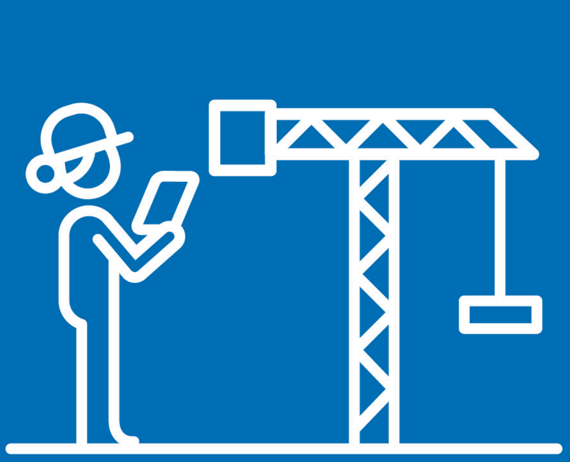
Nordic Innovation

LOW-CARBON CLINICS

Practical experience with carbon reduction initiatives from building projects in the Nordic countries



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PREFACE

This report is a part of the Nordic Sustainable Construction programme initiated by the Nordic Ministers of Construction and Housing and funded by Nordic Innovation. The programme contributes to the Nordic Vision 2030 by supporting the Nordics in becoming the leading region in sustainable and competitive construction and housing with minimised environmental and climate impact.

The programme supports the green transition of the Nordic construction sector by creating and sharing new knowledge, initiating debates in the sector, creating networks, workshops and best practice cases, and facilitating Nordic harmonisation of regulation for buildings' climate impact.

The programme runs from 2021-2024 and consists of the following focus areas:

- Work package 1 – Nordic Harmonisation of Life Cycle Assessment
- Work package 2 – Circular Business Models and Procurement
- Work package 3 – Sustainable Construction Materials and Architecture
- Work package 4 – Emission-free Construction Sites
- Work package 5 – Programme Secretariat and Capacity-Building Activities for Increased Reuse of Construction Materials

This report is a final deliverable for work package 1, task 5; an acceleration programme with knowledge sharing clinics and best practice catalogues. Work Package 1 is led by the Finnish Ministry of Environment.

The work has been carried out by SWECO, BUILD – AALBORG UNIVERSITY, LCA Support and EFLA.

All views, interpretations and recommendations are made by the authors and represent no official statements.

For more information on Nordic Sustainable Construction, visit our website

Nordic Sustainable Construction

SUMMARY

The Low-Carbon Clinics report is part of the Nordic Sustainable Construction programme, which aims to support the Nordic region in becoming a leader in sustainable and competitive construction with minimal environmental and climate impact. This report specifically addresses work package 1, task 5.1, which focuses on knowledge sharing of carbon reduction initiatives for building projects in the Nordic countries and Estonia. The primary goal of the Low-Carbon Clinics project is to facilitate discussions and share best practices for decarbonisation in the construction industry. This is achieved through clinics hosted by local experts who guide decarbonisation strategies tailored to specific projects.

The clinics were designed to address real-life challenges and potential solutions associated with the decarbonisation agenda. The clinics were offered at no cost to the participating clients and involved preliminary discussions, in-person consultations, follow-up consultations and detailed reporting. The projects include a diverse array of building typologies and construction materials from various countries, ensuring a comprehensive approach to carbon reduction. 11 clinics were conducted by local experts from Sweco, EFLA and LCA Support and included:

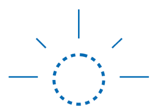
- 2 projects from Denmark
- 1 project from Estonia
- 2 projects from Finland
- 2 projects from Iceland
- 1 project from Norway
- 3 projects from Sweden.

Key findings from the clinics highlight the importance of adhering to climate budgets, continuous life cycle assessment (LCA) monitoring, hotspot analysis for early insights, flexible use of buildings, and the use of biobased materials and low-carbon solutions within traditional building materials. These findings provide valuable guidance for future low-carbon construction initiatives. *Go to the chapter Key findings to read about this in detail.*

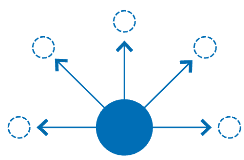
Several challenges were also identified, including variability in LCA methodologies, material-related challenges and location-specific geological conditions. These challenges underscore the need for standardised procedures, systematic approaches to material reuse and careful consideration of local conditions in project planning and execution. *Go to the chapter Key challenges to read about this in detail.*

The report also includes a library of tools and industry knowledge to assist professionals in implementing low-carbon practices effectively. This library is structured according to the relevance of the building phase and provides a valuable resource for industry stakeholders.

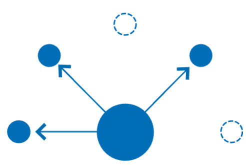
REPORT STRUCTURE



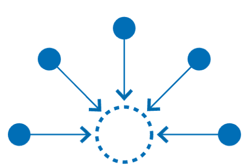
Introduction: This section provides an overview of the project, its purpose and limitations, setting the stage for the subsequent sections.



Low-Carbon Clinics: This section introduces the general procedure for and structure of the clinics. It then presents each clinic, including project descriptions and findings, from the participating countries. Specifically, it covers: two projects from Denmark, one from Estonia, two from Finland, two from Iceland, one from Norway and three from Sweden.



Key findings and challenges: This section summarises the key findings and insights derived from the clinics. It highlights the main takeaways and lessons learned, offering valuable guidance for future low-carbon construction initiatives.



Tools and industry knowledge: This section offers an overview of the available tools and industry knowledge that can assist in working with carbon reduction initiatives in each country for different stages of a building project. It aims to equip industry professionals with the necessary resources to implement low-carbon practices effectively.

INTRODUCTION

The construction industry is a significant contributor to global carbon emissions, necessitating urgent measures to mitigate its environmental impact. In response, various initiatives have been launched to promote low-carbon construction practices. One such initiative is the Low-Carbon Clinics project from the Nordic Sustainable Construction programme, which aims to facilitate the adoption of sustainable building practices across different countries. This project is a collaborative effort designed to share knowledge and best practices for reducing carbon emissions in the construction industry. By bringing together experts from Denmark, Estonia, Finland, Iceland, Norway and Sweden, the project seeks to explore and implement low-carbon solutions in building projects. Leveraging the expertise of these countries, the project aspires to develop a comprehensive understanding of effective carbon reduction strategies.

The primary purpose of the Low-Carbon Clinics project is to facilitate knowledge sharing among industry professionals and policymakers. This includes disseminating information on methods, approaches, requirement specifications and the use of tools essential for carbon reduction initiatives. Additionally, the project aims to compile and share industry knowledge through reports, example catalogues and other resources to support the implementation of low-carbon practices in building projects. By providing a platform for exchanging insights and experiences, the project endeavours to foster a collaborative environment that encourages the adoption of sustainable construction practices.

While the project aims to provide valuable insights into low-carbon construction practices, it is important to acknowledge certain limitations. One significant limitation is the limited cross-border comparability of Life Cycle Assessment (LCA) results. As highlighted in a previous project in the Nordic Sustainable Construction programme (Balouktsi, M., Kanafani, K., Francart, N., Langkjær, N., & Ryberg, M. (2024). Decarbonisation of the building stock), variations in national regulations, data availability and assessment methods can affect the comparability of LCA results across different countries. These discrepancies can pose challenges in establishing standardised benchmarks and evaluating the effectiveness of carbon reduction strategies on an international scale.

LOW-CARBON CLINICS

The purpose of the Low-Carbon Clinics is to facilitate discussions surrounding decarbonisation initiatives for building projects across the Nordic countries and Estonia. By focusing on real-life projects, these clinics aim to address the actual challenges and potential solutions associated with the decarbonisation agenda. The clinics are offered at no cost and are conducted by local experts from each participating country. These experts are well-versed in local and national requirements and developments that may impact projects. Given the complexity of these topics, discussions are conducted in the participants' native languages to ensure open and effective communication.

During the clinics, local experts will provide guidance on decarbonisation strategies and initiatives. The primary objective is to stimulate engaging discussions and inspire participants to take actionable steps toward decarbonisation for their specific projects. Participation in the clinics is voluntary, and advice provided is free of charge, which places the responsibility for implementing discussed initiatives on the participants.

Project owners were encouraged to register for participation in the Low-Carbon Clinics. Following the registration deadline, projects were selected for inclusion in the clinics. The aim was to represent projects from all participating countries and to encompass a diverse array of project typologies and construction materials.

A general procedure was outlined for the clinic facilitators to follow and to obtain consistent content for knowledge sharing. The general procedure was assisted by tailored discussions for each clinic to highlight different project and stakeholder challenges and solutions.

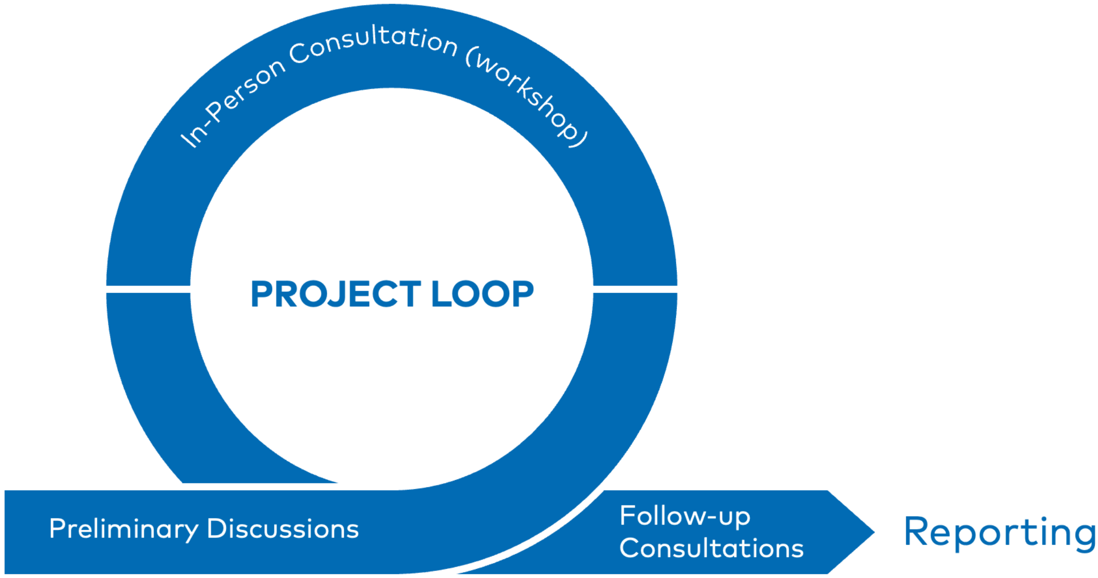


Figure 1. General procedure for the clinics

Preliminary discussions

Preliminary discussions with clinic participants were conducted to gather insights and tailor the workshop agenda to meet the specific needs of each project. These discussions took place through various formats, including online meetings, phone calls, or email correspondence. The key outcome of these preliminary discussions was to ensure that the content of the workshop was relevant and insightful for both the project and the participants.

In-person consultation (workshop)

Based on the preliminary discussions and the defined project scope, in-person meetings were arranged. These meetings involved engaging directly with clients to discuss their specific projects, and provide tailored advice and feedback. A comprehensive analysis of the project was conducted to identify the most significant opportunities for decarbonisation. The discussions focused on strategies for achieving these goals, as well as identifying potential implementation barriers. Areas with the greatest emissions reduction potential and opportunities readily achievable were explored.

Follow-up consultations

Continued support was provided through a follow-up session. During these sessions, the facilitator assisted participants in evaluating and refining their low-carbon strategies.

Reporting

Local experts serving as clinic facilitators documented the decarbonisation discussions, challenges and initiatives from each clinic. The documentation served as the foundation for subsequent reporting and analysis presented in this report.

PROJECT OVERVIEW

Project ID	Project name	Building typology	Country
01	BLVD.31	Apartment building (youth housing) and hotel/serviced apartments	Denmark
02	Svanemølleholm	Office	Denmark
03	Loodusmaja (The Hature House)	Museum and office	Estonia
04	Hiedanranta	Apartment building	Finland
05	Hopeakaivoksentie 47	Apartment building (student housing)	Finland
06	Visitor centre in Þjórsárdalur	Commercial	Iceland
07	East Pier	Airport expansion	Iceland
08	Engebredden	Apartment building	Norway
09	Concept for Group Home	Group home (residential facilities for the elderly, for individuals with disabilities, etc.)	Sweden
10	Logistikposition Söderåsen	Logistics	Sweden
11	Rosenspira	Row houses	Sweden

Image: Holsche Nordberg

01 BLVD.31

Country	Denmark
Typology	Apartment building (young professionals) and hotel/serviced apartments
Area	12,800 m^2 (8,200 m^2 housing and 4,600 m^2 hotel)
Building phase	Detailed design

Based on the successful residential and hotel concept Noli, a 12,800 m^2 timber building near Bella Center will offer both furnished and unfurnished apartments, as well as hotel apartments that can be tailored to individual needs. The new timber building will contain 217 residences and 124 hotel apartments, complemented by shared facilities such as a kitchen, meeting rooms, fitness centre, laundry, café and rooftop terrace, which tenants and hotel guests will share.

The entire residential section will be constructed using prefabricated timber modules, while the hotel section will also be built using prefabricated timber modules from the first floor and up. The hotel basement and ground floor will be made of concrete. All modules will be delivered with complete kitchen, bathroom and wardrobe solutions. The façades will be finished with timber cladding and steel to meet fire safety requirements. The project will include four stair towers for which the construction has not yet been fully determined. There will be a focus on minimising excess use of materials and decreasing the climate impact.

The project aims to attain the DGNB Gold certification and additionally, the project adheres to Skanska's own CO2 requirements which stipulate a maximum of 7.00 kgCO2-eq/m2/year. In alignment with NREP's CO2 targets, the project sets specific benchmarks for emissions across different stages: for A1-A5, the goal is to limit CO2 emissions to 4 kgCO2-eq/m2/year, while for B6, the target is set at 3 kgCO2-eq/m2/year. Moreover, the project incorporates Skanska's biodiversity strategy, focusing on improving on-site biodiversity compared to the initial conditions.

The clinic

Client	Skanska
Type of client	Developer and contractor
Facilitator	Rikke Schack (Sweco DK) Nicolaj Langkjær (Sweco DK)
Participants	Project manager Sustainability manager Architect Contractor Engineer

Preliminary discussions

Skanska has set its own CO2 limit values and developed an environmental programme for development projects. As parts of this, Skanska believes that certifications are a pathway to more sustainable solutions. In Denmark, Skanska primarily works with the certification system DGNB. Skanska projects will be certified to at least DGNB Gold. Furthermore, as part of the environmental programme, Skanska aims to develop projects that align with 7.1 for construction and 7.7 for ownership in the EU taxonomy.

The client provided a Life Cycle Assessment (LCA), which served as the foundational document for the workshop discussions. This calculation detailed the environmental impacts associated with various life-cycle stages of the project. The workshop facilitators conducted a hotspot analysis to identify key areas of concern and opportunities for improvement within the LCA. By utilising the Sweco LCA database, the project was benchmarked against industry standards. This benchmarking facilitated a comparative analysis at both the project and building component levels, offering insights into how the current project aligns with similar past projects. This information was crucial for identifying best practices and areas for enhancement. Given the project's phase (detailed design), a segment of the workshop focused on implementing LCA requirements into the specifications for tenders, drawing on Sweco's extensive experience.

Key workshop findings

One of the primary insights from the workshop was the client's approach to working with a carbon limit value, which was born into the project from the Skanska's own limit value and the investor's (NREP) limit value for new buildings. The approach was based on early contractor involvement. The early involvement and research into different solutions showed that modular wooden constructions could deliver in terms of carbon limit value, time, quality and price constraints. Also, Sweco's LCA database provided valuable insights into the environmental performance of various construction materials, highlighting significant variability in CO2 emissions between high and low-quality timber constructions, as well as concrete. The project team uses Real-Time LCA as a tool to ensure that CO2 remained a core focus throughout the project. Continuous LCA monitoring and adjustments were incorporated throughout the project's life cycle, rather than treating LCA as a one-time reporting requirement. This approach allowed the project team for ongoing optimisation and variant analysis based on updated data and project changes.

The LCA hotspot analysis, prepared by the workshop facilitators, showed the client some interesting results. Aluminium profiles and sheets used in the façade contributed significantly to the climate impact. The climate impact from alternative façade materials was presented and it was discussed whether any of these options could be applied.

Furthermore, the concrete used for the basement and ground floor also contributes significantly to the total emissions. This has been acknowledged by the project team from the early stages. The issue was a priority and constructions have been optimised to make them simpler, with less amounts of concrete and reinforcement, during the design phases. Low-carbon concrete was suggested as a solutions by the facilitators. This solution has also been considered. The client highlighted that working with low-carbon concrete requires a high level of detail early in the project for the engineer to calculate strengths and make comparisons. This has been a key learning from the project to the client.

Key workshop challenges

While there are many advantages by using modular wood constructions, building with this type of construction also presents challenges. One of the main challenges is that the material selection is locked due to constraints imposed by external fire testing requirements. There are limited options for switching manufacturer due to strict regulations that demands new tests even if just smaller adjustments are done. The modules have only been fire-tested and approved with a limited material palette, as this is both costly and time consuming. These constraints limit the flexibility to change materials within the modules, impacting the overall LCA outcomes.

LCA calculations require precise data on material quantities and specifications, which are often not available early in the project. This necessitates early engagement with advisors to provide preliminary estimates on material quantities, a process that can be resource-intensive and requires a shift in industry practices, as current practice and contractual commitments do not allow for delivery of estimates on material quantity and types early in the project.

Setting CO2 requirements at the material level in tenders can lead to unintended consequences, such as the need for larger quantities of a material with lower environmental impact to meet functional requirements. This highlights the importance of considering all parameters and functional units in material comparisons and decisions.

Another issue raised by Skanska is the lack of harmonisation in LCA methodologies across Nordic countries, making cross-border comparisons and collaborations difficult. As an international company, Skanska would benefit from harmonisation by making it possible to develop standardised cross-border methods, tools and strategies for working with decarbonisation.

Follow-up consultation

Regarding optimisation opportunities, the project team reflected on whether any suggestions from the workshop had been pursued or reconsidered in the project. While not necessarily implemented, the learnings from the workshop prompted additional discussions about potential improvements. They specifically challenged the use of aluminium in the façade, suggesting the exploration of other metals and a reassessment of the façade dimensions. This led to a distinction between design, functionality (such as fire safety) and requirements, aiming for further optimisation.

After the workshop, the client highlighted a significant focus on window design, leading to the optimisation of the façade to include only essential window areas. The workshop proved motivational in reconsidering window sizes. Additionally, the team revisited the design of the stair towers, which were originally clad in glass, and after the workshop they started to question the glass façade, resulting in the development of new design variants in response to the workshop discussions.

Image: Henning Larsen

02 Svanemølleholm

Country	Denmark
Typology	Office
Area	14,666 m^2
Building phase	Detailed design

With a new, modern and flexible lease, the future tenants will have optimal surroundings for both work-related and social activities. Overall, the lease should reflect a quality, architecture and interior design that supports the tenants.

The building structure is compact with six full floors including the ground floor and an articulated roof floor. The ground floor along the waterfront by the South Promenade will be buzzing with life when the building's tenant, has lunch in the restaurant. The building's architecture is simple, robust and refined at the same time. The colours are both dark with natural slate façade cladding and warm with internal organic materials.

The project's primary construction materials include reinforced concrete cores, concrete columns and hollow concrete slabs, which together form the structural framework of the building. In addition to these structural elements, the façade of the building is designed with natural stone, which not only enhances the aesthetic appeal of the structure but also contributes to its durability. The combination of these materials reflects a commitment to robust construction practices, ensuring that the building is both functional and visually appealing.

The project's sustainability goals are centred around achieving certification at the DGNB Platin level, as outlined in the DGNB system for 2020. In addition, the project aspires to attain the DGNB Diamond certification, recognising exemplary performance in architecture, and the DGNB Heart label, which highlights exceptional efforts in social sustainability aspects. Furthermore, the project aims to align with the EU Taxonomy 7.7, which reflects compliance with the European Union's criteria for environmentally sustainable economic activities.

The clinic

Client	Nordstern
Type of client	Contractor
Facilitator	Rikke Schack (Sweco DK) Nicolaj Langkjær (Sweco DK)
Participants	Project manager Sustainability manager Sustainability assistant

Preliminary discussions

Nordstern's sustainability strategy focuses on reducing CO_2 emissions and promoting sustainable practices at construction sites. One element is the procurement of green energy, with sites using electricity from renewable sources like wind, hydro, solar and biomass. Reuse/recycling of building materials is also an important part of Nordstern's strategy for decreasing the environmental impact. The goal is for Nordstern sites to recycle 70% of their waste in 2025. Furthermore, all newly initiated residential and office construction projects from 2023 onwards must be certified. In 2023, Nordstern did not fully reach its goal, as 80% of the newly started residential and office projects are planned to be certified.

In response to the client's request to review the Life Cycle Assessment (LCA) delivered before the workshop, a comprehensive workshop was prepared to facilitate an in-depth discussion on critical topics relevant to the construction site's environmental impact and compliance with EU taxonomy. The client provided a preliminary LCA report which served as the foundational document for the workshop discussions. This document outlined the environmental impacts associated with various life-cycle stages of the project. To enhance the understanding of the LCA results, the workshop facilitators conducted a hotspot analysis. This analysis identified key areas of concern and potential improvement within the LCA. The workshop facilitators utilised the Sweco LCA database to benchmark the project against industry standards. This benchmarking allowed for a comparative analysis at both project and building component level, providing insights into how the current project measures up against similar past projects. This information was instrumental to identifying best practices and areas for enhancement. A segment in the workshop was dedicated to understanding the EU taxonomy requirements and discussing how the project can align with these regulations to enhance sustainability and compliance.

Key workshop findings

The Svanemølleholm project has yielded several key insights, particularly from the LCA exercise and the emissions related to the construction process, which offer valuable lessons for future projects.

At the workshop the LCA was reviewed and Sweco's experts had prepared a hotspot analysis. The hotspot analysis was compared to Sweco's extensive LCA database consisting of +225 LCA calculation of building projects. This exercise highlighted some building elements that deviated significantly from the average value in the Sweco database.

Due to the heavy nature of the construction (reinforced concrete), the client and their consultants' will focus on minimising the environmental impact by selecting products with Environmental Product Declarations (EPDs).

The workshop facilitators provided data on the contributions of different phases concerning the building site (A4 and A5), which Nordstern reviewed in anticipation of upcoming legal requirements (Introduced in the Danish Building Regulations in June 2025). Due to the relatively unexplored area, the client has not yet introduced a thoroughly tested system for gathering data on the construction processes. Several solutions have been proposed and are currently being tested on different sites to enhance this data-gathering process.

- Dashboard implementation: A dashboard will be introduced to monitor consumption throughout the project. Maximum allowable values will be set, with penalties or measures implemented if exceeded.
- On-site training: Training sessions will be introduced on site to improve practices.
- Data collection partnerships: Partnerships will be sought to help collect data, particularly on machinery.

- Improved signage and training: Enhanced signage and training will focus on waste management due to its significant impact.
- Dedicated staff: Personnel will be hired to ensure proper sorting of materials.
- Experience sharing: Experiences from different sites will be collected and shared.
- Electric machinery: Challenges with battery life and cost will be addressed through careful planning.

Key workshop challenges

There are significant challenges regarding data collection for emissions related to the construction site (A4 and A5). Questions arise about the best way to arrange the site, partition the building and landscape, as well as which machines to use and where they will be placed. Poor habits have been identified on site, such as unnecessary idling and failure to turn off lights. Studies show that a lot of electricity is consumed when employees are not present.

Follow-up consultation

The client will use the knowledge presented regarding the emissions associated with phases A4 and A5 to plan activities for monitoring and data collection. Based on the LCA hotspot analysis that was reviewed in the workshop, the entries in the LCA for the project have been reviewed. The presentation of requirements in the EU taxonomy, specifically the requirements for chemicals in buildings materials, provided the client with new ideas for how use them in future projects.

Image: KAVAKAVA office

03 Loodusmaja (The Nature House)

Country	Estonia
Typology	Museum and office
Area	15,250 m²
Building phase	Construction

The project is situated within a network of parks, urban blocks, streets, squares, inner courtyards, waterfronts and promenades, creating a cohesive and vibrant district. At the heart of this district lies the Natural History Museum's open, triangular courtyard, which serves as a landscaped gathering hub and central feature. This courtyard is encircled by three distinct yet interconnected buildings, each contributing to the overall functionality and aesthetic of the area:

- Museum building (ELM): This triangular structure is dedicated to housing the museum, providing cultural and educational value to the district.
- Wooden office building ("Dock"): the Dock includes shared spaces for the ELM lobby and the Nature House on the ground floor. This building utilises timber construction to reduce environmental impact.

- City building with street-level frontage: This multi-use building features rental spaces that open directly to the street, enhancing the district's social vibrancy. It is designed to accommodate various functions.

The building foundations and the underground two-story parking lot and part of the exhibition area are made of reinforced concrete. The primary load-bearing elements of the Nature House consist of cross-laminated timber (CLT) and laminated veneer lumber (LVL). CLT is extensively used in walls and floors, providing rigidity through interconnected panels. In high-risk areas, special coatings are applied to enhance fire protection, ensuring safety without compromising sustainability. The façade solutions include glass curtain walls supported by laminated glass posts, designed to carry both the weight and wind loads.

The Nature House project is incorporating life cycle assessment (LCA) calculations during both the preliminary and technical design stages. This makes it the first public building in Estonia to include an LCA, setting a precedent for future projects. The primary goal was to understand the insights that LCA could provide before defining concrete sustainability targets. As a result, RKAS has developed a comprehensive sustainability strategy that requires LCA calculations and sets preliminary limit values. This strategy aims to ensure that new projects meet high environmental standards.

The clinic

Client	Riigi Kinnisvara AS (RKAS, State Real Estate PLC)
Type of client	Building owner
Facilitator	Anni Oviir (LCA support)
Participants	Project Manager Environmental Sustainability Expert Development Director Architect Structural Engineer Construction Project Manager Expert from the Ministry of Climate and the Environment Department of Construction and Living Environment from Ministry of Climate and the Environment

Preliminary discussions

RKAS has incorporated LCA requirements into its sustainability strategy, establishing preliminary limit values to guide new projects. This approach ensures that environmental considerations are integrated into the planning and construction phases, promoting sustainable development. As the availability of environmental data in Estonia improves, RKAS has the opportunity to enhance these standards further, setting more robust and data-driven sustainability goals.

The workshop was planned to address the client's requirements and provide valuable insights into LCA practices. It included a review of initial LCA studies from 2020, conducted using the One Click LCA tool and Level(s) method at the preliminary and technical design stages. The agenda covered the evolution of LCA practices, comparing planning-stage and as-built LCA and discussing actionable takeaways for RKAS. This structured approach ensured that the workshop was informative and relevant, equipping the client with the knowledge needed to implement LCA practices effectively.

Key workshop findings

The workshop provided a fundamental understanding of the life cycle assessment (LCA) in the context of project planning and construction, tailored to the client's interest in integrating LCA practices across various project phases. The initial LCA studies conducted in 2020 were reviewed, the evolution of LCA methods was discussed, and practical ways to incorporate LCA findings to support more sustainable decision-making were explored.

During the workshop, the client shared that while they are in the early stages of incorporating sustainability strategies, they have begun developing preliminary requirements for a life cycle assessment (LCA) as part of a broader approach to climate impact reduction. However, specific tools or systematic methods for reducing carbon footprint are not yet fully established within their processes, highlighting a current gap in resources and structured practices for managing carbon impacts. To support these efforts, the client was advised on integrating LCA into project workflows more strategically, explaining how using tools like One Click LCA and leveraging the Estonian national method and database could help refine carbon reduction goals. We also discussed the importance of defining clear, actionable steps within the planning and construction phases to move toward consistent carbon footprint management, positioning the client to better meet upcoming regulatory requirements in Estonia.

The primary recommendation was for RKAS to conduct an as-built LCA to compare with the design phase LCA. This comparison would highlight key differences between the projected and actual environmental impacts, providing critical insights for refining the Estonian national LCA method. Additionally, the workshop emphasised the need for a better understanding of integrating LCA practices across project stages.

Establishing actionable steps to incorporate LCA insights more consistently was identified as a priority, ensuring that sustainability considerations are embedded throughout the project life cycle.

Key workshop challenges

The workshop also identified several challenges and support needs that must be addressed to facilitate the effective integration of LCA practices. A key challenge is the need for structured processes and resources to consistently integrate LCA across project phases. Currently, the client faces limitations due to insufficient resources and a lack of standardised procedures for carbon footprint management. Additionally, there is a gap in local environmental data, which has previously limited the accuracy and relevance of LCA calculations. Addressing these challenges requires a concerted effort to develop standardised procedures, allocate necessary resources and improve the availability of environmental data.

Follow-up consultation

The client intends to conduct an as-built LCA upon project completion. The workshop laid a strong foundation for integrating LCA practices, aligning with Riigi Kinnisvara AS's stated interest in incorporating these methodologies. Continued collaboration with the workshop facilitators could further support the client in successfully implementing the suggested practices and achieving their sustainability goals.

Image: NOAH architecture office

04 Hiedanranta

Country	Finland
Typology	Apartment building
Area	3101,5 m²
Building Phase	Early design

The project is an apartment building located in Hiedanranta, the new district of Tampere, Finland. The building is designed to have four to five floors and will accommodate 37 apartments. In addition to residential units, the building will include general storage spaces, bicycle parking areas, a sauna area and a civil defence shelter.

The building's structural framework will consist of pillars and slabs in reinforced concrete, providing the necessary support and stability. The walls between apartments will be constructed using light-structured materials to ensure both durability and ease of construction. The primary material for the building's façade will be brick. The specific materials for internal surfaces have not been detailed at this stage of the design.

One of the key sustainability goals is to obtain an environmental certification for the building: either BREEAM, LEED, or the Finnish RTS certification. Additionally, a comprehensive life cycle analysis (LCA) must be conducted to assess the environmental impact of the building throughout its lifespan. The construction site is mandated to be low-emission and a minimum of 85% (per volume) of the construction waste must be recycled.

The clinic

Client	A-Kruunu
Type of client	Building owner (A-Kruunu Oy is a state-owned special assignment company operating under the guidance of the Ministry of the Environment. The company's primary mission is to build affordable rental housing)
Facilitator	Elina Virolainen (Sweco FIN)
Participants	Project owner

Preliminary discussions

A-Kruunu has established sustainability practices for all its projects. The company mandates that all new buildings achieve an energy class-A rating, reflecting high energy efficiency standards. Furthermore, A-Kruunu has set a goal to achieve carbon neutrality in terms of energy consumption by 2030. This commitment to sustainability is evident in the company's proactive approach to integrating energy-efficient technologies and practices in its building projects.

The client, A-Kruunu, had specific requirements and expectations for the workshop agenda. The client provided a detailed presentation about the project, outlining the sustainability requirements set by their client and shared a preliminary CO_2 calculation for different structural frame options.

To effectively address the client's needs, the workshop was planned by gathering comprehensive information about the project from the client. This included general project information, various design options and specific topics that the client wished to discuss.

Key workshop findings

The key discussion points from in workshop was centred around use of low-carbon concrete in the frame foundation, emission-free construction sites, and waste recycling according to the BREEAM Communities-criteria. Since the goals of the project were already settled, the discussion was focused on how to fulfil them. The workshop facilitators could share knowledge in terms of e.g. material prices and use cases etc.

The project has a requirement to calculate the LCA, but there is no limit value. Climate impact reduction will materialise through use of low-emission materials and energy.

One of the significant findings of the workshop was that the project has highly detailed goals for carbon limits. The required level of the low-carbon concrete classification is GWP70 (emissions are 70% of the CO_2e of the average version of the material) for ground, intermediate and top floors, and GWP55 for foundations and load-bearing vertical structures and a deviation from the requirement needs to be compensated in some other structure. It was discussed how such requirements is going to change the material supply industry, most likely in a positive way.

Key workshop challenges

The project team encountered several challenges, primarily due to their limited experience with low-carbon concrete designs. The team required a deeper understanding of how low-carbon concrete would affect the project and procurement processes. They also sought insights from other industry actors who had experience with similar materials, as well as information on potential risks and challenges associated with low-carbon concrete. To address these needs, the workshop facilitators committed to producing a summary of their understanding for a follow-up meeting. Additionally, the topic of climate risk assessment was discussed and the client requested the workshop facilitators to present on this subject in the follow-up meeting.

Follow-up consultation

In the follow-up meeting, the workshop facilitators prepared summaries on two key topics requested by the client: the Global Warming Potential (GWP) of concrete and a climate risk assessment. These summaries were discussed in the follow-up meeting, providing the client with valuable information to support their decision-making. However, it remains unclear whether the client decided to implement a climate risk assessment for the project as an additional sustainability measure. The follow-up discussions highlighted the importance of continuous engagement and knowledge sharing to achieve the project's sustainability goals.

Image: HOAS

05 Hopeakaioksentie 47

Country	Finland
Typology	Apartment building (student housing)
Area	4,424 m² and 308.5 m² retail
Building phase	Construction (earthworks)

Hopeakaivoksentie 47 is a development project situated in the district Kruunuvuorenranta in Helsinki. The project encompasses two buildings, each designed to serve as student housing. The buildings are planned to rise six stories high. In addition to the residential units, the buildings will feature a variety of communal amenities, including a sauna and a common area, which are intended to foster a sense of community among residents. Furthermore, the ground floor will house retail spaces.

The load-bearing structure is primarily composed of reinforced concrete, ensuring building stability and longevity. The façade is predominantly clad in grey brick. The façade design includes variations in colour and assembly, adding visual interest and breaking the monotony of the exterior surfaces. The internal surfaces' material specifications were not detailed in the provided documents.

No specific sustainability goals (certifications, limit values, EU taxonomy, etc.) was defined prior to designing the building.

The clinic

Client	HOAS (Foundation for Student Housing in the Helsinki Region)
Type of client	Building owner (HOAS is a non-profit foundation dedicated to addressing the shortage of student housing in the Helsinki metropolitan area).
Facilitator	Elina Virolainen (Sweco FIN)
Participants	Project owner

Preliminary discussions

HOAS has demonstrated a proactive approach to sustainability by calculating its carbon footprint in accordance with the GHG Protocol. The foundation's emission reduction efforts are aligned with the Science Based Targets initiative (SBTi), which provides a framework for setting ambitious and science-based emission reduction targets. However, HOAS has not set an official carbon neutrality target, primarily due to concerns about the potential impact on rental income. This cautious approach reflects the foundation's need to balance sustainability goals with financial viability, ensuring that the cost of low-emission measures does not unduly burden students.

The client, HOAS, had no specific requirements and wishes for the workshop agenda. To facilitate the discussions, HOAS provided preliminary project presentations and energy efficiency certifications. This preparatory information was used to address the client's specific needs and objectives.

The agenda included introductory sessions, detailed presentations on the Nordic LCA project and the Hopeakaivoksentie project, in-depth discussions on carbon accounting and the formulation of actionable proposals.

Key workshop findings

The workshop revisited HOAS's general goals for energy efficiency and emission limits. HOAS aims to achieve an energy class A rating for their building projects and are also planning to introduce an emission limit for their projects. They are now conducting the LCA analysis in their projects to see how close they would get to the limit used for Helsinki City's new residential buildings (16 kgCO2-eq/m2/year). Due to its current construction phase, the life cycle assessment (LCA) limit was not set for this project.

One of the discussions was centred around the project's plot size. The Hopeakaivoksentie project itself is set on a plot, which is quite small in area, but also had a thick base rock that needed to be detonated. This then guided the discussion to "how to make sure the land mass recycling can be maximised", when there is little or no use for it in the plot itself, nor are there means to store it there.

Key workshop challenges

The workshop participants raised concerns about the long-term performance of low-carbon materials, particularly over several decades. This highlighted the need for thorough evaluation and testing to ensure that the materials used in the project would meet durability standards while contributing to sustainability goals.

One of the primary challenges is the cost associated with low-emission measures. HOAS faces financial constraints, as it cannot pass on the additional costs of these measures to students through increased rents. This financial limitation poses a significant barrier to setting and achieving ambitious sustainability goals, such as carbon neutrality.

To address this challenge, the workshop highlighted the need for practical and cost-effective solutions. Participants discussed various strategies to optimise material usage and reduce costs without compromising on sustainability.

Follow-up consultation

Discussions in the follow-up meeting centred around making sustainability choices and measures more affordable and feasible for HOAS. The workshop facilitators provided valuable examples of changes that could benefit both emissions and cost, such as optimising material masses and exploring alternative construction methods.

The follow-up also included a review of the workshop's outcomes and the progress made towards achieving the project's sustainability goals. This iterative process of review and adjustment ensures that the project remains on track and that any emerging challenges are promptly addressed.

Image: Basalt Architects

06 Visitor Centre in Þjórsárdalur

Country	Iceland
Typology	Commercial
Area	2,145 m²
Building phase	Early design

The visitor centre in Þjórsárdalur, Iceland, will serve as a reception for hotel and bath guests of the Mountain Retreat in Þjórsárdalur. It will also function as an information centre, exhibition space, shops and restaurants, as well as staff facilities. The building is designed on one floor with a basement. Most activities will take place on the ground floor, with technical spaces, storage spaces and staff changing facilities located in the basement.

The building is supported by a load-bearing pad with cast-in-place plinths and a base slab. The basement is also cast in place. On the first floor, load-bearing walls consist of timber on one side and reinforced concrete on the other. The roof is primarily made of traditional wooden beams or glulam, reinforced with steel in some areas. Vertical loads are supported by glulam columns and concrete walls, while horizontal loads are managed by wooden boards in the roof, transferring the load to the foundations through concrete walls or steel braces. The façade will mainly consist of burnt timber cladding, and the interior walls will be clad with timber cladding, plaster, or tiles in wet spaces.

For the visitor centre the project has the goal of undergoing BREEAM certification with a rating of Excellent. Their goal is to reduce the carbon footprint of the project as much as they can during the development stage, and they aim to offset emissions from operations via their own forestry project.

The clinic

Client	Rauðukambar ehf.
Type of client	Building owner
Facilitator	Alexandra Kjeld (EFLA) Sigurður Loftur Thorlacius (EFLA)
Participants	Project owner Architect

Preliminary discussions

The parent company Bláa lónið of the client (owner of Rauðukambar ehf) has defined a goal of BREEAM certification for all their building projects in development.

There were no specific requirements or wishes from the client to the workshop agenda. The agenda included a presentation of the requirements in Iceland (roadmap and new LCA requirements) and some 'benchmark' LCA studies for other buildings that have highlighted hot spots (e.g. concrete, steel and use of hot water). No documentation was shared beforehand, but some of the LCA material for respective buildings had been reviewed to a limited extent in prior meetings. To prepare for the meeting, OneClick was used to compare the benchmark projects from the client with current early designs.

Key workshop findings

The workshop revealed several key findings. Firstly, the significant restrictions posed by Icelandic conditions when designing sustainable buildings were highlighted. Initially, the visitor centre was planned to be constructed from timber, but because of all the steel that had to be used to reinforce the timber, mainly due to seismic activity in the area, the client settled on using concrete to reduce project costs. Significant resources have been made to minimise the carbon footprint, including an optimisation of the concrete used in the project. First the amount of concrete has been minimised and then strength classes was optimised, resulting in the use of nine different strength classes of concrete for the visitor centre. This has further decreased the environmental impact. All water and energy heating are sourced from the client's boreholes, monitored by ÍSOR, Iceland Geosurvey. The feasibility of an on-site concrete plant is being investigated to reduce transportation costs and emissions. The client has also planted 30,000 trees to offset carbon emissions, and plans to certify the forest for carbon credits. Additionally, the potential for better allocation of time and costs associated with the certification process to more impactful sustainability measures was identified.

Key workshop challenges

Several challenges were identified during the workshop. The cost of sustainable materials was found to impact the design of eco-friendly buildings. Geological conditions in Iceland, especially in earthquake-prone zones, limit material choices due to the need for structural strength. Weather conditions necessitate the use of tried-and-tested materials. Furthermore, the sustainability certification process, particularly BREEAM, is time-consuming and requires extensive paperwork, which can be restrictive given the limited time in projects. The costs associated with certification could be better allocated towards sourcing lower-carbon materials.

Follow-up consultation

The client expressed interest in the capacity of LCA to promote continual improvement, but also to communicate a story of improvements since the conceptual design. The calculations from the workshop will serve as a basis for future assessments and design optimisations, and the client intends to update calculations.

Image: Nordic Office of Architecture

07 East Pier

Country	Iceland
Typology	Airport expansion
Area	60,385 m²
Building phase	Early design

The East Pier is part of the expansion of Keflavík Airport. It will feature a new baggage handling system in the basement and on the first floor, along with up to 20 gate areas for contact stands on the second and third floors. The East Pier will connect to the East Wing of the airport and will consist of 3 to 4 floors, including a basement.

The East Pier will be a steel-frame building with a glass curtain wall façade.

The project aims to achieve the BREEAM rating 'Very Good' as a minimum, with aspirations to achieve the 'Excellent' rating. The project furthermore aims to meet the client's Sustainability Framework goal of 350-450 kg CO2-eq/m2.

The clinic

Client	Isavia
Type of client	Building owner
Facilitator	Alexandra Kjeld (EFLA) Sigurður Loftur Thorlacius (EFLA) Björgvin Brynjarsson (EFLA)
Participants	Sustainability manager Architects

Preliminary discussions

The client aims to achieve net zero by 2030, supported by an extensive sustainability framework that all construction projects must follow.

There were no specific requirements or wishes from the client for the workshop agenda. The workshop was designed to cover the current main requirements in Iceland and included 'benchmark' life cycle assessment (LCA) studies for other buildings to highlight important aspects and hot spots. No documentation was shared beforehand, but some LCA material for respective buildings had been reviewed to a limited extent in prior meetings. The workshop agenda included a comprehensive overview of the project background, environmental impacts of the construction sector, examples from the sector, a comparison of different materials and a discussion on challenges and potential improvements.

Key workshop findings

Based on results from previous construction projects at Keflavik Airport, recommendations were made to support the client's sustainability goals for the East Pier. The analysis identified concrete and steel as the primary contributors to the carbon footprint, with structural steel being the main emissions driver. To address this, the potential for significant carbon footprint reduction by using recycled steel and low-carbon concrete was presented. Additionally, the impacts of using low-carbon concrete, aluminium with nearly 100% recycled content, lower-emission structural steel and shorter transport distances were explored. A comparative analysis of cladding materials showed that fibre cement cladding performed better than aluminium cladding, and a comparison of glass curtain wall façades indicated that unitised panels minimised waste and construction time, while stick-on façades allowed for more compact transportation and thus lower emissions.

During the discussion, the client expressed interest in substituting aluminium cladding with fibre cement cladding and exploring lower-carbon cement, despite potential time constraints. They emphasised the need for lower-carbon steel to meet specific quality and strength requirements and highlighted the importance of focusing on the overall carbon footprint rather than solely on recycled content. The client also noted challenges in sourcing recycled aluminium and introduced the idea of incorporating wooden floors as an alternative to tiles. The workshop provided valuable insights and practical recommendations for reducing emissions in the construction of the East Pier.

Key workshop challenges

The main challenges identified by the client were multifaceted. They highlighted the difficulties in sourcing recycled aluminium, noting that it often lacks the natural finish and has visual defects due to impurities. Additionally, obtaining the necessary strength alloy required for the building was challenging. Part of the discussions focused on how a 'recycled material content' requirement can be counterproductive, as recycled materials such as steel and aluminium are not in limitless supply. Instead, the emphasis could be placed on 'low-carbon' materials, leaving it to the suppliers or original manufacturers to determine how this is achieved.

The client also mentioned the difficulty in meeting BREEAM weather requirements and ensuring that materials can withstand the winds in Keflavik. They stressed the importance of selecting materials that will last for the entire lifetime of the building, rather than those that may degrade due to weather conditions. Additionally, the seismic activity in the area influenced the choices of materials, further complicating the selection process.

Follow-up consultation

The client expressed interest in the cladding and glazing discussion which could reduce the embodied carbon significantly together with low-carbon steel and low-carbon concrete. Both concrete suppliers are taking significant steps to reduce the carbon content of the concrete mix. The calculations from the workshop will serve as a basis for future assessments and design optimisations.

Image: Vestaksen Real Estate AS

08 Engebredden

Country	Norway
Typology	Apartment building
Area	6,263 m²
Building phase	Early to detailed design

The project involves the construction of a new residential project right by Strømsø square in Drammen. Engebredden will feature 46 new apartments ranging in size from 45 m^2, with proximity to city life and station.

The load-bearing structure is planned with steel columns and concrete walls, with façade cladding as brick tiles combined with timber and façade panels. Internal floor surfaces are likely to be wood or laminated wood, with gypsum walls and no ceiling plates. The foundations are planned with 16-metre-deep steel pile walls around the perimeter of the building and a 1-metre-thick concrete slab at the basement floor for stability due to difficult geotechnical conditions.

The project aims to align with the EU taxonomy. There is no specific certification scheme, but the client wishes to investigate various carbon emission mitigation measures.

The clinic

Client	Vestaksen Real Estate AS
Type of client	Building owner
Facilitator	Karin Cochard (Sweco NOR) Marie Kyllingstad (Sweco NOR)
Participants	Building owner (2 participants) Contractor with construction and geotechnical expertise Architect

Preliminary discussions

The client has a sustainability framework outlined for their projects. With regards to environmental and energy measures they emphasise investment in solar cell technology, reuse and use of materials that reduce emissions and energy consumption.

Drawings of the building, along with energy and geotechnical studies, were submitted to the workshop facilitators prior to the workshop. The workshop facilitators utilised the carbon designer feature in OneClickLCA to create a reference building that replicates the geometry of the project building while incorporating generic designs for building elements and material selections. This reference building will be employed during the workshop to highlight the material and building element hotspots and provide a preliminary overview of the potential effects of various mitigation measures. Additionally, an assessment was conducted to evaluate the impact of alternative energy supply options.

Key workshop findings

The workshop produced several key findings. Alternative assessments of geotechnical solutions demonstrated the advantage of the planned solution over steel core piles, highlighting the importance of planning height and weight for total greenhouse gas (GHG) emissions from foundations. The use of glulam or CLT wood in bearing columns and stairs/shafts was identified as a significant measure to reduce emissions. Discussions also included the use of low-carbon concrete and avoiding steel beams by utilising internal walls for bearing. Additionally, the possibility of using air-water heat pumps as a baseload and district heating as a peak load was explored, with a need for further cost analysis.

The facilitator has provided alternative assessments for the geotechnical solutions that showed the large advantage of the planned solution instead of steel core piles (as expected). If the building had added several floors and thus weight, it would have increased the risk for needing steel piling. This shows how important the planning of height and weight (above and below ground) is for the total GHG emissions from foundations.

The facilitator investigated the impact of using glulam or CLT wood in the bearing columns and in the stairs/shafts. Shifting from steel columns to glulam columns would contribute significantly to emissions reductions. The steel columns contribute with approximately 6% of total emissions. These emissions could potentially be cut by around 90-95% by shifting to glulam.

Concrete has a very large contribution to total emissions, both in the ground floor slab, in walls and in the hollow core slabs. In situ cast concrete contribute with about 25% of total emissions which can be reduced by about 50% if choosing low-carbon concrete. Also, hollow decks can reduce emissions by using the best available low-carbon class.

Steel beams contribute in the reference building with around 11% of the emissions. Beams may not be necessary if using internal walls as bearing. The total concept of bearing must be further developed but this suggests a large benefit by using internal walls for bearing and avoiding beams.

More hotspots were identified, in particular mortar used for slab levelling and bricks in the façade. These calculations can easily be used for looking at the relative contribution from each building element and material, and to compare with alternative materials, providing information on possible emission reduction from each mitigation measure.

Key workshop challenges

Using CLT and glulam wood in slabs and load-bearing systems comes with challenges. It is still recommended to investigate possibilities related to glulam columns. A study of the implications for area demand in the apartments is needed. When the concepts have been selected there is still a large potential for emission reductions related to product selection. As a result of very high emissions from steel sheets, concrete and steel columns, the mitigation measures moving forward in the detailed design should be to look at the possibility of choosing a lower-carbon concrete and to compare EPDs before choosing steel columns and steel sheets.

Follow-up consultation

The client expressed interest in using the workshop findings to assess further measures regarding the selection of bearing element concepts and product selections. The calculations from the workshop will serve as a basis for future assessments and design optimisations.

Image: Umeå Municipality

09 Concept for Group Home

Country	Sweden
Typology	Group home (residential facilities for the elderly, for individuals with disabilities etc.)
Area	450 m²
Building phase	Strategy/early design

The project involves the construction of group homes, which are currently mostly found in a single level. In the future, two-level group homes are likely to become the most common type of building in new constructions of group homes. These homes must always follow Umeå Municipality's room function programme. The room function programme should be seen as a basis for planning housing according to the municipality's mandate, but it can also be used as a basis for planning other types of housing for individuals who need support.

The apartments should generally be integrated into the community's other housing stock. They should have the same functions and standards as regular housing. In addition, there are higher requirements for accessibility, safety and overview and occasionally individual adaptations based on the occupants needs.

The current standard for single-level group homes is that the load-bearing structure consists of a wooden frame and a concrete slab on the ground. In the future, a standard for two-level group homes will also be developed. The load-bearing structure for this type has not been determined, but the developer is open to try different solutions based on the LCA to lower the climate impact in A1-A5. The materials for the façade is in several projects determined by or described in the detailed development plan. This means that the decision is not up to the developer to choose at all times.

The clinic

Client	Umeå Municipality
Type of client	Building owner and developer
Facilitator	Anna Joelsson (Sweco SWE) Inga Sjöberg (Sweco SWE)
Participants	Project Managers Energy and Maintenance Engineers Environmental Engineers Head of Construction and Property Engineering Warranty Coordinator

Preliminary discussions

Umeå Municipality has demonstrated a strong commitment to sustainability practices. Their ambition is to adhere to the Miljöbyggnad Silver requirements during the design phase, but without pursuing certification. Furthermore, they aim to reduce the climate impact from A1-A5 by 30% compared to Boverket's suggested limit values.

The workshop was tailored to meet specific requirements and wishes expressed by the client. These included discussions on the process of climate calculations, the reuse of materials and installations and the development of the group home concept, particularly the transition from single-floor to two-floor buildings. Additionally, the workshop considered the Swedish NollCO2 certification system. Existing presentations and knowledge were utilised, and Sweco climate cards were employed for interactive discussions. PowerPoint slides on the reuse of installations were prepared using materials from previous projects.

Key workshop findings

The workshop attracted significant interest with many individuals from the client eager to participate. Participants found it intriguing to explore various methodologies for calculating climate impact, and noted the significant differences in results. Understanding the reasons behind these differences, such as life cycle phases, building components, emission factors on electricity and the impact of produced electricity from solar panels, was important. The environmental engineer expressed satisfaction that the information she had previously shared with her colleagues aligned with the workshop presentations. This alignment reassured her that they were on the right track, reinforcing the credibility of her prior communication.

Several initiatives were discussed to reduce the carbon footprint in the municipality's building projects:

- Material selection: Opting for building materials with lower climate impact.
- Material reuse: Encouraging the reuse of materials to minimise waste.
- Flexible use of buildings: Promoting the flexible use of buildings and facilities to optimise their utilisation and prevent them from standing empty at any time during the year or day.
- Client advisories: Advising clients to implement systems and strategies that have a tangible effect on the atmosphere, rather than merely appearing beneficial on paper in a certain certification scheme.

Key workshop challenges

Several challenges were discussed during the workshop. Effectively reusing materials involves establishing a systematic approach and clear communication about the practices and benefits. How climate impact is considered in repair, conversion and extension projects. Clear communication to citizens and municipal employees about climate initiatives is challenging, but helps to build awareness and support. Given that projects are funded by tax money, it is important to use these funds wisely and fairly, balancing citizen expectations with ambitious climate goals. Utilising BIM models efficiently in climate work is also a great challenge and involves systematic integration and proper management of these models through a building's lifecycle, ensuring they are maintained and utilised effectively by property management post-construction. Learning from others' best practices in this area can also provide valuable insights.

Follow-up consultation

A follow-up was conducted one week after the workshop. It was noted that it was too early to observe specific implementations of the knowledge gained. However, the workshop emphasised the importance of reducing climate impact and influenced the operational planning for 2025, incorporating aspects of the discussions. During the follow-up the client expressed how valuable it was to gather all the participants to immerse in the climate aspects, devote several hours to it and lay the foundation with a common language and understanding. It strengthened the ongoing commitment to sustainability and the potential long-term impact of the workshop on future projects.

Image: Catena

10 Logistikposition Söderåsen

Country	Sweden
Typology	Logistics
Area	Approx. 30,000 m²
Building phase	Early design

The Söderåsen project by Catena is a significant development in Bjuv municipality. The project is strategically positioned near the E4 and E6 highways. This logistics hub is anticipated to enhance the logistics network supporting Scandinavia, benefitting not just Bjuv, but the entire region. The building is characterised by an open floor plan with an optimised ceiling height to maximise storage capacity. The design includes strategically placed entrances and loading gates to support efficient logistics flows and enable future redevelopment.

The material description for the load-bearing structure, façade and internal surfaces has not been specified at this stage.

The project is committed to sustainability goals, aiming for a BREEAM-SE rating of excellent, certification with the Swedish climate certification NollCO2 and alignment with the EU taxonomy 7.1. The Catena climate budget (limit value) for A1-A5 is set at 204 kgCO2-eq/m2.

The clinic

Client	Catena
Type of client	Building owner and construction management
Facilitator	Anna Joelsson (Sweco SWE) Inga Sjöberg (Sweco SWE)
Participants	Sustainability manager Sustainability coordinator Project managers

Preliminary discussions

Catena has a sustainability programme which all new developments should follow. It is aligned with both BREEAM and EU taxonomy. It includes climate limit values for A1-A5 for all projects, and the limit values are progressive over the coming years, to ensure improvement.

The client expressed a wish to discuss complex LCA issues, such as different definitions of net-zero, climate compensation, the effects of various certification schemes, and different LCA methods. A report from a similar project exploring construction and material choices in connection to climate optimisation was reviewed in advance, and its findings were discussed during the workshop. Additionally, climate cards by Sweco were used to facilitate interactive discussions.

Key workshop findings

Several initiatives and methods for reducing the carbon footprint were identified. These included setting a climate budget (limit value) for all projects, analysing different construction methods to compare climate impact, cost and technical challenges, and implementing systems and strategies that have a real effect on the atmosphere, rather than merely appearing favourable in certain certification schemes. Catena has achieved a couple of projects with low climate impact, even though their buildings are classified as industrial and thereby not included in the Swedish climate declaration regulation.

Findings include Catena's process where they work based on a strong awareness of the need to meet climate challenges. Through company goals, continuous discussions and experience feedback they integrate climate not all parts of the projects. Carbon budgets with limit values are an important tool and they carry out preliminary LCA calculations in the early stages to identify material replacement needs. Catena test different materials and methods and in some recently completed projects, for example, they have built large-scale frames entirely from wood or steel with a high degree of recycling. Since they specialise in logistics buildings, which are relatively generic in their design, they can effectively evaluate and build on solutions from previous projects.

The workshop also focused on developing an effective climate strategy, optimising processes and refining calculation guidelines. A hotspot analysis from a similar development project was used to provide insights and suggest improvements for the Catena case.

Key workshop challenges

One significant challenge is the variation in LCA methodologies used by different environmental certification schemes such as BREEAM, Swedish national legislation and NollCO2. Additionally, local initiatives as LFM30, Uppsala klimatprotokoll, Stockholm Klimatarena and municipal schemes are emerging defining their own methods and limit values give rise to a plethora of methods to relate to for a company having projects all over Sweden.

Another challenge is the difficulty in finding alternative façade materials with lower climate impact that are as easy to build with as traditional sandwich panels. Furthermore, logistics buildings are not included in the legislation of climate declaration, and can also earn less credits within the Swedish BREEAM adaptation compared to other buildings which limits incentives for improvement. Lastly, the energy demands in the Swedish Building Code could be more differentiated for different building types to better address specific needs.

Follow-up consultation

A follow-up was conducted one week after the workshop. During this follow-up, the client was appreciative of the discussion and hotspot analysis of the material and construction investigation report. It can give new realisations to discuss results thoroughly and plans were made to implement the discussions of the results in upcoming projects. The knowledge gained on the differences between various certification schemes will be utilised in the client’s future development projects.

Image: OBOS Bostadsutveckling

11 Rosenspira

Country	Sweden
Typology	Row houses
Area	Net area: approximately 128 m² per apartment Gross area: approximately 148 m² per apartment
Building phase	Detailed design

The Rosenspira neighbourhood is situated near a planned park with lush greenery. The rowhouses are designed to be two-story buildings. The buildings feature plaster façades in three earthy colours – two shades of green and a warm grey – along with silver windows. The buildings have black tar roofs and green roofs on the storage units.

The homes offer natural light throughout. The downstairs has ample space for socialising in the open kitchen and living room, while the bedrooms are upstairs. There are two bathrooms, and all residences come with parking spaces, either in a shared area or on their own driveway. Each residence also has a standalone storage unit, either by the deck in the back or on the driveway.

Most homes come with a grass lawn and a terrace. The terraces are enclosed with wooden fences, and the property boundaries are marked by hedges.

The load-bearing structure of the rowhouses consists of a wooden frame in flat elements, and the façade is plastered. The heating system includes an exhaust air heat pump with an extra supply air module and low-temperature radiators to reduce power peaks.

In terms of sustainability, the project aims to align with the LFM 30 scheme with a climate goal of 171 kgCO2-eq/m2. From early calculations, it looks like the project will achieve 140 kgCO2-eq/m2).

The clinic

Client	OBOS Bostadsutveckling
Type of client	Construction management / Developer (building owner before they are sold)
Facilitator	Anna Joelsson (Sweco SWE) Sofie Hansen (Sweco SWE)
Participants	Project manager Sustainability manager Sustainability coordinators

Preliminary discussions

OBOS has a goal of working with climate budgets with progressing limit values over the years in all projects where it is possible due to the conditions. The implementation of the limit values starts now and some projects are chosen as pilots to work with climate budgets to quality-assure the method before broad implementation.

The client had specific requirements and wishes for the workshop agenda. They wanted to discuss tricky LCA issues such as different definitions of net-zero, climate compensation, effects outside the building system boundary (D-module) from renewable energy and value chains of wooden buildings, effects from different certification schemes, and different methods of LCA, particularly the effects on the choice of energy supply system. A climate calculation of the project was received in advance, and a hotspot analysis was shown at the workshop.

Key workshop findings

The workshop provided an opportunity to thoroughly discuss and understand complicated concepts related to climate impact and LCA. The discussions emphasised the importance of understanding different methodologies for calculating climate impact and the variations in results due to different life cycle phases, building components, and emission factors. Identified important methodological choices that will affect the result of a climate calculation are:

- The purpose of the calculation – do we need an attributional or consequential LCA?
- The system boundaries of life cycle stages and buildings parts
- Do we include effects outside the system boundaries of the building, as new renewable electricity replacing other electricity, design for reuse after buildings lifetime or the use of wood residues along the production chains when building houses with wood frame?
- The difference in climate effects of accounting for using or producing electricity in an attributional or consequential way
- Quality of data
- Choice of LCA software
- Calculation method for comparing fossil materials to renewable (biogenic) materials.

The hotspot analysis identified the concrete type in the slab and the choice of façade as the building parts and materials that needed further improvement.

Key workshop challenges

Several challenges and support needs were identified during the workshop, including how to choose measures that have a real impact versus the ones that give credit in the certification schemes. The rules of certain certification schemes complicate the implementation of energy measures. For example, the Swedish environmental certification scheme Miljöbyggnad only give credit for renewable electricity produced on-site, whereas renewable electricity produced elsewhere is equally beneficial to the atmosphere. Additionally, some schemes assume that new renewable electricity, for example from solar cells within the project, replaces the Swedish production electricity mix, while others assume that it replaces European marginal electricity. This gives huge differences towards a net-zero goal.

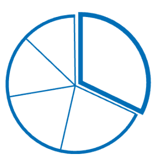
Another challenge is that municipal detailed development plans sometimes restrict the use of reused materials or the selection of materials with the lowest climate impact due to specific requirements for façade materials and colours. The municipalities have a responsibility here to make it easier to choose from a climate perspective.

Follow-up consultation

The follow-up was held one week after the workshop, making it difficult to assess specific implementations. However, the insights gained from the workshop fostered a renewed motivation from the client to focus on climate impact reduction.

KEY FINDINGS

Carbon limit values and continuous LCA monitoring
Several projects emphasise the importance of adhering to climate budgets and continuous LCA monitoring. This approach is an important driver for carbon reductions. BLVD.31 in Denmark aligns with the client's and their investors' CO2 requirements, ensuring that the project stays within the set climate budget. Similarly, Svanemølleholm in Denmark integrates LCA practices into project workflows to continuously monitor and manage the environmental impact. The importance of defining a carbon limit value and implementing systems to monitor progress during the phases was also discussed in the workshop for Logistikposition Söderåsen in Sweden, where they have a clear plan for progressive limit values which they follow in all projects.



Hotspot analysis and data for early insights
Hotspot analysis and early data insights are crucial for identifying carbon reduction opportunities. This approach was identified as an integral part of the process in several projects. The early data insights require collaboration from stakeholders across the whole value chain. Several clients highlighted that new agreements on when and what to deliver in terms of data must be established. Hotspot analyses based on the LCA provided by the client were used in many of the workshops to highlight challenges. The hotspot analysis showed some interesting results in the BLVD.31 project in Denmark and led to an optimisation of the project after the workshop.

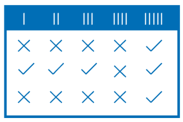
Flexible use of buildings

The flexible use of buildings was highlighted in the discussions in the workshop for the Concept for Group Homes in Sweden. The idea is to optimise a building's utilisation and prevent it from being empty at any time during the year or day. By optimising building utilisation, less area would need to be built, reducing the environmental impact at building stock level.

Biobased materials and low-carbon solutions

The use of biobased materials and low-carbon concrete was a key focus in several projects. Other material and/or building technical solutions were also discussed in the workshops. BLVD.31 uses prefabricated timber modules to minimise material use and climate impact. East Pier recommends using recycled steel and low-carbon concrete to reduce the carbon footprint. In the Engebredden project in Norway it was proposed to explore low-carbon concrete and CLT/Glulam solutions. In the visitor centre project in Iceland, both concrete types and quantities were optimised, resulting in the use of nine different strength classes in the project. In the Hiedanranta, Kuivaamonkatu 3 project in Finland, low-carbon concrete is used in the frame foundation.

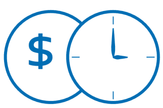
KEY CHALLENGES



Calculation methods and integration of LCA across phases
The variability in LCA methodologies typically in certification schemes and national regulations present significant challenges. This was discussed in the workshop for the Söderåsen project in Sweden, where it was also highlighted that local (municipal) schemes are emerging with different methodologies and limit values, complicating the standardisation of practices. Rosenspira in Sweden finds that certification schemes complicate the implementation of energy measures, which highlights the need for standardised procedures that credit actual benefits to the atmosphere. The integration of LCA across the different design phases was also highlighted as a significant challenge in the discussions on the BLVD.31 project in Denmark and the Loodusmaja project in Estonia.

Material-related challenges
Material-related challenges are stressed in many of the clinics. In the two clinics in Finland, the risk associated with low-carbon materials especially with concerns around long-term performance was discussed. The visitor centre in Þjórsárdalur in Iceland struggles to source low-carbon materials that meet functional requirements. East Pier in Iceland faces difficulties in sourcing recycled aluminium with the necessary strength and finish. In the Concept for Group Home project in Sweden, it was discussed that effectively reusing materials involves establishing a systematic approach and clear communication about the practices and benefits.

Location / geological preconditions
Location limitations and geological conditions, such as seismic activity and earthquakes, pose significant challenges. Projects must consider these factors when selecting materials and designing structures to ensure durability and safety. Geological conditions in Iceland, especially in earthquake-prone zones, limit material choices due to the need for structural strength. Weather conditions necessitate the use of tried-and-tested materials. For example, East Pier must meet BREEAM weather requirements and ensure material durability in harsh conditions, which can be influenced by the project's geographical location. In the Rosenspira project, specific material requirements in detailed municipal development plans could limit the use of reused materials, or the choice of materials with low climate impact. Although it was not discussed in the clinic, changing climate in the future will also impact the choices of materials.



Time and cost constraints
Balancing sustainability goals with project constraints, such as time and cost, is a common challenge. One of the primary challenges is the cost associated with low-emission measures. The client in the Hopeakaivoksentie 47 project in Finland faces financial constraints, as it cannot pass on the additional costs of these measures to students through increased rents. In the visitor centre in Þjórsárdalur in Iceland, both the cost of sustainable materials and the sustainability certification process was found to impact the design of low-carbon buildings. The certification process is found to be time-consuming and requires extensive paperwork, which can be restrictive given the limited time available in projects. The costs associated with certification could be better allocated towards sourcing lower-carbon materials. In the case of Umeå municipality, the benefits of using BIM-models for material compilation when working with climate budgets during a project were discussed, but it is a challenge to find the time and staff resources needed to maintain such models.

LIBRARY OF TOOLS AND INDUSTRY KNOWLEDGE

This section offers an overview of available tools and industry knowledge that can assist in working with carbon reduction initiatives in each country for different stages of a building project.

As part of the preparation for the clinics, the local experts gathered information about publicly available tools and industry knowledge relevant for working with the decarbonisation of building projects. The information was structured according to the relevance of the building phase and is a valuable library for all industry stakeholders.

By sharing the library, the aim is to equip industry professionals with know-how, beyond the knowledge gained from the clinics, to implement low-carbon practices effectively.

The library content is a non-exhaustive list of relevant and available knowledge and tool for each country.

Denmark

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
BUILD 2023:12 Boligbyggeri fra 4 til 1 planet: 25 Best Practice Cases							x
BUILD 2023:21 Klimapåvirkning fra nybyggeri. Analytisk grundlag til fastlæggelse af ny LCA baseret grænseværdi for bygingers klimapåvirkning fra 2025							x
BUILD 2023:10 Klimapåvirkning fra: 45 Træbyggerier	x						x
BUILD 2023 Eksempelbibliotek til LCAbyg 2023							x
Realdania (2024) Klimadata for renovering (Launch 4 october)						x	x
Rambøll, june 2020 CO2-besparelse ved træbyggeri	x						
BUILD 2023:12 Boligbyggeri fra 4 til 1 planet: 25 Best Practice Cases	x						
BUILD 2023:21 Klimapåvirkning fra nybyggeri. Analytisk grundlag til fastlæggelse af ny LCA baseret grænseværdi for bygingers klimapåvirkning fra 2025	x						
Rambøll, october 2021 CO2-besparelse ved konventionelt byggeri		x					
Teknologisk institut, 2019 Design for Disassembly - Håndbog om affaldsforebyggelse i byggeriet		x					

GXN, 2019 Byg cirkulært miniguide		x	x				
BUILD 2023:14 Ressourceforbrug på byggepladsen: Klimapåvirkning af bygningers udførelsesfase			x				
Værdibyg 2017 Renoveringsstrategi						x	
Værdibyg 2023 Den gode dokumentationsproces for genbrugsmaterialer						x	
BUILD 2022:37 Klimapotentialet ved renovering kontra nedrivning med nybyg						x	
BUILD (2022) Helhedsvurdering ved renovering						x	
BUILD 2022:35 Tendenser for renovering						x	
Rambøll, november 2020 Analyse af CO2-udledning og totaløkonomi i renovering og nybyg						x	
Stockholm Resilience Planetary boundaries							x

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Sweco's LCA Database	x	x				x	x
Rambøll LCA Databases	x	x					x
Climate Risk assessment Tool							x
VCBKs casebibliotek	x						x
LCAlive	x						
LCAbyg	x	x				x	
GreenDozer			x		x	x	
CRREM Carbon Risk Real Estate Monitor				x	x		

Estonia

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Ehitusgiid (Construction guide)	x	x	x	x	x	x	x
KredEx surveys and data for energy efficiency (new and existing buildings)							x
Sustainable District Heating, digital textbook, 2022 (Tallinn University of Technology)	x						
Riigi Kinnisvara (State Real Estate) requirements for non residential buildings	x						
National Method for Building Carbon Footprint		x					
General BIM requirements		x					
Study by Tallinn University of Technology: "Reducing Heating Energy Consumption in Apartment Buildings through Raising Consumer Awareness and Changing Behavioral Habits, Based on Individual Heat Consumption Measurement" (2012)				x	x		
Green Book for Spatial Planning, Ministry of Finance, 2020							x
National Outlook: CLIMATE POLICY FRAMEWORK UNTIL 2050 NATIONAL ENERGY AND CLIMATE PLAN UNTIL 2030 CLIMATE CHANGE ADAPTATION DEVELOPMENT PLAN UNTIL 2030							x

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Estonian Land Board Web Maps							x
Estonian CO2 database / TalTech free building LCA tool / Greenhouse gas accounting tool	x						
One Click LCA Carbon Designer / Preoptima (model is not adjusted for Estonia, but gives a rough direction like OCL CD)	x						
KredEx tool for Energy Efficiency	x						
One Click LCA		x					
R8 Digital Operator				x	x		

Finland

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Purkaa vai korjata? : Hiilijalanjälkivaikutukset, elinkaarikustannukset ja ohjauskeinot (FIGBC)						x	x
Kiertotalouden green deal: Resurssiviisas rakennettu ympäristö (FIGBC)							x
Monikäyttöisyys ja muunneltavuus kestävässä rakentamisessa (VTT)							x
Moduulirakentamisen elinkaarenaikainen hiilijalanjälki (VTT)							x
Hiilineutraalin rakennetun alueen ja rakennuksen määritelmät (FIGBC)							x
Ideakortti: Näin otat kiertotalouden mukaan aluesuunnitteluun (FIGBC)							x
Rakennuksen vähähiilisyyden arviontimenetelmä 2021 (YM)	x	x					
Ympäristöministeriön asetus rakennuksen ilmastoselvityksestä (30.9.2022, lausuntokierros)	x	x					
Ideakortti: Näin suunnittelet kiertotalousrakennuksen (FIGBC)	x	x					
Rakennuksen vähähiilisyyden arviontimenetelmä 2021 (YM)	x	x					

Ympäristöministeriön asetus rakennuksen ilmastoselvityksestä (30.9.2022, lausuntokierros)	x	x					
Ideakortti: Näin suunnittelet kiertotalousrakennuksen (FIGBC)	x	x					
Askeleet vähähiilisen rakentamiseen (FIGBC)	x	x					
Vähähiilisen rakennuttamisen opas (A-insinöörit)	x	x					
Pitkäikäisten biohiilivarastojen arviointimenetelmät: Esiselvitys puutuotteista (LUKE/SYKE)	x	x					
Pikaoppaat vähähiilisen rakentamisen kiinteistö- ja rakennusalan ammattilaisille (FIGBC)	x	x					
Design support for the carbon drawdown demonstration are in Jätkäsaari, Helsinki (Aalto yliopisto, Helsingin yliopisto, EU)	x	x					
Päästötön työmaa Green Deal			x				
Ideakortti: Näin maksimoidaan rakennustyömaan kierrätysaste			x				
Energiansäästövinkit rakennustyömaille (FIGBC)			x				
Kiinteistön Hiilineutraali energiankäyttö (FIGBC)				x	x		
Ideakortti: Näin maksimoidaan kiinteistön kierrätysaste (FIGBC)				x	x		
Tilasuunnitelman hiilijalanjäljen arviointiohjelma (FIGBC)				x	x		
Puurakenteiden uudelleenkäyttömahdollisuudet (YM/Tre yliopisto)				x	x		

Purkumateriaalien kelpoisuus eri käyttökohteisiin turvallisuuden ja terveellisyyden näkökulmasta				x	x		
Betonielementtien uudelleenkäyttömahdollisuudet (Tampereen yliopisto)				x	x		
Osittainen purkaminen (FIGBC)				x	x		
Tyhjät tilat, näkökulmia ja keinoja olemassa olevan rakennuskannan uusiokäyttöön (YM)				x	x		
Purkutyöt - opas tekijöille ja teettäjille (YM)				x	x		
Purkukartoitus- Opas laatijalle (YM)				x	x		
Osittainen purkaminen (FIGBC)						x	
Tilasuunnitelman hiilijalanjäljen arviointiohje (FiGBC)						x	

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Kaupunkien/kuntien karttapalvelut							x
Planect							x
OneClick LCA Carbon Designer	x						
CO2data.fi	x	x	x			x	
OneClick LCA		x	x			x	
Tekla CO2		x					
Solibri CO2		x					
Purkukartoituksen raportointilomake (excel pohja YM)				x	x		

Iceland

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Building greener future, ecological priorities in the construction industry in the Nordic countries							x
Ecological priorities in the construction industry in Iceland							x
Icelandic Sustainable Constructions Roadmap to 2030							x
Ecological urban planning	x						
Material quality	x						
Emission-free Construction Sites - Definitions, boundaries and termonology			x				
Emission-free Construction Sites - Knowledge gaps and research needs			x				
Guidelines for greener apartment buildings				x	x		
Mapping and guidelines for utilization potential of construction waste						x	
Construction waste mapping						x	
Guidelines for waste treatment						x	

Circular economy and the constructoin industry						x	
Assessment of hazardous substances in construction and demolition waste and their treatment plan						x	
BREEAM In-Use, Implementing sustainability in building operations				x			
Stakeholder's experience on sustainability certification systems.							x
The effect of energy efficiency and construction materials on a building's carbon footprint (BREEAM certified vs. non-certified)							x

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Level(s)	x	x				x	
Boverkets klimadatabas	x						
CO2-data.fi	x						
OneClickLCA	x	x				x	
NTA Real-Time LCA		x					
LCAbyg	x	x					
LCA FE (GaBi)	x	x				x	

Norway

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
Klimagassutslipp fra byggematerialer, Multiconsult rev2023, oppdrag fra DiBK	x						
Klimakur for bygg og eiendom							x
Notat: Paris Proof bygg og Paris Proof BREEAM							x
Klimafotavtrykk bygg og anlegg, 02.02.2024, Hogne Nersund Larsen et al, Asplan Viak/DIBK							x
Method description for FutureBuilt Zero; Buildings							x
Method description for FutureBuilt Zero; Neighbourhood							x
FutureBuilt nZEB, Kriterier for nær-nullenergibygg							x
Trebasert karbonlagring i bygningsmasse, Gry Alfredsen et al, Nibio rapport, 6/148/2020							x
Veileder for klimagassreduksjoner: Formålsbygg. Context AS på oppdrag fra EBA og Grønn Byggallianse							x
Veileder for klimagassreduksjoner: Boligbygg. Context AS på oppdrag fra EBA og Grønn Byggallianse	x						

Klimavennlige byggematerialer - Potensial for utslippskutt og barrierer mot bruk. Asplan Viak 2020. Oppdrag fra Enova	x	x					
Grønn materialguide		x					
Waste free construction site–A buzzword, nice to have or more, Kristin Fjellheim etal, Resources, Conservation & Recycling Advances Volume 8 2023			x				
Kartlegging av sirkularitet i bygg, Bransjestandard og fremskrivning mot 2050, Marianne Kjendseth Wiik et al, ZEN report No 53- 2023			x				
Veileder for utarbeidelse av klimagassregnskap, DiBK, Byggteknisk forskrift (TEK17) § 17-1, 18.08.2023			x				
Think twice before demolishing						x	

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
OneClickLCA, Carbon Designer + database with EPDs that are classified by material types. Can find e..g. average, best and worst EPDs per material type	x	x				x	
Reduzer: similar functionalities as in OneClickLCA	x	x				x	
DFØ - Klimagassutslepp bygg	x	x					
FutureBuiltZERO-B beregningsverktøy V3.1_310724							x
Sweco tool for carbon budget as basis for evaluation criteria in procurement process		x					

Sweden

Knowledge	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
IVL/KTH Referensvärden för klimatpåverkan vid uppförande av byggnader. Version 3, 2023							x
Boverket Gränsvärde för byggnaders klimatpåverkan							x
IVL Anvisningar för LCA-beräkning av byggprojekt							x
Fossilfritt Sverige Färdplan för fossilfri konkurrenskraft, Bygg och anläggningssektorn							x
LFM 30	x		x			x	x
Sveriges kommuner och regioner Vägledning hållbart byggande och förvaltning							
Upphandlingsmyndigheten Miljömässigt hållbar upphandling							
Boverket Hållbart byggande och förvaltning							
IVL Klimatkrav vid upphandling av byggprojekt							
Scandinavian Sustainable Circular Construction Klimateffektiv arkitektur, konstruktion och materialval							
Svensk Betong Vägledning klimatförbättrad betong utgåva 2							

Skanska EU:s första elektrifierade byggarbetsplats
Energi- coh klimatrådgivningen Spara el
Energimyndigheten Effektiv energianvändning
Energi- coh klimatrådgivningen Renovera och bygga

Tools	Early design	Detailed design	Con-struc-tion	Use	End-of-life	Reno-vation	Strategy
C3	x						x
Level(s)	x	x	x	x	x	x	x
OneClick LCA Carbon Designer	x						
Boverkets klimatdatabas	x	x					
OneClick LCA		x	x	x	x	x	
Byggsektorns miljöberäkningsverktyg (BM)		x					
CC-build		x	x	x	x	x	
BASTA, Byggvarubedömningen, Sunda Hus		x	x	x	x	x	

ABOUT THIS PUBLICATION

Low-Carbon Clinics

Authors: Nicolaj Hostrup Langkjær (SWECO DK), Rikke Schack (SWECO DK)

Local experts, clinic facilitators and other contributors from the project team:
BUILD: Maria Balouktsi, Kai Kanafani, Kikki Lambrecht Ipsen
SWECO DK: Morten Ryberg, Christine Collin
SWECO SWE: Anna Joelsson, Inga Sjöberg, Sofie Hansen
SWECO NOR: Karin Cochard, Marie Kyllingstad
SWECO FIN: Kari Nöjd, Elina Virolainen
LCA Support: Anni Oviir
EFLA: Alexandra Kjeld, Sigurður Loftur Thorlacius, Björgvin Brynjarsson

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Nordic co-operation

Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland and Åland.

Nordic co-operation has firm traditions in politics, economics and culture and plays an important role in European and international forums. The Nordic community strives for a strong Nordic Region in a strong Europe.

Nordic co-operation promotes regional interests and values in a global world. The values shared by the Nordic countries help make the region one of the most innovative and competitive in the world.

The Nordic Council of Ministers
Ved Stranden 18
DK-1061 Copenhagen
pub@norden.org

Read more Nordic publications on www.norden.org/publications