



Increased availability of machine-readable EPDs in the ILCD+EPD+ format

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PROGRAM

Preface

The Smart Built Environment (SBE) is a strategic innovation program for how the built environment focus sector can contribute to Sweden's journey towards becoming a globally pioneering country that realizes the new opportunities that digitalisation will bring. Smart Built Environment is one of 16 strategic innovation programmes that have received support within the framework of strategic innovation areas, a joint venture between Vinnova, the Swedish Energy Agency and Formas. The aim of the initiative is to create conditions for Sweden's international competitiveness and contribute to sustainable solutions to global societal challenges.

SBE Lifecycle Perspective is one of the focus areas of the program. It has been led by Kajsa Byfors (project coordinator) and Jeanette Sveder Lundin and Martin Erlandsson (sub leaders).

The goal of the focus area lifecycle perspective is to integrate life cycle cost (LCC) and life cycle assessment (LCA) into community-building information structures and processes, in order to achieve greater efficiency throughout the life cycle and thus a more sustainable built environment. In order to achieve sustainable community building, it is necessary to consider a lifecycle perspective in terms of planning, design, construction and use of our built environment. The vision is that the integration of life cycle costs (LCC) and Life Cycle Assessments (LCA) into the sector's information structures and processes is an important part of achieving the environmental objectives that we have before us.

In the focus area we coordinate and catalyse ongoing good initiatives and expertise in the field. This way, we can use the expertise that already exists in the sector to ensure that we have a clear system of lifecycle perspectives. We will create national applications based on international standards and analyse how digitalisation and object-based information management from other program activities can support the lifecycle perspective, at all stages of the community building processes.

The work includes analyses of different scenarios for material selection and management in planning, design and construction as well as for operation, maintenance and use. It also includes procurement perspectives and how life-cycle issues are driving forces in the early stages.

This report has been conducted in collaboration with the project 'Digital environmental calculations - complement and elaboration' (in Swedish *Digitala miljöberäkningar- komplement och fördjupning*, Diary No 2018-00346) and 'Web service for quality documented EPD and open resource register' (Webtjänst för kvalitetsdokumenterade EPD och öppet resursregister) Diary No 2018-02642.

Stockholm, 23 September 2019

Summary

This report presents the results as part of the project 'Digital environmental calculations – complements and elaboration'. The work focuses on increasing availability of machine-readable Environmental Product Declarations (EPD) through an open-source software tool, called EPD Editor, by using the ILCD+EPD+ structure.

Machine-readable EPD information is based on EPD information and underlying LCA results. An LCA makes it possible to calculate the environmental impact during the entire life cycle of any construction product or works. EPDs are used to communicate LCA results in a transparent way using independent verification of the underlying information and common calculation rules.

The aim of providing EPD information in a machine-readable format is to facilitate the seamless flow of information between different actors downstream in the value chain by using a format and structure that enables data exchange through application programming interface (API). The data format (xml) and structure, called ILCD+EPD, is used as EPD exchange format in the project. This current EPD format, called ILCD+EPD, has been extended, called ILCD+EPD+, through work in a previous SBE project to include a possible classification of the quality of the background LCA (Q metadata). This project focussed on the integration of this format and structure into the EPD Editor to facilitate transfer of EPD information in the machine-readable format. The EPD Editor is a free open-source software.

Within this project 17 EPDs were transferred into the machine-readable format with Q metadata using the EPD Editor. In addition, ways to create and export machine-readable EPD files directly from existing commercial LCA software were analysed.

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Introduction

The Project Smart Built Environment (SBE) Lifecycle Perspective develops support, implements and evaluates how a future digital environmental calculation for a construction work can be made as efficiently as possible. The future life cycle assessment (LCA) calculation is assumed to be made as part of information and communication tools already used in the construction or real estate sector that are originally designed for other purposes, as an additional environmental performance-based information feature. An LCA makes it possible to calculate the environmental impact during the entire life cycle of any construction product or works. An Environmental Product Declaration (EPD) includes third party verified LCA results and additional environmental information for all kind of construction products and is used as source data for construction works LCA calculations.

As the users of these tools are not expected to be experts in EPD/LCA, there may be a need for additional information in the form of a quality assessment of the LCA data, referred to as Q metadata (Erlandsson 2018), to enable the user to understand the scope and limitations of the reported information and its implications of the use in other applications.

During recent years, efforts were made to make this type of information accessible in a way that can be processed by software programmes. As an example, the International EPD® System launched a data hub¹ in 2018 for so-called machine-readable EPD information. Availability of machine-readable EPD information aims to facilitate the seamless flow of information in the value chain, starting with the collection and calculation of EPD information of a product to the use in different applications. Further actors in the value chain of EPD information are providers and publishers of EPD information, such as EPD programme operators, consumers of the product and construction works in which the product is used.

Machine-readable EPD information is displayed in the digital xml-format following a specific structure that enables data exchange through application programming interface (API). The structure is based on the International Reference Life Cycle Data System (ILCD)², developed by the European Commission Joint Research Centre, which aims to facilitate the

¹ <https://data.environdec.com/>

² <https://eplca.jrc.ec.europa.eu/uploads/JRC-Reference-Report-ILCD-Handbook-Towards-more-sustainable-production-and-consumption-for-a-resource-efficient-Europe.pdf>

exchange of life cycle inventory data between different LCA application tools. Further information fields that are relevant for EPD information and that are not included in the ILCD structure are added as so-called EPD-additions in the ILCD+EPD structure by the InData Working Group³.

Within a previous SBE project, information about the quality assessment of the LCA data, called Q metadata, and a content declaration of the product were added as a further expansion of the ILCD+EPD structure, resulting in the LCD+EPD+ structure.

This report describes the results of work package 2 in the corresponding SBE project, which focuses on increasing availability of machine-readable EPDs through an open-source software tool following the ILCD+EPD+ system. The work package had the goal to transfer at least ten EPDs through an EPD Editor into the machine-readable format and to further explore ways to create and export machine-readable EPD files directly from LCA software. The development and practical implementation in existing and further developed software solutions is described in this report.

1 Format and requirements for LCA information

1.1 The ILCD+EPD+ structure

ILCD is a structure used for transferring life cycle inventory data in Europe based on LCA methodology. Additional information for EPDs based on the core product category rules for EPD for construction products as defined in EN 15804 has been added to a structure called ILCD+EPD by the InData Working Group⁴. The ILCD+EPD structure allows including most of the information given in an EPD, following the required format for reporting an LCA result and LCA information modules. Within a previous SBE project additional information was developed to perform a quality assessment of the LCA, called Q metadata and together with information about the content of the product added to the ILCD+EPD structure.

³ <https://www.indata.network/resources>

⁴ <https://www.indata.network/resources>

The ILCD+EPD+⁵ structure, with an extra “+” at the end, is the result of this addition to the structure. The structure was presented to the InData Working Group in order to receive feedback on the added features of the structure and to lay the foundation for implementation of this structure in the future as an input to future iterations of related software systems and IT infrastructure.

1.2 Q metadata

The addition of Q metadata aims to support the end-user to assess the quality of LCA results in an EPD via different parameters and methodological choices used in the underlying LCA study such as included manufacturing sites, use of system expansion, allocation procedures, and the use of specific and generic data. This is a response to the fact that LCAs may be created based on different interpretations of the standards, different levels of ambition and different representativeness.

Q metadata consists of questions which can be divided into criteria type A and B, the former seeking to unravel how precise and valid the used data is whereas the latter summarizes the methodology and assumptions made in the LCA. Criteria type A has a question/answer approach while type B has a yes/no format with an additional comment section that is mandatory should the answer be yes. The goal is to contribute with information that can be considered when studying LCA results, resulting in an even more accurate and trustworthy comparison between different EPDs while also increasing the transparency of the methodology settings and assumptions made in the LCAs. More information on Q metadata is presented in the report by Erlandsson and others (2018)⁶.

1.3 Content declaration

Substances of very high concern (SVHC), covered by the chemical legislation REACH, in construction product EPDs are mandatory to report on according to EN 15804. Suppliers must therefore mention if any of their products contain more than 0.1% SVHC by weight. In addition to the content covered in the ILCD+EPD structure, the ILCD+EPD+ structure includes the following parts:

- Content declaration for the declared product.

⁵<https://www.ivl.se/download/18.57581b9b167ee95ab9926ba6/1553704338819/C367.pdf>

⁶<https://www.ivl.se/download/18.57581b9b167ee95ab9926ba6/1553704338819/C367.pdf>

- Information on existence of any SVHC substance in a component of the declared product and if so its hazardous class.
- Specification of the SVHC substance by CAS and/or EC number.
- Voluntary information on circularity aspects for the declared product, as for example recycled and/or renewable content of the component/material.

2 Classification and identification systems

2.1 Classification systems

Classifying data means structuring information so that different actors more easily can find and use information that they specifically seek. With building projects becoming more and more complex classification systems play a vital part as they help increase the efficiency and accuracy⁷. Harmonization efforts through standardization exist in the field of classification, however interpretations of the standards differ in different countries.

Within the construction sector, Building Information Modelling (BIM), is a common tool for structuring information⁸. The purpose of BIM is to ensure that information in a construction project is created at the right time and in the right format, thus enabling better decision-making. Linking environmental information, such as LCA and EPD information, to a construction project and the building model is facilitated using a classification system, which simplifies the exchange of parts in the design phase of the building and to find a suitable material or component for the application in the building. Integrating BIM and LCA by using the same classification system aims to facilitate this process. Several applications exist for adapting BIM in different ways, for example bSDD, IFC, CoClass, OmniClass, MasterFormat, UniFormat, CCS, ETIM and TALO 2000.

bSDD

The BuildingSMART Data Dictionary is a shared, open and international library of objects and their attributes utilizing ISO 12006-3 terminology for the construction and building industry⁹. The tool enables sharing and exchanging product information through modelling of objects and validation of data in order to streamline mapping between different users, manufacturers and applications.

IFC

Industry Foundation Class, IFC, is a data model which describes building and construction industry data¹⁰. It is a neutral, non-proprietary platform

⁷ https://www.smartbuilt.se/library/3407/framtidens-smarta-digitala-miljoeberaekning_webb.pdf

⁸ <https://www.bimalliance.se/vad-aer-bim/>

⁹ <http://bsdd.buildingsmart.org/>

¹⁰ <http://bsdd.buildingsmart.org/>

with an object-based file format, developed by BuildingSMART and commonly used in BIM based projects. The data model is an official International Standard ISO 16739-1:2018 and well-established around the world. The Danish government has made the IFC format compulsory for building projects within public procurement, the Norwegian government require IFC in all projects and the Finnish state-owned facility management Senate Properties demands IFC compatible software in all their projects.

CoClass

CoClass is a Swedish classification system based on international standards for built environment and contains descriptions of objects, properties and activities for both houses and facilities¹¹. It is based on the standards ISO 12006-2 and ISO/IEC 81346 and provides a common information structure throughout the life cycle of all built environment. CoClass coding has the following hierarchical structure:

- construction complexes,
- functional systems,
- constructive systems,
- components and
- production results.

2.2 Identification systems

Identification systems separate products, facilitating identification of product variations. It is common to provide items, packaging and services with a unique article number, assuring that no two products are the same.

Global Trade Item Numbers, GTIN, is a global identification system where each identification code is 8, 12, 13 or 14 digits long¹². A scan-able barcode containing the information on the GTIN code facilitates sharing of the codes. The product information is stored in a database and can be accessed for business transactions and other purposes such as e-commerce.

GTINs were prior to this year commonly reused when a product expired, however this changed 2018 in order to increase traceability and security of information for end-users. There is ongoing work to integrate GTIN information in EPDs and other environmental product information systems (e.g. BASTA, eBVD).

¹¹ <https://coclass.byggjtjanst.se/login>

¹² <https://www.gs1.se/>

3 Transferring EPD information in the machine-readable format using the EPD Editor

3.1 Background and development of the EPD Editor

The EPD Editor is a stand-alone application and open-source tool for transferring EPD information from a non-machine-readable format into a machine-readable format (xml-file). The tool was initially developed as an extension to the open-source LCA software openLCA and became later a stand-alone application. Already before this project, the application used the structure of the ILCD+EPD system and requires manual input of data for the transfer of non-machine readable to machine-readable EPD information. The transfer takes place via the creation of new items in the application such as the relevant EPD information, sources, flows and contacts. A detailed description of the functioning of the application is available in the EPD Manual¹³. The EPD Editor was further developed within this project to integrate the developments of the ILCD+EPD+ structure, including Q metadata and content declaration through an added input functionality in the application.

When creating a machine-readable EPD, information must be added in six different tabs named Dataset information, Modelling and validation, Administrative information, Environmental indicators, Content declaration and Q metadata. The last two tabs were developed within this project together with Green Delta and have been added as a part of the ILCD+EPD+ expansion.

Datasets created in the EPD Editor can be uploaded to an online data hub via a built-in upload function, such as the data hub¹⁴ hosted by the International EPD[®] System.

3.2 Q metadata

The tab Q metadata contains six different criteria whereas the first four are open-ended questions with different alternatives that questions the

¹³

<https://www.environdec.com/contentassets/e443066ff8b746ba91960401b16229ba/manual-epd-editor-190808.pdf>

¹⁴ <https://data.environdec.com/>

validity of the product itself, the manufacturing site, whether and how much specific data has been used and how the EPD relate to certain certifications.

Figure 1. Q metadata Criteria 1

Criteria five consists of nine sub-questions with a yes/no-alternative, in which a comment must be made if the question is answered with 'yes'. The questions seek to answer more specific information regarding the LCA modelling and calculations that may not be included in all EPD, hence improving the transparency:

- Allocation procedure applied where a by-product is not attributed to any impact?
- Inherent properties are allocated away and do not reflect the physical flows?
- System expansion applied?
- Recycling of technosphere flow is handled with non-symmetry?
- EPD not based on core process data from the actual manufacturing site?
- The inventory for the core process less than a year old?
- Impact on climate change (GWP result) include biogenic carbon dioxide emissions that are not reported separately?
- Not all mandatory environmental indicators are reported?
- Any other assumptions made?

Criteria six gives information on who issued the Q metadata validation.

3.3 Content declaration

The tab Content declaration consists of two charts in which one can add materials, components or substances. Additional information such as weight percentage, absolute mass, CAS number, EC number, data dictionary, renewable resources, recycled content and comments can also be registered.

Content declaration				
Components and materials				
Component/material	Weight percentage	Absolute mass	CAS number	EC number

Figure 2. Content declaration

3.4 Pilot to test functioning of EPD Editor and increase availability of machine-readable EPDs

A test pilot was conducted to analyse the functioning of the EPD Editor with the new functionality. In the pilot at least ten EPDs were to be transferred into a machine-readable format by making use of the EPD Editor. The EPDs for the pilot were selected from different Swedish companies that had published EPDs in PDF format within the International EPD® System.

The EPDs were categorized as construction products but of different subcategories such as steel reinforcements and floor coverings. Multiple xml-files were created when an EPD included several products or product variations, resulting in 56 machine-readable EPDs files for 17 transferred EPDs.

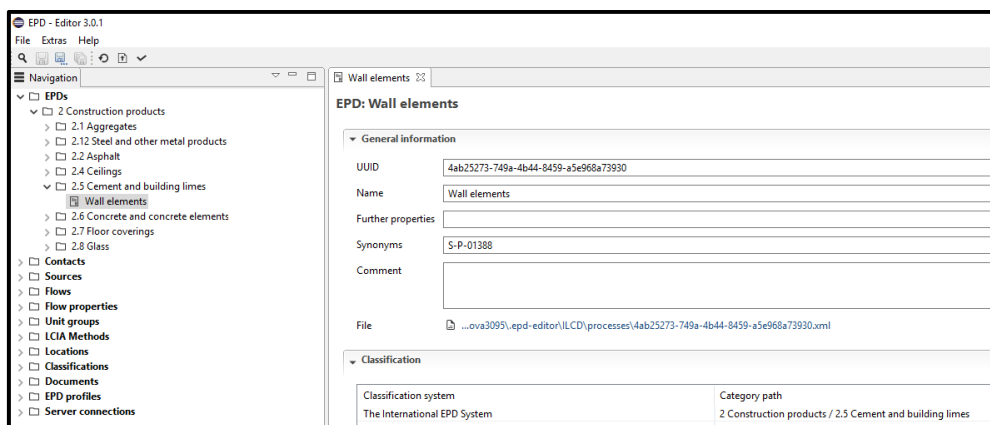


Figure 3. The EPD Editor

Information for the first five tabs in the EPD Editor, including Dataset information, Modelling and validation, Administrative information, Environmental indicators, and Content declaration could be obtained from the EPDs that were published in the pdf format. Not all information for the tab Q metadata was available in the published EPDs as it is not mandatory to report in an EPD. The owners of the EPDs were contacted via e-mail, introduced to the addition of the Q metadata information in

order to be able to obtain the missing information. An Excel template was provided to the EPD owners to facilitate the collection of the sought information on Q metadata.

The provided Q metadata from the companies was transferred to the EPD Editor. However, not all owners responded to the request and did not provide the additional information for the Q metadata. Some EPD owners also perceived difficulties when filling out the requested information for the Q metadata. More guidance was needed to be able to answer questions related to data accuracy and additional documentation specifications, in particular assumptions in the LCA modelling.

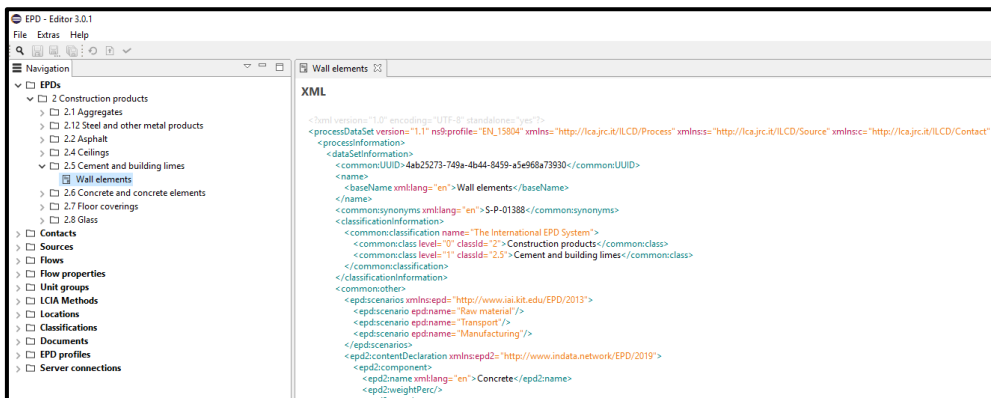


Figure 4. The xml-format

Although a relatively simple process, the manual work took time and could easily be streamlined to lessen future workload. The most time-consuming tasks included transferring data to the tab Environmental indicators and collecting Q metadata from relevant companies. A promising solution to make the transferring of information more efficient is to directly generate this type of information from LCA software, which was investigated within this project and which is described in the following chapter.

4 Using LCA software for the export of machine-readable EPD information

4.1 Current status and development

There are several software programs that facilitate LCA calculations. GaBi from thinkstep and SimaPro from PRé are amongst the more widely used programs but there are also a few other popular ones named OpenLCA, Umberto LCA and One Click LCA. This project analysed how machine-readable EPD information could be created and exported directly from two LCA software programmes: GaBi and SimaPro. These programmes were chosen due to their market share and significance within the field of LCA modelling software. GaBi has been on the market for over 30 years and its database is widely applied in various areas in Europe¹⁵. SimaPro is another well-recognized sustainability software package that was first developed 25 years ago¹⁶.

Export of LCA results in the xml-file format is supported by GaBi and is used for the creation of xml-files for the German database for construction products, called Ökobaudat¹⁷. The export function was tested within this project through a pilot with NCC and is further described in this chapter.

Within this project, possibilities to export of LCA and EPD information in the form of the xml-file format by SimaPro were further investigated. In conversations with representatives from Pré requirements for an export according to the ILCD+EPD system were presented and possible export solutions were discussed. The current development work for SimaPro aims to enable export of machine-readable LCA and EPD information in the second half of 2019. A test pilot is scheduled for the fall 2019.

Whilst the development with the export of machine-readable LCA and EPD information has already delivered promising results for the studied LCA modelling software, the inclusion of other information, such as Q metadata and content declaration of the product is not yet included in the current development efforts.

¹⁵ <https://www.gabi-software.com/sweden/index/>

¹⁶ <https://simapro.com/about/>

¹⁷ <https://www.oekobaudat.de/en.html>

4.2 Export of machine-readable EPD information from GaBi

When operating the software program GaBi, a certain structure for modelling is essential to be able to export the information in the desired machine-readable format. This structure follows the instructions for the export of machine-readable LCA information according to the Ökobaudat structure.¹⁸

A new plan for the LCA modelling in GaBi must be named with the corresponding category number and product name. It is important to note that only one process can be fixed to one module and the modules cannot be exported to any scenarios. Modules exist separately, there is for example no option for aggregating modules, such as A1-A3.

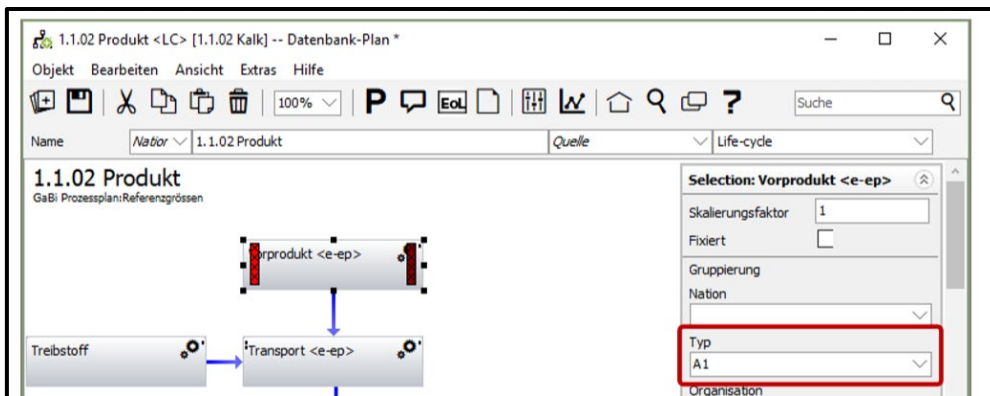


Figure 6. Defining life cycle modules in GaBi

The documentation is added via creating a new process on the same plan that is used for the export. This process must have the same category number and designation as the plan designation. This can be done under the tab “Documentation” where mandatory information can be filled in.

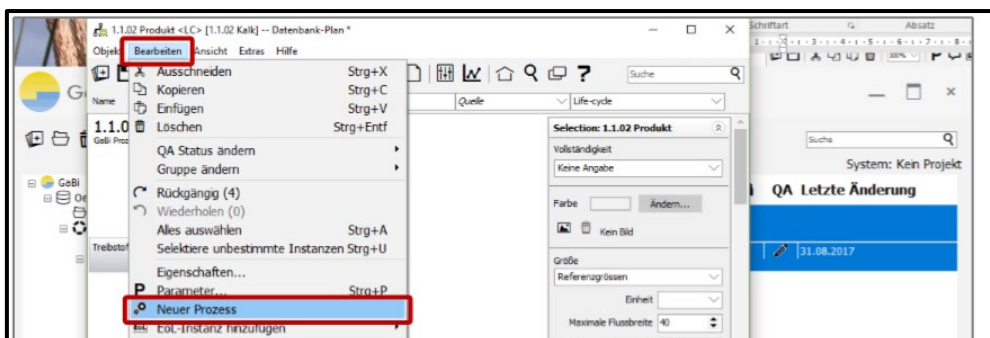


Figure 7. Creating a new process in GaBi

¹⁸https://www.oekobaudat.de/fileadmin/downloads/Einreichung/2017-09-18_Nutzungshinweise_zur_GaBi_OEKOBAUDAT_Exportschnittstelle.pdf

After selecting the reference flow in the documentation tab, the LCA and EPD information can be exported via the Oekobaudat export function.

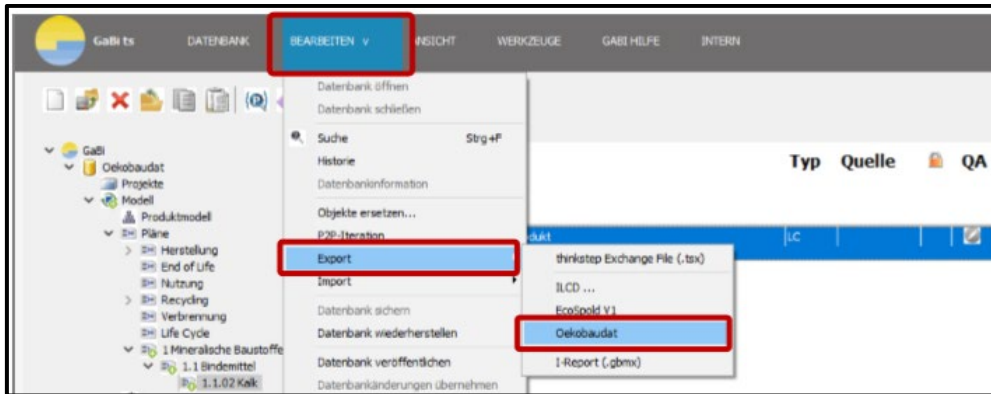


Figure 8. Exporting LCA information in GaBi

4.3 Pilots

To test the functioning of the above described export function, a test pilot for the export of machine-readable LCA and EPD information was conducted together with thinkstep and NCC. The test pilot included several stages, including the automatic import of data into GaBi by using a bill of materials from another software solution, and the export of LCA and EPD information in a machine-readable format. The full description of the test pilot is published in a separate project report¹⁹.

Together with partners of the test pilot, a machine-readable xml-file of the LCA results was created. The file was developed using the export function described above. Not all information required for the ILCD+EPD system could be added through the documentation function in GaBi. The missing information for the dataset could be entered via the EPD Editor tool

A successful test was conducted including the transfer and upload of the dataset via the EPD Editor to the online data hub of the International EPD® System for machine-readable EPD information²⁰.

¹⁹ Strömberg, L., 2019. Testpilot. Standardiserad process för livscykelanalys i BIM i ett NCC:s projekt. SBE rapport.

²⁰ <https://data.environdec.com/showProcess.xhtml?uuid=ceab5e27-6ec8-4f05-8135-9fa369992315&stock=Environdata>

5 Future outlook

Within this project and work package, progress was made to increase the availability of machine-readable EPD information. There is still a considerable potential to further increase this availability. Some programme operators in Europe, including actors in Germany, Norway and Sweden made progress to align their efforts in transferring EPD information to the machine-readable format and to increase the number of EPDs available in this format. The work of the InData working group highly contributed to harmonize these discussions on the format and structure of the information. Further harmonization and contributions from other actors in the field are needed to further facilitate the use of machine-readable EPD information in different applications.

With the development of LCA software solutions on the market, allowing for the integrated export of LCA results and other relevant information in a standardized format and structure, the creation of machine-readable EPD information will be made more time- and cost efficient. It is currently possible to export some information required for the machine-readable EPD through the LCA software GaBi. Further work is done to also allow export of this type of information through the LCA software SimaPro. The more information required for the format and structure that can be integrated in existing software solutions, the more time-efficient and seamless will be the transfer of the information into the machine-readable format.

With the aim to facilitate the seamless flow of information between different actors in the value chain, an increased demand on the user side for this type of information is expected to contribute to a higher availability of machine-readable EPD information. Integration of environmental information in BIM, use of the information in public procurement or building certification schemes are examples of uses that may lead to an increased demand for this type of information.

Within BIM categorization of product information is listed as a crucial aspect for the applicability of the environmental information. Future adaptations seek to integrate a classification system and an identification system to improve the transparency and accuracy while also simplifying the process of exchanging parts in the design part and making it easier to identify product variations in an early stage of the design process for new construction projects. This will likely result in an increased use of environmental information in applications such as BIM.

Recognition of support

Funds have been obtained from the Smart Built Environment Innovation Program, which is a joint venture between Vinnova, the Swedish Energy Agency and Formas, as well as the SBUF (Construction Development Fund).

References

Erlandsson M (2018): Q metadata for EPD. Quality-assured environmental Product declarations (EPD) for healthy competition and increased transparency. Smart Built Environment and IVL Swedish Environmental Research Institute, December 2018.

Erlandsson M, Jönsson J A, Kusche O, Schönberg E, Welling S (2018): Efficient use of digital EPD via ILCD+EPD+. Including format additions suggested by Smart Built Environment (SBE). Smart Built Environment and IVL Swedish Environmental Research Institute, December 2018.



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