based on step 4c, the final score for the chemical would be LT-1.

If all answers are "No" in the scoring algorithm, the score is LT-UNK. If the chemical of interest is not found on any of the GreenScreen Specified Lists, the chemical does not receive a List Translator score. The result should be communicated as "NoGSLT."[11]

31. STEP 5 – REPORT LIST TRANSLATOR RESULTS

31.1 Supporting Documentation

Each List Translator assessment should include, at a minimum:

1) Chemical Name and CASRN (can be redacted, as applicable),
2) List Translator score,
3) List Translator Hazard Summary Table, including lists where chemical is found, and
4) Explanation of resolution of any LT-P1 results.

31.2 Format

Depending on the end use of List Translator assessment, document findings using one of the following formats:

1) Health Product Declaration (HPD) Format[12]

   HPD Builder may be used to document a product's intentional ingredients, residuals, and hazards, as well as other information known about the product and the status of efforts for further disclosure.

2) Custom Format

   For proprietary ingredients, chemical name and CASRN may be withheld; however, report function, amount, resulting GreenScreen List Translator score, and hazards driving the score.

32. AUTOMATION OF GREENSCREEN LIST TRANSLATOR

Licensed GreenScreen List Translator Automators have developed automated tools that can be used to search for GreenScreen List Translator assessment results for a chemical of interest. Visit the Greenscreen website for a list of Licensed GreenScreen List Translator Automators and their tools.[13]

11 Note that some databases which incorporate both GreenScreen Benchmark scores and GreenScreen List Translator scores, such as the Health Product Declaration® (HPD) Builder, use "NoGS" to indicate there is no publicly available GreenScreen Benchmark score available for a given chemical, and the chemical has no GreenScreen List Translator score.

12 www.hpdcollaborative.org, accessed 12/15/17.

13 https://www.greenscreenchemicals.org/professionals/public-access-providers, accessed 12/15/17.