Onto-DESIDE GA number: 101058682

ONTO-DESIDE

DELIVERABLE

FAIR integrated ontology network - v.4

Deliverable number	D3.6
Deliverable name	FAIR integrated ontology network - v.4
Work package	WP3
Lead partner	LIU
Contributing partners	RS
Deadline	2025-06-30
Dissemination level	Public
Date	2025-06-27

Funded by
the European Union

PROJECT INFORMATION

Project summary

Circular economy aims at reducing value loss and avoiding waste, by circulating materials or product parts before they become waste. Today, lack of support for sharing data in a secure, quality assured, and automated way is one of the main obstacles that industry actors point to when creating new circular value networks. Together with using different terminologies and not having explicit definitions of the concepts that appear in data, this makes it very difficult to create new ecosystems of actors in Europe today. This project will address the core challenges of making decentralized data and information understandable and usable for humans as well as machines. The project will leverage open standards for semantic data interoperability in establishing a shared vocabulary (ontology network) for data documentation, as well as a decentralized digital platform that enables collaboration in a secure and privacy-preserving manner.

The project addresses several open research problems, including the development of ontologies that need to model a wide range of different materials and products, not only providing vertical interoperability but also horizontal interoperability, for cross-industry value networks. As well as transdisciplinary research on methods to find, analyze and assess new circular value chain configurations opened by considering resource, information, value and energy flows as an integral part of the same complex system. Three industry use cases, from radically different industry domains, act as drivers for the research and development activities, as well as test beds and demonstrators for the cross-industry applicability of the results. The developed solutions will allow for automation of planning, management, and execution of circular value networks, at a European scale, and beyond. The project thereby supports acceleration of the digital and green transitions, automating the discovery and formation of new collaborations in the circular economy.

Project start date and duration

1st of June 2022, 36 months

Project consortium

No	Partner	Abbreviation	Country
1	Linköping University	LIU	Sweden
2	Interuniversitair Micro-Electronica Centrum	IMEC	Belgium
3	Concular Ug Haftungsbeschrankt	CON	Germany
4	+Impakt Luxembourg Sarl	POS	Luxembourg
5	Circularise Bv	CIRC	The Netherlands
6	Universitaet Hamburg	UHAM	Germany
7	Circular.Fashion Ug (Haftungsbeschrankt)	FAS	Germany
8	Lindner Group Kg	LIN	Germany
9	Ragn-Sells Recycling Ab	RS	Sweden
10	Texon Italia Srl	TEXON	Italy
11	Rare Earths Industry Association	REIA	Belgium
12	Prague University of Economics and Business	VSE	Czech Republic

Document Reference

Project acronym	Onto-DESIDE			
Programme	Horizon Europe			
Grant agreement number	101058682			
Project URL	https://ontodeside.eu/			
EU Project Officer	Giuseppina LAURITANO			
Project Coordinator	Name	Eva Blomqvist	Phone	+46 13 28 27 72
	E-mail	eva.blomqvist@liu.se	Phone	
Project Manager	Name	Svjetlana Stekovic	Phone	+46 13 28 69 55
	E-mail	svjetlana.stekovic@liu.se	Phone	+46 701 91 66 76
Deputy PC	Name	Olaf Hartig	Phone	+46 13 28 56 39
	E-mail	olaf.hartig@liu.se	Phone	
Deliverable name	FAIR integrated ontology network - v.4			
Deliverable number	D3.6			
Deliverable version	Ontology Network Version v0.4.0			
Deliverable nature	Other			
Deliverable level	Public			
Due date	2025-06-30			
Delivery date	2025-06-27			
Keywords	Ontology Network, Ontologies			

Document Change Log

Version	Date	Description	Authors	Checked by
0.1	2025-06-04	Initial draft	Huanyu Li	Eva Blomqvist
0.2	2025-06-26	Text updated to address the review comments	Huanyu Li	Eva Blomqvist

Document Approval

Version	Date	Name	Role in the project	Beneficiary
0.1	2025-06-26	Els de Vleeschauwer	Reviewer of the GitHub repository and document	IMEC
0.2	2025-06-30	Eva Blomqvist	PC	LIU

Contents

Abbreviations

Abbreviation	Explanation
CE	Circular Economy
CVN	Circular Value Network
Dx.x	Deliverable x.x
EMMO	Elementary Multiperspective Material Ontology
FAIR	Findability, Accessibility, Interoperability, and Reusability
ODP	Ontology Design Pattern
OGC	Open Geospatial Consortium
OWL	Web Ontology Language
URI	Uniform Resource Identifier
WP	Work Package
W3C	World Wide Web Consortium
XD	eXtreme Design Methodology

Summary

This deliverable presents the fourth prototype of the Onto-DESIDE ontology network. The network was initially introduced and motivated in Deliverables D3.1 and D3.2, with the first prototype released in D3.3, followed by updated versions in D3.4 and D3.5. While the primary deliverable is the online ontology network itself[1], this brief report summarizes its main content. It also includes documentation of the respective files comprising the network (release v1.0.0) in the appendix. Notice that this release version refers to the network as a whole and may differ from the version numbers of individual modules.

The ontology network prototype consists of (1): fourteen ontology modules, i.e. small ontologies, that are connected through `owl:imports` or by referencing concepts across modules; (2): an integrated ontology that imports all core modules, providing a unified and integrated view of the network; (3): three use case ontologies addressing the textile, construction and electronics domains; (4): an alignment module that includes semantic alignments between relevant ontologies, with a focus on the circular economy (CE) and materials science domains.

[1] Available at https://w3id.org/CEON/

1 Introduction

Ontologies are a key enabler for semantic interoperability since they can provide formal definitions of concepts and their relations, for describing the data to be exchanged. The Onto-DESIDE project develops a technology for allowing data sharing about materials, components, and products, as well as actors, capabilities and processes, as part of circular value networks (CVNs), at a global scale and across industry domains. The associated metadata and structures for transforming data into information (semantic descriptions, vocabularies) will be openly available and aligned with the FAIR principles (Findability, Accessibility, Interoperability, and Reusability). This approach is intended to maximize semantic interoperability and support high levels of automation in data sharing and exchange.

This document describes the ontology deliverable D3.6 (deliverable type OTHER, fourth version of D3.3), which is published publicly on GitHub[2], and that provides the foundations of the necessary core ontologies to enable semantic interoperability. This document describes the fourth version of the deliverable, presenting the fourth prototype versions of the ontologies which is a major release of the ontologies within Onto-DESIDE.

2 Ontology Network

The main content of this deliverable is the ontology network itself, but here we give a brief textual overview of the outline and content of the network.

2.1 Methodology

As presented in D3.1 and 3.2, we rely on an agile ontology development methodology, inspired by eXtreme Design (XD) [3]. This methodology supports an agile work process, suitable for the three iterations of the project, where both requirements and solutions evolve and emerge incrementally. The basis of the ontology development, is a set of "stories", exemplifying and detailing the intended use of the ontologies. These stories are then transformed into ontology requirements, (e.g. Competency Questions (CQs) [12]) and other requirements (e.g. reasoning requirements), and thereafter formally represented in an ontology language, in our case OWL[3]. This methodology emphasizes highly modular ontologies, i.e. both for separation of concerns but also as a way to allow for modeling certain aspects without having the full picture of the requirements at hand, which is the case in our project. Further, the notion of Ontology Design Patterns (ODPs) [4, 9] is applied. Here ODPs refer to small, highly generic ontology modules that are reusable across all industry domains and represent the shared core design decisions of the ontology network. For further methodological details, and the full list of requirements, refer to D3.1 and 3.2.

2.2 Outline of the Ontology Network

The requirements analysis presented in D3.1 resulted in a quite extensive set of ontological requirements, i.e. 55 ontology stories resulting from the analysis of D2.1 (and D6.1) and 17 stories resulting from the analysis of the circular value network (CVN) concept itself and its definitions in standards and usage in D6.1 and D2.1. Many of them are use case-specific, in terms of involving specific concepts of an industry domain. Still, many of them can also be generalized across domains. Notably there are many clear parallels and recurring topics among the three project use cases. It should also be noted that these initial requirements were preliminary and have since been updated and consolidated in D2.3.

In the first and second iterations of the project, we focused on identifying the core topics to be covered by ontology modules. This was guided by the initial set of requirements, and refined through feedback from the use cases, resulting in ontology releases v0.1.0 and v0.2.0, respectively. In the third iteration, the emphasis shifted to expanding

[2] With the permanent URI https://w3id.org/CEON/
[3] https://www.w3.org/OWL/

coverage and aligning with relevant standards and existing ontologies, resulting in ontology release v0.3.0 fore evaluation. In the evaluation of the third iteration, the developed ontologies (v0.3.0) were tested within a cross-industry scenario (refer to D6.9 for details on the evaluation process and results). Taking the evaluation result into account, we have further updated the ontology network and released version 1.0.0. Figure 1 shows details about the latest release of the developed ontologies in this deliverable (D3.6), including not only the core network, but also three use case ontologies, and an alignment module for CE and materials related ontologies. Note that the boxes do not represent single concepts in an ontology, but rather areas, i.e. topics, that should be covered by some ontology module. The blue boxes and ovals represent the 15 modules included in this release (D3.6), reflecting an increase from the 9 modules presented in D3.4 and 13 modules in D3.5. The lines between the boxes represent some common sense relations between the topics, and are in the actual implementation of the ontology network replaced by formal relations between modules, e.g. in some cases `owl:imports`, as well as some other alignments, reuse of concepts between modules, or specific object properties connecting concepts inside the modules.

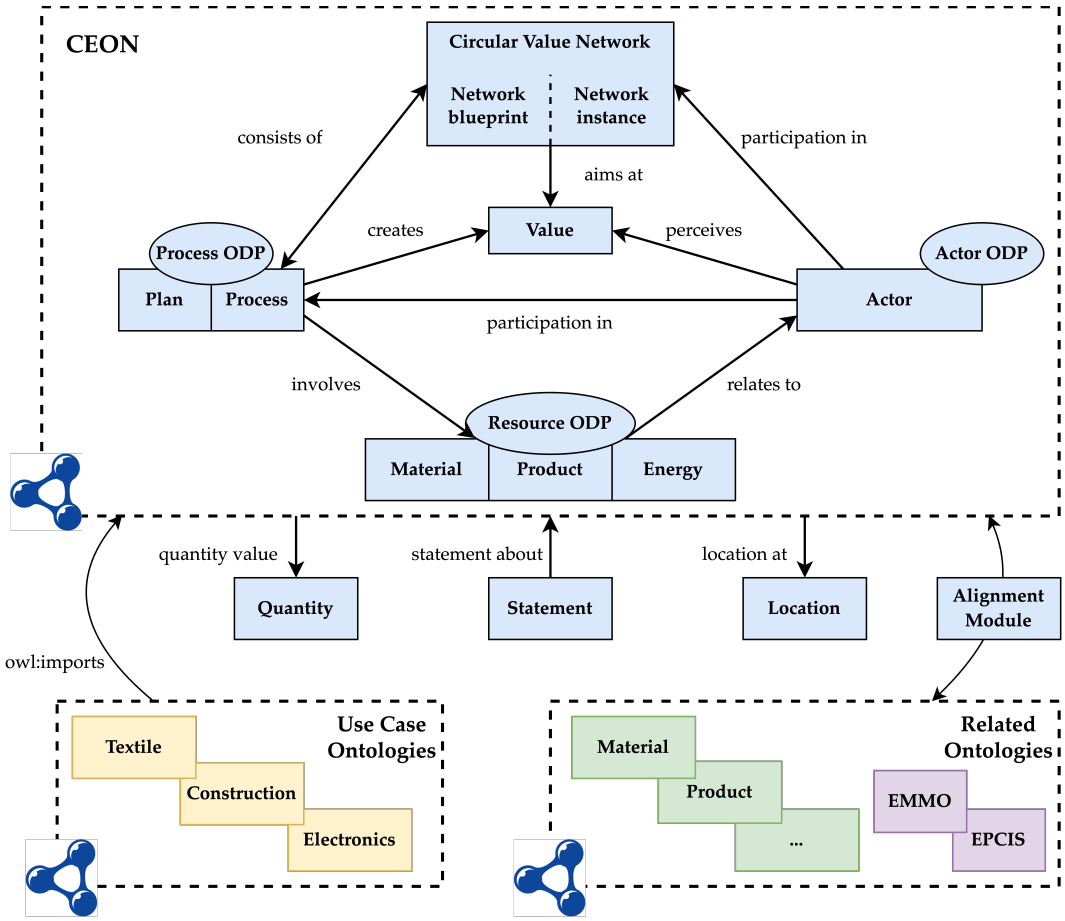


Figure 1: Informal illustration of the core topics of the ontology network.

2.3 Core Cross-Domain Topics

In this section we provide a brief description of the set of core modules, nine of which were already identified for D3.3 and D3.4 (i.e. actorODP, processODP, resourceODP, actor, process, material, product, cvn and value), four were identified for D3.5 (i.e. quantity, statement, location and energy), one was decoupled from the process module for D3.6 (i.e. plan), as illustrated in Figure 1. The actual modules can be found in our GitHub repository[4] and their documentation in the appendix of this document. In the latest release (v1.0.0) in this deliverable, we further include (1): an integrated version of CEON (where all modules are imported into one ontology file using `owl:imports`);

[4] https://github.com/LiUSemWeb/CEON/tree/main

(2): a module of alignments between CEON and relevant ontologies for CE and materials domains; (3): three use case ontologies for the textile, construction and electronics domains. The core cross-domain topics covered by the ontology network are listed below.

- Circular Value Network
- Value
- Actor
- Process
- Resource
- Quantity
- Statement
- Location

2.3.1 Circular Value Network

This topic is in the current version of the network represented by one module, which details the core concept of the ontology network, i.e. the Circular Value Network (CVN) itself. A CVN operates according to a blueprint, which describes the planned setup of the network. A planned setup usually (1): specifies how resources are transformed or operated by actors of certain types, (2): follows or targets certain types of circular strategies (e.g. refurbishment of a product) and (3): relates to typical value propositions and goals. Such a setup can be viewed as a network blueprint. In addition to a blueprint, the module also supports modeling of concrete instances of value networks, i.e. an actual value network where the roles are filled by various actors of the appropriate types, with a specific goal, and specific value proposition (and value created) in mind.

Our starting point for this module was an analysis of several terminologies, ontologies, and emerging standards, cf. D3.1, including the emerging standards in ISO 59004, the Circularity Thinking methodology, as well as a generalisation over the project use cases and requirements in D6.1-3 and D2.1-3. The CVN module reuses and connects to concepts defined in the actor, process, and value modules, as a Circular Value Network inherently links actors through processes to the creation of value. The terminology of the value network concept is aligned with the ISO 59004:2024 term glossary (3.5.3 value network).

2.3.2 Value

Although value is a very central concept in the Circular Economy (CE), and closely related to the circular value network through its value proposition, it remains a challenging concept to define and represent formally in data. Following the discussions on the value concept that is currently ongoing in other fora, e.g. standardization bodies and our work in WP5, the value module models the basic concepts and relationships needed to represent values, value propositions, value perceptions, and related constructs. In addition, we model the connections between the value module and CVN value basically through defining that specific CVNs or their blueprints can aim at specific values therefore stating some value propositions. Additionally, we capture the fact that value is contextual, e.g. that a resource has some value in relation to a specific actor, or in a specific context. The terminology of the value module is aligned with the ISO 59004:2024 term glossary (3.1.7 value).

2.3.3 Actor

A circular value network is in essence composed of a set of actors filling certain roles in different phases of the network's flows, and in relation to certain resources. Hence, the actors are the ones that actually realize the value network, and perform the work to transform materials, components, and products in the various steps in the value network phases. Similar to the value network itself, also actors can be modeled at two levels, i.e. as actor types that can fill certain typical roles in a network, such as a "recycler" or "manufacturer", and the concrete actors, that are usually organizations, that take on those roles in a specific network instantiation. Actors are also related to their capabilities and competencies, which determines if they are able to fulfill a certain role in a network or not. Further, actors take on various roles in relation to resources, e.g. holding certain resources, owning them, selling them, buying them.

The modeling of this topic is done at two levels in the ontology network, i.e. one actor ODP, which holds the most general concepts that are essentially independent of any industry domain or circular strategy, and an actor module that specializes that ODP and includes CVN-specific concepts, as well as specific roles in relation to circular strategies. These modules refer to concepts in the process and resource ODPs. The terminology of the actor module is aligned with the ISO 59004:2024 term glossary (3.4.1 organization, 3.4.2 interested party, stakeholder).

2.3.4 Process

Each circular value network realizes one or more circular value flows, which can be seen as a process of transforming some resource, e.g. from materials, to components, into products, and then potentially back again. Such processes have different phases, e.g. the phase that takes something from materials to components, or the phase of deconstructing a product into its material composition, and each phase can further be subdivided into smaller steps (pieces of work), which can be performed by different actors. However, at this point we chose to simply model all this at the level of executions and sub-executions. This is done by specializing a process that can transform one situation into another — for example, by changing the state of affairs, such as the situations of actors or resources. Then each situation is supposed to satisfy a plan which has a plan execution. Each step may then also have inputs and outputs, with respect to the situation of its corresponding process, both in terms of resources, but also work, energy, and information, for instance, and may result in some waste, i.e. transforming something for a certain state of affairs (situation) to another state of affairs (situation). Steps can be performed by actors, i.e. participants in the value network, with the right capabilities. For these aspects, many relevant ontologies already exist. The module(s) addressing this topic will primarily serve as a bridge, facilitating future alignment with these existing models to enable their integration into the broader ontology network.

The current realization of this topic consists of one process ODP, specifying the generic concepts involved in process modeling, and a process module as a specialization of that, for including the CVN-specific processes that are targeted in the project, and a plan module detailing process settings and plan executions. The process module refers to concepts in the actor and resource ODPs, and the plan module refers to concepts in process ODP.

2.3.5 Resource

Resources are at the core of the circular economy, since they constitute the physical flows that are circulated, and the things which are needed as input and output of each process. Most prominently the resources are the materials, components, and products that the network aims to manage circularly, but resources can also include the additional materials needed for processing, such as consumables or catalysts, and energy needed in different processes. We have introduced the energy module to satisfy the requirements related to energy that emerged in the project requirements (D2.3).

This part of the network is realized through a generic resource ODP, which is then specialized into three modules, i.e. one modeling materials, one modeling products and components and one modeling energies. The materials module is modeled in the same style as the EMMO core ontology for materials modeling. The terminology of the

resource ODP and the product module is aligned with the ISO 59004:2024 term glossary (3.1.5 resource, 3.2.1 solution, 3.2.2 product).

2.3.6 Quantity

A cross cutting notion when sharing data in the circular economy is to be able to represent actual quantities, e.g. quantities of materials or products, but also quantities of energy use, or quantification of value aspects. To represent such more detailed quantity information of resources or processes, we modeled the quantity module which can be used to represent quantity values, for instance values that are associated with processes such as dismantling costs or transport costs. In detail, we reuse the QUDT [14] (Quantities, Units, Dimensions, and Types) ontology by specializing its quantity value concept and its related relationships.

2.3.7 Statement

From our requirements it is also clear that we need to be able to express facts about facts, i.e. metadata about the information shared in the circular value network. The most obvious case is to keep the traceability of what actor has made a certain claim, e.g. about a product or its components, or any resource in general. Thus we need to model the general concept of a statement. To further detail the kinds of statements required in the data we have modeled two specific types of statements within the ontology: quantity statements and participation statements. A quantity statement expresses a relation between some thing and a literal value, commonly with an associated unit of measure, e.g. the weight of a product in grams. A participation statement is used to represent the role of an actor in relation to a resource, e.g. this could represent statements about who has issued a data sheet, or who is the manufacturer of the product the data sheet is about.

2.3.8 Location

Location appears in many places in the overall list of requirements (e.g. D3.1-D3.2). Resources are associated with a specific location at a given point in time, but they may also have an origin point and a traceable history of places they have been. Similarly for actors, information etc. Different use cases demand varying levels of granularity in location information. For example, a construction-related use case might require precise details, such as specifying that an object is on the second floor of a building. In contrast, a take-back system may necessitate exact coordinates for a crate of products awaiting pick-up. While in other cases location information such as the country of origin of a certain product or material may suffice. Hence, we need both a generic notion of location, but also a "pluggable" structure where more specific models can be added for specific use cases.

We propose a dedicated module for the relevant concepts and relationships of location. This module integrates existing standard ontologies (e.g. the OGC standard GeoSPARQL) and introduces new concepts and relationships relevant to our ontology network. Notably, the concept of “location at" in Figure 1 serves as a generic relationship linking diverse entities to the location concept.

3 FAIR Ontology Publishing

Once ontologies have been modeled, they also need to be shared with the community. In order to actually be useful, they need to be both findable, accessible, interpretable and interoperable with standards and other ontologies, as well as highly reusable. In general, this holds for all scientific results and artefacts, but perhaps specifically for ontologies, that are supposed to act as mediators and provide semantic interoperability in a domain. To guide and support the sharing of scientific results in general, and artefacts in particular, the FAIR principles were proposed [35]. The ontologies developed by the project are published according to the FAIR principles. However, recent analyses by several researchers and projects [28, 20, 11, 17] come to the conclusion that there are different ways to

fulfill the FAIR principles, and it is not always clear exactly what is the best solution. Still, many of the principles are quite naturally fulfilled simply by the fact that we rely on Web technologies, e.g. the ontology language OWL which is based on Web standards, and use URIs as unique identifiers. In this section, we therefore discuss what aspects are important to take into account, as well as outline some specific methodological practices for the project.

3.1 Ontology Design Guidelines

In order to allow for a good design and representation of our ontologies, we have set up a number of concrete design guidelines for the project. These include:

- URIs – Each ontology should have a unique and resolvable URI, using the stable URI namespace of the project. Ontology modules are collected under the sub-path `https://w3id.org/CEON/ontology/`.
- Versioning – Each ontology module has a version IRI that includes a version number, but the ontology URI always leads to the latest version.
- Naming conventions – Local names (in terms of URI suffixes) are created using the camel notation, where classes start with a capital letter, and properties with a lower case letter.
- Labels – Every entity in the ontology modules should have a label (using `rdfs:label`), at least in English.
- Documentation – The ontology modules themselves are documented using a set of annotation properties, e.g. `dc:creator`., and `rdfs:comment` is used to document all the elements inside the ontology (in terms of natural language definitions and explanations in English).

Changes to the ontologies are managed through issues and branching in the underlying GitHub repository where the ontologies are stored.

3.2 Publishing Pipeline

The development of the ontology network will entail multiple interdependent ontologies, several of which will go though multiple development iterations. In order to keep track of such changes, we are using a GitHub[5] repository to handle versioning and to create new releases. Proper ontology versioning ensures both consistency and predictability over time, since any reference to a specific version of the ontology will remain valid.

The w3id service is used to provide permanent identifiers for the ontologies, all of which are aligned with the ontology releases. This provides a way of decoupling the identifiers used from any specific domain name or publishing platform, thus providing resilience in the long term, and the identifiers can be redirected as needed. Additionally, the w3id service can be used to support some aspects of content negotiation, allowing the ontologies to be made available according to the requirements of the user (e.g. Turtle files when access by an application, human-readable documentation when accessed via a browser).

Documentation is an important aspect when it comes to making ontologies both accessible and understandable. However, creating such documentation can be both labor intensive and time-consuming. In order to streamline this process, the project leverages pyLODE[6] for generating web-friendly documentation directly from the ontology files, thus removing the need for manually creating such content. Additionally, we employ OWL2VOWL[7] and WebVOWL[8] to generate interactive visualizations, providing an easy to understand overview of each ontology. These tools are all available open-source under the MIT licence and are combined into a pipeline that allows ontology documentation to be generated automatically, ensuring that the documentation always remains up to date.

[5] https://github.com/LiUSemWeb/CEON/
[6] https://github.com/RDFLib/pyLODE
[7] https://github.com/VisualDataWeb/OWL2VOWL
[8] https://github.com/VisualDataWeb/WebVOWL

4 Ontology Evaluation Summary

In this section, we briefly summarize the findings from the ontology evaluation conducted during the third project evaluation phase, and reported in D6.9. In addition, we comment on how the areas of improvement have been addressed, and what is left for future ontology maintenance, or in some cases deliberately left undefined for flexibility reasons.

4.1 Ontology Evaluation Method

First of all, applying an ontology in a concrete use case is often the best evaluation method, where both errors and misconceptions can be found, and the effectiveness of the ontology assessed. Hence the main evaluation of the ontology network constitutes applying it in our project use cases, together with the data sharing platform, and gathering feedback and observations from there. When it comes to the ontologies, applying them in the use cases mainly involves modeling the concrete use case-specific data (e.g. from D6.4-D6.6), being able to formulate appropriate queries on the data, supporting the user stories and other requirements. For this purpose, a set of use case-specific ontologies were built, i.e. one per use case, as test cases for ontology application. While building these ontologies in the first project iteration, a number of minor issues and missing concepts were identified in the core ontology modules, which were added to, or modified in, the core modules. In addition, a set of intermediate modules, mainly with reused concepts from other generic ontologies were also added to the network, to connect the highly generic core modules presented here, to use case specific concepts. In the second iteration, no further missing core concepts were identified when modeling the use case data, but the use case ontologies, and the intermediate modules were extended to cover the more extensive evaluation scenarios (see D6.5).

More in detail, for the evaluation in the third iteration (as mentioned in D6.9), two additional dimensions were introduced to conduct the evaluation of our ontology network, which are (1): data representation for a cross-domain scenario; (2): alignment with CE and materials related ontologies. For the first dimension, ontology engineers noted missing, ambiguous, incompatible or insufficient elements in the ontologies when using them to create data mappings for the cross-domain scenario, as well as for each industry domain. Identified issues were documented via the GitHub issue tracking system. For both dimensions, online meetings were organized including ontology engineers (from WP3 or WP4) and domain experts from the three use cases in which PowerPoint slides and ontology sketches were used for illustrating modeling solutions. In these meetings specific notions were discussed in-depth, such as the distinction between a product, batch and item, which could then be introduced with appropriate terminology and restrictions in the ontology.

After testing the ability to specialize the ontologies for the use case data and requirements, we also conducted a more technical evaluation, including requirements validation and verification. As described in D6.8 and D6.9, ontology characteristics and consistency were assessed using Protégé, reasoner plugins (such as the HermiT reasoner), and manual inspection of inferred axioms. The purpose was to identify inconsistencies in the ontologies, and to provide input for updates to the ontology.

Next, the OOPS! [29] and FOOPS! [10] validators were used to detect potential violations of best practices in ontology modeling and publishing. The generated reports provided feedback on a range of design aspects. In some scenarios, however, a conscious design decision can lead to an error or warning being reported, such as when the domain or range of a property is deliberately left undefined, or when inverse relations and disjointess is deliberately left out in order to increase flexibility and reduce computational complexity of reasoning. Hence, the results from these validators are to be used mainly as guidance, rather than as an absolute list of issues to correct.

Another (non-user focused) evaluation was the verification of ontological requirements using SPARQL queries. That is, formulating the CQs presented in D3.2 (which are updates of those in D3.1) related to each ontology module as a SPARQL query using the ontology vocabulary. When the modules were developed, a set of CQs was proposed for each module. The intention is that each developed module should be capable of answering its corresponding set of CQs. During the first evaluation, we tested each module by trying to formulate a SPARQL query for each of the

CQs. In the second iteration we tested the full set of CQs from D3.2. We also document what CQs are (partially or fully) covered in each module by using the annotation property `odp:coverRequirements`. In the third iteration, we further investigate how the latest ontology network cover the requirements.

4.2 Ontology Evaluation Results

In this section, we briefly summarize the evaluation results, including general observations from developing the use case-specific ontologies, as well as the technical and user-based evaluations previously detailed in D6.9. This serves to remind the reader of the starting point for the current work on the updated version of the ontology network.

When specializing the ontology network to represent the concrete data outlined in D6.4, i.e. in the first and second project iterations, a few notions were identified that were missing (or modeled without sufficient details) in the first release. Also in the second release of the core ontology modules a few notions were not considered sufficiently modeled. Such notions include energy, value and locations. Therefore, we include new modules in the core ontology network, or extend previous ones, since these three topics are generic. In the third project iteration, we identified that some concepts within the three use case ontologies are general across domains. Therefore, we moved these concepts or relationships (e.g. resource condition and various costs for processes) to core modules, such as the resourceODP or product module.

Regarding the technical evaluation, no inconsistencies nor unexpected inferences were detected when applying reasoners to the ontology modules and going through the list of inferred axioms manually. While this does not necessarily imply that there are no semantic defects in the ontology, at least they are formally correct. Hence, there were no issues from this evaluation that had to be addressed in the ontologies. The reports generated by the OOPS! validator categorizes problems as minor, important, or critical. The reports generated by FOOPS! on the other hand provide a summary of the proportion of tests passed, and lists detected errors. In the evaluation reports, all of the findings from these tools were included, regardless of whether they should be interpreted as errors or merely as observations that may need careful consideration. The reports were summarized in D6.9. However not all of them would be addressed in the end, since some issues are also triggered based on things that are conscious design choices. Still, quite a few issues were detected, although a lot fewer than in the first two iterations, and in the next section we report on how these issues have been addressed.

Regarding the testing of ontology modules with SPARQL queries, a set of only partially covered CQs were detected. Mostly this is due to that the generic ODPs and core modules were annotated to solve CQs that were expressed in a more concrete way, so that the module actually did not include the specific concepts mentioned in the CQ, but where one could infer through common sense that probably those would be possible subclasses of the included concepts. For instance, such a case could be a CQ mentioning the “product” concept, while the resourceODP only includes the notion of a resource, not the concrete notion of a product, while it can be assumed that a product could be considered to be a resource. In this way we exposed an ambiguity in what is actually meant with addressing a CQ, i.e. whether the concrete terms in the CQ have to be present in the ontology module or not, for considering it to be covered. Another common reason for partial coverage was the modularization of the ontology network, where in several cases concepts are defined in different modules, and hence a CQ that mentions one concept from one module and a second one from another module, would not be considered completely covered by either module, but using the ontology network as a whole the CQ is addressed. This raises the need for also performing integration testing, and potentially even providing an integration module for using (and testing) all modules together. Such an integrated module is included in this release as described in this deliverable. In the second iteration the CQ validation was therefore done in a slightly different way, where all modules were considered together, avoiding having to connect a CQ to one module alone. In Table 6 and Table 7, we update the requirements coverage for the CE related and use case related requirements, respectively.

4.3 Main Changes Implemented

The evaluation results from the third iteration provide a solid foundation for updating the ontology network. Furthermore, the cross-industry evaluation scenario from this iteration offers valuable data examples to be incorporated into the integrated version of CEON.

4.3.1 Main changes according to ontology evaluation results

In this section, we provide a summary of the issues that have been addressed as part of the latest version of the ontology network in this deliverable. These issues can be classified into two groups which are modeling issues identified through the development, where such issues needed to be further discussed among our ontology engineers and/or domain experts; and issues identified in the third evaluation including CQ verification and OOPS! and FOOPS! testing, for instance. In more detail, we have the modeling-related issues (which we have addressed in this release) such as refactoring process-related modules, by just breaking down the modules for more easier extension and reuse. Then for better documentation, we re-organize the landing webpage to give a more clear classification of our developed ontologies. For instance, (1): the core modules are further divided and labeled by topics (actor, process, resource, cvn and supplementary modules); (2): an integrated version of CEON with imports of all core modules is also provided.

Moving to the technical evaluation of the core ontology network. In Table 1, we summarize the reported errors from OOPS! and FOOPS! and describe how they have been addressed. We have registered CEON-related modules in registries including prefix.cc and LOV. Moreover, detailed metadata (e.g. previous version), provenance metadata (e.g. issued date) have been added into the latest CEON version.

Table 1: Summary of errors reported by the OOPS! and FOOPS! validators and how they have been addressed.

Reported issue	**Comment**
Prefix not found in prefix.cc nor LOV registries	Addressed in v1.0.0 for core modules.
Ontology not found in prefix.cc nor LOV registries	Addressed in v1.0.0 for core modules.
Metadata not accessible in prefix.cc nor LOV registries	Addressed in v1.0.0 for core modules.
Missing parts of recommended metadata	Added where applicable for all ontology modules.
Missing detailed metadata	Addressed in v1.0.0 for core modules.
Detailed provenance metadata missing	Added where applicable, but ontology not yet in final release.
Unconnected ontology elements	Addressed for all ontology modules.
Check vocabulary reuse	Updated but some are left unspecified by design.
Missing domain or range in properties	Updated but some are left unspecified by design.
Missing disjointness	Commonly left out for flexibility, addressed where applicable.
Inverse relationships not explicitly declared	Commonly left out for reduced complexity.

In response to the requirements verification using SPARQL queries, we manually check if new requirements will be covered when we introduce/update new modules and update use case ontologies (i.e. construction, textile and electronics). Then we address identified issues coming from previous discussions in consortium meetings/workshops and from the result of the third evaluation in terms of the new evaluation dimension (describe evaluation scenarios for the three industry domains, e.g. some concepts in use case ontologies could be generic and are moved to the respective core ontology modules). In Tables 6 and 7 from Appendix A, we have lists of the total set of requirements from D3.2 and show whether they are currently covered or not by the ontology network, with comparison to the requirements coverage in D3.4, and D3.5. While this is showing that not all requirements are covered, it is still in line with the prioritization made by WP6, i.e. through the data delivered in D6.4 - D6.6 and the evaluation scenarios chosen for the three project iterations (cf. D6.7, D6.8 and D6.9). Moreover, the intention is not to cover all requirements by building new modules, but rather provide bridges for alignments and integration of existing on-

tologies. For instance, detailed task modeling or actor role modeling is most likely out of scope of the core concepts in CEON, since either existing ontologies already cover this area or they are required in specific domain scenarios that could be included as an extension of the core of CEON in the domain ontologies.

4.3.2 Main additions of data examples in the fully imported version

As mentioned in Section 2.2, one of the updates in this release is the inclusion of an integrated module with all core modules of CEON imported. Additionally, we provide a data example based on a cross-industry scenario, previously used in the third evaluation phase of the project and documented in D6.9. In this release, we have adapted the example to be represented as an instance within the fully imported CEON model, using general concepts and relationships rather than those specific to particular use cases (i.e. textile, construction, or electronics). The data example is illustrated in Figures 2 to 5.

These examples depict scenarios across a product's life cycle, including purchasing products from a recycling company, repairing products by manufacturers, and handling products at the end of their life (e.g. through dismantling, recycling, or take-back programs). Figure 2 shows a buyer comparing prices of similar products offered by two different suppliers (one is a recycling company), purchasing one from the recycling company. These recycled products are then used in a production process to manufacture new goods, representing a beginning-of-life scenario. Figure 3 illustrates a mid-life scenario where a product becomes broken. In such cases, the original manufacturer may offer a repair service. Figure 4 presents an end-of-life scenario where a product can not only be dismantled or recycled but may also be resold to other actors. Figure 5 depicts a take-back scenario, in which end-of-life products are collected for further processing or reuse.

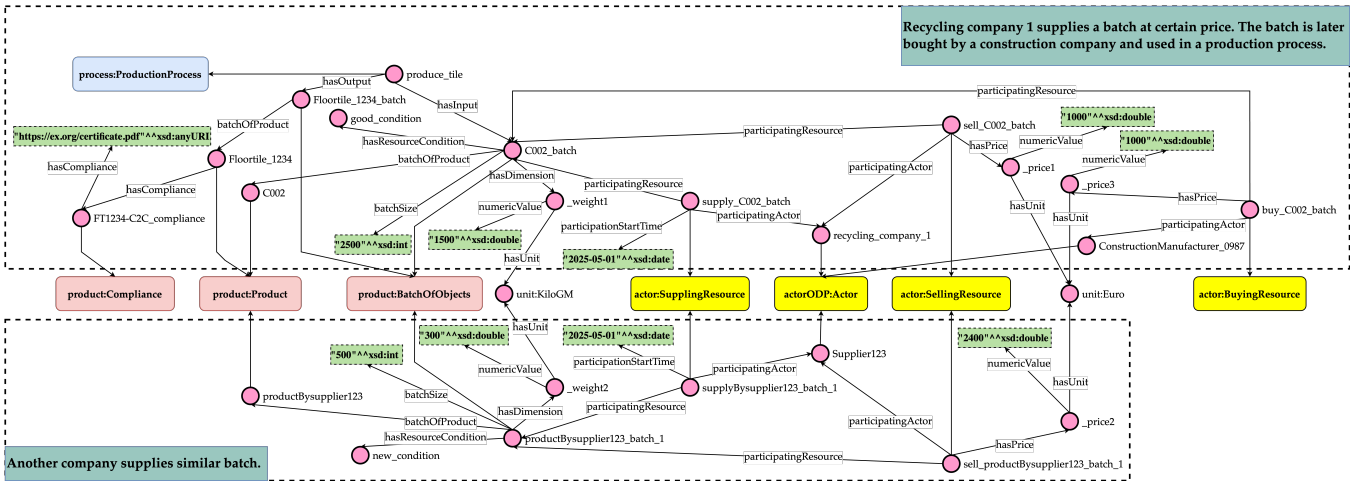


Figure 2: A recycling example of a batch of products (beginning-of-life).

5 Ontology Alignment Plan and Result Update

5.1 Ontology Alignment Pipeline

To enhance the interoperability and knowledge exchange among relevant ontologies in the Circular Economy domain, we conduct experiments of aligning relevant ontologies. These relevant ontologies cover the ones surveyed in our prior work [21], and include newcomers after the previous survey was published, and the top-level ontology, EMMO (Elementary Multiperspective Material Ontology)[9]. Therefore, we have 6 CE-related ontologies, a number

[9] https://github.com/emmo-repo/EMMO

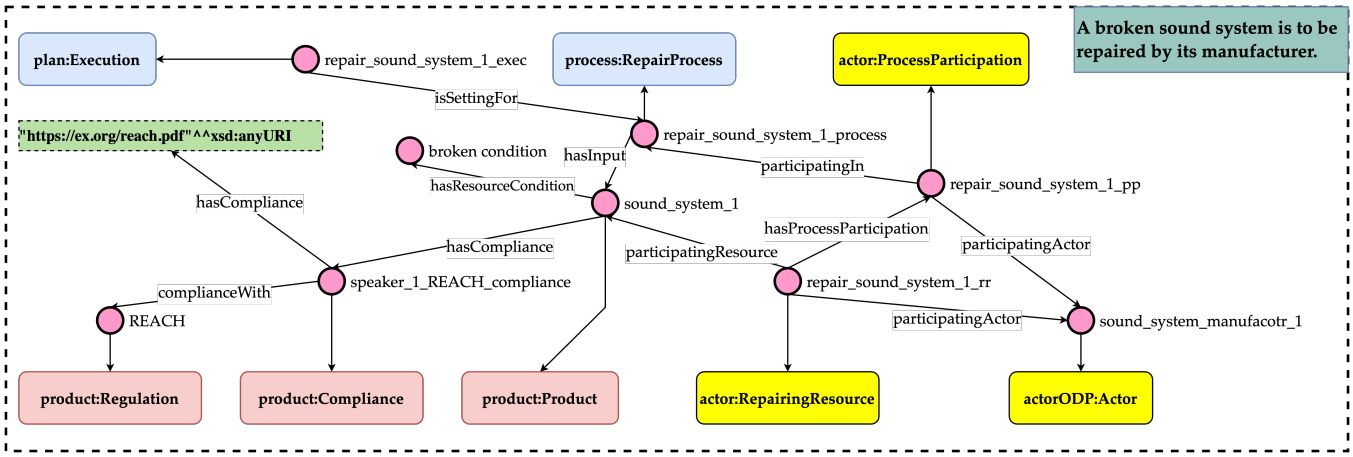


Figure 3: A repairing example of a set of products (middle-of-life - use phase).

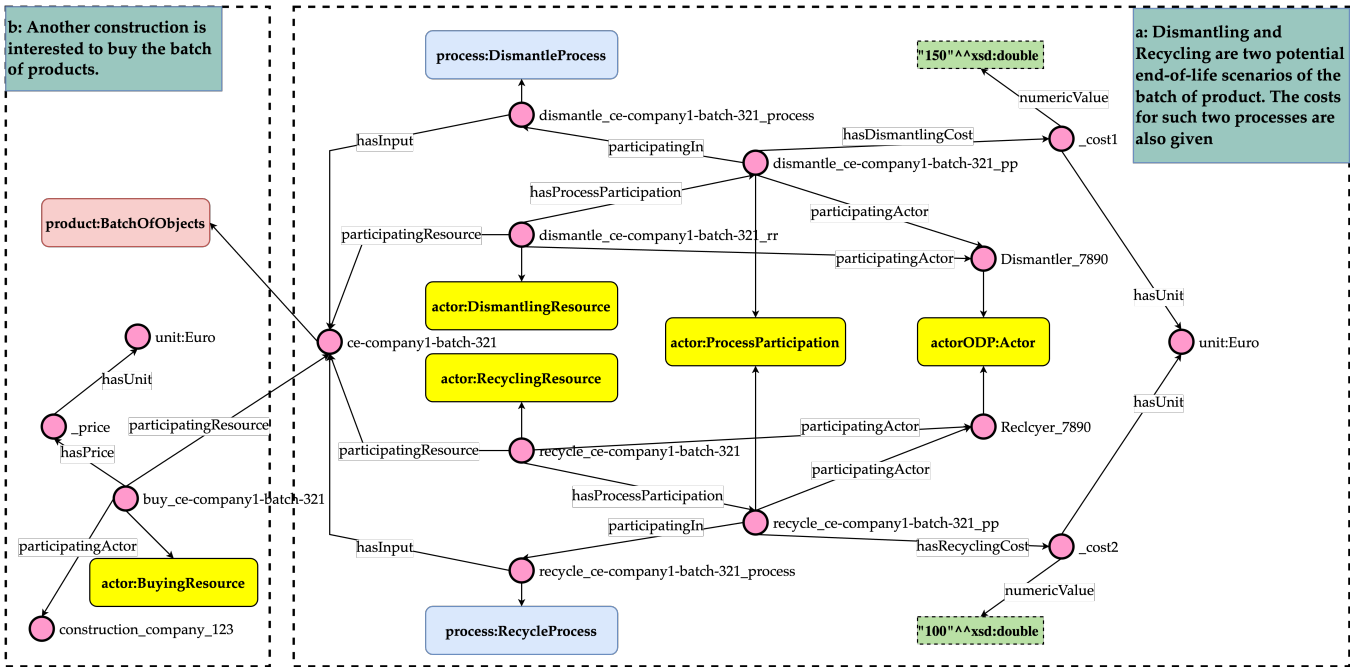


Figure 4: An example of reusing a batch of products (end-of-life).

of domain-specific ontologies (5 for sustainability, 13 for materials, 14 for manufacturing, 9 for products, and 8 for logistics) and 1 top-level ontology (EMMO) to include in our ontology matching tasks.

In the deliverables D3.2 and D3.5, we presented the ontology alignment plan and methods, as well as the initial alignment results. In this section, we mainly present the updates of the ontology alignment methods and result. As we presented in D3.2 and D3.5, there are three established ontology matching tasks in our plan. They are (a): producing alignments among CE-specific ontologies, (b): producing alignments between CEON and industry domain-specific ontologies, and (c): producing alignments between CEON and top-level ontologies (e.g. EMMO).

The pipeline as shown in Figure 6 is built upon general ontology matching frameworks (e.g. [19]) that many ontology matching tools are developed based on such a framework. This pipeline includes five essential steps which are *Matching By OM Tools*, *Voting or Filtering*, *Validation and Manual Matching*, *Conflict Checking* and *Publishing and Maintaining Alignments*. In this deliverable, we extend the previous methodology by incorporating additional ontology matching tools and refining voting, filtering, validation and conflict checking steps.

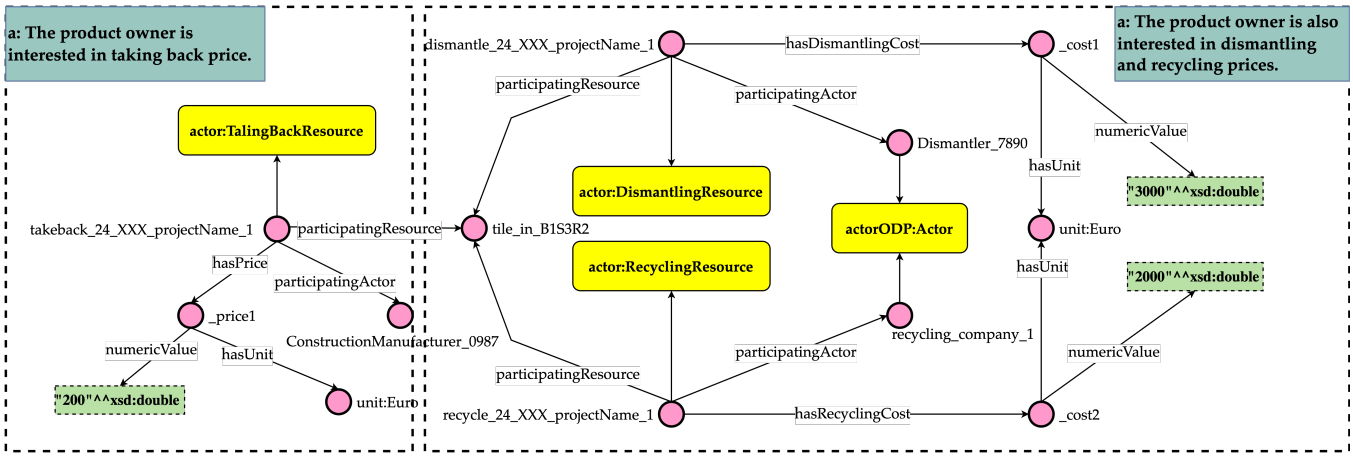


Figure 5: A takeback example of a batch of products (end-of-life).

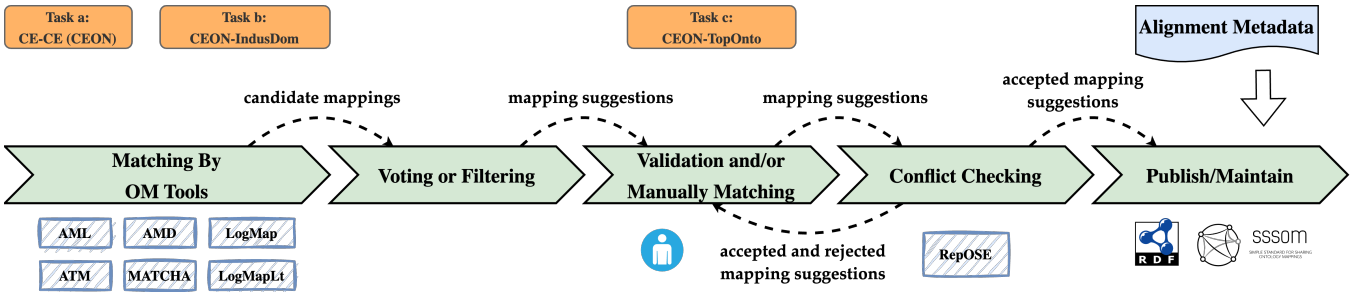


Figure 6: A pipeline of producing alignments based on the general framework outlined in [19].

5.2 Related Ontologies

5.2.1 CE-related Ontologies

We noted that not many ontologies for CE can be found when we conducted the ontology survey [21]. Most target very specific use cases in specific industry domains. The four CE-related ontologies are Circular Materials and Activities Ontology (CAMO) [32], Circular Exchange Ontology (CEO) [32], Building Circularity Assessment Ontology (BCAO) [26], Sustainable Bioeconomy and Bioproducts Ontology (BiOnto) [2]. Recently, the Digital Product Passport Ontology (DPPO) [18] was developed which is relevant to CE domain. As shown in Table 2, BCAO, CAMO and DPPO are relatively small ontologies considering the number of classes and axioms. Among them, BCAO has a more detailed taxonomy (i.e. 48 *SubClassOf* axioms) as well as more properties. For the three bigger ontologies (i.e. BiOnto, CEO and CEON), we see that (1): all three have detailed taxonomies (considering the number of classes and number of *SubClassOf* axioms); (2): all three have a number of property definitions while CEON and CEO also have hierarchies of properties (i.e. number of *SubObjectPropertyOf* axioms). In addition, all six ontologies shown in Table 2 have coherent TBoxes, as they do not contain any unsatisfiable concept names in their TBoxes. They are also consistent, as each has a model.

5.2.2 Materials-related Ontologies

The materials module in CEON reuses material-related concepts from the top-level ontology EMMO. This allows for modeling of materials at various levels of granularity. The previous survey [21] includes nine materials-related ontologies. In this work, seven more related ontologies are included. We note that although these ontologies have a general focus on materials, they still can be categorized into specific sub-topics such as, **t1:** *materials related to manufacturing processes focusing on more specific domain implementation (i.e. building materials)*; **t2:** *compu-*

Table 2: Ontology Characteristics for CE-related Ontologies.

	BCAO [26]	BiOnto [2]	CAMO [32]	CEO [32]	DPPO [18]	CEON
coherence (for TBox)	✓	✓	✓	✓	✓	✓
consistency	✓	✓	✓	✓	✓	✓
# of classes	37	780	86	62	15	147
# of individuals	0	0	0	2	0	71
# of object properties	19	64	1	78	5	87
# of data properties	17	5	7	25	3	34
# of axioms	212	2636	239	880	103	3215
# of SubClassOf axioms	48	804	88	124	13	159
# of SubObjectPropertyOf axioms	16	1	0	57	2	34
# of SubDataPropertyOf axioms	1	0	0	0	2	4
# of EquivalentClasses axioms	0	106	0	16	4	14
# of DisjointClasses axioms	10	0	1	1	0	0

tational or theoretical materials science; **t3:** *mechanical analysis on materials (i.e. mechanical testing)* and **t4:** *general data representation for material science and engineering domain*. For instance, AMO (Additive Manufacturing Ontology) [24] and BWMD-Domain ontology [33] share a similar industrial focus on modeling materials in the context of manufacturing (AMO for additive manufacturing specifically). On the other hand, Industrial Ontology Foundry Core ontology (IOF-core) [7] defines general materials which can be inputs of manufacturing processes. IOF-core ontology is also reused by some ontologies mentioned below (i.e. MSEO and MECH). About the more specific domain implementation, there are related ontologies, BUILDMAT (Building Material Ontology) [34], MPO (Material Properties Ontology) [30], and DEB (Devices, Experimental scaffolds and Biomaterials Ontology) [15]. Both BUILDMAT and MPO share the same focus on construction or building-related materials. Additionally, MPO focuses on representing material properties in the building context. DEB has a more general focus on representing and organizing information in the domain of biomaterials through the processes of designing, manufacturing and testing.

As mentioned above, one characteristic of materials-related ontologies is their focus on knowledge representation for computational or theoretical materials science (**t2**). For instance, MDO (Materials Design Ontology) [22], enables computational materials design-based data integration through representing structures and properties of materials. This is expanded by MAMBO [27], which integrates the chemical entity concept of ChEBI[10] with MDO for molecular material modeling. Similar to MPO, MATONTO (MatOnto ontology) [5] focuses on modeling material properties. MSEO (Material Science and Engineering Ontology) [16], extending a number of concepts from IOF-core and BFO[11], focus on representing material structures on both meso and micro levels. Z-BRE4K [6] has an industrial focus representing materials-related properties and measurements.

In terms of the mechanical testing perspective, there are related ontologies, MTO (Mechanical Testing Ontology) [25] and MECH (Materials Mechanics Ontology) [8] which focus on representing mechanical testing methods while MECH has a specific application aim for named entity recognition tasks. For the last characteristic of materials-related ontologies in general data representation, the examples are MWO (The MatWerk Ontology) [13], NMRRVOCAB (Materials Data Vocabulary) [23] and PMDco (Platform Material Digital Core Ontology) [1]. MWO and PMDco have a similar focus on data representation. MWO focuses on representing data of both scientific research and infrastructural status in the materials science and engineering community. PMDco [1] is a general ontology focusing on improving semantic interoperability in materials science and engineering domain, which is also reused by MECH. NMRRVOCAB aims to provide a vocabulary describing how NIST Materials Resource Registry[12] register records of material science.

[10]Chemical Entities of Biological Interest: https://www.ebi.ac.uk/chebi/
[11]Basic Formal Ontology: https://basic-formal-ontology.org
[12]https://materials.registry.nist.gov/

Table 3: Ontology Characteristics for Materials-related Ontologies.

	AMO [24]	BUILDMAT [34]	BWMD-Domain [33]	DEB [15]	IOF-core [7]	MAMBO [27]	MATONTO [5]	MDO [22]	MECH [8]	MPO [30]	MSEO [16]	MTO [25]	MWO [13]	NMRRVOCAB [23]	PMDco [1]	Z-BRE4K [6]	CEON
surveyed in [21]	✓	✓	✓		✓		✓	✓		✓				✓		✓	
coherence (for TBox)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
consistency	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
# of classes	293	27	772	601	93	57	848	37	450	140	239	421	116	3	239	56	147
# of individuals	139	12	0	0	0	21	131	2	0	0	2	2	5	994	20	0	71
# of object properties	19	56	24	12	103	35	83	32	26	13	129	158	74	0	113	53	87
# of data properties	5	7	11	109	0	63	13	32	0	8	3	3	29	0	15	26	34
# of axioms	1475	411	4664	2138	1764	632	5249	458	1746	549	3618	4352	1122	5503	2957	517	3215
# of SubClassOf axioms	520	26	771	666	172	43	1190	49	521	173	334	501	93	2	234	55	159
# of SubObjectPropertyOf axioms	4	47	21	0	68	17	74	0	17	0	92	107	8	0	51	0	34
# of SubDataPropertyOf axioms	3	5	10	63	0	42	3	0	0	0	2	2	6	0	8	0	4
# of EquivalentClasses axioms	19	0	0	8	21	0	282	0	12	0	35	35	7	0	22	0	14
# of DisjointClasses axioms	6	4	20	0	10	20	163	1	0	0	12	12	0	0	11	0	0

In terms of coherence, as shown in Table 3, all ontologies have coherent TBoxes since none contain unsatisfiable concepts. However, MAMBO and MATONTO are inconsistent because they include instance assertions over data properties that conflict with the range definitions of the corresponding data properties.

5.3 Updated Ontology Alignment Results

The resulting alignments of Task a can be seen in Table 4. The alignments have been made available as an independent module in the latest ontology release (v1.0.0). The results reveal strong dependencies on ontology scope and design. Narrow-scope ontologies such as CAMO (e.g. 86 classes and 8 properties), DPPO (15 classes, 8 properties) and CEO (62 classes, 103 properties) produced less mappings. CEON-CAMO yielded only one equivalence mapping on *Actor*. The main reason is that CAMO's model is narrower than that in CEON where CAMO has a specific scope such as that resources can be either materials or products while energy can also be a type of resource in CEON. Similarly, there are not so many mappings between CEON and CEO. There are mappings on classes (e.g. *Product*, *Resource* and *Geometry*) as well as mappings on object properties (e.g. *duringTime* and *hasTime*). DPPO's focus on digital product passports limited its overlap with CEON to basic concepts like *Actor* and *Product*. In contrast, BiOnto's rich hierarchy enabled 32 mappings with CEON, including *Material*, *Process*, and *Energy* concepts. However, the ontology network, including CEON, BiOnto and their mappings has an incoherent TBox even though CEON and BiOnto have coherent TBoxes. For instance, the class *Biofuel* in BiOnto is unsatisfiable due to the following axioms (1) $ceon{:}\,FossilFuel \sqsubseteq bionto{:}\,FossilFuel$, (2) $bionto{:}\,NaturalGas \equiv bionto{:}\,Fertilizer \sqcup bionto{:}\,Fuel$, (3) $ceon{:}\,NaturalGas \sqsubseteq ceon{:}\,FossilFuel$, (4) $bionto{:}\,Fuel \equiv bionto{:}\,Biofuel \sqcup bionto{:}\,FossilFuel$, (5) $bionto{:}\,Biofuel \sqcap bionto{:}\,FossilFuel \sqsubseteq \bot$, (6) $bionto{:}\,NaturalGas \sqsubseteq ceon{:}\,NaturalGas$. After further examining the ontology network, including CEON, BiOnto, and their alignments, as well as reviewing energy domain knowledge, we find that the aforementioned axiom (2) represents a potential modeling defect, given that natural gas is a type of fossil fuel, which in turn is a type of fuel.

The resulting alignments of Task b can be seen in Table 5. CEON-MATONTO exhibits the most mappings (16), primarily chemical elements (e.g. *Boron*, *Chromium*), reflecting a shared focus on representing material composition on the level of chemical elements. CEON-MDO also aligns well (5 mappings) on representing structural information of materials, including chemical formulas like (e.g. *ReducedFormula*, *HillFormula*), due to CEON's

Table 4: Mapping results for Task a.

summary	subject_source	object_source	subject_id	object_id	relationship
CEON-CAMO (1 mapping), coherent	ceon	camo	ceon:Actor	camo:actor	=
CEON-CEO (5 mappings), coherent	ceon	ceo	ceon:duringTime	owl-time:hasTime	<=
	ceon	ceo	ceon:TimeInterval	owl-time:Interval	<=
	ceon	ceo	ceon:Product	ceo:Product	>=
	ceon	ceo	ceon:Resource	ceo:Resource	=
	ceon	ceo	opengis:Geometry	opengis:Geometry	=
CEON-BiOnto (32 mappings), incoherent	ceon	bionto	qudt:Quantity	bionto:Quantity	=
	ceon	bionto	ceon:Organisation	bionto:Organization	=
	ceon	bionto	ceon:Person	bionto:Person	=
	ceon	bionto	ceon:Biofuel	bionto:Biofuel	=
	ceon	bionto	ceon:Biogas	bionto:Biogas	=
	ceon	bionto	ceon:Biomass	bionto:Biomas	=
	ceon	bionto	ceon:Coal	bionto:Coal	=
	ceon	bionto	ceon:Energy	bionto:Energy	=
	ceon	bionto	ceon:EnergySource	bionto:EnergySource	=
	ceon	bionto	ceon:FossilFuel	bionto:FossilFuel	=
	ceon	bionto	ceon:NaturalGas	bionto:NaturalGas	=
	ceon	bionto	ceon:Petroleum	bionto:Petroleum	=
	ceon	bionto	ceon:RenewableEnergy	bionto:RenewableEnergy	=
	ceon	bionto	ceon:Celulose	bionto:Cellulose	=
	ceon	bionto	ceon:ChemicalElement	bionto:ChemicalElement	=
	ceon	bionto	ceon:Iron	bionto:Iron	=
	ceon	bionto	ceon:Material	bionto:Material	=
	ceon	bionto	ceon:Nickel	bionto:Nickel	=
	ceon	bionto	ceon:Catalyst	bionto:Catalyst	=
	ceon	bionto	ceon:ManufacturingProcess	bionto:Manufacturing	=
	ceon	bionto	ceon:ProductionProcess	bionto:Production	=
	ceon	bionto	ceon:RecycleProcess	bionto:Recycling	=
	ceon	bionto	ceon:ServiceProcess	bionto:Service	=
	ceon	bionto	ceon:Event	bionto:Event	=
	ceon	bionto	ceon:hasPart	bionto:hasPart	=
	ceon	bionto	ceon:Plan	bionto:Plan	=
	ceon	bionto	ceon:Process	bionto:Proces	=
	ceon	bionto	ceon:hasPart	bionto:hasPart	=
	ceon	bionto	ceon:Information	bionto:Information	=
	ceon	bionto	ceon:Resource	bionto:Resource	=
	ceon	bionto	ceon:ValueProposition	bionto:ValueProposition	=
	ceon	bionto	prov:Entity	bionto:Entity	=
CEON-DPPO (9 mappings), coherent	ceon	dppo	qudt:Unit	dppo:Unit	=
	ceon	dppo	ceon:Actor	dppo:Actor	=
	ceon	dppo	ceon:endTime	dppo:endTime	=
	ceon	dppo	ceon:hasPart	dppo:hasPart	=
	ceon	dppo	ceon:startTime	dppo:startTime	=
	ceon	dppo	ceon:Product	dppo:Product	=
	ceon	dppo	ceon:containsInformation	dppo:containsInformation	=
	ceon	dppo	ceon:hasPart	dppo:hasPart	=
	ceon	dppo	ceon:isAbout	dppo:isAbout	=

adoption of MDO's data property design for using various chemical formulas to represent material compositions. Some other materials related ontologies also focus on representing materials and compositions but on a general level including BUILDMAT (*Material* and *Constituent*), IOF-core (*MaterialComponent*), MAMBO (*Material*), MECH

Table 5: Mapping results for Task b on materials ontologies.

summary	subject_source	object_source	subject_id	object_id	relationship
CEON-BUILDMAT (3 mappings), coherent	ceon	buildmat	qudt:Unit	qudt:Unit	=
	ceon	buildmat	ceon:Material	buildmat:Material	=
	ceon	buildmat	ceon:Constituent	buildmat:Constituent	=
	ceon	buildmat	qudt:hasUnit	buildmat:hasUnit	=
CEON-DEB (2 mappings), coherent	ceon	deb	ceon:Titanium	deb:Titanium	=
	ceon	deb	opengis:Geometry	deb:Geometry	=
CEON-IOF-core (6 mappings), coherent	ceon	iof-core	ceon:Person	iof-core:Person	=
	ceon	iof-core	ceon:Capability	iof-core:Capability	=
	ceon	iof-core	ceon:MaterialComponent	iof-core:MaterialComponent	=
	ceon	iof-core	ceon:ManufacturingProcess	iof-core:ManufacturingProcess	=
	ceon	iof-core	ceon:hasInput	iof-core:hasInput	=
	ceon	iof-core	ceon:hasOutput	iof-core:hasOutput	=
CEON-MAMBO (1 mapping), incoherent	ceon	mambo	ceon:Material	mambo:Material	=
CEON-MATONTO (16 mappings), coherent	ceon	matonto	ceon:Boron	matonto:Boron	=
	ceon	matonto	ceon:Chromium	matonto:Chromium	=
	ceon	matonto	ceon:Copper	matonto:Copper	=
	ceon	matonto	ceon:Dysprosium	matonto:Dysprosium	=
	ceon	matonto	ceon:Iron	matonto:Iron	=
	ceon	matonto	ceon:Magnesium	matonto:Magnesium	=
	ceon	matonto	ceon:Manganese	matonto:Manganese	=
	ceon	matonto	ceon:Neodymium	matonto:Neodymium	=
	ceon	matonto	ceon:Nickel	matonto:Nickel	=
	ceon	matonto	ceon:Niobium	matonto:Niobium	=
	ceon	matonto	ceon:Silicon	matonto:Silicon	=
	ceon	matonto	ceon:Titanium	matonto:Titanium	=
	ceon	matonto	ceon:Zinc	matonto:Zinc	=
	ceon	matonto	ceon:Catalyst	matonto:Catalyst	=
	ceon	matonto	ceon:hasPart	matonto:hasPart	=
	ceon	matonto	prov:Role	bfo:Role	=
CEON-MDO (5 mappings), coherent	ceon	mdo	ceon:Material	mdo:Material	=
	ceon	mdo	ceon:AnonymousFormula	mdo:AnonymousFormula	=
	ceon	mdo	ceon:HillFormula	mdo:HillFormula	=
	ceon	mdo	ceon:ReducedChemicalFormula	mdo:ReducedFormula	=
	ceon	mdo	ceon:DescriptiveFormula	mdo:DescriptiveFormula	=
CEON-MECH (5 mappings), coherent	ceon	mech	ceon:Location	pmdco:Location	=
	ceon	mech	ceon:Location	mech:Location	=
	ceon	mech	ceon:Composition	mech:Composition	=
	ceon	mech	ceon:Process	pmdco:Process	=
	ceon	mech	ceon:hasInput	pmdco:input	=
CEON-MPO (1 mapping), coherent	ceon	mpo	ceon:Material	mpo:Material	=
CEON-MSEO (7 mappings), coherent	ceon	mseo	ceon:Person	iof-core:Person	=
	ceon	mseo	ceon:Capability	iof-core:Capability	=
	ceon	mseo	ceon:MaterialComponent	iof-core:MaterialComponent	=
	ceon	mseo	ceon:ChemicalEntity	chebi:ChemicalEntity	=
	ceon	mseo	ceon:ManufacturingProcess	iof-core:ManufacturingProcess	=
	ceon	mseo	ceon:hasInput	iof-core:hasInput	=
	ceon	mseo	ceon:hasOutput	iof-core:hasOutput	=
CEON-MTO (4 mappings), coherent	ceon	mto	ceon:Organisation	commoncore:Organization	=
	ceon	mto	ceon:Energy	mto:Energy	=
	ceon	mto	ceon:ManufacturingProcess	iofcore:ManufacturingProcess	=
	ceon	mto	ceon:hasPart	obo:has_part	=
CEON-MWO (9 mappings), coherent	ceon	mwo	ceon:Organisation	mwo:Organization	=
	ceon	mwo	ceon:Person	schema-org:Person	=
	ceon	mwo	ceon:Person	mwo:Person	=
	ceon	mwo	ceon:Material	emmo:Material	=
	ceon	mwo	ceon:Material	mwo:Material	=
	ceon	mwo	ceon:Material	mdo:Material	=
	ceon	mwo	ceon:hasPart	mwo:hasPart	=
	ceon	mwo	ceon:hasPostalCode	mwo:hasPostalCode	=
	ceon	mwo	ceon:ChemicalElement	mwo:ChemicalElement	=
CEON-PMDco (8 mappings), coherent	ceon	pmdco	ceon:Organisation	prov:Organization	=
	ceon	pmdco	ceon:Person	prov:Person	=
	ceon	pmdco	ceon:ChemicalEntity	chebi:CHEBI_24431	=
	ceon	pmdco	ceon:Description	pmdco:Description	=
	ceon	pmdco	ceon:Plan	prov:Plan	=
	ceon	pmdco	ceon:Process	pmdco:Process	=
	ceon	pmdco	ceon:hasInput	pmdco:input	=
	ceon	pmdco	ceon:hasOutput	pmdco:output	=

(*Composition*), MSEO (*MaterialComponent* and *ChemicalEntity*), MWO (*Material*), and PMDco (*ChemicalEntity*). Another key observation is that we find quite a number of mappings on general concepts such as *Person* (IOF-core, MSEO, PMDco), *Organization* (MWO, PMDco). This is because many such materials domain ontologies reuse general concepts from existing ontologies such as the Provenance Ontology[13] or the schema of Schema.org[14]. In addition, several ontologies contain a focus on representing processes and corresponding inputs or outputs that result in mappings on classes such as *Process* and *ManufacturingProcess* and object properties such as *hasInput* and *hasOutput*.

6 Concluding Remarks and Future Work

The current state of the GitHub repository, constituting the deliverable D3.6, consists of 14 core ontology modules, where three of them are considered to be generic ODPs (Process ODP, Actor ODP and Resource ODP); eight of them are considered to model CE-related domain knowledge for representing circular value networks (Circular Value Network, Value, Actor, Process, Plan, Material, Product and Energy modules); three of them are considered to be supplementary to annotate CE data (i.e. Quantity, Statement and Location modules). Moreover, an integrated version with all core modules imported, and an alignment module are released. Three use case ontologies for textile, construction and electronics domains are also included in this release. All are published online in our ontology repository, including human-friendly documentation generated automatically from the ontology files, and versioned through GitHub. This release (v1.0.0) has followed the result of the third evaluation of the project, and has been subsequently updated. It should be noted that additional ontology modules have also been developed that are not part of the core ontology network. This includes modules reusing external ontologies, such as BOT (Building Topology Ontology) [31] and QUDT (Quantities, Units, Dimensions, and Types Ontology) [14]. These additional ontology modules are not included in this release.

Future work will follow the maintenance plan introduced in D3.7, which outlines three maintenance scenarios: reusing, updating, and correcting CEON. The plan also introduces a framework for maintaining ontologies that includes methodological and technical support, as well as social aspects such as community-level discussions for standardization.

[13] https://www.w3.org/TR/prov-o/
[14] https://schema.org

References

[1] Bernd Bayerlein, Markus Schilling, Henk Birkholz, Matthias Jung, Jörg Waitelonis, Lutz Mädler, and Harald Sack. PMD Core Ontology: Achieving semantic interoperability in materials science. *Materials & Design*, 237:112603, 2024. doi:10.1016/j.matdes.2023.112603.

[2] Chiara Bicchielli, Noemi Biancone, Fernando Ferri, and Patrizia Grifoni. BiOnto: An Ontology for Sustainable Bioeconomy and Bioproducts. *Sustainability*, 13(8):4265, 2021. doi:10.3390/su13084265.

[3] Eva Blomqvist, Karl Hammar, and Valentina Presutti. Engineering Ontologies with Patterns-The eXtreme Design Methodology. *Ontology Engineering with Ontology Design Patterns*, 25:23–50, 2016. doi:10.3233/978-1-61499-676-7-23.

[4] Eva Blomqvist and Kurt Sandkuhl. PATTERNS IN ONTOLOGY ENGINEERING: CLASSIFICATION OF ONTOLOGY PATTERNS. In *Proceedings of the Seventh International Conference on Enterprise Information Systems (ICEIS)*, volume 3, pages 413–416. Citeseer, 2005. doi:10.5220/0002518804130416.

[5] Kwok Cheung, John Drennan, and Jane Hunter. Towards an Ontology for Data-driven Discovery of New Materials. In *Semantic Scientific Knowledge Integration AAAI/SSS Workshop*, pages 9–14, 2008. URL: https://cdn.aaai.org/Symposia/Spring/2008/SS-08-05/SS08-05-003.pdf.

[6] Sangje Cho, Marlène Hildebrand-Ehrhardt, Gokan May, and Dimitris Kiritsis. Ontology for Strategies and Predictive Maintenance models. *IFAC-PapersOnLine*, 53(3):257–264, 2020. 4th IFAC Workshop on Advanced Maintenance Engineering, Services and Technologies - AMEST 2020. doi:10.1016/j.ifacol.2020.11.042.

[7] Milos Drobnjakovic, Boonserm Kulvatunyou, Farhad Ameri, Chris Will, Barry Smith, and Albert Jones. The Industrial Ontologies Foundry (IOF) Core Ontology. In *Proceedings of the 12nd International Workshop on Formal Ontologies meet Industry (FOMI 2022) Co-located with workshops about the Industrial Ontology Foundry (IOF) and the European project OntoCommons (EU H2020 project)*, volume 3240 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2022. URL: https://ceur-ws.org/Vol-3240/paper3.pdf.

[8] Ali Riza Durmaz and Akhil Thomas. Material properties ontology. Accessed: 2025-03-04. URL: https://w3id.org/pmd/materials-mechanics-ontology/1.0.1.

[9] Aldo Gangemi. Ontology design patterns for semantic web content. In *The Semantic Web–ISWC 2005: 4th International Semantic Web Conference, ISWC 2005, Galway, Ireland, November 6-10, 2005. Proceedings 4*, pages 262–276. Springer, 2005. doi:10.1007/11574620_21.

[10] Daniel Garijo, Oscar Corcho, and Maria Poveda-Villalón. FOOPS!: An Ontology Pitfall Scanner for the FAIR Principles. In *International Semantic Web Conference (ISWC) 2021: Posters, Demos, and Industry Tracks*, volume 2980 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2021. URL: http://ceur-ws.org/Vol-2980/paper321.pdf.

[11] Daniel Garijo and María Poveda-Villalón. Best Practices for Implementing FAIR Vocabularies and Ontologies on the Web. *Applications and Practices in Ontology Design, Extraction, and Reasoning*, 49:39, 2020. doi:10.3233/SSW200034.

[12] Michael Grüninger and Mark S Fox. The role of competency questions in enterprise engineering. *Benchmarking—Theory and practice*, pages 22–31, 1995. doi:10.1007/978-0-387-34847-6_3.

[13] Abril Azócar Guzmán, Ahmad Zainul Ihsan, Said Fathalla, and Angelika Gedsun. The MatWerk ontology. Accessed: 2025-03-04. URL: http://purls.helmholtz-metadaten.de/mwo/1.0.1.

[14] Ralph Haas, Paul J Keller, Jack Hodges, and Jack Spivak. Quantities, units, dimensions and data types ontologies (QUDT). Accessed: 2024-12-18. URL: http://qudt.org.

[15] Osnat Hakimi, Josep Luis Gelpi, Martin Krallinger, Fabio Curi, Dmitry Repchevsky, and Maria-Pau Ginebra. The Devices, Experimental Scaffolds, and Biomaterials Ontology (DEB): A Tool for Mapping, Annotation, and Analysis of Biomaterials Data. *Advanced Functional Materials*, 30(16):1909910, 2020. doi:10.1002/adfm.201909910.

[16] Thomas Hanke. Material Science and Engineering ontology. Accessed: 2025-03-04. URL: https://matportal.org/ontologies/MSEO.

[17] Krzysztof Janowicz, Pascal Hitzler, Benjamin Adams, Dave Kolas, and Charles Vardeman II. Five stars of linked data vocabulary use. *Semantic Web*, 5(3):173–176, 2014. doi:10.3233/SW-140135.

[18] Maike Jansen, Eva Blomqvist, Robin Keskisärkkä, Huanyu Li, Mikael Lindecrantz, Karin Wannerberg, André Pomp, Tobias Meisen, and Holger Berg. Designing an Ontology Network for Digital Product Passports. In *The Semantic Web: ESWC 2024 Satellite Events*, pages 220–237. Springer Nature Switzerland, 2025. doi:10.1007/978-3-031-78955-7_19.

[19] Patrick Lambrix and Rajaramb Kaliyaperumal. A session-based ontology alignment approach enabling user involvement. *Semantic Web*, 2017. doi:10.3233/SW-160243.

[20] Yann Le Franc, Jessica Parland-von Essen, Luiz Bonino, Heikki Lehväslaiho, Gerard Coen, and Christine Staiger. D2.2 fair semantics: First recommendations, March 2020. doi:10.5281/zenodo.5361930.

[21] Huanyu Li, Mina Abd Nikooie Pour, Ying Li, Mikael Lindecrantz, Eva Blomqvist, and Patrick Lambrix. A Survey of General Ontologies for the Cross-Industry Domain of Circular Economy. In *Companion Proc. of the ACM Web Conference 2023*. ACM, 2023. doi:10.1145/3543873.3587613.

[22] Huanyu Li, Rickard Armiento, and Patrick Lambrix. An Ontology for the Materials Design Domain. In Jeff Z. Pan, Valentina A. M. Tamma, Claudia d'Amato, Krzysztof Janowicz, Bo Fu, Axel Polleres, Oshani Seneviratne, and Lalana Kagal, editors, *The Semantic Web - ISWC 2020 - 19th International Semantic Web Conference, Athens, Greece, November 2-6, 2020, Proceedings, Part II*, volume 12507 of *Lecture Notes in Computer Science*, pages 212–227. Springer, 2020. doi:10.1007/978-3-030-62466-8_14.

[23] Andrea Medina-Smith and Chandler Becker. Simple Knowledge Organization System (SKOS) version of Materials Data Vocabulary, 2017. doi:10.18434/T4/1435037.

[24] Munira Mohd Ali, Rahul Rai, J. Neil Otte, and Barry Smith. A product life cycle ontology for additive manufacturing. *Computers in Industry*, 105:191–203, 2019. doi:10.1016/j.compind.2018.12.007.

[25] Joana Francisco Morgado, Emanuele Ghedini, Gerhard Goldbeck, Adham Hashibon, Georg J. Schmitz, Jesper Friis, and Anne F. de Baas. Mechanical Testing Ontology for Digital-Twins: a Roadmap Based on EMMO. In *Proceedings of the International Workshop on Semantic Digital Twins co-located with the 17th Extended Semantic Web Conference (ESWC 2020)*. CEUR-WS.org, 2020. URL: https://ceur-ws.org/Vol-2615/paper3.pdf.

[26] Lina Morkunaite, Fayez Al Naber, Ekaterina Petrova, and Kjeld Svidt. An Open Data Platform for Early-Stage Building Circularity Assessment. In *Proceedings of the 37th International Conference of CIB W78*, 2021.

[27] Fabio Le Piane, Matteo Baldoni, Mauro Gaspari, and Francesco Mercuri. Molecular and Materials Basic Ontology: Development and First Steps. In *Supplementary Proceedings of the XXIII International Conference on Data Analytics and Management in Data Intensive Domains (DAMDID/RCDL 2021)*. CEUR-WS.org, 2021. URL: https://ceur-ws.org/Vol-3036/paper19.pdf.

[28] María Poveda-Villalón, Paola Espinoza-Arias, Daniel Garijo, and Oscar Corcho. Coming to Terms with FAIR Ontologies. In *Knowledge Engineering and Knowledge Management*, pages 255–270, Cham, 2020. Springer International Publishing. doi:10.1007/978-3-030-61244-3_18.

[29] María Poveda-Villalón, Asunción Gómez-Pérez, and Mari Carmen Suárez-Figueroa. OOPS! (OntOlogy Pitfall Scanner!): An On-line Tool for Ontology Evaluation. *International Journal on Semantic Web and Information Systems (IJSWIS)*, 10(2):7–34, 2014. doi:10.4018/ijswis.2014040102.

[30] María Poveda-Villalón and Serge Chávez-Feria. Material properties ontology. Accessed: 2023-02-06. URL: https://bimerr.iot.linkeddata.es/def/material-properties/.

[31] Mads Holten Rasmussen, Maxime Lefrançois, Georg Ferdinand Schneider, and Pieter Pauwels. BOT: The building topology ontology of the W3C linked building data group. *Semantic Web*, 12(1):143–161, 2021. doi:10.3233/SW-200385.

[32] Elke Sauter, Rob Lemmens, and Pieter Pauwels. CEO and CAMO ontologies: a circulation medium for materials in the construction industry. In *6th International Symposium on Life-Cycle Civil Engineering (IALCCE)*, pages 1645–1652. CRC Press, 2019.

[33] Prathap Valluru, Janakiram Karlapudi, Karsten Menzel, Teemu Mätäsniemi, and Jari Shemeikka. A Semantic Data Model to Represent Building Material Data in AEC Collaborative Workflows. In *Boosting Collaborative Networks 4.0: 21st IFIP WG 5.5 Working Conference on Virtual Enterprises, PRO-VE 2020 Valencia, Spain, November 23–25, 2020 Proceedings*, pages 133–142. Springer, 2020. doi:10.1007/978-3-030-62412-5_11.

[34] Prathap Valluru, Janakiram Karlapudi, Karsten Menzel, Teemu Mätäsniemi, and Jari Shemeikka. A Semantic Data Model to Represent Building Material Data in AEC Collaborative Workflows. In *Boosting Collaborative Networks 4.0: 21st IFIP WG 5.5 Working Conference on Virtual Enterprises, PRO-VE 2020 Valencia, Spain, November 23–25, 2020 Proceedings*, pages 133–142, Valencia, Spain, 2020. Springer. doi:10.1007/978-3-030-62412-5_11.

[35] Mark D. Wilkinson, Michel Dumontier, IJsbrand Jan Aalbersberg, Gabrielle Appleton, Myles Axton, Arie Baak, Niklas Blomberg, Jan-Willem Boiten, Luiz Bonino da Silva Santos, Philip E. Bourne, Jildau Bouwman, Anthony J. Brookes, Tim Clark, Mercè Crosas, Ingrid Dillo, Olivier Dumon, Scott Edmunds, Chris T. Evelo, Richard Finkers, Alejandra Gonzalez-Beltran, Alasdair J.G. Gray, Paul Groth, Carole Goble, Jeffrey S. Grethe, Jaap Heringa, Peter A.C 't Hoen, Rob Hooft, Tobias Kuhn, Ruben Kok, Joost Kok, Scott J. Lusher, Maryann E. Martone, Albert Mons, Abel L. Packer, Bengt Persson, Philippe Rocca-Serra, Marco Roos, Rene van Schaik, Susanna-Assunta Sansone, Erik Schultes, Thierry Sengstag, Ted Slater, George Strawn, Morris A. Swertz, Mark Thompson, Johan van der Lei, Erik van Mulligen, Jan Velterop, Andra Waagmeester, Peter Wittenburg, Katherine Wolstencroft, Jun Zhao, and Barend Mons. The FAIR guiding principles for scientific data management and stewardship. *Scientific data*, 3:160018:1–9, 2016. doi:10.1038/sdata.2016.18.

Appendices

In this appendix we first provide the lists of requirements and their coverage in the current ontology network, then some snapshot images of the VOWL visualizations of the ODPs and ontology modules that are available online. For interactive and up-to-date visualizations we refer the reader to the respective documentation pages linked from http://w3id.org/CEON/. Further we provide the documentation for the latest version of each ODP and ontology module.

A Requirements Coverage

In Tables 6 and 7 we provide an overview of the current coverage of requirements in this release of the ontology network. Complete coverage (green) indicates that the mentioned concepts are directly modelled by the ontology network, and that the CQ can be answered, e.g. by formulating an appropriate SPARQL query. Indirect coverage (yellow) indicates that the exact concepts and relations are not present in the core modules, but that more general ones are included, thus facilitating the specialisation of those core modules to cover the concrete concepts and relations mentioned, for instance, in one of the use case-specific ontologies. Partial coverage (orange) indicates that only some aspects are currently modelled, and some parts are still missing and/or are not intended to be included in the core modules but are specific to an industry domain. White colour indicates CQs that have not yet been modelled, for instance since they may be considered out of scope of the project given the priorities set by the overall project requirements in WP2, or because they are industry specific.

Since in the second iteration of the project, we updated the overall requirements in WP2. For instance, requirements are identified as **CVN-*** in the first iteration, while in the second iteration, requirements were updated based more detailed specifications and were identified as **CE*.**. In this CEON release, we make a detailed mapping between these two group of requirements. Among the updated requirements in the second iteration, we have addressed a number of requirements after the second evaluation which has been reported in D3.5. In Table 6, we show how the competency questions are satisfied in D3.6 with comparison to D3.4 and D3.5. All CQs indicated with a check mark symbol (✓) reflect updates made since D3.5.

In Table 7, we show the status of requirements coverage for the three use cases and compare evaluation result from D3.4 and D3.5. We also include an update for new addressed CQs in the table.

Table 6: Competency questions from ontological stories for general CE domain, as listed in D3.4 and D3.6. Colors indicate whether the requirements are covered (green), indirectly covered (yellow), partly covered (orange) or not covered (white), by the current ontology network.

ID (CVN), D3.4	ID (CE), D3.6						
CVN-CVN-1	CE1-1	CE2-1					
CVN-CVN-2	CE5-18	CE12-8	CE12-9				
CVN-CVN-3	CE1-1	CE11-6	CE11-7	CE12-5			
CVN-CVN-4	CE3-5	CE8-2	CE7-4				
CVN-CVN-5	CE3-5	CE10-7	CE7-5				
CVN-CVN-6	CE3-1	CE4-1					
CVN-Proc-1	CE1-1	CE3-2					
CVN-Proc-2	CE3-4	CE4-4	CE5-7				
CVN-Proc-3	CE1-1	CE12-1					
CVN-Proc-4	CE3-5	CE8-2	CE10-7	CE7-5	CE7-4		
CVN-Proc-5	CE1-1						
CVN-VP-1	CE5-16						
CVN-VP-2	CE9-4 (✓)						
CVN-VP-3	CE10-10 (✓)	CE11-10					
CVN-VP-4	CE11-2 (✓)						
CVN-Res-1	CE1-2 (✓)	CE4-3 (✓)	CE5-2	CE9-1	CE12-4	CE11-8	CE3-3

CVN-Res-2	CE5-2						
CVN-Res-3	CE1-2 (✓)	CE5-2					
CVN-Res-4							
CVN-Ph-1							
CVN-Ph-2	CE1-1	CE3-4	CE4-4	CE5-7	CE12-1		
CVN-Ph-3							
CVN-Ph-4	CE3-4	CE4-4	CE5-7				
CVN-Ph-5	CE10-1	CE12-2					
CVN-Wo-1	CE3-4	CE5-17					
CVN-Wo-2							
CVN-Wo-3							
CVN-Wo-4							
CVN-Wo-5	CE3-5	CE7-4					
CVN-Wo-6	CE3-5	CE10-7	CE7-5				
CVN-Wo-7							
CVN-Wo-8	CE2-1						
CVN-Wo-9	CE3-2						
CVN-Ac-1	CE10-1						
CVN-Ac-2	CE10-4						
CVN-Ac-3							
CVN-Ac-4	CE2-2	CE10-9	CE10-4	CE6-3 (✓)	CE4-2		
CVN-Ac-5	CE1-1	CE2-1					
CVN-Ac-6	CE1-1	CE2-1					
CVN-Ac-7	CE2-1						
CVN-Co-1	CE10-1	CE11-1	CE12-2				
CVN-Co-2	CE10-1	CE11-1	CE12-2				
CVN-Co-3	CE10-1	CE11-1	CE12-2				
CVN-Co-4	CE10-1	CE11-1	CE12-2				
CVN-Co-6	CE10-1	CE11-1	CE12-2				
CVN-Co-7	CE10-1	CE11-1	CE12-2				
CVN-Co-8	CE10-1	CE11-1	CE12-2				
CVN-Co-9	CE10-1	CE11-1	CE12-2				
CVN-Ty-1							
CVN-Ty-2							
CVN-Ty-3	CE3-1	CE4-1					
CVN-In-1	CE3-5	CE7-4					
CVN-In-2	CE3-5	CE7-4					
CVN-In-3	CE3-5	CE7-4					
CVN-In-4	CE3-5	CE7-4					
CVN-Out-1	CE3-5	CE10-7	CE7-5				
CVN-Out-2	CE3-5	CE10-7	CE7-5				
CVN-Out-3	CE3-5	CE10-7	CE7-5				
CVN-Out-4	CE3-5	CE10-7	CE7-5				
CVN-Inf-1	CE9-1	CE11-4					
CVN-Inf-2	CE10-2	CE11-5					
CVN-Inf-3	CE10-2	CE11-5					
CVN-Inf-4	CE11-3						
CVN-Infr-1	CE10-4						
CVN-Infr-2							
CVN-Infr-3							
CVN-Cal-1							
CVN-Cal-2							
CVN-RT-1							
CVN-RT-2							
CVN-RT-3							
CVN-RT-4							
CVN-Comp-1	CE5-2						
CVN-Comp-2	CE5-2						
CVN-VT-1	CE1-3 (✓)						
CVN-VT-2							
CVN-VT-3							
	New CQs or more specific CQs						

	CE5-1	CE5-3	CE5-4	CE5-5	CE5-6	CE5-8	CE5-9
	CE5-10	CE5-11	CE5-12	CE5-13	CE5-14	CE5-15	CE5-19 (✓)
	CE6-1	CE6-2	CE7-1	CE7-2	CE7-3	CE7-6 (✓)	CE7-7
	CE7-8 (✓)	CE8-1	CE8-3	CE9-2 (✓)	CE9-3	CE9-5	CE10-3
	CE10-5	CE10-6	CE10-8	CE11-9	CE11-11	CE12-3	CE12-10
	CE12-11	CE13-1	CE13-2	CE13-3	CE13-4	CE13-5	CE13-6
In this release, 9 CQs (CE1-2, CE1-3, CE4-3, CE5-19, CE6-3, CE7-8, CE9-4, CE10-10, CE11-2) were updated to fully covered and 2 CQs (CE7-6, CE9-2) were updated to partly covered.							

Table 7: Competency questions from ontological stories for three use cases, as listed in D3.*. Colors indicate whether the requirements are covered (green), indirectly covered (yellow), partly covered (orange) or not covered (white), by the current ontology network.

ID (Const.), D3.4	ID (Const.), D3.5	ID (Const.), D3.6	ID (Elec.), D3.4	ID (Elec.), D3.5	ID (Elec.), D3.6	ID (Text.), D3.4	ID (Text.), D3.5	ID (Text.), D3.6
C0-1	C0-1	C0-1	E1-1	E1-1	E1-1	T1-1	T1-1	T1-1
C0-2	C0-2	C0-2	E1-2	E1-2	E1-2	T1-2	T1-2	T1-2
C1-1	C1-1	C1-1	E1-3	E1-3	E1-3	T2-1	T2-1	T2-1
C1-2	C1-2	C1-2	E1-4	E1-4	E1-4	T2-2	T2-2	T2-2
C1-3	C1-3	C1-3	E1-5	E1-5	E1-5	T2-3	T2-3	T2-3
	C1-4	C1-4	E1-6	E1-6	E1-6	T2-4	T2-4	T2-4
C2-1	C2-1	C2-1	E1-7	E1-7	E1-7	T2-5	T2-5	T2-5
C2-2	C2-2	C2-2	E1-8	E1-8	E1-8	T3-1	T3-1	T3-1
C2-3	C2-3	C2-3	E1-9	E1-9	E1-9	T3-2	T3-2	T3-2
C2-4	C2-4	C2-4	E1-10	E1-10	E1-10	T3-3	T3-3	T3-3
	C2-5	C2-5	E1-11	E1-11	E1-11	T3-4	T3-4	T3-4
	C2-6	C2-6	E1-12	E1-12	E1-12	T3-5	T3-5	T3-5
C3-1	C3-1	C3-1	E1-13	E1-13	E1-13	T4-1	T4-1	T4-1
C3-2	C3-2	C3-2	E1-14	E1-14	E1-14	T4-2	T4-2	T4-2
C3-3	C3-3	C3-3	E1-15	E1-15	E1-15	T4-3	T4-3	T4-3
C3-4	C3-4	C3-4		E1-16	E1-16	T4-4	T4-4	T4-4
C3-5	C3-5	C3-5	E2-1	E2-1	E2-1	T4-5	T4-5	T4-5
C3-6	C3-6	C3-6	E2-2	E2-2	E2-2	T5-1	T5-1	T5-1
C3-7	C3-7	C3-7	E2-3	E2-3	E2-3	T6-1	T6-1	T6-1
C3-8	C3-8	C3-8	E2-4	E2-4	E2-4	T7-1	T7-1	T7-1
C3-9	C3-9	C3-9	E2-5	E2-5	E2-5	T8-1	T8-1	T8-1
C4-1	C4-1	C4-1	E2-6	E2-6	E2-6	T8-2	T8-2	T8-2
C4-2	C4-2	C4-2	E2-7	E2-7	E2-7	T8-3	T8-3	T8-3
C4-3	C4-3	C4-3	E2-8	E2-8	E2-8	T9-1	T9-1	T9-1
C4-4	C4-4	C4-4	E2-9	E2-9	E2-9	T9-2	T9-2	T9-2
C4-5	C4-5	C4-5	E2-10	E2-10	E2-10	T10-1	T10-1	T10-1
C4-6	C4-6	C4-6		E2-11	E2-11	T10-2	T10-2	T10-2
C4-7	C4-7	C4-7		E2-12	E2-12	T10-3	T10-3	T10-3
C4-8	C4-8	C4-8	E3-1	E3-1	E3-1	T10-4	T10-4	T10-4
C4-9	C4-9	C4-9	E3-2	E3-2	E3-2		T11-1	T11-1
C4-10	C4-10	C4-10	E3-3	E3-3	E3-3		T11-2	T11-2
C5-1	C5-1	C5-1	E3-4	E3-4	E3-4		T12-1	T12-1
C5-2	C5-2	C5-2	E3-5	E3-5	E3-5		T13-1	T13-1
	C5-3	C5-3	E3-6	E3-6	E3-6		T13-2	T13-2
C6-1	C6-1	C6-1	E3-7	E3-7	E3-7	T14-1	T14-1	T14-1
C6-2	C6-2	C6-2	E3-8	E3-8	E3-8	T15-1	T15-1	T15-1
C6-3	C6-3	C6-3		E3-9	E3-9		T16-1	T16-1
C6-4	C6-4	C6-4	E4-1	E4-1	E4-1		T17-1	T17-1
C7-1	C7-1	C7-1	E4-2	E4-2	E4-2	T18-1	T18-1	T18-1
C7-2	C7-2	C7-2	E4-3	E4-3	E4-3	T19-1	T19-1	T19-1
C7-3	C7-3	C7-3	E4-4	E4-4	E4-4	T20-1	T20-1	T20-1
C7-4	C7-4	C7-4	E4-5	E4-5	E4-5	T21-1	T21-1	T21-1
C7-5	C7-5	C7-5	E4-6	E4-6	E4-6		T22-1	T22-1
C7-6	C7-6	C7-6	E4-7	E4-7	E4-7		T22-2	T22-2
C8-1	C8-1	C8-1	E4-8	E4-8	E4-8	T23-1	T23-1	T23-1

C8-2	C8-2	C8-2	E4-9	E4-9	E4-9		T23-2	T23-2
C8-3	C8-3	C8-3	E4-10	E4-10	E4-10			
C8-4	C8-4	C8-4	E4-11	E4-11	E4-11			
C9-1	C9-1	C9-1	E5-1	E5-1	E5-1			
C9-2	C9-2	C9-2	E5-2	E5-2	E5-2			
C9-3	C9-3	C9-3	E5-3	E5-3	E5-3			
C9-4	C9-4	C9-4	E5-4	E5-4	E5-4			
C10-1	C10-1	C10-1	E5-5	E5-5	E5-5			
C10-2	C10-2	C10-2	E5-6	E5-6	E5-6			
C10-3	C10-3	C10-3	E5-7	E5-7	E5-7			
C10-4	C10-4	C10-4		E5-8	E5-8			
C11-1	C11-1	C11-1		E5-9	E5-9			
C11-2	C11-2	C11-2	E6-1	E6-1	E6-1			
C11-3	C11-3	C11-3	E6-2	E6-2	E6-2			
C12-1	C12-1	C12-1	E6-3	E6-3	E6-3			
C12-2	C12-2	C12-2	E6-4	E6-4	E6-4			
C12-3	C12-3	C12-3	E6-5	E6-5	E6-5			
C13-1	C13-1	C13-1	E6-6	E6-6	E6-6			
C13-2	C13-2	C13-2	E6-7	E6-7	E6-7			
C13-3	C13-3	C13-3		E6-8	E6-8			
C13-4	C13-4	C13-4						
C13-5	C13-5	C13-5						
C13-6	C13-6	C13-6						
C13-8	C13-8	C13-8						
C13-9	C13-9	C13-9						
C13-10	C13-10	C13-10						
In this release, 10 CQs were updated to partly or fully covered			In this release, 4 CQs were updated to partly or fully covered			In this release, 14 CQs were updated to partly or fully covered		

B Module Illustrations

Below, in Figures 7 to 20 we illustrate the content of the 14 core modules, using the visual notation of WebVOWL. The same illustrations are available in an interactive clickable manner on the documentation page of each module.

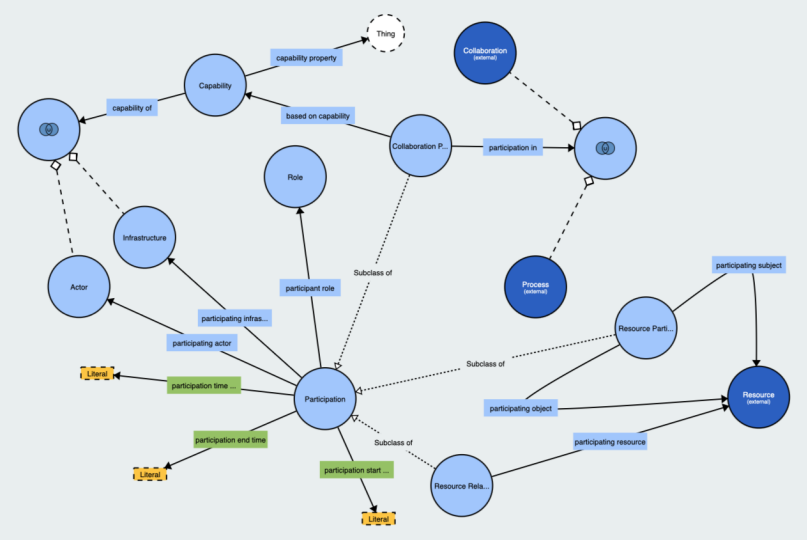


Figure 7: VOWL visualisation of the actor ODP.

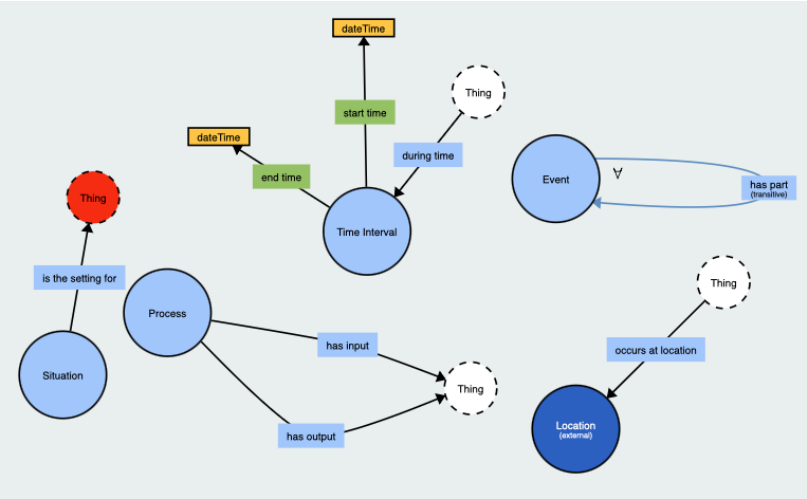


Figure 8: VOWL visualisation of the process ODP.

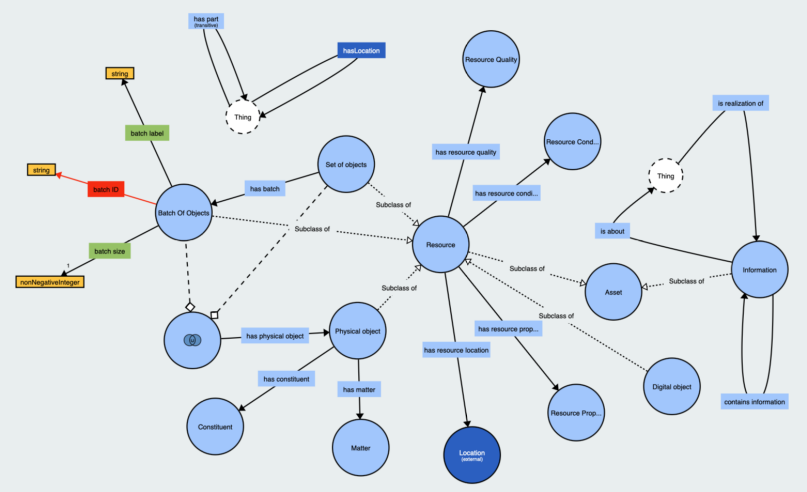


Figure 9: VOWL visualisation of the resource ODP.

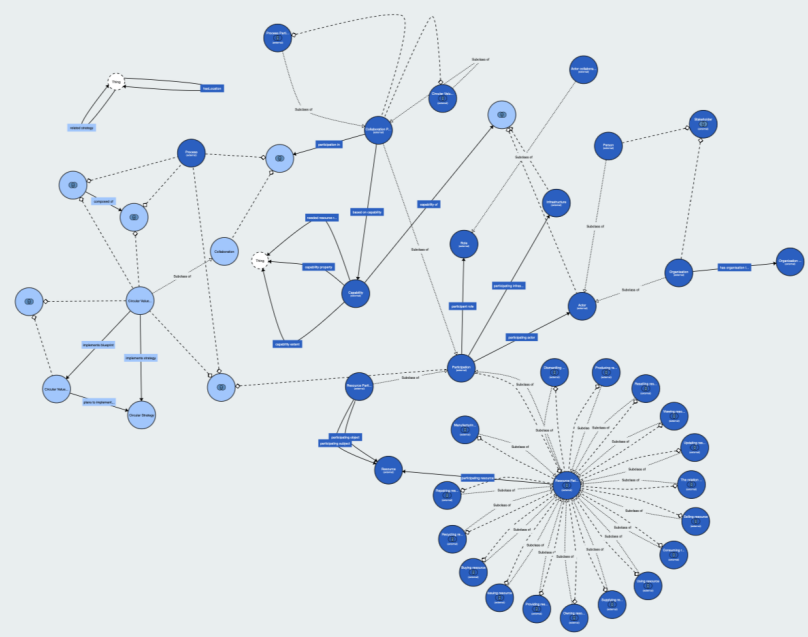


Figure 10: VOWL visualisation of the core part of the CVN module.

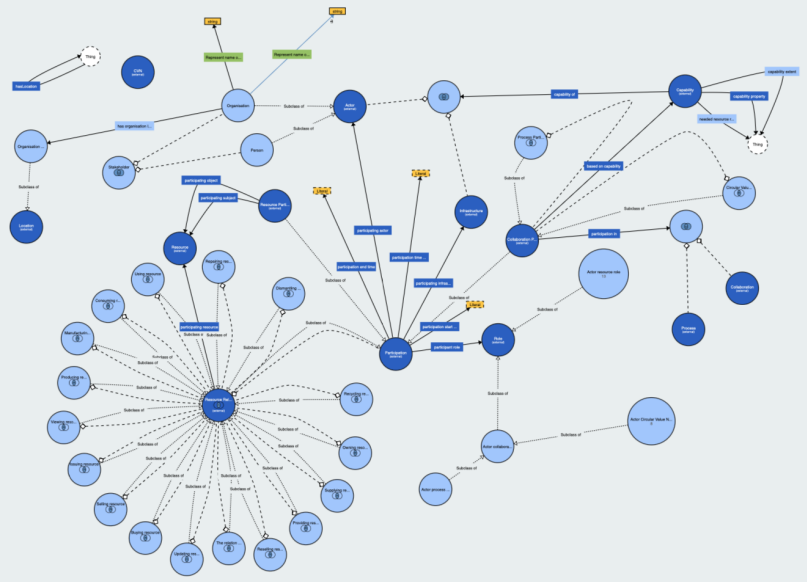


Figure 11: VOWL visualisation of the actor module, specialising the actor ODP.

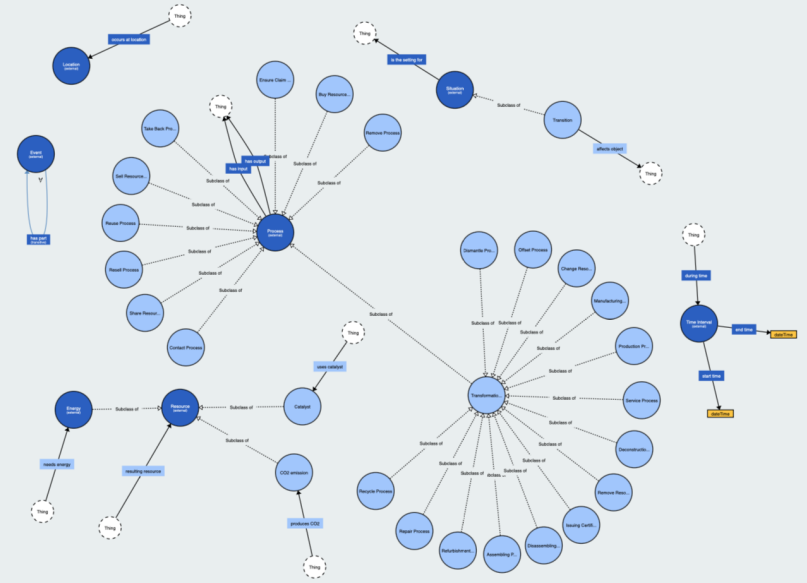


Figure 12: VOWL visualisation of the process module, specialising the process ODP.

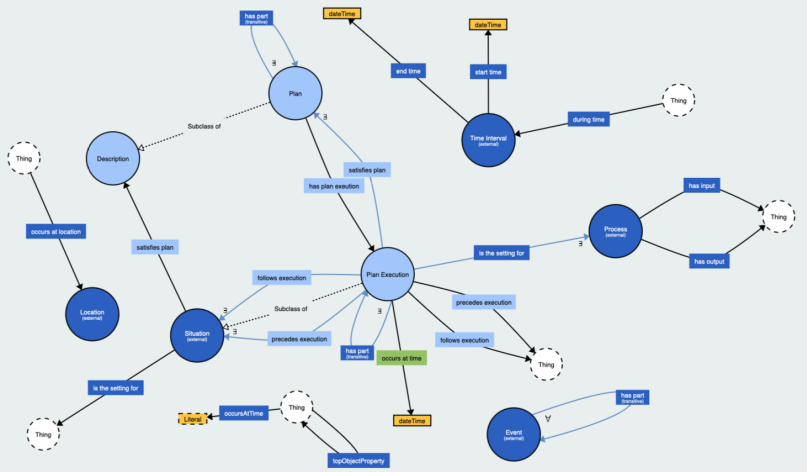


Figure 13: VOWL visualisation of the plan module, specialising the process ODP.

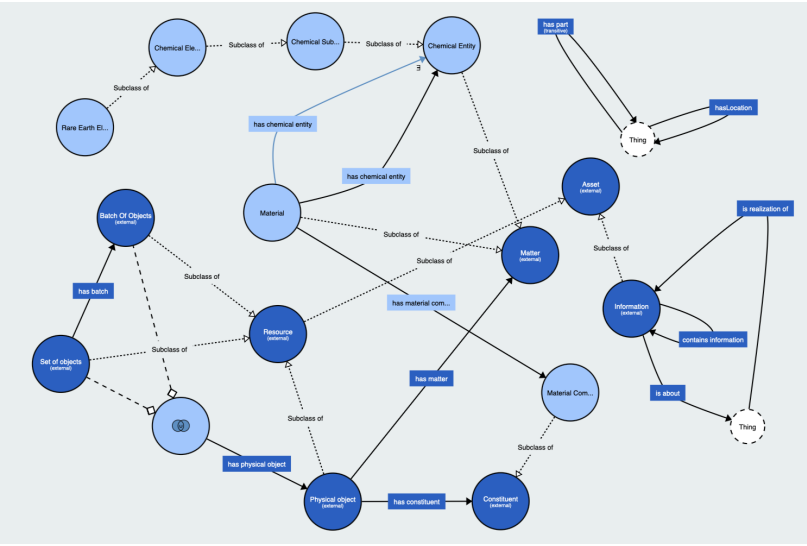


Figure 14: VOWL visualisation of the material module, specialising the resource ODP.

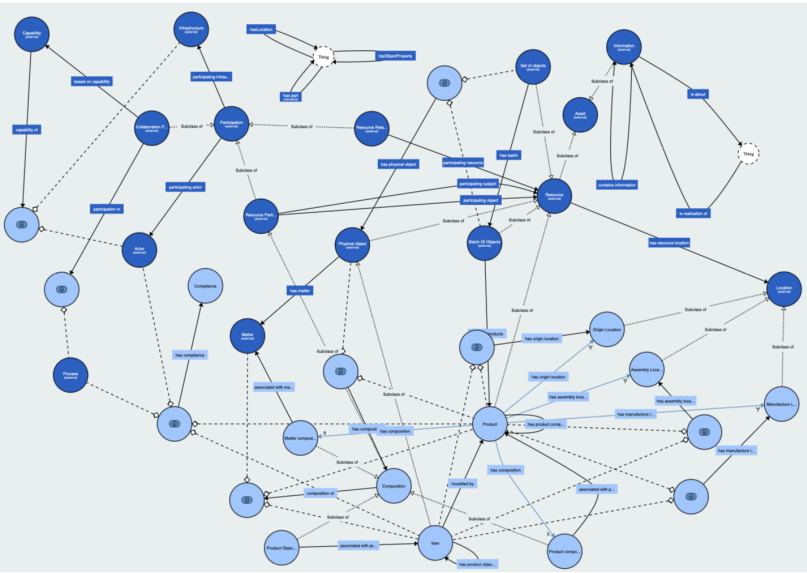


Figure 15: VOWL visualisation of the product module, specialising the resource ODP.

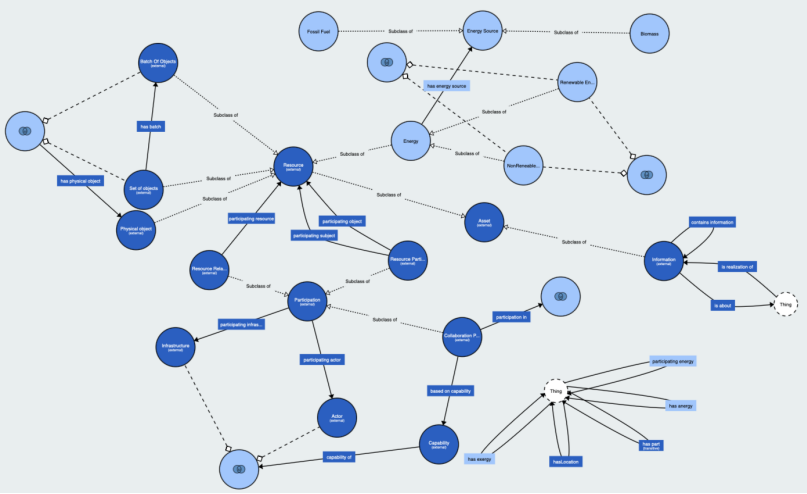


Figure 16: VOWL visualisation of the energy module, specialising the resource ODP.

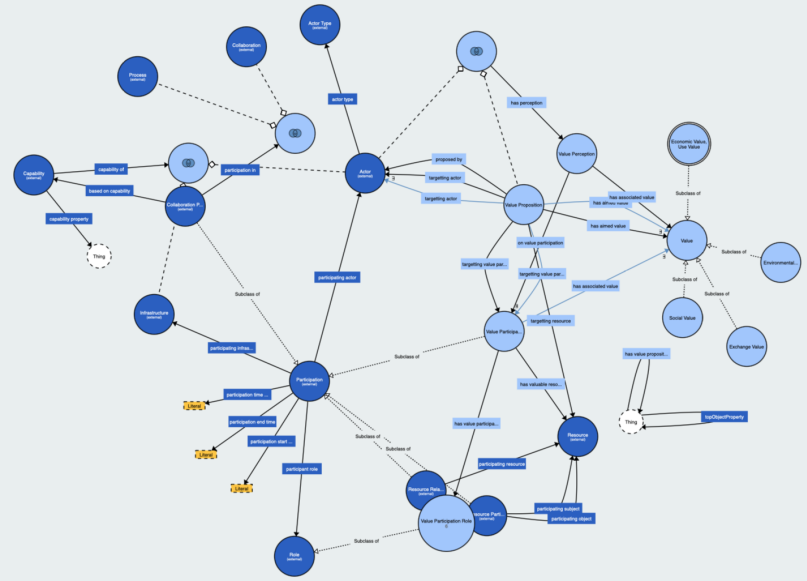


Figure 17: VOWL visualisation of the stub for the value module.

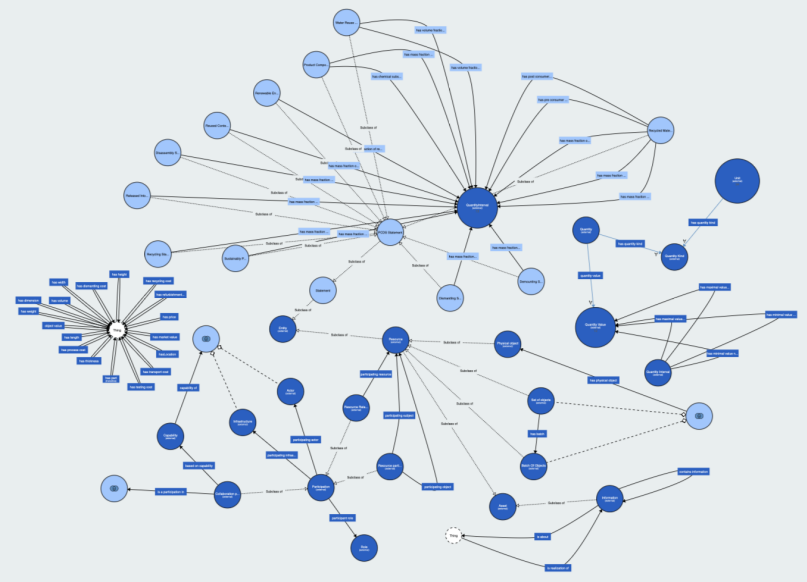


Figure 18: VOWL visualisation of the stub for the statement module.

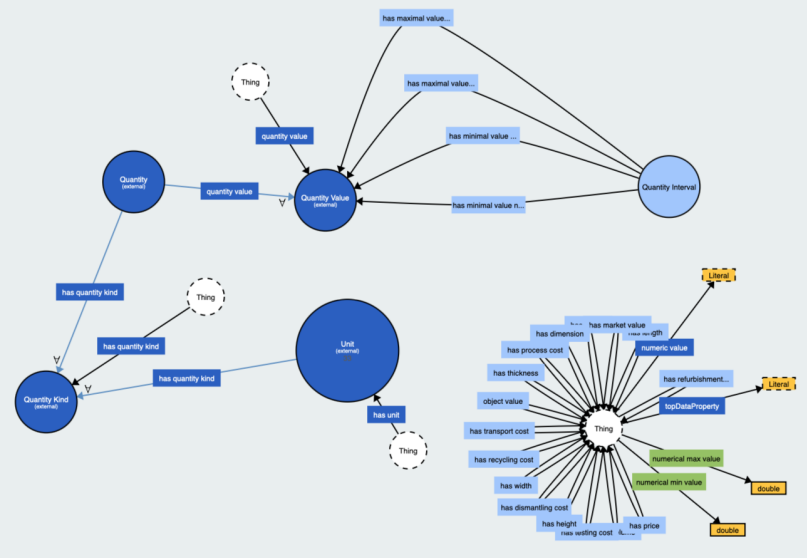


Figure 19: VOWL visualisation of the stub for the quantity module.

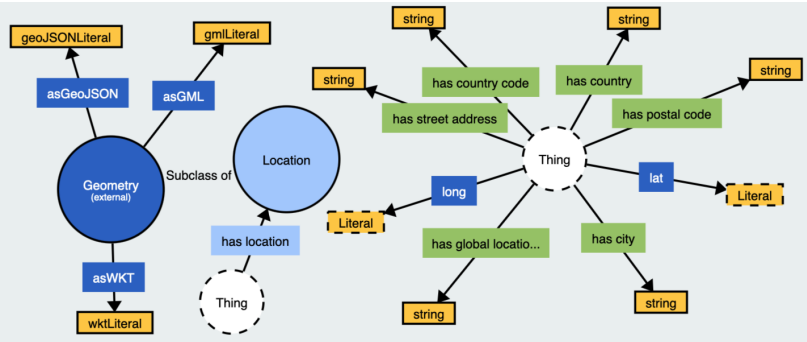


Figure 20: VOWL visualisation of the stub for the location module.

C Module Documentation

In this appendix we provide a snapshot of the documentation pages of the 14 core modules, as available online.

Circular Economy Ontology Network (CEON) - Actor Module

Metadata

IRI

http://w3id.org/CEON/ontology/actor/

Title

Circular Economy Ontology Network (CEON) - Actor Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-11-13

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/actor/0.4/

Version Info

0.4

Prior Version

0.3

Preferred Namespace Prefix

ceon-actor

Preferred Namespace Uri

http://w3id.org/CEON/ontology/actor/

Description

The Actor module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: C0-1, C0-2, C3-4, T3-4.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: C0-1, C0-2, C3-4, T3-4.

Classes

Actor Cvn Role [c]

IRI http://w3id.org/CEON/ontology/actor/ActorCVNRole

Sub Class Of ActorCollaborationRole [c]

Named Individuals
collector [ni]
dismantler [ni]
manufacturer [ni]
recycler [ni]
reseller [ni]
seller [ni]
supplier [ni]
user [ni]

Actor Collaboration Role [c]

IRI http://w3id.org/CEON/ontology/actor/ActorCollaborationRole

Sub Class Of actorODP:Role [c]

Super Class Of
ActorCVNRole [c]
ActorProcessRole [c]

Actor Process Role [c]

IRI http://w3id.org/CEON/ontology/actor/ActorProcessRole

Sub Class Of ActorCollaborationRole [c]

Actor Resource Role [c]

IRI http://w3id.org/CEON/ontology/actor/ActorResourceRole

Sub Class Of actorODP:Role [c]

Named Individuals
buyer [ni]
consumer [ni]
issuer [ni]
owner [ni]
producer [ni]
provider [ni]
repairer [ni]
reseller [ni]
seller [ni]
supplier [ni]
updater [ni]
user [ni]
viewer [ni]

Buying Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/BuyingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value buyer [c]

Cvn Participation [c]

IRI	http://w3id.org/CEON/ontology/actor/CVNParticipation
Sub Class Of	actorODP:CollaborationParticipation [c] actorODP:participationIn [op] some http://w3id.org/CEON/ontology/cvn/CVN [c] *and* actorODP:participatingActor [op] some actorODP:Actor [c] *and* actorODP:CollaborationParticipation [c] *and* actorODP:participantRole [op] some ActorCVNRole [c]

Consuming Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ConsumingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value consumer [c] *and* actorODP:ResourceRelation [c]

Dismantling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/DismantlingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value dismantler [c] *and* actorODP:ResourceRelation [c]

Issuing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/IssuingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value issuer [c]

Manufacturing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ManufacturingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value manufacturer [c] *and* actorODP:ResourceRelation [c]

Organisation [c]

IRI	http://w3id.org/CEON/ontology/actor/Organisation
Is Defined By	ISO 59004:2024 - 3.4.1 organization
Description	Person or group of people that has its own functions with responsibilities, authorities, and relationships to achieve its objectives. The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private (e.g. foundation, union, association, agency, municipality, region, country, intergovernmental agencies). A group of organizations can also be considered as an organization that has, alone or collectively,their own objectives.
Sub Class Of	actorODP:Actor [c] hasOrganisationLocation [op] only OrganisationLocation [c] *and* hasOrganisationLocation [op] some OrganisationLocation [c]
In Domain Of	hasOrganisationLocation [op] hasOrganisationName [dp]
Restriction	hasOrganisationName [dp] some Organisation [c]

Organisation Location [c]

IRI	http://w3id.org/CEON/ontology/actor/OrganisationLocation
Sub Class Of	http://w3id.org/CEON/ontology/location/Location [c]
In Range Of	hasOrganisationLocation [op]

Owning Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/OwningResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value owner [c]

Person [c]

IRI	http://w3id.org/CEON/ontology/actor/Person
Sub Class Of	actorODP:Actor [c]

Process Participation [c]

IRI	http://w3id.org/CEON/ontology/actor/ProcessParticipation
Sub Class Of	actorODP:CollaborationParticipation [c] actorODP:participantRole [op] some ActorProcessRole [c] *and* actorODP:participationIn [op] some http://w3id.org/CEON/ontology/processODP/Process [c] *and* actorODP:CollaborationParticipation [c] *and* actorODP:participatingActor [op] some actorODP:Actor [c]

Producing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ProducingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value producer [c] *and* actorODP:ResourceRelation [c]

Providing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ProvidingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value provider [c]

Recycling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/RecyclingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value recycler [c]

Repairing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/RepairingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value repairer [c] *and* actorODP:ResourceRelation [c]

Reselling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ResellingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value reseller [c]

Selling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/SellingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value seller [c] *and* actorODP:ResourceRelation [c]

Stakeholder [c]

IRI	http://w3id.org/CEON/ontology/actor/Stakeholder
Is Defined By	ISO 59004:2024 - 3.4.2 interested party, stakeholder
Description	Person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity. To “perceive itself to be affected” means the perception has been made known to the organization.
Sub Class Of	Organisation [c] *or* Person [c]

Supplying Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/SupplyingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value supplier [c] *and* actorODP:ResourceRelation [c]

Taking Back Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/TakingBackResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value collector [c]

Updating Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/UpdatingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value updater [c] *and* actorODP:ResourceRelation [c]

Using Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/UsingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value user [c] *and* actorODP:ResourceRelation [c]

Viewing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ViewingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value viewer [c]

Actor [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Actor
Super Class Of	Organisation [c] Person [c]

Capability [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Capability
In Domain Of	capabilityExtent [op] neededResourceRelation [op]

Collaboration Participation [c]

IRI	http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation
Super Class Of	CVNParticipation [c] ProcessParticipation [c]

Participation [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Participation

Resource Relation [C]

IRI `http://w3id.org/CEON/ontology/actorODP/ResourceRelation`

Sub Class Of

actorODP:participatingActor [OP] some actorODP:Actor [C] *and*
actorODP:Participation [C] *and* actorODP:participantRole [OP] some
ActorResourceRole [C] *and* actorODP:participatingResource [OP] some
http://w3id.org/CEON/ontology/resourceODP/Resource [C]

Super Class Of

BuyingResource [C]
ConsumingResource [C]
DismantlingResource [C]
IssuingResource [C]
ManufacturingResource [C]
OwningResource [C]
ProducingResource [C]
ProvidingResource [C]
RecyclingResource [C]
RepairingResource [C]
ResellingResource [C]
SellingResource [C]
SupplyingResource [C]
TakingBackResource [C]
UpdatingResource [C]
UsingResource [C]
ViewingResource [C]

Role [C]

IRI `http://w3id.org/CEON/ontology/actorODP/Role`

Super Class Of

ActorCollaborationRole [C]
ActorResourceRole [C]

Cvn [C]

IRI `http://w3id.org/CEON/ontology/cvn/CVN`

Location [C]

IRI `http://w3id.org/CEON/ontology/location/Location`

Super Class Of OrganisationLocation [C]

Process [C]

IRI `http://w3id.org/CEON/ontology/processODP/Process`

Resource [C]

IRI `http://w3id.org/CEON/ontology/resourceODP/Resource`

Object Properties

capability extent op

IRI	http://w3id.org/CEON/ontology/actor/capabilityExtent
Sub Property Of	actorODP:capabilityProperty op
Domain	actorODP:Capability c

has organisation location op

IRI	http://w3id.org/CEON/ontology/actor/hasOrganisationLocation
Sub Property Of	http://w3id.org/CEON/ontology/location/hasLocation op
Domain	Organisation c
Range	OrganisationLocation c

needed resource relation op

IRI	http://w3id.org/CEON/ontology/actor/neededResourceRelation
Sub Property Of	actorODP:capabilityProperty op
Domain	actorODP:Capability c

capability property op

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityProperty
Super Property Of	• capabilityExtent op • neededResourceRelation op

participant role op

IRI	http://w3id.org/CEON/ontology/actorODP/participantRole

participating actor op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingActor

participating resource op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingResource

participation in [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participationIn

has location [op]

IRI	http://w3id.org/CEON/ontology/location/hasLocation
Super Property Of	hasOrganisationLocation [op]

Datatype Properties

has organisation name [dp]

IRI	http://w3id.org/CEON/ontology/actor/hasOrganisationName
Domain	Organisation [c]
Range	xsd:string

Annotation Properties

contributor [ap]

IRI	http://purl.org/dc/terms/contributor

created [ap]

IRI	http://purl.org/dc/terms/created

creator [ap]

IRI	http://purl.org/dc/terms/creator

description [ap]

IRI	http://purl.org/dc/terms/description

issued [ap]

IRI	http://purl.org/dc/terms/issued

license [ap]

IRI	http://purl.org/dc/terms/license

publisher ap

IRI http://purl.org/dc/terms/publisher

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:
http://w3id.org/CEON/ontology/actor/

actorODP
http://w3id.org/CEON/ontology/actorODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

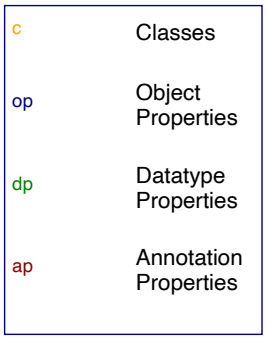
rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties

Circular Economy Ontology Network (CEON) - Actor ODP

Metadata

IRI

http://w3id.org/CEON/ontology/actorODP/

Title

Circular Economy Ontology Network (CEON) - Actor ODP

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-05-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/actorODP/0.4/

Version Info

0.4

Prior Version

0.3

Preferred Namespace Prefix

ceon-actorODP

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/actorODP/

Description

A core ODP of the CEON ontology network, defining aspects of the actor concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Process-3, CVN-Actor-1,4,6,7, CVN-Competency-3, CVN-Information-4, C11-1, C11-3, E1-6,6,6,9, E4-10.

Covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE2-1, CE2-2, CE4-2, CE6-3, CE12-1, CE10-1, CE10-3, CE10-4, CE10-9, C3-6, C3-9, C11-1, C11-3, C13-8, C13-10, E1-6, E1-9, E4-10.

Classes

Actor [C]

IRI	http://w3id.org/CEON/ontology/actorODP/Actor
In Range Of	participatingActor [OP]

Capability [c]

IRI http://w3id.org/CEON/ontology/actorODP/Capability

In Domain Of
capabilityOf [op]
capabilityProperty [op]

In Range Of
basedOnCapability [op]

Collaboration Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation

Sub Class Of
Participation [c]

In Domain Of
basedOnCapability [op]
participationIn [op]

Infrastructure [c]

IRI http://w3id.org/CEON/ontology/actorODP/Infrastructure

In Range Of
participatingInfrastructure [op]

Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/Participation

Sub Class Of
participationTimePoint [dp] *exactly* 1 1 [c] *or* participationStartTime [dp] *exactly* 1 1 [c]

In Domain Of
participantRole [op]
participatingActor [op]
participatingInfrastructure [op]
participationEndTime [dp]
participationStartTime [dp]
participationTimePoint [dp]

Super Class Of
CollaborationParticipation [c]
ResourceParticipation [c]
ResourceRelation [c]

Resource Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/ResourceParticipation

Sub Class Of
Participation [c]

In Domain Of
participatingObject [op]
participatingSubject [op]

Resource Relation [c]

IRI	http://w3id.org/CEON/ontology/actorODP/ResourceRelation
Sub Class Of	Participation [c]
In Domain Of	participatingResource [op]

Role [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Role
In Range Of	participantRole [op]

Collaboration [c]

IRI	http://w3id.org/CEON/ontology/cvn/Collaboration

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource
In Range Of	participatingObject [op] participatingResource [op] participatingSubject [op]

Object Properties

based on capability [op]

IRI	http://w3id.org/CEON/ontology/actorODP/basedOnCapability
Domain	CollaborationParticipation [c]
Range	Capability [c]

capability of [op]

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityOf
Domain	Capability [c]
Range	Infrastructure [c] *or* Actor [c]

capability property [op]

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityProperty
Domain	Capability [c]

participant role [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participantRole
Domain	Participation [c]
Range	Role [c]

participating actor [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participatingActor
Domain	Participation [c]
Range	Actor [c]

participating infrastructure [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participatingInfrastructure
Domain	Participation [c]
Range	Infrastructure [c]

participating object [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participatingObject
Domain	ResourceParticipation [c]
Range	resourceODP:Resource [c]

participating resource [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participatingResource
Domain	ResourceRelation [c]
Range	resourceODP:Resource [c]

participating subject [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participatingSubject
Domain	ResourceParticipation [c]
Range	resourceODP:Resource [c]

participation in [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participationIn
Domain	CollaborationParticipation [c]
Range	processODP:Process [c] *or* cvn:Collaboration [c]

Datatype Properties

participation end time [dp]

IRI	http://w3id.org/CEON/ontology/actorODP/participationEndTime
Domain	Participation [c]
Range	xsd:date [c] *or* xsd:gYear [c] *or* xsd:gMonthYear [c] *or* xsd:dateTime [c]

participation start time [dp]

IRI	http://w3id.org/CEON/ontology/actorODP/participationStartTime
Domain	Participation [c]
Range	xsd:gYear [c] *or* xsd:dateTime [c] *or* xsd:gMonthYear [c] *or* xsd:date [c]

participation time point [dp]

IRI	http://w3id.org/CEON/ontology/actorODP/participationTimePoint
Domain	Participation [c]
Range	xsd:dateTime [c] *or* xsd:gYear [c] *or* xsd:gMonthYear [c] *or* xsd:date [c]

Annotation Properties

contributor ap

IRI http://purl.org/dc/terms/contributor

created ap

IRI http://purl.org/dc/terms/created

creator ap

IRI http://purl.org/dc/terms/creator

description ap

IRI http://purl.org/dc/terms/description

issued ap

IRI http://purl.org/dc/terms/issued

license ap

IRI http://purl.org/dc/terms/license

publisher ap

IRI http://purl.org/dc/terms/publisher

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:

http://w3id.org/CEON/ontology/actorODP/

cvn

http://w3id.org/CEON/ontology/cvn/

dcterms

http://purl.org/dc/terms/

geo

http://www.opengis.net/ont/geosparql#

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

processODP

http://w3id.org/CEON/ontology/processODP/

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

resourceODP

http://w3id.org/CEON/ontology/resourceODP/

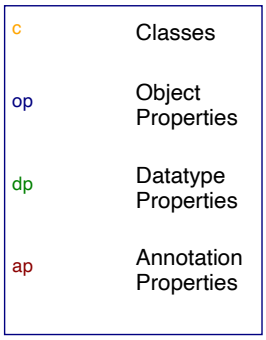
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Circular Value Network Module

Metadata

IRI

http://w3id.org/CEON/ontology/cvn/

Title

Circular Economy Ontology Network (CEON) - Circular Value Network Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-05-22

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/cvn/0.3/

Version Info

0.3

Prior Version

0.2

Preferred Namespace Prefix

ceon-cvn

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/cvn/

Description

A core module of the CEON ontology network, defining aspects of the circular value network (CVN) itself.

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-CVN-1, CVN-Process-1,6, CVN-VP-1, CVN-Type-3, C0-1.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE2-1, CE3-1, CE3-2, CE4-1, CE5-16, C0-1.

Classes

Participation [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Participation

Cvn [c]

IRI	http://w3id.org/CEON/ontology/cvn/CVN
Is Defined By	ISO 59004:2024 - 3.5.3 value network
Description	A network of interlinked value chains and interested parties.
Sub Class Of	Collaboration [c]
In Domain Of	implementsBlueprint [op] implementsStrategy [op]

Cvn Blueprint [c]

IRI	http://w3id.org/CEON/ontology/cvn/CVNBlueprint
In Domain Of	plansToImplementStrategy [op]
In Range Of	implementsBlueprint [op]

Circular Strategy [c]

IRI	http://w3id.org/CEON/ontology/cvn/CircularStrategy
In Range Of	implementsStrategy [op] plansToImplementStrategy [op]

Collaboration [c]

IRI	http://w3id.org/CEON/ontology/cvn/Collaboration
Super Class Of	CVN [c]

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource

Value [c]

IRI	http://w3id.org/CEON/ontology/value/Value
In Range Of	createsValue [op]

Value Proposition [c]

IRI	http://w3id.org/CEON/ontology/value/ValueProposition
In Range Of	aimsAtValue [op]

Object Properties

aims at value [op]

IRI	http://w3id.org/CEON/ontology/cvn/aimsAtValue
Domain	CVNBlueprint [c] *or* CVN [c]
Range	value:ValueProposition [c]

composed of [op]

IRI	http://w3id.org/CEON/ontology/cvn/composedOf
Domain	CVN [c] *or* processODP:Process [c]
Range	processODP:Process [c] *or* CVN [c]

creates value [op]

IRI	http://w3id.org/CEON/ontology/cvn/createsValue
Domain	processODP:Process [c] *or* actorODP:Participation [c] *or* CVN [c]
Range	value:Value [c]

implements blueprint [op]

IRI	http://w3id.org/CEON/ontology/cvn/implementsBlueprint
Domain	CVN [c]
Range	CVNBlueprint [c]

implements strategy [op]

IRI	http://w3id.org/CEON/ontology/cvn/implementsStrategy
Sub Property Of	relatedStrategy [op]
Domain	CVN [c]
Range	CircularStrategy [c]

plans to implement strategy [op]

IRI	http://w3id.org/CEON/ontology/cvn/plansToImplementStrategy
Sub Property Of	relatedStrategy [op]
Domain	CVNBlueprint [c]
Range	CircularStrategy [c]

related strategy [op]

IRI	http://w3id.org/CEON/ontology/cvn/relatedStrategy
Super Property Of	• implementsStrategy [op] • plansToImplementStrategy [op]

Namespaces

:
http://w3id.org/CEON/ontology/cvn/

actor
http://w3id.org/CEON/ontology/actor/

actorODP
http://w3id.org/CEON/ontology/actorODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

processODP
http://w3id.org/CEON/ontology/processODP/

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

resourceODP
http://w3id.org/CEON/ontology/resourceODP/

value
http://w3id.org/CEON/ontology/value/

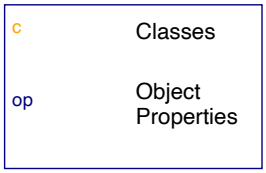
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Material Module

Metadata

IRI

http://w3id.org/CEON/ontology/material/

Title

Circular Economy Ontology Network (CEON) - Material Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-03-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/material/0.4/

Version Info

0.4

Prior Version

0.3

Preferred Namespace Prefix

ceon-material

Preferred Namespace Uri

http://w3id.org/CEON/ontology/material/

Description

The Material module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-2, CVN-ResourceType-4, C3-3, E1-3, E2-4, E5-2, T1-1, T10-2.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE5-2, C3-3, E1-1, E1-3, E1-11, E1-13, E2-4, E3-2, E3-5, E5-2, E5-4, E5-5, T1-1, T9-2, T10-2, T10-4, T22-2.

Classes

Aluminum [C]

IRI	http://w3id.org/CEON/ontology/material/Aluminum
Sub Class Of	ChemicalElement [C]

Boron [C]

IRI	http://w3id.org/CEON/ontology/material/Boron
Sub Class Of	ChemicalElement [C]

Cellulose [C]

IRI	http://w3id.org/CEON/ontology/material/Cellulose
Sub Class Of	Material [C]

Cerium [C]

IRI	http://w3id.org/CEON/ontology/material/Cerium
Sub Class Of	RareEarthElement [C]

Chemical Element [C]

IRI	http://w3id.org/CEON/ontology/material/ChemicalElement
Sub Class Of	ChemicalSubstance [C]
Super Class Of	Aluminum [C] Boron [C] Chromium [C] Copper [C] Iron [C] Magnesium [C] Manganese [C] Nickel [C] Niobium [C] RareEarthElement [C] Silicon [C] Titanium [C] Zinc [C]

Chemical Entity[c]

IRI	http://w3id.org/CEON/ontology/material/ChemicalEntity
Sub Class Of	resourceODP:Matter[c]
In Range Of	hasChemicalEntity[op]
Super Class Of	ChemicalSubstance[c] MolecularEntity[c]

Chemical Substance[c]

IRI	http://w3id.org/CEON/ontology/material/ChemicalSubstance
Sub Class Of	ChemicalEntity[c]
Super Class Of	ChemicalElement[c]

Chromium[c]

IRI	http://w3id.org/CEON/ontology/material/Chromium
Sub Class Of	ChemicalElement[c]

Copper[c]

IRI	http://w3id.org/CEON/ontology/material/Copper
Sub Class Of	ChemicalElement[c]

Dysprosium[c]

IRI	http://w3id.org/CEON/ontology/material/Dysprosium
Sub Class Of	RareEarthElement[c]

Erbium[c]

IRI	http://w3id.org/CEON/ontology/material/Erbium
Sub Class Of	RareEarthElement[c]

Europium[c]

IRI	http://w3id.org/CEON/ontology/material/Europium
Sub Class Of	RareEarthElement[c]

Gadolinium [C]

IRI	http://w3id.org/CEON/ontology/material/Gadolinium
Sub Class Of	RareEarthElement [C]

Holmium [C]

IRI	http://w3id.org/CEON/ontology/material/Holmium
Sub Class Of	RareEarthElement [C]

Iron [C]

IRI	http://w3id.org/CEON/ontology/material/Iron
Sub Class Of	ChemicalElement [C]

Lanthanum [C]

IRI	http://w3id.org/CEON/ontology/material/Lanthanum
Sub Class Of	RareEarthElement [C]

Lutetium [C]

IRI	http://w3id.org/CEON/ontology/material/Lutetium
Sub Class Of	RareEarthElement [C]

Magnesium [C]

IRI	http://w3id.org/CEON/ontology/material/Magnesium
Sub Class Of	ChemicalElement [C]

Manganese [C]

IRI	http://w3id.org/CEON/ontology/material/Manganese
Sub Class Of	ChemicalElement [C]

Material [c]

IRI	http://w3id.org/CEON/ontology/material/Material
Sub Class Of	resourceODP:Matter [c]
In Domain Of	hasChemicalEntity [op] hasMaterialComponent [op]
Restriction	hasChemicalEntity [op] some Material [c]
Super Class Of	Cellulose [c]

Material Component [c]

IRI	http://w3id.org/CEON/ontology/material/MaterialComponent
Sub Class Of	resourceODP:Constituent [c]
In Range Of	hasMaterialComponent [op]

Molecular Entity [c]

IRI	http://w3id.org/CEON/ontology/material/MolecularEntity
Sub Class Of	ChemicalEntity [c]

Neodymium [c]

IRI	http://w3id.org/CEON/ontology/material/Neodymium
Sub Class Of	RareEarthElement [c]

Nickel [c]

IRI	http://w3id.org/CEON/ontology/material/Nickel
Sub Class Of	ChemicalElement [c]

Niobium [c]

IRI	http://w3id.org/CEON/ontology/material/Niobium
Sub Class Of	ChemicalElement [c]

Praseodymium [c]

IRI	http://w3id.org/CEON/ontology/material/Praseodymium
Sub Class Of	RareEarthElement [c]

Promethium [C]

IRI	http://w3id.org/CEON/ontology/material/Promethium
Sub Class Of	RareEarthElement [C]

Rare Earth Element [C]

IRI	http://w3id.org/CEON/ontology/material/RareEarthElement
Sub Class Of	ChemicalElement [C]
Super Class Of	Cerium [C] Dysprosium [C] Erbium [C] Europium [C] Gadolinium [C] Holmium [C] Lanthanum [C] Lutetium [C] Neodymium [C] Praseodymium [C] Promethium [C] Samarium [C] Scandium [C] Tantalum [C] Terbium [C] Thulium [C] Ytterbium [C] Yttrium [C]

Samarium [C]

IRI	http://w3id.org/CEON/ontology/material/Samarium
Sub Class Of	RareEarthElement [C]

Scandium [C]

IRI	http://w3id.org/CEON/ontology/material/Scandium
Sub Class Of	RareEarthElement [C]

Silicon [C]

IRI	http://w3id.org/CEON/ontology/material/Silicon
Sub Class Of	ChemicalElement [C]

Tantalum [C]

IRI	http://w3id.org/CEON/ontology/material/Tantalum
Sub Class Of	RareEarthElement [C]

Terbium [C]

IRI http://w3id.org/CEON/ontology/material/Terbium

Sub Class Of RareEarthElement [C]

Thulium [C]

IRI http://w3id.org/CEON/ontology/material/Thulium

Sub Class Of RareEarthElement [C]

Titanium [C]

IRI http://w3id.org/CEON/ontology/material/Titanium

Sub Class Of ChemicalElement [C]

Ytterbium [C]

IRI http://w3id.org/CEON/ontology/material/Ytterbium

Sub Class Of RareEarthElement [C]

Yttrium [C]

IRI http://w3id.org/CEON/ontology/material/Yttrium

Sub Class Of RareEarthElement [C]

Zinc [C]

IRI http://w3id.org/CEON/ontology/material/Zinc

Sub Class Of ChemicalElement [C]

Constituent [C]

IRI http://w3id.org/CEON/ontology/resourceODP/Constituent

Super Class Of MaterialComponent [C]

Matter [C]

IRI http://w3id.org/CEON/ontology/resourceODP/Matter

Super Class Of ChemicalEntity [C]
Material [C]

Object Properties

has chemical entity op

IRI	http://w3id.org/CEON/ontology/material/hasChemicalEntity
Domain	Material c
Range	ChemicalEntity c

has material component op

IRI	http://w3id.org/CEON/ontology/material/hasMaterialComponent
Domain	Material c
Range	MaterialComponent c

Datatype Properties

anonymous formula dp

IRI	http://w3id.org/CEON/ontology/material/anonymousFormula

descriptive formula dp

IRI	http://w3id.org/CEON/ontology/material/descriptiveFormula

hill formula dp

IRI	http://w3id.org/CEON/ontology/material/hillFormula

reduced chemical formula dp

IRI	http://w3id.org/CEON/ontology/material/reducedChemicalFormula

Namespaces

:
http://w3id.org/CEON/ontology/material/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

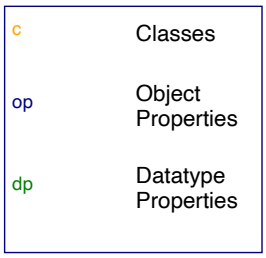
resourceODP

http://w3id.org/CEON/ontology/resourceODP/

vann

http://purl.org/vocab/vann/

Legend



Circular Economy Ontology Network (CEON) - Process Module

Metadata

IRI

http://w3id.org/CEON/ontology/process/

Title

Circular Economy Ontology Network (CEON) - Process Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-05-21

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/process/0.5/

Version Info

0.5

Prior Version

0.4

Preferred Namespace Prefix

ceon-process

Preferred Namespace Uri

https://w3id.org/CEON/ontology/process/

Description

The Process module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: T8-2.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: T8-2.

Classes

Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/Energy
Sub Class Of	resourceODP:Resource [c]
In Range Of	needsEnergy [op]

Assembling Process [c]

IRI	http://w3id.org/CEON/ontology/process/AssemblingProcess
Sub Class Of	TransformationProcess [c]

Buy Resource Process [c]

IRI	http://w3id.org/CEON/ontology/process/BuyResourceProcess
Sub Class Of	processODP:Process

Co2Emission [c]

IRI	http://w3id.org/CEON/ontology/process/CO2Emission
Sub Class Of	resourceODP:Resource [c]
In Range Of	producesCO2 [op]

Catalyst [c]

IRI	http://w3id.org/CEON/ontology/process/Catalyst
Sub Class Of	resourceODP:Resource [c]
In Range Of	usesCatalyst [op]

Change Resource Process [c]

IRI	http://w3id.org/CEON/ontology/process/ChangeResourceProcess
Sub Class Of	TransformationProcess [c]

Contact Process [c]

IRI	http://w3id.org/CEON/ontology/process/ContactProcess
Sub Class Of	processODP:Process

Deconstruction Process [C]

IRI	http://w3id.org/CEON/ontology/process/DeconstructionProcess
Sub Class Of	TransformationProcess [C]

Disassembling Process [C]

IRI	http://w3id.org/CEON/ontology/process/DisassemblingProcess
Sub Class Of	TransformationProcess [C]

Dismantle Process [C]

IRI	http://w3id.org/CEON/ontology/process/DismantleProcess
Sub Class Of	TransformationProcess [C]

Ensure Claim Process [C]

IRI	http://w3id.org/CEON/ontology/process/EnsureClaimProcess
Sub Class Of	processODP:Process

Issuing Certificate Process [C]

IRI	http://w3id.org/CEON/ontology/process/IssuingCertificateProcess
Sub Class Of	TransformationProcess [C]

Manufacturing Process [C]

IRI	http://w3id.org/CEON/ontology/process/ManufacturingProcess
Sub Class Of	TransformationProcess [C]

Offset Process [C]

IRI	http://w3id.org/CEON/ontology/process/OffsetProcess
Sub Class Of	TransformationProcess [C]

Production Process [C]

IRI	http://w3id.org/CEON/ontology/process/ProductionProcess
Sub Class Of	TransformationProcess [C]

Recycle Process [C]

IRI http://w3id.org/CEON/ontology/process/RecycleProcess

Sub Class Of TransformationProcess [C]

Refurbishment Process [C]

IRI http://w3id.org/CEON/ontology/process/RefurbishmentProcess

Sub Class Of TransformationProcess [C]

Remove Process [C]

IRI http://w3id.org/CEON/ontology/process/RemoveProcess

Sub Class Of processODP:Process

Remove Resource Process [C]

IRI http://w3id.org/CEON/ontology/process/RemoveResourceProcess

Sub Class Of TransformationProcess [C]

Repair Process [C]

IRI http://w3id.org/CEON/ontology/process/RepairProcess

Sub Class Of TransformationProcess [C]

Resell Process [C]

IRI http://w3id.org/CEON/ontology/process/ResellProcess

Sub Class Of processODP:Process

Reuse Process [C]

IRI http://w3id.org/CEON/ontology/process/ReuseProcess

Sub Class Of processODP:Process

Sell Resource Process [C]

IRI http://w3id.org/CEON/ontology/process/SellResourceProcess

Sub Class Of processODP:Process

Service Process [C]

IRI http://w3id.org/CEON/ontology/process/ServiceProcess

Sub Class Of TransformationProcess [C]

Share Resource Process [C]

IRI http://w3id.org/CEON/ontology/process/ShareResourceProcess

Sub Class Of processODP:Process

Take Back Process [C]

IRI http://w3id.org/CEON/ontology/process/TakeBackProcess

Sub Class Of processODP:Process

Transformation Process [C]

IRI http://w3id.org/CEON/ontology/process/TransformationProcess

Is Defined By ISO 59004:2024 - 3.5.5 process

Description Set of interrelated or interacting activities that transforms inputs into outputs.

Sub Class Of processODP:Process

Super Class Of
AssemblingProcess [C]
ChangeResourceProcess [C]
DeconstructionProcess [C]
DisassemblingProcess [C]
DismantleProcess [C]
IssuingCertificateProcess [C]
ManufacturingProcess [C]
OffsetProcess [C]
ProductionProcess [C]
RecycleProcess [C]
RefurbishmentProcess [C]
RemoveResourceProcess [C]
RepairProcess [C]
ServiceProcess [C]

Transition [C]

IRI http://w3id.org/CEON/ontology/process/Transition

Sub Class Of processODP:Situation

In Domain Of affectsObject [OP]

Event [c]

IRI	http://w3id.org/CEON/ontology/processODP/Event

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource
In Range Of	resultingResource [op]
Super Class Of	http://w3id.org/CEON/ontology/energy/Energy [c] CO2Emission [c] Catalyst [c]

Object Properties

affects object [op]

IRI	http://w3id.org/CEON/ontology/process/affectsObject
Sub Property Of	processODP:isSettingFor
Domain	Transition [c]

needs energy [op]

IRI	http://w3id.org/CEON/ontology/process/needsEnergy
Sub Property Of	processODP:hasInput [op]
Range	http://w3id.org/CEON/ontology/energy/Energy [c]

produces co2 [op]

IRI	http://w3id.org/CEON/ontology/process/producesCO2
Sub Property Of	processODP:hasOutput [op]
Range	CO2Emission [c]

resulting resource [op]

IRI	http://w3id.org/CEON/ontology/process/resultingResource
Sub Property Of	processODP:hasOutput [op]
Range	resourceODP:Resource [c]

uses catalyst [op]

IRI	http://w3id.org/CEON/ontology/process/usesCatalyst
Sub Property Of	processODP:hasInput [op]
Range	Catalyst [c]

has input [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasInput
Super Property Of	• needsEnergy [op] • usesCatalyst [op]

has output [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasOutput
Super Property Of	• producesCO2 [op] • resultingResource [op]

Namespaces

:
http://w3id.org/CEON/ontology/process/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

processODP
http://w3id.org/CEON/ontology/processODP/

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

resourceODP
http://w3id.org/CEON/ontology/resourceODP/

vann
http://purl.org/vocab/vann/

Legend

c	Classes
op	Object Properties

Circular Economy Ontology Network (CEON) - Plan Module

Metadata

IRI

http://w3id.org/CEON/ontology/plan/

Title

Circular Economy Ontology Network (CEON) - Plan Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-06-19

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/plan/0.1/

Version Info

0.1

Preferred Namespace Prefix

ceon-plan

Preferred Namespace Uri

https://w3id.org/CEON/ontology/plan/

Description

The Plan module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: T8-2.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: T8-2.

Classes

Description [C]

IRI	http://w3id.org/CEON/ontology/plan/Description
In Range Of	satisfiesPlan [OP]
Super Class Of	Plan [C]

Plan [c]

IRI	`http://w3id.org/CEON/ontology/plan/Plan`
Sub Class Of	Description [c]
In Domain Of	hasPlanExecution [op]
Restriction	processODP:hasPart some Plan [c]

Plan Execution [c]

IRI	`http://w3id.org/CEON/ontology/plan/PlanExecution`
Sub Class Of	processODP:Situation processODP:duringTime some processODP:TimeInterval [c] *or* processODP:occursAtTime [dp] some xsd:dateTime [c]
In Domain Of	followsExecution [op] precedesExecution [op] occursAtTime [dp]
In Range Of	hasPlanExecution [op]
Restriction	followsExecution [op] some PlanExecution [c] precedesExecution [op] some PlanExecution [c] satisfiesPlan [op] some PlanExecution [c] processODP:hasPart some PlanExecution [c] processODP:isSettingFor some PlanExecution [c]

Object Properties

follows execution [op]

IRI	`http://w3id.org/CEON/ontology/plan/followsExecution`
Sub Property Of	processODP:isSettingFor
Domain	PlanExecution [c]

has plan execution [op]

IRI	`http://w3id.org/CEON/ontology/plan/hasPlanExecution`
Sub Property Of	topObjectProperty [op]
Domain	Plan [c]
Range	PlanExecution [c]

precedes execution op

IRI	http://w3id.org/CEON/ontology/plan/precedesExecution
Sub Property Of	processODP:isSettingFor
Domain	PlanExecution c

satisfies plan op

IRI	http://w3id.org/CEON/ontology/plan/satisfiesPlan
Sub Property Of	topObjectProperty op
Domain	processODP:Situation
Range	Description c

has input op

IRI	http://w3id.org/CEON/ontology/processODP/hasInput

has output op

IRI	http://w3id.org/CEON/ontology/processODP/hasOutput

Datatype Properties

occurs at time dp

IRI	http://w3id.org/CEON/ontology/plan/occursAtTime
Domain	PlanExecution c
Range	xsd:dateTime

occurs at time dp

IRI	http://w3id.org/CEON/ontology/processODP/occursAtTime

Namespaces

:

http://w3id.org/CEON/ontology/plan/

dcterms

http://purl.org/dc/terms/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

processODP

http://w3id.org/CEON/ontology/processODP/

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

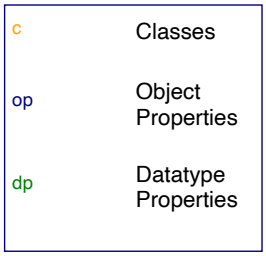
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Process ODP

Metadata

IRI

http://w3id.org/CEON/ontology/processODP/

Title

Circular Economy Ontology Network (CEON) - Process ODP

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-05-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/processODP/0.5/

Version Info

0.5

Prior Version

0.4

Preferred Namespace Prefix

ceon-processODP

Preferred Namespace Uri

http://w3id.org/CEON/ontology/processODP/

Description

A core ODP of the CEON ontology network, defining aspects of the process concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Process-3,4,5, C3-1, C4-2, C4-5, C4-7, C4-9, C13-2, E2-6

Covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE3-5, CE7-4, CE7-5, CE8-2, CE10-7, CE12-1, C3-1, C4-2, C4-5, C4-7, C4-9, C13-2, E1-9, E2-6, E3-7, T10-1.

Classes

Location [c]

IRI	http://w3id.org/CEON/ontology/location/Location
In Range Of	occursAtLocation [op]

Event [c]

IRI	http://w3id.org/CEON/ontology/processODP/Event
Sub Class Of	hasInput [op] some Thing [c] *and* hasOutput [op] some Thing [c]
Restriction	hasPart [op] only Event [c]

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process
Description	Something that takes place over a (longer) period of time and changes some state of affairs.
Sub Class Of	hasInput [op] some Thing [c] *and* hasOutput [op] some Thing [c]
In Domain Of	hasInput [op] hasOutput [op]
Restriction	hasPart [op] only Process [c]

Situation [c]

IRI	http://w3id.org/CEON/ontology/processODP/Situation
In Domain Of	isSettingFor [op]
Restriction	isSettingFor [op] some Situation [c]

Time Interval [c]

IRI	http://w3id.org/CEON/ontology/processODP/TimeInterval
In Domain Of	endTime [dp] startTime [dp]
In Range Of	duringTime [op]

Object Properties

during time [op]

IRI	http://w3id.org/CEON/ontology/processODP/duringTime
Range	TimeInterval [c]

has input op

IRI	http://w3id.org/CEON/ontology/processODP/hasInput
Domain	Process c

has output op

IRI	http://w3id.org/CEON/ontology/processODP/hasOutput
Domain	Process c

has part op

IRI	http://w3id.org/CEON/ontology/processODP/hasPart

is setting for op

IRI	http://w3id.org/CEON/ontology/processODP/isSettingFor
Super Property Of	occursAtLocation op
Domain	Situation c

occurs at location op

IRI	http://w3id.org/CEON/ontology/processODP/occursAtLocation
Sub Property Of	isSettingFor op
Range	http://w3id.org/CEON/ontology/location/Location c

Datatype Properties

end time dp

IRI	http://w3id.org/CEON/ontology/processODP/endTime
Domain	TimeInterval c
Range	xsd:dateTime

start time dp

IRI	http://w3id.org/CEON/ontology/processODP/startTime
Domain	TimeInterval c
Range	xsd:dateTime

Annotation Properties

contributor ap

IRI http://purl.org/dc/terms/contributor

created ap

IRI http://purl.org/dc/terms/created

creator ap

IRI http://purl.org/dc/terms/creator

description ap

IRI http://purl.org/dc/terms/description

issued ap

IRI http://purl.org/dc/terms/issued

license ap

IRI http://purl.org/dc/terms/license

publisher ap

IRI http://purl.org/dc/terms/publisher

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:

http://w3id.org/CEON/ontology/processODP/

dcterms

http://purl.org/dc/terms/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

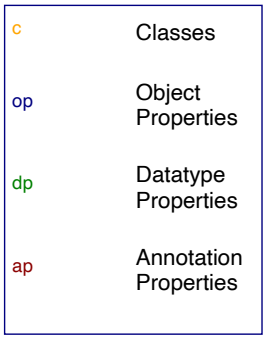
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Product Module

Metadata

IRI

http://w3id.org/CEON/ontology/product/

Title

Circular Economy Ontology Network (CEON) - Product Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-03-19

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/product/0.5/

Version Info

0.5

Prior Version

0.4

Preferred Namespace Prefix

ceon-product

Preferred Namespace Uri

http://w3id.org/CEON/ontology/product/

Description

The Product module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-2, CVN-ResrouceType-4, C11-2, C12-1, C13-3, E2-1, T8-3.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE5-2, C1-4, C2-5, C5-3, C11-2, C12-1, C13-3, C13-4, C13-9, E1-4, E1-5, E1-15, E2-1, E3-2, E3-5, E4-1, E4-2, E4-8, E4-9, E6-7, T4-3, T4-5, T6-1, T8-3, T9-2.

Classes

Actor [C]

IRI http://w3id.org/CEON/ontology/actorODP/Actor

Resource Relation [C]

IRI http://w3id.org/CEON/ontology/actorODP/ResourceRelation

Location [c]

IRI http://w3id.org/CEON/ontology/location/Location

Super Class Of
- AssemblyLocation [c]
- ManufactureLocation [c]
- OriginLocation [c]
- ProductionLocation [c]
- SupplierLocation [c]

Process [c]

IRI http://w3id.org/CEON/ontology/processODP/Process

Assembly Location [c]

IRI http://w3id.org/CEON/ontology/product/AssemblyLocation

Sub Class Of
- http://w3id.org/CEON/ontology/location/Location [c]

In Domain Of
- countryOfAssembly [dp]

In Range Of
- hasAssemblyLocation [op]

Restriction
- http://w3id.org/CEON/ontology/location/hasCity [dp] *max* 1 AssemblyLocation [c]
- http://w3id.org/CEON/ontology/location/hasPostalCode [dp] *max* 1 AssemblyLocation [c]
- http://w3id.org/CEON/ontology/location/hasStreetAddress [dp] *max* 1 AssemblyLocation [c]
- countryOfAssembly [dp] *max* 1 AssemblyLocation [c]

Compliance [c]

IRI http://w3id.org/CEON/ontology/product/Compliance

In Domain Of
- complianceWith [op]
- hasCertificate [dp]

In Range Of
- hasCompliance [op]

Super Class Of
- ISOCompliance [c]
- REACHCompliance [c]
- RoHSCompliance [c]

Composition [c]

IRI	http://w3id.org/CEON/ontology/product/Composition
Sub Class Of	actorODP:ResourceParticipation
In Domain Of	compositionOf [op] compositionQuantity [dp]
In Range Of	hasComposition [op]
Super Class Of	MatterComposition [c] ProductComposition [c] ProductObjectComposition [c]

Iso Compliance [c]

IRI	http://w3id.org/CEON/ontology/product/ISOCompliance
Sub Class Of	Compliance [c]

Item [c]

IRI	http://w3id.org/CEON/ontology/product/Item
Sub Class Of	resourceODP:PhysicalObject [c]
In Domain Of	hasProductObjectComponent [op] modelledBy [op]
In Range Of	associatedWithProductObject [op] hasProductObjectComponent [op]
Restriction	modelledBy [op] *exactly* 1 Item [c]

Manufacture Location [c]

IRI	http://w3id.org/CEON/ontology/product/ManufactureLocation
Sub Class Of	http://w3id.org/CEON/ontology/location/Location [c]
In Domain Of	countryOfManufacture [dp]
In Range Of	hasManufacturerLocation [op]
Restriction	http://w3id.org/CEON/ontology/location/hasCity [dp] *max* 1 ManufactureLocation [c] http://w3id.org/CEON/ontology/location/hasPostalCode [dp] *max* 1 ManufactureLocation [c] http://w3id.org/CEON/ontology/location/hasStreetAddress [dp] *max* 1 ManufactureLocation [c] countryOfManufacture [dp] *max* 1 ManufactureLocation [c]

Matter Composition [c]

IRI	http://w3id.org/CEON/ontology/product/MatterComposition
Sub Class Of	Composition [c]
In Domain Of	associatedWithMatter [op]
Restriction	associatedWithMatter [op] *exactly* 1 MatterComposition [c]

Origin Location [c]

IRI	http://w3id.org/CEON/ontology/product/OriginLocation
Sub Class Of	http://w3id.org/CEON/ontology/location/Location [c]
In Domain Of	countryOfOrigin [dp]
In Range Of	hasOriginLocation [op]
Restriction	http://w3id.org/CEON/ontology/location/hasCity [dp] *max* 1 OriginLocation [c] http://w3id.org/CEON/ontology/location/hasPostalCode [dp] *max* 1 OriginLocation [c] http://w3id.org/CEON/ontology/location/hasStreetAddress [dp] *max* 1 OriginLocation [c] countryOfOrigin [dp] *max* 1 OriginLocation [c]

Product [c]

IRI	http://w3id.org/CEON/ontology/product/Product
Is Defined By	ISO 59004:2024 -3.2.2 product
Sub Class Of	Solution [c] resourceODP:Resource
In Domain Of	hasProductComponent [op]
In Range Of	associatedWithProductModel [op] batchOfProduct [op] hasProductComponent [op] modelledBy [op]
Restriction	hasComposition [op] some Product [c] hasComposition [op] some Product [c] hasAssemblyLocation [op] only Product [c] hasManufacturerLocation [op] only Product [c] hasOriginLocation [op] only Product [c]

Product Composition [c]

IRI	http://w3id.org/CEON/ontology/product/ProductComposition
Sub Class Of	Composition [c]
In Domain Of	associatedWithProductModel [op]
Restriction	associatedWithProductModel [op] *exactly* 1 ProductComposition [c]

Product Object Composition [c]

IRI	http://w3id.org/CEON/ontology/product/ProductObjectComposition
Sub Class Of	Composition [c]
In Domain Of	associatedWithProductObject [op]
Restriction	associatedWithProductObject [op] *exactly* 1 ProductObjectComposition [c]

Production Location [c]

IRI	http://w3id.org/CEON/ontology/product/ProductionLocation
Sub Class Of	http://w3id.org/CEON/ontology/location/Location [c]
In Domain Of	countryOfProduction [dp] productionSite [dp]
Restriction	http://w3id.org/CEON/ontology/location/hasCity [dp] *max* 1 ProductionLocation [c] http://w3id.org/CEON/ontology/location/hasPostalCode [dp] *max* 1 ProductionLocation [c] http://w3id.org/CEON/ontology/location/hasStreetAddress [dp] *max* 1 ProductionLocation [c] countryOfProduction [dp] *max* 1 ProductionLocation [c] productionSite [dp] *max* 1 ProductionLocation [c]

Reach Compliance [c]

IRI	http://w3id.org/CEON/ontology/product/REACHCompliance
Sub Class Of	Compliance [c]
Equivalentclass	complianceWith [op] value REACH [c]

Regulation [c]

IRI	http://w3id.org/CEON/ontology/product/Regulation
Named Individuals	REACH [ni] RoHS [ni]

Ro Hs Compliance [c]

IRI	http://w3id.org/CEON/ontology/product/RoHSCompliance
Sub Class Of	Compliance [c]
Equivalentclass	complianceWith [op] value RoHS [c]

Solution [c]

IRI	http://w3id.org/CEON/ontology/product/Solution
Is Defined By	ISO 59004:2024 - 3.2.1 solution
Super Class Of	Product [c]

Supplier Location [c]

IRI	http://w3id.org/CEON/ontology/product/SupplierLocation
Sub Class Of	http://w3id.org/CEON/ontology/location/Location [c]

Batch Of Objects [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/BatchOfObjects
In Domain Of	batchOfProduct [op]
Restriction	batchOfProduct [op] *exactly* 1 resourceODP:BatchOfObjects [c]

Matter [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Matter
In Range Of	associatedWithMatter [op]

Physical Object [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/PhysicalObject
Super Class Of	Item [c]

Object Properties

has location [op]

IRI `http://w3id.org/CEON/ontology/location/hasLocation`

Super Property Of
- hasAssemblyLocation [op]
- hasManufacturerLocation [op]
- hasOriginLocation [op]

associated with matter [op]

IRI `http://w3id.org/CEON/ontology/product/associatedWithMatter`

Domain MatterComposition [c]

Range resourceODP:Matter [c]

associated with product model [op]

IRI `http://w3id.org/CEON/ontology/product/associatedWithProductModel`

Domain ProductComposition [c]

Range Product [c]

associated with product object [op]

IRI `http://w3id.org/CEON/ontology/product/associatedWithProductObject`

Sub Property Of topObjectProperty [op]

Domain ProductObjectComposition [c]

Range Item [c]

batch of product [op]

IRI `http://w3id.org/CEON/ontology/product/batchOfProduct`

Domain resourceODP:BatchOfObjects [c]

Range Product [c]

compliance with [op]

IRI `http://w3id.org/CEON/ontology/product/complianceWith`

Domain Compliance [c]

composition of [op]

IRI	http://w3id.org/CEON/ontology/product/compositionOf
Domain	Composition [c]
Range	resourceODP:Matter [c] *or* Item [c] *or* Product [c]

has assembly location [op]

IRI	http://w3id.org/CEON/ontology/product/hasAssemblyLocation
Sub Property Of	http://w3id.org/CEON/ontology/location/hasLocation [op]
Domain	Product [c] *or* Item [c]
Range	AssemblyLocation [c]

has compliance [op]

IRI	http://w3id.org/CEON/ontology/product/hasCompliance
Domain	Product [c] *or* actorODP:Actor [c] *or* http://w3id.org/CEON/ontology/processODP/Process [c] *or* Item [c]
Range	Compliance [c]

has composition [op]

IRI	http://w3id.org/CEON/ontology/product/hasComposition
Domain	resourceODP:PhysicalObject [c] *or* Product [c]
Range	Composition [c]

has manufacturer location [op]

IRI	http://w3id.org/CEON/ontology/product/hasManufacturerLocation
Sub Property Of	http://w3id.org/CEON/ontology/location/hasLocation [op]
Domain	Item [c] *or* Product [c]
Range	ManufactureLocation [c]

has origin location [op]

IRI	http://w3id.org/CEON/ontology/product/hasOriginLocation
Sub Property Of	http://w3id.org/CEON/ontology/location/hasLocation [op]
Domain	Product [c] *or* Item [c]
Range	OriginLocation [c]

has product component op

IRI	http://w3id.org/CEON/ontology/product/hasProductComponent
Domain	Product c
Range	Product c

has product object component op

IRI	http://w3id.org/CEON/ontology/product/hasProductObjectComponent
Domain	Item c
Range	Item c

modelled by op

IRI	http://w3id.org/CEON/ontology/product/modelledBy
Domain	Item c
Range	Product c

Datatype Properties

has city dp

IRI	http://w3id.org/CEON/ontology/location/hasCity
Sub Property Of	topDataProperty dp

has country dp

IRI	http://w3id.org/CEON/ontology/location/hasCountry
Super Property Of	• countryOfAssembly dp • countryOfManufacture dp • countryOfOrigin dp • countryOfProduction dp

has postal code dp

IRI	http://w3id.org/CEON/ontology/location/hasPostalCode
Sub Property Of	topDataProperty dp

has street address dp

IRI	http://w3id.org/CEON/ontology/location/hasStreetAddress
Sub Property Of	topDataProperty dp

composition quantity dp

IRI	http://w3id.org/CEON/ontology/product/compositionQuantity
Domain	Composition c
Range	xsd:double

country of assembly dp

IRI	http://w3id.org/CEON/ontology/product/countryOfAssembly
Sub Property Of	http://w3id.org/CEON/ontology/location/hasCountry dp
Domain	AssemblyLocation c
Range	xsd:string

country of manufacture dp

IRI	http://w3id.org/CEON/ontology/product/countryOfManufacture
Sub Property Of	http://w3id.org/CEON/ontology/location/hasCountry dp
Domain	ManufactureLocation c
Range	xsd:string

country of origin dp

IRI	http://w3id.org/CEON/ontology/product/countryOfOrigin
Sub Property Of	http://w3id.org/CEON/ontology/location/hasCountry dp
Domain	OriginLocation c
Range	xsd:string

country of production dp

IRI	http://w3id.org/CEON/ontology/product/countryOfProduction
Sub Property Of	http://w3id.org/CEON/ontology/location/hasCountry dp
Domain	ProductionLocation c
Range	xsd:string

has brand dp

IRI	http://w3id.org/CEON/ontology/product/hasBrand
Range	xsd:string

has certificate dp

IRI	http://w3id.org/CEON/ontology/product/hasCertificate
Domain	Compliance c

has global trade item number dp

IRI	http://w3id.org/CEON/ontology/product/hasGlobalTradeItemNumber
Range	xsd:string

has product name dp

IRI	http://w3id.org/CEON/ontology/product/hasProductName
Range	xsd:string

production site dp

IRI	http://w3id.org/CEON/ontology/product/productionSite
Domain	ProductionLocation c
Range	xsd:string

Namespaces

:

http://w3id.org/CEON/ontology/product/

actorODP

http://w3id.org/CEON/ontology/actorODP/

dcterms

http://purl.org/dc/terms/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

resourceODP

http://w3id.org/CEON/ontology/resourceODP/

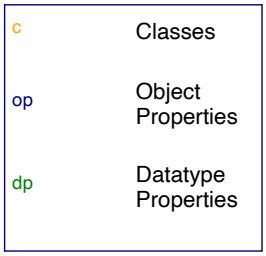
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Resource ODP

Metadata

IRI

http://w3id.org/CEON/ontology/resourceODP/

Title

Circular Economy Ontology Network (CEON) - Resource ODP

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-03-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/resourceODP/0.5/

Version Info

0.5

Prior Version

0.4

Preferred Namespace Prefix

ceon-resourceODP

Preferred Namespace Uri

http://w3id.org/CEON/ontology/resourceODP/

Description

A core ODP of the CEON ontology network defining aspects of the resource concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-1,3, CVN-Composition-1,2, CVN-ResrouceType-4, C7-3, E2-2, E4-6, E5-1, E6-3, T3-1.

Covers the following requirements from Onto-DESIDE D3.2: CE1-2, CE3-3, CE4-3, CE5-2, CE9-1, CE10-1, CE11-8, CE12-2, CE12-4, C7-3, E2-2, E4-6, E5-1, E6-3, T3-1, T19-1, T20-1, T22-2.

Classes

Location [c]

IRI	http://w3id.org/CEON/ontology/location/Location
In Range Of	hasResourceLocation [op]

Asset [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Asset
Super Class Of	Information [c] Resource [c]

Batch Of Objects [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/BatchOfObjects
Sub Class Of	Resource [c] hasPhysicalObject [op] some PhysicalObject [c] *and* hasPhysicalObject [op] only PhysicalObject [c]
In Domain Of	batchID [dp] batchLabel [dp] batchSize [dp]
In Range Of	hasBatch [op]
Restriction	batchSize [dp] *exactly* 1 BatchOfObjects [c]

Constituent [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Constituent
In Range Of	hasConstituent [op]

Digital Object [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/DigitalObject
Sub Class Of	Resource [c]

Information [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Information
Sub Class Of	Asset [c]
In Domain Of	containsInformation [op] isAbout [op]
In Range Of	containsInformation [op] isRealizationOf [op]

Matter [c]

IRI http://w3id.org/CEON/ontology/resourceODP/Matter

In Range Of hasMatter [op]

Physical Object [c]

IRI http://w3id.org/CEON/ontology/resourceODP/PhysicalObject

Sub Class Of
Resource [c]
hasConstituent [op] some Constituent [c] *and* hasConstituent [op] only Constituent [c]
hasMatter [op] some Matter [c] *and* hasMatter [op] only Matter [c]

In Domain Of
hasConstituent [op]
hasMatter [op]

In Range Of hasPhysicalObject [op]

Resource [c]

IRI http://w3id.org/CEON/ontology/resourceODP/Resource

Is Defined By ISO 59004:2024 - 3.1.5 resource

Sub Class Of
Asset [c]
hasResourceCondition [op] only ResourceCondition [c] *and* hasResourceCondition [op] some ResourceCondition [c]
hasResourceProperty [op] only ResourceProperty [c] *and* hasResourceProperty [op] some ResourceProperty [c]
hasResourceQuality [op] only ResourceQuality [c] *and* hasResourceQuality [op] some ResourceQuality [c]

In Domain Of
hasResourceCondition [op]
hasResourceLocation [op]
hasResourceProperty [op]
hasResourceQuality [op]

Super Class Of
BatchOfObjects [c]
DigitalObject [c]
PhysicalObject [c]
SetOfObjects [c]

Resource Condition [c]

IRI http://w3id.org/CEON/ontology/resourceODP/ResourceCondition

In Range Of hasResourceCondition [op]

Resource Property [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/ResourceProperty
In Range Of	hasResourceProperty [op]

Resource Quality [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/ResourceQuality
In Range Of	hasResourceQuality [op]

Set Of Objects [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/SetOfObjects
Sub Class Of	Resource [c] hasBatch [op] only BatchOfObjects [c] *and* hasBatch [op] some BatchOfObjects [c] hasPhysicalObject [op] some PhysicalObject [c] *and* hasPhysicalObject [op] only PhysicalObject [c]
In Domain Of	hasBatch [op]

Object Properties

has location [op]

IRI	http://w3id.org/CEON/ontology/location/hasLocation
Super Property Of	hasResourceLocation [op]

contains information [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/containsInformation
Sub Property Of	hasPart [op]
Domain	Information [c]
Range	Information [c]

has batch [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasBatch
Domain	SetOfObjects [c]
Range	BatchOfObjects [c]

has constituent [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasConstituent
Sub Property Of	hasPart [op]
Domain	PhysicalObject [c]
Range	Constituent [c]

has matter [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasMatter
Domain	PhysicalObject [c]
Range	Matter [c]

has part [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasPart
Super Property Of	• containsInformation [op] • hasConstituent [op]

has physical object [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasPhysicalObject
Domain	BatchOfObjects [c] *or* SetOfObjects [c]
Range	PhysicalObject [c]

has resource condition [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasResourceCondition
Domain	Resource [c]
Range	ResourceCondition [c]

has resource location [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasResourceLocation
Sub Property Of	location:hasLocation [op]
Domain	Resource [c]
Range	location:Location [c]

has resource property op

IRI http://w3id.org/CEON/ontology/resourceODP/hasResourceProperty

Domain Resource c

Range ResourceProperty c

has resource quality op

IRI http://w3id.org/CEON/ontology/resourceODP/hasResourceQuality

Domain Resource c

Range ResourceQuality c

is about op

IRI http://w3id.org/CEON/ontology/resourceODP/isAbout

Domain Information c

is realization of op

IRI http://w3id.org/CEON/ontology/resourceODP/isRealizationOf

Range Information c

Datatype Properties

batch id dp

IRI http://w3id.org/CEON/ontology/resourceODP/batchID

Domain BatchOfObjects c

Range xsd:string

batch label dp

IRI http://w3id.org/CEON/ontology/resourceODP/batchLabel

Domain BatchOfObjects c

Range xsd:string

batch size dp

IRI	http://w3id.org/CEON/ontology/resourceODP/batchSize
Domain	BatchOfObjects c
Range	xsd:nonNegativeInteger

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

issued ap

IRI	http://purl.org/dc/terms/issued

license ap

IRI	http://purl.org/dc/terms/license

publisher ap

IRI	http://purl.org/dc/terms/publisher

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI	http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:

http://w3id.org/CEON/ontology/resourceODP/

dcterms

http://purl.org/dc/terms/

geo

http://www.opengis.net/ont/geosparql#

location

http://w3id.org/CEON/ontology/location/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend

c	Classes
op	Object Properties
dp	Datatype Properties
ap	Annotation Properties

Circular Economy Ontology Network (CEON) - Energy Module

Metadata

IRI

http://w3id.org/CEON/ontology/energy/

Title

Circular Economy Ontology Network (CEON) - Energy Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-03-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/energy/0.2/

Version Info

0.2

Prior Version

0.1

Preferred Namespace Prefix

ceon-energy

Preferred Namespace Uri

http://w3id.org/CEON/ontology/energy/

Description

A module of the CEON ontology network defining aspects of the energy concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE1-2, CE4-3, CE6-3, CE7-4, CE7-4, CE8-2, CE9-2, CE10-7, CE10-9, CE11-6, CE12-5.

Classes

Biofuel [C]

IRI	http://w3id.org/CEON/ontology/energy/Biofuel
Sub Class Of	Biomass [C]

Biogas [C]

IRI	http://w3id.org/CEON/ontology/energy/Biogas
Sub Class Of	Biomass [C]

Biomass [c]

IRI	http://w3id.org/CEON/ontology/energy/Biomass
Sub Class Of	EnergySource [c]
Super Class Of	Biofuel [c] Biogas [c]

Coal [c]

IRI	http://w3id.org/CEON/ontology/energy/Coal
Sub Class Of	FossilFuel [c]

Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/Energy
Sub Class Of	http://w3id.org/CEON/ontology/resourceODP/Resource
In Domain Of	hasEnergySource [op]
Super Class Of	NonRenewableEnergy [c] RenewableEnergy [c]

Energy Composition [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyComposition
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/ResourceParticipation
In Domain Of	hasEnergyComponentPercentage [dp]

Energy Conversion [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyConversion
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/ResourceRelation

Energy Infrastructure [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyInfrastructure
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/Infrastructure

Energy Source [c]

IRI http://w3id.org/CEON/ontology/energy/EnergySource

In Domain Of
hasCarbonIntensity [dp]
hasSustainability [dp]

In Range Of
hasEnergySource [op]

Super Class Of
Biomass [c]
FossilFuel [c]
GeothermalEnergySource [c]
Hydropower [c]
SolarEnergySource [c]
WindEnergySource [c]

Fossil Fuel [c]

IRI http://w3id.org/CEON/ontology/energy/FossilFuel

Sub Class Of
EnergySource [c]

Super Class Of
Coal [c]
NaturalGas [c]
Petroleum [c]

Geothermal Energy Source [c]

IRI http://w3id.org/CEON/ontology/energy/GeothermalEnergySource

Sub Class Of
EnergySource [c]

Hydropower [c]

IRI http://w3id.org/CEON/ontology/energy/Hydropower

Sub Class Of
EnergySource [c]

Natural Gas [c]

IRI http://w3id.org/CEON/ontology/energy/NaturalGas

Sub Class Of
FossilFuel [c]

Non Renewable Energy [c]

IRI http://w3id.org/CEON/ontology/energy/NonRenewableEnergy

Sub Class Of
Energy [c]

Petroleum [c]

IRI	http://w3id.org/CEON/ontology/energy/Petroleum
Sub Class Of	FossilFuel [c]

Renewable Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/RenewableEnergy
Sub Class Of	Energy [c]

Solar Energy Source [c]

IRI	http://w3id.org/CEON/ontology/energy/SolarEnergySource
Sub Class Of	EnergySource [c]

Wind Energy Source [c]

IRI	http://w3id.org/CEON/ontology/energy/WindEnergySource
Sub Class Of	EnergySource [c]

Object Properties

has anergy [op]

IRI	http://w3id.org/CEON/ontology/energy/hasAnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingObject

has converted energy [op]

IRI	http://w3id.org/CEON/ontology/energy/hasConvertedEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingResource
Range	NonRenewableEnergy [c] *or* RenewableEnergy [c]

has energy source [op]

IRI	http://w3id.org/CEON/ontology/energy/hasEnergySource
Domain	Energy [c]
Range	EnergySource [c]

has exergy op

IRI	http://w3id.org/CEON/ontology/energy/hasExergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingObject

has original energy op

IRI	http://w3id.org/CEON/ontology/energy/hasOriginalEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingResource
Range	NonRenewableEnergy c *or* RenewableEnergy c

participating energy op

IRI	http://w3id.org/CEON/ontology/energy/participatingEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingSubject

Datatype Properties

has carbon intensity dp

IRI	http://w3id.org/CEON/ontology/energy/hasCarbonIntensity
Domain	EnergySource c
Range	xsd:double

has energy component percentage dp

IRI	http://w3id.org/CEON/ontology/energy/hasEnergyComponentPercentage
Domain	EnergyComposition c
Range	xsd:double

has sustainability dp

IRI	http://w3id.org/CEON/ontology/energy/hasSustainability
Domain	EnergySource c
Range	xsd:double

Namespaces

:

http://w3id.org/CEON/ontology/energy/

dcterms

http://purl.org/dc/terms/

geo

http://www.opengis.net/ont/geosparql#

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

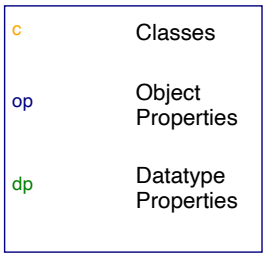
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Value Module

Metadata

IRI

`http://w3id.org/CEON/ontology/value/`

Title

Circular Economy Ontology Network (CEON) - Value Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2025-05-20

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/value/0.3/

Version Info

0.3

Preferred Namespace Prefix

ceon-value

Preferred Namespace Uri

https://w3id.org/CEON/ontoloy/value/

Description

A core ODP of the CEON ontology network, defining aspects of the value concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE1-3, CE5-16, CE5-17, CE5-19, CE7-8, CE9-4, CE10-10, CE11-2, C2-1, C4-4, C4-6, C5-2.

Classes

Resource [c]

IRI `http://w3id.org/CEON/ontology/resourceODP/Resource`

In Range Of

hasValuableResource [op]
targettingResource [op]

Economic Value [C]

IRI	http://w3id.org/CEON/ontology/value/EconomicValue
Sub Class Of	Value [C]
Equivalentclass	UseValue [C]

Environmental Value [C]

IRI	http://w3id.org/CEON/ontology/value/EnvironmentalValue
Sub Class Of	Value [C]

Exchange Value [C]

IRI	http://w3id.org/CEON/ontology/value/ExchangeValue
Sub Class Of	Value [C]

Social Value [C]

IRI	http://w3id.org/CEON/ontology/value/SocialValue
Sub Class Of	Value [C]

Use Value [C]

IRI	http://w3id.org/CEON/ontology/value/UseValue
Sub Class Of	Value [C]

Value [c]

IRI	http://w3id.org/CEON/ontology/value/Value
Is Defined By	ISO 59004:2024 - 3.1.7 value
Description	Gain(s) or benefit(s) from satisfying needs and expectations, in relation to the use and conservation of resources. EXAMPLE: Revenue, savings, productivity, sustainability, satisfaction, empowerment, engagement, experience, public health, trust. Value is relative to, and determined by the perception of, those interested party(ies) able to capture it. Value can be financial or non-financial, e.g. social, environmental, other gains or benefits. Value is dynamic over time.
In Range Of	hasAimedValue [op] hasAssociatedValue [op]
Super Class Of	EconomicValue [c] EnvironmentalValue [c] ExchangeValue [c] SocialValue [c] UseValue [c]

Value Participation [c]

IRI	http://w3id.org/CEON/ontology/value/ValueParticipation
Sub Class Of	actorODP:Participation
In Domain Of	hasValuableResource [op] hasValueParticipantRole [op]
In Range Of	onValueParticipation [op] targettingValueParticipation [op]
Restriction	hasAssociatedValue [op] some ValueParticipation [c]

Value Participation Role [c]

IRI	http://w3id.org/CEON/ontology/value/ValueParticipationRole
Sub Class Of	actorODP:Role
In Range Of	hasValueParticipantRole [op]
Named Individuals	ValueConsumer [ni] ValueContributor [ni] ValueCreator [ni] ValueDestroyer [ni] ValueDistributor [ni] ValueEvaluator [ni]

Value Perception [c]

IRI	http://w3id.org/CEON/ontology/value/ValuePerception
In Domain Of	hasAssociatedValue [op] onValueParticipation [op]
In Range Of	hasPerception [op]

Value Proposition [c]

IRI	http://w3id.org/CEON/ontology/value/ValueProposition
In Domain Of	hasAimedValue [op] proposedBy [op] targettingActor [op] targettingResource [op] targettingValueParticipation [op]
Restriction	hasAimedValue [op] some ValueProposition [c] targettingActor [op] some ValueProposition [c] targettingValueParticipation [op] some ValueProposition [c]

Object Properties

has aimed value [op]

IRI	http://w3id.org/CEON/ontology/value/hasAimedValue
Domain	ValueProposition [c]
Range	Value [c]

has associated value [op]

IRI	http://w3id.org/CEON/ontology/value/hasAssociatedValue
Sub Property Of	topObjectProperty [op]
Domain	ValuePerception [c]
Range	Value [c]

has perception [op]

IRI	http://w3id.org/CEON/ontology/value/hasPerception
Domain	actorODP:Actor [c] *or* ValueProposition [c]
Range	ValuePerception [c]

has vp targets op

IRI	http://w3id.org/CEON/ontology/value/hasVPTargets
Super Property Of	• targettingActor op • targettingResource op • targettingValueParticipation op

has valuable resource op

IRI	http://w3id.org/CEON/ontology/value/hasValuableResource
Sub Property Of	topObjectProperty op
Domain	ValueParticipation c
Range	http://w3id.org/CEON/ontology/resourceODP/Resource c

has value participant role op

IRI	http://w3id.org/CEON/ontology/value/hasValueParticipantRole
Sub Property Of	actorODP:participantRole
Domain	ValueParticipation c
Range	ValueParticipationRole c

on value participation op

IRI	http://w3id.org/CEON/ontology/value/onValueParticipation
Domain	ValuePerception c
Range	ValueParticipation c

proposed by op

IRI	http://w3id.org/CEON/ontology/value/proposedBy
Domain	ValueProposition c
Range	actorODP:Actor

targetting actor op

IRI	http://w3id.org/CEON/ontology/value/targettingActor
Sub Property Of	hasVPTargets op
Domain	ValueProposition c
Range	actorODP:Actor

targetting resource [op]

IRI	`http://w3id.org/CEON/ontology/value/targettingResource`
Sub Property Of	hasVPTargets [op]
Domain	ValueProposition [c]
Range	http://w3id.org/CEON/ontology/resourceODP/Resource [c]

targetting value participation [op]

IRI	`http://w3id.org/CEON/ontology/value/targettingValueParticipation`
Sub Property Of	hasVPTargets [op]
Domain	ValueProposition [c]
Range	ValueParticipation [c]

Namespaces

:

`http://w3id.org/CEON/ontology/value/`

actorODP

`http://w3id.org/CEON/ontology/actorODP/`

dcterms

`http://purl.org/dc/terms/`

odp

`http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#`

owl

`http://www.w3.org/2002/07/owl#`

prov

`http://www.w3.org/ns/prov#`

rdf

`http://www.w3.org/1999/02/22-rdf-syntax-ns#`

rdfs

`http://www.w3.org/2000/01/rdf-schema#`

vann

`http://purl.org/vocab/vann/`

xsd

`http://www.w3.org/2001/XMLSchema#`

Legend

c	Classes
op	Object Properties

Circular Economy Ontology Network (CEON) - Statement Module

Metadata

IRI

http://w3id.org/CEON/ontology/statement/

Title

Circular Economy Ontology Network (CEON) - Statement Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-03-23

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/statement/0.2/

Version Info

0.2

Prior Version

0.1

Preferred Namespace Prefix

ceon-statement

Preferred Namespace Uri

http://w3id.org/CEON/ontology/statement/

Description

A module to represent statements of CEON resources.

Classes

Quantity Interval [c]

IRI `http://w3id.org/CEON/ontology/quantity#QuantityInterval`

In Range Of

hasChemicalSubstanceThresholdUsedByManufacturer [op]
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix [op]
hasMassFractionForDemounting [op]
hasMassFractionForDisassembly [op]
hasMassFractionOfAllDisclosedChemicalSubstance [op]
hasMassFractionOfDismantableComponentsForReuseAndRecycle [op]
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass [op]
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass [op]
hasMassFractionOfProductDesignedForRecyclingToOriginalInput [op]
hasMassFractionOfProductReleasedIntoEnvironment [op]
hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op]
hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op]
hasMassFractionOfReusedPartsOutOfTheTotalProduct [op]
hasPostConsumerRecycledMaterialCompositionThreshold [op]
hasPreConsumerRecycledMaterialCompositionThreshold [op]
hasQuantityInterval [op]
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction [op]
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction [op]

Named Individuals

0ge-0le [ni]
0gt-0.001le [ni]
0gt-0.01le [ni]
0gt-0.1le [ni]
0gt-10le [ni]
0.1ge-0.1le [ni]
1ge [ni]
10gt-25le [ni]
25gt-50le [ni]
50gt-75le [ni]
75gt-95le [ni]
95gt-99le [ni]
99gt-100le [ni]

Availability [c]

IRI `http://w3id.org/CEON/ontology/statement/Availability`

In Range Of

hasAvailability [op]

Named Individuals

public [ni]
secrectAgreement [ni]

Demounting Statement[c]

IRI http://w3id.org/CEON/ontology/statement/DemountingStatement

Sub Class Of PCDSStatement[c]

In Domain Of hasMassFractionForDemounting[op]

Super Class Of MFOfProductDesignedCleanlyRemovedFromFixedAssemblyAvailabilityStatement[c]
MFOfProductDesignedCleanlyRemovedFromFixedAssemblyStatement[c]

Disassembly Statement[c]

IRI http://w3id.org/CEON/ontology/statement/DisassemblyStatement

Sub Class Of PCDSStatement[c]

In Domain Of hasMassFractionForDisassembly[op]

Super Class Of MFOfProductDesignedCleanlyRemovedFromProductAssemblyAvailabilityStatement[c]
MFOfProductDesignedCleanlyRemovedFromProductAssemblyStatement[c]

Disclosed Chemical Subtance Statement[c]

IRI http://w3id.org/CEON/ontology/statement/DisclosedChemicalSubtanceStatement

Sub Class Of ProductCompositionStatement[c]
hasChemicalSubstanceThresholdUsedByManufacturer[op] value 0gt-0.001le[c] *or*
hasChemicalSubstanceThresholdUsedByManufacturer[op] value 1ge[c] *or*
hasChemicalSubstanceThresholdUsedByManufacturer[op] value 0gt-0.1le[c] *or*
hasChemicalSubstanceThresholdUsedByManufacturer[op] value 0gt-0.01le[c]

Dismantling Statement[c]

IRI http://w3id.org/CEON/ontology/statement/DismantlingStatement

Sub Class Of PCDSStatement[c]

In Domain Of hasMassFractionOfDismantableComponentsForReuseAndRecycle[op]

Super Class Of MFOfDismantlableComponentForReuseRecycledAvailabilityStatement[c]
MFOfDismantlableComponentForReuseRecycledStatement[c]

Fraction Of Renewable Energy Availability Statement[c]

IRI http://w3id.org/CEON/ontology/statement/FractionOfRenewableEnergyAvailabilityStatement

Sub Class Of RenewableEnergyStatement[c]

Fraction Of Renewable Energy Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/FractionOfRenewableEnergyStatement`

Sub Class Of

RenewableEnergyStatement[c]
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 50gt-75le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 75gt-95le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 25gt-50le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 99gt-100le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 0ge-0le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 10gt-25le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 0gt-10le[c] *or*
hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix[op] value 95gt-99le[c]

Hazardous Substance Declaration Availabiltity Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/HazardousSubstanceDeclarationAvailabiltityStatement`

Sub Class Of ProductCompositionStatement[c]

Hazardous Substance Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/HazardousSubstancesStatement`

Sub Class Of ProductCompositionStatement[c]

Mf Of Dismantlable Component For Reuse Recycled Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfDismantlableComponentForReuseRecycledAvailabilityStatement`

Sub Class Of DismantlingStatement[c]

Mf Of Dismantlable Component For Reuse Recycled Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfDismantlableComponentForReuseRecycledStatement`

Sub Class Of

DismantlingStatement[c]
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 25gt-50le[c] *or*
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 0ge-0le[c] *or* hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 99gt-100le[c] *or*
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 75gt-95le[c] *or*
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 10gt-25le[c] *or*
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 95gt-99le[c] *or*
hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 0gt-10le[c] *or* hasMassFractionOfDismantableComponentsForReuseAndRecycle[op] value 50gt-75le[c]

Mf Of Post Consumer Recycled Material Content Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfPostConsumerRecycledMaterialContentAvailabilityStatement`

Sub Class Of RecycledMaterialStatement[c]

Mf Of Post Consumer Recycled Material Content Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfPostConsumerRecycledMaterialContentStatement`

Sub Class Of

RecycledMaterialStatement[c]
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 95gt-99le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 50gt-75le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 10gt-25le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 75gt-95le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 0ge-0le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 99gt-100le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 25gt-50le[c] *or*
hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 0gt-10le[c]

Mf Of Pre Consumer Recycled Material Content Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfPreConsumerRecycledMaterialContentAvailabilityStatement`

Sub Class Of RecycledMaterialStatement[c]

Mf Of Pre Consumer Recycled Material Content Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfPreConsumerRecycledMaterialContentStatement`

Sub Class Of

RecycledMaterialStatement[c]
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 25gt-50le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 50gt-75le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 75gt-95le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 95gt-99le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 0gt-10le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 0ge-0le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 99gt-100le[c] *or*
hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass[op] value 10gt-25le[c]

Mf Of Product Designed Cleanly Removed From Fixed Assembly Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductDesignedCleanlyRemovedFromFixedAssemblyAvailabilityStatement`

Sub Class Of

DemountingStatement[c]

Mf Of Product Designed Cleanly Removed From Fixed Assembly Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductDesignedCleanlyRemovedFromFixedAssemblyStatement`

Sub Class Of

DemountingStatement[c]
hasMassFractionForDemounting[op] value 99gt-100le[c] *or*
hasMassFractionForDemounting[op] value 0ge-0le[c] *or*
hasMassFractionForDemounting[op] value 50gt-75le[c] *or*
hasMassFractionForDemounting[op] value 0gt-10le[c] *or*
hasMassFractionForDemounting[op] value 95gt-99le[c] *or*
hasMassFractionForDemounting[op] value 75gt-95le[c] *or*
hasMassFractionForDemounting[op] value 25gt-50le[c] *or*
hasMassFractionForDemounting[op] value 10gt-25le[c]

Mf Of Product Designed Cleanly Removed From Product Assembly Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductDesignedCleanlyRemovedFromProductAssemblyAvailabilityStatement`

Sub Class Of

DisassemblyStatement[c]

Mf Of Product Designed Cleanly Removed From Product Assembly Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductDesignedCleanlyRemovedFromProductAssemblyStatement`

Sub Class Of

DisassemblyStatement[c]
hasMassFractionForDisassembly[op] value 95gt-99le[c] *or*
hasMassFractionForDisassembly[op] value 10gt-25le[c] *or*
hasMassFractionForDisassembly[op] value 25gt-50le[c] *or*
hasMassFractionForDisassembly[op] value 75gt-95le[c] *or*
hasMassFractionForDisassembly[op] value 50gt-75le[c] *or*
hasMassFractionForDisassembly[op] value 0gt-10le[c] *or*
hasMassFractionForDisassembly[op] value 99gt-100le[c] *or*
hasMassFractionForDisassembly[op] value 0ge-0le[c]

Mf Of Product Recycling At Similar Level Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductRecyclingAtSimilarLevelAvailabilityStatement`

Sub Class Of

RecyclingStatement[c]

Mf Of Product Recycling At Similar Level Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductRecyclingAtSimilarLevelStatement`

Sub Class Of

RecyclingStatement[c]
hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 50gt-75le[c] *or* hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 99gt-100le[c] *or*
hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 75gt-95le[c] *or* hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 95gt-99le[c] *or*
hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 25gt-50le[c] *or* hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 0ge-0le[c] *or*
hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 10gt-25le[c] *or* hasMassFractionOfProductDesignedForRecyclingToOriginalInput[op] value 0gt-10le[c]

Mf Of Product Released To Environment Availablity Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductReleasedToEnvironmentAvailablityStatement`

Sub Class Of

ReleasedIntoEnvironmentStatement[c]

Mf Of Product Released To Environment Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfProductReleasedToEnvironmentStatement`

Sub Class Of

ReleasedIntoEnvironmentStatement [c]
hasMassFractionOfProductReleasedIntoEnvironment [op] value 10gt-25le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 25gt-50le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 95gt-99le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 0ge-0le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 0gt-10le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 50gt-75le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 99gt-100le [c] *or*
hasMassFractionOfProductReleasedIntoEnvironment [op] value 75gt-95le [c]

Mf Of Recycled Material Content Availability Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfRecycledMaterialContentAvailabilityStatement`

Sub Class Of RecycledMaterialStatement [c]

Mf Of Renewable Material Availability Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfRenewableMaterialAvailabilityStatement`

Sub Class Of SustainablyProducedRenewableMaterialStatement [c]

Mf Of Reused Part Availability Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MFOfReusedPartAvailabilityStatement`

Sub Class Of ReusedContentStatement [c]

Mass Fraction Of Disclosed Chemical Substance Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MassFractionOfDisclosedChemicalSubstanceStatement`

Sub Class Of

ProductCompositionStatement [c]
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 0gt-10le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 10gt-25le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 75gt-95le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 95gt-99le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 50gt-75le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 0ge-0le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 25gt-50le [c] *or*
hasMassFractionOfAllDisclosedChemicalSubstance [op] value 99gt-100le [c]

Mass Fraction Of Recycled Material Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MassFractionOfRecycledMaterialStatement`

Sub Class Of

RecycledMaterialStatement [c]
hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 50gt-75le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 25gt-50le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 99gt-100le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 95gt-99le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 0ge-0le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 75gt-95le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 0gt-10le [c] *or* hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] value 10gt-25le [c]

Mass Fraction Of Renewable Material Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MassFractionOfRenewableMaterialStatement`

Sub Class Of

SustainablyProducedRenewableMaterialStatement [c]
hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 75gt-95le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 25gt-50le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 95gt-99le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 0ge-0le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 10gt-25le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 99gt-100le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 50gt-75le [c] *or* hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op] value 0gt-10le [c]

Mass Fraction Of Reused Part Statement [c]

IRI `http://w3id.org/CEON/ontology/statement/MassFractionOfReusedPartStatement`

Sub Class Of

ReusedContentStatement [c]
hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 0gt-10le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 75gt-95le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 25gt-50le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 10gt-25le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 95gt-99le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 99gt-100le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 0ge-0le [c] *or* hasMassFractionOfReusedPartsOutOfTheTotalProduct [op] value 50gt-75le [c]

Pc Availability Statement [C]

IRI http://w3id.org/CEON/ontology/statement/PCAvailabilityStatement

Sub Class Of ProductCompositionStatement [C]

Pcds Statement [C]

IRI http://w3id.org/CEON/ontology/statement/PCDSStatement

Sub Class Of Statement [C]

Super Class Of
DemountingStatement [C]
DisassemblyStatement [C]
DismantlingStatement [C]
ProductCompositionStatement [C]
RecycledMaterialStatement [C]
RecyclingStatement [C]
ReleasedIntoEnvironmentStatement [C]
RenewableEnergyStatement [C]
ReusedContentStatement [C]
SustainablyProducedRenewableMaterialStatement [C]
WaterReuseOrRecirculationStatement [C]

Post Consumer Recycled Material Composition Availability Statement [C]

IRI http://w3id.org/CEON/ontology/statement/PostConsumerRecycledMaterialCompositionAvailabilityStatement

Sub Class Of RecycledMaterialStatement [C]

Post Consumer Recycled Material Composition Statement [C]

IRI http://w3id.org/CEON/ontology/statement/PostConsumerRecycledMaterialCompositionStatement

Sub Class Of RecycledMaterialStatement [C]

Restriction hasPostConsumerRecycledMaterialCompositionThreshold [OP] value PostConsumerRecycledMaterialCompositionStatement [C]

Pre Consumer Recycled Material Composition Availability Statement [C]

IRI http://w3id.org/CEON/ontology/statement/PreConsumerRecycledMaterialCompositionAvailabilityStatement

Sub Class Of RecycledMaterialStatement [C]

Pre Consumer Recycled Material Composition Statement [C]

IRI	http://w3id.org/CEON/ontology/statement/PreConsumerRecycledMaterialCompositionStatement
Sub Class Of	RecycledMaterialStatement [C]
Restriction	hasPreConsumerRecycledMaterialCompositionThreshold [OP] value PreConsumerRecycledMaterialCompositionStatement [C]

Product Composition Certification Statement [C]

IRI	http://w3id.org/CEON/ontology/statement/ProductCompositionCertificationStatement
Sub Class Of	ProductCompositionStatement [C]

Product Composition Statement [C]

IRI	http://w3id.org/CEON/ontology/statement/ProductCompositionStatement
Sub Class Of	PCDSStatement [C]
In Domain Of	hasChemicalSubstanceThresholdUsedByManufacturer [OP] hasMassFractionOfAllDisclosedChemicalSubstance [OP]
Super Class Of	DisclosedChemicalSubtanceStatement [C] HazardousSubstanceDeclarationAvailabiltityStatement [C] HazardousSubstanceStatement [C] MassFractionOfDisclosedChemicalSubstanceStatement [C] PCAvailabilityStatement [C] ProductCompositionCertificationStatement [C] ProductCompositionValidationStatement [C]

Product Composition Validation Statement [C]

IRI	http://w3id.org/CEON/ontology/statement/ProductCompositionValidationStatement
Sub Class Of	ProductCompositionStatement [C]

Recycled Material Statement [c]

IRI	http://w3id.org/CEON/ontology/statement/RecycledMaterialStatement
Sub Class Of	PCDSStatement [c]
In Domain Of	hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass [op] hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass [op] hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op] hasPostConsumerRecycledMaterialCompositionThreshold [op] hasPreConsumerRecycledMaterialCompositionThreshold [op]
Super Class Of	MFOfPostConsumerRecycledMaterialContentAvailabilityStatement [c] MFOfPostConsumerRecycledMaterialContentStatement [c] MFOfPreConsumerRecycledMaterialContentAvailabilityStatement [c] MFOfPreConsumerRecycledMaterialContentStatement [c] MFOfRecycledMaterialContentAvailabilityStatement [c] MassFractionOfRecycledMaterialStatement [c] PostConsumerRecycledMaterialCompositionAvailabilityStatement [c] PostConsumerRecycledMaterialCompositionStatement [c] PreConsumerRecycledMaterialCompositionAvailabilityStatement [c] PreConsumerRecycledMaterialCompositionStatement [c]

Recycling Statement [c]

IRI	http://w3id.org/CEON/ontology/statement/RecyclingStatement
Sub Class Of	PCDSStatement [c]
In Domain Of	hasMassFractionOfProductDesignedForRecyclingToOriginalInput [op]
Super Class Of	MFOfProductRecyclingAtSimilarLevelAvailabilityStatement [c] MFOfProductRecyclingAtSimilarLevelStatement [c]

Released Into Environment Statement [c]

IRI	http://w3id.org/CEON/ontology/statement/ReleasedIntoEnvironmentStatement
Sub Class Of	PCDSStatement [c]
In Domain Of	hasMassFractionOfProductReleasedIntoEnvironment [op]
Super Class Of	MFOfProductReleasedToEnvironmentAvailablityStatement [c] MFOfProductReleasedToEnvironmentStatement [c]

Renewable Energy Statement [c]

IRI http://w3id.org/CEON/ontology/statement/RenewableEnergyStatement

Sub Class Of PCDSStatement [c]

In Domain Of hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix [op]

Super Class Of FractionOfRenewableEnergyAvailabilityStatement [c]
FractionOfRenewableEnergyStatement [c]

Reused Content Statement [c]

IRI http://w3id.org/CEON/ontology/statement/ReusedContentStatement

Sub Class Of PCDSStatement [c]

In Domain Of hasMassFractionOfReusedPartsOutOfTheTotalProduct [op]

Super Class Of MFOfReusedPartAvailabilityStatement [c]
MassFractionOfReusedPartStatement [c]

Statement [c]

IRI http://w3id.org/CEON/ontology/statement/Statement

Sub Class Of Entity [c]

In Domain Of statementAbout [op]
statementValue [dp]

Super Class Of PCDSStatement [c]

Sustainably Produced Renewable Material Statement [c]

IRI http://w3id.org/CEON/ontology/statement/SustainablyProducedRenewableMaterialStatement

Sub Class Of PCDSStatement [c]

In Domain Of hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op]

Super Class Of MFOfRenewableMaterialAvailabilityStatement [c]
MassFractionOfRenewableMaterialStatement [c]

Vf Of Reduction Direct Water Availability Statement [c]

IRI http://w3id.org/CEON/ontology/statement/VFOfReductionDirectWaterAvailabilityStatement

Sub Class Of WaterReuseOrRecirculationStatement [c]

Vf Of Reduction Direct Water Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/VFOfReductionDirectWaterStatement`

Sub Class Of

WaterReuseOrRecirculationStatement[c]
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 50gt-75le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 0ge-0le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 0gt-10le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 75gt-95le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 95gt-99le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 10gt-25le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 99gt-100le[c] *or*
hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction[op] value 25gt-50le[c]

Vf Of Reused Recirculated Water Availability Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/VFOfReusedRecirculatedWaterAvailabilityStatement`

Sub Class Of WaterReuseOrRecirculationStatement[c]

Vf Of Reused Recirculated Water Statement[c]

IRI `http://w3id.org/CEON/ontology/statement/VFOfReusedRecirculatedWaterStatement`

Sub Class Of

WaterReuseOrRecirculationStatement[c]
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 50gt-75le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 0gt-10le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 99gt-100le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 10gt-25le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 75gt-95le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 0ge-0le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 95gt-99le[c] *or*
hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction[op] value 25gt-50le[c]

Validation [c]

IRI	http://w3id.org/CEON/ontology/statement/Validation
In Range Of	hasValidation [op]
Named Individuals	certified [ni] validatedByThirdParty [ni]

Water Reuse Or Recirculation Statement [c]

IRI	http://w3id.org/CEON/ontology/statement/WaterReuseOrRecirculationStatement
Sub Class Of	PCDSStatement [c]
In Domain Of	hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction [op] hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction [op]
Super Class Of	VFOfReductionDirectWaterAvailabilityStatement [c] VFOfReductionDirectWaterStatement [c] VFOfReusedRecirculatedWaterAvailabilityStatement [c] VFOfReusedRecirculatedWaterStatement [c]

Entity [c]

IRI	http://www.w3.org/ns/prov#Entity
Super Class Of	resourceODP:Resource Statement [c]

Role [c]

IRI	http://www.w3.org/ns/prov#Role
Super Class Of	http://w3id.org/CEON/ontology/actorODP/Role

Object Properties

has availability [op]

IRI	http://w3id.org/CEON/ontology/statement/hasAvailability
Range	Availability [c]

has chemical substance threshold used by manufacturer [op]

IRI	http://w3id.org/CEON/ontology/statement/hasChemicalSubstanceThresholdUsedByManufacturer
Sub Property Of	hasQuantityInterval [op]
Domain	ProductCompositionStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has fraction of renewable energy out of the total production energy mix [op]

IRI	http://w3id.org/CEON/ontology/statement/hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix
Sub Property Of	hasQuantityInterval [op]
Domain	RenewableEnergyStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction for demounting [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionForDemounting
Sub Property Of	hasQuantityInterval [op]
Domain	DemountingStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction for disassembly [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionForDisassembly
Sub Property Of	hasQuantityInterval [op]
Domain	DisassemblyStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction of all disclosed chemical substance [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfAllDisclosedChemicalSubstance
Sub Property Of	hasQuantityInterval [op]
Domain	ProductCompositionStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction of dismantable components for reuse and recycle op

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfDismantableComponentsForReuseAndRecycle
Sub Property Of	hasQuantityInterval op
Domain	DismantlingStatement c
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval c

has mass fraction of post consumer recycled materials out of the total product mass op

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass
Sub Property Of	hasQuantityInterval op
Domain	RecycledMaterialStatement c
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval c

has mass fraction of pre consumer recycled materials out of the total product mass op

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass
Sub Property Of	hasQuantityInterval op
Domain	RecycledMaterialStatement c
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval c

has mass fraction of product designed for recycling to original input op

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfProductDesignedForRecyclingToOriginalInput
Sub Property Of	hasQuantityInterval op
Domain	RecyclingStatement c
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval c

has mass fraction of product released into environment op

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfProductReleasedIntoEnvironment
Sub Property Of	hasQuantityInterval op
Domain	ReleasedIntoEnvironmentStatement c
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval c

has mass fraction of recycled materials out of the total product mass [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass
Sub Property Of	hasQuantityInterval [op]
Domain	RecycledMaterialStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction of renewable materials out of the total product mass [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass
Sub Property Of	hasQuantityInterval [op]
Domain	SustainablyProducedRenewableMaterialStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has mass fraction of reused parts out of the total product [op]

IRI	http://w3id.org/CEON/ontology/statement/hasMassFractionOfReusedPartsOutOfTheTotalProduct
Sub Property Of	hasQuantityInterval [op]
Domain	ReusedContentStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has post consumer recycled material composition threshold [op]

IRI	http://w3id.org/CEON/ontology/statement/hasPostConsumerRecycledMaterialCompositionThreshold
Sub Property Of	hasQuantityInterval [op]
Domain	RecycledMaterialStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has pre consumer recycled material composition threshold [op]

IRI	http://w3id.org/CEON/ontology/statement/hasPreConsumerRecycledMaterialCompositionThreshold
Sub Property Of	hasQuantityInterval [op]
Domain	RecycledMaterialStatement [c]
Range	http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has quantity interval [op]

IRI `http://w3id.org/CEON/ontology/statement/hasQuantityInterval`

Super Property Of

- hasChemicalSubstanceThresholdUsedByManufacturer [op]
- hasFractionOfRenewableEnergyOutOfTheTotalProductionEnergyMix [op]
- hasMassFractionForDemounting [op]
- hasMassFractionForDisassembly [op]
- hasMassFractionOfAllDisclosedChemicalSubstance [op]
- hasMassFractionOfDismantableComponentsForReuseAndRecycle [op]
- hasMassFractionOfPostConsumerRecycledMaterialsOutOfTheTotalProductMass [op]
- hasMassFractionOfPreConsumerRecycledMaterialsOutOfTheTotalProductMass [op]
- hasMassFractionOfProductDesignedForRecyclingToOriginalInput [op]
- hasMassFractionOfProductReleasedIntoEnvironment [op]
- hasMassFractionOfRecycledMaterialsOutOfTheTotalProductMass [op]
- hasMassFractionOfRenewableMaterialsOutOfTheTotalProductMass [op]
- hasMassFractionOfReusedPartsOutOfTheTotalProduct [op]
- hasPostConsumerRecycledMaterialCompositionThreshold [op]
- hasPreConsumerRecycledMaterialCompositionThreshold [op]
- hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction [op]
- hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction [op]

Range http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has validation [op]

IRI `http://w3id.org/CEON/ontology/statement/hasValidation`

Range Validation [c]

has volume fraction of reduction of direct water consumption used in production [op]

IRI `http://w3id.org/CEON/ontology/statement/hasVolumeFractionOfReductionOfDirectWaterConsumptionUsedInProduction`

Sub Property Of hasQuantityInterval [op]

Domain WaterReuseOrRecirculationStatement [c]

Range http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

has volume fraction of reused or recirculated water used in production [op]

IRI `http://w3id.org/CEON/ontology/statement/hasVolumeFractionOfReusedOrRecirculatedWaterUsedInProduction`

Sub Property Of hasQuantityInterval [op]

Domain WaterReuseOrRecirculationStatement [c]

Range http://w3id.org/CEON/ontology/quantity#QuantityInterval [c]

statement about [op]

IRI	`http://w3id.org/CEON/ontology/statement/statementAbout`
Domain	Statement [c]

Datatype Properties

available end date [dp]

IRI	`http://w3id.org/CEON/ontology/statement/availableEndDate`
Range	xsd:date

available start date [dp]

IRI	`http://w3id.org/CEON/ontology/statement/availableStartDate`
Range	xsd:date

is pcds statement true [dp]

IRI	`http://w3id.org/CEON/ontology/statement/isPCDSStatementTrue`
Range	xsd:boolean

statement value [dp]

IRI	`http://w3id.org/CEON/ontology/statement/statementValue`
Domain	Statement [c]

Annotation Properties

issued [ap]

IRI	`http://purl.org/dc/terms/issued`

publisher [ap]

IRI	`http://purl.org/dc/terms/publisher`

has unit [ap]

IRI	`http://qudt.org/schema/qudt/hasUnit`

numeric value [ap]

IRI http://qudt.org/schema/qudt/numericValue

has maximal value included of interval [ap]

IRI http://w3id.org/CEON/ontology/quantity#hasMaximalValueIncludedOfInterval

has minimal value included of interval [ap]

IRI http://w3id.org/CEON/ontology/quantity#hasMinimalValueIncludedOfInterval

has minimal value not included of interval [ap]

IRI http://w3id.org/CEON/ontology/quantity#hasMinimalValueNotIncludedOfInterval

Pcd Smapping [ap]

IRI http://w3id.org/CEON/ontology/statement/PCDSmapping

Namespaces

:

http://w3id.org/CEON/ontology/statement/

dcterms

http://purl.org/dc/terms/

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

resourceODP

http://w3id.org/CEON/ontology/resourceODP/

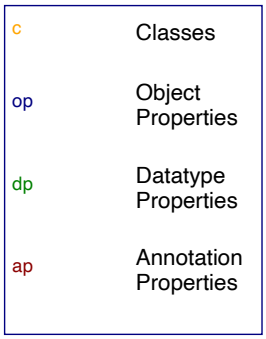
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties

Circular Economy Ontology Network (CEON) - Quantity Module

Metadata

IRI

http://w3id.org/CEON/ontology/quantity/

Title

Circular Economy Ontology Network (CEON) - Quantity Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2024-12-31

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/quantity/0.2/

Version Info

0.2

Prior Version

0.1

Preferred Namespace Prefix

ceon-quantity

Preferred Namespace Uri

http://w3id.org/CEON/ontology/quantity/

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: C3-2, C13-1, C13-4, E3-1, E4-11, T6-1, T10-1.

Classes

Quantity Interval [c]

IRI http://w3id.org/CEON/ontology/quantity/QuantityInterval

In Domain Of

hasMaximalValueIncludedOfInterval [op]
hasMaximalValueNotIncludedOfInterval [op]
hasMinimalValueIncludedOfInterval [op]
hasMinimalValueNotIncludedOfInterval [op]

Object Properties

has dimension [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasDimension
Sub Property Of	qudt:quantityValue
Super Property Of	• hasHeight [op] • hasLength [op] • hasThickness [op] • hasWidth [op]

has dismantling cost [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasDismantlingCost
Sub Property Of	hasProcessCost [op]

has height [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasHeight
Sub Property Of	hasDimension [op]

has length [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasLength
Sub Property Of	hasDimension [op]

has market value [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasMarketValue
Sub Property Of	qudt:quantityValue

has maximal value included of interval [op]

IRI	http://w3id.org/CEON/ontology/quantity/hasMaximalValueIncludedOfInterval
Sub Property Of	qudt:quantityValue
Domain	QuantityInterval [c]
Range	qudt:QuantityValue

has maximal value not included of interval op

IRI	http://w3id.org/CEON/ontology/quantity/hasMaximalValueNotIncludedOfInterval
Sub Property Of	qudt:quantityValue
Domain	QuantityInterval c
Range	qudt:QuantityValue

has minimal value included of interval op

IRI	http://w3id.org/CEON/ontology/quantity/hasMinimalValueIncludedOfInterval
Sub Property Of	qudt:quantityValue
Domain	QuantityInterval c
Range	qudt:QuantityValue

has minimal value not included of interval op

IRI	http://w3id.org/CEON/ontology/quantity/hasMinimalValueNotIncludedOfInterval
Sub Property Of	qudt:quantityValue
Domain	QuantityInterval c
Range	qudt:QuantityValue

has price op

IRI	http://w3id.org/CEON/ontology/quantity/hasPrice
Sub Property Of	qudt:quantityValue

has process cost op

IRI	http://w3id.org/CEON/ontology/quantity/hasProcessCost
Sub Property Of	qudt:quantityValue
Super Property Of	• hasDismantlingCost op • hasRecyclingCost op • hasRefurbishmentCost op • hasTestingCost op • hasTransportCost op

has recycling cost op

IRI	http://w3id.org/CEON/ontology/quantity/hasRecyclingCost
Sub Property Of	hasProcessCost op

has refurbishment cost op

IRI http://w3id.org/CEON/ontology/quantity/hasRefurbishmentCost

Sub Property Of hasProcessCost op

has testing cost op

IRI http://w3id.org/CEON/ontology/quantity/hasTestingCost

Sub Property Of hasProcessCost op

has thickness op

IRI http://w3id.org/CEON/ontology/quantity/hasThickness

Sub Property Of hasDimension op

has transport cost op

IRI http://w3id.org/CEON/ontology/quantity/hasTransportCost

Sub Property Of hasProcessCost op

has volume op

IRI http://w3id.org/CEON/ontology/quantity/hasVolume

Sub Property Of qudt:quantityValue

has weight op

IRI http://w3id.org/CEON/ontology/quantity/hasWeight

Sub Property Of qudt:quantityValue

has width op

IRI http://w3id.org/CEON/ontology/quantity/hasWidth

Sub Property Of hasDimension op

object value op

IRI http://w3id.org/CEON/ontology/quantity/objectValue

Sub Property Of qudt:hasQuantityKind

Datatype Properties

numerical max value dp

IRI	http://w3id.org/CEON/ontology/quantity/numericalMaxValue
Range	xsd:double

numerical min value dp

IRI	http://w3id.org/CEON/ontology/quantity/numericalMinValue
Sub Property Of	topDataProperty dp
Range	xsd:double

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

issued ap

IRI	http://purl.org/dc/terms/issued

publisher ap

IRI	http://purl.org/dc/terms/publisher

covers requirements ap

IRI	http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:

http://w3id.org/CEON/ontology/quantity/

dcterms

http://purl.org/dc/terms/

owl

http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

qudt

http://qudt.org/schema/qudt/

qudt-unit

http://qudt.org/vocab/unit/

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

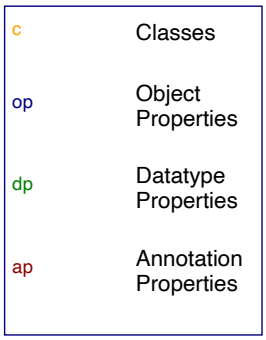
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Location Module

Metadata

IRI

http://w3id.org/CEON/ontology/location/

Title

Circular Economy Ontology Network (CEON) - Location Module

Publisher

Onto-DESIDE

Creator

Huanyu Li

Contributor

Eva Blomqvist

Date Created

2025-03-19

Date Issued

2025-06-30

License

https://creativecommons.org/licenses/by/4.0/

Version Iri

http://w3id.org/CEON/ontology/location/0.2/

Version Info

0.2

Prior Version

0.1

Preferred Namespace Prefix

ceon-location

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/location/

Description

A module the CEON ontology network, defining aspects of the location concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE3-3, C3-2, C13-4, E2-12.

Classes

Location [C]

IRI	http://w3id.org/CEON/ontology/location/Location
Sub Class Of	Geometry [C]
In Range Of	hasLocation [OP]

Geometry [c]

IRI	http://www.opengis.net/ont/geosparql#Geometry
Description	A coherent set of direct positions in space. The positions are held within a Spatial Reference System (SRS).
In Domain Of	as GML [dp] as GeoJSON [dp] as WKT [dp]
Super Class Of	Location [c]

Object Properties

has location [op]

IRI	http://w3id.org/CEON/ontology/location/hasLocation
Range	Location [c]

Datatype Properties

has city [dp]

IRI	http://w3id.org/CEON/ontology/location/hasCity
Range	xsd:string

has country [dp]

IRI	http://w3id.org/CEON/ontology/location/hasCountry
Range	xsd:string

has country code [dp]

IRI	http://w3id.org/CEON/ontology/location/hasCountryCode
Range	xsd:string

has global location number [dp]

IRI	http://w3id.org/CEON/ontology/location/hasGlobalLocationNumber
Range	xsd:string

has postal code dp

IRI	http://w3id.org/CEON/ontology/location/hasPostalCode
Range	xsd:string

has street address dp

IRI	http://w3id.org/CEON/ontology/location/hasStreetAddress
Range	xsd:string

as GML dp

IRI	http://www.opengis.net/ont/geosparql#asGML
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The GML serialization of a Geometry.
Domain	Geometry c
Range	geo:gmlLiteral

as GeoJSON dp

IRI	http://www.opengis.net/ont/geosparql#asGeoJSON
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The GeoJSON serialization of a Geometry.
Domain	Geometry c
Range	geo:geoJSONLiteral

as WKT dp

IRI	http://www.opengis.net/ont/geosparql#asWKT
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The WKT serialization of a Geometry.
Domain	Geometry c
Range	geo:wktLiteral

lat dp

IRI	http://www.w3.org/2003/01/geo/wgs84_pos#lat

long dp

IRI http://www.w3.org/2003/01/geo/wgs84_pos#long

Annotation Properties

contributor ap

IRI http://purl.org/dc/terms/contributor

created ap

IRI http://purl.org/dc/terms/created

creator ap

IRI http://purl.org/dc/terms/creator

description ap

IRI http://purl.org/dc/terms/description

issued ap

IRI http://purl.org/dc/terms/issued

license ap

IRI http://purl.org/dc/terms/license

publisher ap

IRI http://purl.org/dc/terms/publisher

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri [ap]

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements [ap]

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

definition [ap]

IRI http://www.w3.org/2004/02/skos/core#definition

pref label [ap]

IRI http://www.w3.org/2004/02/skos/core#prefLabel

Namespaces

:
http://w3id.org/CEON/ontology/location/

dcterms
http://purl.org/dc/terms/

geo
http://www.opengis.net/ont/geosparql#

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

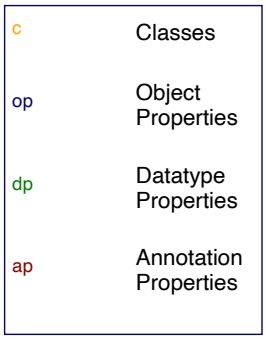
rdfs
http://www.w3.org/2000/01/rdf-schema#

skos
http://www.w3.org/2004/02/skos/core#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties