



Open Data Standard for Plastics found in Packaging and Waste Electronics

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1.0 What is an Open Data Standard?

An open data standard is a set of common guidelines that define how data should be structured, formatted, and shared. The goal of an open data standard is to make data interoperable so that it can be easily understood and used across different systems, platforms, and organizations.

Some key characteristics of open data standards:

- **Publicly available:** The standards documentation is freely accessible to anyone. There are no restrictions or fees to access the standard.
- **Non-proprietary:** Open standards are not owned or controlled by a single private entity. They can be implemented by anyone.
- **Consensus-driven:** Standards are developed through a transparent, collaborative process with input from a broad community.
- **Royalty-free:** They can be adopted and used without any licensing fees or royalties.
- **Platform-independent:** Open standards have no dependencies on specific technologies or vendors. They can work across diverse systems.
- **Extensible:** The standards allow for future expansion and adaptation as needs evolve over time.

- Implementation-agnostic: They focus on data interoperability and do not require specific technical implementations.

By standardizing data structure and semantics, open data standards make it easier for diverse systems and organizations to exchange, aggregate, and integrate data. This enables transparency, collaboration, reproducibility, and automation across data ecosystems. For example, common data languages are essential for linked open data and semantic web initiatives. Overall, open standards remove data friction and silos, allowing knowledge to flow more freely.

1.1 Using an Open Data Standard:

1. Get familiar with the standard
 - Review the documentation and understand the terminology, definitions, schemas, and structure of the standard. Knowing the basic components will make it easier to apply the standard properly.
2. Map your data
 - Identify what data you want to model and map it to the entities and attributes defined in the standard. For example, map your packaging materials data to the Materials schema.
3. Follow the schema
 - Organize your data based on the schema requirements. Include the required properties, use the correct data types, follow any enumerations. This ensures your data is valid.
4. Use common identifiers
 - When applicable, reference entity identifiers from the standard rather than creating your own. This links your data to existing definitions.
5. Add relationship data
 - If defined in the standard, provide data on relationships between entities using lists like MaterialConstituents. This connects your data.
6. Use controlled vocabularies
 - Where the standard defines controlled lists like MaterialType, use these fixed values to annotate your data.
7. Provide context
 - Include metadata like units, descriptions, and timestamps to add clarity and context around the data.

8. Share usable data

- Share the data in usable formats like JSON, XML, CSV following the standard's guidance. Use URLs and identifiers in your data to link to other data sources.

9. Update over time

- As the standard evolves, check for revisions and update your implementations to leverage improvements while maintaining backward compatibility.

10. Give feedback

- Share feedback on using the standard with the maintainers. This allows the standard to keep improving.

Following these guidelines helps ensure your data is well-structured, comparable, and integrated with other data in the ecosystem based on the standard. This unlocks the downstream benefits of open standards like improved collaboration, transparency, and automation.

The open data standard aims to provide detailed material information on plastics used in packaging and electronic waste streams. This will improve transparency, collaboration, and circularity across these interconnected value chains.

The standard will define data schemas for different plastic polymers, additives, fillers, and reinforcements used in packaging and electronics. Key properties like polymer type, density, melt flow index, mechanical strength, chemical resistance, and processing methods will be covered.

Controlled vocabularies will standardize terminology for plastic resins, grades, colorants, plasticizers, stabilizers, and other additives. Controlled lists for certification schemes, compliance levels, and sustainability attributes will enable rich annotation of materials data.

The standard will also model plastic components, defining parts molded or fabricated from specific plastic formulations. Detailed specifications on shapes, dimensions, weights, production methods, and performance will be included.

Relationships like material constituents, recyclability, and end-of-life pathways will connect materials to components. This will provide crucial transparency into component composition and recyclability.

At the product level, the standard will cover packaging formats like bottles, bags, clamshells assembled from plastic components. It will also cover electronics product categories and plastic parts like cases, enclosures, and internal components.

Waste flows of post-consumer packaging and end-of-life electronics will be modeled, quantifying plastic volumes going into municipal recycling, specialized recovery systems, incineration, and landfills globally.

Overall, the standard will enable detailed tracing of plastics across the packaging and e-waste ecosystem. By standardizing terminology, properties, relationships and volumes, it aims to unlock collaboration, innovation and acceleration of the plastics circular economy.

The open data standard aims to provide a common framework for sharing data across a particular industry supply chain. It enables different stakeholders like manufacturers, brands, retailers, service providers, regulators and more to exchange information in a standardized format.

The standard defines data schemas for the core entities that are handled across the supply chain. This includes basic materials, processed materials, components, finished products, bundles/multipacks, and delivery loads.

Standardized properties, relationships, identifiers and controlled vocabularies are defined for each schema. This provides a consistent way to capture details like technical specifications, production details, sustainability attributes, compliance levels, usage statistics and more.

Controlled lists serve as reference data for industry terminology. They provide fixed values for annotating entities with common descriptors like product types, certifications, grades, production methods and so on.

Relationship lists enable linking different entities like defining the material composition of a component or product. Unique identifiers assign a permanent reference tag to each entity, enabling traceability across systems.

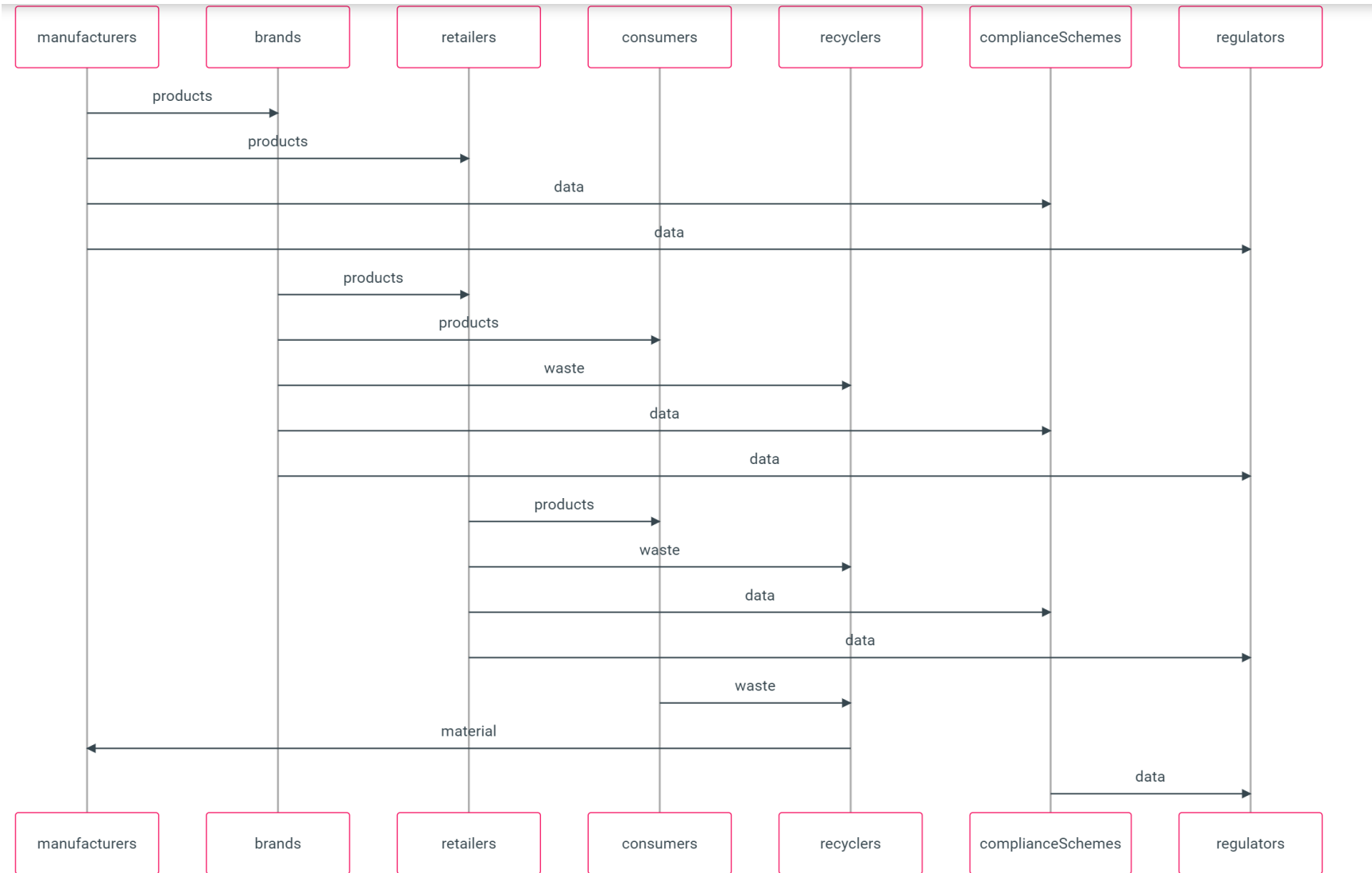
The goal is establishing a single source of truth for industry data. This provides transparency, facilitates data sharing between systems, and enables collaboration across the supply chain. With a common data language, it becomes easier to optimize production, distribution, compliance, recycling and other processes.

Overall, the standard removes friction and creates interoperability between diverse stakeholders in the ecosystem. By adopting a standardized schema, terminology and identifiers, data can flow efficiently while maintaining meaning and lineage. This unlocks the benefits of open data sharing and exchange.

1.2 Waste and Data Flows

The diagram below can help you to visualise how information might flow across the packaging and electronics supply chain using an open data standard. The standard supports data exchange between necessary parties whilst preserving a single source of truth across the industry.

Figure 1: Data Flows



1.3 Definitions

Base Materials:

- Captures highly granular data on raw materials like polymers, paper, glass, metals, coatings, inks, adhesives.
- Includes technical specifications, processing methods, chemical properties, sustainability certifications, compliance levels.
- Enables tracing materials back to their elemental ingredients and production origins.

Materials:

- Defines specific formulations, grades, or variations of base materials.
- Such as PET resin grades used for different packaging components, paper types with certain coatings.
- Detailed data on composition percentages, material combinations, processing required.

Components:

- Models individual packaging parts like bottles, caps, labels, films, trays, cans.
- Specifies weights, dimensions, volumes along with production and molding details.
- Allows combining different materials into a single component like a PET bottle with PP cap.

Complete Products:

- Combinations of components that create finished packaging or products.
- Such as a bottle, cap and label forming a complete package.
- Includes assembly methods, overall specifications like weight and dimensions.

Multipack:

- Configurations that group multiple units of complete packaging or products.
- Like six bottles shrink-wrapped together or case of canned goods.

Loads:

- Bringing together complete packs and multipacks for logistics.
- Can encompass different packaging tiers - primary, secondary, tertiary.
- Specifies palletizing, box configurations, distribution data.

Controlled List:

In an open data standard, controlled lists are predefined sets of allowed values that can be used for certain fields.

Some key aspects of controlled lists:

- They provide a fixed vocabulary of options for specific attributes like material types, certifications, shapes etc.
- The lists are defined upfront as part of the data standard specification.
- Anyone implementing the standard must use the values only from these controlled lists for those fields.
- The lists ensure consistency in terminology across different users of the standard.

1.4 Relationship List

Relationship lists in an open data standard define the connections and compositions between different entities. Some key aspects:

- They link entries from one schema to related entries in another schema.
- Relationship lists capture hierarchical or network structures between data entities.
- They provide details like percentages, quantities, sequences to describe relationships.
- Enables tracing an item's ingredients or constituents at different levels.
- Allows combining simple entities into complex objects.
- Help maintain connections across different stages of production or supply chain.
- Critical for tracking upstream sources and downstream usage of items.
- Different organizations can provide data at different points in the relationship chain.

1.5 Data Formats

Text Files

- Simple plaintext files with data fields separated by delimiters like commas or tabs.
- Easy to create and read but limited functionality for packaging data.
- Good for storing small datasets or exporting subsets of data.
- File formats like TXT, CSV commonly used.

Spreadsheets

- Data stored in tables in software like Excel, Numbers, OpenOffice.
- Allows basic data manipulation, analysis, visualization.

- Powerful for managing smaller data sets.
- Limitations in handling complex relationships and large data volumes.
- Formats like XLSX, ODS, CSV can be used.

Relational Databases

- Data organized into related tables with schema. Robust data manipulation capabilities.
- Allows complex querying, joining of data, enforcing data integrity.
- Scales to large datasets and high concurrency.
- Requires database administration skills. MySQL, PostgreSQL, Oracle are common technologies.

Web Services

- API interfaces that allow programmatic access to read, write, update data.
- Enable seamless integration between systems and applications.
- Support continuous data synchronization.
- Requires API development skills. REST, SOAP, and GraphQL are popular standards.

Dedicated Software

- Custom desktop, mobile, or web apps designed around the standard.
- Offer complete support for standard's data schemas, relationships and rules.
- Enable optimized workflows, visualizations, analytics.
- Require software development but maximize value of standard.

Overall, the optimal use of the standard involves robust relational or NoSQL databases, API-based web services, and custom software applications. This unlocks the full capabilities of the standard for large-scale, interconnected packaging data.

1.6 Identifiers

Identifiers are unique codes that are assigned to each entity or record in the standard. They allow unambiguously referencing specific objects.

For example, a particular type of plastic resin material used in packaging may get an identifier like "m-234f81d3-4729-4394-8f41-27cebf87c robes".

This identifier then uniquely points to that material across all systems and datasets implementing the open data standard.

Some key properties of identifiers:

- Globally unique - The identifier is guaranteed to only represent that entity and no other. This allows it to be a universal reference.
- Persistent - The identifier will continue pointing to that entity over time. It does not get reused or reassigned.
- Opaque - There is no inherent meaning or information encoded in the identifier. It is simply a random unique code.
- Machine-readable - The identifier is structured in a way that computer systems can easily interpret and process.

Within an open data standard, identifiers enable joining data from diverse sources by matching on the common identifiers. They also allow tracking entities across the entire supply chain.

Overall, identifiers are a crucial component of open data standards that remove ambiguity and provide a consistent way to reference specific objects like materials, components, products etc.

1.7 Generating a UUID

A UUID (Universally Unique Identifier) is a standardized type of unique identifier that is commonly used in software and distributed systems. Here are some key properties of UUIDs:

- UUIDs are 128-bit values that are extremely unlikely to clash or be duplicated.
- They are generated algorithmically instead of being sequential, which makes them effectively random.
- The randomness and large number space (2^{128}) make collisions virtually impossible.
- UUIDs follow a standard format - a 32 digit hexadecimal number separated into 5 groups by hyphens. Example: 123e4567-e89b-12d3-a456-426614174000

Generating a UUID must be done by a machine – the following are a list of online tools available for creating UUIDs.

- [Online UUID Generator](#)
- [UUID Generator](#)
- [Online UUID/GUID Generator](#)
- [Generate UUID Online](#)

2.0 General Overview

Here is a detailed explanation of the relationships going from base material to load in an open data model for plastics:

The BaseMaterial entity represents the unprocessed plastic resin pellets or powders that serve as the raw inputs to production. Details like material type, density, manufacturer, and recycled content percentage are captured.

BaseMaterials are processed and enhanced into functional Materials by adding colorants, plasticizers, stabilizers and other additives. The Material entity links back to its BaseMaterial origins via a "DerivedFrom" relationship to maintain traceability.

These Materials are then used to manufacture plastic Components through an injection molding or extrusion process. A "MaterialConstituents" relationship connects each Component to its constituent Material(s) and their percentages to capture the bill of materials.

Components are assembled together to produce finished Products like bottles or electronics housings. The "ComponentConstituents" relationship models this assembly by linking Components to the Products containing them.

For efficiency, Products are frequently grouped together into MultiPack bundles. A "ProductConstituent" relationship connects the MultiPack to its constituent Product definition.

MultiPacks are itemized and enumerated in LoadCatalogs that represent the contents of bulk shipments or inventory. The "LoadContents" relationship links Catalogs to MultiPacks.

Finally, LoadCatalogs are associated with real-world Loads, which are physical shipments between supply chain nodes. The "DefinedBy" relationship ties Loads to the Catalogs listing their composition.

This chained set of relationships enables full traceability and transparency from base resins at the start of the value chain to multi-product loads at the end. The data model structures material flows at each major stage.

3.0 Base materials

In an open data standard, the BaseMaterials entity refers specifically to the basic, unprocessed plastic resins and polymers that serve as the starting point for creating plastic

components and products. The BaseMaterials entity models the core attributes of these raw plastic substances before further enhancement.

Each base material is identified with properties like a name, text description, density, melt flow rate, and most critically - the material type categorized from a controlled vocabulary. This material type uses terms like PE, PP, PET to classify the resin polymer class. Additional specifications can include certifications relevant to base resins, such as biodegradability standards or recycled content validation programs. The percentage and evidence type for any recycled content can also be captured.

Finished plastic Materials suitable for production use are then derived from these BaseMaterials by incorporating functional additives like colorants, plasticizers, stabilizers, etc. The Materials entity links back to its originating BaseMaterial(s) to enable traceability. Components and products further down the supply chain utilize these enhanced Materials, rather than directly using raw BaseMaterials.

This distinction between unprocessed base resins and finished materials supports mapping the complete flow of plastics from initial resin to final product. By tracking BaseMaterials as the raw inputs before functionalization, open data standards can provide insights into the foundational building blocks flowing into the system. Representing these relationships between BaseMaterials, Materials, Components, and Products is key for transparency.

"BaseMaterials" refers specifically to the basic polymer resins that get transformed into functional Materials and applied in manufacturing. Capturing BaseMaterials as a separate entity enables deeper visibility into the nature of plastic inputs into the production system.

Table 1: Base Materials required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers documentation for information on how to construct this identifier
baseMaterialName	required	String	The name of the base material this row relates to. e.g., Polypropylene or Aluminium or Silica
baseMaterialType	recommended	String	Is the base material 'synthetic' or 'biobased'? Use the identifier of the material type that this row relates to. The entry here should be drawn from the Material Type Controlled List.
materialChemCID	recommended	String	The PubChem CID for the exact base material used. The PubChem CID is PubChem's compound identifier, which is a non-zero integer for a unique chemical structure. PubChem CID can be found using their search. If for some reason the PubChem CID cannot be

			located, consider contributing to PubChem and create the compound identifier. However, if this cannot be done, please enter Unknown.
externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the base material in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
certification	recommended	Boolean	Does the base material have a certificate (e.g. FSC, REACH, FSA etc.)? Answer as: TRUE for yes and FALSE for no.
certificationClaims	recommended	List	The information regarding the certification. The entries should be the Certification Claims Relationship List identifiers.
manufacturedCountry	recommended	Numeric	The country the component was manufactured in. Use the country numeric ISO codes as described in the ISO 3166 international standard.
updateDate	required	String	eeee

4.0 Materials

The Materials entity in an open data standard for plastics captures comprehensive details about finished plastic materials utilized in components and products. Each material has a unique name identifier to unambiguously reference that specific material. An optional text description field allows providing any additional contextual details about the material. To categorize the foundational resin type, the material type field uses a controlled vocabulary with standard terms like HDPE, LDPE, PET.

Other attributes that can be captured include the color of the material, density measured in g/cm³, and melt flow index measured in g/10 min to characterize the flow properties. Any functional additives incorporated into the material during processing, such as plasticizers, flame retardants, stabilizers, are listed using an array of additive names. The percentage composition of each additive can also be specified in a parallel array of percentage floats.

To enable traceability back to the raw inputs, the Materials entity links to BaseMaterials IDs representing the original resin feedstocks. The percentages of recycled content and renewable content can also be captured to quantify sustainability performance. Relevant

certifications, manufacturing details, supply chain node company information, and geographic origin data further build out the picture of material flows and provenance.

Overall, the structured Materials entity allows representing finished plastic substances with a comprehensive level of detail. The fields and relationships support tracking material attributes and flows in a standardized open data model. This Materials data enables critical circularity and sustainability analysis when linked to BaseMaterials, Components, and Products.

Table 2: Materials required fields and data types

Column	Status	Format	Notes
identifier	required	String	The globally unique identifier for the created material unique identifier. See identifiers section for information on how to construct this identifier
materialName	required	String	The name of the material this row relates to. (e.g., Aluminum 3000 Series or Borosilicate glass)
externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the material in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
materialConstituents	required	List	The information regarding the constituents that are combined to create this material. The entries should be from the Material Constituents Relationship List identifier.
combinationPurpose	recommended	String	Why is this material being used? Use the identifier of the function that this row relates to. The entry here should be drawn from the Function Controlled List.
certification	recommended	Boolean	Does the material have a certificate (e.g. FSC, REACH, FSA etc.)? Answer as: TRUE for yes and FALSE for no.
certificationClaims	recommended	List	The information regarding the certification. The entries should be the Certification Claims Relationship List identifiers.
manufacturedCountry	recommended	Numeric	The country the component was manufactured in. Use the country numeric ISO codes as described in the ISO 3166 international standard.

updateDate	required	String	The date that the material was provided/last updated. Use the format dd/mm/yyyy.
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This structures Materials with clear mandatory vs optional fields and defined data types. The links to BaseMaterials enable traceability.

5.0 Components

The Components entity represents the distinct plastic parts and pieces that ultimately make up a finished product or packaging. Each component is modeled with attributes like a name identifier, description field, component type categorization, color, mass in grams, and physical characteristics such as shape, flexibility, and opacity. The component type is selected from a controlled vocabulary list of standard terms such as bottle, film, lid, casing, etc. This enables consistent classification of components.

Any disruptor materials present in the component that might inhibit recycling can be specified, which provides critical data for assessing circularity. The Materials that make up each component are linked through a MaterialConstituents relationship. This traces what specific plastic materials a component is constructed from and at what percentages. Understanding the material makeup is crucial because it impacts the overall properties and recyclability profile of the component.

These individual Component entities are then assembled together to model finished CompletePackaging or Products through a ComponentConstituents relationship. This recursively builds up the full bill of materials and enables tracking where each component is used. Having a structured representation of components as discrete plastic parts used in the final product is a key piece in the open data chain connecting raw Materials to complete Products.

In summary, the Components entity refers to the distinct plastic parts and pieces that come together to form final items. The open data model allows capturing critical details about each component, tracing material composition, and understanding how components combine into full assemblies.

Table 3: Components required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
name	recommended	String	The name of this component.
description	recommended	String	A brief description of this component.

externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the component in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
imageURLs	recommended	List	A list of URLs that links to a picture of the component. Please see the guidelines below on how to capture the image and name the URL.
LOWcode	recommended	String	The list of waste code for only the component, by itself. LOW code is synonymous with European Waste Catalogue Code (EWC). For example: an empty bottle would have a LOWcode of 15 01 02. Please use Dposal or legislation.gov to find the LOWcode. Note: The LOWcode can based on its combination with other components and the actual product contained in the completePackaging. Be sure to only include the component LOWcode. If you cannot find the code or are uncertain please enter Uncertain.
componentConstituents	required	List	The information regarding the constituents that are combined to create this component. The entries should be from the Component Constituents Relationship List identifier.
height	recommended	Numeric	The height of the component. Please see the guidelines below on how to properly measure and report the height.
heightDate	recommended	String	The date that the height was last verified/measured. Use the format dd/mm/yyyy.
width	recommended	Numeric	The width of the component. Please see the guidelines below on how to properly measure and report the width.
widthDate	recommended	String	The date that the width was last verified/measured. Use the format dd/mm/yyyy.
depth	recommended	Numeric	The depth of the component. Please see the guidelines below on how to properly measure and report the depth.

depthDate	recommended	String	The date that the depth was last verified/measured. Use the format dd/mm/yyyy.
volume	recommended	Numeric	The amount of space the component takes up. Note: this is related to the size of the component and is different to capacity. Using the height, width, and depth found using the measurement guidelines, calculate the component's volume using: height x width x depth.
volumeDate	recommended	String	The date that the volume was last verified/measured. Use the format dd/mm/yyyy.
weight	required	Numeric	The weight of the component.
weightTolerance	required	Numeric	The threshold of weight that components can vary by. This is given as +/- x%.
weightToleranceType	required	String	Either grams or percentage based on the value provided in weightTolerance
weightDate	recommended	String	The date that the weight was last verified/measured. Use the format dd/mm/yyyy.
shape	recommended	String	What is the shape of the component? The entry should contain the shape controlled list identifier for the component.
function	recommended	String	What is the function of the component? The entry should contain the function controlled list identifier for the component.
flexibility	recommended	String	Whether the component is considered flexible or rigid. The entry should be the flexibility controlled list identifier.
branding	required	Boolean	Does the component contain your own brand (logo, trademark, or any distinctive mark)? Answer as: TRUE for yes and FALSE for no.
componentEndOfLifeRoutes	recommended	List	The information regarding this component's proposed end of life routes. The entries should be the component end of life routes identifiers.

colour	recommended	String	The actual colour of the component at point of production using CMYK (Cyan-Magenta-Yellow-black) values. The format is specified according to cmyk(C%, M%, Y%, K%), where C, M, Y, and K are the percent values for the cyan, magenta, yellow, and black values of the color. For example: black is cmyk(0%,0%,0%,100%). If there are multiple colours input decorative.
opacity	recommended	String	The transparency of the colours. The entry should be the opacity controlled list identifier.
loaned	required	Boolean	Is the component hired or loaned out as reusable packaging? Answer as: TRUE for yes and FALSE for no.
reuseSystems	recommended	List	The system(s) that facilitates the reuse of the component e.g., Loop. The entries should be the reuse system controlled list identifier(s).
partOfMultipack	required	Boolean	Is the component part of a multipack? Answer as: TRUE for yes and FALSE for no.
recycledContent	recommended	Numeric	The minimum allowable percent of how much recycled content is included in the makeup of the component. t is 'required' for plastic packaging where for the purposes of this standard we refer to UK's HM Revenue & Customs definition of recycled content. "Recycled plastic is plastic that has been reprocessed from recovered material by using a chemical or manufacturing process. This is so it can be used either for its original purpose or for other purposes. This does not include organic recycling. Recovered material is pre-consumer plastic or post-consumer plastic that both: a) is no longer suitable to be used in the process from which it was generated and would otherwise have been used for energy recovery (for example, by incineration) or disposed of as waste (for example, by being sent to landfill); b) has been collected and recovered for use as a material input for a recycling or manufacturing process, instead of new primary material"

recycledContentClaims	required	List	The information regarding the recycled contents. The entries should be the recycled content claims relationship list identifiers.
recyclability	recommended	Boolean	Is the component recyclable (as determined by a reputable source)? Answer as: TRUE for yes and FALSE for no.
recyclabilityClaims	recommended	List	The information regarding this recyclability claims. The entries should be the recyclability claims relationship list identifiers.
certification	recommended	Boolean	Does the component have a certificate (e.g. FSC, REACH, FSA etc.)? Answer as: TRUE for yes and FALSE for no.
certificationClaims	recommended	List	The information regarding the certifications. The entries should be the certification claims relationship list identifiers.
manufacturedCountry	recommended	Numeric	The country the component was manufactured in. Use the country numeric ISO codes as described in the ISO 3166 international standard.
updateDate	required	String	The date that the component was provided/last updated. Use the format dd/mm/yyyy.
releaseDate	recommended	String	The date that the component will be available to use. Use the format dd/mm/yyyy.
discontinueDate	recommended	String	The date that the component will no longer be available to use. Use the format dd/mm/yyyy.

6.0 Complete Products

The CompleteProduct entity models the fully assembled end product with all components integrated together. It enables capturing comprehensive details to provide material and component traceability and transparency on sustainability characteristics.

A mandatory name field specifies a descriptive identifier for the specific product, such as "500ml PET water bottle". An optional text description allows additional contextual details. The product type field categorizes the product from a controlled vocabulary, for example "bottle".

Optional fields allow specifying images visually depicting the product, physical characteristics like size dimensions, volume, weight, and shape, usage contexts describing typical applications and environments, and geographical origin details.

A ComponentConstituents relationship links to an array of Component objects that make up the product's bill of materials. Each Component captures further attributes like name, type, materials, mass percentage, and manufacturing details. Alternatively, the material constituents can be directly specified at the product level as an array of Material objects with types and percentages.

Other optional fields enable specifying relevant sustainability certifications, compliance documentation proving regulatory approval, end-of-life details like recyclability and reuse instructions, and supply chain node information on companies involved in producing, filling, and distributing the product.

In summary, the structured CompleteProduct entity allows representing finished, assembled products comprehensively, enabling material and component traceability and transparency through both mandatory and optional fields.

Table 4: Complete products required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
name	recommended	String	The name of this complete packaging.
description	recommended	String	A brief description of this complete packaging.
externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the complete packaging in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}

imageURLs	recommended	List	URL(s) that links to a picture of the complete packaging. Please see the guidelines below on how to capture the image and name the URL.
completePackagingConstituentsIdentifier	required	List	The information regarding the constituents that are combined to create this complete packaging. The entries should be from the Complete Packaging Constituents Relationship List identifier.
LOWcodeWOproduct	recommended	String	The list of waste code for only the complete packaging, by itself (excluding the product). LOW code is synonymous with European Waste Catalogue Code (EWC). For example: an empty bottle would have a LOWcode of 15 01 02. Please use Dsposal or legislation.gov to find the LOWcode. Note: The LOWcode can based on its combination with other components and the actual product contained in the complete packaging. Be sure to only include the complete packaging LOWcode and not the complete packaging with the product. If you cannot find the code or are uncertain please enter Uncertain.
productType	recommended	String	Information about the product contained in the complete packaging. The entry here should be drawn from the product type controlled list.

			What components (if any) come into direct contact with the product before purchased by a consumer? If none of the components come into contact with the product use NA.
componentContactWithProduct	required	List	
LOWcodeWproduct	recommended	String	The list of waste code for everything in the complete packaging. LOW code is synonymous with European Waste Catalogue Code (EWC). For example: an empty bottle would have a LOWcode of 15 01 02. Please use Dsposal or legislation.gov to find the LOWcode. Note: The LOWcode can based on its combination with other components and the actual product contained in the complete packaging. Be sure to include the complete packaging LOWcode with the product. If you cannot find the code or are uncertain please enter Uncertain.
onTheGo	required	Boolean	Is the complete packaging often classed as packaging that will end up in street bins? Answer as: TRUE for yes and FALSE for no.
householdWaste	required	Boolean	Is the complete packaging often classed as packaging that will end up in kerbside collections? Answer as: TRUE for yes and FALSE for no.
depositReturnSchemes	required	List	Which countries support a deposit return scheme for this particular complete packaging? The entries here should be drawn from the deposit return scheme controlled list.

completePackagingEndOfLifeRoutes	recommended	List	The information regarding this complete packaging's proposed end of life routes. The entries should be the complete packaging end of life routes identifiers.
recyclability	recommended	Boolean	Is the complete packaging recyclable (as determined by a reputable source)? Answer as: TRUE for yes and FALSE for no.
recyclabilityClaims	recommended	List	The information regarding this recyclability claims. The entries should be the recyclability claims relationship list identifiers.
height	recommended	Numeric	The height of the complete packaging. Please see the guidelines below on how to properly measure and report the height.
heightDate	recommended	String	The date that the height was last verified/measured. Use the format dd/mm/yyyy.
width	recommended	Numeric	The width of the complete packaging. Please see the guidelines below on how to properly measure and report the width.
widthDate	recommended	String	The date that the width was last verified/measured. Use the format dd/mm/yyyy.
depth	recommended	Numeric	The depth of the complete packaging. Please see the guidelines below on how to properly measure and report the depth.
depthDate	recommended	String	The date that the depth was last verified/measured. Use the format dd/mm/yyyy.
volume	recommended	Numeric	Using the height, width, and depth found using the measurement guidelines, calculate the complete packaging's volume using: height x width x depth.

volumeDate	recommended	String	The date that the volume was last verified/measured. Use the format dd/mm/yyyy.
weight	required	Numeric	The weight of the complete packaging.
weightTolerance	required	Numeric	The threshold of weight that complete packaging can vary by. This can be given in grams or percentage.
weightToleranceType	required	String	Either grams or percentage based on the value provided in weightTolerance
weightDate	recommended	String	The date that the weight was last verified/measured. Use the format dd/mm/yyyy.
servingCapacity	recommended	Numeric	The serving capacity of the complete packaging - how much of a product that can be contained in the complete packaging.
servingCapacityDate	recommended	String	The date that the serving capacity was last verified/measured. Use the format dd/mm/yyyy.
partOfMultipack	required	Boolean	Is the complete packaging part of a multipack? Answer as: TRUE for yes and FALSE for no.
certification	recommended	Boolean	Does the complete packaging have a certificate (e.g. FSC, REACH, FSA etc.)? Answer as: TRUE for yes and FALSE for no.
certificationClaims	recommended	List	The information regarding the certifications. The entries should be the certification claims relationship list identifiers.
updateDate	required	String	The date that the complete packaging was provided/last updated. Use the format dd/mm/yyyy.
releaseDate	recommended	String	The date that the complete packaging will be available

			to use. Use the format dd/mm/yyyy.
discontinueDate	recommended	String	The date that the complete packaging will no longer be available to use. Use the format dd/mm/yyyy.

This standard identifies key mandatory attributes while also allowing for optional inclusion of details on characteristics, life cycle, supply chain etc., enabling extensibility.

7.0 Multi-Pack

The Multi-Pack entity refers to a product set or bundle of multiple identical product units grouped together for efficiency. For example, a Multi-Pack could represent a 6-pack of plastic water bottles wrapped in outer shrink wrap plastic film for grab-and-go purchases. Another case is a bulk pack of 100 injection molded HDPE caps all productd into a larger external pouch bag for shipping.

The Multi-Pack entity captures details about the set as a whole, rather than modeling each item individually. This includes a descriptive name identifier such as "6-pack of 500ml PET water bottles" and an optional free text description field for additional context about the multi-pack bundle. A key attribute is the item count field which specifies the number of individual products productd in the set.

Details on any outer packaging used for the set can also be captured, such as the type of shrink wrap film or dimensions of an external cardboard box. This enables representing the relationships between the inner and outer packaging layers.

Rather than duplicating complete details over and over for each identical item, the Multi-Pack links to the CompleteProduct definition for the product being multiplied through a ProductConstituent relationship. This reuses the existing standalone product definition and models the constituent relationship to that product.

Some benefits of modeling Multi-Packs in a structured standardized way include enabling grouping of identical items for efficiency, capturing outer packaging relationships, supporting logistics planning and shipping cases of products, providing visibility into volumes and item counts, and allowing products to be traced in aggregate flows through the system.

Overall, the Multi-Pack entity provides a way to represent bundled sets of multiple equal products, which is a very common pattern in packaging and electronics. Capturing Multi-

Packs in a standardized open data model supports circularity and sustainability analysis at a grouped level.

Table 5: Multi-pack products required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
name	recommended	String	The name of this multipack.
description	recommended	String	A brief description of this multipack.
externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the multipack in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
multipackConstituentsIdentifiers	required	List	The information regarding the constituents that are combined to create this multipack. The entries should be from the Multipack Constituents Relationship List identifier.
tier	recommended	Integer	The tier associated with the multipack. The inner most tier denoted as 1, and the outermost tier is the biggest number.
identicalQuantity	required	Numeric	Number of identical units for the unique complete packaging item or a component this row corresponds to.
updateDate	required	String	The date that the multipack was provided/last updated. Use the format dd/mm/yyyy.
releaseDate	recommended	String	The date that the component will be available to use. Use the format dd/mm/yyyy.
discontinueDate	recommended	String	The date that the component will no longer be available to use. Use the format dd/mm/yyyy.

8.0 Load Catalog

The load catalog entity captures the composition and contents of a bulk shipment, delivery or inventory grouping (a "load") of products or materials. For example, a 40-foot shipping container full of different product food items being transported overseas or a mixed pallet of electronics being stored in a warehouse.

Each load catalog is identified by a unique name or ID and contains an itemized list of the specific products, components, and/or materials contained in that bulk load. Details on the quantity or volume of each item type is captured to provide visibility into the constituent makeup of the load.

Relationships link the catalog to the defined Product, Component, and Material entities representing each item type included. This allows traceability back to the full definition and attributes of each constituent, rather than having to duplicate all details.

Additional load-level attributes can also be captured, such as total weight, dimensions, container or pallet information, loading/unloading locations, supply chain node points, certification documentation, and transportation miles.

Some key benefits of explicitly modeling load catalogs in a standardized structure include: providing visibility into bulk shipment contents, enabling tracking of aggregated flows through the system, supporting logistics and inventory management, minimizing data duplication through relationships, and allowing material and product traceability at the batch level.

In summary, the load catalog entity represents itemized composition details for bulk product, component, and material shipments. Capturing this data enables important sustainability insights into aggregate flows and inventory traceability in the packaging and electronics supply chain.

Table 6: Load Catalogs required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
name	recommended	String	The name of this load.
description	recommended	String	A brief description of this load.

externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the load catalogue in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
loadIdentifier	required	String	The unique identifier of the created load. A globally unique identifier. See identifiers section for information on how to construct this identifier.
packagingItems	required	List	The complete packaging and/or the multipack identifiers used to create the load. There must be an equivalent record in the Complete Packaging or Multipack data.
quantityInLoad	required	Numeric	Number of units for the packaging items found in a load that this row corresponds to.
level	required	String	The intended use of the component for the packaging. The entry here should be drawn from the level controlled list.
updateDate	required	String	The date that the load catalogue was provided/last updated. Use the format dd/mm/yyyy.

In summary, this structures LoadCatalog with mandatory and optional fields, defined data types, and relationships to trace item specifics.

9.0 Load

The Load entity captures the composition and movement details of a specific shipment or delivery of products, components, or materials between two points in the supply chain. Each Load represents a physical, real-world aggregation of items being transferred from an origin to a destination.

A Load is identified by a unique ID along with attributes like a name, description, total weight, dimensions, and type of container or pallet used. The loading and unloading locations specify the origin and destination facilities or warehouses. Dates provide the shipment timeframe.

The Load links to a LoadCatalog that enumerates the specific item types and quantities contained as the load's contents. This allows traceability to the Product, Component, and Material entities that define each constituent while avoiding data duplication.

As the Load moves between supply chain nodes, a ChainOfCustody relationship connects the organizations taking custody along the way. This provides visibility into who handled the Load at each point. TransportSegment details capture the modes, distances, and emissions associated with each leg of the journey.

Key benefits of modeling Loads in a structured format include: capturing real-world shipments, enabling aggregation of items, tracking custody flows and transportation, minimizing data redundancy through relationships, and allowing traceability of constituents. This supports logistics, inventory management, and sustainability insights.

In summary, the Load entity represents an actual, physical shipment or delivery containing many Products, Components, and/or Materials moving through the supply chain. Linking Loads to LoadCatalogs and ChainOfCustody provides comprehensive traceability and transparency into aggregate material flows.

Table 7: Load required fields and data types

Column	Status	Format	Notes
identifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
name	recommended	String	The name of this load.
description	recommended	String	A brief description of this load.
externalIdentifiers	recommended	Dictionary	A dictionary of identifiers that might be used to identify the load in other systems. For example: manufacturer's own internal identifier, bar codes or global trade item number (gtin). To provide external identifiers please follow this format. {'externalIdentifierName1': 'identifier1', 'externalIdentifierName2': 'identifier2'}
loadIdentifiers	required	List	The unique identifier of the created load. There must be an equivalent identifier found in the Load Catalogue.
startDate	required	String	The date that the load began for the destination. Use the format dd/mm/yyyy.
endDate	required	String	The date that the load ended for the destination. Use the format dd/mm/yyyy.
destinationAddressName	recommended	String	The name of the load destination address.
destinationAddressStreet	required	String	The street address of this load destination.

destinationAddressCountry	required	String	The country of this load destination.
destinationPostalCode	required	String	The postal code of this load destination.
timesSent	required	Numeric	The number of times this load was sent to the destination during the specified time period.
updateDate	required	String	The date that the load was provided/last updated. Use the format dd/mm/yyyy.

10.0 Controlled Lists

The purpose of a controlled list in an open data standard is to provide a standardized set of allowed values for certain attributes or properties. Some key benefits of using controlled lists include:

- Standardization - It ensures all users of the standard are using consistent and common values for particular fields, facilitating integration and shared meaning.
- Fixed vocabulary - Controlled lists act as a fixed vocabulary or dictionary for the standard, avoiding free-text values and synonyms which can lead to ambiguity.
- Extensibility - Lists can be extended in a backwards compatible way by adding new allowed values when needed.
- Validation - Data conforming to the standard can be validated against the controlled options.
- Code list mappings - Values can be mapped to external code systems and ontologies, enabling interoperability.
- Metadata binding - Additional metadata like definitions, categorization etc. can be bound to list values.
- Localization - Controlled list values can have translations to support multiple languages.
- Documentation - The lists provide context and documentation for the standard.
- Automation - Systems can leverage controlled lists to automate data validation, normalization, code mappings etc.

Controlled lists promote standardized, extensible and interoperable data sharing per the requirements of an open data standard. List values get clearly defined meaning within the standard's ecosystem.

10.1 Controlled List: Material Types

Table 8: Material Types		
Identifier	Category	Detailed Description
material-type-0001	synthetic	Derived from crude oil, natural gas or coal. Does not occur naturally.
material-type-0002	plant-based	Derived from plant sources like cellulose, starch etc. Includes wood, paper, cotton, some bioplastics.
material-type-0003	animal-based	Derived from animal sources. Includes leather, wool, silk, bone, tortoiseshell.
material-type-0004	mineral-based	Obtained from mineral ores like metal, glass, ceramics, concrete.
material-type-0005	fossil-fuel-based	Obtained from fossil-fuel sources like coal, petroleum, natural gas.
material-type-0006	metal	Elemental metals and metal alloys like steel, aluminum, copper.
material-type-0007	glass	Inorganic, non-metallic material made by melting silica or sand with modifiers.
material-type-0008	paper	Thin material produced by pressing together moist fibers. Made from cellulose pulp derived from wood, rags or grasses.
material-type-0009	plastic	Synthetic organic polymers like polyethylene, PVC, nylon, polypropylene. May be fossil-fuel or bio-based.
material-type-0010	wood	Hard fibrous material from trees or shrubs used for fuel, construction, tools etc.
material-type-0011	ceramic	Inorganic, non-metallic solids made from compounds like clay, silicone, glass. May be crystalline or non-crystalline.
material-type-0012	composite	Made from two or more constituent materials with different physical or chemical properties.
material-type-0013	textile	Fibers, filaments, yarns processed into flexible woven or non-woven fabrics like cotton, wool, silk.
material-type-0014	rubber	Elastic hydrocarbon polymer obtained from latex of tropical plants or synthetically produced.

material-type-0015	foam	Lightweight cellular structure made by trapping pockets of gas in liquid or solid.
material-type-0016	natural	Occurring material sourced directly from nature without chemical processing. Includes lumber, cotton, wool.

10.2 Controlled List: Certification

Table 9: Certification		
Identifier	Certification Name	Issuing Organization
cert-source-0001	Forest Stewardship Council (FSC)	FSC International
cert-source-0002	Programme for the Endorsement of Forest Certification (PEFC)	PEFC Council
cert-source-0003	Sustainable Forestry Initiative (SFI)	Sustainable Forestry Initiative
cert-source-0004	Rainforest Alliance Certified	Rainforest Alliance
cert-source-0005	Roundtable on Sustainable Palm Oil (RSPO)	RSPO
cert-source-0006	Aquaculture Stewardship Council (ASC)	Aquaculture Stewardship Council
cert-source-0007	Marine Stewardship Council (MSC)	Marine Stewardship Council
cert-source-0008	Fairtrade	Fairtrade International
cert-source-0009	SA8000	Social Accountability International
cert-source-0010	OHSAS 18001	British Standards Institution
cert-source-0011	International Organization for Standardization (ISO)	International Organization for Standardization
cert-source-0012	Global Organic Textile Standard (GOTS)	Global Standard gGmbH
cert-source-0013	Cradle to Cradle Certified	Cradle to Cradle Products Innovation Institute
cert-source-0014	Bluesign	Bluesign Technologies AG
cert-source-0015	Global Recycled Standard (GRS)	Textile Exchange
cert-source-0016	Organic Content Standard (OCS)	Textile Exchange
cert-source-0017	Recycled Claim Standard (RCS)	Textile Exchange

cert-source-0018	Nordic Swan Ecolabel	Nordic Ecolabelling
cert-source-0019	EU Ecolabel	European Commission
cert-source-0020	Cradle to Cradle Material Health Certificate	Cradle to Cradle Products Innovation Institute

10.3 Controlled Lists: Material Purpose

Table 10: Material Purpose		
Identifier	Category	Detailed Description
material-purpose-0001	structural	Provides strength and stability to the plastic.
material-purpose-0002	impact modifier	Improves impact strength and toughness.
material-purpose-0003	plasticizer	Increases flexibility, workability and stretchability.
material-purpose-0004	thermal stabilizer	Provides temperature and heat stability.
material-purpose-0005	UV stabilizer	Provides stability and protection against UV radiation.
material-purpose-0006	antioxidant	Prevents oxidation and degradation by atmospheric oxygen.
material-purpose-0007	flame retardant	Reduces flammability and provides fire resistance.
material-purpose-0008	smoke suppressant	Reduces smoke production during combustion.
material-purpose-0009	anti-static additive	Dissipates and prevents buildup of static electricity.
material-purpose-0010	blowing agent	Produces an expanded closed-cell foam structure.
material-purpose-0011	nucleating agent	Provides more uniform foam cell formation.

material-purpose-0012	slip additive	Reduces friction and improves surface finish.
material-purpose-0013	antiblock additive	Prevents plastic films from sticking together.
material-purpose-0014	lubricant	Reduces friction, adhesion and wear in plastic processing.
material-purpose-0015	antifog additive	Prevents condensation and fogging on plastic surfaces.
material-purpose-0016	adhesion promoter	Improves bonding to other materials like printing inks and coatings.
material-purpose-0017	moisture barrier	Provides water and moisture resistance.
material-purpose-0018	oxygen barrier	Prevents passage of oxygen molecules.
material-purpose-0019	carbon dioxide barrier	Prevents passage of carbon dioxide molecules.
material-purpose-0020	odor absorber	Absorbs and reduces undesirable odors.
material-purpose-0021	light stabilizer	Provides protection against damage from ultraviolet and visible light.
material-purpose-0022	antistatic agent	Improves conductivity and prevents static charge buildup.

material-purpose-0023	coupling agent	Promotes adhesion between the plastic matrix and fillers or reinforcements.
material-purpose-0024	curing agent	Participates in crosslinking reactions to form thermoset materials.
material-purpose-0025	dispersing agent	Promotes separation of pigment particles to maximize coloring power.
material-purpose-0026	emulsifier	Facilitates formation and stabilization of emulsions and dispersions.
material-purpose-0027	initiator	Starts polymerization reactions and influences molecular weight.
material-purpose-0028	optical brightener	Absorbs ultraviolet radiation and emits blue light for enhanced whiteness.
material-purpose-0029	pH regulator	Controls pH to prevent damage during processing and in end use.
material-purpose-0030	plasticizer	Increases flexibility, stretchability, workability of plastic.
material-purpose-0031	processing aid	Improves melt flow, reduces viscosity, enhances dispersion during processing.
material-purpose-0032	stabilizer	Maintains properties and prevents degradation during processing and use.
material-purpose-0033	toughening agent	Improves impact strength and resistance to cracking.
material-purpose-0034	activator	Initiates or accelerates chemical reactions, including curing.
material-purpose-0035	adhesive	Bonds plastic to other materials like printing inks, coatings, and substrates.
material-purpose-0036	blowing agent	Produces cellular structure via release of gas during processing.
material-purpose-0037	catalyst	Accelerates chemical reactions without being consumed.
material-purpose-0038	coalescing agent	Aids film formation from polymer emulsions and dispersions.

material-purpose-0039	curing agent	Undergoes crosslinking reactions to transform polymers into network structures.
material-purpose-0040	flame retardant	Inhibits ignition, reduces flammability and rate of burning.
material-purpose-0041	heat stabilizer	Reduces thermal degradation at elevated temperatures during processing and use.
material-purpose-0042	internal lubricant	Reduces friction between polymer chains to improve melt flow.
material-purpose-0043	plastic filler	Extends, bulks up and reinforces plastic formulations.
material-purpose-0044	plasticizer	Softens and increases flexibility of polymeric material.
material-purpose-0045	slip agent	Reduces coefficient of friction in polymers.
material-purpose-0046	thermal conductor	Improves heat transfer in plastics.
material-purpose-0047	viscosity depressant	Lowers viscosity to improve flow during processing.
material-purpose-0048	crosslinking agent	Chemically joins polymer chains together.
material-purpose-0049	foaming agent	Generates gas bubbles to produce cellular foam structures.
material-purpose-0050	opacity enhancer	Increases opacity and blocks transmission of light.

10.4 Controlled List: Opacity

Table 11: Opacity		
identifier	category	detailed
c-opacity-0001	opaque	does not allow light to pass through; not able to be seen through; solid colour

c-opacity-0002	translucent	allows light, but not detailed shapes, to pass through; semi-transparent; tinted colour
c-opacity-0003	transparent	allows light to pass through so that objects behind can be distinctly seen; no colour/ clear

10.5 Controlled List: Function

Table 12: Function		
Identifier	Category	Description
function-0001	container	Rigid receptacle for storing and transporting goods
function-0002	bottle	Rigid container with narrow neck for storing and dispensing liquids
function-0003	jar	Wide mouthed rigid container for solid or semi-solid products
function-0004	jug	Rigid container with handle and pouring spout for liquids
function-0005	tub	Rigid container with flat bottom and sides for semi-solid products
function-0006	bucket	Cylindrical open top container with handle
function-0007	drum	Cylindrical shipping container
function-0008	keg	Small cask for storing and dispensing liquids
function-0009	bin	Large open top container for loose bulk items
function-0010	tank	Large storage reservoir
function-0011	can	Cylindrical container for food, beverages, chemicals etc.
function-0012	cup	Small open cylindrical container for liquids and semi-solids
function-0013	tray	Shallow container for holding or carrying products
function-0014	blister pack	Preformed plastic cavity sealed with foil backing
function-0015	pouch	Flexible bag-like package
function-0016	sachet	Small flexible plastic sealed pouch
function-0017	bag	Flexible container made of thin film, paper, plastic etc.
function-0018	sack	Large bag used for transporting bulk materials

function-0019	box	Rectangular container with walls and lid or flaps
function-0020	carton	Foldable box made of paperboard, cardboard etc.
function-0021	crate	Heavy duty open top container for bulk transport
function-0022	case	Protective enclosure for transporting goods
function-0023	capsule	Small sealed container for single dose products
function-0024	cylinder	Canister with curved sides used for gases etc.
function-0025	envelope	Flexible container with sealing flap for letters etc.
function-0026	tube	Long hollow cylinder used for creams, pastes etc.
function-0027	vial	Small glass or plastic bottle used in healthcare
function-0028	ampoule	Small sealed glass or plastic container for injectables
function-0029	carboy	Large glass or plastic bottle with narrow neck and handle
function-0030	demijohn	Wide mouthed glass bottle with wicker case
function-0031	capsule	Gelatin shell enclosing medicines or supplements
function-0032	packet	Small bag containing single use portions of foods etc.
function-0033	spool	Cylinder for winding thread, wire, tape etc.
function-0034	reel	Cylinder for winding films, paper, wire etc.
function-0035	roll	Cylinder with wound flexible material
function-0036	pallet	Portable platform for handling, storage and transport
function-0037	cask	Barrel-shaped container for liquids
function-0038	barrel	Cylindrical container with flat ends
function-0039	hogshead	Large barrel holding liquor
function-0040	firkin	Small barrel for beer, ale etc.
function-0041	kilderkin	Half-size firkin barrel
function-0042	pin	Small firkin-type barrel
function-0043	rundlet	Quarter size firkin barrel
function-0044	pipe	Long hollow cylinder for fluids and gases

function-0045	hose	Flexible tube conveying fluids and gases
function-0046	capsule	Small sealed container for single dose products
function-0047	capsule	Gelatin shell enclosing medicines or supplements
function-0048	packet	Small bag containing single use portions of foods etc.
function-0049	spool	Cylinder for winding thread, wire, tape etc.
function-0050	reel	Cylinder for winding films, paper, wire etc.
function-0051	roll	Cylinder with wound flexible material
function-0052	sleeve	Tubular package slipped over item
function-0053	liner	Inner protective layer inside a container
function-0054	cap	Lid that seals the opening of a container
function-0055	stopper	Seals the opening of bottles, tubes etc.
function-0056	plug	Fits inside and seals openings
function-0057	nozzle	Tapered opening that controls fluid flow
function-0058	spout	Angled tubular opening for pouring liquids
function-0059	handle	Attached grip enabling carrying
function-0060	pump	Mechanism for dispensing fluids
function-0061	capsule	Small sealed container for single dose products
function-0062	capsule	Gelatin shell enclosing medicines or supplements
function-0063	packet	Small bag containing single use portions of foods etc.
function-0064	spool	Cylinder for winding thread, wire, tape etc.
function-0065	reel	Cylinder for winding films, paper, wire etc.
function-0066	roll	Cylinder with wound flexible material
function-0067	sleeve	Tubular package slipped over item
function-0068	liner	Inner protective layer inside a container
function-0069	cap	Lid that seals the opening of a container
function-0070	stopper	Seals the opening of bottles, tubes etc.

function-0071	plug	Fits inside and seals openings
function-0072	nozzle	Tapered opening that controls fluid flow
function-0073	spout	Angled tubular opening for pouring liquids
function-0074	handle	Attached grip enabling carrying
function-0075	pump	Mechanism for dispensing fluids
function-0076	strap	Band for securing items
function-0077	tag	Label providing identification and information
function-0078	seal	Secures contents and prevents tampering
function-0079	fastener	Joins components mechanically
function-0080	hinge	Flexible joint allowing movement between parts
function-0081	latch	Mechanism that secures a door shut
function-0082	lock	Mechanism that secures item against access
function-0083	clasp	Device that holds things together
function-0084	buckle	Securing and adjustment device
function-0085	zipper	Interlocking teeth fastener for bags etc.
function-0086	button	Knob that secures clothing
function-0087	pin	Slender fastener to secure items
function-0088	clip	Device that grips objects to attach them
function-0089	rivet	Tubular metal fastener
function-0090	staple	U shaped metal fastener
function-0091	hook	Curved device catching and holding objects
function-0092	loop	Ring shape used to fasten items
function-0093	eyelet	Metal ring on an edge for threading

function-0094	grommet	Reinforced eyelet to protect from tearing
function-0095	adhesive	Substance used for sticking items together
function-0096	tape	Material in strips with adhesive coating
function-0097	glue	Adhesive substance used for bonding
function-0098	paste	Viscous adhesive substance
function-0099	sealant	Substance used to seal gaps and prevent leakage
function-0100	foam	Lightweight cellular cushioning material

10.6 Controlled List: Flexibility

Table 13: Flexibility		
Identifier	Category	Description
flexibility-0001	Flexible	Can be repeatedly bent without breaking
flexibility-0002	Pliable	Can be bent or folded repeatedly
flexibility-0003	Malleable	Can be worked into different shapes
flexibility-0004	Ductile	Can be stretched into wire
flexibility-0005	Elastic	Can stretch and return to original shape
flexibility-0006	Resilient	Can resume original shape after bending
flexibility-0007	Springy	Bounces back after compression
flexibility-0008	Supple	Easily bent without stiffness
flexibility-0009	Rigid	Cannot be bent out of shape

flexibility-0010	Stiff	Difficult to bend out of shape
flexibility-0011	Inflexible	Resistant to bending forces
flexibility-0012	Unyielding	Does not give way under pressure
flexibility-0013	Brittle	Likely to crack or shatter when bent
flexibility-0014	Fragile	Easily broken when bent or deformed
flexibility-0015	Frangible	Intentionally breakable or shatterable
flexibility-0016	Pliant	Easily bent, flexible
flexibility-0017	Flaccid	Limp, lacking firmness
flexibility-0018	Lax	Loose, without stiffness
flexibility-0019	Floppy	Bending and hanging loosely
flexibility-0020	Limber	Easily bending and flexing

10.7 Controlled List: Component Disruptors

Table 14: Component Disruptors		
Identifier	Category	Description
disruptor-0001	Contaminant	Food residue
disruptor-0002	Contaminant	Biological residue
disruptor-0003	Contaminant	Chemical residue
disruptor-0004	Contaminant	Hazardous chemicals

disruptor-0005	Contaminant	Medical/bodily fluids
disruptor-0006	Contaminant	Oils, greases, lubricants
disruptor-0007	Contaminant	Waxes, adhesives
disruptor-0008	Contaminant	Wet strength additives
disruptor-0009	Ink	Bleeding inks
disruptor-0010	Ink	Non-dispersible inks
disruptor-0011	Ink	Mineral oil based inks
disruptor-0012	Label	Full body sleeve labels
disruptor-0013	Label	Labels covering >40% surface
disruptor-0014	Adhesive	Non-water soluble adhesives
disruptor-0015	Adhesive	Two-part reactant adhesives
disruptor-0016	Component	Metal components
disruptor-0017	Component	PVC components
disruptor-0018	Component	Silicone components
disruptor-0019	Component	Non-PO plastic >10%
disruptor-0020	Additive	Oxydegradable additives
disruptor-0021	Additive	Biodegradable additives
disruptor-0022	Additive	Fluorinated additives
disruptor-0023	Additive	Brominated flame retardants
disruptor-0024	Additive	Phthalate plasticizers
disruptor-0025	Additive	Bisphenol compounds
disruptor-0026	Density	High density fillers
disruptor-0027	Size	Particles too small
disruptor-0028	Size	Parts too large
disruptor-0029	Composite	Multilayer laminates
disruptor-0030	Composite	Metallized layers

disruptor-0031	Composite	Co-extruded layers
disruptor-0032	Barrier	EVOH layers >5%
disruptor-0033	Barrier	Polyamide layers
disruptor-0034	Barrier	PVDC layers
disruptor-0035	Colorant	Carbon black
disruptor-0036	Colorant	Mineral colorants
disruptor-0037	Strength	Glass fibers
disruptor-0038	Reactive	Degradable polymers
disruptor-0039	Reactive	Crosslinking polymers
disruptor-0040	Shape	Closed shapes
disruptor-0041	Shape	Intricate shapes
disruptor-0042	Other	Bi-oriented films
disruptor-0043	Other	Viscose rayon
disruptor-0044	Other	Natural fibers
disruptor-0045	Other	Compostable materials
disruptor-0046	Other	Nano particles
disruptor-0047	Other	Radio-frequency identification
disruptor-0048	Other	Wet strength agents
disruptor-0049	Other	Wax coatings
disruptor-0050	Other	Silicone coatings

10.8 Controlled List: Reuse Systems

Table 15: Reuse Systems		
Identifier	Category	Description
reuse-0001	Global	Loop - A global reuse platform enabled by a multi-stakeholder coalition of companies and governments. Facilitates collection,

		cleaning and redistribution of reusable packaging through partnerships with retailers, brands and waste management.
reuse-0002	Regional	Recup - A European reuse platform that collects post-consumer packaging in stores and public spaces and transports to regional cleaning facilities. Uses digital watermarks for package authentication and sorting.
reuse-0003	Material	RePlast - A chemical recycling system focused on collecting, sorting, decontaminating and reprocessing post-consumer plastics. Reprocessed resin and monomers can be used to remake new plastic packaging.
reuse-0004	Industry	Retail Reuse Alliance - A business consortium of major retailers committed to establishing in-store collection points for reusable consumer packaging that is cleaned and redistributed through their supply chains.
reuse-0005	Deposit	Bottle Bills - Container deposit legislation in 10 US states that requires a refundable deposit on beverage containers to incentivize consumer returns. Containers are collected, cleaned and refilled.
reuse-0006	Supply Chain	Closed Loop Supply - A company managed take-back program that collects post-consumer packaging from brands and reroutes it directly back to manufacturers for reprocessing and reuse.
reuse-0007	Community	Community Reuse Program - A grassroots community-based initiative to collect and centrally process reusable packaging for redistribution. Provides jobs and reuse education.
reuse-0008	Direct	Milkman Model - Home delivery services that directly collect reusable packaging from consumers and return to suppliers for cleaning and reuse in a closed loop.
reuse-0009	Store	In-store Collection - Retailer initiative where select stores have collection points for reusable packaging returned by consumers. Centralized processing and redistribution.
reuse-0010	Digital	ReuseChain - A blockchain-based digital reuse platform with QR codes or NFC tags on packaging that tracks lifecycle reuse and directly incentivizes return to reuse centers.

10.9 Controlled List: Shape

Table 16: Shape		
Identifier	Category	Description
shape-0001	2D	Circle
shape-0002	2D	Oval
shape-0003	2D	Ellipse
shape-0004	2D	Square
shape-0005	2D	Rectangle
shape-0006	2D	Rhombus
shape-0007	2D	Parallelogram
shape-0008	2D	Trapezoid
shape-0009	2D	Triangle
shape-0010	2D	Right triangle
shape-0011	2D	Isosceles triangle
shape-0012	2D	Equilateral triangle
shape-0013	2D	Pentagon
shape-0014	2D	Hexagon
shape-0015	2D	Heptagon
shape-0016	2D	Octagon
shape-0017	2D	Nonagon
shape-0018	2D	Decagon
shape-0019	2D	Dodecagon
shape-0020	2D	Star
shape-0021	2D	Cross
shape-0022	2D	Crescent
shape-0023	2D	Semi-circle

shape-0024	2D	Quarter circle
shape-0025	3D	Sphere
shape-0026	3D	Hemisphere
shape-0027	3D	Cone
shape-0028	3D	Cylinder
shape-0029	3D	Cuboid
shape-0030	3D	Cube
shape-0031	3D	Pyramid
shape-0032	3D	Tetrahedron
shape-0033	3D	Octahedron
shape-0034	3D	Dodecahedron
shape-0035	3D	Torus
shape-0036	3D	Prism
shape-0037	3D	Triangular prism
shape-0038	3D	Pentagonal prism
shape-0039	3D	Hexagonal prism
shape-0040	3D	Oval
shape-0041	3D	Ovoid
shape-0042	3D	Ellipsoid
shape-0043	3D	Paraboloid
shape-0044	3D	Hyperboloid
shape-0045	3D	Helix
shape-0046	3D	Spiral
shape-0047	3D	Coil
shape-0048	3D	Double helix
shape-0049	3D	Toroid

shape-0050	3D	Lens
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10.10 Controlled Lists: Deposit Return

Table 17: Deposit Return		
Identifier	Category	Description
deposit-0001	US State	California Beverage Container Recycling Program - Covers glass, plastic, aluminum containers. 5-10 cent redemption value. In effect since 1987.
deposit-0002	US State	Connecticut Bottle Bill - Covers beer, soft drink, water, tea bottles. 5 cent redemption. Enacted in 1978.
deposit-0003	US State	Hawaii Deposit Beverage Container Program - Covers all beverage containers except dairy/infant formula. 5 cent redemption. In effect since 2005.
deposit-0004	US State	Iowa Bottle Bill - Covers beer, wine, liquor and carbonated beverage containers. 5 cent redemption. Enacted in 1979.
deposit-0005	US State	Maine Beverage Container Redemption Program - Covers spirits, wine, soda, water, juice containers. 5-15 cent redemption. Since 1978.
deposit-0006	US State	Massachusetts Bottle Bill - Covers beer, malt, carbonated soft drinks. 5 cent redemption. Enacted 1983.
deposit-0007	US State	Michigan Bottle Deposit Law - Covers carbonated beverages, beer, wine coolers. 10 cent redemption. Since 1978.
deposit-0008	US State	New York Returnable Container Act - Covers beer, soft drinks, water. 5 cent redemption. Effective since 1983.
deposit-0009	US State	Oregon Beverage Container Redemption System - Covers all beverage containers except milk, infant formula, broth. 10 cent redemption. Enacted 1971.
deposit-0010	US State	Vermont Beverage Container Law - Covers liquor, beer, mixed spirit drinks, wine, soft drinks. 5-15 cent redemption. Since 1973.

deposit-0011	Canadian Province	Alberta Beverage Container Recycling Program - Covers all ready-to-drink beverage containers. 10 cent redemption. Implemented in the 1970s.
deposit-0012	Canadian Province	British Columbia Beverage Container Recycling Program - Covers all ready-to-drink beverage containers except milk and milk substitutes. 5-10 cent redemption. Launched 1970.
deposit-0013	Canadian Province	Manitoba Beverage Container Program - Covers liquor, wine, coolers, soft drinks, juices, water. 10 cent redemption. Operational since 2010.
deposit-0014	Canadian Province	Nova Scotia Beverage Container Deposit-Refund Program - Covers ready-to-drink beverage containers. 5-20 cent redemption. Established 1996.
deposit-0015	Canadian Province	Ontario Deposit Return Program - Covers beer, wine, spirits, soft drinks containers. 10 cent redemption. To launch 2023.

10.11 Controlled Lists: Complete Product Disruptors at EOL (End of Life)

Table 18: Complete Product Disruptors *End of life disruptors		
Identifier	Category	Description
disruptor-0001	Contaminant	Food residue - Can lead to contamination in recycling streams
disruptor-0002	Contaminant	Oil, grease, lubricants - Cause issues in repulping and attract contaminants in recycling
disruptor-0003	Contaminant	Wax coatings - Interfere with paper recycling and repulping
disruptor-0004	Contaminant	Biological residues - Can lead to contamination issues
disruptor-0005	Contaminant	Medical waste - Causes health hazards and contamination
disruptor-0006	Component	Metal components - Need to be separated in recycling
disruptor-0007	Component	PVC components - Interfere with plastic recycling
disruptor-0008	Component	Silicone components - Cause issues in plastic recycling
disruptor-0009	Component	Non-PO plastic >10% - Can affect recyclability of packaging
disruptor-0010	Composite	Multilayer films - Difficult to separate and recycle
disruptor-0011	Composite	Metallized layers - Not compatible with recyclable films

disruptor-0012	Composite	Co-extruded polymers - Challenging to separate and recycle
disruptor-0013	Adhesive	Wet strength additives - Increase strength when wet but disrupt repulping
disruptor-0014	Adhesive	Two-part reactant adhesives - Cure into thermoset materials not recyclable
disruptor-0015	Label	Full body shrink sleeves - Cover surface and disrupt recyclability
disruptor-0016	Label	Full coverage labels - Prevent optical sortation in recycling
disruptor-0017	Additive	Biodegradable additives - Can degrade polymers during reprocessing
disruptor-0018	Additive	Fluorinated additives - Persist in environment and disrupt recycling
disruptor-0019	Additive	Brominated flame retardants - Interfere with recycling of plastics
disruptor-0020	Additive	Antimicrobial additives - Can be toxic if carried into recycled materials
disruptor-0021	Density	High density fillers - Cause sink/float separation issues in recycling
disruptor-0022	Reactive	Thermoset resins - Cannot be remelted or remolded after curing
disruptor-0023	Reactive	Crosslinked polymers - Prevent melting and recycling of plastics
disruptor-0024	Colorant	Carbon black pigments - Absorb sortation optical wavelengths
disruptor-0025	Colorant	Mineral colorants - Inorganic, high density, disrupt plastic recycling
disruptor-0026	Strength	Fiber reinforcement - Glass/carbon fibers hinder reprocessing
disruptor-0027	Strength	Mineral fillers - Increase composite density and cause separation issues
disruptor-0028	Shape	Closed shapes - Traps gases, liquids causing separation issues
disruptor-0029	Shape	Intricate shapes - Difficult to clean and problematic in recycling
disruptor-0030	Barrier	EVOH layers >5% - Limit recyclability of packaging
disruptor-0031	Barrier	Polyamide layers - Interfere with PET recycling
disruptor-0032	Barrier	PVDC layers - Hinder recyclability of packaging films
disruptor-0033	Size	Particles too small - Lost during reprocessing of recyclables

disruptor-0034	Size	Parts too large - Exceed equipment capacity limits
disruptor-0035	Other	Oxodegradable additives - Fragment polymers prior to recycling
disruptor-0036	Other	Radiofrequency identification tags - Interfere with recycling systems
disruptor-0037	Other	Wet strength agents - Increase strength when wet but disrupt repulping
disruptor-0038	Other	Natural fibers - Cause issues when repulping and recycling
disruptor-0039	Other	Compostable materials - Contaminate conventional plastic recycling
disruptor-0040	Other	Viscose rayon - Causes issues when recycling with cellulose fibers
disruptor-0041	Ink	Non-dispersible inks - Not compatible with recycling systems
disruptor-0042	Ink	Mineral oil based inks - Problematic for paper recycling processes
disruptor-0043	Ink	Metallic inks - Interfere with detection during automated sorting
disruptor-0044	Ink	Security inks - Disable automated detection and sorting
disruptor-0045	Hazardous	Battery components - Toxic materials contaminate recycling streams
disruptor-0046	Hazardous	Light bulbs/lamps - Contain mercury, a hazardous material
disruptor-0047	Hazardous	Lead crystal glassware - Releases toxic lead compounds during recycling
disruptor-0048	Hazardous	Products containing asbestos - Release carcinogenic asbestos fibers if damaged
disruptor-0049	Hazardous	Gas cylinders - Potentially explosive under pressure
disruptor-0050	Hazardous	Aerosol cans - Risk of explosion if compressed

10.12 Controlled Lists: Levels

Table 19: Levels		
Identifier	Category	Description
level-0001	Primary	The individual sale unit container that directly contains the product and is handed to the end consumer. For example - a plastic bottle or aluminum can holding a beverage.

level-0002	Secondary	An outer packaging used to group primary packages together into a single unit for sale, display or distribution. For example - a corrugated cardboard box containing multiple beverage bottles.
level-0003	Multipack	A packaging format used to bundle multiple primary packages or secondary packages together for sale to consumers. For example - plastic shrink wrap bundling a 6 pack of canned beverages.
level-0004	Shipment	Packaging designed specifically for shipping single or multiple sales units to end consumers or retailers. For example - a corrugated box with protective inner packaging used to mail an item.
level-0005	Transit	Outer protective packaging used for storage, handling and transport of multiple secondary or shipment packages together. For example - stretch wrapping bundles of corrugated boxes onto a pallet.
level-0006	Display	Packaging intended for in-store product presentation and merchandising to consumers. For example - clear plastic clamshell packaging allowing product visibility.
level-0007	Group	Packaging format for bundling multiple primary packages, secondary packages or multipacks together into larger units for logistics. For example - shrink wrapped trays containing cans.
level-0008	Logistic	Protective packaging systems used for storage, handling and transportation of large quantities of packaging during distribution. For example - intermodal containers, cargo nets, dunnage.
level-0009	Service	Packaging designed for immediate consumption that is filled at point of sale. For example - paper cup and lid, food takeout containers.
level-0010	Portion	Small single serving packaging for portioned food, condiments, toiletries etc. For example - ketchup packet, shampoo sachet.

10.13 Controlled Lists: End of Life Routes

Table 20: End of life routes		
Identifier	Category	Description
route-0001	Recycling	Mechanical recycling - Sorting, processing and remanufacturing materials into new products.

route-0002	Recycling	Chemical recycling - Deconstructing polymers into monomers or basic chemicals for reproduction of new plastics.
route-0003	Composting	Industrial composting - Large scale biological decomposition of organic wastes from centralized collection.
route-0004	Composting	Home composting - On-site biological decomposition of household kitchen and garden waste.
route-0005	Anaerobic digestion	Breakdown of biodegradable materials by microorganisms in the absence of oxygen to produce biogas and digestate.
route-0006	Waste-to-energy	Incineration of waste coupled with energy recovery in the form of electricity, heat or fuel production.
route-0007	Refuse	Landfilling - Permanent disposal of waste in purpose-built, lined landfill sites.
route-0008	Refuse	Littering - Improper disposal leading to uncontrolled buildup of waste in open environments.
route-0009	Reuse	Direct reuse - Repeated use of a packaging in its original form and purpose through refill and return.
route-0010	Reuse	Repurpose - Using a post-consumer packaging for a new use different from its original purpose.
route-0011	Collection	Store drop-off - Consumer returns packaging to designated collection points.
route-0012	Collection	Curbside pickup - Scheduled collection of specified recyclables directly from households.
route-0013	Collection	Deposit return - Consumers return containers to redemption centers to collect a monetary deposit.
route-0014	Collection	Buy-back centers - Consumers sell their segregated recyclable materials, sometimes by weight.
route-0015	Collection	Bring banks - Containers located in public areas for collecting one or more recyclable materials.

10.14 Controlled List: Recycled Content Evidence

Table 21: Recycled Content Evidence

identifier	category	detailed
c-recycled-evidence-0001	certificate	Yes/No depending on presence of a certificate

10.15 Controlled List: Weight Tolerance Types

identifier	category
1	grams
2	percentage

11.0 Relationship Lists

Relationship lists allow defining connections and associations between different entities or data elements in the standard. They specify how items relate to and link with each other.

For example, a relationship list could map a packaging component to the specific materials used in its fabrication. This defines the composition at a granular level.

Other examples include:

- Relating a product or SKU to the packaging configurations used for its distribution.
- Linking a complete packaged item to its individual components like bottle, cap, label.
- Connecting a material to its constituent base material ingredients.
- Associating a component with its possible end-of-life treatment pathways.
- Linking a certification claim to the specific materials/components it applies to.

Unlike controlled vocabulary lists that have predefined values, relationship lists are customizable for each implementation. Users populate them to fit their data requirements.

Relationship lists enable complex many-to-many mappings between entities. This adds crucial context and traceability to the data standard.

They facilitate analysis like material flows, composition, product packaging configurations, and more. Linking data elements together this way adds meaning.

Relationship lists require planning to manage over time across systems. But their flexibility provides a powerful method to capture intricate supply chain connections in a structured format. Overall, they adapt standards to new use cases and add richness to the data.

11.1 Material Constituent List

Here is a detailed explanation of what a material constituents list is in an open data standard, along with an example:

A material constituents list defines the specific base materials, additives, and other substances that are combined to create a material formulation. It allows tracing a processed material back to its raw material makeup at a granular level.

For example, a PET plastic resin used to produce packaging may contain the following material constituents:

- Polyethylene terephthalate (PET) - 85%
- Impact modifier - 5%
- Coloring pigment - 3%
- UV stabilizer - 2%
- Antioxidant - 0.5%
- Mineral filler - 4%
- Lubricant - 0.5%

Each material constituent would have an identifier, the material name, the percentage of the overall material composition, and potentially additional attributes like purpose or processing details.

Table 8: Material Constituent

Column	Status	Format	Notes
materialConstituentsIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
materialCombinationIdentifier	required	String	The unique identifier of the materials that this component is made of. There must be an equivalent record in the Base_Materials OR Materials data.

materialPurpose	recommended	String	Why is this base material or material being used? Use the identifier of the material purpose that this row relates to. The entry here should be drawn from the Material Purpose Controlled List.
virginMaterial	recommended	Numeric	The maximum allowable percent of the material that was newly created for the material.
layer	recommended	Numeric	The layer associated with the material. The inner most layer (the layer closest to the product) denoted as 1, and the outermost layer is the biggest number.
materialPercentage	recommended	Numeric	The percentage of the total materials making-up the material. For every unique material, materialPercentage should add to 100%.

The material constituents list provides full transparency into the composition of processed materials used in packaging components and products. By assigning an identifier to each material constituent and linking it to the final material formulation, traceability and accuracy is improved. This enables better analysis of factors like recyclability, sustainability, safety, compliance, and more. Overall it removes opacity and adds crucial context to material data.

11.2 Component Constituent List

A component constituents list specifies the materials that are used to fabricate an individual packaging component. It allows tracing a component back to its material makeup.

For example, a plastic bottle component may contain the following constituents:

- PET resin material - 75%
- Polypropylene resin material - 15%
- Pigment material - 5%
- Mineral filler material - 5%

Each component constituent would have an identifier, the material identifier, and potentially additional attributes like the percentage of the overall component composition.

The component constituents list provides transparency into the materials making up packaging components. By linking the materials to the final component, it enables better analysis of factors like:

- Recyclability - based on the material mix
- Sustainability - depending on material attributes
- Compliance - relating to regulated materials
- Cost - according to material costs
- Performance - based on material properties

Table 9: Component Constituents

Column	Status	Format	Notes
componentConstituentsIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
materialCombinationIdentifier	required	String	The unique identifier of the materials that this component is made of. There must be an equivalent record in the Materials OR Components data.

11.3 Complete Packaging Constituents

A complete packaging constituents list specifies the components that make up a complete packaging item. It allows tracing a complete package back to its component parts.

For example, a bottled beverage complete packaging may contain the following constituents:

- PET bottle component
- PP cap component
- Paper label component

Each constituent would have an identifier, the component identifier, and potentially additional attributes.

Column	Status	Format	Notes
completePackagingConstituentsIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier

completePackagingCombinationIdentifier	required	String	The unique identifier of the components and/or complete packaging that this complete packaging is made of. There must be an equivalent record in the Components OR Complete Packaging data.
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11.4 Multipack Constituents

A multipack constituents list specifies the complete packaging items that are bundled together to form a multipack product configuration. It allows tracing a multipack back to its constituent packaging.

For example, a 6-pack of bottled water may contain the following constituents:

- Complete pack 1 - 500ml bottled water
- Complete pack 2 - 500ml bottled water
- Complete pack 3 - 500ml bottled water
- Complete pack 4 - 500ml bottled water
- Complete pack 5 - 500ml bottled water
- Complete pack 6 - 500ml bottled water

Each constituent would have an identifier, the complete pack identifier, and potentially additional attributes like quantity.

Column	Status	Format	Notes
multipackConstituentsIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
multipackCombinationIdentifier	required	String	The unique identifier of components and/or complete packaging that this multipack is made of. There must be an equivalent record in the Components OR Complete Packaging data.

11.5 Certification Claims

A certification claims list allows linking certifications, standards, and seals of approval to specific materials, components, or packaging items. It provides traceability for certification credentials.

For example, a plastic packaging component may have the following certification claims:

- Claim 1 - FSC certification

- Claim 2 - ISO food-grade certification

Each claim would include an identifier, the certification source (e.g. FSC, ISO), and potentially details like issue date and expiry.

The certification claims list enables attaching relevant certificates, seals, and standards conformance to materials, components, and packaging. This provides transparency into sustainability, compliance, safety, quality, and other credentials.

By tracing certifications to specific entities, it improves trust and accountability.

Certifications can be reliably associated where they apply.

Column	Status	Format	Notes
certificationIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
certificationSource	required	String	What source provided the certificate? The entry should be the Certification Source Controlled List identifier.
certificationIssueDate	recommended	String	The date that the certificate was provided/last updated. Use the format dd/mm/yyyy.

Key benefits:

- Validate claims for materials, components and packaging
- Understand relevant standards and credentials
- Assess suitability and compliance
- Drive improvements through standards adoption
- Simplify audit and verification processes

11.6 Recyclability Claims

A recyclability claims list allows linking recyclability endorsements and assessments to specific packaging components or complete packaging items. It provides traceability for recycling credentials.

For example, a plastic bottle component may have the following recyclability claims:

- Claim 1 - Recycle logo from PREP scheme
- Claim 2 - OPRL assessment

Each claim would include an identifier, the claim source (e.g. PREP, OPRL), and potentially details like issue date.

The recyclability claims list enables attaching relevant recycling assessments and endorsements to packaging components and complete packages. This provides transparency into their recyclability status.

By tracing claims to specific entities, it improves accountability. Recycling claims can be reliably associated where they apply.

Key benefits:

- Validate recycling claims on components and packaging
- Understand which schemes have assessed recyclability
- Drive improvements by targeting unendorsed items
- Simplify verification of claims for stakeholders
- Increase consumer trust through endorsement logos

Column	Status	Format	Notes
recyclabilityIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
recyclabilitySource	recommended	String	What source provided the certificate? The entry should be the recyclability source controlled list identifier.
recyclabilityIssueDate	recommended	String	The date that the certificate was provided/last updated. Use the format dd/mm/yyyy.

Overall, the recyclability claims list attaches important third-party assessments on recycling potential. This brings clarity to the scope and validity of recycling claims made on packaging.

11.7 Component End of Life Routes

The component end of life routes list defines the intended destination and treatment options for a packaging component after its use. It allows specifying the preferred end of life pathways.

For example, a plastic bottle component may have these end of life routes:

- Route 1 - Recycle

- Route 2 - Energy recovery
- Route 3 - Dispose

Each route would have an identifier, the end of life route from a controlled list, an order of precedence, and any disruptors.

This list provides transparency into the optimal end of life handling for packaging components. By tracing routes to specific components, it enables better management of used packaging including:

- Improved recycling based on component mix
- Streamlining of waste logistics
- Strategic improvements by identifying disruptors
- Consumer education on disposal for components

Key benefits:

- Clarity on preferred component disposal
- Understanding of contingencies if optimal route not possible
- Data to design for recyclability and optimize end of life

Column	Status	Format	Notes
componentEndOfLifeRouteIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
componentEndOfLifeRoute	required	String	What is the intended end of life route for this component? The entry should be the end of life route controlled list identifier.
orderOfPrecedence	recommended	Numeric	The order that end of life routes should be used. The preferred route denoted as 1, and the last best option being the biggest number.
componentDisruptors	required	List	What challenges this end of life route for this component has. The entry should be the component end of life route disruptors controlled list identifier.

Overall, the component end of life routes list attaches crucial information about the intended fate of packaging components after use. This informs sustainable strategies and waste management.

11.8 Recycled Content Claims

The recycled content claims list allows linking evidence for recycled material content percentage claims to specific packaging components. It provides traceability for recycling credentials.

For example, a plastic packaging component may have the following recycled content claim:

- Claim 1 - Has 50% post-consumer recycled content

The claim would include an identifier, evidence type (e.g. certificate), reference number, and issue date.

The recycled content claims list enables attaching relevant supporting evidence for recycled content percentages in packaging components. This provides transparency into the accuracy of claims.

By tracing claims to specific components, it improves accountability. Recycled content can be reliably associated where it applies.

Key benefits:

- Validate recycled content claims on components
- Understand type of evidence for the claim
- Drive use of recycled materials with trusted claims
- Simplify verification of recycled content
- Increase consumer trust in recycling claims

Column	Status	Format	Notes
recycledContentIdentifier	required	String	A globally unique identifier. See identifiers section for information on how to construct this identifier
recycledContentEvidenceType	recommended	String	What type of document provides the information regarding the claim? The entry should be the recycled content evidence type identifier.

recycledContentEvidenceReference	recommended	String	An accompanying reference number associated with the recycled content evidence type for the component.
recycledContentIssueDate	recommended	String	The date that the recycled content evidence was issued. Use the format dd/mm/yyyy.

Overall, the recycled content claims list attaches crucial information to verify recycled material use in packaging components. This brings clarity to the scope and validity of recycled content claims.

12.0 Conclusion

The open data standard presented in this report aims to revolutionize the way data on plastic materials, components, products, and waste flows are captured, structured, and shared across the packaging and electronics supply chains. By providing a comprehensive and standardized framework, it enables diverse stakeholders – including manufacturers, brands, retailers, recyclers, regulators, and NGOs – to exchange information seamlessly and collaborate more effectively towards a circular plastics economy.

The standard covers the entire lifecycle of plastics, from the raw polymer resins to the finished products and their eventual end-of-life waste management. It defines clear data schemas for key entities such as BaseMaterials, Materials, Components, Products, MultiPacks, LoadCatalogs, and Loads. Each entity is modeled with a wide range of attributes that capture critical information for transparency and decision-making.

For BaseMaterials, which represent the unprocessed plastic resins, the standard captures properties like material type, density, recycled content percentage, and relevant certifications. The Materials entity builds upon this by incorporating details on finished plastic materials used in production, including color, additives, material constituents, and processing methods.

Moving up the supply chain, the Component entity models individual product parts and specifies their material composition, physical properties, manufacturing details, and recycled content. The Product entity represents complete items assembled from components and captures overall product characteristics. MultiPacks and LoadCatalogs allow for the aggregation of products into larger units for efficient logistics and inventory management.

Crucially, the standard employs unique identifiers for each entity, enabling granular traceability across the entire supply chain. Through the use of relationship lists, the flow of

materials can be tracked from initial base resins to the creation of products and eventual waste outcomes. This level of transparency is invaluable for assessing the environmental impact of plastic usage, identifying hotspots for improvement, and supporting extended producer responsibility.

The standard also incorporates controlled vocabularies for key attributes, ensuring consistency in terminology and facilitating data analysis. Certification details, recycled content percentages, and end-of-life processing methods are captured using standardized lists, enabling comparability across the industry.

By providing a common data language, the open data standard removes barriers to collaboration and unlocks the power of data-driven insights. Stakeholders can more easily assess the sustainability performance of their plastic usage, optimize material choices, redesign products for recyclability, and participate in industry-wide initiatives. Policymakers and NGOs can leverage the harmonized data to inform evidence-based regulations and hold actors accountable for their plastic footprint.

The potential impact of widespread adoption of this open data standard is immense. It can accelerate the transition to a circular economy for plastics by enabling better decision-making, fostering innovation, and driving collective action. As more stakeholders align their data practices with the standard, the depth and breadth of insights will continue to grow, propelling the industry towards a more sustainable future.

However, the journey is not over. There is a need to expand the standard to cover additional plastics applications and regions, engaging an even wider range of stakeholders. Continuous improvement of the standard based on real-world feedback and evolving industry needs will be critical. But with the foundation laid out in this report, the path towards a data-driven, circular plastics economy is clearer than ever before.

In conclusion, this open data standard represents a major milestone in the quest to tackle the global plastic waste challenge. By harnessing the power of standardized, transparent, and actionable data, it empowers stakeholders across the packaging and electronics supply chains to drive meaningful change and build a more sustainable future for plastics.