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Abstract

The beta version of Level(s) – the European Commission's proposal for a common reporting framework of the sustainability of buildings – was extensively tested by the Finnish construction sector during 2018 – 2019. This test period was jointly arranged by the Ministry of the Environment and the Green Building Council Finland. This report summarises the feedback collected from participants in the test phase.

Apparently, Level(s) has good potential to become a common language of sustainability reporting for the building and construction sector. There seems to be a clear need and interest for this among the stakeholders in Finland. However, in order to reach this stage, Level(s) should be further developed. The most acute needs for development include improving the clarity and accessibility of the guidance document, restructuring of the assessment levels and reconsideration of the system boundaries. Furthermore, compatibility with national practices and building information modelling was found essential in the feedback gathered from the test group.

The feedback from this test will be delivered to European Commission for the purpose of development of Level(s). The findings will also be used for taking forward the Finnish roadmap for low carbon construction, which aims at mandatory life cycle assessment and carbon footprint threshold levels during the 2020´s.

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Tiivistelmä

Beetaversiota Level(s)-menetelmästä (Euroopan komission ehdotus rakennusten kestävyyden yhtenäiseksi raportointikehykseksi) testattiin laajasti Suomen rakennusalalla vuosina 2018–2019. Ympäristöministeriö ja Green Building Council Finland järjestivät yhdessä testausajan. Tämä selonteko esittää lyhyesti testausvaiheeseen osallistuneilta kerättyä palautetta.

Level(s) näyttäisi mahdollisesti soveltuvan yhteiseksi kieleksi kestävyysraportointiin rakennusalalla. Suomessa sidosryhmillä näyttää selvästi olevan tarvetta ja kiinnostusta tähän. Jotta tälle tasolle päästäisiin, Level(s)-menetelmää tulee kuitenkin kehittää lisää. Akuuteimmat kehitystarpeet liittyvät ohjeiden selvyyden ja saatavuuden parantamiseen, arviointitasojen uudelleenjärjestämiseen ja järjestelmän rajojen harkintaan. Testiryhmältä kerätyssä palautteessa pidettiin ensiarvoisen tärkeänä sitä, että menetelmä on yhteensopiva kansallisten toimintamallien ja rakennustietojen mallintamisen kanssa.

Palaute tähän testiin toimitetaan Euroopan komissiolle Level(s)-menetelmän kehittämiseksi. Tuloksia käytetään myös edistämään vähähiilisen rakentamisen tiekartan toteutumista Suomessa, missä tavoitteena on ottaa käyttöön pakolliset elinkaariarvioinnit ja kynnysarvot hiilijalanjäljelle 2020-luvun aikana.

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Referat

Beta versionen av Level(s) – EU-kommissionens förslag om en gemensam bas för rapportering som rör byggnaders hållbarhet – testades ingående av den finska anläggningssektorn 2018–2019. Testperioden anordnades gemensamt av miljöministeriet och Green Building Council Finland. Denna rapport sammanfattar respons från deltagarna i testfasen.

Level(s) har uppenbarligen goda förutsättningar att bli ett gemensamt språk för rapportering om hållbarhet som rör bygg- och anläggningssektorn. Det verkar finnas ett klart behov och intresse för detta bland intressegrupperna i Finland. För att nå detta stadie bör dock Level(s) utvecklas ytterligare. Det akutaste utvecklingsbehovet gäller förbättringen av vägledningsdokumentets tydlighet och tillgång samt omstrukturering av bedömningsnivåer och omprövning av systemavgränsningar. I responsen konstaterade testgruppen dessutom att förenlighet med nationell praxis och byggnadsinformationsmodellering är väsentligt.

Responsen från denna test kommer att levereras till EU-kommissionen i syfte att utveckla Level(s). Resultaten kommer också att användas för att föra vidare den finska färdplanen för koldioxidsnålt byggande vars mål är obligatorisk livscykelanalys och tröskelnivåer för koldioxidavtryck under 2020-talet.

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Contents

Summary

Level(s) is a voluntary reporting framework to improve the sustainability of buildings. Using existing standards, Level(s) provides a common EU approach to the assessment of environmental performance in the built environment.

The beta version of Level(s) was tested in Finland during 2018 – 2019 in more than 20 construction projects. Construction companies, real-estate owners, contractors, consultants and manufacturers took part in the testing, which was focused at energy efficiency, greenhouse gas emissions and circular economy of buildings. The outcome of the test is documented in this report. The main conclusions are:

Positive feedback:

+ Testing was considered to give more understanding about the sustainability of buildings.
+ Testing influenced the design and reporting of building project. It also gave incentives for setting sustainability goals for participating contractors.
+ Calculating the carbon footprint was not considered too challenging.

Areas of improvement:

– The guidance documents were considered complex and difficult to use.
– Gathering the required data and getting familiar with the assessment requirements is very time consuming.
– The added value of three different assessment levels remains unclear, whereas there is no assessment level for setting targets in a pre-planning or procurement stage.
– Level(s) was considered to require additional work but provide no clear added value compared to commercial green building certification schemes.
– The lack of "handprint" reporting possibility was considered as a limitation.

1 Part 1: Summary of the test results

This report is a summary of the testing of Level(s) beta version in Finland during 2018 – 2019. The report is divided into two parts. Part 1 is a summary of the feedback received from the testers. Part 2 includes the results of the buildings that were assessed using the beta version of Level(s).

1.1 Level(s): What and why?

The construction sector is one of the most intensive users of energy and emitter of greenhouse gas (GHG) emissions: one third of global GHG emissions, approximately 40 % of available primary energy and half of global raw materials can be attributed to construction.

This is a critical challenge for the construction sector. However, the construction sector may also hold a significant potential for reaching the goals for resource efficiency, circular material flows, and net zero emissions that have been set in the EU for 2030 and 2050.

Level(s) has been developed by the European Commission in collaboration with EU´s member states, construction industry and third sector for measuring and reporting the sustainability and resource efficiency of buildings. The aim has been to create a "common language" for supporting communication. Furthermore, the goal has also been to develop a tool that guides to design and build a resource efficient buildings that consume less energy, cause less GHG emissions, use materials effectively, provide users with good indoor air and are fit for future changes.

1.1.1 The structure of Level(s)

The Level(s) framework is based on existing EN standards, mostly EN 15978. Level(s) is arranged into six macro objectives (MO) that each describe certain aspect of sustainability or resource-efficiency.

Level(s) is suited for use in both new buildings and refurbishment projects. It is primarily intended for assessment of residential buildings or offices, but its generic approach lends itself to other building types as well.

Table 1 describes the macro objectives of Level(s).

Table 1. The macro objectives of Level(s) and related indicators.

Macro Objective	Indicator or Tool
1: Greenhouse gas emissions along a buildings life cycle	Indicator 1.1 Use stage energy performance
	Indicator 1.2 Life cycle Global Warming Potential
2: Resource efficient and circular material life cycles	Tool 2.1 Life cycle tools: Building bill of materials
	Tool 2.2 - Scenario 1 Building and elemental service life planning
	Tool 2.2 - Scenario 2 Design for adaptability and refurbishment
	Tool 2.2 - Scenario 3 Design for deconstruction, reuse and recyclability
	Indicator 2.3 Construction and demolition waste
3: Efficient use of water resources	Indicator 3.1 Total water consumption
4: Healthy and comfortable spaces	Indicator 4.1 Indoor air quality
	Indicator 4.2 Time outside of thermal comfort range
5: Adaptation and resilience to climate change	Tool 5.1 Scenarios for projected future climatic conditions: Protection of occupier health and thermal comfort
6: Optimised life cycle cost and value	Indicator 6.1 Life cycle costs
	Indicator 6.2 Value creation and risk factors

The Level(s) assessment can be carried out in three different levels of accuracy:

- Level 1: Simplified assessment
- Level 2: Comparative assessment
- Level 3: Detailed optimisation

These three assessment levels are intended for enabling the use of Level(s) for users who have different skills and requirements. The simplified assessment offers a common platform for comparing functionally similar buildings. On advanced levels the assessment scheme support the comparison and optimisation of detailed design solutions. The advanced assessment options are intended to be used by experienced life cycle assessment (LCA) consultants.

1.2 Testing of Level(s)

1.2.1 Testing in EU and Finland

The European Commission has opened an online portal for help and coordination of testing Level(s) in different building projects. So far, Level(s) has been tested in over 20 countries and more than 130 buildings have been registered into the test. Finland is among those countries in which participation into testing has been active. At the time of the writing of this report, the tests of 18 Finnish construction projects – including 24 individual buildings – have been accomplished.

The test in Finland was arranged by the Ministry of the Environment and Green Building Council Finland. The test was open to all interested projects and stakeholders, not just LCA professionals. This way, the aim was to investigate how robust and easily approachable the beta version of Level(s) was. Among the participants of the test public sector, construction companies, constructors, consultants and building material producers were all represented.

The results of the indicators and tools were reported using the Excel template provided by the European Commission. In addition to this, a separate round of feedback was collected using an online questionnaire.

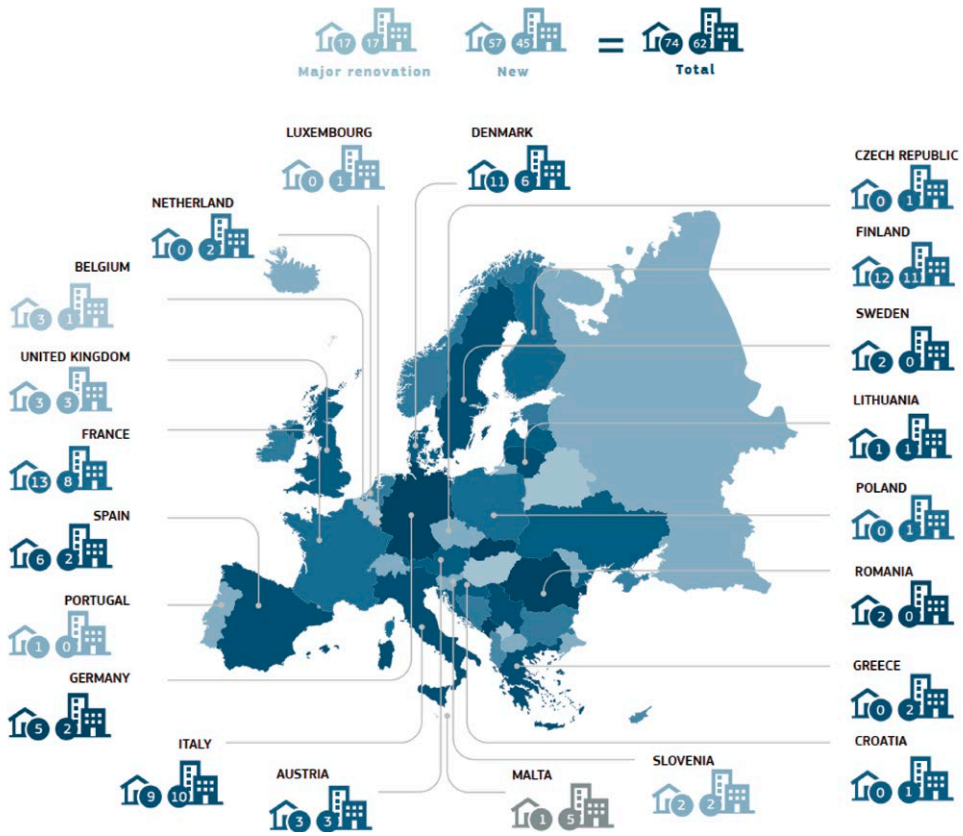

Figure 1. **The scope of Level(s) testing in Europe. Source: European Commission (2019).**

1.2.2 Scope of the test in Finland

The Land Use and Building Act of Finland is currently under total revision. In this process, the need to introduce regulations on life cycle aspects and climate impacts of buildings has been raised among the stakeholders of the working groups of the revision process. Therefore, the feedback from the Level(s) test will be used as a part of the roadmap towards low carbon construction in Finland. The aim of the roadmap is to bring lifecycle carbon footprint threshold levels for buildings into norms by the mid 2020´s.

For these reasons, the focus of the test in Finland has been in lifecycle carbon footprint calculations and circular economy. All test projects had to include indicators 1.1 (use stage energy performance), 1.2 (life cycle global warming potential) and 2.1 (building bill of materials) into their minimum scope. However, many other indicators have been included in several of the test projects (Table 2).

The Level(s) framework was tested in different types of construction projects. Among these were 22 new buildings and two refurbishments. Building typologies were also diverse. Half of the tested buildings were residential, one quarter were schools, and the rest consisted of offices, healthcare buildings and dormitories.

Table 2. Tested indicators and tools of Level(s) in Finland according to the buildings in question. Colour shows which indicator and tools have been tested in which project.

Level 1: orange, Level 2: yellow, Level 3: green.

Building	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Indicator 1.1: Use stage energy performance	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L1	L2	L2	L1	L2
Indicator 1.2: Life cycle Global Warming Potential	L1	L1	L1	L1	L2	L1	L2	L1	L2		L1	L3	L1	L1	L1	L2	L2	L1	L2
Tool 2.1: Life cycle tools: Building bill of materials	L1	L1	L1	L1	L1	L1	L2	L1	L2	L1	L1	L3	L1	L1	L1	L2	L2	L1	L2
Tool 2.2: Scenario 1 - Building and elemental service life planning		L1				L1	L1	L1	L1	L1				L1	L1	L1	L1		L1
Tool 2.2: Scenario 2 - Design for adaptability and refurbishment	L1																		
Tool 2.2: Scenario 3 - Design for deconstruction, reuse and recyclability											L1							L1	
Indicator 2.3: Construction and demolition waste			L1			L1				L1								L1	L1
Indicator 3.1: Total water consumption	L1		L1	L1		L1					L1							L1	L1
Indicator 4.1: Indoor quality						L1												L1	
Indicator 4.2: Time outside of thermal comfort range						L1												L1	L1
Tool 5.1: Scenarios for projected future climatic conditions																			
Indicator 6.1: Life cycle costs						L1	L2												
Indicator 6.2: Value creation and risk factors																			
Cradle to cradle Life Cycle Assessment (LCA)					L1		L2												L2

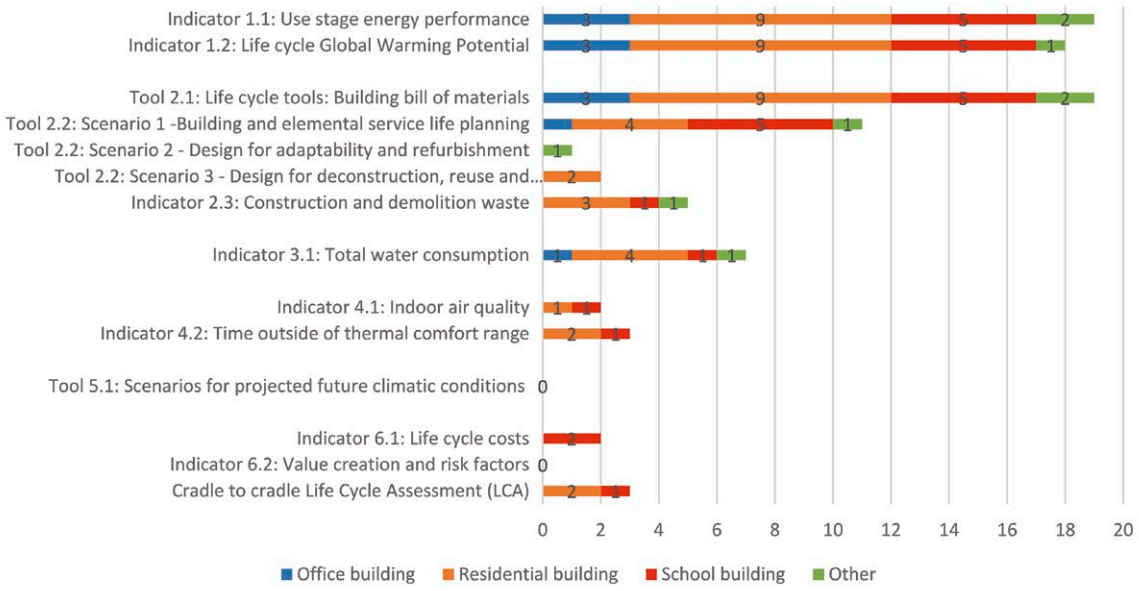

Figure 2. **Level(s) indicators tested in different types of construction projects.**

1.2.3 How the test was organized

The Ministry of the Environment and the Green Building Council supported the test in Finland. An online workspace was opened for communication and for sharing materials. Workshops were arranged for discussion and sharing of experiences. It was also possible to receive guidance through email. In addition, a small financial support was given to the test projects to cover costs that would have been beyond the scope of a normal construction project.

1.3 Feedback from the test

1.3.1 About the feedback

The primary aim of the test was to give experience based observations and ideas for further development of both Level(s) and the Finnish roadmap to low carbon building. As the test group in Finland was intentionally rather heterogenic regarding their assessment skills, the feedback is diverse as well. The comments dealt with a range of issues starting from the general working process of LCA to specific methodological observations of how LCA is framed in Level(s).

Needs for further development were recognised in the structure, indicators, tools and guidance as well as the impact of using Level(s). The feedback from the test is described in

short in the following chapters of Part 1 of this report. Part 2 includes descriptions of the buildings that have finished the test.

The feedback is arranged as follows: First, the expectations for the test are described. Then, the general views on the benefits of Level(s) as a tool for guiding design decisions are presented. Thereafter, the detailed comments on the methodology of Level(s) are presented. Finally, the views on the potential of Level(s) for industry-wide use are presented.

1.3.2 What were the expectations that motivated the use of Level(s)?

There appears to be several reasons for participating into the testing of the beta version of Level(s). The three most important reasons were to gather information in order to establish objectives and targets for the sustainability of the project, to gather information about the benefits for end-users of more sustainable buildings, and to gather support for benchmarking and comparisons of the performance of different buildings. The responses are further described in Figure 3.

Additional reported incentives for participating in the test were the development of skills, interest in participating in a carbon footprinting pilot, motivation to learn more about environmental product information in Finland, and gaining general knowledge on the metrics of sustainable construction.

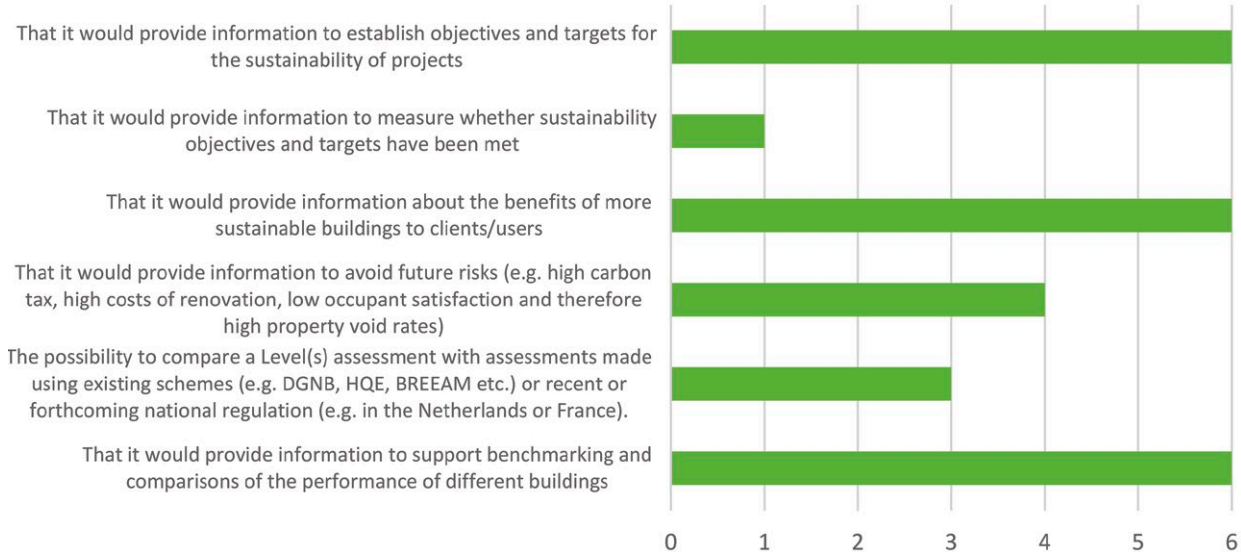

Figure 3. General expectations that motivated the use of Level(s). Source: European Commission´s test phase survey (Finnish projects).

1.3.3 How useful was Level(s) in project management and comparison?

Based on the survey there appears to be potential for a freely available guidance framework for sustainable construction. However, the beta version of Level(s) was not considered suitable for wider use. The attitudes towards the usability and usefulness of Level(s) are shown in Figure 4.

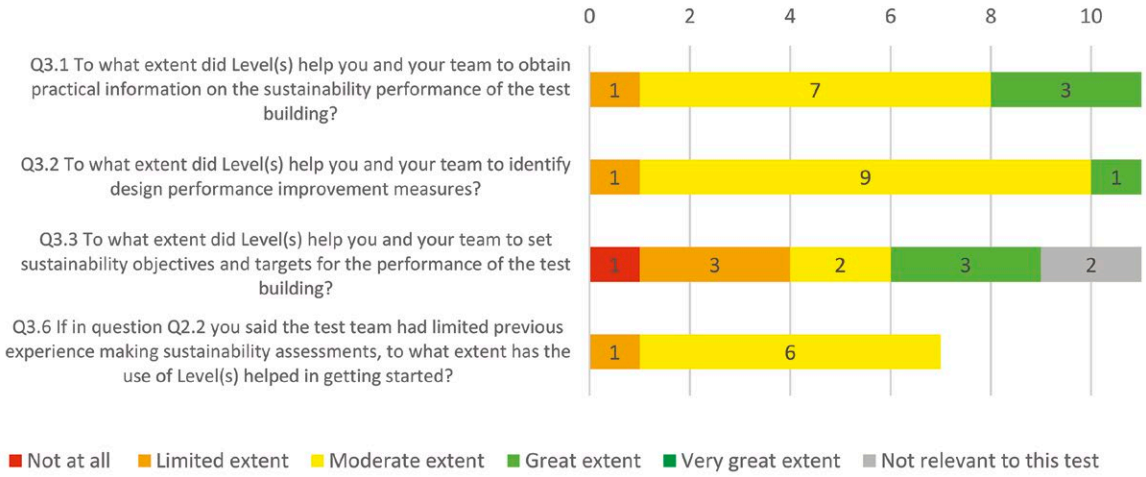

Figure 4. Views of the usefulness of Level(s).

Based on the feedback Level(s) was considered helpful for offering practical information on the sustainability of the project (Q3.1) and identifying the needs for improvement (Q3.2). The same applied to the usefulness of Level(s) in getting started in sustainability assessments (Q3.6).

The written feedback revealed what were the factors that made Level(s) less useful. These comments were mostly about the usability of the guidance document, contents of individual indicators and smoothness of the assessment process. This part of the feedback is further described in the following sub-chapters of this report.

Although the usefulness of Level(s) did not reach top scores, it was still mentioned to have brought real value in the test projects. Participating into the test had helped organisations to identify development needs in their own design processes and operative models. In the projects that were in their design stages, the calculation of the carbon footprint (indicator 1.2) had helped in practice to make design decisions in the project. Thus Level(s) had already in its beta phase brought added value to the sustainability of these projects.

The feedback suggests that the beta version of Level(s) may help projects in their design stage through the comparison of design alternatives. The consistent assessment framework makes this possible. Furthermore, the feedback indicates that benchmark

information might increase this usefulness in further versions of Level(s) and its possible national implementations. Still, the framework does not yet support the comparison of different projects, as the calculation data may differ and the system boundaries may not be exactly matching. This could be addressed while the quality criteria for the comparability of the data used for calculations are further developed.

1.3.4 Feedback on the guidance documents

The accessibility and clarity of the guidance documents of the beta version of Level(s) appears to have been very challenging for the test group. This feedback was also reported by the most experienced of the LCA consultants who participated into the test. The guidance documents were considered to be sufficient in the coverage, but it appeared to be difficult to find relevant information and to implement that into the assessment process at hand.

Problems related to the guidance documents were described as follows:

- Cross-references within the document make it slow to read. As the text is fragmented, it becomes harder to comprehend.
- References to external documents – mainly EN standards – were considered difficult. Especially non-experienced tester reported on this. As they have no previous knowledge on the contents and hierarchy of the standards, the implementation of the guidance becomes slow as one has to buy the standard and become familiar with it before being able to continue with Level(s). More practical examples and guidance was asked for ("don´t tell me which standard to apply – just tell me what I need to do next").
- National common practice that define many of these metrics may conflict with the guidance of Level(s) and this caused extra work and uncertainty. Most test projects already contained much of the data that was requested to be reported in Level(s), but it seemed to be difficult to check if the existing data – e.g. floor area, primary energy demand or bill of quantities – were in the format requested in Level(s). It remained unclear for many if the national practices for reporting certain key indicators deviated from the requirements of Level(s), as e.g. the Energy Performance of Buildings Directive may have been implemented differently in different EU member states.
- Interpretation of the guidance text was reported difficult. This is partially because it is in a foreign language, and partially because the text itself was considered to offer multiple interpretations.

As the results of different test projects were cross-compared, it is apparent that different test teams had interpreted the same guidance differently. This applied for instance to the functional units of comparison, to temporal system boundaries and to reporting the stored carbon in wood-based building products. In addition, the reporting template seemed to offer room for differing interpretations.

1.3.5 The comprehensibility of the structure, indicators and tools

For many participants of the test, Level(s) offered the possibility to become familiar with the principles of sustainable construction and provided suggestions for find further information. The given feedback shows that most of the indicators of the beta version of Level(s) are already being addressed in the projects using one method or another. Thus, no entirely new or foreign ways of sustainability assessment are being suggested. Although the close connection between Level(s) and standards was criticized from the viewpoint of usability of the guidance document, it was also seen as methodologically solid and a preferred option.

The beta version of Level(s) was considered too complicated and laborious – an attitude expressed by both novice and experienced assessors. This was mainly argued based on the perceived complexity and inaccessibility of the guidance document, as described earlier. However, the feedback on the comprehensibility of Level(s) should be read within the scope of the Finnish pilot project (focussed on indicators 1.1, 1.2 and 2.1).

The feedback suggests that there may be elements in the Level(s) framework that are felt to be unnecessary but laborious. This applies especially to the bill of materials (tool 2.1), in which the materials are requested to be grouped into four main groups (metal minerals, non-metallic minerals, biomass, and fossil energy materials). This grouping was described as overly generalised and not done in normal construction projects. Thus, although the aim of this grouping may be to simplify the framework, it was in fact reported to cause more work than usual without bringing any added value for the projects. This way of presenting materials was not supported. Furthermore, it was suggested that the potential for circular economy should be more emphasized.

The physical system boundary suggested in Level(s) seems to omit parts of residential and office buildings that are normally included in the sustainability assessment of buildings and that are within the scope of the national LCA scheme in Finland. These parts – such as the exclusion of toilets of office buildings or the separate reporting of garages of residential buildings – can make the assessments complicated if the same building needs to be reported with slightly different scopes for different assessment schemes.

Suggestions for simplifying the reporting requirements were especially given regarding the physical system boundary of the beta version of Level(s). In early design stages – and often also when applying for building permits – the materials for certain building service appliances, telecom and data installations or fixed furniture are not yet known. It was suggested that the level of detail would be eased in these building parts or alternatively, mean values for the typical amounts of these components should be provided with the assessment scheme.

Regarding the temporal system boundaries, it was suggested that life cycle modules A1-5, B4-6 and C3-4 would make a realistic temporal coverage for the assessment. This differs slightly from the two alternative system boundary options of the beta version of Level(s).

The use of different assessment levels 1, 2 and 3 was – surprisingly – seen as a factor that makes it more difficult to start using Level(s). The feedback data suggests that the differences between these levels remained rather unclear for the testers and that it was quite difficult to understand in the beginning of the assessment how the selection of an assessment level would in fact guide the process. As a practical recommendation it was suggested that the "easiest" level would be compatible with national assessment schemes and other reporting or documentation practices. This was thought to help getting started with Level(s) and to lower the threshold for taking it into use in different organisations.

The differences between the beta version of Level(s) and national and commercial assessment schemes were considered problematic. This was mainly because it may be difficult to translate exactly the reporting of one assessment scheme into Level(s) and vice versa. The testers asked for a table of comparison on how Level(s) differs from main commercial assessment schemes or from the national assessment scheme.

1.3.6 Working with Level(s)

The experience of the test group was two-fold. On one hand, working with Level(s) was seen as an interesting and educating journey. On the other hand, it was felt to be more laborious and methodologically complex than expected – although the aims of a common reporting format were considered to be good and worth supporting.

One obstacle above all appeared to be the life cycle inventory analysis of the studied building. Although this is not a unique feature of Level(s) but a common issue in LCA, the current level of detail of construction projects does not appear to be accurate enough. Building information models (BIM) were reported to have eased the inventory, but still some of the specialities of the physical system boundary of Level(s) caused slow manual gathering of data. Therefore, there were calls among the test group requesting for regional

average inventory values for materials that are hard to define in early design stages of a building – in which Level(s) would have greatest steering potential.

A particular obstacle was identified in the reporting template. It was unclear which parts of the reporting are mandatory and which voluntary. Furthermore, the data sets from a typical construction project were considered not to match with the requirements of the reporting template and this caused extra work. It was therefore suggested that the required reports could be directly exportable from a BIM model without any manual grouping or translation work in the next version of Level(s).

The availability of Environmental Product Declarations (EPDs) is very limited in Finland. There is no national database for generic product data yet. This limits the use of Level(s) and LCA in general in cross-comparison of different assessments made by different assessors.

1.3.7 Incentives for resource-efficiency and sustainable choices

Certain concerns were raised regarding the coverage of the indicators of the beta version. In some comments there were concerns about how the flexibility and adaptability of a building could be credited in the assessment process.

There were suggestions for emphasising the importance of modules A1-5 in the assessment, because their impacts e.g. to the climate occur right now within the most critical years of the implementation of the Paris Agreement. Similarly, some comments were made on the relevance of the C module in the assessment, as its impacts are uncertain. Furthermore, the carbon intensity of energy production is decreasing in Finland through legislation, and the implementation as such of a dynamic decarbonisation scenario into module B6 was unclear in the beta version of Level(s). Thus, the role of materials may be underestimated and the role of operational energy overestimated in the results of the assessment.

1.3.8 The coverage of indicators and tools

Part of the test group considered that the beta version of Level(s) was very comprehensive in its coverage. A few comments were given, however, on the need to include additional indicators, such as adaptability of spatial design, the potential for circular economy of the materials and reporting of the positive environmental "handprint" of the project.

1.4 The potential for a common language for sustainable buildings

There are some alternative green building certification schemes in the Finnish market. The most commonly used are LEED, BREEAM, the Finnish RTS GLT Environmental Classification and the Nordic Swan Ecolabel. A common language for the reporting was generally welcomed, and the RTS system has already taken steps towards compatibility with Level(s).

Based on the feedback it can be concluded that the strengths and weaknesses of the beta version of Level(s) as a common language include the following:

Strengths:

+ The beta version has already given more understanding about the sustainability of buildings. Its use has influenced the design and reporting of building project. It has also provided incentives for participating contractors to set sustainability goals.
+ The indicators of Level(s) are already familiar from other assessment schemes.
+ Calculating the carbon footprint was not found too challenging.

Weaknesses:

– The guidance documents were considered complex and difficult to use.
– Gathering the required data and becoming familiar with the assessment requirements was found very time consuming.
– The added value of three different assessment levels remained unclear, whereas there was no assessment level for setting targets in a pre-planning or procurement stage.
– Level(s) was considered to require additional work but provide no clear added value compared to commercial green building certification schemes.
– The lack of certain qualitative indicators, such as "carbon handprint" reporting possibility was considered as a limitation.

2 Part 2: The case studies

2.1 Presentation of the studied buildings

This section of the report includes a summary of each of the case study buildings that were received for this report.

The description of each project includes the basic information, the Level(s) indicators that were tested, and the results for indicator 1.2 (global warming potential, GWP). The rating of the used data is also presented, as well as the mass of the different building materials, where available.

The presentation of the GWP results is adopted from the format given in the Level(s) reporting template. The results are divided into corresponding life cycle stages (production, construction, use and end-of-life stages). The benefits and loads beyond the system boundary are provided as additional information. Also, the biogenic carbon storage is reported separately for most projects. The primary unit for comparison is 1m2 of useable internal floor area per year, for a default reference study period of 60 years (kgCO2e/m2/a). Furthermore, possible deviations from the Level(s) method are reported separately case by case.

The organizers of the test did not carry out any verification of the test results. The results are provided as reported by the test groups.

It should be noted that the results are not mutually comparable, due to several factors: the assessments have been carried out in different project stages, and this has had an impact on the inventory, especially in its coverage and level of detail. As the test group was deliberately chosen to be heterogenic in terms of their LCA experience, the guidance of Level(s) may have been interpreted inconsistently. As described in chapter 1, the aim of the test was to gain an understanding about the robustness and usability of the beta version of Level(s). For this purpose, the inconsistencies of the results are in fact beneficial, as they point out needs for further development or clarification of the Level(s) framework.

Table 3. Projects that provided reports for the Finnish Level(s) beta test.

Building	Type	Project type	No.	Project stage
1 Perniö Healthcare Centre	Healthcare	New building	1	Completion and handover stage
2 Perkkaa Campus	Office	New building	1	Implementation stage
3 As Oy Vantaan Varikonaarre	Residential	New building	1	Design stage
4 Smart Premises	Office	New building	1	Design stage
5 KOy Helsingin Punanotkonkatu 2	Residential	New building	1	Design stage
6 Kontioniemi School	School	New building	1	Design stage
7 Stora Enso Green School	School	New building	1	Design stage
8 Lighthouse Joensuu Student Housing	Residential	New building	1	Design stage
9 Finnish-Russian School	School	New building	3	Design stage
10 Vuorela school and dormitory	School and dormitory	Refurbishment	1	Design stage
11 Eskolantie 4 and 6	Residential	New building	2	Design stage
12 City of Helsinki Urban Environment Department	Office	New building	1	Design stage
13 Sisco LowCarb	Residential	New building	1	Design stage
14 Pudasjärvi Log Campus	School	New building	1	Implementation stage
15 Tehtaankatu School	School	Refurbishment	1	Design stage
16 Helene and A-Kruunu	Residential	New building	4	Design stage
17 VAV Nordic Swan	Residential	New building	1	Implementation stage
18 Villa Saint-Gobain	Residential	New building	1	Design stage
			24	

2.2 Perniö Healthcare Centre

Photo: Teijo Talot Oy

Description of the project	
Type of project	New building for temporary use (3–5 years)
Completed	2018
Building type	Healthcare
Floor area	Heated floor area 395,5 m^2 (incl. technical facilities)
Service life	Required service life: Not defined Designed service life: 50 years
Construction method	Prefabricated timber-framed volumetric units
Energy efficiency	E-value: 98 kWh/m^2, energy-efficiency class B_{2018}
Project stage	Completion and handover stage
Short description	One storey building consisting of six factory manufactured building modules, delivered complete with foundations. The building operates as substitute premises and will be moved to a new location after about five years.
Level(s) test group	
Person in charge	Heidi Karlsson, Quality Manager, Teijo-Talot Oy
LCA consultant	Heidi Karlsson, Quality Manager, Teijo-Talot Oy
Energy consultant	Timo Juha, Teijo-Talot Oy
Owner	Teijo-Talot Oy
Architect	Mika Saari, Arkkitehtuuristudio Saari
Structural engineer	Timo Juha, Teijo-Talot Oy
Main contractor	Teijo-Talot Oy

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software	One Click LCA
Dataset	One Click LCA
Notes	The building serves as a temporary healthcare station. Its multiple possible relocations have not been included in the assessment.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 2 Design for adaptability and refurbishment	Level 1
Indicator 3.1 Total water consumption	Level 1
Indicator 6.2 Value creation and risk factors	used

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	1,22
A4-5 Construction stage	4,49
B1-7 Use stage	14,66
C1-4 End-of-life stage	7,62
A-C Total	**27,99**
Additional information	
D Benefits and loads beyond the system boundary	-5,53
Biogenic Carbon storage	-4,17

Mass of building material groups kg/m^2	
Metals	n/a
Non-metallic minerals	n/a
Biomass	n/a
Fossil energy	n/a
A-C Total	**n/a**

Results for tool 2.1 were reported in a different format with the ministry's approval

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	n/a
2.1 Geographical representativeness	n/a
3.1 Time-related representativeness	n/a
4.1 Uncertainty	n/a
The overall rating for the performance assessment	n/a
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	0
3 – Independent verification	
3. Independent verification of the assessment	0

2.3 Perkkaa Campus

Photo: Ramboll Finland

Description of the project	
Type of project	New building
Completed	2019
Building type	Office
Floor area	Heated floor area 19 225 m^2
Service life	Required service life: Frame and foundation 100 years Designed service life: -
Construction method	Prefabricated elements: composite columns, steel beams and hollow core slabs
Energy efficiency	E-value: 88 kWh/m^2, energy-efficiency class B_{2013}
Project stage	Implementation stage
Short description	New headquarters for Ramboll Finland, in in Espoo, Finland. The project consists of an office building and a separate adjacent parking building.
Level(s) test group	
Person in charge	Johanna Mero-Petit, Senior Consultant, Ramboll Finland Oy
LCA consultant	Ramboll Finland Oy
Energy consultant	Casper Wilén, Energy Specialist, Ramboll Finland Oy
Owner	Keva
Architect	Cederqvist & Jäntti Arkkitehdit Oy
Structural engineer	Ramboll Finland Oy
Main contractor	Hartela Oy

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software and dataset	One Click LCA
Notes	Excluded from calculations: internal light fittings, control systems and sensors, communication and security installations, telecom and data installations, utilities connections, substations and equipment.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1
Indicator 6.2 Value creation and risk factors	used

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	12,14
A4-5 Construction stage	0,43
B1-7 Use stage	15,79
C1-4 End-of-life stage	0,35
A-C Total	**28,70**
Additional information	
D Benefits and loads beyond the system boundary	-2,20
Biogenic carbon storage	-0,17

Mass of building material groups kg/m^2	
Metals	156
Non-metallic minerals	2 320
Biomass	3
Fossil energy	26
A-C Total	**2 505**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	2
3.1 Time-related representativeness	3
4.1 Uncertainty	-
The overall rating for the performance assessment	1,17
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	2
3 – Independent verification	
3. Independent verification of the assessment	2

2.4 Vantaan Varikonaarre

Image: Mika Päivärinne Architects

Description of the project	
Type of project	New building
Completed	2018 – 2019
Building type	Residential
Floor area	Heated floor area 2 607 m^2
Service life	Required service life: - Designed service life: Load-bearing structures 100 years
Construction method	Prefabricated wall panels and hollow-core slabs
Energy efficiency	E-value: 98 kWh/m^2, energy-efficiency class C_{2013}
Project stage	Design stage
Short description	A five-storey residential building with two staircases and 46 flats.
Level(s) test group	
Person in charge	Mari Levirinne-Kara, Environmental Specialist, SRV
LCA consultant	Mari Levirinne-Kara, Environmental Specialist, SRV
Energy consultant	Katri Paatero, Insinööritoimisto Vesitaito Oy
Owner	-
Architect	Mika Päivärinne Architects
Structural engineer	-
Main contractor	SRV

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software and dataset	One Click LCA
Notes	HVAC-materials not defined. The evaluation of data quality index is done for the material hotspots that caused the most emissions.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Indicator 2.3 Construction and demolition waste	Level 1
Indicator 3.1 Total water consumption	Level 1

Global warming potential kgCO_2e/m²/a	
A1-3 Product stage	3,55
A4-5 Construction stage	0,43
B1-7 Use stage	25,02
C1-4 End-of-life stage	0,08
A-C Total	**29,08**
Additional information	
D Benefits and loads beyond the system boundary	0,34
Biogenic carbon storage	0,01

Mass of building material groups kg/m²	
Metals	11
Non-metallic minerals	1 326
Biomass	2
Fossil energy	1
A-C Total	**1 340**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	-
2.1 Geographical representativeness	-
3.1 Time-related representativeness	-
4.1 Uncertainty	-
The overall rating for the performance assessment	1.0
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	1.0
3 – Independent verification	
3. Independent verification of the assessment	1.0

2.5 Smart Premises

Image: Design Team Oy

Description of the project	
Type of project	New building
Completed	2018 – 2019
Building type	Residential
Floor area	Heated floor area 2 607 m^2
Service life	Required service life: foundation 100 years, frame 50 years Designed service life
Construction method	Prefabricated wall panels
Energy efficiency	E-value: 113 kWh/ m^2, energy-efficiency class B_{2013}
Project stage	Design stage
Short description	A five-storey office building with a ground floor restaurant wing.
Level(s) test group	
Person in charge	Mari Levirinne-Kara, Environmental Specialist, SRV
LCA consultant	Mari Levirinne-Kara, Environmental Specialist, SRV
Energy consultant	Jonathan Nyman, Sweco
Owner	SRV
Architect	Stephen Kemppainen / Design Team Oy
Structural engineer	-
Main contractor	SRV

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software and dataset	One Click LCA
Notes	The evaluation of data quality index was done for the material hotspots causing the most emissions.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Indicator 3.1 Total water consumption	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	3,71
A4-5 Construction stage	0,33
B1-7 Use stage	18,56
C1-4 End-of-life stage	0,09
A-C Total	**22,69**
Additional information	
D Benefits and loads beyond the system boundary	0,78
Biogenic carbon storage	0,00

Mass of building material groups kg/m^2	
Metals	33
Non-metallic minerals	900
Biomass	1
Fossil energy	0
A-C Total	**934**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	-
2.1 Geographical representativeness	-
3.1 Time-related representativeness	-
4.1 Uncertainty	-
The overall rating for the performance assessment	1.0
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	1.0
3 – Independent verification	
3. Independent verification of the assessment	1.0

2.6 Punanotkonkatu 2

Image: NRT Architects

Description of the project	
Type of project	New building
Completed	2020
Building type	Residential
Floor area	Heated floor area 6 956 m^2
Service life	Required service life: - Designed service life: -
Construction method	Prefabricated wall panels
Energy efficiency	E-value: 119 kWh/m^2, energy-efficiency class C_{2013}
Project stage	Design stage
Short description	An eight-storey residential building, with shops on the ground floor, as well as underground floors for parking and other facilities.
Level(s) test group	
Person in charge	Niina Rajakoski, Construction Manager, Ilmarinen
LCA consultant	Juhani Huuhtanen, Consultant, Green Building Partners
Energy consultant	Jaakko Pulliainen, Vesitaito Oy
Owner	Ilmarinen
Architect	NRT Architects / Eeva-Liisa Elo-Lehtinen
Structural engineer	-
Main contractor	SRV

Test details	
Life cycle stages	A1-3, A4-5, B2, B4, B6, C1-4
Software and dataset	-
Notes	Calculation based on GBC Finland's guidance. Reference study period: 50 years.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 2
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Cradle to cradle Life Cycle Assessment (LCA)	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	6,74
A4-5 Construction stage	1,37
B1-7 Use stage	26,98
C1-4 End-of-life stage	0,50
A-C Total	**35,60**

Additional information	
D Benefits and loads beyond the system boundary	n/a
Biogenic carbon storage	n/a

Mass of building material groups kg/m^2	
Metals	94
Non-metallic minerals	2 221
Biomass	6
Fossil energy	9
A-C Total	**2 330**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	2
4.1 Uncertainty	1
The overall rating for the performance assessment	1,7
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

2.7 Kontioniemi School

Photo: Kontiolahden kunta

Description of the project	
Type of the project	New building
Completed	2018
Building type	School
Floor area	Heated floor area 1 699 m^2 Unheated floor area 1 250 m^2
Service life	Required service life: 100 years Designed service life
Construction method	Prefabricated
Energy efficiency	E-value: 91 kWh/ m^2, energy-efficiency class B_{2018}
Project stage	Design stage
Short description	A school for 96 elementary school pupils and 16 pre-school pupils plus 15 members of staff. Altogether 127 persons.
Level(s) test group	
Person in charge	Mika Keskisalo, Karelia AMK
LCA consultant	Mika Keskisalo, Karelia AMK
Energy consultant	Johanna Kinnunen, Rakennuttajatoimisto Protiimi Oy
Owner	Kontiolahti municipality
Architect	Pauli Nuutinen, Suunnittelutoimisto Pauli Nuutinen Ky
Structural engineer	Markku Kantelinen, Insinööritoimisto Kantelinen Oy
Main contractor	Rakennustoimisto Eero Reijonen Oy

Test details	
Life cycle stages	A1-3, A4-5, B1-2, B5-6, C1-4, D
Software and dataset	One Click LCA
Notes	Incomplete life cycle. Results based on design documents. Land use results were not available. Use stages B4-B3 and B7 were not included at the use stage.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1
Indicator 2.3 Construction and demolition waste	Level 1
Indicator 3.1 Total water consumption	Level 1
Indicator 4.1 Indoor air quality	Level 1
Indicator 4.2 Time outside of thermal comfort range	Level 1
Indicator 6.1 Life cycle costs	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	4,76
A4-5 Construction stage	0,55
B1-7 Use stage	12,32
C1-4 End-of-life stage	0,21
A-C Total	**17,84**
Additional information	
D Benefits and loads beyond the system boundary	-1,25
Biogenic carbon storage	-0,89

Mass of building material groups kg/m^2	
Metals	32
Non-metallic minerals	2 446
Biomass	35
Fossil energy	15
A-C Total	**2 527**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	2
3.1 Time-related representativeness	2
4.1 Uncertainty	0
The overall rating for the performance assessment	1,0
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	1
3 – Independent verification	
3. Independent verification of the assessment	0

2.8 Eco School Concept

Image: Stora Enso

Description of the project	
Type of the project	New building
Completed	2018
Building type	School and multi-purpose facility
Floor area	Heated floor area 5 780 m^2
Service life	Required service life: 50 years Designed service life: 50 years
Construction method	Prefabricated wall panels (CLT)
Energy efficiency	E-value not calculated, energy-efficiency class C_{2018}
Project stage	Design stage
Short description	Concept for a modular wooden school building. Modules allow flexible design, and the school building can be customized from basic modules according to space requirements. The testing examined how material choices are reflected in the environmental impact of a building's life cycle.
Level(s) test group	
Person in charge	Lauri Linkosalmi, Senior Manager, Stora Enso Wood Products Oy Ltd
LCA consultant	Tytti Bruce-Hyrkäs, Director, Bionova Oy
Energy consultant	-
Owner	Stora Enso Wood Products Oy Ltd
Architect	Aleksi Niemeläinen, Arkkitehti SAFA, Futudesign Oy
Structural engineer	-
Main contractor	-
Other participants	Sami Typpö, Business Developer Manager, Stora Enso Wood Products Oy Ltd

Test details	
Life cycle stages	A1-3, A4-5, B4-7, C1-4, D
Software and dataset	One Click LCA
Notes	Two alternatives for comparison: (a) CLT-framed schools and (b) concrete-framed schools. Not included: Stairs and ramps, control systems, sensors, cooling, water treatment, lifts, telecom and data installations, substations and equipment, paving and other hard surfaces, fencing, railings and walls

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 2
Tool 2.1 Life cycle tools: Building bill of materials	Level 2
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1
Indicator 6.1 Life cycle costs	Level 2
Cradle to cradle Life Cycle Assessment (LCA)	Level 2

Global warming potential $kgCO_2e/m^2/a$	CLT	Concrete
A1-3 Product stage	3,20	4,76
A4-5 Construction stage	0,42	0,44
B1-7 Use stage	38,70	38,44
C1-4 End-of-life stage	0,32	0,21
A-C Total	**42,64**	**43,84**
Additional information		
D Benefits and loads beyond the system boundary	-1,68	-1,13
Biogenic carbon storage	-2,50	-0,65

Mass of building material groups kg/m^2	CLT	Concrete
Metals	34	49
Non-metallic minerals	1 403	2 076
Biomass	88	19
Fossil energy	8	9
A-C Total	**1 533**	**2 153**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	3
The overall rating for the performance assessment	2,8
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	3

2.9 Joensuu Lighthouse Student Housing

Photo: Stora Enso

Description of the project	
Type of the project	New building
Completed	2018
Building type	Residential
Floor area	Heated floor area 4 800 m^2
Service life	Required service life: 50 years Designed service life: 50 years
Construction method	Prefabricated wall panels
Energy efficiency	E-value: 108 kWh/ m^2, energy-efficiency class C_{2013}
Project stage	Design stage
Short description	At the time of construction, the 14-storey wooden residential building is the highest of its kind in Finland. The building comprises 114 flats.
Level(s) test group	
Person in charge	Lauri Linkosalmi, Senior Manager, Stora Enso Wood Products Oy Ltd
LCA consultant	Lauri Linkosalmi, Senior Manager, Stora Enso Wood Products Oy Ltd
Energy consultant	Henri Piipponen, Energy Specialist, Granlund Joensuu Oy
Owner	Opiskelija-asunnot Oy Joensuun ELLI
Architect	Samuli Sallinen, Arcadia Oy Arkkitehtitoimisto
Structural engineer	Tomi Rautiainen, A-Insinöörit Oy
Main contractor	Rakennustoimisto Eero Reijonen Oy
Other participants	Jarmo Hämäläinen, Toimitusjohtaja, Rakennustoimisto Eero Reijonen Oy Mika Keskisalo, Rakennesuunnittelija, A-Insinöörit Oy

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software and dataset	One Click LCA

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	5,52
A4-5 Construction stage	0,58
B1-7 Use stage	22,59
C1-4 End-of-life stage	0,74
A-C Total	**29,43**
Additional information	
D Benefits and loads beyond the system boundary	-4,05
Biogenic carbon storage	-5,39

Mass of building material groups kg/m^2	
Metals	55
Non-metallic minerals	650
Biomass	207
Fossil energy	17
A-C Total	**929**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	2
4.1 Uncertainty	3
The overall rating for the performance assessment	2,7
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	2

2.10 Finnish-Russian School in Helsinki

Image: AFKS Architects

Description of the project	
Type of the project	Competition for a new building
Completed	Estimated 2020
Building type	School
Floor area	Heated floor area 7 248…7 840 m^2
Service life	Required service life: 100 years (surfaces 30, frame + foundation 100, envelope 50, floors 10-20, building services 15-50)
Construction method	Various (competition phase)
Energy efficiency	E-value 79..80 kWh/m^2, energy-efficiency class A_{2018}
Project stage	Competition
Short description	A design competition was organized for the design of a new building for a Finnish-Russian school. The winner was selected at the end of 2018. Level(s) testing examined the lifecycle impacts of construction between three different design options.
Level(s) test group	
Person in charge	Mirkka Rekola, Advisor, Senate Properties
LCA consultant	Tytti Bruce-Hyrkäs, Director, Bionova Oy
Energy consultant	Mikael Lappalainen, Energy Specialist, Granlund Oy
Owner	Senate Properties
Architect	Frondelius-Keppo-Salmenperä Architects
Structural engineer	-
Main contractor	SRV

Test details	
Life cycle stages	A1-3, A4-5, B4-7, C1-4, D
Software and dataset	One Click LCA
Notes	Not included: Technical installations, stairs and ramps, control systems, sensors, cooling, water treatment, lifts, telecom and data installations, substations and equipment, paving and other hard surfaces, fencing, railings and walls

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 2
Tool 2.1 Life cycle tools: Building bill of materials	Level 2
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1

Global warming potential $kgCO_2e/m^2/a$	Alt.1: Akkuna Wood	Alt.2: Akkuna Concrete	Alt.3: Maatuska
A1-3 Product stage	1,62	3,10	2,09
A4-5 Construction stage	0,35	0,40	0,37
B1-7 Use stage	27,05	27,33	27,03
C1-4 End-of-life stage	0,28	0,31	0,31
A-C Total	**29,30**	**31,15**	**29,81**
Additional information			
D Benefits and loads beyond the system boundary	-1,87	-0,68	-2,34
Biogenic carbon storage	-4,40	-0,25	-5,04

Mass of building material groups kg/m^2	Alt.1: Akkuna Wood	Alt.2: Akkuna Concrete	Alt.3: Maatuska
Metals	13	25	10
Non-metallic minerals	840	1 197	390
Biomass	164	10	118
Fossil energy	20	34	71
A-C Total	1 037	1 266	589

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	3
The overall rating for the performance assessment	2,8
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

2.11 Vuorela School and Dormitory

Photo: Senate Properties

Description of the project	
Type of the project	Refurbishment
Completed	2019 – 2020 (original building 1902)
Building type	School, dormitory
Floor area	Heated floor area 1 727 m^2
Service life	Required service life: 100 years Designed service life: -
Construction method	-
Energy efficiency	E-value: 193 kWh/ m^2, energy-efficiency class C_{2018}
Project stage	Design stage
Short description	A building with school facilities, 5 flats and kitchen serving the whole institution. Located in an area of dispersed settlement. The building's façades and certain interior spaces are protected. Therefore, the obligation to improve energy efficiency in a major renovation did not concern this project.
Level(s) test group	
Person in charge	Mirkka Rekola, Advisor, Senate Properties
LCA consultant	-
Energy consultant	Janne Jokisalo, Ramboll Finland Oy
Owner	Senate Properties
Architect	Davidson – Tarkela Architects
Structural engineer	-
Main contractor	Mijorak
Other participants	Construction company Teuvo Hautala Oy (demolition works)

Test details	
Life cycle stages	A1-3, A4-5, B1-7, C1-4, D
Software and dataset	One Click LCA
Notes	The results of the GWP calculations were reported in a format that is not compatible with Level(s) template.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1
Indicator 2.3 Construction and demolition waste	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	n/a
A4-5 Construction stage	n/a
B1-7 Use stage	n/a
C1-4 End-of-life stage	n/a
A-C Total	**n/a**

Additional information	
D Benefits and loads beyond the system boundary	n/a
Biogenic carbon storage	n/a

Mass of building material groups kg/m^2	
Metals	n/a
Non-metallic minerals	n/a
Biomass	n/a
Fossil energy	n/a
A-C Total	**n/a**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	n/a
2.1 Geographical representativeness	n/a
3.1 Time-related representativeness	n/a
4.1 Uncertainty	n/a
The overall rating for the performance assessment	2.7
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

2.12 Eskolantie 4 and 6

Photo: Tuomas Uusheimo

Description of the project	
Type of the project	New building
Completed	2014
Building type	Residential
Floor area	Heated floor area 8 040 m^2
Service life	Required service life: - Designed service life: -
Construction method	Volumetric CLT units
Energy efficiency	E-value: 107 kWh/m^2, energy-efficiency class C_{2013}
Project stage	Operation and occupation stage
Short description	Two 6-7 storey wooden residential buildings. The total number of flats is 51.
Level(s) test group	
Person in charge	Markus Lukin, City of Helsinki
LCA consultant	Markus Lukin, Johanna af Hällström and Petteri Huuska, City of Helsinki
Energy consultant	Insinööritoimisto Vesitaito Oy
Owner	City of Helsinki
Architect	Matti Iiramo Architects Oy
Structural engineer	A-insinöörit Oy and Sweco Oy
Main contractor	SRV

Test details	
Life cycle stages	A1-3, B1-7, C1-4, D
Software and dataset	One Click LCA

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 3 Design for deconstruction, reuse and recyclability	Level 1
Indicator 3.1 Total water consumption	Level 1

Global warming potential kgCO_2e/m^2/a	
A1-3 Product stage	7,32
A4-5 Construction stage	n/a
B1-7 Use stage	28,92
C1-4 End-of-life stage	0,13
A-C Total	**36,37**
Additional information	
D Benefits and loads beyond the system boundary	2,24
Biogenic carbon storage	n/a

Mass of building material groups kg/m^2	
Metals	72
Non-metallic minerals	350
Biomass	227
Fossil energy	0
A-C Total	**649**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	1
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	2
The overall rating for the performance assessment	2,2
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	0

2.1.3 City of Helsinki Urban Environment Department

Image: Arkkitehtitoimisto Lahdelma & Mahlamäki

Description of the project	
Type of the project	New building
Completed	2020
Building type	Office
Floor area	Heated floor area 35 261 m^2
Service life	Required service lives: Frame 100, building services 25-50, building automation 15 years
Construction method	On site and prefabrication
Energy efficiency	E-value: 85 kWh/m^2, energy-efficiency class B_{2013}
Project stage	Design stage
Short description	An eight-storey office building with facilities for events and exhibitions, various meeting rooms and a restaurant.
Level(s) test group	
Person in charge	Sara Tapiala, City of Helsinki
LCA consultant	Ulla Nykter, Granlund Consulting Oy
Energy consultant	Casper Wilén, Ramboll Finland Oy
Owner	City of Helsinki
Architect	Lahdelma & Mahlamäki architects
Structural engineer	Ramboll Finland Oy
Main contractor	Skanska
Other participants	-

Test details	
Life cycle stages	A1-3, A5, B1-6, C1-4, D
Software and dataset	One Click LCA

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 3
Tool 2.1 Life cycle tools: Building bill of materials	Level 3

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	6,76
A4-5 Construction stage	1,73
B1-7 Use stage	0,91
C1-4 End-of-life stage	29,49
A-C Total	**38,89**
Additional information	
D Benefits and loads beyond the system boundary	-0,05
Biogenic carbon storage	n/a

Mass of building material groups kg/m^2	
Metals	n/a
Non-metallic minerals	n/a
Biomass	n/a
Fossil energy	n/a
A-C Total	**n/a**

Results for tool 2.1 were not reported

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	0
2.1 Geographical representativeness	2
3.1 Time-related representativeness	0
4.1 Uncertainty	0
The overall rating for the performance assessment	0,3
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

2.14 Sisco LowCarb Wooden House

Image: Markus Råbergh

Description of the project	
Type of the project	New building
Completed	-
Building type	Residential
Floor area	Heated floor area 1 170 m^2
Service life	Required service life: - Designed service life: -
Construction method	Prefabricated
Energy efficiency	E-value: 85 kWh/m^2, energy-efficiency class B_{2018}
Project stage	Design stage
Short description	A four storey wooden residential building with 20 flats. It is a conceptual example of construction where the building is built of spatial elements manufactured in dry and warm factory premises. After the building's foundations are ready, the elements will be assembled on the site.
Level(s) test group	
Person in charge	Sirje Vares, VTT Technical Research Centre
LCA consultant	Sirje Vares, VTT Technical Research Centre
Energy consultant	Jenni Venäläinen, EcoSensor
Owner	-
Architect	Principal designer Markus Råbergh, Sisco Oy
Structural engineer	-
Main contractor	-
Other participants	Sisco Oyj, Pasi Typpö, Termex Oy

Test details	
Life cycle stages	A1-3, B1-7, C1-4, D
Software and dataset	VTT ILMARI

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	3,32
A4-5 Construction stage	0,50
B1-7 Use stage	16,21
C1-4 End-of-life stage	6,15
A-C Total	**26,18**
Additional information	
D Benefits and loads beyond the system boundary	-2,20
Biogenic carbon storage	-5,63

Mass of building material groups kg/m^2	
Metals	6
Non-metallic minerals	1 249
Biomass	274
Fossil energy	0
A-C Total	**1 530**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	3
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	2
The overall rating for the performance assessment	2,5
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	0

2.15 Pudasjärvi Log Campus

Photo: Raimo Ahonen

Description of the project	
Type of the project	New building
Completed	2016
Building type	School
Floor area	Heated floor area 9 778 m^2
Service life	Required service life: Log frame 150 years, other parts 100 years
Construction method	On site
Energy efficiency	E-value: 124 kWh/m^2, energy-efficiency class B_{2012}
Project stage	Use stage
Short description	The Pudasjärvi Log Campus is a healthy, eco-friendly and modern learning environment, with the renowned Finnish educational system giving a good start in life for 800 pupils from preschool to upper secondary school levels.
Level(s) test group	
Person in charge	Mikko Löf, Planning Manager, Kontio Log Houses
LCA consultant	Mikko Löf, Planning Manager, Kontio Log Houses Antti Virkkunen, Vesitaito Oy
Energy consultant	Pekka Mairinoja, Green Building Partners
Owner	Kuntarahoitus Municipality Finance
Architect	Lukkaroinen Architects
Structural engineer	-
Main contractor	Lemminkäinen
Other participants	-

Test details	
Life cycle stages	A1-3, B1-7, C1-4, D
Software and dataset	One Click LCA

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	3,37
A4-5 Construction stage	0,33
B1-7 Use stage	29,05
C1-4 End-of-life stage	0,51
A-C Total	**33,26**
Additional information	
D Benefits and loads beyond the system boundary	-2,85
Biogenic carbon storage	-5,42

Mass of building material groups kg/m^2	
Metals	10
Non-metallic minerals	654
Biomass	210
Fossil energy	33
A-C Total	**908**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	1
3.1 Time-related representativeness	1
4.1 Uncertainty	1
The overall rating for the performance assessment	1,2
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	1
3 – Independent verification	
3. Independent verification of the assessment	2

2.16 Tehtaankatu School

Photo: Simon le Roux

Description of the project	
Type of the project	Refurbishment
Completed	2020 – 2021
Building type	School
Floor area	Heated floor area 3 373 m^2
Service life	Required service life: 50 years
Construction method	On site
Energy efficiency	E-value: 161 kWh/m^2, energy-efficiency class C_{2018}
Project stage	Design stage
Short description	In the extensive renovation of the elementary school, its pupil capacity is also increased with technical and operational changes. The facilities are also upgraded to meet current standards for school buildings.
Level(s) test group	
Person in charge	Mikko Keinänen, Leo Maaskola Engineers Oy
LCA consultant	-
Energy consultant	Mikko Keinänen, Leo Maaskola Engineers Oy
Owner	City of Helsinki
Architect	Arto Harjunpää, NRT Architects
Structural engineer	-
Main contractor	-
Other participants	-

Test details	
Life cycle stages	A1-A3, A4-A5 ,B4-B6, C1-C4, D
Software and dataset	One Click LCA

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	2,01
A4-5 Construction stage	0,78
B1-7 Use stage	54,80
C1-4 End-of-life stage	0,45
A-C Total	**58,04**
Additional information	
D Benefits and loads beyond the system boundary	0,55
Biogenic carbon storage	0,38

Mass of building material groups kg/m^2	
Metals	37
Non-metallic minerals	58
Biomass	0
Fossil energy	0
A-C Total	**95**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	1
2.1 Geographical representativeness	2
3.1 Time-related representativeness	1
4.1 Uncertainty	1
The overall rating for the performance assessment	1,2
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	1
3 – Independent verification	
3. Independent verification of the assessment	0

2.17 Helene and A-Kruunu

Photo: A-Kruunu Oy

Description of the project	
Type of the project	Refurbishment
Completed	2020 – 2021
Building type	School
Floor area	Heated floor areas: Helene A 1 686 m^2, Helene BC 2 754 m2, Kruunu A 1 653 m^2, Kruunu BC 2 798 m^2
Service life	Required service life: 100 years
Construction method	-
Energy efficiency	E-value: 105 / 101 kWh/m^2, energy-efficiency class C_{2013}
Project stage	Design stage
Short description	Comparison of two already built residential buildings with identical floor areas and layout (except for small differences in floor area resulting from the size of the elements), but built from different materials. The one has a wooden element structure (Kruunu) and the other concrete element structure (Helene). Both structures comprise two buildings (A and BC), a private yard, common car parking facility and a yard deck above it.
Level(s) test group	
Person in charge	Vesa Ijäs, Development Manager, ARA
LCA consultant	Tytti Bruce, Director, Bionova Oy
Energy consultant	Milla Vähä-Ruohola, Optiplan Oy
Owner	A-Kruunu Oy
Architect	ARK-house Architects
Structural engineer	
Main contractor	Rakennusliike Reponen Oy
Other participants	

Test details	
Life cycle stages	A1-A3,A4-A5,B4-B6, C1-C4, D
Software and dataset	One Click LCA
Notes	Not included: Control systems and sensors in in-built lighting system, cooling plant and distribution in energy system, drainage system in sanitary systems, telecom and data installations in other systems.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 2
Indicator 1.2 Life cycle Global Warming Potential	Level 2
Tool 2.1 Life cycle tools: Building bill of materials	Level 2
Tool 2.2 - Scenario 1 Building and elemental service life planning	Level 1

Global warming potential kgCO_2e/m^2/a	Helene A	Helene BC	Kruunu A	Kruunu BC
A1-3 Product stage	5,97	5,82	4,11	4,12
A4-5 Construction stage	0,79	0,80	0,57	0,56
B1-7 Use stage	24,30	22,68	23,88	22,30
C1-4 End-of-life stage	0,23	0,23	0,34	0,34
A-C Total	**31,29**	**29,53**	**28,89**	**27,33**
Additional information				
D Benefits and loads beyond the system boundary	-1,31	-1,28	-2,03	-2,02
Biogenic carbon storage	-0,40	-0,36	-3,15	-3,20

Mass of building material groups kg/m^2	Helene A	Helene BC	Kruunu A	Kruunu BC
Metals	115	107	55	50
Non-metallic minerals	2 034	2003	984	972
Biomass	18	15	119	121
Fossil energy	5	3	6	5
A-C Total	2 173	2 128	1 164	1 147

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	3
The overall rating for the performance assessment	2,8
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

2.18 VAV Nordic Swan Block of Flats

Photo: Henrik Kettunen

Description of the project	
Type of the project	New building
Completed	2018
Building type	Residential
Floor area	Heated floor area 6 795 m^2
Service life	Required service life: 100 years
Construction method	-
Energy efficiency	E-value: 104 kWh/m^2, energy-efficiency class C_{2012}
Project stage	Use stage
Short description	Two eight-storey wooden residential buildings with a total of 127 flats. The building meets the environmental criteria of the Nordic Swan label.
Level(s) test group	
Person in charge	Vesa Ijäs, Development Manager, ARA
LCA consultant	Riina Ahola, Project Manager, Optiplan Oy
Energy consultant	Milla Vähä-Ruohola, Project Manager, Optiplan Oy
Owner	VAV Asunnot Oy
Architect	Kanttia 2 Architects
Structural engineer	-
Main contractor	NCC Suomi Oy
Other participants	-

Test details	
Life cycle stages	A1-A3, A4, A5, B4-B5, B6 and C1-C4 + D.
Software and dataset	One Click LCA
Notes	Not included: Fixed furniture, majority of yard structures. Building service appliances estimated on a floor area based factor.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 1
Indicator 1.2 Life cycle Global Warming Potential	Level 1
Tool 2.1 Life cycle tools: Building bill of materials	Level 1
Tool 2.2 – Scenario 3 Design for deconstruction, reuse and recyclability	Level 1
Indicator 2.3 Construction and demolition waste	Level 1
Indicator 3.1 Total water consumption	Level 1
Indicator 4.1 Indoor air quality	Level 1
Indicator 4.2 Time outside of thermal comfort range	Level 1

Global warming potential $kgCO_2e/m^2/a$	
A1-3 Product stage	6,36
A4-5 Construction stage	1,13
B1-7 Use stage	20,13
C1-4 End-of-life stage	0,13
A-C Total	**27,75**

Additional information	
D Benefits and loads beyond the system boundary	-2,20
Biogenic carbon storage	0,36

Mass of building material groups kg/m^2	
Metals	68
Non-metallic minerals	2 830
Biomass	2
Fossil energy	4
A-C Total	**2 904**

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	-
The overall rating for the performance assessment	1,3
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	2
3 – Independent verification	
3. Independent verification of the assessment	1

2.19 Villa Saint-Gobain

Photo: Saint-Gobain Finland Oy

Description of the project	
Type of the project	New building
Completed	2013
Building type	Residential / single-family home
Floor area	Heated floor area 164 m^2
Service life	Required service life: 100 years
Construction method	Prefabricated elements
Energy efficiency	E-value: 55 kWh/m^2, energy-efficiency class A_{2012}
Project stage	Use stage
Short description	A zero-energy building with 2 floors. During the Level(s) testing, it was tested how different material selections would have affected the carbon footprint of the building.
Level(s) test group	
Person in charge	Anne Kaiser, Sustainability Manager, Saint-Gobain Finland Oy
LCA consultant	Tytti Bruce and Anastasia Sipari, Bionova Oy
Energy consultant	Alma Koivu, Insinööritoimisto Vesitaito Oy
Owner	Private
Architect	Tiina Antinoja and Olli Metso
Structural engineer	-
Main contractor	Iin Fasadi Oy / Niksupuutuote Ky
Other participants	-

Test details	
Life cycle stages	A1-A3, A4-A5, B4-B6, C1-C4, D.
Software and dataset	One Click LCA
Notes	Not included: stairs and ramps, control systems and sensors, cooling plant and distribution, water treatment systems, firefighting installations, telecom and data installations, connections and diversions, paving and other hard surfacing, fencing, railings and walls.

Indicators and tools tested	
Indicator 1.1 Use stage energy performance	Level 2
Indicator 1.2 Life cycle Global Warming Potential	Level 2
Tool 2.1 Life cycle tools: Building bill of materials	Level 2
Tool 2.2 – Scenario 1 Building and elemental service life planning	Level 1
Indicator 2.3 Construction and demolition waste	Level 1
Indicator 3.1 Total water consumption	Level 1
Indicator 4.2 Time outside of thermal comfort range	Level 1
Cradle to cradle Life Cycle Assessment (LCA)	Level 2

Global warming potential $kgCO_2e/m^2/a$	As built	Standard insulation	Concrete walls	Wooden facade
A1-3 Product stage	4,81	4,46	5,56	4,59
A4-5 Construction stage	0,36	0,36	0,38	0,36
B1-7 Use stage	14,42	15,84	14,31	14,33
C1-4 End-of-life stage	0,16	0,16	0,23	0,18
A-C Total	**19,75**	**20,83**	**20,48**	**19,46**
Additional information				
D Benefits and loads beyond the system boundary	-0,92	-0,82	1,08	-1,01
Biogenic carbon storage	-1,09	-1,09	-1,07	-1,35

Mass of building material groups kg/m^2	As built	Standard insulation	Concrete walls	Wooden facade
Metals	23	23	28	23
Non-metallic minerals	458	451	829	421
Biomass	31	31	31	41
Fossil energy	15	12	15	15
A-C Total	527	517	903	500

Ratings	
1 - Basis for the performance assessment	
1.1 Technical representativeness	2
2.1 Geographical representativeness	3
3.1 Time-related representativeness	3
4.1 Uncertainty	3
The overall rating for the performance assessment	2,8
2 – Professional capabilities	
2. Technical capability of the personnel carrying out the assessment	3
3 – Independent verification	
3. Independent verification of the assessment	1

The beta version of Level(s) – European Commission's proposal for common reporting framework of the sustainability of buildings – was extensively tested by the Finnish construction sector during 2018 – 2019. This test period was jointly arranged by the Ministry of the Environment and the Green Building Council Finland. This report summarises the feedback collected from participants in the test phase.

Apparently Level(s) has good potential to become a common language of sustainability reporting for the building and construction sector. There seems to be a clear need and interest for this among the stakeholders in Finland. However, in order to reach this stage, Level(s) should be further developed. The most acute needs for development include improving the clarity and accessibility of the guidance document, restructuring of the assessment levels and reconsideration of the system boundaries. Furthermore, compatibility with national practices and building information modelling was found essential in the feedback gathered from the test group.

The feedback from this test will be delivered to European Commission for the purpose of development of Level(s). The findings will also be used for taking forward the Finnish roadmap for low carbon construction, which aims at mandatory life cycle assessment and carbon footprint threshold levels during the 2020´s.

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