

EeBGuide

Operational guidance for Life Cycle Assessment studies of
the Energy Efficient Buildings Initiative



Description of the course (1/4)

❖ Context

- The EeBGuide aims to provide calculation rules for the preparation of Life Cycle Assessment (LCA) studies for energy-efficient buildings and products.
- Project supported by the European Commission under the 7th Framework Programme for Research and Technological Development.
- Duration: 1 year (november 2011-october 2012)
- Project partners:



Description of the course (2/4)

❖ Context

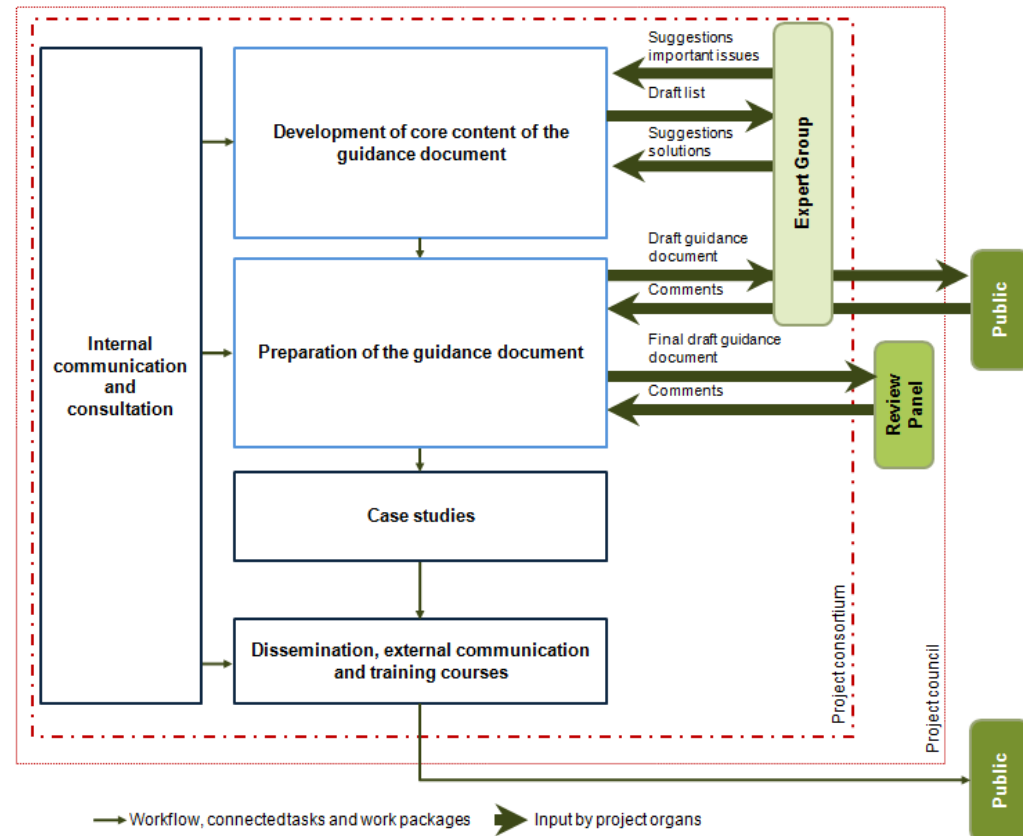
- The EeBGuide gives guidance and defines methods and provisions to conduct LCA studies within the framework of the Energy Efficient Building European Initiative (E2B EI).
- It is primarily intended to be used by LCA practitioners within research projects of the E2B Public Private Partnership (PPP).



Description of the course (3/4)

❖ Context

- The guide has been developed with a strong focus on applicability. Therefore, stakeholders and LCA experts have been involved in its development.



Description of the course (4/4)

❖ **Aim**

- Dissemination of the EeBGuide contents to stakeholders and interested parties within the European Union and at the international level.
- Training of professionals and potential users in the application of the EeBGuide to conduct LCA studies buildings and construction products.

❖ **Audience**

- Practitioners and potential users of LCA in industry and research.

❖ **Method**

- Lectures and discussion of examples.

Contents of the course (1/4)

❖ Introduction to EeBGuide

- Life Cycle Assessment Studies in the construction sector.
- LCA studies within E2B EI / EeB PPP.
- EeBGuide within the European context of sustainable construction.
- Who is addressed by the EeBGuide?

❖ Methodological approach

- Identification of important aspects.
- Procedure for choosing provisions.
- EeBGuide provisions: strictness vs. flexibility.
- Use of three study types: screening, simplified and complete LCA
- Use of a baseline scenario.



❖ How to use the guidance document

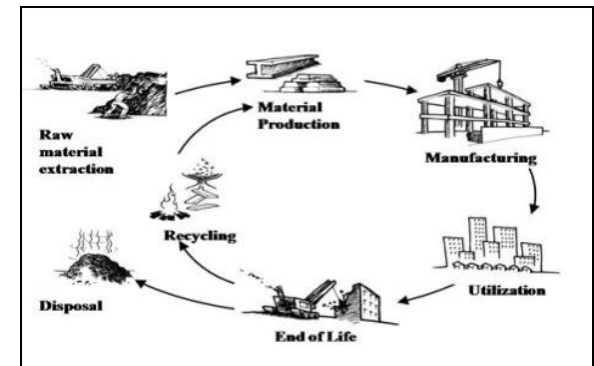
- Structure of the guidance document.
- Reporting templates.
- Compliance with EeBGuide.
- Service life planning.

Contents of the course (2/4)

----- Part: General LCA -----

❖ General provisions and guidance

- Goal definition.
- Scope definition.
- Life Cycle Inventory Analysis.
- Life Cycle Impact Assessment.
- Interpretation.
- Reporting.



Contents of the course (3/4)

----- Part A: Products -----

❖ Provisions and guidance for Products

- General aspects specific to products.
- Module A: product and construction process stages.
- Module B: use stage.
- Module C: end-of-life stage.
- Module D: benefits and loads beyond the system boundary.

❖ Application in case studies for Products

- Common building product.
- EeB product.



Contents of the course (4/4)

----- Part B: Buildings -----

❖ Provisions and guidance for Buildings

- General aspects specific to buildings.
- Module A: product and construction process stages.
- Module B: use stage.
- Module C: end-of-life stage.
- Module D: benefits and loads beyond the system boundary.

❖ Application in case studies for Buildings

- New building.
- Existing building.



❖ Perspectives and Conclusions

Overview

- I. **Introduction**
- II. Methodological approach
- III. How to use the guidance document
- IV. General provisions and guidance
- V. Provisions and guidance for products
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings
- VIII. Application in case studies for buildings
- IX. Conclusions and perspectives

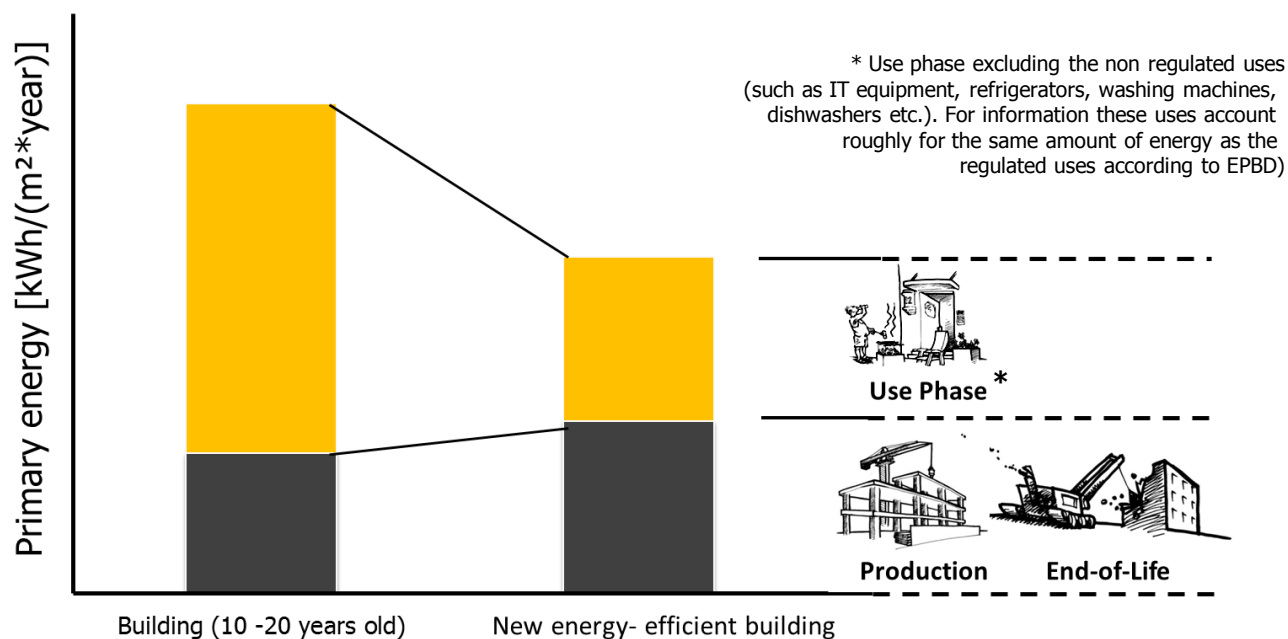


I. Introduction to the EeBGuide

- ❖ **Life Cycle Assessment Studies in the construction sector**
- ❖ **LCA studies within E2B EI / EeB PPP**
- ❖ **EeBGuide within the European context of sustainable construction**
- ❖ **Who is addressed by the EeBGuide?**

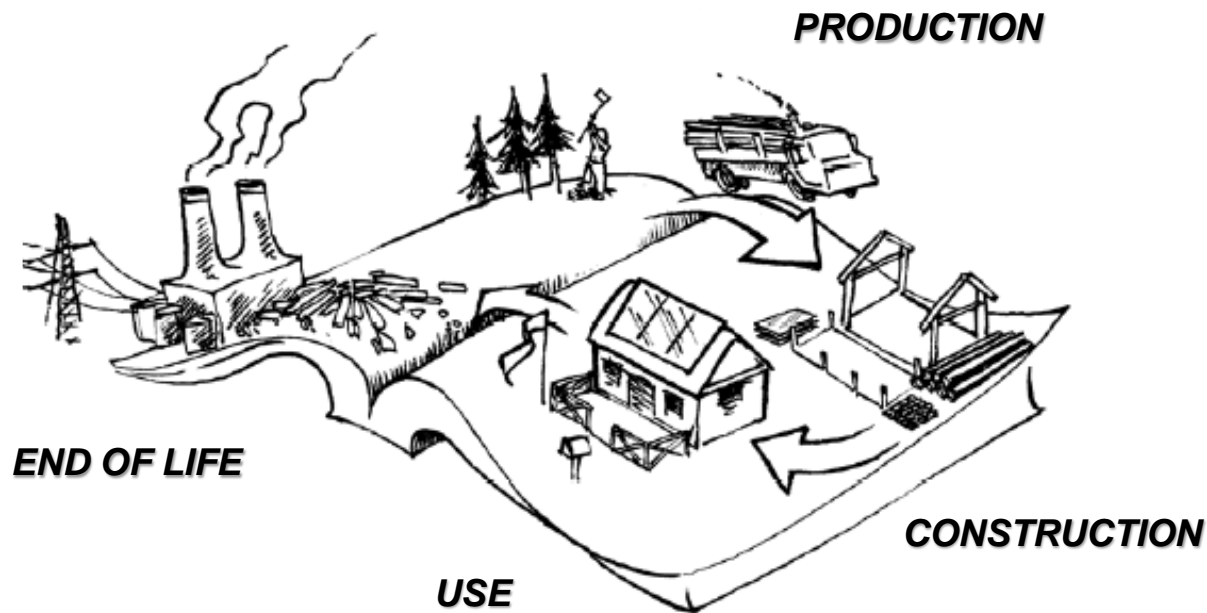
Why do we need LCA in the building sector?

- ❖ Example of ratio “use phase” vs. “production and end-of life” impacts of a building (10-20 years old) compared to a new energy-efficient building



Why do we need LCA in the building sector?

- ❖ Need of a life cycle perspective to account for both direct (e.g. use phase) but also indirect impacts (e.g. upstream and downstream processes)



LCA studies in the construction sector

❖ Sources of rules and guidance for the LCA practitioner:

- ISO 14040 Environmental management – Life cycle assessment – Principles and framework.
- ISO 14044 Environmental management – Life cycle assessment – Requirements and guidelines
- International Reference Life Cycle Data System (ILCD) Handbook.
- EN 15804 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- EN 15978 – Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method.

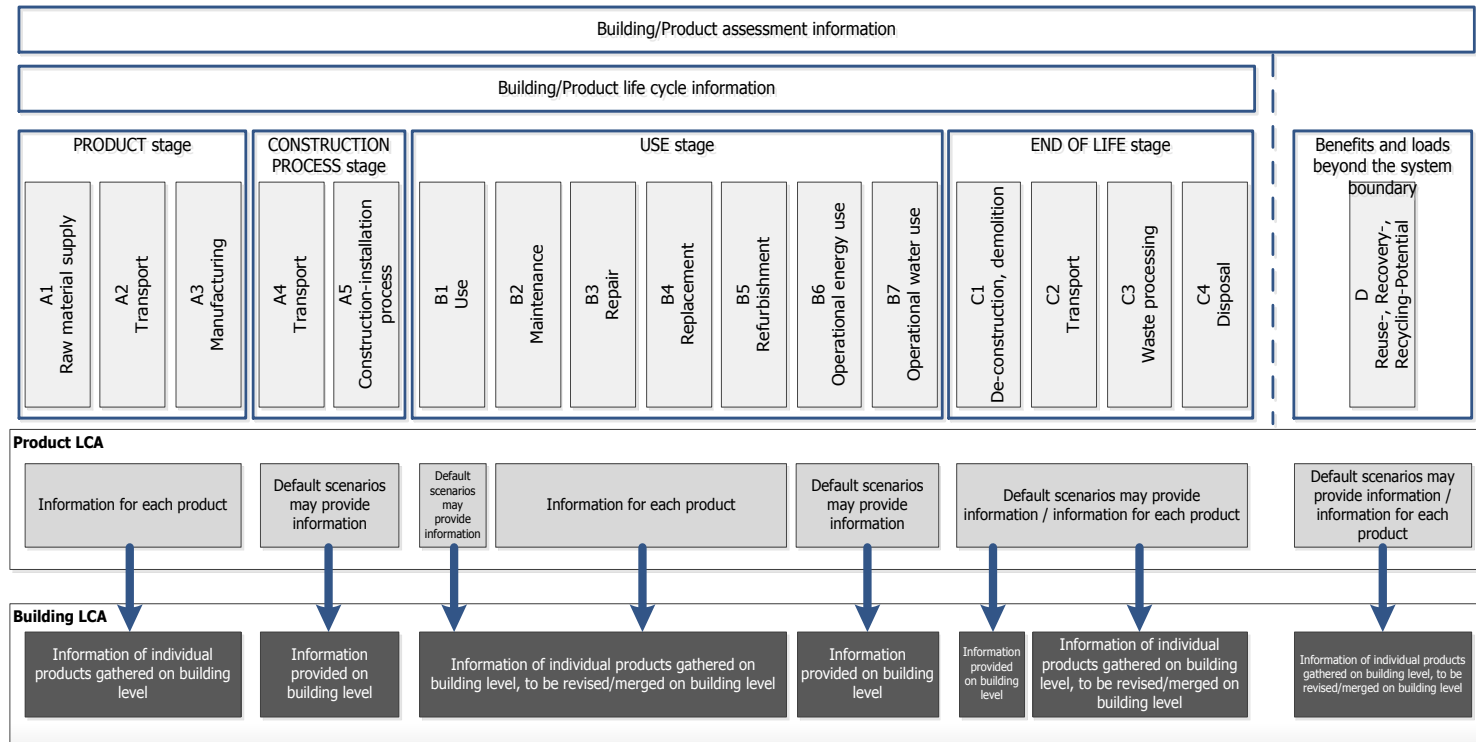
❖ Example of reference guide for LCA practitioner:

- ILCD Handbook (*International Reference Life Cycle Data System*).

The EeBGuide adopts recommendations and definitions from the ILCD handbook and adapts them to the construction sector, merging them with EN 15804 and EN 15978 standards.

LCA studies in the construction sector

- ❖ Modularity principle proposed by CEN TC 350 (Sustainability of construction works) is followed:



LCA studies within E2B EI / EeB PPP

LCA can be used as:

- ❖ Ex-post assessment of a developed technology:
 - Ensure provision of the necessary information within the work items of technology development.
 - Discuss and set realistic objectives for the LCA study and coherent with available resources.
 - Define one stand-alone work item for the LCA calculation, whereas data collection could be part of technology related work packages.
- ❖ Decision support tool within technology development:
 - Integrate LCA work as part of the technology development work item.
 - Iterative approach: gradual improvement of the data preciseness will allow more meaningful LCA results.
 - Flexibility from all actors and innovative development procedures are required to obtain a better outcome in terms of improving the environmental performance of the technology.

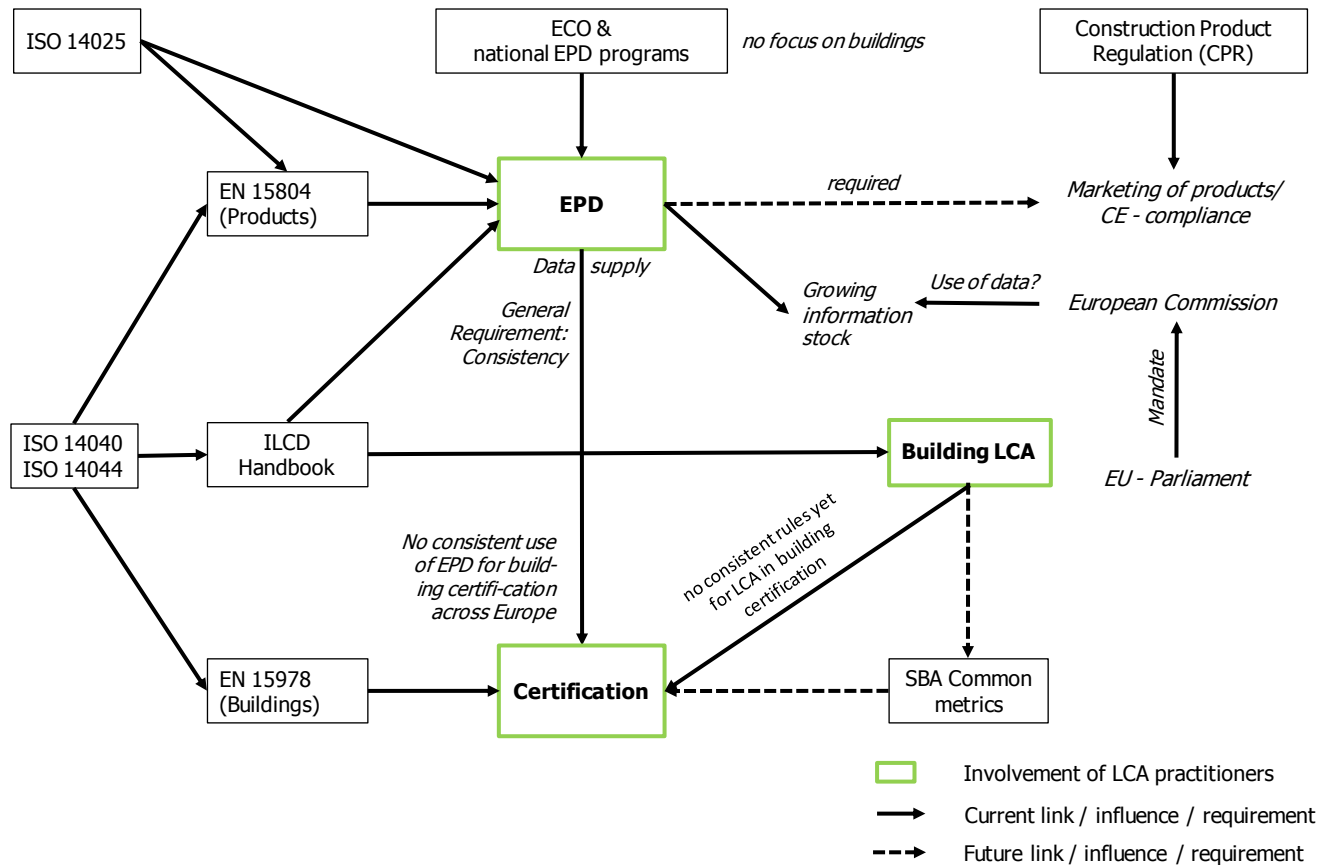
In order to maximize environmental optimization potentials, LCA should fed back into the technology development cycle.

European context of sustainable construction (1/4)

- ❖ LCA is currently used as the basis for product assessments, especially to provide Environmental Product Declarations (EPDs) used in building assessments/certification schemes.
- ❖ The Construction Products Regulation (CPR) contains additional essential requirements stating that EPDs should be used when available for the assessment of the environmental impacts of construction works.
- ❖ It is expected that these new requirements will lead to a broad delivery of product-specific environmental information by manufacturers as well as the use of LCA for assessing the environmental performance of buildings.
- ❖ Building labelling schemes use their own individual set of calculation rules for building LCA and may refer to EN 15978.

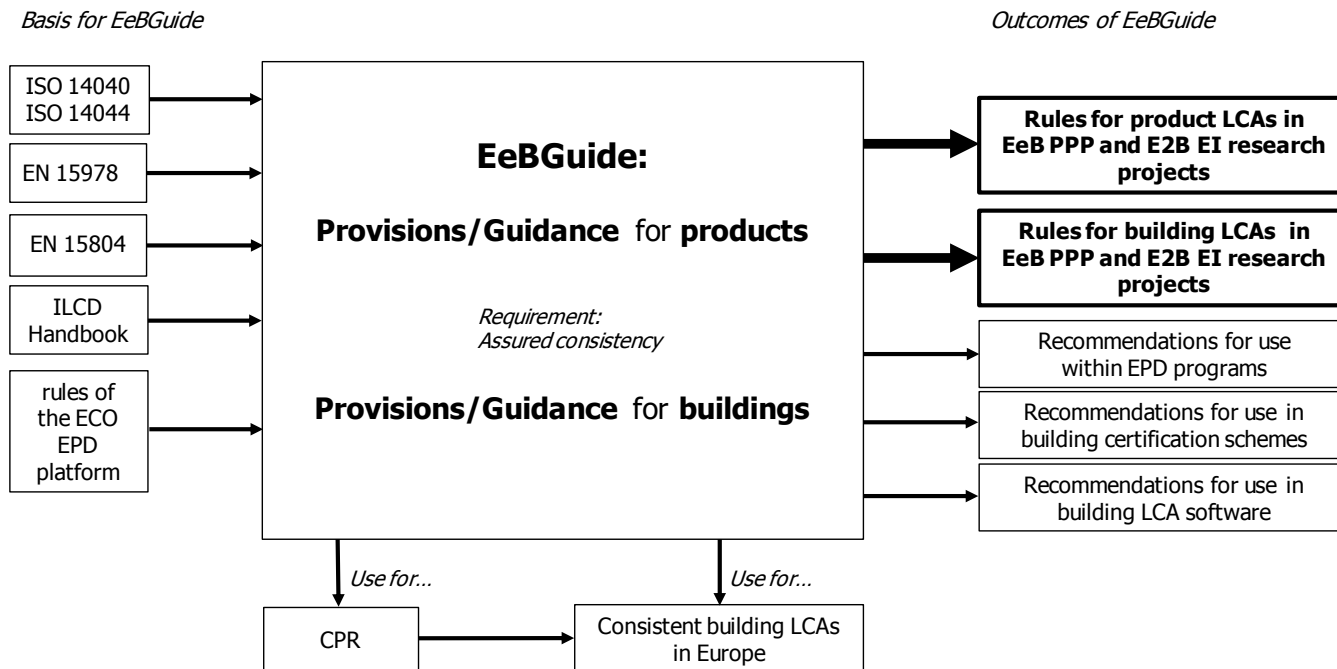
Consistency is needed between data supply (product data/EPD) and data use (building LCA).

European context of sustainable construction (2/4)



European context of sustainable construction (3/4)

EeBGuide establishes the link between the different standards, schemes and legislation within the European context:



European context of sustainable construction (4/4)

- ❖ **Impact on LCA practitioners and technology development**, assisting practitioners to perform LCA studies in a clear, pre-defined and well-structured way in order to produce more robust, harmonized and quality assured LCA results.
- ❖ **Impact on building certification schemes and national EPD programs**, fostering the integration of LCA into building schemes and providing guidance to a growing number of LCA experts and to those EPD programs developing Product Category Rules of new innovative solutions.
- ❖ **Impact on standards, legislation and political background**, filling the current gap of direct and in-detail advice for practitioners on how to conduct a LCA study.
- ❖ **Social impact**, fostering the creation of new high technology jobs and the integration of participatory approaches.
- ❖ **Impact on European competitiveness**, supporting the decoupling growth from resource depletion by delivering the framework for a consistent environmental evaluation.

Who is addressed by the EeBGuide? (1/2)

PRIMARY AUDIENCE:

LCA practitioners:

- ❖ with previous basic knowledge and practical experience (although not detailed knowledge is required),
- ❖ who are required to deliver an LCA study within an European research project, specially those falling under the EeB PPP framework.



- The goals of projects under the EeB PPP framework are:
“to deliver, implement and optimise building and district concepts that have the technical, economic and societal potential to drastically decrease energy consumption and reduce CO₂ emissions in both new and existing buildings across the European Union”
- Target audience of these projects are: researchers, companies, designers and consultants in the field of construction.

Who is addressed by the EeBGuide? (2/2)

SECONDARY AUDIENCE:

- ❖ LCA practitioners who seek practical yet scientifically sound guidance to deliver an LCA study that is, as far as possible, in line with European standards EN 15804 and EN 15978 and the ILCD handbook.
- ❖ Developers of LCA software for buildings who can use the EeBGuide to choose consistent data, methodology, reference or default values according to different study types.
- ❖ Experts responsible for the definition of calculation rules for building labelling schemes, as well as EPD programs. In such cases, EeBGuide provides generally agreed calculation methods.

For all of them, previous basic knowledge and practical experience is presumed, although not detailed knowledge is required.

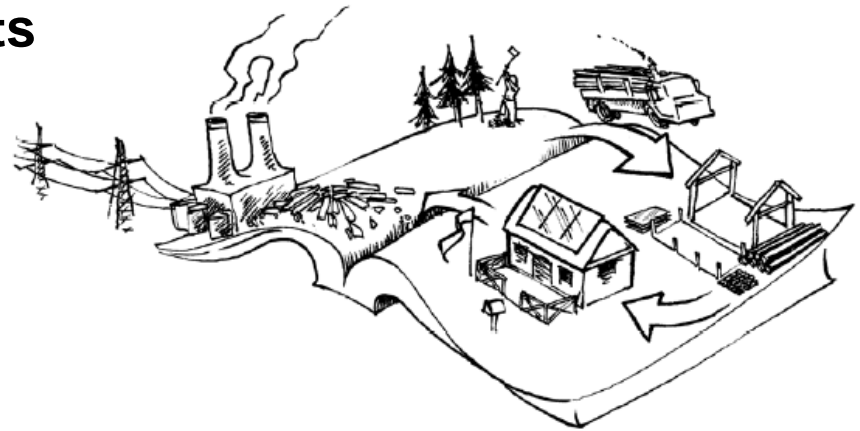
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- IX. Perspectives and conclusions



II. Methodological approach

- ❖ Identification of important aspects
- ❖ Procedure for choosing provisions
- ❖ EeBGuide provisions: strictness vs. flexibility
- ❖ Use of three study types
- ❖ Use of baseline scenario



Identification of important aspects

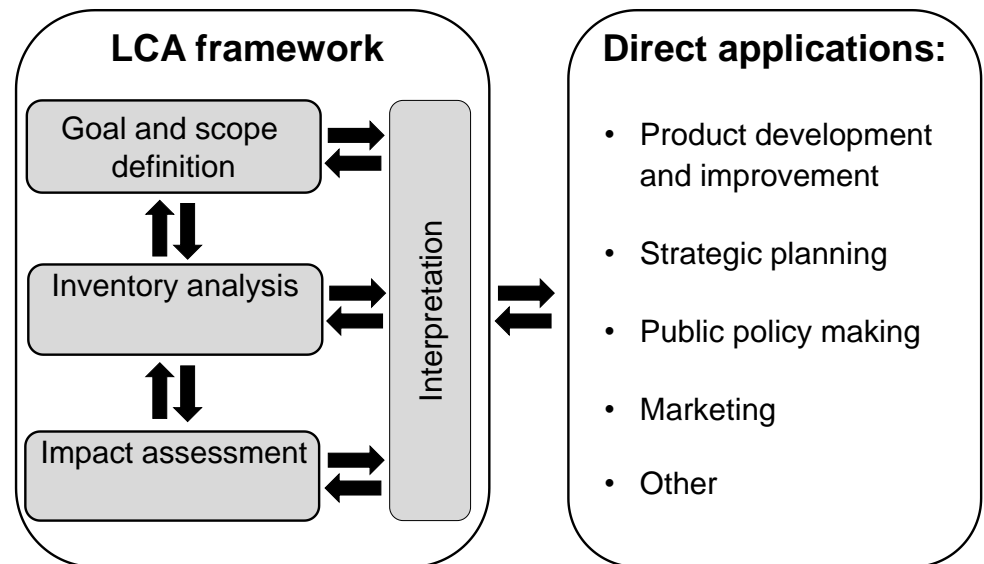
❖ Definition of an „aspect“ in EeBGuide

- Aspects: all kinds of items that need to be thought of, if one conducts an LCA study, e.g.
 - system boundaries,
 - indicators to assess,
 - background-data to use,
 - use of modelling parameters such as transport distances,
 - metrics to calculate operational energy demand,
 - rules how to calculate water consumption,
 - rules how to allocate impacts to co-products, etc.
 - ...
- Aspects may be on different levels and stages of conducting an LCA study

Identification of important aspects

❖ Using the steps of the LCA framework (ISO 14040-44):

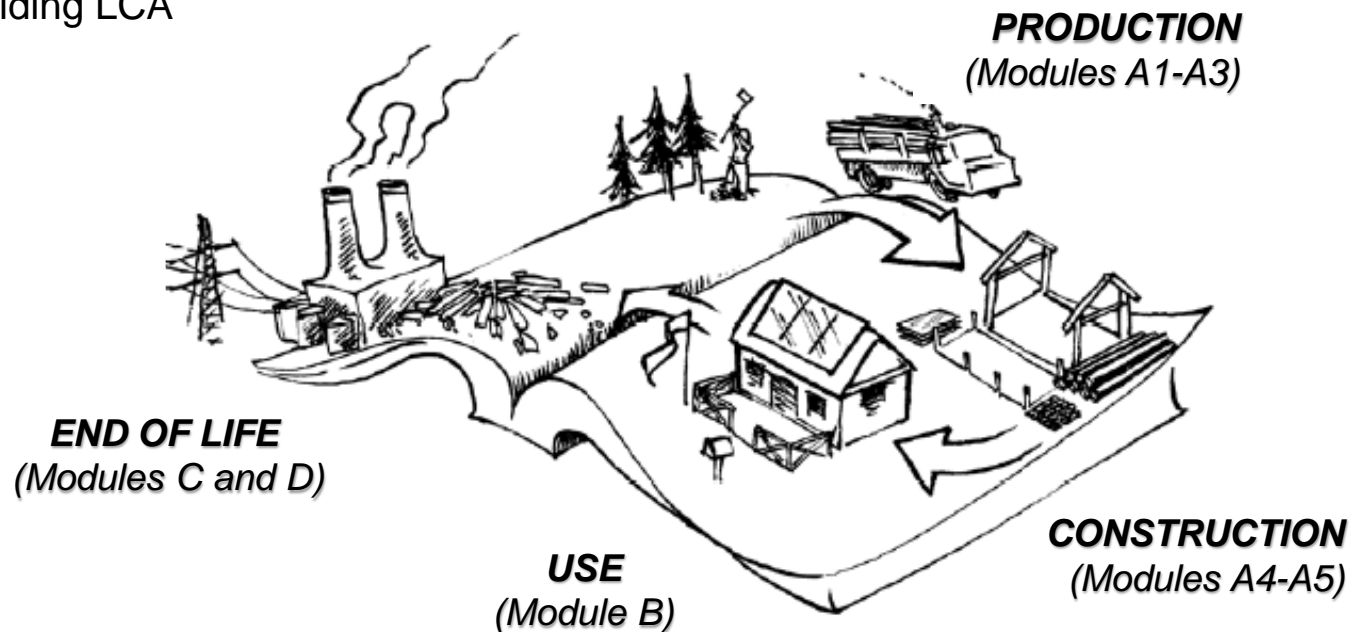
- Aspects identified for both product and building LCA



Source: ISO 14040

Identification of important aspects

- ❖ Using the conventional life cycle stages of a building (EN 15804 / EN 15978)
 - Aspects identified for both product and building LCA



Identification of important aspects

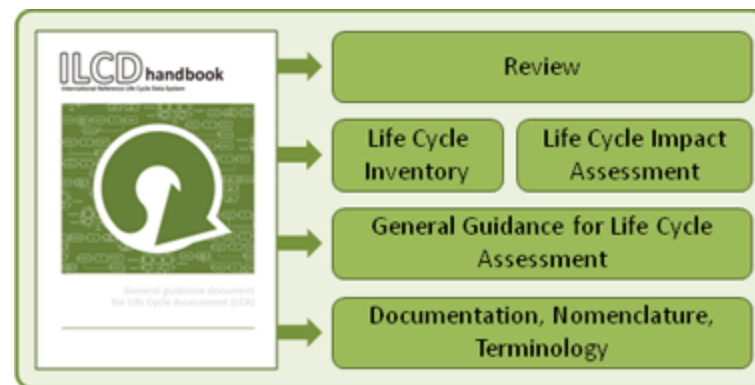
❖ Method for selecting the aspects

- Consulting literature, reference documents.
- LCA experts workshops.
- EeBGuide partners' brainstorming meetings.

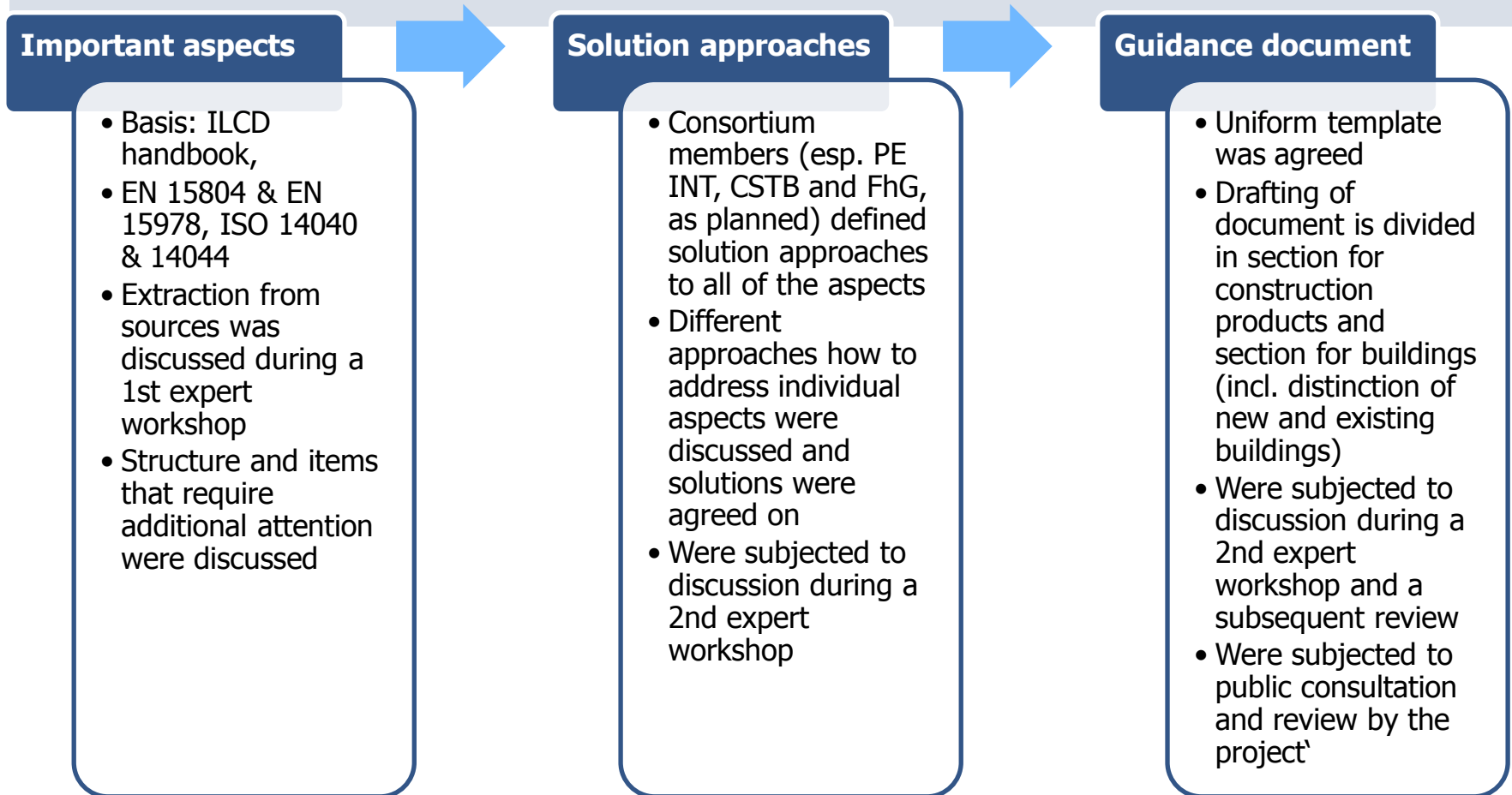


❖ Reference documents for EeBGuide:

- ISO 14040 and ISO 14044
- EN 15804
- EN 15978
- ILCD handbook
- Other scientific reports, articles.
- Other standards (e.g. ISO 15686 series).



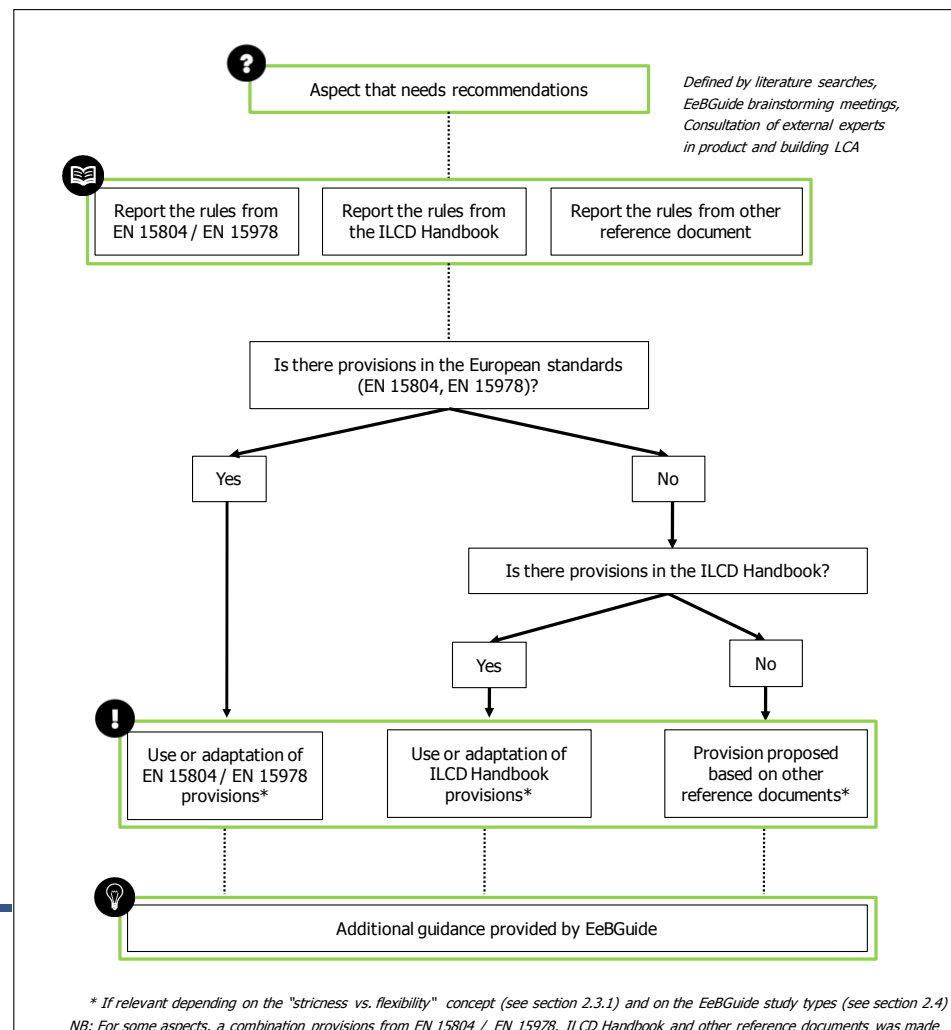
Identification of important aspects: a participatory approach



Procedure for choosing provisions

❖ Procedure for choosing provisions and guidance:

- Report the rules from Reference documents
- EeBGuide provisions based
 - TC 350 Standards
 - ILCD Handbook
 - Other documents
- EeBGuide additional guidance



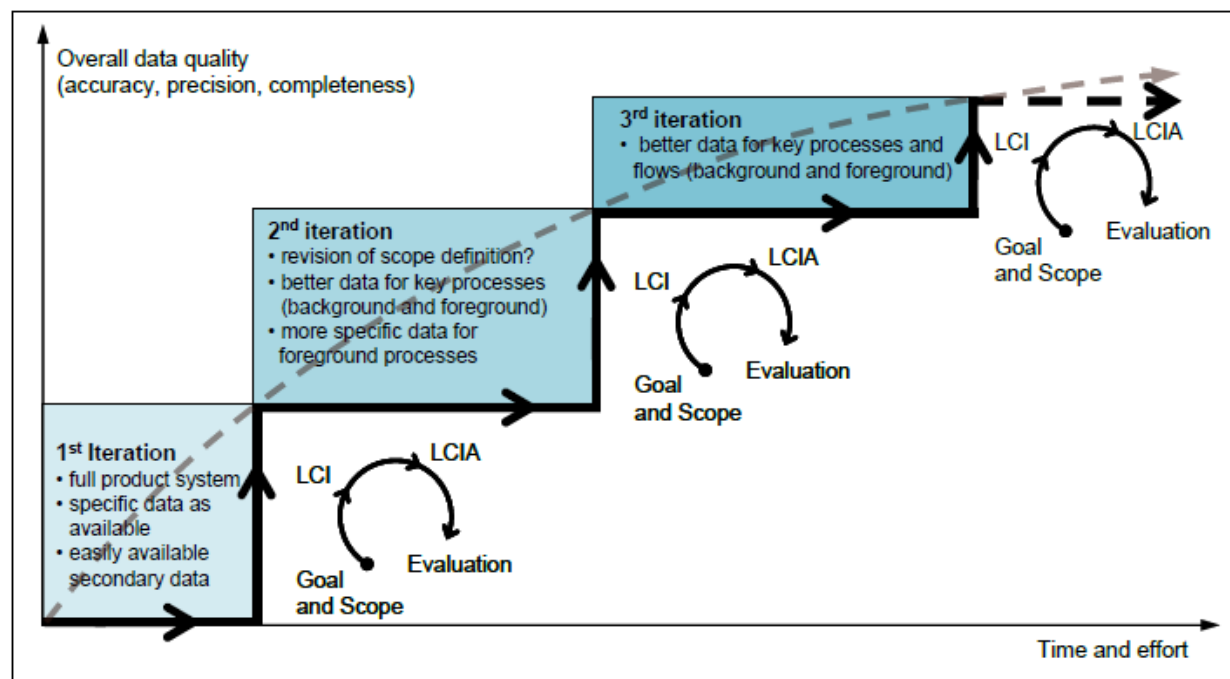
EeBGuide provisions: strictness vs. flexibility

- ❖ **LCA originally** developed as a **flexible methodology** that can be adjusted to answer different kind of questions [CALCAS 2009]. The practitioner should be aware that under specific goal definition, following the ILCD Handbook may lead to adapt the provisions given in e.g. the EN 15804 / EN 15978 standards.
- ❖ **“Strictness” perspective in EeBGuide provisions / guidance**
 - Aim at providing consistent rules for the implementation of the EN 15804 / EN 15978 standards in practice, in line with more operational projects like the SB Alliance Common Metrics. Such a perspective is more likely to fall under the secondary audience e.g. for EPD and building certification purposes (but not only).
- ❖ **“Flexibility” perspective in EeBGuide provisions / guidance**
 - EeBGuide intentions are to detail the different goal and scope definitions that can be found in practice e.g. assessing the introduction of a new technology into the market by the use of consequential modelling. Such a perspective is more likely to fall under the primary audience as E2B EI projects (but not only).

Use of three study types

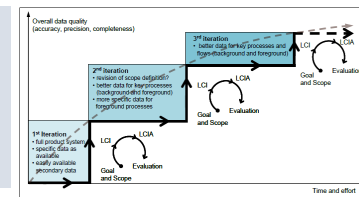
❖ Iterative nature of the LCA methodology:

- Screening LCA (1st iteration)
- Simplified LCA (2nd iteration)
- Complete LCA (3rd iteration)



Source: ILCD Handbook

Use of three study types



- ❖ EeBGuide mainly provides guidance on data types and calculation rules for both screening and simplified LCA.
- ❖ The final choice to remove a life cycle stage or a Life Cycle Impact Assessment (LCIA) indicators is left to the practitioner.

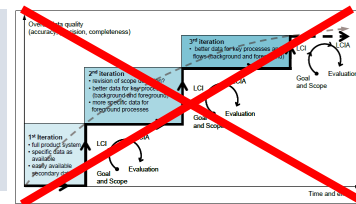
For each study types...

- Goal of the study
- Experience of the practitioner
- Data availability
- State of development of the product or building
- Etc.



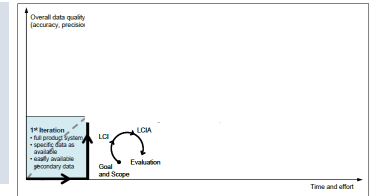
- Completeness of the assessment
- Data representativeness
- Documentation of LCA results
- Communication of LCA report

Distinction from a “focused” assessment



- ❖ It has to be noted that the concept of LCA generally has two basic connotations:
 - LCA covers the entire life cycle of a product or service.
 - LCA covers more than one environmental area of concern.
- ❖ If a practitioner does a study that only covers selected life cycle stages (outside the scope of the screening, simplified and complete LCA study types) or that only use one single indicator, it actually refers to a “Focused Assessment” and not to an LCA.
- ❖ Examples of focused assessment are e.g.:
 - Study only focused on operational energy use (B6) in order to show the results of different energy supply systems and using only one environmental indicator.
 - Study for a facility management company only focusing on maintenance (B2), repair (B3, B4) and operational water use (B7) and using only one environmental indicator.

Use of three study types: screening LCA (1/3)



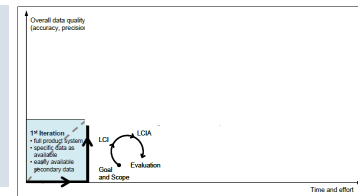
❖ Purpose:

- May serve for a initial (quick) overview on the environmental impacts of a building/product.
- It does not allow to obtain detailed results or perform public comparative assertions.
- Helpful in early design stages to identify environmental hotspots requiring an additional in-depth assessment.

❖ Completeness of the assessment:

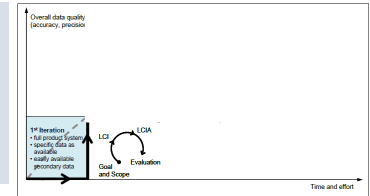
- Focused on the main contributors (be careful when considering if certain components of the system are significant or not). Module D may be included if the goal definition is to assess design for dismantling or recycling alternatives.
- Adapted calculation rules can be used (e.g. use of statistical data).
- Cut-off rules according to EN 15978, EN 15804 and ILCD Handbook may not apply, so some components can be omitted or default values can be used instead of detailed specific data.

Use of three study types: screening LCA (2/3)



- ❖ **Completeness of the assessment (following):**
 - At least two environmental indicators taken from EN 15804 / ILCD Handbook.
- ❖ **Data Representativeness:** generic assumptions according to the goal and scope of the study.
 - Geography: as far as feasible, the study should relate to the country in which the building/product is built/produced. If that is not possible, assumptions from a country with a similar context, average European data or average global data could be used.
 - Technology: as close as possible.
 - Precision: average LCA data or default values on major components should be used.
 - Consistency: qualitative assessment.
- ❖ **Documentation:** use the reporting template provided.
- ❖ **Communication:** internal purposes only (including architectural competitions), adding a statement about uncertainty of the results.

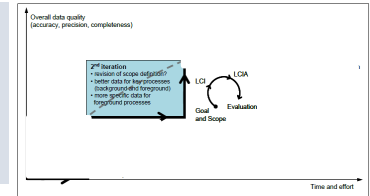
Use of three study types: screening LCA (3/3)



❖ Examples:

- Building LCA study in order to identify environmental optimization potentials in early design stages.
- Supporting documentation within an architectural competition.
- Comparison of a new innovative product and a usual one (e.g. within a company)

Use of three study types: simplified LCA (1/3)



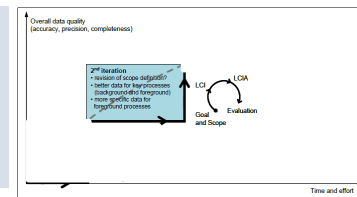
❖ Purpose:

- Quick assessments of a building/product.
- Pragmatic approach.
- In-between the screening and the complete LCA.

❖ Completeness of the assessment:

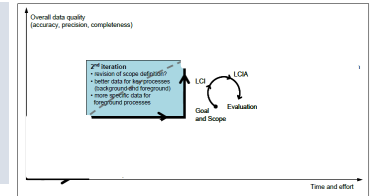
- Focused on the major contributing input materials, water and energy use.
- Adapted calculation rules should be used.
- Cut-off rules according to EN 15978 and EN 15804 may not apply, so some components can be omitted or default values can be used instead of detailed specific data.
- More comprehensive set of indicators than for the screening LCA (e.g. taken from both EN 15804 / EN 15978 and ILCD Handbook).

Use of three study types: simplified LCA (2/3)



- ❖ **Data Representativeness:** data used should be more representative of the product or building under assessment.
 - Geography: as far as feasible, the study should relate to the country in which the building/product is built/produced. If that is not possible, assumptions from a country with a similar context or average European data could be used. Global average data should be avoided whenever possible.
 - Technology: as close as possible, reasoning the selection of specific datasets.
 - Precision: specific environmental quantitative information should be used. EPDs of average product and generic LCA data may be used.
 - Consistency: qualitative assessment.
- ❖ **Documentation:** use the reporting template provided.
- ❖ **Communication:** internal or external purposes; for external communication, an independent review is needed before publication. Special precautions to take in the case of comparative assertions.

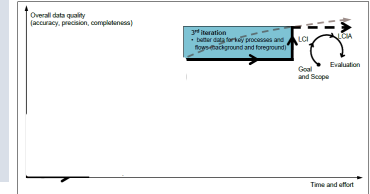
Use of three study types: simplified LCA (3/3)



❖ Examples:

- Building LCA study for labelling schemes (e.g. DGNB).
- LCA of a building conducted by a stakeholder interested in getting detailed assessment for a given life cycle stage.
- LCA for developing an environmental fact sheet for a specific product.

Use of three study types: complete LCA (1/3)



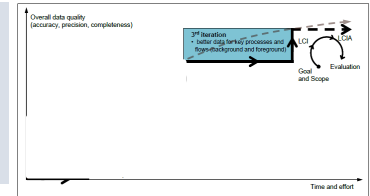
❖ Purpose:

- Regular approach to LCA following ISO 14040/14044.
- It covers the entire life cycle of the building or the product under assessment.
- It serves to identify environmental hotspots and give assurance concerning the contribution from individual life cycle stages or components of the assessed system.

❖ Completeness of the assessment:

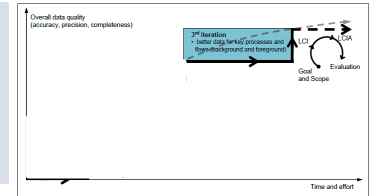
- The assessment should ideally consider the whole life cycle (from cradle to grave), as well as a relevant set of environmental impact categories according to EN 15978 and ILCD handbook. In addition, module D should be included if relevant.
- Calculation rules for the different contributors (e.g. building products, operational energy and water use) should be based on detailed methods (e.g. bottom up approach).
- Cut-off rules recommended by ILCD Handbook should be followed (stricter than the ones derived from EN 15804 and EN 15978).

Use of three study types: complete LCA (2/3)



- ❖ **Data Representativeness:** an appropriate level of data representativeness must be ensured.
 - Geography: LCI data should represent the country in which the material is sold or in which the process takes place.
 - Technology: LCI data should reflect the applicable technology.
 - Precision: Specific descriptions of the products should be used.
 - Consistency: qualitative assessment should be made.
- ❖ **Documentation:** use the reporting template provided.
- ❖ **Communication:** internal or external purposes. For external communication, an independent review/verification is needed before publication. In the case of comparative assertions intended to be disclosed to the public, a critical review by a panel of interested parties shall be conducted.

Use of three study types: complete LCA (3/3)



❖ Examples:

- Comparative LCA study of different buildings or building designs.
- Selection of the most appropriate construction strategy for the refurbishment of a building's envelope.
- Detailed identification of the environmental hotspots of a product or a building.

Use of baseline scenario

- ❖ A baseline scenario is provided in order to facilitate the comparison of LCA studies within European research projects, as LCA final results can be deviated due to the use of different set of parameters values.
 - Its use is suggested but not mandatory for all LCA studies conducted within E2B EI projects / EeB PPP.
 - The application of this scenario does not imply a total comparability of all LCA studies done in different E2B EI / EeB PPP projects as works would be needed for other parameters.
 - Other baseline scenario can be defined depending on the goal/scope of the study.

Parameter	Standard parameter value
Reference study period	50 years
LCA data for electricity consumption	European (annual) average datasets or national (annual) average data if more relevant for the study
Future technological developments (modules B, C & D)	No future technological developments are assessed, currently used technology is the basis for the assessment
Average transportation distance in Europe for Module A4	300 km ¹
Carbon storage	Carbon storage is not considered
End of Life scenarios (modules C & D)	Use contemporary percentages for each building material (do not use probabilistic scenario)

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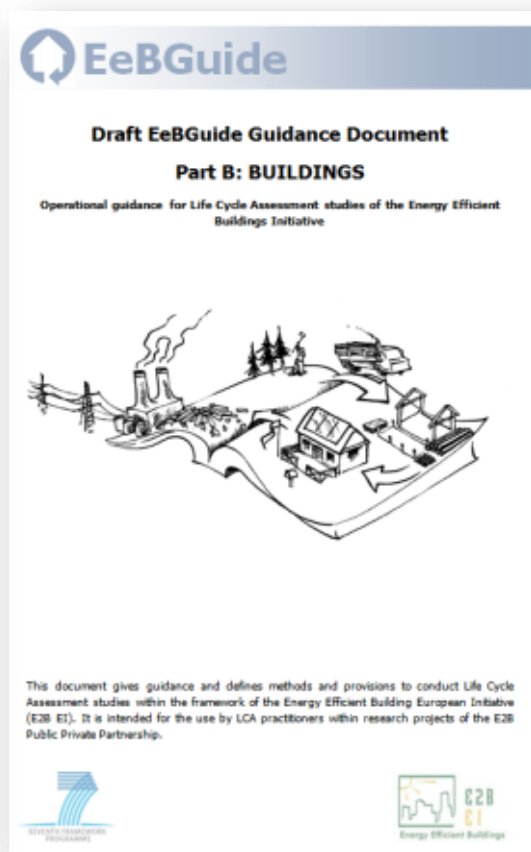


III. How to use the guidance document

- ❖ **Structure of the guidance document**
- ❖ **Reporting templates**
- ❖ **Compliance with EeBGuide**
- ❖ **Service life planning**



Structure of the guidance document



- ❖ Two documents:
- ❖ Part A (products*)
- ❖ Part B (buildings)

- ❖ Each document structured according to the life cycle stages and LCA methodology.

* Covering all building related construction products, materials, components and services.

Structure of the guidance document

Building Assessment Information			
Life cycle stage modules		Name of the sub-module	
Building life cycle information	PRODUCT stage	A1	Raw material supply
		A2	Transport
		A3	Manufacturing
	CONSTRUCTION PROCESS stage	A4	Transport
		A5	Construction, installation processes
	USE stage	B1	Use
		B2	Maintenance
		B3	Repair
		B4	Replacement
		B5	Refurbishment
		B6	Operational energy use
		B7	Operational water use
	END OF LIFE stage	C1	De-construction, demolition
		C2	Transport
		C3	Waste processing
		C4	Disposal
Suppl. information beyond the life cycle	Benefits and loads beyond the system boundary	D	Reuse-, recovery- and/or, recycling potentials- potential

Structure of the guidance document

Section

-
- 1. Introduction
 - 2. Methodological approach for EeBGuide
 - 3. How to use this guidance document

Common contents
for Part A & Part B

- 3. General aspects
- 4. Aspects concerning Module A
- 5. Aspects concerning Module B
- 6. Aspects concerning Module C
- 7. Aspects concerning Module D

Specific and different contents for
products (Part A) and buildings (Part B)

Additional information

Glossary

Literature

Structure of the guidance document

Overview of the template for reporting each important aspect	
Name of the aspect	
Description of the aspect	
Related study objective	<ul style="list-style-type: none"> - stand-alone LCA - comparative assertion
Related study phase	<ul style="list-style-type: none"> - goal and scope definition - life cycle inventory (LCI) analysis - life cycle impact assessment (LCIA) - interpretation - reporting
Relevant for (study type)	<ul style="list-style-type: none"> - screening LCA - simplified LCA - complete LCA
Relevant for (product/building)	<ul style="list-style-type: none"> - new buildings - existing buildings - building products
Provisions	
Rules from	<ul style="list-style-type: none"> - EN 15978 - EN 15804 - ILCD Handbook - ISO 14044
Guidance	

Structure of the guidance document

❖ Template for reporting an important aspect





- **Description:** The aspect is briefly described and the main problem is pointed out.
- **Provisions*:** If possible, provisions are given, mainly referred to European standards (EN 15978 and EN 15804) or the ILCD Handbook.
- **Rules from:** Links to further literature are provided.
- **Guidance:** Operational guidance is given to every problematic aspect.

* Provisions are usually mandatory for European research projects. Used in other context, provisions can serve as guidance or information source.

Aspect		B- 01 "Building services"				
Description		How and if to consider building services (e.g. ESCOs, Landlord, etc.), energy performance contracting?				
related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> construction products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA	<input checked="" type="checkbox"/> complete LCA
Provisions		Relevant for LCA studies are the upstream energy supply mechanisms that need to be reflected adequately and the energy demand of a building. Any business models of how the energy is provided are only of relevance, if the technical energy supply is affected.				
Rules from:						
EN 15978:		7.4.4 Boundaries of the use stage (Modules B1 - B7) 7.4.4.1 General				
EN 15804:		6.2.4 B1-B5, Use stage, information modules related to the building fabric 6.2.5 B6-B7, use stage, information modules related to the operation of the building				
ILCD:		not mentioned				
Guidance		Different economic models, e.g. of energy supply and their technical consequences could be assessed by means of scenario analysis. It should be noted that for an LCA study, the economic model behind an operation is not the decisive point, but technical consequences out of different economic models.				






Structure of the guidance document

Description of icons for assisting navigation (1/5)

Icon	Meaning
	Description of the aspect: The aspect of concern is described and the critical points are highlighted, the typical question within this context may be provided.
	Provision of a solution: How to address the aspect of concern is given here.
	Reference to standards: Further references to standards such as ISO 14040, ISO 14044, EN 15978 or EN 15804 are provided.
	Guidance on the aspect: Guidance is given on aspects for which there is no single solution or where additional explanations are helpful.




Structure of the guidance document

Description of icons for assisting navigation (2/5)

Icon	Meaning
	Section “General”: Aspects that relate not to a single life cycle stage but cover several stages or are independent of individual life cycle stages are grouped in the section “General”.
	Module “A” according to CEN TC 350 (EN 15804 and EN 15978): Aspects that relate to life cycle stage A (Product stage and Construction stage) are grouped here.
	Module “B” according to CEN TC 350 (EN 15804 and EN 15978): Aspects that relate to life cycle stage B (Use stage) are grouped here.
	Module “C” according to CEN TC 350 (EN 15804 and EN 15978): Aspects that relate to life cycle stage C (End of Life stage) are grouped here.
	Module “D” according to CEN TC 350 (EN 15804 and EN 15978): Aspects that relate to issues beyond life cycle studied (Benefits and loads beyond the system boundaries) are grouped here.




Structure of the guidance document

Description of icons for assisting navigation (3/5)

Icon	Meaning
	Aspect refers to “new buildings”: Aspects that relate to new buildings are mentioned here.
	Aspect refers to “existing buildings”: Aspects that relate to existing buildings are mentioned here.
	Aspect refers to “products”: Aspects that relate to products, materials, components and services are mentioned here.




Structure of the guidance document

Description of icons for assisting navigation (4/5)

Icon	Meaning
	Screening: Aspects are sorted by the study type that they apply to. This icon symbolizes whether an aspect is important for a “screening” LCA (see Table 3 for definition of “screening”).
	Simplified: Aspects are sorted by the study type that they apply to. This icon symbolizes whether an aspect is important for a “simplified” LCA (see Table 3 for definition of “simplified”).
	Complete: Aspects are sorted by the study type that they apply to. This icon symbolizes whether an aspect is important for a “complete” LCA (see Table 3 for definition of “complete”).

Structure of the guidance document

Description of icons for assisting navigation (5/5)

Icon	Meaning
	Applicable: If the icon has a black background the aspect is relevant for that scope (e.g. aspect is relevant for “new buildings”).
	Can be applied: If the icon has a grey background the definition can be relevant for that aspects (e.g. aspect is applicable for “existing buildings”, but can if needed be also applied for “new buildings”).
	Not applicable: If the icon has a grey background and is crossed the definition is not relevant for that aspect (e.g. aspect is not concerning “new buildings”).

Structure of the guidance document

❖ Online InfoHub

- The Info Hub simplifies the guidance document by directing users through the guidance materials, highlighting specific sections according to their purpose and requirements.

❖ Forum of users

- The purpose of the forum of users is to inform LCA and building interested practitioners about the project but also to create a forum for the exchange between practitioners concerning the choice of data, calculation rules, building LCA software, interpretation of results.

www.eebguide.eu



The screenshot shows the EeBGuide Project website. The header includes the EeBGuide Project logo and the text "Operational Guidance for Life Cycle Assessment Studies of the Energy Efficient Buildings Initiative". A navigation bar contains links: Home, Project Overview, Management Structure, Work Packages, Events, Media Centre, Consultation, and InfoHub. The main content area is titled "InfoHub" and describes its purpose: "The purpose of the Info Hub is to disseminate the guidance and supporting materials developed to support the guide." It also states that it will serve as a central information hub for LCA studies related to the "Energy efficient Buildings Public Private Partnership (EeB Initiative)". On the right, there is a logo for the European Commission Research & Innovation Environment, funded by the Seventh Framework Programme for Research (FP7). Below the main content, there is a section for "Construction21.eu EUROPE" with the tagline "The European platform for green building practitioners". This section includes a navigation bar with links: HOME, NEWS, CASE STUDIES, PRODUCTS, MEMBERS, COMPANIES, and WHO WE ARE. Below this, it mentions the "EeBGuide Group" and lists details: "Community details", "Created 11/05/2012", "Community manager: Johannes Gartner", "Members: 14", "Local communities: 1", and "Open community". It also states the mission: "Thematic: Building energy efficiency technologies and materials" and provides the website URL: "http://www.eebguide.eu" and the internet focus: "Building and product LCA guideline development".

www.construction21.eu

Structure of the guidance document

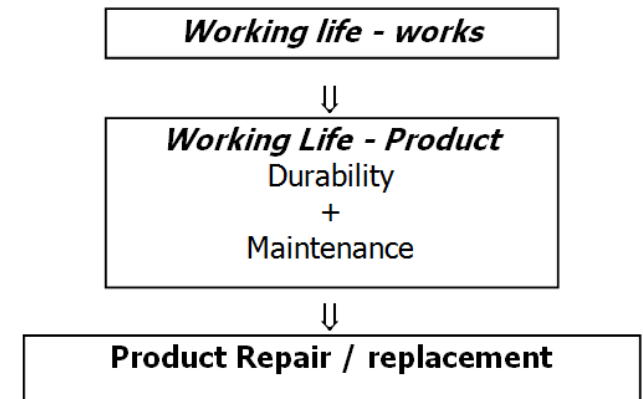
Navigation in the document (printed or online version)

- Selection of the scale of the assessment (product, building)
- Selection of the study type (screening, simplified, complete LCA)
- Selection of the life cycle stage of a building to consider



Service Life planning (1/2)

- ❖ LCA studies in the constructions sector often entails the assessment of technical systems with a typically very long service life.
- ❖ Its duration may have a significant influence on the LCA results.
- ❖ Buildings parts not accessible from a technical and economical point of view should be designed for the same service life as the building.
- ❖ Other building parts and products may have a shorter service life.



Service Life planning (2/2)

- ❖ ISO 15686 (Part 8) standard describes the requirements on Reference Service Life (RSL) of products and components.
- ❖ The RSL should be adjusted in the design process to establish the service life of a product/component in a particular use or situation.
- ❖ The responsibility for providing RSLs for products lies mainly with producers of the product in question.

Planned Service Life

(a $X = Y$ years)

Building Design Life: Y years

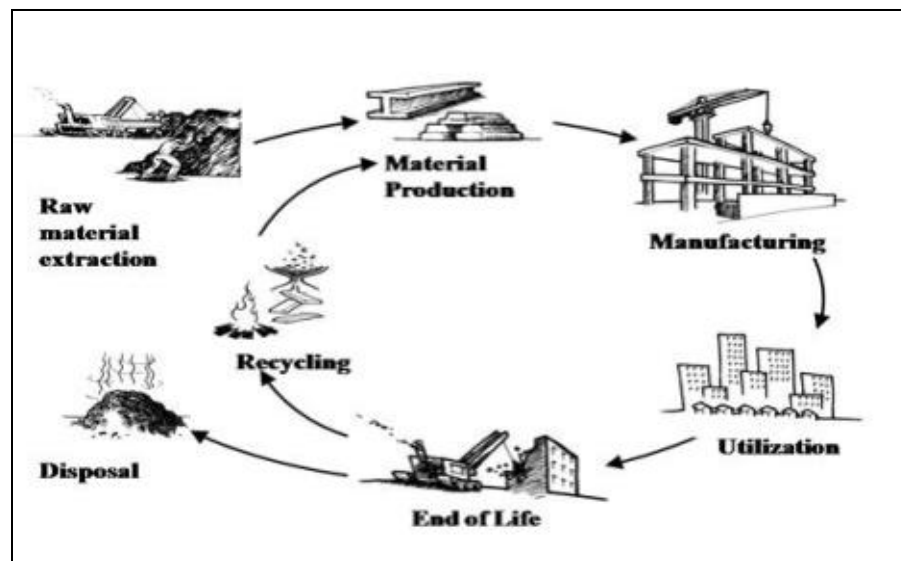
Building Parts, not repairable: Y years

Building parts, repairable: X years

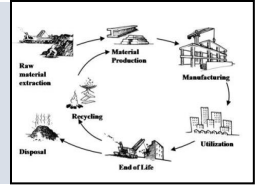
EeBGuide

Operational guidance for Life Cycle Assessment studies of the Energy Efficient Buildings Initiative

Part: General LCA



Description of part: General LCA of this course



❖ Context

- LCA studies at the product and building scale

❖ Aim

- To help LCA practitioners to perform product and building LCA studies in a more harmonised way
- To bring them knowledge and guidance from the LCA community in order to improve their practice and the quality of their studies

❖ Audience

- Product and building LCA practitioners...
- ...involved in European research projects

❖ Method

- Selection of key general LCA aspects with provisions and recommendations
- “stand-alone” slides as far as possible

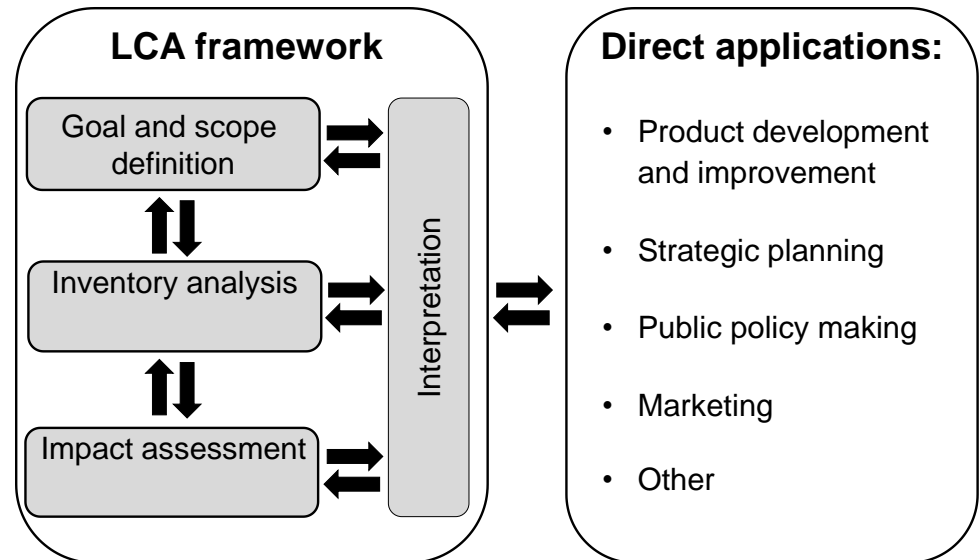
Overview

- I. Introduction
- II. Methodological approach
- III. How to use the guidance document
- IV. General provisions and guidance**
- V. Provisions and guidance for products
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings
- VIII. Application in case studies for buildings
- IX. Conclusions and perspectives



IV – General provisions and guidance

- ❖ **Goal definition**
- ❖ **Scope definition**
- ❖ **Life Cycle Inventory Analysis**
- ❖ **Life Cycle Impact Assessment**
- ❖ **Interpretation**
- ❖ **Reporting**



General aspects: goal definition

Goal definition

Scope
definition

Inventory
analysis

Impact
assessment

Interpretation

Reporting







- ❖ **G-01 Goal definition for building and product LCA**
- ❖ **G-02 Classifying the decision-context as situations A, B and C for building and product LCA**
- ❖ G-03 Future technical developments and innovation
- ❖ **G-04 Comparative assertion for building and product LCA**

← *overview*

← *overview*

← *overview*

G-01 Goal definition for building and product LCA (1/2)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					
					complete LCA

The goal definition of a study is a key LCA requirement as it guides all the detailed aspects of the scope definition which then determined LCI and LCIA provisions. Decisions made in this first step will influence the study results and applicability. It has to be documented in details.

? How can the practitioner set up the goal of the study?



ILCD Handbook: the context and the intended use of the assessment should be defined. Aspects to define: intended applications, limitations, reasons, target audience, comparisons involved (if any), and commissioner.







❖ Goal definition is crucial and has implications for:


- Scope of the study
- Life cycle inventory analysis
- Impact assessment
- Interpretation
- Reporting / Critical review
- All life cycle stage aspects for products.




As a result, Goal definition is connected to all the provisions/guidance provided in EeB Guide

G-01 Goal definition for building and product LCA (2/2)

<i>related study objective</i>	<input checked="" type="checkbox"/> stand-alone LCA			<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

- 

For building LCA, EN 15978 guidance should be used by LCA practitioners to define the goal and scope of the study.
- 

The EeBGuide reporting templates for screening, simplified and complete LCA can be used in the definition and documentation of the goal of a LCA study. However, the study type may be adjusted by the practitioner.
- ❖ **Examples for product LCA studies:**

 - To provide EPD in an harmonized way so it can be used for building LCA (EN 15804).
 - Orientation of product ecodesign choices within a company.
- ❖ **Examples for building LCA studies (EN 15978):**

 - Assistance in a decision-making process (comparing different building design).
 - Declaring performance with respect to environmental regulations / labelling schemes.

G-02 Classifying the decision-context as situations A, B and C (ILCD Handbook) for product and building LCA (1/3)

related study objective		stand-alone LCA		comparative assertion	
related study phase	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	new buildings	existing buildings	building products	screening LCA	simplified LCA
				complete LCA	

❖ LCA is a flexible methodology that can be adjusted to answer different goals. The ILCD Handbook distinguishes different decision contexts for LCA studies, as part of the goal and scope definition.

- Generally speaking, most LCA studies have used the so-called « attributional » modeling perspective. It enables to calculate average impact of a product or a process. The ILCD Handbook refers to it as “**situation A**”
- Consequential LCA** enables to assess the consequence of a decision choice that potentially have a large effect on the market (e. g. implementation of a new regulation, massiv spread of renewable energies in a national context and its effect on the grid mix). The ILCD Handbook refers to it as “**situation B**”.

? Which situation study has to be applied for product or building LCA?

Decision support?	Yes	Kind of process-changes in background system / other systems	
		None or small-scale	Large-scale
		Situation A "Micro-level decision support"	Situation B "Meso/macro-level decision support"
No	Situation C "Accounting" (with C1: including interactions with other systems, C2: excluding interactions with other systems)		

Source: ILCD Handbook

G-02 Classifying the decision-context as situations A, B and C (ILCD Handbook) for product and building LCA (2/3)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

- ❖ **Use situation A (attributional LCA) for:**
 - Ecodesign of an individual product or building.
 - Development of Product Category Rules or Environmental Product Declarations.
- ❖ **Use situation B (consequential LCA) for:**
 - Building sector assessment and/or policy development (e.g. assessment of marginal effects of a wide spread development of renewable energies; assessment of the entire building stock of a certain region).
- ❖ Situation C is unclear within the building sector, as even internal LCA studies are oriented to support decisions.
- ❖ The use of situation A or B should be justified providing evidences on the possible modifications on the background system.
- ❖ EN 15804 and EN 15978 only relate to attributional LCA studies (situation A).
- ❖ Situation B requires appropriate LCI data, the identification of market mechanisms and affected processes that should be included in the system boundaries.

G-02 Classifying the decision-context as situations A, B and C (ILCD Handbook) for product and building LCA (3/3)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

❖ Example of consequential studies in national contexts:

- French context: examples are the assessment of the marginal effect of electric heating in winter due to peak demand leading to restart fossil electric power plant (marginal increase of CO2 emissions of the French grid mix).

❖ Other examples of consequential studies:

- Assessment of the marginal effects of the prohibition of light bulbs (e.g. within the EU)
- Assessment of the marginal effects of electromobility vs. current mobility.
- Assessment of the increased use of bio-fuel (vs. food).

G-04 Comparative assertion for building and product LCA (1/2)

related study objective		<input type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

Meaningful and robust comparative assertion requires the consideration of certain aspects.

? How a comparative assertion can be done in buildings LCA applications?

! The equivalence of systems being compared shall be ensured. According to ISO 14044 and ILCD: the same functional unit, system boundary, data quality requirements and allocation procedures have to be applied.

❖ EN 15978 provides rules to be considered in the comparison of buildings.

💡 1) Comparative assertion for product LCA based on EN 15804 in E2B EI research projects

- Follow EN 15804 provisions for comparisons between regular and innovative products.
- Under specific conditions, comparative assertion may be done following EN 157804 provisions if the product model is from cradle to grave. Check with ILCD provisions (*section 6.10 “Comparison between systems”*) to complement EN 15804 rules.

G-04 Comparative assertion for building and product LCA (2/2)

<i>related study objective</i>		<input type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

2) Practical guidance when comparing building design alternatives

- ❖ Comparative assertions are conducted to choose among design alternatives during the early design stages of a building project.
- ❖ Users, that may be not LCA experts, shall rely on the same software when comparing two building alternatives.
- ❖ Generally speaking, LCA software for buildings contain built-in methodological choices and background databases.
- ❖ The user should check reports and user manuals of the software to check for compliance with EeBGuide provisions (and if needed ILCD Handbook and EN 15978) for comparative assertions.
- ❖ Complementary information on the use of LCA in building design can be found in a previous European project (deliverable available online: www.sintef.no/project/LoRe-LCA/Deliverables/LoRE-LCA-WP4-D4.1-KTH-report_20111213.pdf)





General aspects: scope definition

Goal definition

Scope
definition

Inventory
analysis

Impact
assessment

Interpretation

Reporting

- ❖ G- 05 Scope definition for building and product LCA
- ❖ G- 07 Functional equivalent vs. functional unit vs. declared unit
- ❖ **G- 11 Cut-off rules for screening, simplified, complete LCA**
- ❖ G- 13/G-14 Infrastructure machinery and capital equipment for material production, energy, water, waste and transport for screening, simplified and complete LCA
- ❖ G- 15 Transport of goods in LCA studies
- ❖ G- 16 Accounting for carbon storage / carbon sequestration
- ❖ G- 17 Differences in background data system boundaries
- ❖ G- 18 Allocation
- ❖ G- 19 Allocation case: production of renewable energy on-site
- ❖ G- 20 Allocation case: reuse, recycling and recovery

overview



G-11 Cut-off rules (1/2)

related study objective		B3 stand-alone LCA		B3 comparative assertion	
related study phase	B3 goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input type="checkbox"/> screening LCA	<input type="checkbox"/> simplified LCA
				<input type="checkbox"/> complete LCA	

Non-relevant life cycle stages, specific processes and flows can be omitted from the system model. The apparent paradox is that one must know the final result of the LCA in order to decide if those elements are relevant or not.

? What should be the cut-off rules for a product or building LCA?

- ❖ **EN 15804 / EN 15978:** “materials and processes can be omitted if the process contributes with less than 1% of mass or primary energy of the total, and all excluded materials and processes do not exceed 5% of total energy use and mass”.
- ❖ **Cut-off rules should not be used to hide results.**
 - The standard states that “all inputs and outputs to a (unit) process shall be included in the calculation, for which data are available”, this avoids an arbitrary removal of processes..
- ❖ **Specific guidance for product LCA studies:**
 - Refer to existing cut-off rules in the background LCI database (no need to modify it).
 - It is recommended to account for the available LCI and do not systematically neglect input flows.
 - Cut-off rules should be extended in complete LCA studies to account for ILCD provisions.

G-11 Cut-off rules (2/2)

related study objective		stand-alone LCA		comparative assertion		
related study phase	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting	
relevant for	new buildings	existing buildings	building products	screening LCA	simplified LCA	complete LCA

❖ Specific guidance for product LCA studies (cont'd):

- Cut-off rules can be defined for the exclusion of capital equipment or ancillary materials.
- Practical guidance can be found in dedicated PCR for building products and technical equipment.

❖ Specific guidance for building LCA studies:

- In that case, the practitioner is likely to use already LCA or EPD data which have been calculated applying cut-off rules.
- The cut-off rules should be used differently in the case of screening, simplified and complete LCA studies.

❖ Specific guidance for screening and simplified LCA studies:

- Cut-off rules are less strict as for complete LCA studies, but omissions have to be justified by practitioners (e.g. due to potentially missing data).
- It is recommended to use default values as far as possible for optional building products, limiting the cut-off rules even for screening and simplified studies while easing the completion of the study.



General aspects: inventory analysis

Goal definition

Scope
definition

**Inventory
analysis**

Impact
assessment







Interpretation

Reporting

❖ G- 21 Background databases in LCA studies

❖ **G- 22 Data quality**  *overview*

G-21 Data Quality







<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

Data quality is a relative concept (the data can be of good quality for the context X while of bad quality for the context Y); the quality of data has to be justified transparently in the context of its use.

? How should the quality of LCA data be described?

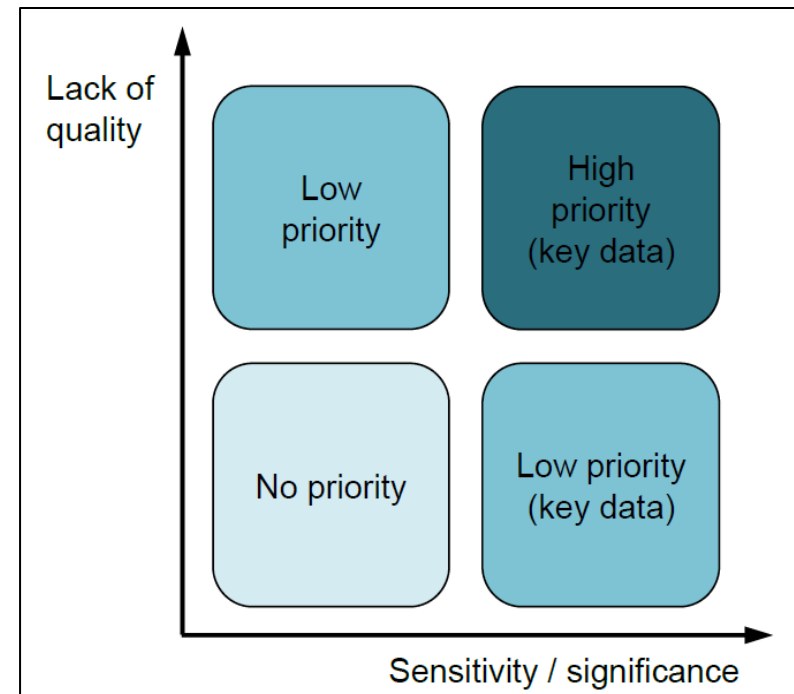
- ❖ Data quality of LCA studies should meet at least the requirements of EN 15978 and 15804.
- ❖ Data quality assessment should be conducted in practice according to the goal and scope of the LCA study and the practitioner should be cautious when using LCA data.
- ❖ The interpretation of the data quality should be connected to the context of its use i.e. does the data significantly influence the results? (see next slide).

G-21 Data Quality

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

❖ The data quality assessment can be carried out at two levels:

- Data quality check for the **entry data** by means of data quality indicators (e.g. A, B,C, D that may be based on the Pedigree matrix).
- Data quality check for the **LCA results** for buildings. Key materials or processes accounting for an important part of the environmental impact results and based on low quality data, should be further studied in order to improve the accuracy of the data used.



Source: ILCD Handbook

General aspects: impact assessment

Goal definition

Scope
definition

Inventory
analysis

**Impact
assessment**

Interpretation

Reporting

- ❖ **G- 27 Choice of environmental indicators – screening and simplified LCA**
- ❖ **G- 28 Choice of environmental indicators – complete LCA**
- ❖ G- 29 Abiotic resources depletion indicator
- ❖ G- 30 Land use indicator
- ❖ G- 31 Biodiversity indicator
- ❖ G- 32 Human toxicity and ecotoxicity indicators
- ❖ G- 33 Ionizing radiation indicator
- ❖ G- 34 Water consumption as a new impact category

 *overview*

 *overview*

G-27/G- 28 Choice of environmental indicators – General recommendations (1/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input checked="" type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
					<input checked="" type="checkbox"/> complete LCA

Currently, a high number of indicators are available in the LCA literature: LCI, mid-point or end-points indicators. In some cases, different methods are available to assess the same impact and the same indicator.

? Which indicators and methodology should be chosen?

- ❖ Generally speaking, the set of indicators should be consistent and comprehensive.
- ❖ EeBGuide does not give rules on the choice of indicators for each study types (this aspect is very sensitive to the goal definition and to the context of use). EN 15978 et EN 15804 give a list of indicators that can be used as well as the ones in the ILCD Handbook.
- ❖ Recommendations for each study type are breakdown in two parts:
 - **Number of indicators** depending on the study type (screening, simplified, complete LCA)
 - **Calculation rules** for the indicators (i.e. characterization factors to apply):
 - Indicators based on reminder LCI flows → determined from the cumulative LCI if available.
 - LCIA indicators from EN 15804 / EN 15978 as well as additional sources (mid-point, end-point) not covered by these standards → use ILCD et CML 2002 LCIA methods.

G-27/G- 28 Choice of environmental indicators – Number of indicators (2/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input checked="" type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

❖ For all study types:

- The set of indicators should be as consistent as possible to avoid e.g. shift of burdens.







	Screening LCA	Simplified LCA	Complete LCA
GENERAL GUIDANCE	At least 1 or 2 indicators covering the three area of protection: resources, ecosystems, human health	A more comprehensive set of indicators than for screening LCA covering the three area of protection	A comprehensive set of indicators covering the three area of protection: resources, ecosystems, human health
EXAMPLES	Examples of a reduced set of indicators: non renewable primary energy, GWP, water consumption, waste*		Examples of a complete set of indicators: list from EN 15804**, list from ILCD Handbook (including mid-point or end-point indicators)***

* source: SBA common metrics: <http://sballiance.org>

** The list of indicators from EN 15804 is not fully based on LCIA indicators as some of them only correspond to reminder LCI flows (e.g. indicators describing resource use or waste), they are useful information for interpretation of LCA result but do not correspond (strictly) to LCIA indicators according to ISO 14040-44.

***A complete set of LCIA indicators have not been standardized so far, recent LCIA methods proposed a comprehensive set of indicators e.g. ReCiPe that can be selected by the practitioner if appropriate. The identification of a comprehensive and relevant set of indicators is still an on-going topic that needs joint further research from statistics (identification of correlation), decision making point of view (selection by a panel or by the decision maker of the most relevant indicators depending on the product under study).

G-27/G- 28 Choice of environmental indicators – Indicators from EN 15804 / EN 15978 standards (3/5)

<i>related study objective</i>	<input checked="" type="checkbox"/> stand-alone LCA			<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input checked="" type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

LCIA indicators

Impact Category	Parameter	Parameter unit expressed per functional/declared unit
Global Warming	Global warming potential, GWP;	kg CO ₂ equiv
Ozone Depletion	Depletion potential of the stratospheric ozone layer, ODP;	kg CFC 11 equiv
Acidification for soil and water	Acidification potential of soil and water, AP;	kg SO ₂ equiv
Eutrophication	Eutrophication potential, EP;	kg (PO ₄) ³⁻ equiv
Photochemical ozone creation	Formation potential of tropospheric ozone,, POCP;	kg Ethene equiv
Depletion of abiotic resources-elements	Abiotic depletion potential (ADP-elements) for non fossil resources ^a	kg Sb equiv
Depletion of abiotic resources-fossil fuels	Abiotic depletion potential (ADP-fossil fuels) for fossil resources ^a	MJ, net calorific value
^a The abiotic depletion potential is calculated and declared in two different indicators: <ul style="list-style-type: none"> ADP-elements: include all non renewable, abiotic material resources (i.e. excepting fossil resources); ADP -fossil fuels include all fossil resources. 		

LCI reminder output flows (waste)

Parameter	Parameter unit expressed per functional/declared unit
Hazardous waste disposed	kg
Non hazardous waste disposed	kg
Radioactive waste disposed	kg

LCI reminder input flows (resource use)

Parameter	Parameter unit expressed per functional/declared unit
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non renewable primary energy excluding non renewable primary energy resources used as raw materials	MJ, net calorific value
Use of non renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of non renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of secondary material	kg
Use of renewable secondary fuels	MJ, net calorific value
Use of non renewable secondary fuels	MJ, net calorific value
Use of net fresh water	m ³

Other output flows (reuse, recovery, recycling)

Parameter	Parameter unit expressed per functional/declared unit
Components for re-use	kg
Materials for recycling	kg
Materials for energy recovery	kg
Exported energy	MJ per energy carrier

G-27/G- 28 Choice of environmental indicators – Calculation rules for EN 15804 LCIA indicators (4/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input checked="" type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

- ❖ **EN 15804 does not mention in 2012 the exact list of references to enable the practitioners to calculate the 7 LCIA indicators (see the table in the previous slide).** Here, both ILCD and CML 2002 references are given for information (until the references be clearly given by the CEN TC 350).

	References of the LCIA method(s) to be used for the indicator*	Single agreed method available so far between ILCD and CML?
GWP	ILCD recommended method and CML based upon IPCC: [IPCC, 2007]	YES
ODP	ILCD recommended method and CML based upon WMO: [WMO, 1999]	YES
AP	CML 2002 method: [Huijbregts et al, 2001] for AP and [Guinée et al, 2002] for EP ILCD recommended method: [Van Zelm et al, 2008]	NO , ILCD recommended method has not been previously used, current discrepancy between EN 15804 (equiv. SO ₂ unit from CML 2002) while the ILCD recommended method uses equiv. H+ unit based on accumulative exceedance.
EP		
POCP	CML 2002 method: [Derwent et al, 1998] ILCD recommended method: [Van Zelm et al, 2008]	NO , ILCD recommended method has not been previously used, may not be have been implemented in the LCA software so far .
ADP-fossil	ILCD recommended method based upon CML 2002: [Oers et al, 2002]	YES
ADP-elements	ILCD recommended method based upon CML 2002: [Oers et al, 2002]	YES BUT , the type of resources recommended by CML and ILCD is « reserve base » which is a new approach compared to the usual LCA practice based on ultimate reserves.

* The full references to the LCIA methods, ILCD or CML 2002 are available pages 17-19 of the following ILCD report: <http://lct.jrc.ec.europa.eu/assessment/LCIA-CF-09-02-2012-def.pdf>

G-27/G- 28 Choice of environmental indicators – Additional indicators from the ILCD Handbook (5/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input checked="" type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

- ❖ **Refer to the other aspects of the EeBGuide, section “Life Cycle Impact Assessment” for more information:** resource depletion, land use, biodiversity, human toxicity and ecotoxicity, ionizing radiations, water consumption as a new impact category.
- ❖ **References for Life Cycle Assessment methods and indicators outside the scope of CEN TC 350 standards:**

Please consult the ILCD Handbook to get the references of existing methods (as well as the ICLD recommended methods) for the following impact categories:*

- Methods and indicators to assess:
 - Human toxicity
 - Particulate matter/respiratory
 - Ionizing radiations
 - Ecotoxicity (aquatic, marine and terrestrial)
 - Land use
 - Resource depletion (including alternative methods next to ADP used in TC 350 standards)
 - Other impacts (e.g. noise, odours).
- Other methods to assess GWP, ODP, POCP, AP, EP, ADP (in addition to indicators from the standards)

** Both “mid-point” (potential) and “end-point” (damages) indicators*



General aspects: interpretation

Goal definition

Scope
definition

Inventory
analysis

Impact
assessment

Interpretation

Reporting

- ❖ **G- 35 Normalisation of impacts*** ← **overview***
- ❖ G- 36 Weighting of indicators
- ❖ G- 37 Uncertainty analysis for comparative assertion
- ❖ **G- 38 Sensitivity analysis** ← **overview**
- ❖ G- 39 Scenario analysis

** See provisions/guidance in Part B: Buildings of these training materials*

G-38 Sensitivity analysis

<i>related study objective</i>			<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input checked="" type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

As part of the Interpretation stage, the sensitivity analysis aims at assessing the reliability of the study by checking the influence of main parameters into the final results.

? How a sensitivity analysis can be conducted depending on the study type?

- ❖ A sensitivity analysis should be conducted for comparative assertion, whereas it may be used in the case of a stand-alone LCA if relevant.
- ❖ **Guidance for building LCA studies:** aspects such as Reference Study Period (RSP) of the building, End-of-life scenarios, transportation distances or key data for building products, energy and water consumptions can be assessed within a sensitivity analysis.
- ❖ **Guidance for product LCA studies:** key data, End-of-life scenarios and transportation distances are aspects that can be assessed within a sensitivity analysis.

General aspects: reporting

Goal definition

Scope
definition

Inventory
analysis

Impact
assessment

Interpretation

Reporting

❖ **G- 40 Communication of LCA results**

❖ **G- 41 Reproducibility**

❖ G- 42 Life cycle inventory documentation







❖ G- 43 Documentation of LCA results

❖ G- 44 Critical review

 *overview*

 *overview*

G-40 Communication of LCA results

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					
					complete LCA

The external and internal communication of LCA results is still error-prone.

? How shall LCA results be communicated?

- ❖ The documentation of complete LCA studies should be in line with ISO 14044, EN 15804 and EN 15978.
- ❖ EeBGuide provides reporting templates for building and product LCA studies that should be used and that are generally in line with the mentioned standards.
- ❖ Requirements concerning reporting are part of the study type definitions and are covered by the EeBGuide reporting templates.
- ❖ Special requirements for external reports and comparative assertions are given in ISO 14044.
- ❖ ISO 14025 and EN 15804 require that independent verifiers of EPDs generate a report documenting the verification process.

G-41 Reproducibility (1/2)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

According to ISO 14044 and the ILCD Handbook, reproducibility requires to document comprehensively data, assumptions and calculation rules. Due to different data sources and confidential data sets, reproducibility may be difficult to achieve.

? **How to ensure reproducibility of the study using a reasonable amount of time?**

- ❖ Description of LCA aspects should be as transparent as possible. Assumptions regarding confidential data should be made available to independent critical reviewer (if relevant).
- ❖ **General guidance:** for complete LCA studies, the practitioner should review whether he needs to extend the EeBGuide reporting template in order to allow third parties to reproduce the study. To this end, ILCD LCA report template and LCI reference data set format can be used.
- ❖ **Specific guidance for confidential studies:** a balance between reproducibility and confidentiality has to be settled. Third-part review can be useful in that sense.

G-41 Reproducibility (2/2)

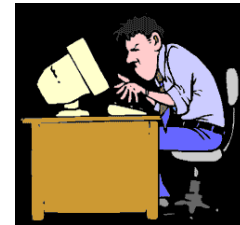
<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

❖ Specific guidance for building LCA studies:

The LCA methodology cannot be applied in the building sector with the same level of details than in industry. Different simplifications are needed e.g. the choice in most of the building LCA software to only use indicators as “entry data”.

In that specific cases, reproducibility can still be ensured by:

- Harmonization of physical building description data.
- Choice of a common national set of generic LCA data.
- Common requirements for LCA software tools:
 - Provide dedicated user manuals.
 - Document in a transparent way the assumptions used for data, calculation rules and expression of results.
 - Ease the data selection (e.g. using a predefined building description).



Overview

- I. Introduction
- II. Methodological approach
- III. How to use the guidance document
- IV. General provisions and guidance
- V. Provisions and guidance for products**
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings
- VIII. Application in case studies for buildings
- IX. Conclusions and perspectives



Overview

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EeBGuide

Operational guidance for Life Cycle Assessment studies of
the Energy Efficient Buildings Initiative

Part B: Buildings



Description of part B of this course



❖ Context

- LCA studies at the building scale, using construction product LCAs as “bricks”

❖ Aim

- To help LCA practitioners to perform building LCA studies in a more harmonised way
- To bring them knowledge and guidance in order to improve their practice
- To help tool developers to improve their tools

❖ Audience

- Building LCA practitioners and building LCA tool developers...
- ...involved in European research projects or in other kinds of building LCA studies

❖ Method

- Selection of key aspects and presentation of provisions and recommendations
- Illustration / application through building case studies
- “stand-alone” slides as far as possible

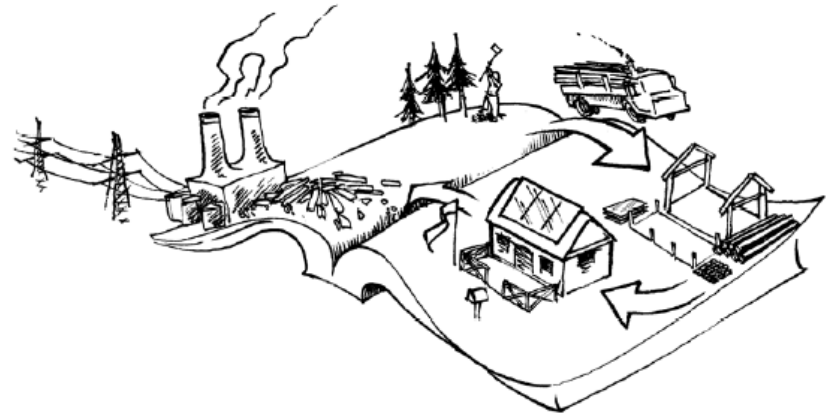
Overview

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- V. Provisions and guidance for products
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings**
- VIII. Application in case studies for buildings
- IX. Conclusions and perspectives



VI – Provisions and guidance for Buildings

- ❖ General aspects specific to buildings
- ❖ Module A: product and construction process stages
- ❖ Module B: use stage
- ❖ Module C: end-of-life stage
- ❖ Module D: benefits and loads beyond the system boundary



Life cycle stages and potential contributors for buildings



EXAMPLES OF CONTRIBUTORS

EXAMPLES OF CONTRIBUTORS		A	B	C
	PRODUCT stage (modules A1 to A3)	CONSTRUCTION PROCESS stage (modules A4 to A5)	USE stage (modules B1 to B7)	END OF LIFE stage (module C1 to C4)
Building products and equipment	Raw material supply, Transport, Manufacturing	Transport, Construction installation processes	Use, Maintenance, Repair, Replacement, Refurbishment	De-construction, Transport, Waste processing, disposal
Operational Energy uses			Operational Energy Use , regulated end- uses (B6) Operational Energy Use , other end-uses (B6)	
Operational Water uses			Operational Water Use (B7)	
Construction site		Construction installation process (A5)		De-construction, Demolition (C1)
Transport of users			Transport of users	

General aspects specific to buildings

Scope
definition

- ❖ **G- 06 Functional equivalent** ← **overview**
- ❖ G- 08 Reference study period
- ❖ G- 09 Object of assessment with regard to energy-efficient buildings
- ❖ G- 10 Definition of system boundaries for new buildings
- ❖ **G- 11 Definition of system boundaries for existing buildings** ← **overview**
- ❖ **G- 17 Differences in background data system boundaries** ← **overview**
- ❖ G- 19 Allocation case: Production of renewable energy on-site

Inventory
analysis

- ❖ **G- 23/G- 24/G- 25 Choice of LCI/LCIA-datasets for screening, simplified and complete LCA** ← **overview**
- ❖ G- 26 Use of building physical description data

Interpretation

- ❖ **G-35 Normalisation of impacts*** ← **overview**

Note : the other general aspects have been presented in the General section of this series of courses

G-06 Functional equivalent

related study objective		<input type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for					
	new buildings	existing buildings	construction products	screening LCA	simplified LCA
					complete LCA

The functional equivalent is a representation of the required and quantified functional and/or technical requirements for a building or an assembled system (part of works), which is used as a basis for comparison. Comparison of different options/cases shall only be made on the basis of their functional equivalency.

? How to correctly define the functional equivalent ?

- ❖ **EN 15978: The functional equivalent shall include at least: building type, relevant technical and functional requirements, pattern of use and required service life.**
- ❖ **Example for a building:**
 - Type of building: office building, 4000 m² net floor area
 - Use: tempered net floor area
 - Relevant technical and functional requirements: heated and cooled rooms with a temperature range between 20°C and 26°C, air change rate of 30m³/h.person, lighting level 300 Lux, see also specifications in DIN 18599
 - Pattern of use: 200 workers, working time from 7.00 am till 6.00 pm, 5 days/week, 48 weeks/year
 - Service life: 50 years

G-11 Definition of system boundary for existing buildings

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

A clear definition of the system boundaries is needed to better understand and interpret the LCA results, as well as to use them for comparative assertions or stand-alone LCA.

? How system boundary should be defined for existing buildings?

- ❖ For existing buildings, the system boundary should include all stages representing the remaining service life and the end of life of the building (EN 15978).
- ❖ Four different types of operations may be identified: rehabilitation; reference rehabilitation; complete demolition and new construction; and maintenance of an existing building.
- ❖ The following contributors to the environmental impacts should be considered:
 - New building products.
 - Products discarded during the operation.
 - Energy and water consumptions of the building before and after the rehabilitation.
 - Deconstruction, demolition, reconstruction and new construction operations.

G-17 Differences in background data system boundaries

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA






Practitioners have to deal with different data sources (public and commercial LCI databases, EPDs, literature, etc.) calculated applying different rules. Special attention has to be paid to assess the consistency of these different sources.

? How can the practitioner deal with different background data?

- ❖ EPDs compliant with EN 15804 declare LCIA information separately per each module as well as additional technical information facilitating its use in building LCA studies.
- ❖ A good understanding about the scope of the used EPDs (e.g. cradle-to-gate, cradle-to-gate with options or cradle-to-grave) is necessary.
- ❖ Whenever possible, use of EPDs compliant with EN 15804 should prevail if more relevant than other background data.
- ❖ Regarding public or commercial databases, it is strongly recommended to use data from consistent sources (including potential appropriate EPDs).

G-23/G-24/G-25

Choice of LCI/LCIA datasets (1/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

Different LCA data are needed to assess the environmental impacts of buildings. They enable to quantify the different impacts related to the building products and equipment, the construction site, the operational energy and water uses as well as the deconstruction of the building.

? Which data to choose depending on the study type for building LCA?

! The LCA practitioner or the user of building LCA software should use adapted data for the description of the building components for each study type.

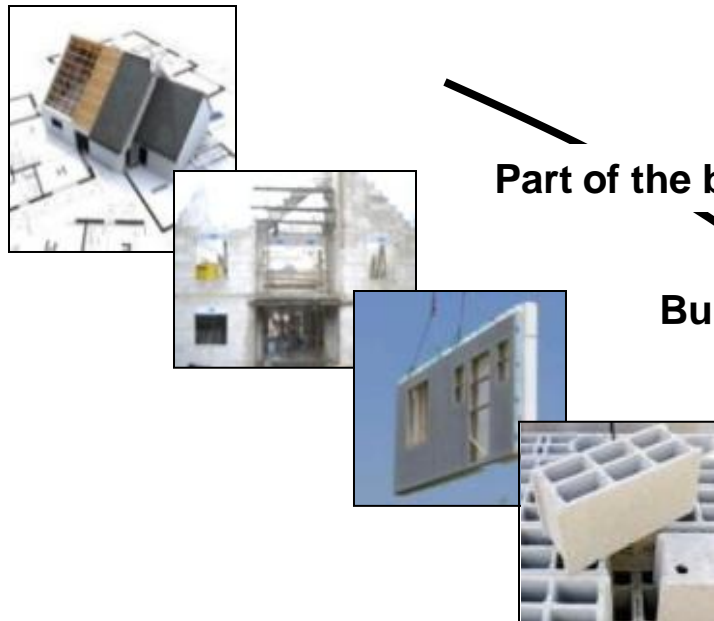
- The next slides present the recommendations for the building products and technical equipment
- See the other aspects for the life cycle impact calculations for building products datasets e.g. for adapting cradle-to-gate and cradle-to-grave data (module A1-A3).
- See the other aspects for the recommendations for the choice of datasets e.g. for construction site data (module A5), operational energy and water use (B6, B7).

G-23/G-24/G-25

Choice of LCI/LCIA datasets (2/5)

<i>related study objective</i>	<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	new buildings	existing buildings	building products	screening LCA	simplified LCA
				complete LCA	

Different LCA data are needed to assess the environmental impacts of buildings. They enable to quantify the different impacts related to the building products and equipment, the construction site, the operational energy and water uses as well as the deconstruction of the building.









Different levels of description of a building should be used depending on the stages of the project (e.g. early design, detailed design...) but also on the practitioners (e.g. architects, design office, construction companies)

**Level of description
of the building**

G-23/G-24/G-25

Choice of LCI/LCIA datasets (3/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA
				 complete LCA	

❖ Detailed Guidance for the list of building parts to include

List of building part/components/materials and products to include for each study type	Screening LCA	Simplified LCA	Complete LCA
Roof Load- bearing structure Exterior and basement walls Windows Floor slabs Foundation Floor Finishes/ Coverings	Mandatory	Mandatory	Mandatory
Refrigeration/ Coolants Decorative wall finishes/ coatings (e.g. wallpaper, paints) Doors Heating/ Cooling/ Lightning Equipment and any power-generating equipment (e.g. wind turbines/ PV/ solar heating) Equipment for internal transport (e.g. lifts, escalators), water and sewerage systems, electrical distribution system	Optional due to potentially missing data <u>(NB: use default values if available)</u>	Optional due to potentially missing data <u>(NB: use default values if available)</u>	Mandatory

according to SBA Common Metrics Framework 2009 and EeBGuide adaptations

Calculation rules

G-23/G-24/G-25

Choice of LCI/LCIA datasets (4/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	new buildings	existing buildings	building products	screening LCA	simplified LCA
				complete LCA	







? Which LCA data of building products to choose depending on the study type?

!	Screening LCA		Simplified LCA	Complete LCA
	PROVISIONS			
	Generic LCA data should roughly describe the impact of the products implemented in the buildings.		Generic LCA data should more precisely describe the impact of the products implemented in the buildings.	Specific LCA data should closely describe the impact of the products implemented in the buildings.
	Generic LCA of the building product may represent (if possible and if relevant) the total consumption mix in Europe (if the study is used for EU projects) or in every European countries, else the production mix of a neighborhood country using appropriate rules to adapt the generic data to the new context.		Generic LCA data of the building product may represent (if possible and if relevant) the total consumption mix in Europe (if the study is used for EU projects) or in every European countries, else the production mix of a neighborhood country using appropriate rules to adapt the generic data to the new context.	They may come from industry data (e.g. EPD) at EU or national level provided by building manufacturers, else be extrapolated from generic data if specific data are currently missing, else the goal definition is not in accordance with e.g. PCR or EPD rules (e.g. different indicators considered).

Types of LCA data

G-23/G-24/G-25

Choice of LCI/LCIA datasets (5/5)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input type="checkbox"/> goal and scope definition	<input checked="" type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA







❖ Practical availability of databases in Europe to be used for each study type

	Screening LCA	Simplified LCA	Complete LCA
Types of data / databases	Generic LCA databases with building products	Generic LCA databases, (across industry sector, trade union) with building products	Specific LCA databases (e.g. based on industry databases like EPD)* with building products
Examples of databases	Ecoinvent, ELCD, ESUCO etc.	Ecoinvent, ELCD, ESUCO etc.	National EPD databases like INIES (France), IBU (Germany), etc.

* Complete LCA is supposed to be conducted in a detailed design prior to the construction of the building. In that sense, specific data are considered more precise than generic data as they reflect the products implemented in the building. However, complete LCA study type has also other requirements that may not be fulfilled with the current available specific data like EPDs (e.g. cut-off rules, consistent set of indicators etc.). In that context, the practitioner may still rely on generic data providing full suite of LCI, LCIA parameters and stricter cut-off rules for his complete LCA assessment if relevant for his goal definition.

Databases availability

G-35 Normalisation of indicators (1/4)

related study objective			<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion
related study phase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					
					complete LCA

According to the ILCD Handbook, the normalization step refers to the expression of indicators (LCIA, midpoints or endpoints) relative to a common reference by dividing the indicator results by the respective reference value. Different normalization factors can be applied in practice to help the interpretation of results in the building sector.

? How can the practitioner carry out a normalisation of impacts?



ILCD Handbook







“Provisions: 6.7 Preparing the basis for the impact assessment [...] Normalisation and weighting: [...] XIII) MAY – Results interpretation: Normalisation and weighting are in addition optional steps under ISO 14044:2006 that are recommended to support the results interpretation (see part 6.3.6)”



Guidance: 2 different ways of doing normalisation for building LCA

- 1) Help to identify the most relevant indicators among the global set of indicators
- 2) Comparison of LCA results with existing benchmarks

G-35 Normalisation of indicators (2/4)

<i>related study objective</i>	<input checked="" type="checkbox"/> stand-alone LCA			<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

1) Help to identify the most relevant indicators among the global set of indicators








Examples of normalisation factors per equivalent inhabitants per year for 4 impact categories of EN 15804 for the French context taken from [Peuportier, 2008]

Mid-point indicators	Unit	equiv- person /year	source
GWP	kg eq-CO ₂	8680	CITEPA
AP	kg eq-SO ₂	62.3	CITEPA
POCP	kg eq-C ₂ H ₄	19.7	CITEPA
EP	kg eq-PO ₄ ³⁻	38.1	IFEN

Other indicators	Unit	eq-person	Source
Primary energy demand	MJ	48 670	Observatoire de l'énergie
Water consumption	m3	339	IFEN
radioactive waste	dm3	0.51	ANDRA
Other wastes	kg-eq	10400	ADEME

G-35 Normalisation of indicators (3/4)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/> complete LCA

2) Comparison of environmental indicators with existing benchmarks (e.g. low, good, best practice)



Examples of reference values* for new buildings (detached houses) taken from the first French HQE Performance test (conducted in 2011). Results are presented for the median values.









Detached Houses	Non renewable primary energy	Global warming potential	Water consumption	Inert waste
	kWh/m ² NFA/year	kg eq-CO ₂ /m ² NFA/year	L/m ² NFA/year	kg/m ² NFA/year
Equipment, products and materials	48	11,6	161	36
Operational energy consumption (thermal regulation use)	53	3,5	15	1,2
Operational energy consumption (other uses)	58	2,2	42	3,4
Operational water consumption	3	0,9	1584	0,8
TOTAL	162	18	1802	42



* These values are strongly dependent of the building type, the data used and the assumptions made. Hence a comparison of building LCA results with such values has to be made with care. For the French context, the practitioner should be aware that the French HQE Performance is an on-going project with a second test in 2012. Updated values will be made available. For more information, please consult the website <http://assohqe.org/hqe/>

G-35 Normalisation of indicators (4/4)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting	
<i>relevant for</i>						
	new buildings	existing buildings	building products	screening LCA	simplified LCA	complete LCA

2) Comparison of environmental indicators with existing benchmarks (e.g. low, good, best practice)



Examples of reference values* for educational, office, hotel and residential buildings taken from the DGNB labelling schemes.

Educational, office, hotel, residential buildings (ref. study period 50 years)	GWP	ODP	POCP	AP	EP	PE _{nr}	PE _{tot}
	[kg CO ₂ - Equ. /m ² *a]	[kg CFC ₁₁ - Equ./m ² *a]	[kg C ₂ H ₄ - Equ./m ² *a]	[kg SO ₂ - Equ./m ² *a]	[kg PO ₄ ⁻³ - Equ./m ² *a]	[MJ/ m ² *a]	[MJ/ m ² *a]
Reference value for construction, refurbishment and EoL (Module A1-A3 & B2-B5 & C & D)	9,40	5,30E-07	0,0042	0,037	0,0047	123	151





* These values are strongly dependent of the building type, the data used and the assumptions made. Hence a comparison of building LCA results with such values has to be made with care.

Building aspects – Modules A, B, C & D





❖ **Choices made:**

- to select and present key aspects, not all aspects
- to follow the life cycle stages of a building

❖ **Conventions:**

-  for Provisions (rules to be applied)
-  for Guidance (recommendations, state-of-art, information)

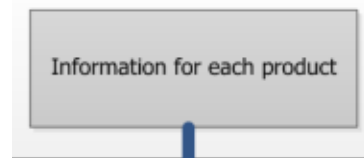
Building aspects – Modules A, B, C & D

Building Assessment Information				
Life cycle stage modules			Name of the sub-module	
Building life cycle information		PRODUCT stage	A1	Raw material supply
			A2	Transport
			A3	Manufacturing
		CONSTRUCTION PROCESS stage	A4	Transport
			A5	Construction, installation processes
		USE stage	B1	Use
			B2	Maintenance
			B3	Repair
			B4	Replacement
			B5	Refurbishment
			B6	Operational energy use
			B7	Operational water use
		END OF LIFE stage	C1	De-construction, demolition
			C2	Transport
			C3	Waste processing
			C4	Disposal
Suppl. information beyond the life cycle		Benefits and loads beyond the system boundary	D	Reuse-, recovery- and/or, recycling potentials- potential

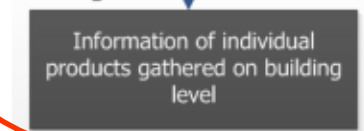
Aspects for module A: product stage



Product LCA









Building LCA



- **A- 01 Use and adaptation of available cradle-to-gate and cradle-to-grave LCA or EPD data for building products and technical equipment**
- A- 02 Accounting of technical building equipment – screening and simplified LCA
- A- 03 Accounting of technical building equipment - complete LCA

A-01 Use and adaptation of available cradle-to-gate and cradle-to-grave LCA or EPD data for building products and technical equipment

? Which LCA or EPD data to use in a building LCA study?
How to adapt them if they are not fully appropriate?

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					
					complete LCA

❖ Use existing LCA or EPD databases, use a single database as far as possible

❖ EN 15978: see §10.2.2. and §10.2.3.

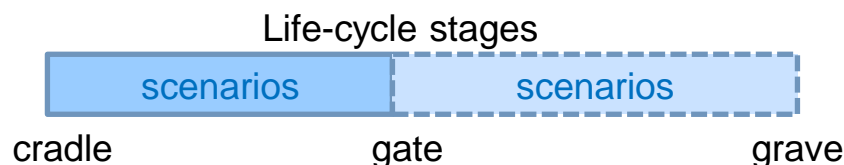
💡 Use of existing databases







- The use of a **single database** is highly recommended when conducting a building LCA study (because databases differ in assumptions and methodologies).
- The use of 2 different databases (e.g. one for technical equipment with specific PCR) can be justified if the main conclusions of the study are not affected by this use.

❖ Adaptation of cradle-to-gate data

- Data can be adapted either for the production stage or for the additional life-cycle stages (modules other than A1-A3).

A-01 Use and adaptation of available cradle-to-gate and cradle-to-grave LCA or EPD data for building products and technical equipment *(cont'd)*



<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion		
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting	
<i>relevant for</i>	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA	 complete LCA

❖ Use of scenarios for gate to grave data

- Scenarios are needed to assess the cradle-to-grave impacts depending on the goal and scope of the study.
- For cradle-to-grave data: scenarios included should be checked for consistency with the building under study.
- If EPD is breakdown into different life cycle stages, the user can adapt data stage by stage (difficulty if EPD data are aggregated).
- The scenarios for gate to grave impacts need to use default values (or if possible specific values) for some important parameters (e.g. transportation distance to the building site and related processes, service life, share of end-of-life scenarios).
- Follow this Guidance for other modules, else use scenarios proposed by building LCA tools, else refer to certification schemes.

Aspects for module A: construction process stage *(cont'd)*



A4 – Transport

- A- 04/05 Transportation of products to the construction site – screening and simplified LCA / complete LCA

A5 – Construction - Installation process

- A- 06 Construction installation process impacts for screening LCA
- **A- 07/08 Land preparation and earthwork during the construction process – screening and simplified LCA / complete LCA**
- A- 09/10 Product storage on site before installation – screening and simplified LCA / complete LCA
- A- 11/12 Transport of construction workers – screening and simplified LCA / complete LCA
- A- 13/14 Transportation of construction machinery to the building site – screening and simplified LCA / complete LCA
- A- 15/16 Installation of the product into the building – screening and simplified LCA / complete LCA
- A- 17 Accounting of on-site capital goods (e.g. construction machinery, bungalows...)
- A- 18/19 Water and energy demand – screening and simplified LCA / complete LCA
- A- 20/21 Construction wastes - screening and simplified LCA / complete LCA
- A- 22/23 Prefabrication of building products – screening and simplified LCA / Complete LCA

Default scenarios may provide information

Information provided on building level

A- 07/08 Land preparation and earthwork during the construction process

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA

? Should the land preparation and earthwork during the construction process be considered?

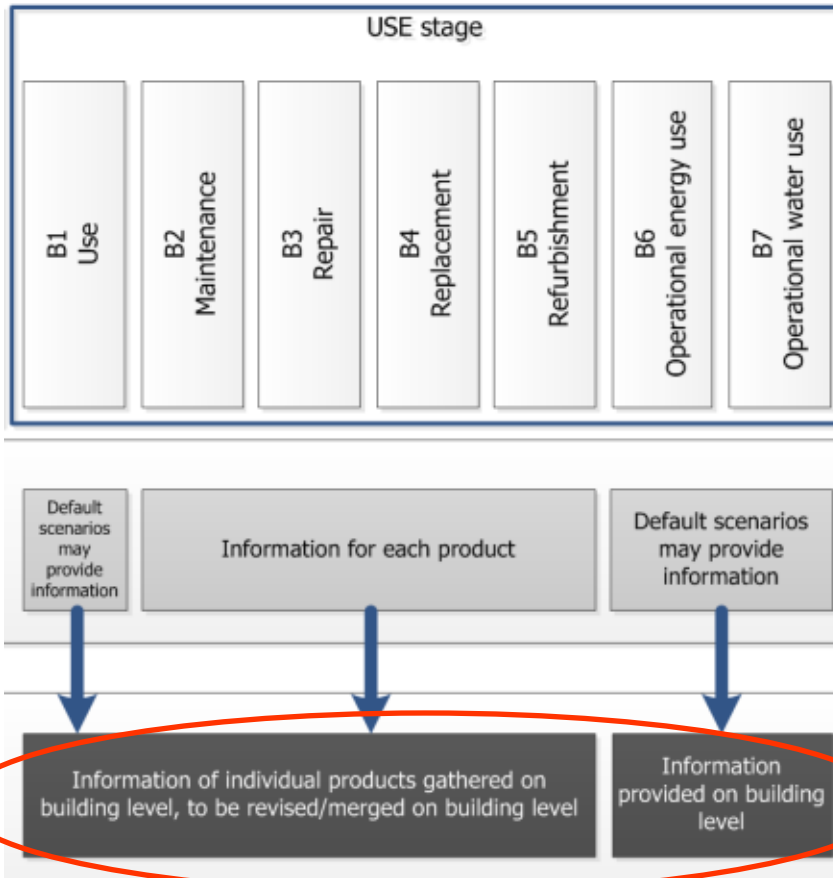
Screening and simplified LCA

- ❖ It may be included if relevant (e.g. interesting for a construction company)
- ❖ See EN 15978, § 8.5: the system boundary for the construction process shall include the ground works and landscaping
- ❖ Use default values (ratios, generic data, etc.) and refer to cut-off rules ; ratio can be defined with stakeholders
- ❖ For most construction projects, this aspect may be neglected due to minor relevance

Complete LCA

- ❖ It should be included if relevant for the goal and scope
- ❖ See EN 15978 (§ 8.5) the system boundary for the construction process shall include the ground works and landscaping
- ❖ Use detailed calculation (based on specific data) ; take into account fuel consumption of construction machinery
- ❖ For most construction projects, this aspect may be neglected due to minor relevance

Aspects for module B: use stage



B1 – Use

- B- 01 Emissions of dangerous substances to indoor air during the use stage
- **B- 02 Release of dangerous substances to soil and water during the use stage***

B2 – Maintenance

- B- 03/04/05 Maintenance with screening LCA / simplified LCA / complete LCA

B3 – Repair

- B- 06/07/08 Repair with screening LCA / simplified LCA / complete LCA

B4 – Replacement

- **B- 11 Definition of the service life of a building product**
- B- 12 Replacement frequency
- B- 13/14/15 Replacement with screening LCA / simplified LCA / complete LCA

* See provisions/guidance in Part A: Products of these training materials

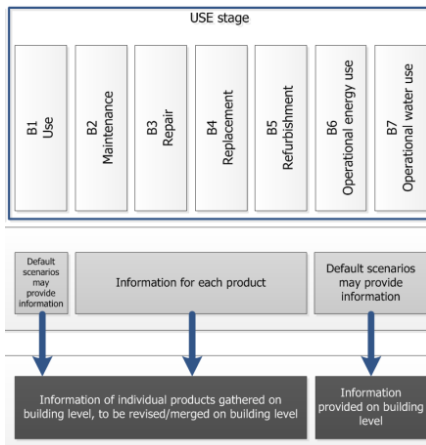
Aspects for module B: use stage *(cont'd)*

B5 – Refurbishment

- B- 16 Refurbishment for screening, simplified and complete LCA

B6 – Operational energy use

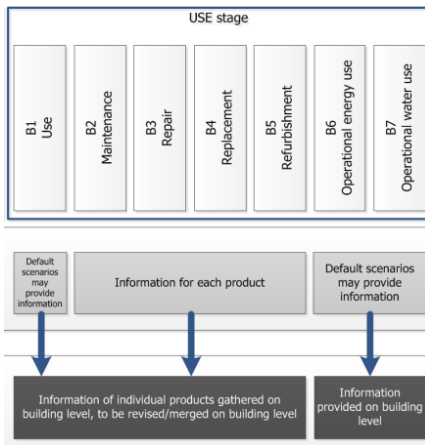
- **B- 17/18/19 Operational energy demand for new buildings – Boundaries and scenarios for screening LCA / simplified LCA / complete LCA**
- B- 20 Operational energy demand for existing buildings – Boundaries and scenarios
- B- 21 Operational energy demand for new buildings – Consideration of user behaviour
- B- 22 Operational energy demand for existing buildings – Consideration of user behaviour
- B- 23 Operational energy calculation – Allocation of energy production for on-site systems connected to grid
- B- 24 Dynamic LCA data for assessing the impact of electricity consumption



Aspects for module B: use stage *(cont'd)*

B7 – Operational water use

- **B- 25/26/27 Assessment of operational Water use in screening LCA / simplified LCA / complete LCA**
- B- 28 Accounting of different types of waste water treatment



Module B – other aspects not related to a single life cycle stage

- B- 29 Building services
- B- 30 Assessment of the transport of people
- **B- 31 Distinction between modules B2, B3, B4 and B5**

B-11 Definition of the service life of building products (1/2)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

? How to define the service life of products/components/systems? Why is it important?

- ❖ **Service life data have an influence on:**
 - Number of replacements within the reference study period
 - Potential influence on other in-use aspects, e.g. operating energy consumption, because of gradual loss of performance versus time

... and should be provided with a **maintenance scenario**
- ❖ **Service life of a product is influenced by many parameters:** indoor and outdoor conditions, maintenance level, etc. (see ISO 15686-8) → Refer to the **ISO 15868 series** dealing with service life planning
- ❖ **Service life could be based on empirical, probabilistic or statistical data and should always take into account the intended use** → EN 15804 requires that the intended use and in-use conditions of the products are specified and documented

B-11 Definition of the service life of building products (2/2)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

- ❖ **When developing LCA at the building scale on the basis of several EPDs:** it should be verified that the declared service lives and in-use conditions are compatible with the specificities of the building (notably its localization and maintenances scenarios)
- ❖ **Only end-of-life related to loss of performances should be taken into account in the base case scenario**
- ❖ **Service life data should be determined on the basis of:**
 - Individual EPD (cradle to gate with corresponding option, or cradle to grave)
 - Client requirements and current practices
 - Products and components manufacturer's information
 - Existing applicable standards such as ISO 15686-1, -2, -7 and -8
 - Conventional service life on a national context or within a LCA software for buildings
- ❖ **It is expected that some service life data may be missing for the assessment at building scale:** in that case, several additional sources may be used, as public or private databases and various publications (e.g. DBMC)

B-17/18/19 Operational energy demand for new buildings - Boundaries and scenarios (1/4)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
				complete LCA	

? How this aspect can be addressed for screening LCA / simplified LCA / complete LCA of new buildings?

- ❖ Calculation of energy demand: influenced by several parameters as the selection of uses
- ❖ In priority: building-related uses such as heating and cooling (cf. EPBD)
- ❖ 3 groups of uses :
 - **Main building-related uses (covered by EPBD):** heating, cooling and air conditioning, ventilation, domestic hot water, lighting and auxiliary devices
 - **Other uses from building integrated systems:** lifts, shutters, security and communication devices, etc
 - **Non building-related uses:** computers, refrigerators, machines, etc. linked to the building activity
- ❖ Approach : selection of uses + final energy demand and related carriers + LCA per energy carrier => impacts

B-17/18/19 Operational energy demand for new buildings - Boundaries and scenarios (2/4)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

❖ Selection of energy uses and calculation method (1/2)

	Screening LCA	Simplified LCA	Complete LCA
Main building-related uses (covered by EPBD)	<p>Should be included</p> <p>➔ Simplified calculation or estimation or expected performance target (1)</p>	<p>Should be included</p> <p>➔ National calculation tools/methods or thermal dynamic simulation</p> <p>➔ For comparative assertions, use calculation tool and methodology “EPA-NR”</p>	<p>Should be included</p> <p>➔ National calculation tools/methods or thermal dynamic simulation (hourly consumption data) (2)</p>

(1): adapted to early design stage

(2): scenario and data should be specific to the object of the study

B-17/18/19 Operational energy demand for new buildings - Boundaries and scenarios (3/4)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

❖ Selection of energy uses and calculation method (2/2)

	Screening LCA	Simplified LCA	Complete LCA
Other uses from building integrated systems	May be included (3) ➔ Conventional or statistical data	Should be included ➔ Conventional or statistical scenario	Should be included ➔ Conventional or statistical scenario or more accurate data (2)
Non building-related uses	May be included (3) ➔ Conventional or statistical data (4)	May be included ➔ Conventional or statistical scenario (4)	Every energy use may be included ➔ Conventional or statistical scenario or more accurate data (2)

(2): scenario and data should be specific to the object of the study

(3): according to the object of the assessment

(4): if no information, possible to use EN 15603 ratio

B-17/18/19

Assessment of operational water use (4/4)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA

- ❖ From energy consumption data (and related energy carriers) to environmental impacts

	Screening LCA	Simplified LCA	Complete LCA
Electricity	Generic LCA data representing the annual average mix of the country	Generic LCA data representing the annual average mix of the country or marginal mix (for consequential modelling) or hourly LCA data (see “dynamic LCA” concept)	Specific LCA data (if available) or generic LCA data representing the annual average mix of the country or marginal mix (for consequential modelling) or hourly LCA data (see “dynamic LCA” concept)
Gas, oil, wood, etc.	Generic LCA data*	Generic LCA data*	Specific LCA data* (if available) or generic LCA data*

* The infrastructure (e.g. the boilers, radiators...) should be accounted as technical equipment. Equipment contributes to the embodied impacts as for the building products (see the corresponding aspect described in the module A1-A3 for buildings)

B-25 / B-26 / B-27

Assessment of operational water use (1/3)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA

? How operational water use can be addressed for screening LCA / simplified LCA / complete LCA? Which boundaries and scenarios ?

- ❖ **The assessment of operational water use includes 3 elements:**
 - the amount of consumed water during normal operation (m^3)
 - the impacts due to the production of drinking water (upstream processes)
 - the impacts due to wastewater treatments (downstream processes)
- ❖ **This assessment should be included into the LCA studies** in order to be consistent within the overall assessment methodology (use of a “**net fresh water**” indicator for different life cycle phases)
- ❖ **Usually the water consumption during use phase is the most important**, compared to the other phases of the life cycle

B-25 / B-26 / B-27

Assessment of operational water use (2/3)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

❖ EN 15978: Boundary of the operational water use

- should include drinking water, water for sanitation, domestic hot water, irrigation, water for heating, cooling, ventilation and humidification, and other specific water use (e.g. fountains, swimming pools, saunas)
- non building-related water uses (e.g. dishwashers, washing machines): should be included and reported separately.

❖ Provisions

	Screening LCA	Simplified LCA	Complete LCA
Operational water consumption (volume)	Statistical data	Top-down approach	Bottom-up approach
Upstream and downstream processes	Generic LCA data	Generic LCA data	Specific LCA data or generic LCA data

- ❖ **Comparative assertions:** should be supported by a sensitivity analysis of different parameters and hypothesis (especially on the user behaviour). The baseline scenario should be developed by using default values for all the parameters. The default values should be based on statistics on the most common values of the moment (therefore regular update is necessary)

B-25 / B-26 / B-27

Assessment of operational water use (3/3)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
relevant for	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA

❖ Detailed Guidance

	Screening LCA	Simplified LCA	Complete LCA
Operational water consumption (volume)	Statistical data, average values available in the country, according to the building type (1) or method of a labelling scheme	Top-down approach: estimation of the total consumption by taking into account the savings obtained by using some water saving devices and possibly extra consumption due to some specific systems (3) or method of a labelling scheme	Bottom-up approach: calculation of the total consumption by taking into account the characteristics of each water consumption device, the use factor and all the other influent parameters (4)
Upstream and downstream processes	Consider the most representative technologies and use generic LCA data (2)	Consider the most representative technologies and use generic LCA data (2)	For each type of technology, specific LCA data (5) may be used or generic data in special cases

(1): e.g. 50m³/pers/year for a dwelling

(2): from LCI databases as ELCD, Gabi, Ecoinvent, etc.

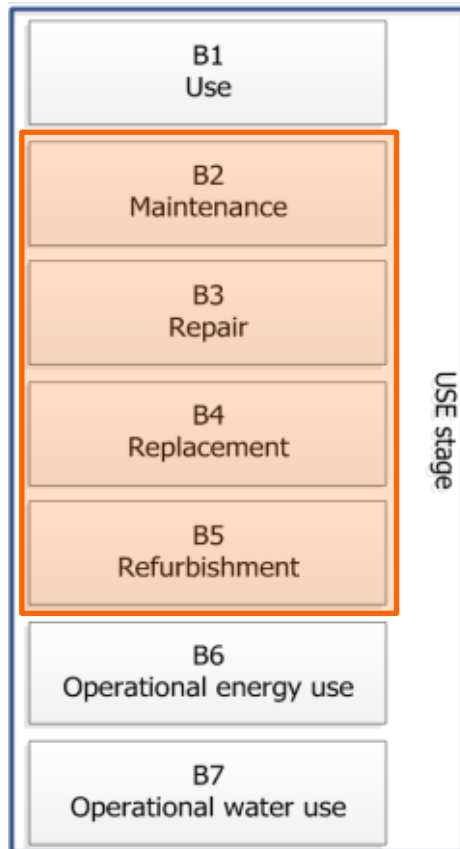
(3): e.g. fountains, swimming pools, saunas

(4): **The bottom-up approach could be considered as the most suitable since it allows a more precise sensibility analysis and hence more efficient performance improvement/optimization**

(5): e.g. EPD on waste water treatment provided by the industry

B-31 Distinction between modules B2, B3, B4 and B5 (1/8)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>








? How to determine to which module a specific operation should be attributed?

Provisions

- ❖ EN 15804 and EN 15978 give definitions and examples
- ❖ **B2 – Maintenance:** actions to maintain a product or building part in a state in which it can perform its functions. These actions are part of the “intended use” definition provided with a product’s RSL. Planned actions as preventive and regular maintenance and cleaning.
- ❖ **B3 – Repair:** actions to return a product or building part to an acceptable condition in which it can perform its required functional and technical performances, e.g. corrective treatment of a product, replacement of a broken component or part (not a whole element) due to damage (unforeseeable events)

B-31 Distinction between modules B2, B3, B4 and B5 (2/8)

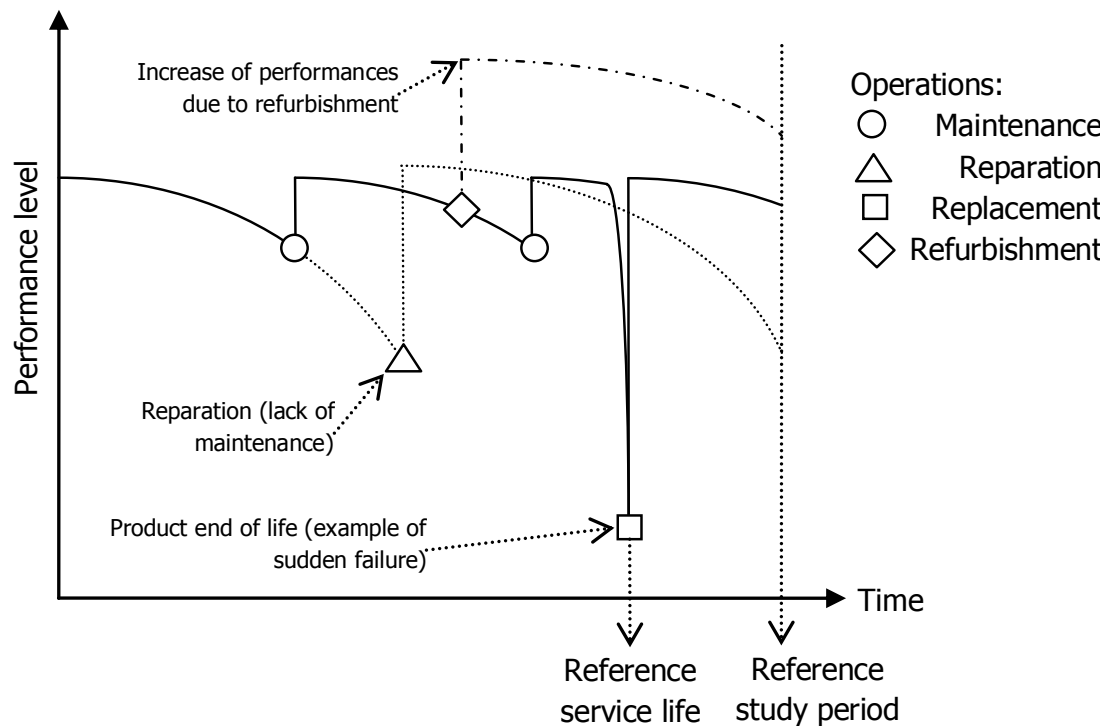
related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
relevant for					
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

- ❖ **B4 – Replacement:** replacement of a whole element, including the production and installation of a new (and identical) element. Product's Reference service life (RSL), valid under a set of specific conditions, should be used to calculate the number of replacements (*cf. "Replacement frequency" aspect*)
- ❖ **B5 – Refurbishment:** concerted programs of maintenance, repair and/or replacement activity, across a significant part or whole section of the building (important modifications that would impact several building components, modify building performances and/or functions)
- **All these aspects are related to the notions of durability and service life planning** (see ISO 15686 series). Furthermore, *"service life planning can only address foreseeable changes. Since service life planning is concerned with foreseeable risks, it is not applicable to the estimation of obsolescence [...] or to defective performance resulting from unforeseeable events or processes"*

B-31 Distinction between modules B2, B3, B4 and B5 (3/8)

related study objective		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
related study phase	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	Impact assessment (LCIA)	interpretation	reporting
relevant for	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA

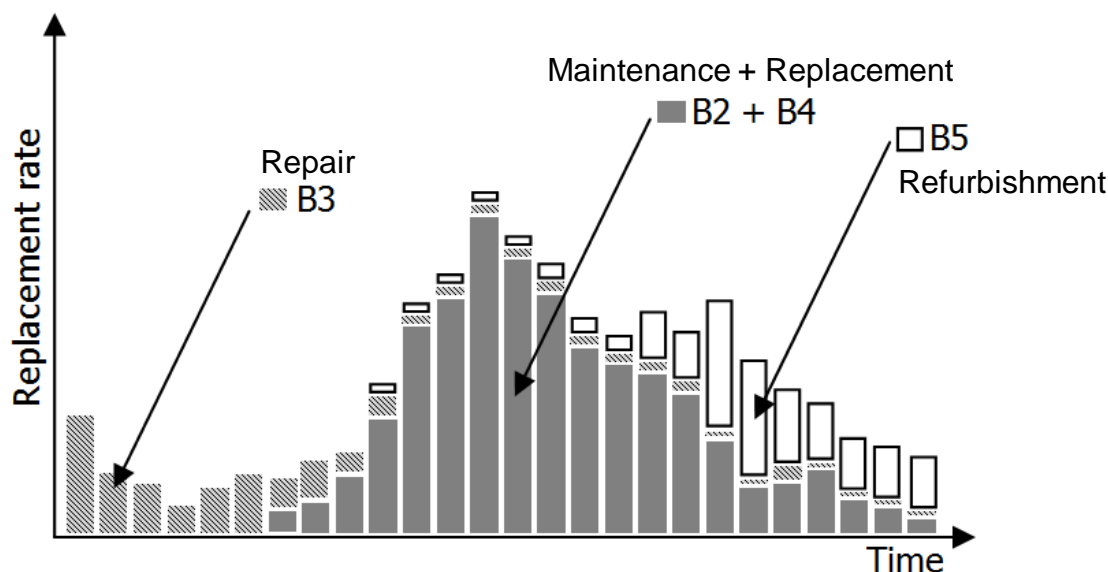
Example of performance over time according to the type of operations
(many other cases are possible)



B-31 Distinction between modules B2, B3, B4 and B5 (4/8)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA

Hypothetical distribution of replacement rate according to main causes of replacement



- Replacement caused by foreseeable loss of performances (RSL).
- ▨ Replacement caused by unforeseeable loss of performances.
- Replacement caused by obsolescence of the product or the building part (product still meets its initial performance requirements).

B-31 Distinction between modules B2, B3, B4 and B5 (5/8)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	

Guidance

- ❖ Apply the following principles, solely based on the distinction between the causes of end of life:
 - End-of-life due to performance decrease over time:
 - Causes related to foreseeable events (cf. RSL and associated conditions) → **Maintenance** and **Replacement** scenarios
 - Causes related to unforeseeable events → **Repair** scenario
 - End-of-life due to new expectations regarding the building performance level or functionalities (e.g. obsolescence) → **Refurbishment** scenario

B-31 Distinction between modules B2, B3, B4 and B5 (6/8)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/> goal and scope definition	<input type="checkbox"/> inventory analysis (LCI)	<input type="checkbox"/> impact assessment (LCIA)	<input type="checkbox"/> interpretation	<input type="checkbox"/> reporting
<i>relevant for</i>	<input checked="" type="checkbox"/> new buildings	<input checked="" type="checkbox"/> existing buildings	<input checked="" type="checkbox"/> building products	<input checked="" type="checkbox"/> screening LCA	<input checked="" type="checkbox"/> simplified LCA
				<input checked="" type="checkbox"/> complete LCA	






❖ B2 - Maintenance

- For building LCA, maintenance should take into account Maintenance modules as provided within EPDs + additional information if needed (e.g. state-of-art practices)
- Operations are performed under normal conditions, in a given context (e.g. climate).
- Consistency with building physical structure: influence of neighbouring components

❖ B3 - Repair

- For product and building LCA, Repair module should not be included in the baseline scenario
- For building LCA, Repair module may cover all operations (including replacement), outside the scope of normal conditions, related to improper installation or use of a product, unforeseeable event (flood, etc.)
- Repair scenarios could be based on the history of the building (existing buildings) or could be used to assess environmental impacts of specific risks (new buildings)

B-31 Distinction between modules B2, B3, B4 and B5 (7/8)

<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	Impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	 new buildings	 existing buildings	 building products	 screening LCA	 simplified LCA

❖ B4 - Replacement

- Replacement necessarily relates to RSL: it happens at the end-of-life of a product
- If a replacement is caused by an event outside the conditions defined by RSL, it should be considered as Repair
- For product LCA, the boundaries of replacement include: production, transportation and replacement process of the replaced component and ancillary products, waste management and end-of-life of the removed component and ancillary products
- Most of these processes may be similar to other modules of product LCA (e.g. A4, C1). In any case, it should be clearly stated whether or not assumptions regarding Replacement modules are similar to those used for other modules.
- For building LCA, Replacement scenario should be consistent with the building physical structure: influence of neighboring components (e.g. accessibility, possible replacement of other components, etc.).

B-31 Distinction between modules B2, B3, B4 and B5 (8/8)

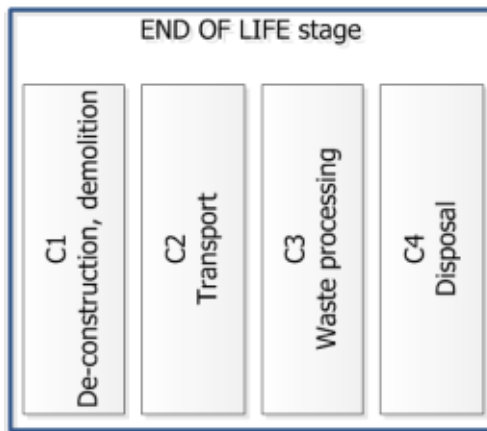
<i>related study objective</i>		<input checked="" type="checkbox"/> stand-alone LCA		<input checked="" type="checkbox"/> comparative assertion	
<i>related study phase</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	goal and scope definition	inventory analysis (LCI)	impact assessment (LCIA)	interpretation	reporting
<i>relevant for</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	new buildings	existing buildings	building products	screening LCA	simplified LCA
					complete LCA

❖ B5 - Refurbishment

- For product LCA, no refurbishment module has to be included in the baseline scenario
- For building LCA, refurbishment module should not be included in the baseline scenario if building service life is equivalent to the reference study period.
- Refurbishment scenario shall be developed if the service life of the building is lower than the Reference study period, and recommended for very long Reference study periods (>100 years)

- ❖ **Additional recommendation :** The progressive loss of performances of some components will have an impact on the overall behaviour of the building (e.g. loss of performance of insulation may lead to an increase of energy demand due to heating). If sufficient data are available these aspects should be addressed by using a sensitivity analysis.

Aspects for module C: end-of-life stage



Module C1 – De-construction, demolition stage

- C-01 Demolition/ Deconstruction – screening and simplified LCA
- C-02 Demolition/ Deconstruction – complete LCA

Module C2 – Transport

No specific aspect, refer to EN 15978 for information

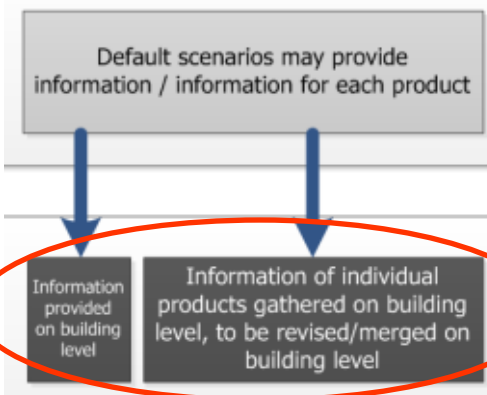
Module C3 – Waste processing

No specific aspect, refer to EN 15978 for information

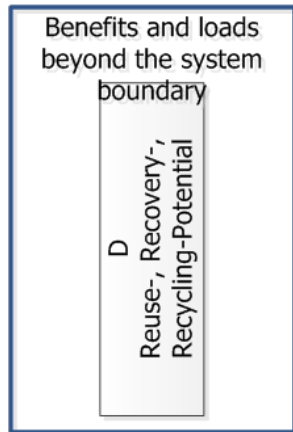
Module C4 – Disposal

- C-03 LCA modelling of landfill / disposal

No aspect is presented here, refer to the Product section of this series of courses and to EU LCA standards



Aspects for module D: benefits and loads beyond the system boundary



- D-01 Inclusion of module D
- D-02 Reuse - water consumption
- D-03 Credits for recycling and energy recovery

No aspect is presented here, refer to the Product section of this series of courses and to EN 15978 standards

Default scenarios may provide information / information for each product



Information of individual products gathered on building level, to be revised/merged on building level

Overview

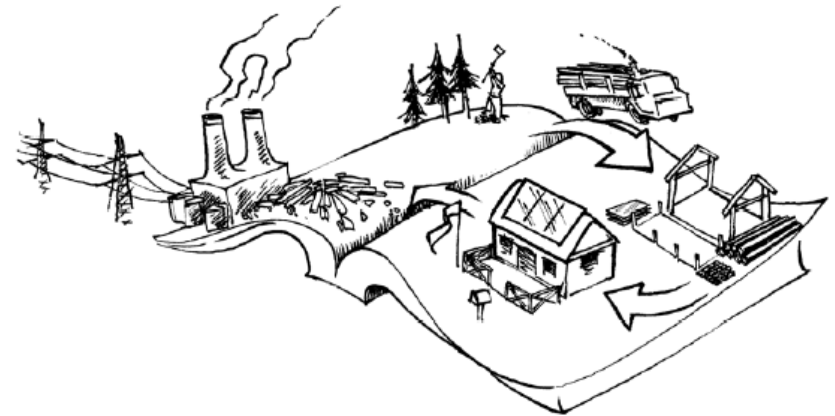
- I. Introduction
- II. Methodological approach
- III. How to use the guidance document
- IV. General provisions and guidance
- V. Provisions and guidance for products
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings
- VIII. Application in case studies for buildings**
- IX. Conclusions and perspectives



Application in case studies for buildings

NEW AND EXISTING BUILDINGS

- ❖ Case study 3: new building
- ❖ Case study 4: existing building



Case study 3: new building



Case study 3: new building



❖ **Main characteristics of the house:**

- Detached house for 5 persons in Tours (France)
- Surface area: 129 m²
- Built in 2008 / Constructive system: aerated concrete block
- Energy performance target: “BBC” label (French low energy label)

❖ **Short description of the house:**

- The house is composed of 5 bedrooms, a storeroom, a garage, a kitchen, a living room, 2 bathrooms.
- Heating: provided by a floor heating thermodynamics (coupled to a air/water heat pump) as well as steel radiators.
- Domestic hot water (DHW): provided by solar water heaters (hot tank of 300 L powered by 4 m² of glazed solar collectors on the roof).
- Ventilation: provided by a controlled mechanical ventilation (single flow).

Case study 3: new building



❖ Study type:

- Complete LCA
- Stand alone LCA

❖ Building LCA software:

- ELODIE version 1.2
www.elodie-cstb.fr

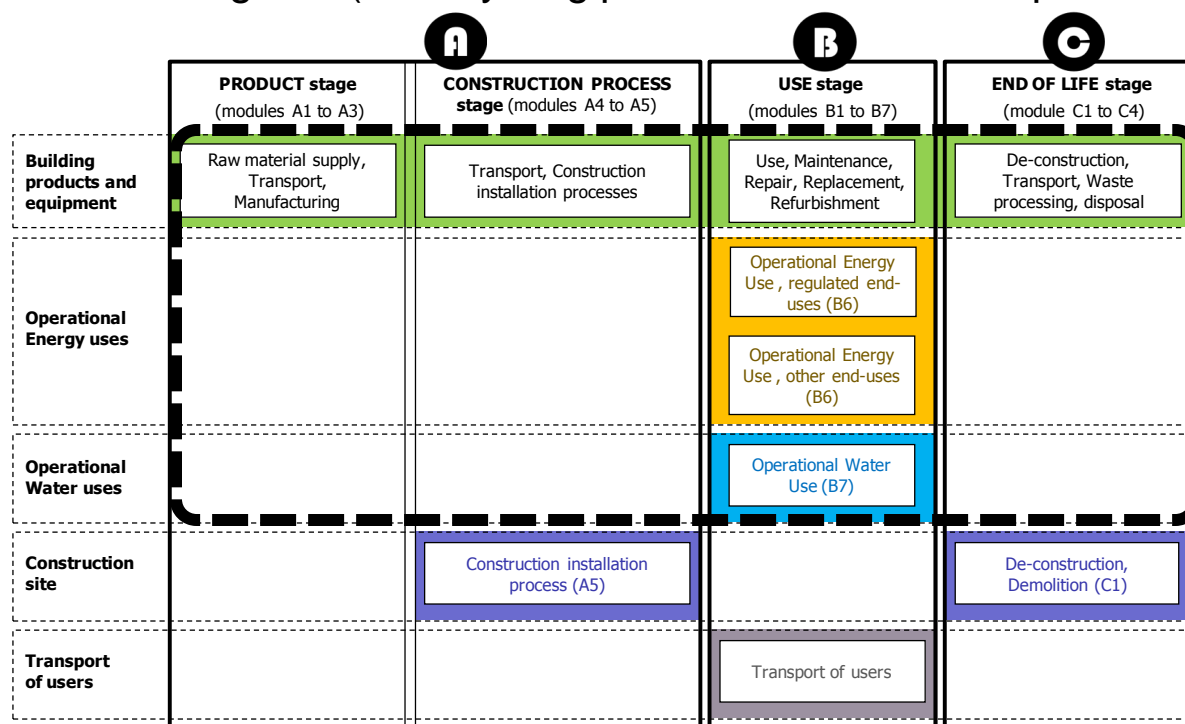
Goal/ Purpose of the study	Level of complexity	<input type="checkbox"/>	Screening
		<input type="checkbox"/>	Simplified
		<input checked="" type="checkbox"/>	Complete
	related study objective	<input type="checkbox"/>	Comparative assertion
		<input checked="" type="checkbox"/>	Stand alone LCA
	object of assertion	<input checked="" type="checkbox"/>	New building
		<input type="checkbox"/>	Existing building
		<input type="checkbox"/>	internal
		<input checked="" type="checkbox"/>	external
	communication purpose	<input type="checkbox"/>	for customer to customer
	<input type="checkbox"/>	publication	
	<input type="checkbox"/>	[name different communication purpose]	

Case study 3: new building



❖ Scope definition (system boundaries):

- LCA from cradle-to-grave (no recycling potentials and no transport of users included)



Case study 3: new building

❖ Scope definition (system boundaries):

- Building products and technical equipment included

Considered products and equipments	9. HVAC	Heating - Ventilation - Cooling - Domestic hot water system	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	10. Sanitary facilities	Toilet (bowl and sets hunting), Urinals, Shower trays, plumbing...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	11. Electricity and communication network	Electricity wiring and equipment (high and low voltage)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
		Communication network and equipment	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	12. Safety equipments	Fire safety system, intrusion detection system...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	M
	13. Lighting	General interior lighting and control systems...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	14. Lifts	Elevator, escalator, dumbwaiters...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	M
	15. Electricity generating units	Photovoltaic systems including inverters...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	M

Considered products and equipments			Included	Not existing	Screening	Simplified	Complete
	1. External works	Onsite network (water, gaz, sewers, heat...)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
		Vats and tanks, water retention...	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	M
		Parkings and covered surface	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	2. Foundations - infrastructure	Foundations -Load-bearing structure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
		Wall basement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
	3. Exterior walls - vertical structure	Exterior walls	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
		Structural vertical elements	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
		Stairs, pedestrian ramps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
		External surface coating, facing, painting	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
	4. Floor - horizontal structure	Floor structure and slabs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
5. Roof	Covering and tightness elements		<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
	Roof framework		<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
6. Interior walls	Partitioning walls and internal doors		<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
	Suspended ceiling		<input type="checkbox"/>	<input checked="" type="checkbox"/>	0	0	M
7. Windows and joinery work	Windows and joinery work		<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
	Doors		<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M
8. Interior finishes	Floor finishes and covering, screeds		<input checked="" type="checkbox"/>	<input type="checkbox"/>	M	M	M
	Paintings, wallpaper, decorative products		<input checked="" type="checkbox"/>	<input type="checkbox"/>	0	0	M

Case study 3: new building



❖ Scope definition (system boundaries):

- Operational energy and water uses included

Considered operational energy uses	Comments	
	Heating	<input checked="" type="checkbox"/>
	Air conditioning	<input checked="" type="checkbox"/>
	Domestic hot water	<input checked="" type="checkbox"/>
	Ventilation	<input checked="" type="checkbox"/>
	Building related uses	
	Lighting	<input checked="" type="checkbox"/>
	Auxiliary (pumps, control and automation)	<input checked="" type="checkbox"/>
	Building integrated systems (eg. Lifts, shutters, safety equipments...)	<input type="checkbox"/>
	No information	
	Non building related uses	To specify (e.g. plug-in appliances, dishwashers, TV...) <input checked="" type="checkbox"/>
		Consumption of user appliances are derived from french statistical data and calculated according to the surface NFA of the house.

Considered operational water uses	Drinking water	<input checked="" type="checkbox"/>	
	Water for sanitation	<input checked="" type="checkbox"/>	
	Domestic hot water	<input checked="" type="checkbox"/>	
	Irrigation of associated landscape areas	<input type="checkbox"/>	
	Building-related water-consuming processes		
	water for heating, cooling, ventilation and humidification	<input type="checkbox"/>	No information on HVAC system consumption
	Cleaning of interior or exterior spaces	<input checked="" type="checkbox"/>	Interior spaces
	Other specific water use of building-integrated systems e.g. fountains, swimming pools...	<input type="checkbox"/>	No other integrated systems
	Non building-related uses	To specify... <input type="checkbox"/>	Washing machines and dishwashers

Case study 3: new building



❖ Environmental indicators:

Used Indicators	<input checked="" type="checkbox"/>	1. Global warming potential	GWP
	<input checked="" type="checkbox"/>	2. Acidification Potential	AP
	<input type="checkbox"/>	3. Eutrophication Potential	EP
	<input checked="" type="checkbox"/>	4. Photochemical Ozone Creation Potential	POCP
	<input checked="" type="checkbox"/>	5. Total use of renewable primary energy	PERE
	<input checked="" type="checkbox"/>	6. Total use of non-renewable primary energy	PENRE
	<input checked="" type="checkbox"/>	7. Depletion potential of the stratospheric ozone layer	ODP
	<input type="checkbox"/>	8. Abiotic Resource Depletion Potential for elements	ADPE
	<input type="checkbox"/>	9. Abiotic Resource Depletion Potential of fossil fuels	ADPF
	<input type="checkbox"/>	10. Secondary Materials	SM
	<input type="checkbox"/>	11. Secondary fuels - renewable	RSF
	<input type="checkbox"/>	12. Secondary fuels – non renewable	NRSF
	<input checked="" type="checkbox"/>	13. Net Fresh Water	FW
	<input checked="" type="checkbox"/>	14. Hazardous Waste	HWD
	<input checked="" type="checkbox"/>	15. Non Hazardous Waste	NHWD
	<input checked="" type="checkbox"/>	16. Radioactive Waste	RWD
	<input type="checkbox"/>	17. Components for Re-Use	CFR
	<input type="checkbox"/>	18. Materials for Recycling	MFR
	<input type="checkbox"/>	19. Materials for Energy Recovery	MER
	<input checked="" type="checkbox"/>	20. Exported Energy	EE
	<input checked="" type="checkbox"/>	additional indicator : Water Pollution	WP
	<input checked="" type="checkbox"/>	additional indicator : Air Pollution	AP
	<input checked="" type="checkbox"/>	additional indicator : ADP total (element + fossil fuels)	ADPtot
	<input checked="" type="checkbox"/>	additional indicator : Inert Waste	IW

Case study 3: new building



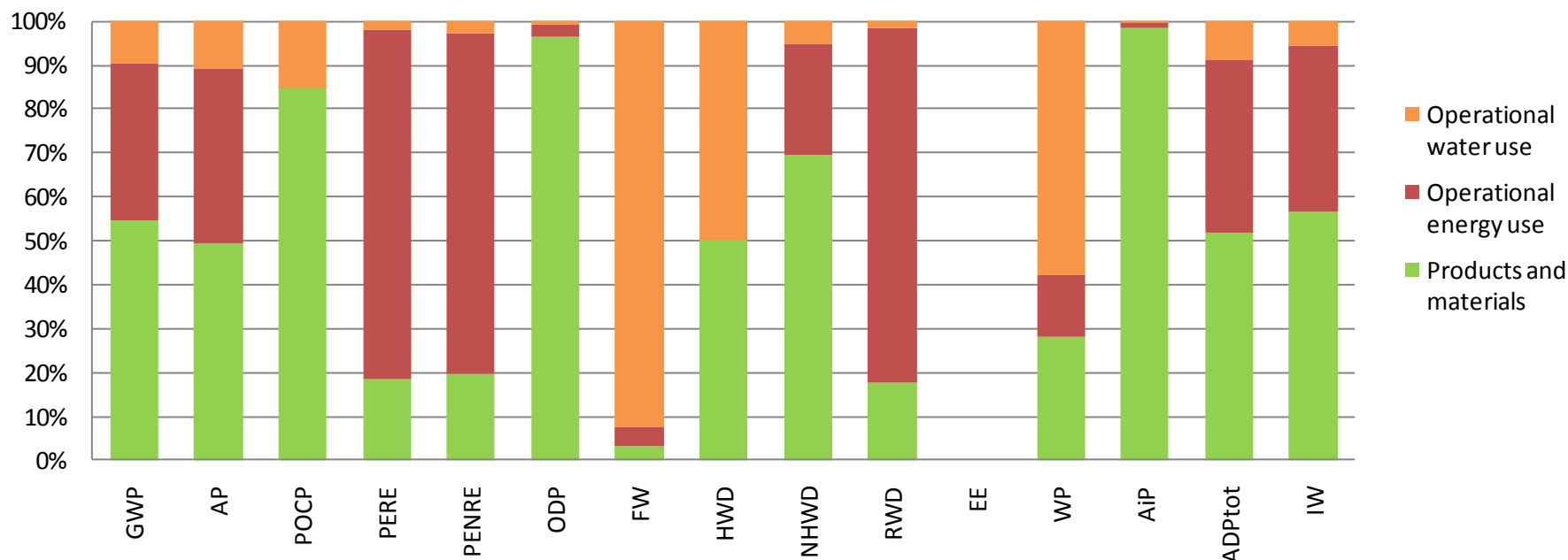
❖ Baseline scenario:

Baseline scenario	G- 08 "Reference study period"	50 years
	G- 10 "Future technical developments and innovation"	No innovation to be considered, current technologies to be used
	G- 12 "Accounting for carbon storage / carbon sequestration"	Carbon storage is not considered
	G- 25 "Water consumption as a new impact category"	Not scarcity of water to be considered
	B- 03 "Transport of people"	No transport of people to be considered
	B- 14 "Replacement frequency"	Replacement in whole number cycles
	B- 20 "Electricity consumption in dynamic LCA data"	Annual average data sets for electricity
	B- 25 "Operational energy demand – Consideration of user behavior for stand-alone or comparative LCA of new buildings"	No user behavior to be considered

Case study 3: new building



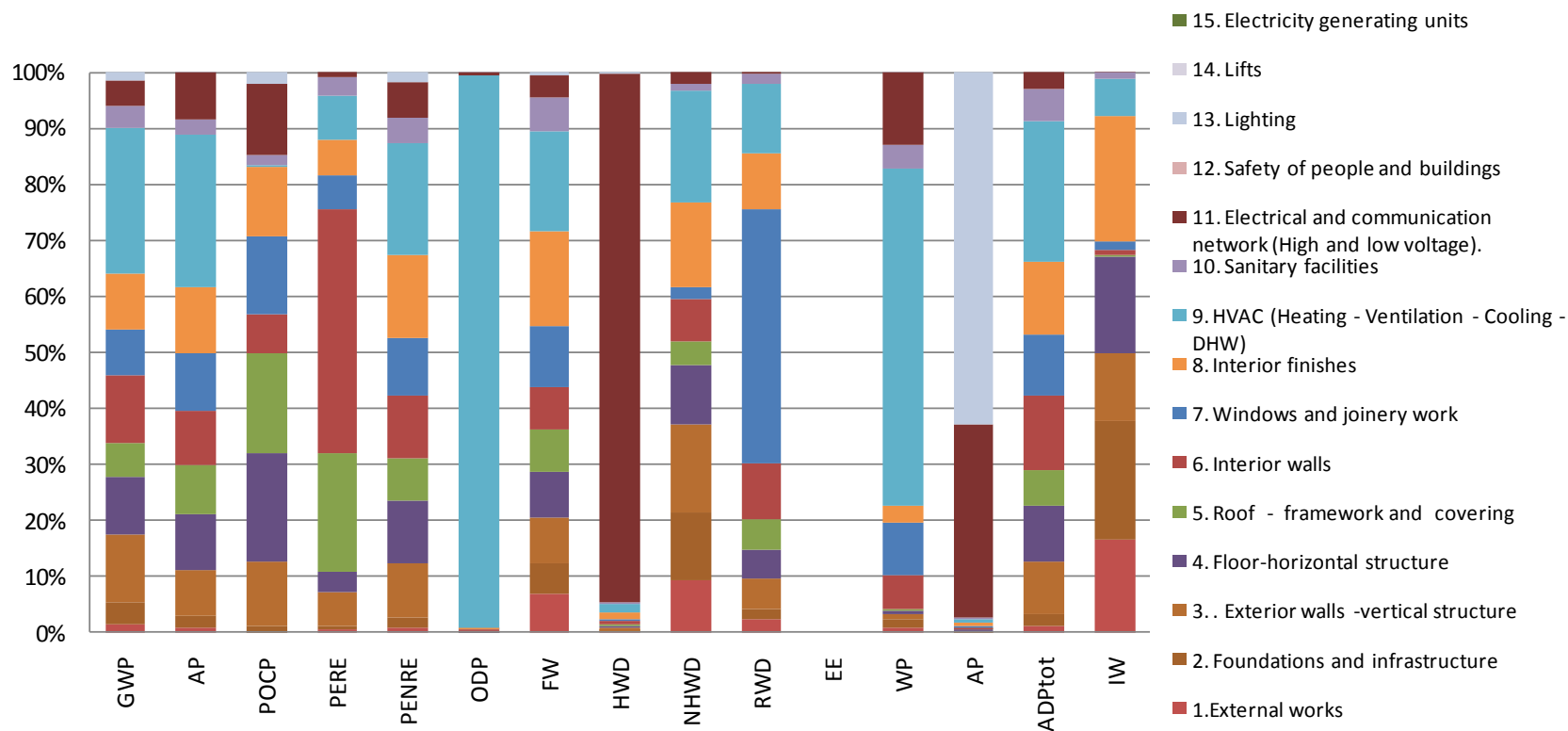
❖ LCA results breakdown per contributor (baseline scenario):



Case study 3: new building



❖ LCA results breakdown for the contributor “building products and equipment”:



Case study 3: new building



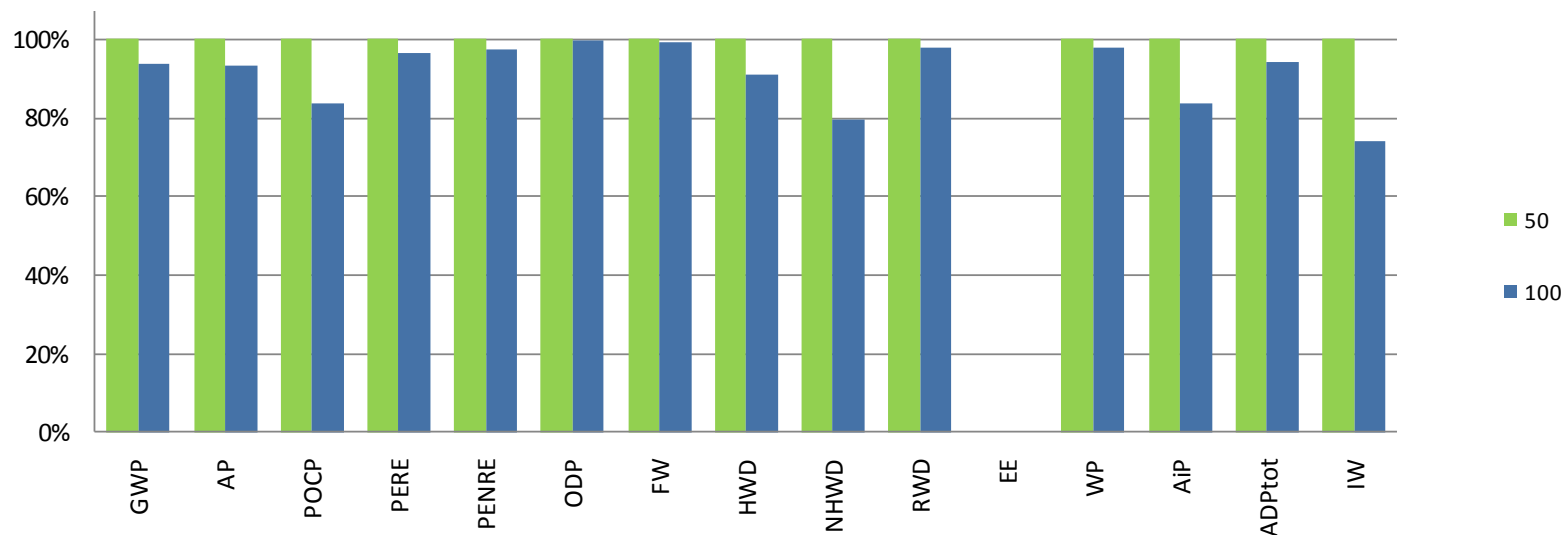
❖ Sensitivity analysis

- Only the RSP is modified
- From 50 years to 100 years

G- 08 "Reference study period"

100 years

❖ Results (sensitivity analysis)



Case study 3: new building



❖ Interpretation (baseline scenario)

- ❖ The results of the Life Cycle assessment of the permits to draw up the following conclusions:
 - The **contribution of products and equipments** is **predominant for** some important indicator of environmental impacts as **GWP, Non Hazardous Waste**.
 - **Operational energy use** is, for its part, the **main driver for non-renewable** and renewable **primary energy** and **radioactive waste**. It is also a significant contributor to ADP and GWP.
 - **Operational water use** is the **main driver** for the **indicator net fresh water use** whereas the contribution of product and operational energy use is slightly significant.
 - Finally, one of the main levers for this house in term of diminution of environmental impacts appears to be the contributor products and equipment. Indeed, building related uses are somehow already optimized. However we cannot conclude about the influence of non-building related uses as they represent conventional scenario defined with the help of statistical data.

Case study 3: new building



❖ Interpretation (alternative scenario)

❖ Interpretation of the results of the alternative scenario:

- The study was performed for a baseline scenario considering a reference study period (RSP) of 50 years and also for “100 years scenario” considering a RSP of 100 years. The graph show total LCA results expressed per year of operation are slightly modified by this modification for most indicators. But some important differences can be seen if we focus on the contributor products and equipment: for example the quantity of inert waste is, for scenario “100 years”, reduced down to 40%.
- However the methodology taken into account in the study to extend the service life of the building might not be appropriate as it consider only more replacement of component. Recommendation of the Operational guidance propose to develop senario for refurbishment (see module B, aspect *B- 16 “Refurbishment for screening, simplified and complete LCA”*). For example, scenario for energy efficiency improvement could be drawn up considering higher thermal expectations and better equipment efficiency. As well, operational water uses might also be influenced by the refurbishment.

Case study 3: new building



- ❖ **Conclusions of the case study for new building**
- ❖ Main aspects and methodological rules defined in the EeBGuidance have been followed for the LCA of the case study.
- ❖ It ends up finally to:
 - A clear definition of the objectives, scope and system boundaries for the study.
 - An interesting analysis. E.g.: for the considered case study, it has enable the practitioner to estimate the margin of improvement for specific contributors regarding specific indicators. This point was made possible by a contribution analysis: it has permitted to understand the weight of building process and element to total impacts.
 - A “standardisation” about the way of reporting the results of LCA of buildings that make easier the review.

Case study 4: existing building



Case study 4: existing building



❖ **Main characteristics:**

- Apartment block for 162 people in Terrassa (Barcelona).
- Net floor area: 6125 m².
- Built in 1975.
- 16 floors in total, including the ground floor.
- 60 apartments, 4 per floor (excluding the ground floor).
- Each apartment has its own heating, ventilation, hot water production, etc. systems.
- In 2010-2011, the building was refurbished with the aim of improving the thermal insulation of the façade (4,000 m²).
- The rehabilitation work consisted of adding a external layer of insulation material (expanded polystyrene). Windows were not substituted and only the outer layer of the original façade was removed.

Case study 4: existing building



❖ Study type:

- Simplified LCA
- Stand alone LCA

❖ Building LCA software:

- ELODIE version 1.2
www.elodie-cstb.fr

Goal/ Purpose of the study	Level of complexity	<input type="checkbox"/> Screening <input checked="" type="checkbox"/> Simplified <input type="checkbox"/> Complete
	related study objective	<input type="checkbox"/> Comparative assertion <input checked="" type="checkbox"/> Stand alone LCA
	object of assertion	<input type="checkbox"/> New building <input checked="" type="checkbox"/> Existing building
	communication purpose	<input type="checkbox"/> internal <input type="checkbox"/> external <input type="checkbox"/> for costumer to costumer <input type="checkbox"/> publication <input checked="" type="checkbox"/> <i>Case study of the EeBGuide project</i>

Case study 4: existing building



❖ Scope definition (system boundaries):

- As it is an existing building, only use phase was included.

	A PRODUCT stage (modules A1 to A3)	B CONSTRUCTION PROCESS stage (modules A4 to A5)	C USE stage (modules B1 to B7)	END OF LIFE stage (module C1 to C4)
Building products and equipment	Raw material supply, Transport, Manufacturing	Transport, Construction installation processes	Use, Maintenance, Repair, Replacement, Refurbishment	De-construction, Transport, Waste processing, disposal
Operational Energy uses			Operational Energy Use, regulated end-uses (B6) Operational Energy Use, other end-uses (B6)	
Operational Water uses			Operational Water Use (B7)	
Construction site		Construction installation process (A5)		De-construction, Demolition (C1)
Transport of users			Transport of users	

Case study 4: existing building



❖ Scope definition (system boundaries):

- Operational energy use included

❖ Environmental indicators:

- | | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | 1. Global warming potential |
| <input checked="" type="checkbox"/> | 2. Acidification Potential |
| <input checked="" type="checkbox"/> | 3. Eutrophication Potential |
| <input checked="" type="checkbox"/> | 4. Photochemical Ozone Creation Potential |
| <input checked="" type="checkbox"/> | 5. Total use of renewable primary energy |
| <input checked="" type="checkbox"/> | 6. Total use of non-renewable primary energy |
| <input checked="" type="checkbox"/> | 7. Depletion potential of the stratospheric ozone layer |
| <input checked="" type="checkbox"/> | 8. Abiotic Resource Depletion Potential for elements |
| <input type="checkbox"/> | 9. Abiotic Resource Depletion Potential of fossil fuels |

Building related uses

- | | |
|---|-------------------------------------|
| Heating | <input checked="" type="checkbox"/> |
| Air conditioning
(Cooling and humidification/de-humidification) | <input checked="" type="checkbox"/> |
| Domestic hot water | <input checked="" type="checkbox"/> |
| Ventilation | <input type="checkbox"/> |
| Lighting | <input checked="" type="checkbox"/> |
| Auxiliary (pumps, control and automation) | <input type="checkbox"/> |
| Building integrated systems
(eg. Lifts, shutters, automated gate, lighting for | <input type="checkbox"/> |

Case study 4: existing building



❖ Baseline scenario:

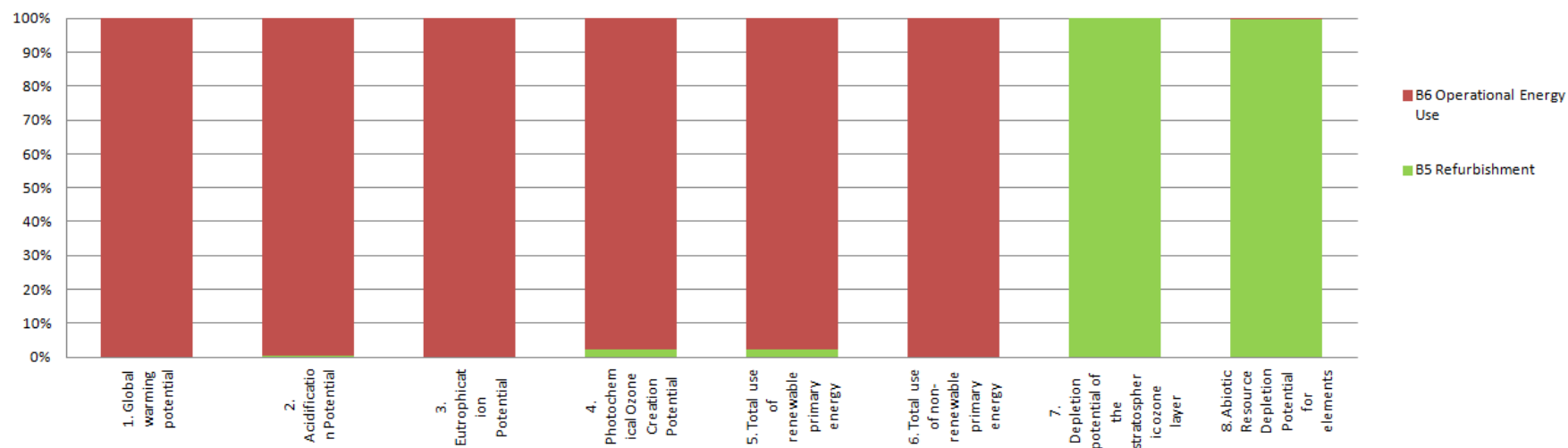
Baseline scenario	G- 08 "Reference study period"	50 years
	G- 10 "Future technical developments and innovation"	No innovation to be considered, current technologies to be used
	G- 12 "Accounting for carbon storage / carbon sequestration"	Carbon storage is not considered
	G- 25 "Water consumption as a new impact category"	Not scarcity of water to be considered
	B- 03 "Transport of people"	No transport of people to be considered
	B- 14 "Replacement frequency"	Replacement in whole number cycles
	B- 20 "Electricity consumption in dynamic LCA data"	Annual average data sets for electricity
	B- 25 "Operational energy demand – Consideration of user behavior for stand-alone or comparative LCA of new buildings"	No user behavior to be considered

Case study 4: existing building



❖ LCA results breakdown per contributor:

Overview of the building LCA results

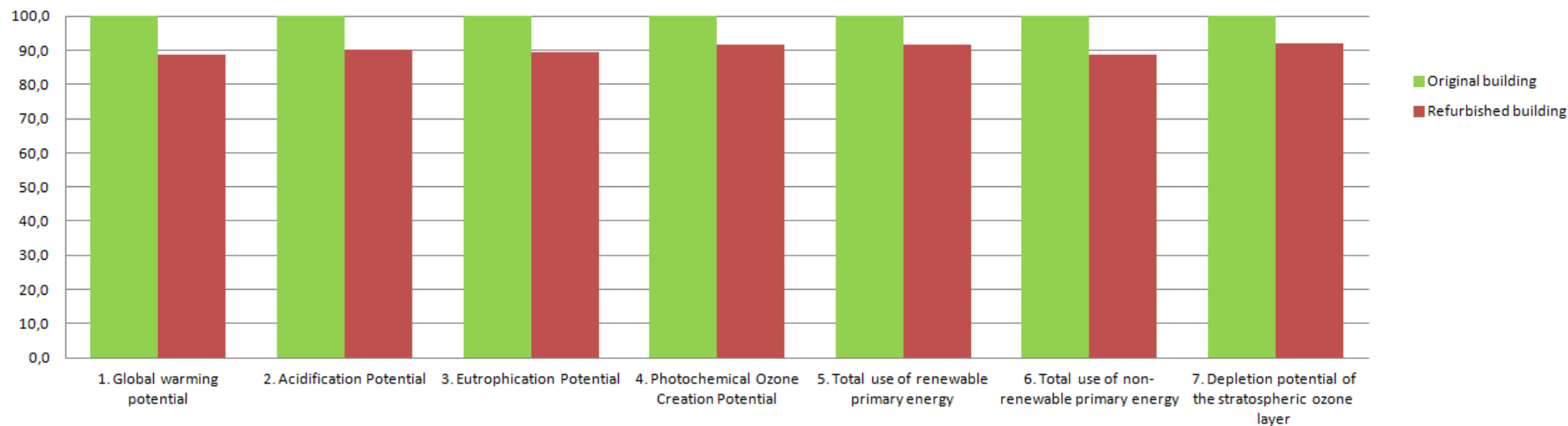


Case study 4: existing building



❖ Comparison of the use phase before and after the refurbishment

Building LCA results before and after the refurbishment



- ❖ Remarkable increase in the amount of abiotic resources consumed in the refurbishment scenario

Case study 4: existing building



- ❖ The results of the simplified Life Cycle assessment of the permits to draw up the following conclusions:
 - The refurbishment entails a reduction of the environmental impacts (circa 10%) for all impact categories, except for the Abiotic Depletion Potential.
 - The improvement of the LCA results is due to the reduction of the energy consumption for heating and cooling during the use phase.
 - The increase in the consumption of the abiotic resources is due to the use of non-renewable materials for the refurbishment work (e.g. expanded polystyrene, mortar...).

Overview

- I. Introduction
- II. Methodological approach
- III. How to use the guidance document
- IV. General provisions and guidance
- V. Provisions and guidance for products
- VI. Application in case studies for products
- VII. Provisions and guidance for buildings
- VIII. Application in case studies for buildings
- IX. Conclusions and perspectives**



Conclusions and perspectives (1/9)

- ❖ Findings of the EeBGuide project
- ❖ Connections to research projects and initiatives
- ❖ Possible future developments of EeBGuide



Conclusions and perspectives (2/9)

❖ Findings of the EeBGuide project

- **Initial aim:** to summarize existing provisions from CEN standards and ILCD Handbook and give operational guidance to LCA practitioners and tool developers on important and critical topics of LCA applied to the construction sector (LCA studies at the product or building scale)*
- **EeBGuide contents are based on:**
 - Combination of both CEN TC350 standards and ILCD Handbook methodological aspects
 - Findings from the EeBGuide project partner's expertise and R&D activities
 - Findings from other European research projects
- **Combination / merging of both CEN TC350 and ILCD provisions**
 - Transparent presentation
 - Merging relevant provisions in a consistent way (even if some conflicts remain)
 - As far as possible, provisions from EN 15804 and EN 15978 were applied first, and in case of no provisions given, then ILCD Handbook provisions were considered
 - In some cases, both provisions were considered as they provide complementary rules fulfilling different goals and scopes for product or building LCAs

Conclusions and perspectives (3/9)

❖ Findings of the EeBGuide project *(cont'd)*

- **Main contribution:** assembly of the latest findings from the LCA & Construction community in a structured document including the description of around **100 aspects**
 - General aspects are structured according to the LCA framework
 - Product and building aspects are separated in two volumes and structured according to the life cycle modules and stages of EN 15804 and EN 15978
 - Distinction between
 - 3 LCA types: screening, simplified and complete (adaptation to the project stage, from early to detailed design)
 - stand-alone LCA and comparative assertion (ensure that results to be compared are not biased)
 - new and existing buildings (differ in goal and system boundaries)
 - Other EeBGuide contribution: detailed reporting and review templates for case studies
-
- **It is easy for LCA practitioners to navigate through the Guide**
 - **Consistent guidance providing highly operational and scientifically-based contents**
 - **The Building LCA community can now refer to these uniform recommendations**

Conclusions and perspectives (4/9)

❖ **Connections to previous European research projects in LCA & buildings**

- ENSLIC project (ENergy Saving through promotion of Lfe Cycle assessment in Buildings) promotes the use of life cycle assessment (LCA) techniques in design for new buildings and for refurbishment, in order to achieve an energy saving in the construction and operation of buildings.

- Website of the project:

<http://circe.cps.unizar.es/enslic/index.htm>



- LoRe-LCA project (Low Resource consumption buildings and constructions by use of LCA in design and decision making)

- Website of the project:

www.sintef.no/Projectweb/LoRe-LCA/Training/



Conclusions and perspectives (5/9)

❖ Connections to on-going (in 2012) European research projects

- SuperBuildings (Sustainability and Performance assessment and Benchmarking of Buildings)

- Website of the project:

<http://cic.vtt.fi/superbuildings/>



- OpenHouse: “The main objective of this project is to develop and to implement a common European transparent building assessment methodology, complementing the existing ones, for planning and constructing sustainable buildings by means of an open approach and technical platform.”

- Website of the project:

www.sintef.no/Projectweb/LoRe-LCA/Training/



- These projects' outcomes are relevant sources of information and complementary guidance for some aspects covered in EeBGuide as well as the other previous EU projects from the 6th and 7th framework programme (e.g. PRESCO...)

Conclusions and perspectives (6/9)

❖ Connections to other research projects and initiatives

- Sustainable Building Alliance: see SBA common metrics framework (2009) and related project “Piloting SBA common metrics” (2011-2012) targeted at feasibility and comparability.
- Website of the project:
<http://sballiance.org/>
- ECO-platform project: on-going project conducted at the EU level in order to progress towards EPD harmonisation



❖ Connections to the CEN standardisation committee

- EeBGuide may be a useful document for the CEN TC350 when revising the EN 15804 / EN 15978 standards.



Conclusions and perspectives (7/9)

❖ Connections to other projects and initiatives

- International Symposium on LCA & Construction 2012 co-organized by Ifsttar and CSTB in France in July 2012 with the following topics covered:
 - Life cycle inventory data: validation, aggregation, uncertainties
 - Methods for buildings
 - Decision and management
 - LCA case studies for buildings and infrastructures
 - Dynamic life cycle assessment, service life and indicators
 - Methods for construction materials
 - End of life, waste and allocation
- 3rd day of the symposium dealing with the articulation of the LCA & construction research with its implementation in practice (in line with the goal of the EeBGuide project)
- Website of the symposium (with full articles and online presentations etc.):

<http://lca-construction2012.ifsttar.fr/>



Conclusions and perspectives (9/9)

❖ Possible future developments of EeBGuide

- More work would be needed to:
 - Analyse in more details the implications of ILCD Handbook provisions for different goal definitions
 - Improve the definitions of the 3 study types through feedbacks from case studies
 - Incorporate future developments and standardisation outcomes
 - Conduct comparative LCA in early design of products and buildings
- Future research should also focus on a common European reference building as a baseline scenario (in order to provide average European values for its parameters, which will facilitate comparisons between research projects and support the evolution of building labelling / certification schemes)

➤ Towards a new version of EeBGuide (from version 1.0 to version 2.0)?

Conclusions and perspectives (8/9)

❖ Last but not least...

EeBGuide enabled to create a platform in between research activities (EU projects, others projects, scientific conferences), standardisation activities (CEN TC 350 standards) and practical implementation of LCA in the construction sector by the different stakeholders.

Website with the InfoHub



www.eebguide.eu

Forum of users



www.construction21.eu

Operational guidance for Life Cycle Assessment studies of the Energy Efficient Buildings Initiative

Thank you for your attention!

