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BUILDING COMPONENTS AND BUILDINGS

NativeLCA - a systematic approach for the selection of environmental datasets as generic data: application to construction products in a national context

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Abstract
Purpose The aim of this paper is to propose guidelines for the selection of an accurate life cycle assessment (LCA) dataset of building products to be used as generic data for a national context.
Methods The guidelines are structured within a methodology, called NativeLCA. First, a review of available datasets for construction products is presented such as generic LCA and Environmental Product Declaration (EPD) databases for both national (e.g. France, Germany, Spain etc.) and European context. Secondly, a method is proposed to choose appropriate generic datasets by means of a hybrid methodology. A meta-analysis is conducted in the first step on the sample of collected datasets from the literature. When relevant, product-specific data (EPD of the different producers) are averaged to represent an average data or existing generic data are adapted to be more suitable for the context. Then, a data quality assessment enables to rank the different datasets according to the goal and scope of the study.
Results and discussion This study provides consistent guidelines that can be used by building LCA practitioners to select relevant datasets depending on their goal and scope. A full case study for stone wool boards illustrates and demonstrates the applicability and usefulness of the proposed methodology, namely in the selection of a coherent dataset as generic data for a national context. This work highlights the issues in terms of choice and adaptation of existing data for a national context. Industry data cannot be adapted due to confidentiality issues unlike unit process generic data. The use of data quality indicators then helps to select the relevant generic data for each context according to user needs.
Conclusions While further efforts are needed to develop regional and sector-specific LCA databases adapted for each national context, the proposed guidelines showed that the current use or adaptation of existing data, if consistently done, can lead practitioners to increase the reliability of building LCA studies according to their goal and scope definition.

Keywords Building products · Data quality · EPD · Generic data · LCA

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1 Introduction

Buildings are responsible for various environmental impacts. In OECD countries and in the European Union, they consume about 30 % of total primary energy and account for more than 30 % of the greenhouse gas emissions (EC 2008; UNEP 2007; CIB 1999). Housing in the European Union contributes to 20 to 35 % of the total environmental impact of products, and the construction materials used in residential buildings are responsible for 3 to 4 % (EC 2006). As a result, there is a growing need to assess buildings from an environmental point of view. Over the past few years, the Life Cycle Assessment (LCA) approach appears to be the reference method to assess building's environmental impacts. Different sector-specific LCA tools are already available for building materials, assemblies and full buildings (Ortiz et al. 2009). Recently, the outcomes of the LCA Construction 2012 conference gathering researchers, experts and practitioners of LCA in the construction sector recommend better linking research and operational guidance for some applied works such as the development of national sector-specific databases (Lasvaux et al. 2014a). This topic is particularly important because LCA studies of buildings require a large amount of data on building materials, products and processes. However, from an operational point of view, practitioners and developers of building LCA tools currently face practical issues when selecting data for the assessment of a building. Some LCA data can be provided by the building industry, others by generic databases. Data can also be provided at various levels, e.g. European average, national average from industry data, company specific data or site-specific data. Datasets can be either missing or not fully appropriate to describe the environmental impacts of a construction product sold in a national market. This is likely to occur, for example, when calculating the environmental performance of construction products and buildings following the two CEN/TC 350 standards EN 15804 and EN 15978 (CEN 2012). Such standards (including CEN Technical Report TR 15941 (CEN 2010)) already offer guidelines for the choice of a LCA dataset (from existing ones) to be used in each European national context, but these guidelines are not sufficiently detailed to be helpful in practice. As the use of LCA is growing within the European construction sector due to the development of LCA-based public policies and building labelling schemes, systematic guidance are needed to correctly characterise available LCA datasets.

The objective of this paper is thus to propose guidelines for the selection of a consistent set of generic data to be used in product, building assemblies and building LCA studies for a national context. Guidelines are structured within a methodology, which is called NativeLCA, and its applicability is illustrated for a case study in the European context. This choice is made to be in compliance with available guidance such as the ISO 14040-44 standards (ISO 2006 a, b), ILCD Handbook (EC-JRC 2011), the EN 15804 and EN 15978 standards (CEN 2012) and the operational EeBGuide guidance for building LCA (EeBGuide 2012; Lasvaux et al. 2014b).

This paper comprises five main sections, including the introduction. Section 2 presents a state-of-the-art of previous studies that have been already proposed to adapt existing datasets to be suitable in a different geographical context or to develop new LCA datasets and databases.

Section 3 describes the NativeLCA methodology, and Sect. 4 presents a full case study of its application for an insulation product. Section 5 discusses NativeLCA application for other construction products. Finally, the conclusion summarises the main advantages and other possible applications of this methodology.

2 Review of national and sector-specific LCA databases in development

This section presents existing and works in progress concerning the development of generic LCA data for a regional context. They consist in new LCA studies, adaptation of existing datasets and the selection of existing data through data quality assessment (DQA). A first sub-section defines more specifically the terms generic, average and specific data that are often misused in practice. Then, a review of previous studies is presented in Sects. 2.2 to 2.4.

2.1 Definition of generic, average and specific data

Different wording and practices are found in the literature concerning the definition of LCA data, i.e. generic, average and specific data. Background generic data are used to model upstream and downstream processes that are not under the control of the manufacturer of a building product. In fact, generic datasets can be defined as "a surrogate data used if no system specific data are available" (CEN 2010; EC-JRC 2011) and/or can be developed using at least partly other information than the one measured for the specific process.

On the other hand, an average dataset is a combination of different specific datasets and/or other average data that are aggregated in order to represent a combination of processes, e.g. a product group (EC-JRC 2011). Averaging can be applied to technologies, products, sites, countries and time-scale. EN 15804 and TR 15941 define average (mean values) as "data combined from different manufacturers or production sites for the same declared unit" (CEN 2010; EC-JRC 2011).

Specific foreground data (or primary data) correspond to data collected at the manufacturer's plant (e.g. the electricity consumed in the process, the amount of raw materials, the internal transportation of the product etc.), but that does not represent the impacts of a product sold in a national market by different producers. According to the ILCD Handbook, a specific dataset, *stricto sensu*, is a representation of a single process (e.g. a specific technology operated on a given site) or system (e.g. a specific product model of a single brand) (EC-JRC 2011).

2.2 Development of new LCA data or databases

2.2.1 Determination of new generic LCA data

To determine generic LCA datasets for a national context in the construction sector, the most accurate method is to carry out a new study for each construction material and product (Hodková and Lasvaux 2012). Even though examples exist, e.g. for the Swiss context through the Ecoinvent data or in France, e.g. through a recent study (Gomès et al. 2013), few appropriate generic data for a national context exists. In most of the countries in Europe, few generic datasets and only some site-specific LCA data are available. Another option is to determine default values for building products in partnership with the relevant stakeholders (e.g. industries, government and LCA experts). This approach requires that all construction stakeholders of a country agree on LCA results for default compositions of building assemblies (Peuportier et al. 2011) but would hide differences between similar buildings environmental performances. This may not be a feasible approach to provide generic data in a short term.

2.2.2 Development of LCA databases in the European context

A detailed review of available European and national LCA datasets is presented in the Electronic supplementary material: "Review of available LCA data and databases for the European context". The review, collection and characterisation of available LCA datasets of construction materials and products is essential to allow the selection of the most adequate to each construction material and product and each national context.

2.3 Adaptation of existing LCA data

When existing data are in the form of unit processes, the first parameters and processes to modify is the electrical grid mixes as shown in the adaptation of the Ecoinvent database for US conditions (EarthShift 2012). However, requirements for data adaptations come from goal definition. According to Baitz et al. (2012), in practical applications, realistic contextualisation probably always calls for more than just a switch of the energy mixes. In addition, high expertise is needed to prevent from wrong contextualisation. Some previous adaptations of LCA data were found in a thorough search of reference literature (de Eicker et al. 2010a; de Eicker et al. 2010b).

A contextualisation of the Ecoinvent generic database is currently being made in Quebec (Canada) as the geographical representativeness of the original database (see Sect. 3.3.2) is not compliant with the destination country (Bourgault et al. 2010). It considers all types of industrial processes but does not include other generic or EPD databases. The methodology used, starting from the unit process level adaptation, is a heavy task for geographical areas like Canada that do not have such a comprehensive database. A similar research work was recently completed in New Zealand based on European country-specific industry data and extracted from the GaBi LCA software. Datasets of 13 common building materials were adapted in order to be in accordance with the New Zealand context. The methodology consisted in adapting selected unit processes based on the analysis of hot spots of selected impact categories of the original data (Nebel et al. 2011). The work was more a feasibility study to adapt existing generic data to another context than the development of a generic database because, in general, much more data is needed for a national database.

Another research study by Colodel et al. (2010) proposed developing a systematic procedure for the transferability of Life Cycle Inventory (LCI) data from a "reference country" to a "target country" by means of a "transfer factor". The proposed method is only applicable for unit process level inventory. The authors used a two-step approach. First, the influencing processes are identified at the unit process level through a contribution analysis for the chosen impact categories ("bottom-up" approach). Then a set of *country indicators* such as the technology share, the energy balance per ton of product, the national inventory emissions reports and the emission limits is used to shift from the original country to another one. This contextualisation procedure can be applied to processes from any industrial sector. The adaptation of a German LCI data for cement production for the USA and Japan showed the feasibility of the approach.

At the European level, the development of regional construction sector-specific LCA generic databases is an on-going process. For example, a database, called the European SUstainable COnstruction database (ESUCO), is being developed by the German Green Building Council (Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) e.V.) for every European country. The German Ökobau.dat database on construction materials is derived to the other European countries. This database will be available only to the auditors of the German DGNB certification schemes while the methodology used in its development is not publicly available. Nevertheless, DGNB states the need for country-specific LCA datasets in order to take into account production practices, material diversity and electric mix of each country (DGNB 2011). This need is also highlighted in the recent European project EeBGuide (EeBGuide 2012).

Looking at the requirements from a technical report (TR 15941:2010 par. 4.3.4) of EN 15804 standard for the selection and use of generic data, it is advised to make compensations for generic data to take into account the differences in local conditions (e.g. when extrapolating a European generic data to a national context). This report suggests compensation on a quantitative empirical basis. However, the report also states that "this presupposes the practitioner's detailed understanding of the information under the local conditions and therefore understanding the different measures to be taken for compensating any bias in the information".

In Italy, an adapted LCA database of building materials was developed in 2009. It included the contextualisation of the existing Ecoinvent data of building materials. While the choice of each dataset was based on pre-defined data quality indicators, information concerning the methodology used to adapt the data is not publicly available (Barozzi et al. 2009). However, such a work is time and resources consuming. In addition, it cannot be performed by every practitioner due to the potential use of confidential data directly linked to their availabilities as disaggregated unit process LCI data.

Another approach was chosen for the national Envimat database in Czech Republic (Hodková et al. 2012), where during the first "transitional stage" the unmodified existing generic data of construction materials from a single source (Ecoinvent) coexist with the few country-specific datasets available from Czech EPDs. Although this approach uses two inconsistent types of data, it was chosen to support the development of national EPDs and to enable environmental assessment of buildings in the country as soon as possible.

2.4 Use of existing LCA data with data quality indicators

Adaptation of LCI is not always possible due to time and cost constraints, but also to the confidentiality of unit process raw data such as the "recipe" of the product. For example, industry data are provided most of the times as aggregated datasets for the production phase, with no possibility let to the practitioner to adapt parameters such as transport distances or energy mix). In the same time, for sector-specific applications (e.g. building LCA studies), a large amount of data is required to model the various building assemblies, components, products and materials. In that case, even if data are not always adequate in the context of the study (e.g. for a national context in Europe), it may be better to use not yet fully appropriate data than no data. In that case, data quality assessment can be very useful to highlight the appropriateness of the data used according to the goal and scope of the study. Typical criteria considered are: technological, geographical, and time-related representativeness, completeness, precision/uncertainty, methodological appropriateness and consistency (Weidema and Waesnes 1996; EC-JRC 2011). According to Biemann et al. (2013), while criteria such as uncertainty and completeness (in terms of the number of elementary flows of the inventory) can be rated at the dataset level, aspects related to time, geography, technology and modelling approaches are user dependent. Generally speaking, the quality of LCA data is a relative concept, e.g. a dataset can be suitable in a given national context while the same data can be inappropriate in another national context. DQA allow practitioner to assess the level of representativeness of specific information (site-specific, generic etc.).

Previous works have proposed various criteria to be used in data quality indicators (DQI) for sector-specific applications (May et al. 2003; Wang et al. 2013). This can be the case of sector-specific aggregated data but also of unit process generic data (e.g. datasets from the ELCD database, see ESM 1). For example, the Ecoinvent database uses a pedigree matrix with five DQI that are then converted into an uncertainty distribution. In the new version of this database (version 3), data covering all geographical contexts, including the world average, are provided. However, the Ecoinvent centre stated that many of these datasets will be just extrapolated from one of existing regional datasets, especially from the Swiss or European contexts (Weidema et al. 2013). In these cases, data will be of less quality and the uncertainty from these extrapolations will be higher for these data non-adapted to the targeted context. Further information on the extrapolation of Ecoinvent data in version 3 can be found in Weidema et al. (2013). As a conclusion of Sect. 2, Fig. 1 presents the different types of available datasets that can be found in the LCA literature for the construction sector.

3 NativeLCA methodology

Several datasets are needed for the calculation of LCA of buildings but no coherent methodologies for their selection for each construction material and product were identified in the literature, not even in the EN 15804 and EN 15978 standards. The proposed methodology provides a large scope (namely considering a large number of European LCA databases), a straightforward approach and a single focus (the selection of a LCA dataset to be directly used by the practitioner, avoiding inventory analysis and LCA system modelling).

A statement from FprEN15978:2011 can be considered as a basis for NativeLCA development by referring that (CEN 2011):

> "If no specific EPD in accordance with the requirements of EN 15804 is available for the product which is used in the building, the product stage information modules (A1 to A3) of "available generic (not specific) EPD or a dataset" of a similar product may be used and adapted to create a new dataset to reflect the actual situation as closely as possible;
> Such a dataset shall be "made" only on the basis of suitably reliable and accurate information available for both products;
> In making such adaptations, assumptions shall not simply default to the best case but shall conservatively represent a realistic condition".

NativeLCA is an iterative methodology in four steps based on the collection (AFNOR 2004), characterisation (Baitz et al. 2012), qualification (Barozzi et al. 2009) and selection (Biemann et al. 2013) of available datasets to be used at the date of the study as appropriate data for a national context (see Fig. 2). The four steps of NativeLCA are presented in Fig. 3. Each step is described below in a dedicated section.

The first steps of NativeLCA are mainly based on meta-analyses works (Zumsteg et al. 2012; Whitaker et al. 2012;

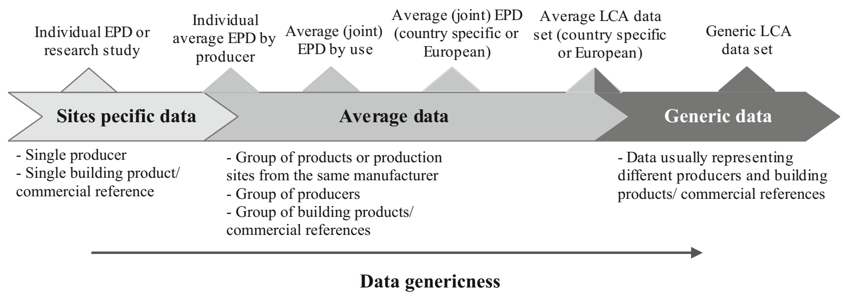


Fig. 1 Types of LCA datasets available in the LCA literature for the construction sector

Padey et al. 2012; Zamagni et al. 2012). The general idea is to collect existing LCA datasets for a targeted construction product, to describe the assumptions of the LCA and to report the impact values for the sample of data. If LCI information is available, the data can be harmonised and adapted to the scope of the study (e.g. change of the electricity mix from one country to the targeted country).

3.1 Goal and scope definition

NativeLCA methodology can be used with similar steps but different aims, and an adequate scope has also to be defined before its application. In fact, the proposed methodology can be used in the selection of a representative and consistent LCA dataset of building products when it is necessary to achieve the following goals:

- Choose among available data on background processes (e.g. data on raw material extraction process for an EPD for a national context);
- Choose available data for a product or building assembly study (e.g. data for a building LCA practitioner to make a simplified LCA or early design assessment) for a national context;
- Choose available data for a database integrated in a building LCA software (e.g. generic data on the main building materials to be used in early design) for a national context;
- Conduct a cross-check of available data with a new site-specific LCA dataset at a national level;
- Assist LCA experts in checking the plausibility of LCA results in a critical review or verification process in a specific country.

In addition, the corresponding scope of the application of NativeLCA should also be defined (see Table 1 including the case study information further discussed in Sect. 4):

- The various LCA calculation rules (e.g. defined for the study or referring to existing sector-specific standard, e.g. EN 15804 for EPDs of construction products);
- The functional unit of the data of the study;

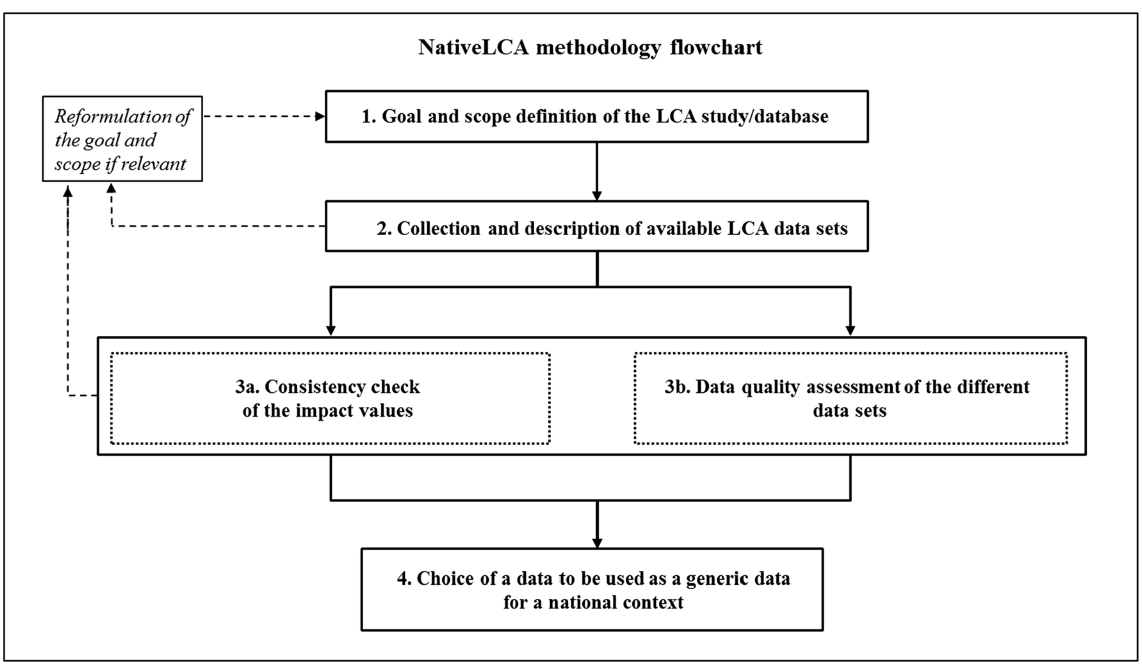


Fig. 2 NativeLCA methodology flowchart

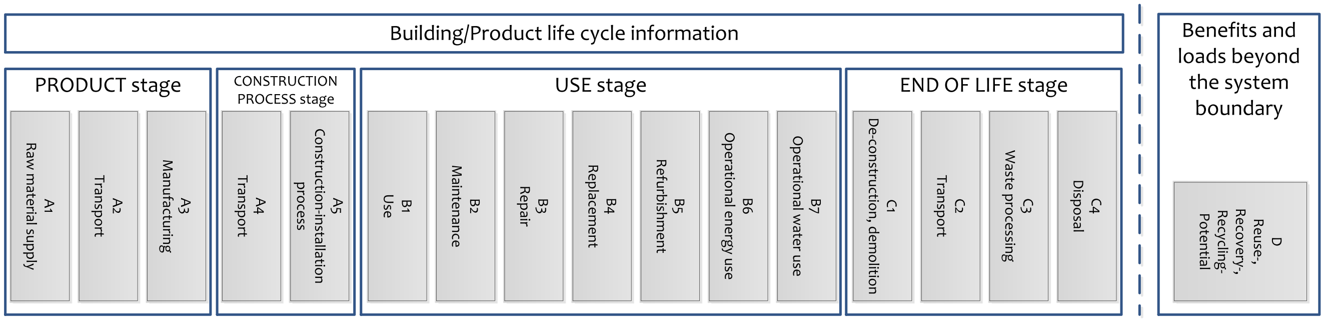


Fig. 3 Conventional life cycle stages according to EN 15804 and EN 15978 used as a framework to classify the data collected in the literature

- The characterisation of each construction material and product under study, namely their intended composition/formula, physical and chemical characteristics;
- The life cycle stages to be considered should also be described and justified in detail in order to define a precise life cycle system boundary (e.g. cradle to gate—see ESM 1);
- The LCI flows and LCIA parameters to be considered because they are relevant in a national context.
- As a starting point, the conventional life cycle stages proposed in EN 15978 standards are used as a general framework to classify each collected data according to these conventional stages (see Fig. 3).

During the scope definition, the number and the type of LCIA indicators must be chosen. For a first application of NativeLCA on a construction product, a normalisation step can be conducted to identify if impact category are of low or high relevance for the products using a specific set of normalisation factors (e.g. CML 2001). Following the normalisation step, the number of impact category can be adjusted in the scope of the study to focus on the most relevant aspects.

3.2 Collection and description of available LCA datasets

Step 2 of NativeLCA methodology corresponds to the description of LCA datasets, including data quality information and meta-data.

Each dataset is firstly characterised by its meta-data, which corresponds to all relevant information that describes the LCA study, the data and methodological rules. Table 2 presents the meta-data characterised in NativeLCA such as the name, source, type of the data, the organisation or database from which the data comes from, the functional unit and the

Table 1 Description of step 1 of NativeLCA methodology

Step	Sub-step	Procedure	Comments	Case study (reinforcing steel)
Step 1	Goal definition	Describe the goal of the LCA study/LCA database for construction products		Determine the appropriate LCA data for reinforcing steel sold on the French market to be integrated in a database of a building LCA software developed in France
	Scope definition	Core rules followed for the scope definition	For example, according to EN 15804/EN 15978 standards	According to EN 15804
		If relevant	For example, to precise the core rules	
		Functional unit		1 kg of reinforcing steel sold on the French market
		Allocation of co-products		Partitioning (no avoided burdens)
		System boundaries		Cradle to gate
		cutoff rules		According to EN 15804
		Others		–
		Life cycle stages according to EN 15804 / EN 15978	For example, production stage	Module A1–A3 (production stage)
		LCI and LCIA indicators considered in the LCA study/database		limited to the following indicators according to EN 15804: CED, Water consumption (WC), GWP, non-hazardous waste (NHW)

Table 2 Description of steps 2, 3a, and 3b of NativeLCA methodology

Step 2	General information	Name of the LCA data	*Designation included in the generic data/EPD database that describes the type of construction material or product*
		Source of the LCA data	*Report from which database the data has been collected*
		Type of the LCA data	*Describe the type of data - unit process datasets, aggregated datasets i.e. EPD, industry average*
		Organisation responsible for the data	*Describe the data provider - it can be different from the field "source"*
		Functional unit	*Describe the functional unit of the data*
		Characteristics	*Describe physical characteristics of the product*
	Data quality aspects	Reliability	*critical review performed, third-party verification according e.g. to a sector-specific and/o national standard*
		Completeness	
		Geographic representativeness	
		Time-related representativeness	
		Technological representativeness	
	Methodological rules	General methodological rules	
		System boundaries	
		Cut-off rules	
		Allocation of co-products	
		Other aspects (if relevant for the consistency check)	
Step 3a	Reference values information	Number of single manufacturer's LCA or EPD data included in the average	
		Number of manufacturer's included in the average	
		For one manufacturer, number of production sites where data have been collected?	*if applicable*
		Type of aggregation process	*e.g. arithmetic, market shares, production volumes*
	Additional information on variability and uncertainty	information on the variability of the data set	*if applicable, when it is collected directly as an averaged and/or generic data?*
		empirical variability in the averaged data currently assumed to be the reference value (REVA)	*if applicable*
		If yes, numerical expression of the empirical variability	*e.g. confidence interval at 95 %, standard deviation*
		Additional information concerning the sample of data sets used for the REVA calculations	
Step 3b	DQI (data quality)	Reliability	
		Completeness	
		Geographic representativeness	
		Time-related representativeness	
		Technological representativeness	
	DQI (methodological consistency)	General methodological rules	
		System boundaries	
		Cut-off rules	
		Allocation of co-products	
		Other aspects (if relevant for the consistency check)	

characteristics of the construction product (e.g. including physical and chemical composition).

Data quality information is then collected for each dataset. In the NativeLCA methodology, data quality information is broken down into two parts, i.e. the methodological consistency and the representativeness aspects. Data quality information has been defined based on: the data quality aspects considered in the ILCD Handbook (EC-JRC 2011), and the data quality information given in TR 15941 (CEN 2010).

First, NativeLCA checks whether a critical review was performed on the targeted data (which ensures the compliance e.g. to ISO 14040-44). Depending on the scope of the study or database development, the user can also check whether the data was verified according to sector-specific requirements. If the data was not verified or critically reviewed according to the scope of the study or database, the relevant aspects concerning the methodological part are the following: the general rules for the LCA (e.g. foreground and background data), the system boundaries, the cutoff rules, the allocation of co-products, and other aspects (if relevant for step 2).

Afterwards, representativeness aspects must be documented for each dataset. These aspects include: the reliability (e.g. site measurement, literature, expert judgement etc.), the completeness (e.g. production volumes covered), the geographical, the time-related (i.e. the age of the LCA data e.g. 2007) and the technological representativeness.

During step 2, some aspects need special attention:

- For an EPD data which is already in accordance with the scope of the application of NativeLCA defined in step 1 (LCA calculation rules), all the methodological assumptions are assumed to be "valid". However, for such an EPD, data quality aspects (at least the geographic and technological representativeness, when available) need to be documented in order to check its suitability as a generic

data representing the production volume of the construction product sold in the national market[1];
- If a data has been adapted, e.g. change of the electricity mix from a country to another, this information needs to be mentioned in the geographical representativeness (data quality aspects) in Table 2.

At the end of step 2, the pool of datasets is characterised. Next steps concern the check of impact values consistency among the dataset and the data quality assessment.

3.3 Comparison of the dataset impact values

Step 3a of NativeLCA performs a consistency check of impact values to identify the results' differences among collected data (Step 3a in Table 2).

3.3.1 Consistency check of impact values of the different datasets

At step 3a, reference values (REVA), based on the statistical distribution of collected data (step 2), are calculated and compared with each other in order to identify the impact values for a specific construction material depending on the geographical scope: national, European or foreign country in Europe. In addition, step (3b) assesses the "precision" by means of the empirical variability of these reference values for the corresponding construction material.

Unit process generic data are differentiated from aggregated datasets. The main reason for that choice is the possibility for unit process data to be modified when using usual LCA software. These data are kept aside from aggregated data. Before calculating reference values based on aggregated datasets, these are subjected to a suitability check in terms of available LCI and LCIA indicators (defined in the goal and scope of the study) and corresponding life cycle stages.[2]

Datasets are grouped per identical life cycle stages and LCI and LCIA indicators. For the LCIA parameters, the Life Cycle Impact Assessment method used should also be checked, including the corresponding version and/or issue year. It enables selecting data that have the same boundaries and LCI or LCIA to determine empirical reference values. At the same time, this step may be pre-defined depending on whether the collected national or European datasets are already "aggregated data", i.e. based on a sampling of different companies and/or production sites. If not, this step enables calculating an average based on single manufacturer's data (e.g. individual EPD) or group of manufacturer's data (e.g. joint EPD). The calculation can be conducted in a national or European context. Three scales are defined for the reference values (REVA): national, European and foreign, i.e. other countries in Europe (excluding the targeted country). Figure 4 presents a graphical representation of step 3a of NativeLCA.

Calculation rules of REVA data are as follows:

- National REVA should preferably be a weighted mean according to the production volumes, for each environmental indicator and for the same declared unit, of single—and group of—manufacturer's EPDs and average datasets as recommended in European Standards (CEN 2010); when production volumes are not declared, REVA can be a weighted mean according to the market shares;
- Foreign and European REVA should be calculated as weighted mean of declared production volumes, for each environmental indicator and for the same declared unit, of single—and group of—manufacturer's EPDs and average datasets (as recommended in European Standards (CEN 2010));
- An arithmetic mean according to the number of companies included in each dataset, for each environmental indicator and for the same declared unit, of single—and group of—manufacturer's EPDs and average datasets (at a national, foreign and European level), will be a last option for the datasets that neither declare market shares nor production volumes;
- National average LCA datasets that do not include information concerning market shares, production volumes or number of companies considered, and foreign average LCA datasets that do not include information concerning the two last figures, should not be treated as an individual EPD to be used in REVA, but it should be possible to use this dataset as generic in a national context;
- National and foreign (mainly European) average LCA datasets that are considered for REVA quantification should also be considered as individual datasets in the comparisons in order to be used as generic in a national context;
- Table 3 presents the different tasks to be conducted during the calculation of reference values. In addition, the averaged data as reference value may present an empirical variability due to differences in production processes, number of producers, data sources and LCA hypotheses. It leads to an average value±a given value for variability (e.g. assessed using normal and log-normal distribution and corresponding statistical parameters such as the confidence interval at 95 %);
- Empirical variability is usually directly dependent on the number of datasets available for each construction

[1] A specific EPD consistent in terms of methodological rules may be far from representing the production volume of the product sold in the national market. This particularity needs to be documented in the data quality aspects before being assessed (see Sect. 3.3).

[2] Neither existing nor on-going site-specific data from national LCA studies will be subjected to this checking because: they will not be used in the calculation of reference values; they will only be compared with the remaining datasets in the last step of this methodology.

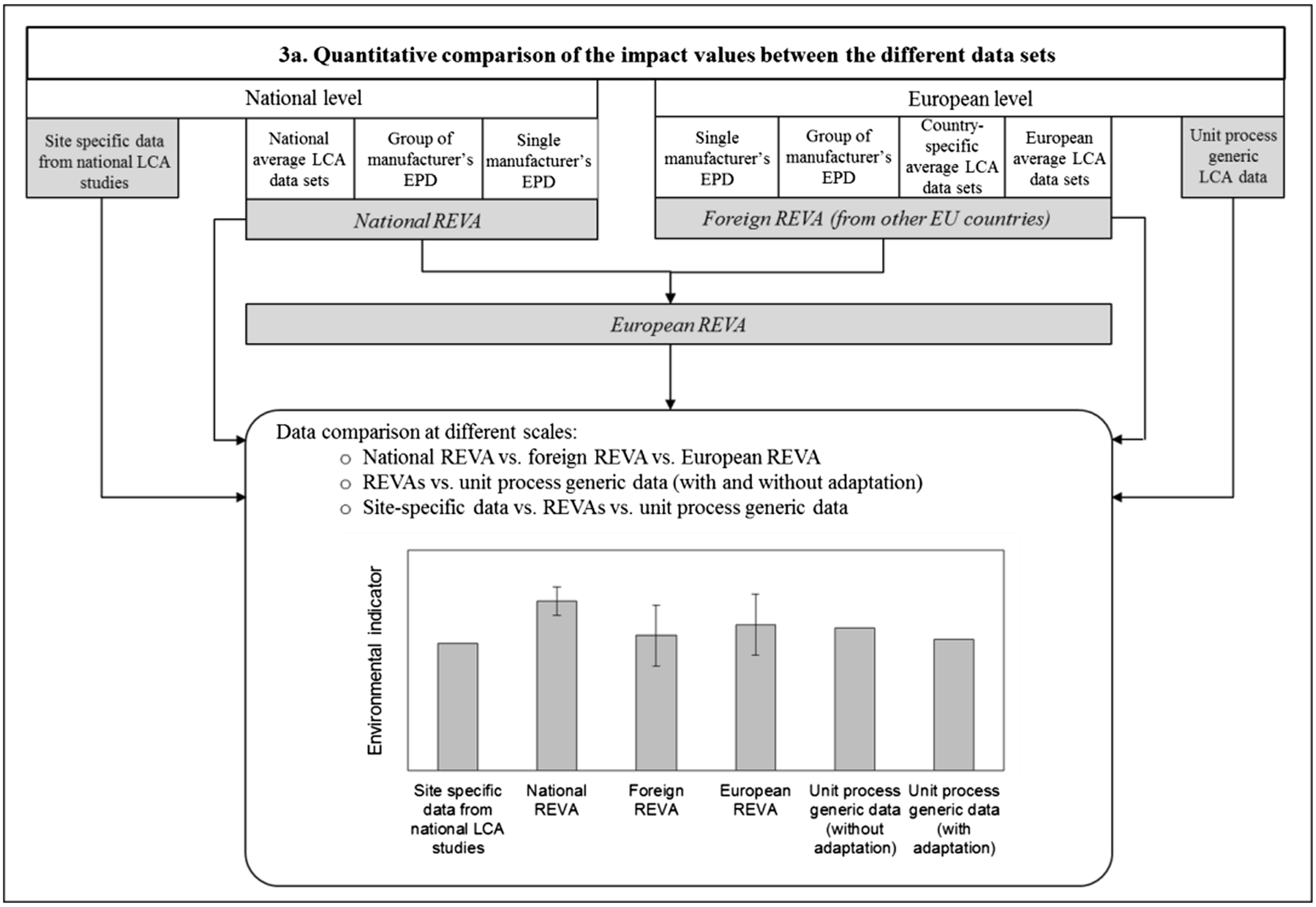


Fig. 4 Graphical representation of step 3a of NativeLCA methodology

material. A statistical criterion is used to exclude some datasets, e.g. confidence interval at 95 %. It must be noted that the type of collected data is a major limitation for the empirical determination of variability. For example, if 50 single manufacturers' EPDs are available for a building product, they are likely to show industrial or empirical variability (in that case it may be due to the average of the various producers). However, if a group of manufacturer's EPDs is collected, the publicly available information may be only the mean value without information about the variability due to the producers.

Figure 4 presents a theoretical example of the impact values of a given environmental indicator, and data are presented including a confidence interval when REVA are based on averaging manufacturer's data. In this example, all the data are plausible for this indicator, i.e. there is not much difference (even though the data quality aspects may be significantly different).

3.3.2 Data quality assessment of the different datasets

In addition, a data quality assessment is conducted (step 3b in Table 2).

According to the ILCD Handbook, data quality assessment enables assessing the "accuracy" of dataset with the theoretical reference value (the generic data of the national context). As the choice of data may be highly dependent on data quality but also methodological consistency according to the goal and scope of the practitioner, it is important to use data quality indicators to highlight whether the chosen datasets fit the requirements.

Based on the description of data quality and methodological aspects (Sect. 3.2), it is proposed here to calculate data quality indicators (DQI) based on the weighting of individual criteria of two pedigree matrixes assessing data quality (representativeness, completeness and reliability) and methodological quality (consistency).

The data quality criterion follows the approach of the Ecoinvent database version 2 (excluding the sampling criteria) based on Weidema and Wesnes (1996) and include:

- Reliability;
- Completeness;
- Time-related representativeness;
- Geographical representativeness;
- Technological representativeness.

Table 3 Description of step 3a of NativeLCA methodology

Steps	Task
Reference values information (sampling, production sites, manufacturers)	Number of single manufacturer's LCA or EPD data included in the average
	Number of manufacturer's included in the average
	(If applicable) For 1 manufacturer, number of production sites where data have been collected?
	Type of average (e.g. arithmetic, market shares, production volumes)
Additional information (variability and uncertainty)	(If applicable) information on the variability of the dataset (when it is collected directly as an averaged and/or generic data)?
	(If applicable) empirical variability in the averaged data currently assumed to be the reference value (REVA)
	If yes, numerical expression of the empirical variability (e.g. confidence interval at 95 %, standard deviation)
	Additional information concerning the sample of datasets used for the REVA calculations

In addition, the methodological consistency criteria are assessed in another pedigree matrix based on ILCD criteria and CEN TR 15941 (CEN 2010):

- General methodological rules;
- Completeness of the elementary flows (according to the LCIA indicators defined in the scope of the study);
- System boundaries;
- Cutoff rules;
- Allocation of co-products.

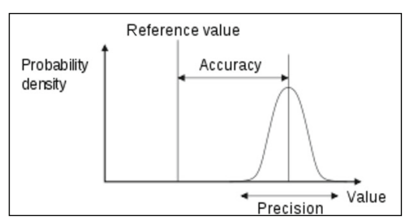
The weighting of each individual criterion follows the approach of the European Commission Product Environmental Footprint (PEF) Guide (EC 2012) with scores from 1 to 5, i.e. meaning very good (1), good (2), fair (3), poor (4) and very poor (5). Figure 5 presents a graphical representation of step 3b including a visual example of the "potential" gap in terms of data quality between the theoretical reference value and the empirical reference value (based on the collected datasets). As an illustration, a theoretical example presents the ranking of the different datasets. The national reference value (REVA) is found to have the higher ranking due to the methodological consistency according to the scope of the study. In addition, this dataset fits the representativeness and completeness criteria much more than foreign or European data that are found less appropriate in this theoretical illustration.

Once the intermediate DQI for both methodological consistency and representativeness are calculated, a global DQI averaging these two intermediate DQI is calculated. By default, the weight for both intermediate DQI is the same. Depending on the LCA practitioner and tool developer preferences, he/she may adjust the weighting by taking into

3b. Data quality assessment of the different data sets

Data quality assessment of the different data sets to assess the accuracy of the data:

- Methodological consistency criteria
- Representativeness and completeness criteria



Source: ILCD Handbook (2011)

Data quality assessment scores (theoretical example)

	Data quality indicators (DQI): scores from 1 to 5					
	Site-specific data	National REVA	Foreign REVA	European REVA	U.p. generic data (without adaptation)	U.p. generic data (with adaptation)
Data already verified according to the scope of the study (LCA methodological rules)?	No	Yes	No	No	No	No
DQI for representativeness and completeness	3	1	3	3	4	3
DQI for methodological consistency	2	1	3	2	4	3
Global DQI (example with equal weighting)	2.5	1.0	3.0	2.5	4.0	3.0

Fig. 5 Graphical representation of step 3b of NativeLCA methodology

account the implementation of the NativeLCA methodology on building products case studies.

It has to be noted that this sub-step (DQI) may be optional if the goal of the study is only to look at the plausibility of LCA values, e.g. when comparing LCA results achieved in a site-specific national study with existing LCA studies at national or European scale for the same product. Similarly, the DQI for methodological consistency may be automatically filled with the highest ranking if the data is already verified according to the scope of the study with consistent LCA methodological rules.

At the end of step 3 of NativeLCA, the LCA practitioner or the tool developer has a broad view of differences among the available datasets in terms of impact values but also in terms of ranking according to the data quality assessment (appropriateness of the data as a generic data for a national context).

3.4 Choice of a data to be used as generic data for a national context

The last step of NativeLCA methodology is the selection of a coherent LCA dataset within the ones available at the date of the study or the database development for building LCA tools. The selection of data is based on the results of steps 2 and 3 compared with the goal and scope defined in step 1. Generally speaking, it is preferable to use data that has the highest DQI. In addition, the comparison of impact values completed in step 3a enables highlighting whether the chosen data is similar or very different from the remaining datasets available for the same product. Even if these differences are significant, understanding their causes contributes to confirming the plausibility of the chosen dataset.

4 Case study—stone wool insulation boards

This section illustrates a practical application of NativeLCA in the selection of a LCA dataset for one building material in a national context. Stone wool was chosen in order to be used as generic for the Portuguese context (Silvestre 2012). There are two main types of stone wool (SW) used in buildings, namely for the insulation of the external walls (both with a thickness between 30 mm and 80 mm): with a density between 35 and 100 kg/m^3 and a thermal conductivity of 0.04 W/(m °C) for any use; with a density between 100 and 180 kg/m^3 and a thermal conductivity of 0.042 W/(m °C) exclusively for use in external insulating systems.

4.1 Step 1—goal and scope definition

The aim of this study is therefore to provide a LCA dataset for each group of densities (or for both groups). The scope is defined by:

- The functional unit is the production of 1 kg of SW (because not all datasets declare the thermal conductivity of the board and because generic datasets also use this functional unit in order to be used to model a board of any density);
- The construction material correspond to different types of SW boards available in the European market, uncoated and produced using a synthetic binder (the most common type of SW boards available in the Portuguese market);
- Concerning the LCI flows and LCIA parameters (and corresponding Environmental Impact Assessment Method (EIAM)), a normalisation of LCIA impacts was conducted for Ecoinvent and ELCD data to provide a first overview of the impacts in six selected environmental categories selected of the two types of SW boards available in these databases (Fig. 6). It was found that Abiotic Depletion Potential (ADP) is the most important environmental impact of SW production in a European context, followed by Acidification Potential (AP) and Global Warming Potential (GWP) in equal terms. Therefore, PE-NRe (consumption of primary energy, non-renewable), AP and GWP are used as a reference to apply NativeLCA methodology. PE-NRe is chosen instead of ADP because it is available in all datasets (contrary to ADP) and contributes significantly to ADP in most of the building materials;
- Only the product stage (A1 to A3) is considered, taking into account the packaging of the SW because four datasets include information about the environmental impact of its production and use.

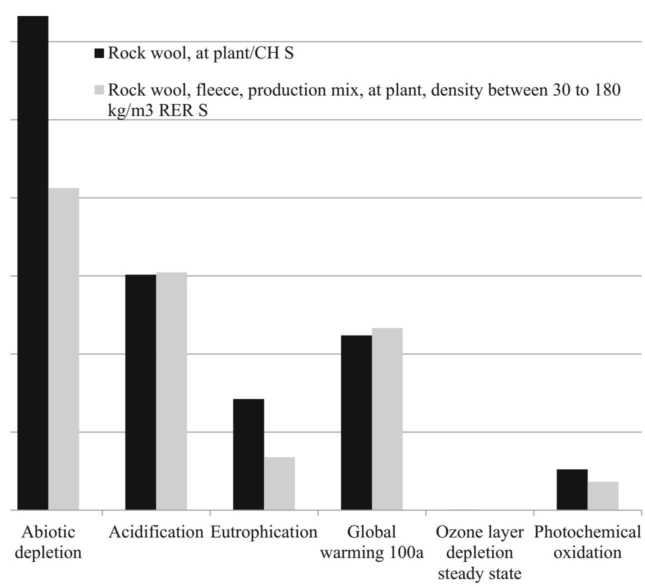


Fig. 6 Environmental impacts after normalisation (CML 2001 version 2.05 and West Europe—1995) of the production processes of 1 kg of SW available in Ecoinvent (“rock wool, at plant”) and ELCD (“Rock wool”) generic databases (the highest value of the chart is 6.33×10^{-13})

4.2 Step 2—collection and description of available LCA datasets

Table 4 identifies and quantifies available LCA datasets for SW production at the European level. Some more datasets were identified but not considered because they are out of the scope defined in step 1 (a French EPD from a Portuguese company that corresponds to board coated on the surface, another four EPD of coated boards, two German EPD of boards produced with a vegetable binder and a cradle to grave Norwegian EPD—that prevents the use of its results in REVA calculation or their comparison with the remaining datasets). Ten individual EPD (one Spanish, seven French and two German) and three generic datasets (two from Ecoinvent and one from ELCD) were therefore considered to represent this type of SW production at the European level. The characterisation of these datasets via meta-data is presented in Tables 5 and 6 (the latter including the necessary data to provide the verification of the methodological consistency and representativeness of the datasets). From Table 6, it can be concluded that:

- Each dataset was achieved using different PCR, cutoff and allocation rules;
- All datasets have similar system boundaries (A1–A3, including or not the packaging material), except DAPc that does not include the complete assessment of stage A1 (raw material extraction and processing, processing of secondary material input) because the corresponding LCA study did not take into account one of the components of the board (the oil, due to lack of production data). Therefore, this limitation will be taken into account in the comparison between dataset figures;
- Only the DAPc and INIES (partially) datasets were subjected to external review, while IBU datasets were verified according to the programme rules. ELCD and Ecoinvent were only critically reviewed internally.

Each dataset is therefore consistent in what concerns assumptions, methods, models and data used in their calculation. The LCI flows and LCIA parameters provided in each dataset (Tables S6 and S7 in Electronic Supplementary Material) are consistent within each other but not similar between different datasets. Nevertheless, they are all in accordance with the goal and scope of this study (namely in terms of functional unit, SW being available on the European market, including the PE-NRe, AP and GWP, and including the production stage, despite the fact that DAPc dataset does not include the complete assessment of the processes of stage A1).

A representativeness check was also made according to the parameters summarised in Table 7:

Table 4 Available datasets for SW production

Product	LCA datasets						
	National (Portugal)			European			
	Site-specific data from national LCA studies/individual EPD	Joint EPD	National average LCA datasets	Individual EPD	Joint EPD	Country-specific or European average LCA datasets	Generic LCA dataset
SW	0	0	0	10	0	0	3

Table 5 Meta-data of each dataset that provides LCA of SW production

Acronym	DAPc	Ecoinvent	ELCD	IBU	INIES
Designation of the database/EPD Programme	Declaración Ambiental de Producto (DAPc)	Ecoinvent version 2.2	European Life Cycle Database version 2.0	Umwelt-Deklarationen (EPD)	Programme de Déclaration Environnementale et Sanitaire pour les produits de construction
Country	Spain	Switzerland	European Union	Germany	France
Type of LCA dataset	Individual EPD	Generic (2 types of SW—packed and unpacked)	Generic (average of several SW products, such as boards, felts and mats)	2 individual EPD (2 types of SW, 1 packed and 1 unpacked)	7 individual EPD (7 types of SW, 1 packed and 6 unpacked)
Sampling procedure	1 plant in Spain	1 company in Switzerland	European plants	1 (packed SW) and 3 (unpacked SW) plants in Germany	1 company in France

- Only the ELCD dataset has a European coverage, while the remaining datasets are only country specific;
- The technology level can be considered as “classic” in the European context for all datasets;
- The thermal conductivity of SW represented by this data are lower or equal to the figures defined in the scope;
- Only in the DAPc and ELCD the background data used correspond to European data;
- The Ecoinvent dataset is the oldest one (the inventory between 1994 and 1997) while the remaining ones resulted from studies done in the last nine years;
- The Ecoinvent dataset is the only one that offers the possibility of modifying background data in order to provide “contextualisation”.

Therefore, a “contextualisation” was made to both Ecoinvent datasets (namely by changing the electricity production mix, from the Swiss to the Portuguese context) and only the “contextualised” values will be considered in the remaining steps of this study. After this step, all datasets were considered valid in terms of consistency and representativeness, even though some of them do not comply with some of the criteria defined. The criteria that were not complied with by each dataset are presented in italic in Tables 6 and 7.

4.3 Step 3a—consistency check of impact values

All non-generic datasets include the LCIA indicators defined for this study and have a similar level of aggregation of data per life cycle stage (A1–A3, including or not the packaging material) and are therefore suitable to be used in the quantification of REVA for PE-NRe, AP and GWP.

Two first trials were made to calculate REVA according to the density of SW (separating datasets in the interval 35–100 kg/m^3 and in the interval 100–180 kg/m^3) and only for datasets that consider SW packaging (signed “packed” in Fig. 7). However, it was found in the first case that the standard deviation of these figures is higher than the one of European REVA considering all datasets for LCIA indicators considered and this option was therefore not taken into account. In the second case, it was found that the standard deviation of this figure is higher than the one of European REVA considering all datasets for two of the impact categories considered (PE-NRe and AP) and that the figures of these datasets are lower than the remaining datasets (and not higher, which is not expected because of the environmental impact of the packaging), and this option was therefore also not taken into account (these datasets appear in Fig. 7, but they were not considered in the European REVA calculation for PE-NRe and GWP because of their low quantity and figures, higher variability and because European REVA should be consistent in

Table 6 Meta-data of each dataset (for SW) that enables consistency verification

Characteristics	DAPc	Ecoinvent	ELCD	IBU	INIES
Methodology/PCR followed	EN 15804:2012; National-based development for each group of materials	Ecoinvent methodology	ISO 14040:2006, ISO 14044:2006 (ISO 2006 a, b)	National-based development for each group of materials	French standard NF P01-010
Functional unit/density (kg/m^3)	1 m^2 and 50 mm thickness; 30	1 kg; weighted density of the mix of boards: 59.49 kg/m^3	1 kg; 140–162 (from 180 to 60 mm)	Packed SW (1 kg; 25–200) and unpacked SW (1 kg; 25–180)	1 m^2; 30, 35, 50, 70 (packed), 130, 140 (2)
System boundaries	A1 (partial)–A3, including the packaging material	A1–A3, without including the packaging material	A1–A3 (without including the packaging material)	A1–A3 (with or without the packaging material)	A1–A3 (6 EPD without including the packaging material and 1 EPD including it)
Cutoff rules	(<5 % mass and energy)	*Not defined by the database management*	Coverage of at least 95 % of mass and energy of the input and output flows, and 98 % of their environmental relevance	Input side—all material flows greater than 1 % of their total mass or contribute more than 1 % of primary energy demand were taken into account; Output side—environmental impact greater than 1 % of total effects of the category	Mass criterion (max. 2 % of the reference flow) according to the French standard (NF P01-010)
Allocation rules	Not described	*ISO 14044:2006 (ISO 2006b) and cutoff rules for the wastes (no system expansion is accounted for in the database)*	Exergetic content, net calorific value or mass, depending on the process	Packed SW (not made) and unpacked SW (based on mass)	Partitioning (energy, mass, economic)
Critical review/verification	External critical review	*Internal critical review*	*Internal critical review*	*Verified by the advisory board according to the programme rules*	*External critical review (3 out of 7)*
Market share of average LCA data (%)	–	Not documented	Not documented	–	–

Table 7 Meta-data of each dataset (for SW) that enables representativeness verification

Characteristics	DAPc	Ecoinvent	ELCD	IBU	INIES
Geographic coverage	*1 plant in Spain*	*1 company in Switzerland*	European plants	*1 (packed SW) and 3 (unpacked SW) plants in Germany*	*1 company in France*
Technological level representativeness	Typical technology for Spanish production	Typical technology of the company	Typical European technology	Typical technology for German production (packed SW) and typical technology of the company (unpacked SW)	Typical technology for that production site
Thermal conductivity (W/(m °C)) (for density, see Table 7)	0.037	0.036 (weighted)	*Not declared*	Between 0.035 and 0.041 (packed SW) and between 0.035 and 0.040 (unpacked SW)	0.035 (3, 1 packed), 0.037, 0.039 (2), 0.04
Energy and transport processes LCA data	ELCD	*Ecoinvent Hypotheses*	ELCD	*GaBi 4*	*AFNOR FD P01-015 Document*
Temporal representativeness	2008	*2000–2002 (data collection, 1994–1997)*	2006	2006 (packed SW) and 2003 (unpacked SW)	2005
Possibility of background data "contextualisation"	*No (aggregated dataset)*	Yes (unit process dataset)	*No (aggregated dataset)*	*No (aggregated dataset)*	*No (aggregated dataset)*

terms of boundaries—modules A1–A3, without considering the packaging material).

The quantification of European REVA for PE-NRe, AP and GWP was made in this step (which in this case could be equally named "foreign" REVA) considering only the seven individual EPDs (from IBU and INIES, which do not include SW packaging) and being an arithmetic mean for each environmental indicator and for the same declared unit, because none of these datasets declare production volumes. A first overview of all datasets (including European REVA and its standard deviation, and Ecoinvent datasets "contextualised" for the Portuguese context—identified by the abbreviation "PT") is presented in Fig. 7 for PE-NRe, AP and GWP for the production of 1 kg of SW. This figure also presents the comparison between European REVA and generic datasets (Ecoinvent and ELCD), and the validity of the latter is only verified for PE-NRe (and only for Ecoinvent), but not for the remaining categories. The validity of two individual EPD (DAPc and IBU—not packed) is also questioned because of their low figures. Therefore, charts that express the relationship between the impacts in each category and the density of the boards in each dataset were built (Figs. 8 and 9), but considering the same thermal performance (considering the thickness of each board necessary to achieve a thermal resistance of the layer of 1 (m^2 °C)/W, taking into account the corresponding density and thermal conductivity presented in Tables 6 and 7). This analysis is also justified by the significant interval of densities of available datasets (30–180 kg/m^3).

ELCD was not considered in these charts since it does not provide the thermal conductivity, two INIES datasets are represented by only one plot because they have similar values, and European REVA is represented by "89.64" which corresponds to the average density—in kilogrammes per cubic metre—of the seven individual EPDs considered in its calculation (the average thermal conductivity being 0.04 W/(m °C)). These charts show that there is an almost "linear" relationship between PE-NRe, GWP and AP for a given thermal performance and the density of the boards (even for "INIES_350" dataset with a density of 35 kg/m^3, which is considered more adequate to acoustic insulation). However, this relationship is not completely expressed for Ecoinvent for GWP and AP (the values are lower than expected), despite its fulfilment being confirmed for PE-NRe (Ecoinvent datasets correspond to the "59.49" values). The DAPc dataset (corresponding to the "30" value with lower PE-NRe) expresses the stated relationship for all impact categories, and the low values observed in Fig. 7 seem to be related with its low density. The IBU unpacked dataset (corresponding to the "102.5" value) continues to show lower values than expected in all impact categories (while the IBU packed dataset, corresponding to the "112.5", only presents a low value for AP which is in accordance with Fig. 7), which may be explained, e.g. by different

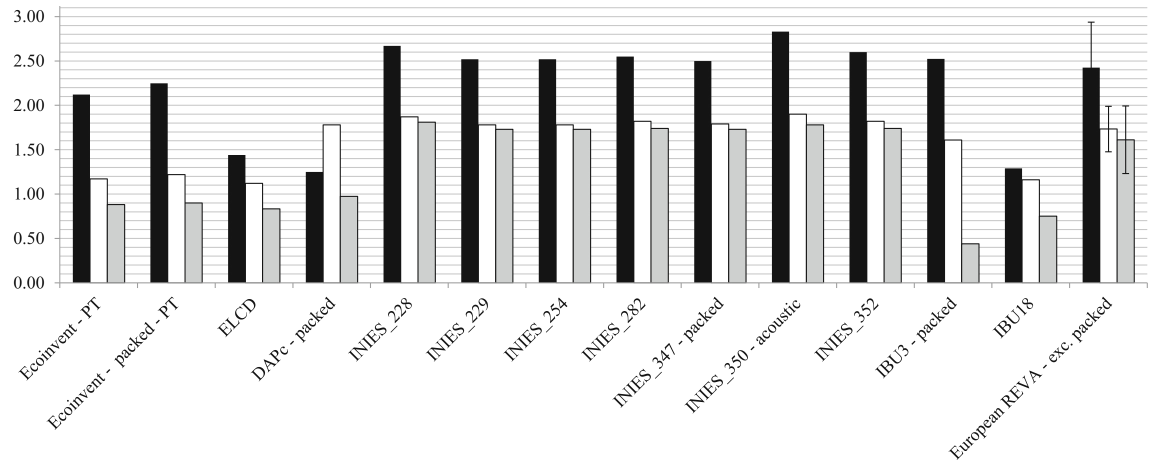


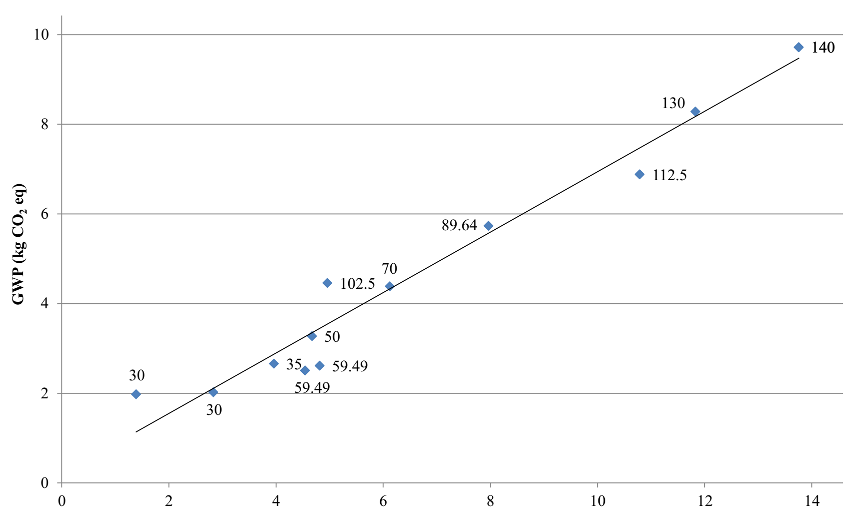
Fig. 7 PE-NRe (*in black*, ×10 MJ), GWP (*in white*, kg CO_2 eq) and AP (*in grey*, $\times10^{-2}$ kg SO_2 eq) in the production of 1 kg of SW from generic (Ecoinvent and ELCD) and individual EPD (DAPc, INIES and IBU) datasets

secondary material or electricity mix use. It is, however, considered adequate to maintain the IBU unpacked dataset in European REVA calculation in order to provide a significant geographical representativeness to this figure.

4.4 Data quality assessment (step 3b) and selection of the dataset to be used as generic for the Portuguese context (step 4)

Considering the conclusions drawn from the analysis made, European REVA has been chosen to be used as generic for the Portuguese context for uncoated SW produced using a synthetic binder and with a density between 35 and 180 kg/m^3. The Ecoinvent dataset was not chosen, and neither was its "contextualised" version. In fact, the environmental profile of this dataset is not in accordance with available EPD, it rather corresponds to a single Swiss plant and is quite old (1994–1997). The ELCD dataset is not represented in Figs. 8 and 9, but using a "hypothetical" value of 0.041 W/(m °C) for the corresponding thermal conductivity and its average value of density, its relative position is not in accordance with the "linear" relationship found for the majority of datasets. The environmental impacts of this dataset were therefore considered low, which can be caused by its high "genericness" and wide scope (average of several SW products, such as boards, felts, mats and other products, with a density between 30 and 180 m^3). The results of the data quality assessment completed for the datasets based on the information of the previous steps are provided in Table 8, they reflect these issues related with Ecoinvent and ELCD, and they aided in the selection of European REVA as the most coherent alternative. Table 9 summarises the decisions that have been made in each of the steps of the application of NativeLCA methodology to SW production.

Fig. 8 PE-NRe and GWP in the production of SW with the same thermal performance, where each point is represented by the corresponding density (kg/m^3)



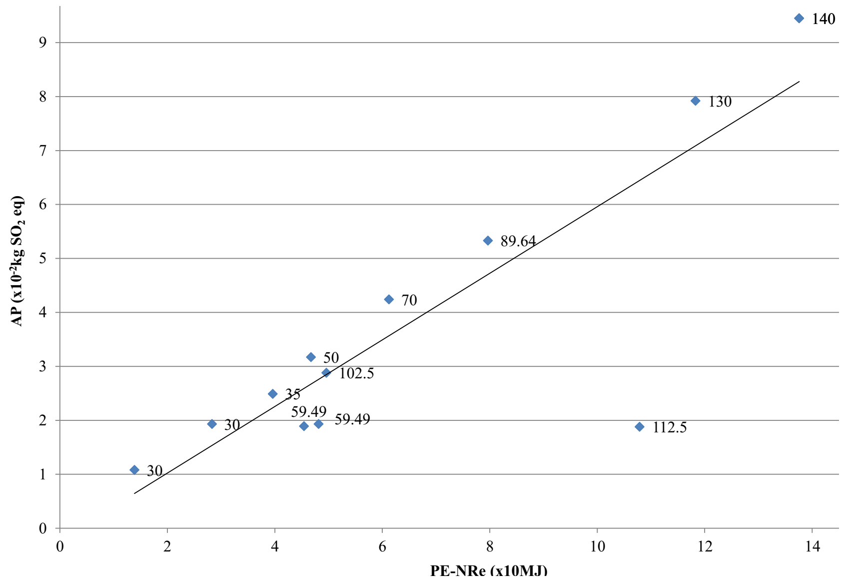


Fig. 9 PE-NRe (*in abscissas*, ×10 MJ) and AP (*in ordinates*, $\times 10^{-2}$ kg SO_2 eq) in the production of SW with the same thermal performance, where each point is represented by the corresponding density (kg/m^3)

5 Discussion

NativeLCA is a flexible methodology that is primarily intended to provide a consistent yet transparent methodology for generic data selection for construction products in a national context on line with the new EN 15804 and EN 15978 standards.

From the case study presented in this paper and from the application of NativeLCA to other materials, it was found that step 4 is highly sensitive to users' preferences as one user's group may prefer using average data from industry, while another user's group may prefer using unit process generic data (with or without adaptation). The reason for that is the consistency of the full generic LCA database, which can provide data on several construction products for building LCA tools. Mixing data can decrease the consistency of the database while using a single source of non-representative data may also be problematic. It is the reason why NativeLCA uses DQI to highlight possible deviations from the scope of the study for representativeness and methodological consistency aspects.

In this section, other potential uses of this framework are discussed by presenting brief examples of the conclusions reached when NativeLCA was applied (validated and fine-tuned) for cement, steel, glass wool and paint, which highlight different cases in some national contexts:

- For cement production, the practitioner may have to decide between CEMBUREAU and Ecoinvent data (see ESM 1). If more emphasis is laid in representativeness (fulfilled, e.g. by industry data), the practitioner may prefer using the former (European average) while the latter may be more appropriate for practitioners that prefer transparency provided by accessing the LCI of unit process generic data;
- For construction steel, the choice can be easier, if the practitioner has access to National average industry data (e.g. the French situation—see Table 1). This should be the datasets chosen, because they are better both in terms of representativeness and in relation to consistency and reliability, when compared with generic or European average (extrapolated from a global average) datasets;
- In the selection of a LCA dataset for glass wool insulation production for a country where both single and group manufacturer's EPDs are available, national reference values should be the choice, mainly because generic

Table 8 Step 3b — data quality assessment

Characteristics	DAPc	Ecoinvent-PT	ELCD	IBU	INIES	European REVA
Data already verified according to the scope of the study (LCA methodological rules)?	Yes	No	No	No	Partially	Partially
DQI for representativeness and completeness	4	4	4	4	4	2
DQI for methodological consistency	5	4	3	4	3	4
Global DQI (considering equal weighting)	4.5	4.0	3.5	4.0	3.5	3.0

Table 9 Summary of decisions made in each of the steps of the application of NativeLCA methodology to SW production

Step 2—foreign data verification Consistency and representativeness	Step 3a—suitability to be used in the quantification of mean values (REVA) for LCI and LCIA indicators and REVA quantification (EPD and average datasets)	Step 3a—data comparison within foreign data: REVA vs generic datasets	Selection of a coherent LCA dataset to be used as generic for a national context: NativeLCA
Eliminated datasets: SW coated boards (French and German EPD) and boards produced with a vegetable binder (German EPD), EPD from cradle to grave (Norwegian)	Calculation of European REVA for packed and unpacked SW boards, and for densities of 35–100 and 100–180 kg/m^3; only European REVA for unpacked SW boards was considered	Generic datasets discarded because of lack of geographical and temporal representativeness (Ecoinvent datasets were “contextualised” for the Portuguese context but represents only 1 Swiss plant) and due to high “genericness” and wide scope (ELCD)	European REVA (with an average density of 89.64 kg/m^3 and an average thermal conductivity of 0.04 W/(m °C)) for uncoated SW boards produced using a synthetic binder and boards with a density between 35 and 180 kg/m^3 (A1–A3)

databases at the European level do not achieve the same level of geographic representativeness;

- If the aim is to choose a LCA dataset for paints production to be used as generic in a geographic context where no data is available, a contextualised generic dataset may be preferred, even against aggregated reference values (REVA) from much more recent single—or group—manufacturer’s EPDs available on other European countries.

Following the last example, when foreign datasets are chosen, mainly because of lack of national data, preference should go to datasets that allow modifications of their background data via “contextualisation”, i.e. unit process generic data. Contextualisation may include in some cases a detailed analysis and change of individual input or outputs flows of a generic dataset, namely based on the differences of industrial statistical information of initial and target regions following (Colodel et al. 2010). Unit process generic datasets are usually the only ones that allow “contextualisation”, which can improve their geographic representativeness. If in the end of a study a practitioner has to choose between, e.g. an ELCD and an Ecoinvent dataset for his national context, he/she may prefer a unit process data (i.e. Ecoinvent) to be able to adapt it (at least the energy mix). However, such choice is highly dependent on his evaluation (trade-offs between having consistent data or representative ones but also between aggregated datasets and unit process data). This means that the aggregated reference values (REVA) calculated in step 3a of the methodology in this paper may not fulfil some user’s needs in every national context. This choice should also be based on all the information compiled in the previous steps of this methodology, mainly on the results of the assessment of consistency and representativeness.

While mixing data sources is not consistent, not having appropriate datasets coming from a single source may also be problematic. That is the reason why NativeLCA methodology provides a systematic approach for the selection of generic data for a national context. It can contribute to improve the reliability and the representativeness of building LCA studies when implementing the new EN 15978 standard.

6 Conclusions

This paper proposes guidelines for the selection of a coherent LCA dataset of building products to be used as generic in a national context, based on the adaptation of available LCA datasets on building products (generic, average, EPD or site-specific). These guidelines are structured within a methodology—NativeLCA, which: is wide-ranging; is straightforward in its application; is focused on the selection of a LCA dataset to be directly used by the practitioner; and applies existing state-of-the art and standards in a systematic way. NativeLCA includes consistency and representativeness verification procedures that check the meta-data of each dataset. It combines empirical averaging of existing aggregated datasets including the variability of the impact values and a data quality assessment. The use of DQI can provide a quantitative classification and corresponding ranking of available datasets in order to ease the choice of the ones that can be considered in NativeLCA. The usefulness and applicability of this approach is illustrated in the full case study for stone wool boards.

NativeLCA can be used with five different aims, such as an essential tool for the selection of a coherent LCA dataset to be used in the early design stage for construction materials or assemblies, while specific data (e.g. single manufacturer's EPDs) can be considered later in the detailed assessment of buildings. This methodology can also provide empirical impact values from different sources providing the user with the possibility of comparing different data for national or European scale for the same construction material.

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