The NonHazCity guide for design & construction of tox-free, circular & climate friendly municipal buildings

Practical Guide

NHC3 Output 2.3

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SUSTAINABLE WATERS
NonHazCity 3

NONHAZCITY

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Contents

Introduction

This guide presents practical insights from pilot projects carried out under the NonHazCity3 (NHC3) initiative, focusing on the processes of design, construction, and renovation of tox-free, circular, and climate friendly municipal buildings.

It showcases best practices, drawing on real-world case studies to illustrate both successful outcomes and lessons learned.

The NHC3 project uses a three-pillar approach:

- Tox-free construction is a construction that avoids hazardous substances in materials or finishes and therefore reduces the impact buildings have on human health and environment (especially the aquatic environment).
- Circularity concept of a closed-loop system for resources, materials, and products, which maintain the value and utility of resources and products for as long as possible, minimises waste and maximises resource efficiency. It promotes recycling, reusing, refurbishing, and sharing, while prioritizing easy repair, upgradability, and disassembly. It aims at removing hazardous substances from the material cycle to enable a circular economy that reduces environmental impact.
- Climate friendly concept involves application of products, components, technologies and construction practices which tend to have the least possible GHG emissions to avoid adverse impact on environment.

The guide includes detailed descriptions of pilot activities, individual case profiles, and the construction phases that were tested, along with the associated results and economic considerations.

A key component is the reflection on tools and solutions (or elements of solutions) applied throughout the projects, including:

- The Step-by-Step Guide for the Process Management of Tox-Free, Circular, and Climate-neutral Construction at Municipalities (Step-by-Step Guide, including its checklists)
- The Byggvarubedömningen® (BVB) Database – a tool for sustainable construction
- The Building Material Catalogue for Tox-Free Construction
- NHC3 series of fact sheets for professionals involved in the construction bussiness

The pilots outlined what worked well, what didn't, and the lessons learned from these experiences.

Given that NHC3 addressed both strategic and technical aspects of construction, the interplay between these two phases is illustrated in **Figure 1**, which serves as a foundation for the step-by-step explanation of the construction and renovation processes.

While this guide emphasizes the technical implementation process of construction or renovation work, it also references the companion output — "The NonHazCity strategic solution for managing hazardous substances in buildings and construction materials: procurement, building certificates and restrictions" - which concentrates on the strategic phase. This strategic framework is cited where relevant to highlight interdependencies or when it supports the technical approach.

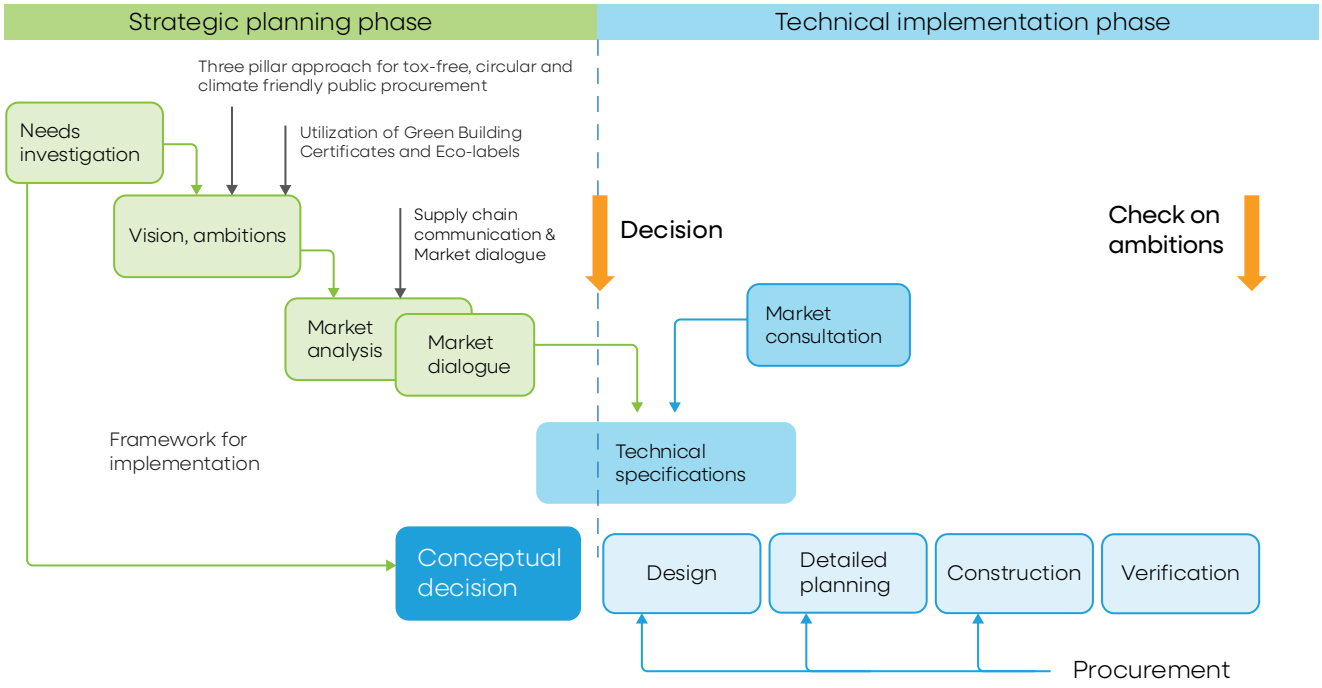


Figure 1. Interrelation of the strategic planning and technical implementation phases to the steps in construction.

1. Case profiles of the pilots

The case profiles of the municipality pilots show how local governments are putting 3-pillar approach into action in practical and effective ways.

STOCKHOLM (SWEDEN)

Stockholm, the capital of Sweden, had 984,700 inhabitants at the end of 2022, with a forecast of 1.15 million in 2024. As of December 31, 2024, Stockholm Municipality had a population of **995,574** inhabitants. The city tested NHC3 solutions in a project by the public housing company AB Familjebostäder, building 87 apartments in Oldmästaren, Bromma. The goal is to improve indoor air quality and achieve Miljöbyggnad Gold certification using the best available techniques. The project focuses on tox-free materials, reducing emissions, and reusing resources, with all indoor materials checked and recorded in a logbook.

Read more detailed description on the NHC3 website

HOLBÆK (DENMARK)

Holbæk Municipality, located in northwestern Zealand, Denmark, had **74,000** inhabitants at the end of 2023. They tested NHC3 solutions in the Jyderup kindergarten construction project, an 1,826 m^2 building with space for 144 children across four group rooms. Completed in November 2024, the building received DGNB Gold certification, a German sustainability certification system. The project aimed to assess whether the materials met low-chemical requirements, contributing to a future strategy for toxin-free buildings.

Read more detailed description on the NHC3 website

VÄSTERAS (SWEDEN)

Västerås is a city in central Sweden with a population of **156, 838** inhabitants at the end of 2023. The city tested NHC3 solutions through a kindergarten project and is building a non-toxic, climate-friendly preschool focused on sustainability, flexibility, and cost-efficiency. The structure combines a concrete foundation with a wooden frame to reduce carbon impact and prioritizes renewable and reused materials. It targets Miljöbyggnad Silver certification, with Gold-level goals for energy, circularity, and chemical safety, monitored via the BVB system.

Read more detailed description on the NHC3 website

RIGA (LATVIA)

Riga, the capital of Latvia, has an estimated population of **615,764** in 2025. The city tested NHC3 solutions with two renovation projects. The first renovation aimed to be a model for tox-free, circular, and climate-friendly renovation of Soviet-era apartment buildings, incorporating sustainable energy and modernizing the building and surrounding area. However, it faced financial challenges and is currently on hold. The second project focuses on renovating a municipal social apartment for a large family, prioritizing eco-friendly materials, energy-efficient windows, and waste sorting.

Read more detailed description on the NHC3 website

TALLINN (ESTONIA)

Tallinn, the capital of Estonia, had **461,094** inhabitants as of May 1, 2025. The city tested NHC3 solutions in a kindergarten construction project, which is planned on the site of a former villa at Manufaktuuri 6, part of a historic textile factory complex. The villa burned down in 2019, leaving only the foundation. To replace it, a sustainable kindergarten is being designed with a focus on non-toxic materials, energy efficiency, and circular construction. An architectural competition emphasized these principles and prioritized wood use, improved indoor conditions for children, and a low CO_2 footprint.

Read more detailed description on the NHC3 website

MARIA MAGDALENEN PARISH (GERMANY)

The Maria Magdalenen parish is is located in the north of Hamburg with approximately 1200 members. The parish tested NHC3 solutions in the parish house renovation project together with partner Auraplan Arhitects. The parish house (built in 1969, ~400 m^2) has poor energy performance and a leaking roof. The renovation promotes non-toxic, circular, and climate-friendly materials within budget limits. After initial roof repair plans proved unfeasible, a second phase considered adding a sloped roof and extra floor for rental space. A green roof was explored but ruled out due to structural constraints.

Read more detailed description on the NHC3 website

2. Guide for design & construction of tox-free, circular & climate friendly municipal buildings

The design and construction/renovation process management phases are illustrated in Figures 1 and 2, aligning with the framework outlined in the Step-by-Step Guide. These figures serve as visual references for understanding the interconnected stages of project implementation. Partner municipalities tested the key stages of practical design and construction/renovation processes.

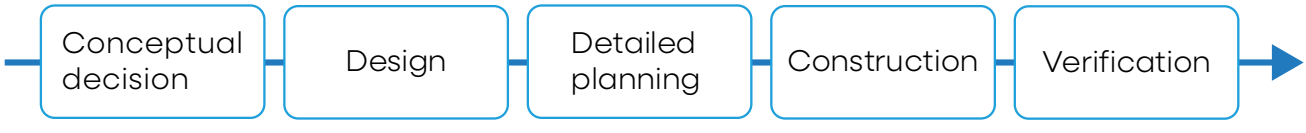


Figure 2. Overview of the key stages involved in design and construction/renovation process management.

2.1 The conceptual decision phase of a municipal construction project

National legislation predefines the minimum requirements, depending on needs, political goals and ambitions of a municipality towards environmental and health protection as well as the budget available, municipalities may set higher standards and targets with respect to tox-free, circularity and climate friendliness aspects.

The most important aspects to be considered:

Higher ambition, goals and measurable targets for tox-free, circular, climate friendly buildings

At the conceptual stage of a construction or refurbishment, it is possible to go beyond the minimum requirements set by national legislation by setting higher demands, goals, and measurable targets—particularly in areas such as toxicity, circularity, and climate friendliness. During this early phase, a decision can also be made regarding the certification of the building and the use of environmental certifications such as Nordic Swan, Miljöbyggnad (Sweden Green Building Council), DGNB (German Sustainable Building Council), BREEAM, or LEED, or the involvement of another independent party for verification.

VÄSTERAS

Västerås preschool project focused on sustainability and flexibility. The project aimed for Miljöbyggnad Silver certification, with **Gold-level performance in energy, circularity, and chemical safety.** PVC flooring was excluded to protect indoor air quality, with alternative materials meeting hygiene, function, and noise standards. Reused and circular flooring is also being considered. Rotating the building 90 degrees improved solar gain and simplified foundation work—boosting both energy efficiency and cost-effectiveness.

HOLBAEK

The Holbæk kindergarten emphasized life cycle assessment, resource efficiency, and social, economic, and ecological quality, aimed for **DGNB Gold certification.** Designed with large canopies, the building maximizes sunlight while preventing overheating and protecting facades and windows for durability. Salt-impregnated wood facades eliminate the need for toxic treatments, and the flat roof combines roofing felt and grass. Indoors, natural, long-lasting materials like wood and linoleum are prioritized for a healthy environment.

Needs assessment of the end-users

The importance of conducting a thorough needs assessment of end-users before initiating any construction, refurbishment, or extension of a public building should not be underestimated. A comprehensive assessment is essential to clearly define the problem to be addressed and should be carried out prior to drafting the technical specifications for procurement. This is particularly crucial when aiming to foster innovation—such as setting standards that exceed legislative requirements or incorporating innovative technologies, solutions, or approaches—in the development of municipal buildings.

STOCKHOLM: end-users' engagement in urban development

Cities and companies actively communicate with end users and tenants, who are seen as key stakeholders. They are informed about construction plans and building quality. Urban developers also gather input from residents to better understand their needs and incorporate them into the planning process.,

PARISH MARIA MAGDALENEN: renovation of parish house for parishioners

Parishioners were regularly informed about the renovation goals and plans and were given the chance to share their needs through parish events. The parish council, as a key end user, actively took part in setting goals and discussing renovation options.

Establishment of **cross-functional implementation team** at municipal level

Regardless of the project's ambition or complexity, construction, renovation, or extension of a building requires adequate financial and human resources. When multiple municipal entities—such as departments, agencies, or municipal companies—are involved, it is crucial to establish clear roles and responsibilities from the outset of the project.

Experience shows that while responsibilities related to financial, managerial, or climate aspects are usually well defined, other equally important areas such as circularity and the use of non-toxic materials may be overlooked unless explicitly assigned to specific municipal specialists. Ensuring these aspects are integrated from the beginning requires deliberate delegation and ownership.

STOCKHOLM

The NHC3 project has strengthened Environmental and Health Administration's **collaboration with other Stockholm City units** like the Chemicals Centre and Circularity Centre, highlighting the need for more consultation—especially around circularity. It also deepened knowledge exchange, enhancing expertise on hazardous chemicals and circularity. A key takeaway is the need for dedicated specialists to support municipal housing companies with knowledge on hazardous substances and circular practices.

TALLINN

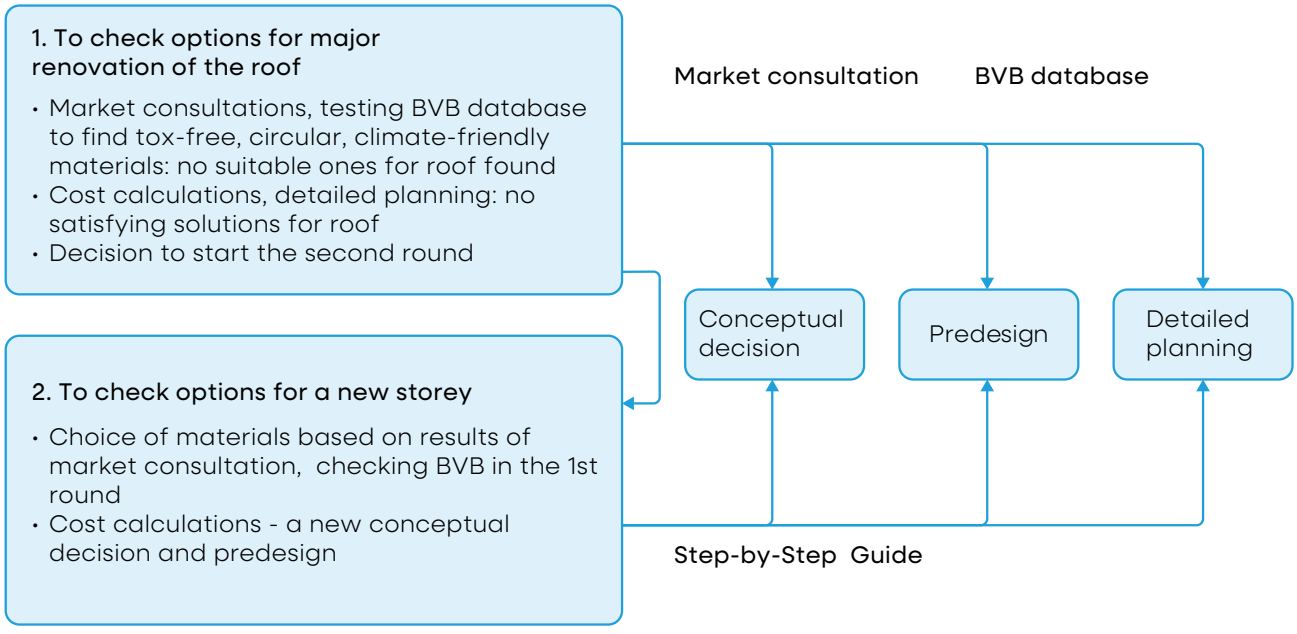
The Tallinn City Property Department, as the NHC3 project implementer, formed a team including a project manager and an end-user representative. **Experts from other municipal departments**—such as procurement, architecture, construction quality, finance, and maintenance—were also involved. With managers from procurement and maintenance, along with an innovation manager, architect, and analyst, the team had the necessary expertise to carry out all tasks required for the pilot project.

Further details on setting high ambitions, conducting needs assessments and establishing a cross-functional team at municipalities can be found in Output 2.2 “The NonHazCity strategic solution for managing hazardous substances in buildings and construction materials: procurement, building certificates and restrictions”.

2.1.1 Best practice examples of the conceptual decision phase

2.1.1.1. The renovation of the parish house by Parish Maria Magdalenen in Hamburg

The renovation of parish building in Hamburg involved two rounds, starting with a conceptual decision to create a clear vision. The process aimed to clarify the possibilities of non-toxic, circular and climate-friendly materials, while ensuring cost savings



Initial objective:

The original goal was to explore options for a major renovation of the flat roof, which was experiencing significant leakage. Due to financial constraints, the parish prioritized the roof over other potential building upgrades.

Market research and consultation:

- Initial market consultations were conducted with building material suppliers. These conversations were positive, with suppliers showing openness to sustainable building discussions.
- The project team utilized the BVB (Byggvarubedömningen) database to search for non-toxic, circular, and climate-friendly materials. This proved to be a valuable tool for conducting a market survey. The Step-by-step Guide helped in organizing information through checklists and guidelines.
- Despite this effort, no suitable roofing materials that met both the sustainability and technical requirements were found within the German market.

Cost estimations and planning:

Detailed cost calculations and planning work were carried out. To improve the energy efficiency and prevent all leakages, various products are required—such as primer, insulation, adhesives, and roofing materials. However, there was a lack of high-quality products that met circular construction principles and economic feasibility. As no satisfactory solutions based on the three-pillar approach for flat roof renovation materials emerged during this phase, a second round of exploration was launched.

New approach and revised objective:

The revised concept involved constructing an additional storey with small office spaces for rental purposes, alongside replacing the flat roof with a sloped design. This would not only resolve the leak issue but also generate future income for the parish.

Design and material selection:

- The results of the first-round market consultations and the BVB database were used to identify suitable materials for the new structure; however, environmentally friendly options could not be found for all the required product groups on German market.
- The BVB's database and Step-by-step guide and its checklists were especially useful in managing the complexity of the planning and ensuring that all sustainability and non-toxic criteria were addressed.

Cost considerations:

A new round of cost estimations focused on balancing budget constraints with an effective and environmentally responsible solution. A green roof was considered due to its ecological benefits; however, structural assessments revealed that the existing building could not support the additional load of a green roof system.

Reflections

This process highlighted the challenges of combining sustainability goals with budget limitations and structural constraints, especially within existing older buildings. However, it also demonstrated the value of open supplier dialogue, structured planning tools, and adapting project goals creatively in response to obstacles.

Success:

When a leak appeared in the parish building roof, the parish council reached out to explore possible solutions. Importantly, they asked whether an environmentally friendly approach was possible — demonstrating that they had taken valuable lessons from the project. As a result, the council has begun to actively consider non-toxic and sustainable construction options, marking a meaningful shift in mindset and a positive outcome of the initiative.

What didn't work:

Due to the small scale of the project, a full, structured market dialogue could not be conducted. Instead, only informal market consultations took place — mainly through discussions with companies and the architect. Smaller projects often lack the scale or budget necessary to support a comprehensive market dialogue process.

About costs

If the original renovation and improvement of energy standards had been carried out, the estimated costs for planning and construction would have been approximately €420,000.

According to the German HOAI (Fee Structure for Architects and Engineers), the planning costs include work during the design phase, detailed planning, and construction. However, activities during the early conceptual phase or later verification stages are not included. If these phases are considered important to ensure the three-pillar approach, they must be negotiated separately or included as part of a certification process.

In the case that certification had been pursued for this project:

The costs for DGNB certification include the (re-)certification fees for the DGNB as well as fees for the auditor, which are roughly estimated at 10–20% of the building costs. Even for a small-scale project, several time-consuming steps are necessary. The smaller the project, the higher the relative share of these efforts. Even at a conservative estimate of 10%, we would have faced additional costs of approximately €45,000 for certification.

This highlights the importance of better integrating the three-pillar approach into regular daily practice, as certification tends to be more practical and cost-effective for larger-scale projects.

Lessons learned

Several meetings with parishioners and neighbors throughout the project were held. These discussions were not only about the building itself, but also about the values behind the reconstruction—particularly the idea of tox-free, environmentally conscious approaches.

- The process created a space for learning, dialogue, and shared ownership of the project.
- The parishioners were actively involved and supportive, which fostered trust and enthusiasm.
- These conversations strengthened the local community's connection to the church and its future.
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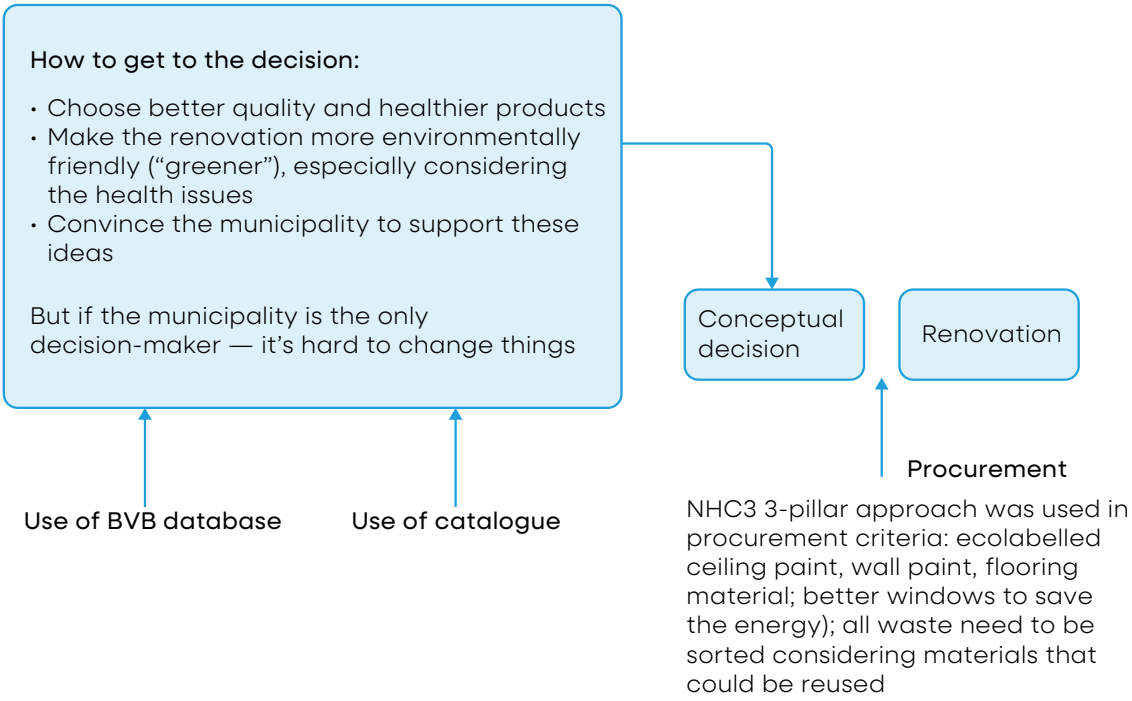
2.1.1.2 The renovation of municipal social housing unit for a large family in Riga

Renovating a municipal social housing unit for a large family involves navigating practical constraints (budget, regulations, existing infrastructure) while also responding to the specific needs of the residents. To reach an appropriate conceptual decision, you may benefit from a structured yet flexible approach. Here is an example of how Riga municipality team reached an appropriate conceptual decision.



Objective:

The aim was to develop a renovation approach for a large municipal social housing unit that is healthier, more environmentally friendly, feasible within municipal systems, and can serve as a replicable pilot for future projects.

Procurement

In Riga the procurement framework involves the estimates for renovation that are prepared by a municipal construction specialist with technical knowledge. This includes listing all tasks that need to be done and required materials and their properties for renovation. Suppliers (bidders) have to submit price offers for these lists.

In the NHC3 pilot the city tested the three-pillar sustainability approach with the new estimator who was open to innovation and included criteria in three key areas to the estimates:

A limitation in the procurement process is that you can not specify brands or exact products, this means that the municipality can only describe the material's type and main properties which makes it hard to push for specific eco-friendly or health-safe products.

Pillar	Focus	Examples Used
Chemicals	Safer indoor environments	Eco-labelled wall/ceiling paint, flooring
Climate	Energy efficiency	Better, more insulating windows
Circularity	Material reuse and waste sorting	Reuse materials where possible; all waste sorted

Challenges with using BVB

BVB database is a good tool for evaluating material health and environmental impact, but it is not adapted to the Latvian market as many listed materials not available locally. Also language and supply issues limit usability.

Building material catalogue for tox-free construction

The catalogue served as a valuable reference, providing information on material properties relevant to non-toxic construction. Some of these properties were used during the planning phase. However, to be fully effective in the local context, the catalogue requires further adaptation—specifically, the inclusion of Latvian products and a full translation into the Latvian language. This would also ensure usability and relevance for local stakeholders, suppliers, and construction professionals.

Key Message:

Riga pilot proves that change is possible — moving from only "cheap-cheap-cheap" thinking towards "healthier living spaces now mean healthier people in the future — which benefits the city". Better housing starts with better choices, supported by the right people.

Success:

A new estimator who was interested and open to innovation. Support from management at all levels — from team leads to top decision-makers. A willingness to justify better, healthier choices, even when they cost more. It was not just about budget — it was about value. Having people open to change made this possible.

Important is to have people who are willing to try something new!

What did not work:

The first cost estimator was sceptical and closed to new ideas.
Having the right people in the right roles made all the difference.

2.2 The design phase of a municipal construction project

Once the conceptual decision on the general requirements for a construction or refurbishment project is made—and the building certification, key goals, and targets for non-toxic, circular, and climate-friendly construction are defined, the design phase can begin. This involves developing the building's visual appearance and structural layout.

The design is typically carried out by an architect or a team of architects responsible for scaled drawings, structural specifications, and preliminary cost and timeline estimates. While some municipalities have in-house architects or architectural bureaus, the design work is usually outsourced to an architectural firm selected through a procurement process.

The most important aspects to be considered:

- **Market consultation.** Market consultations allow procurement documents to be adjusted based on feedback from producers, enabling the inclusion of innovative solutions and helping to avoid unrealistic or outdated specifications. This results in more effective and well-defined contractual terms and conditions.
- **Procurement**. Public procurement for building design can follow various procedures, such as open, restricted, or alternative approaches like negotiated procedures, competitive dialogues, and design contests. The choice of procedure depends on the project's complexity and innovation needs.

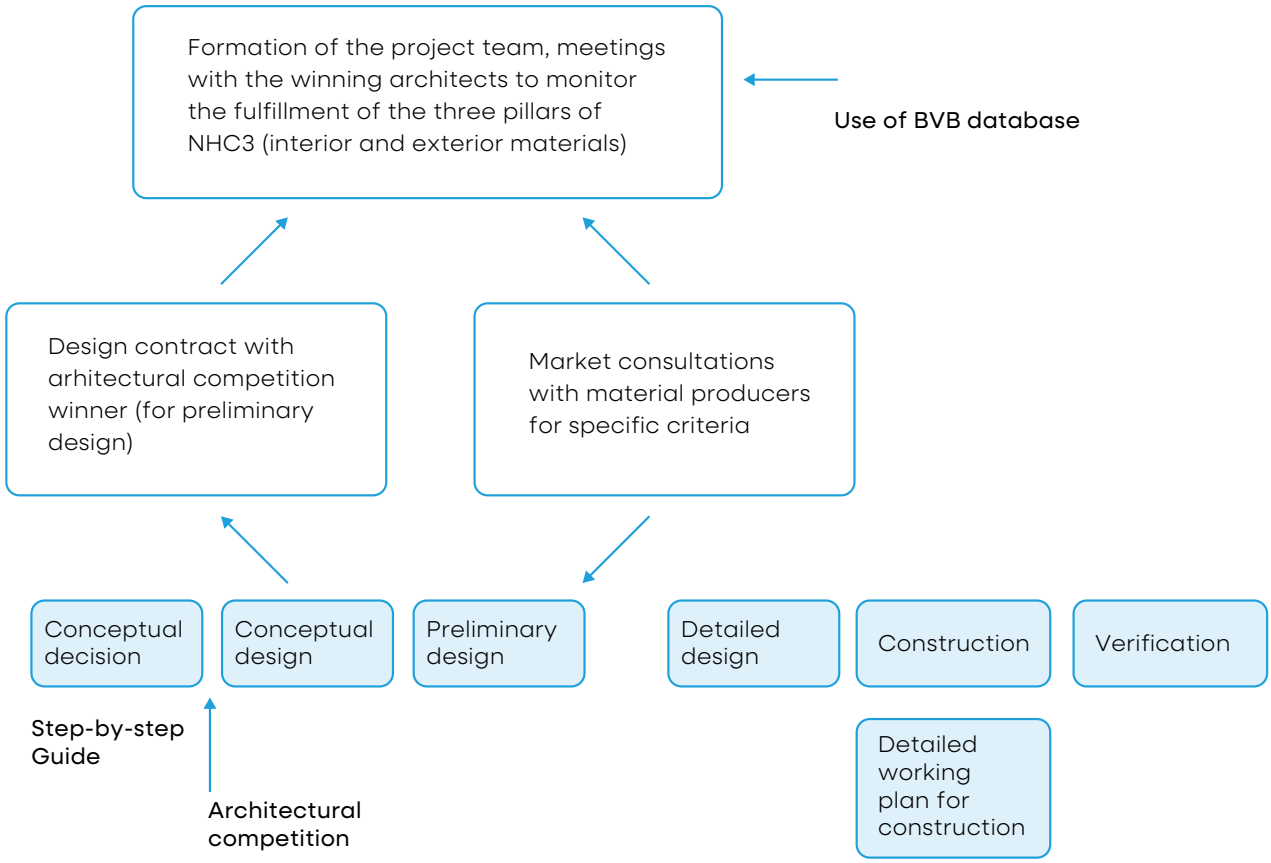
The chosen architect develops the design based on the project's budget, standards, and specific requirements. Key decisions include building shape, materials, energy systems, and sustainability features, with a focus on local conditions and resource efficiency.

As market dialogue and procurement are the main part of the strategic planning phase, examples can be found in Output 2.2 "The NonHazCity strategic solution for managing hazardous substances in buildings and construction materials: procurement, building certificates and restrictions".

2.2.1 Best practice example of design phase

2.2.1.1 Tallinn – from conceptual design to preliminary design: process implementation and setup to build the modern and sustainable kindergarten with less toxic building materials

A new kindergarten is being developed on the historic site of a former villa that was part of the Manufaktuuri textile factory complex (1898–2006). After a fire destroyed the villa in 2019, the opportunity arose to reimagine the site as a model of sustainable construction. This project marks Tallinn's pilot for a healthier, more climate-conscious, and circular kindergarten - from conceptual design to preliminary design.



Pilot for a healthier, greener building

This pilot project aimed to develop a sustainable building by prioritizing energy efficiency and minimizing toxic substances in construction:

Climate friendly design

Energy class A – strong focus on U-values, airtightness, and heat recovery.
Timber structures – reduce CO2 emissions.
Adaptive design – modular parts planned for future repurposing.
Passive cooling – roof overhangs to reduce heat load.
Exploration of solar and rainwater use – subject to heritage constraints.

Toxic-free commitments

Interior & exterior finish materials – selected to avoid hazardous substances.
Indoor air quality goals – class II, with regulated VOC levels and air exchange.
Child-safe materials – prioritized in all spaces.

Circular solutions

Modular timber structures – enable disassembly, reuse, and recycling.
Material lifespan maximization – roof eaves extended for façade protection.
Natural landscaping – use of mulch, gravel, and rubble over synthetic materials.
Preservation – foundation and surrounding trees are retained.

Practical implementation steps

1. Conceptual design phase - collaboratively developed with the Education Department.
2. Preparing architectural competition - criteria were built around the 3-pillar framework (toxicity, circularity, climate friendliness).
3. Selection of winning design. The winning design by Creatomus Solutions OÜ was chosen by a jury, not based on price, but on interior layout quality. While the 3 pillars were considered, spatial design was the key deciding factor.
4. Design contract signed - covers both preliminary and detailed design.

Solutions tested:

The project team utilized the BVB (Byggvarubedömningen) database to search for non-toxic, circular, and climate-friendly materials. The Step-by-step Guide helped in organizing information through checklists.

Procurement approach and market dialogue:

A sustainability criterion was applied for each of the project's three pillars: climate impact, chemical safety and circularity. These criteria were included in the architectural design procurement, setting a new precedent for future public building projects in Tallinn.

Although a market dialogue was attempted, it failed to attract engagement due to its detachment from a concrete procurement.

- Key Finding: The Estonian market currently struggles with providing validated, low-toxicity, circular, and climate-friendly materials.
- Future Focus:
  - Criteria need to be measurable, transparent, and impact-driven
  - Consultations should be linked to specific procurements to encourage participation

Best practice highlights

- **Dual-stage collaboration with architects**
  Dedicated monthly meetings with architects focus on the 3 pillars—addressing environmental impacts alongside technical design. BVB Database will be used to assess material safety and sustainability.
- **Internal team expansion**
  The project team includes representatives from procurement, maintenance, innovation, architecture, and finance, improving cross-sector collaboration.
- **Non-traditional design flow**
  Instead of following a strict linear design process, Tallinn piloted a flexible, iterative approach with early conceptual co-creation and pillar-focused discussions.
- **Knowledge building**
  BEF Estonia delivered training on hazardous substances, enhancing institutional capacity.
- **Innovative procurement**
  Broad, re-usable sustainability criteria are being tested and refined for future tenders.

Circular solutions

Modular timber structures – enable disassembly, reuse, and recycling.

Material lifespan maximization – roof eaves extended for façade protection.

Natural landscaping – use of mulch, gravel, and rubble over synthetic materials.

Preservation – foundation and surrounding trees are retained

Success:

Internal dialogue: Extensive internal discussions increased awareness and improved teamwork around sustainability.

Reusable procurement criteria: Even though they are broad, the 3-pillar criteria can be applied in future tenders, contributing to long-term green public procurement practices.

What did not work:

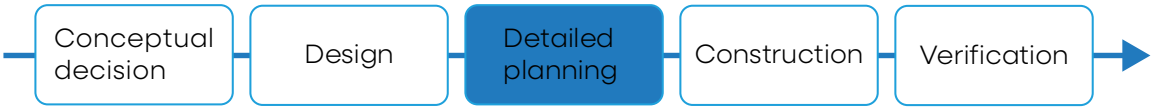
Market consultation limitations:

When not linked to a specific procurement, market consultations had poor attendance. Future efforts will focus on concrete, project-specific dialogues to ensure relevance and participation.

A learning process that transformed team culture

One of the most significant and transformative aspects of the Tallinn pilot has been the shift in internal collaboration and awareness. Monthly meetings between the city's multidisciplinary team and the architects create a unique space for open dialogue—not only about technical construction matters but also about environmental principles. For many involved, this was their first time discussing topics like chemical safety and circularity at such a practical level. Through regular interactions and training sessions, team members from different sub-departments developed a shared language around sustainability, which has strengthened internal processes and laid the foundation for more informed, consistent decision-making in future city projects.

2.3. The detailed planning phase of a municipal construction project



Once the building design is ready, detailed planning can begin to develop technical construction documents for the project. These documents are needed for permits and guide the construction company on how to build, what materials to use, and which technical solutions to apply. At this stage, decisions are made about the structure and layers of walls, floors, and roofs. The municipality, as the client, defines the characteristics of visible surfaces in the rooms, influencing the room's look, comfort, ease of maintenance, and durability.

The most important aspects to be considered:

Product databases and platforms

Various platforms and databases support construction stakeholders in making sustainable purchasing decisions. These include interactive project logbooks (e.g. BVB), networking and certification tools (e.g. Nordic Swan), and data sources that require user interpretation and comparison (e.g. Environmental Product Declarations). If the municipality has chosen to follow a certification system, such as the Nordic Swan, or Sweden's Miljöbyggnad, the framework for material selection is already defined.

Tender specifications

If no certification system is chosen, it is crucial to set clear material requirements in the tender specifications. Vague references to sustainability will not guide companies toward circular, toxic-free solutions. At this stage, project costs often become a key focus, with revised estimates typically higher than initial ones. Therefore, it is vital to keep the NonHazCity3 three-pillar approach a priority, even when looking for budget savings.

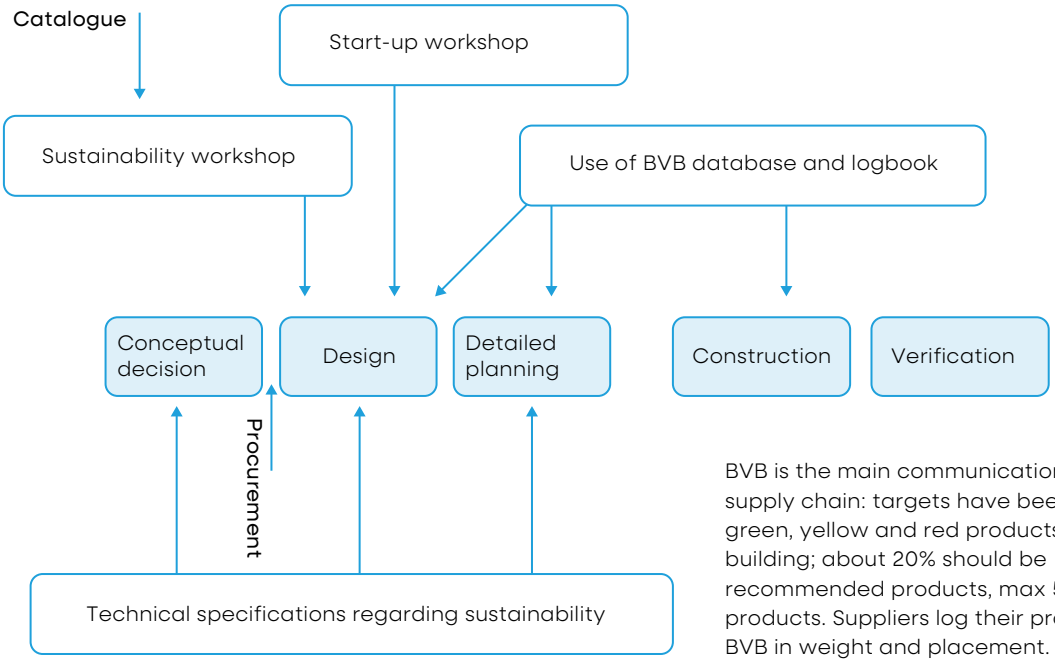
VÄSTERAS

All construction products used in the project will be registered in the BVB (Byggvarubedömningen) logbook to ensure transparency and traceability regarding their environmental and health impacts. The goal was to reach for 20% of the listed products assessed with the highest BVB rating "Recommended", also maximum 5% "Avoided", which reflects strong performance in terms of sustainability, low environmental impact, and safe chemical content. This target supports the project's broader ambition to prioritize healthier and more sustainable material choices throughout the construction process.

2.3.1 Best practice example of detailed planning phase

2.3.1.1. Västerås - From concept to design and detailed planning: a holistic approach to chemical safety, energy, and circularity

This case describes how Västerås was developing a non-toxic, climate-friendly preschool using a sustainability-focused approach in both design and construction. The building will be certified to Miljöbyggnad Silver, with Gold-level targets for energy efficiency, circularity, and chemical safety. Material use is carefully monitored using the BVB logbook.



BVB is the main communication tool in the supply chain: targets have been set for green, yellow and red products in the building; about 20% should be recommended products, max 5% avoided products. Suppliers log their products in BVB in weight and placement.

Key highlights:

- A wooden frame was chosen instead of concrete, significantly reducing CO[] emissions and supporting climate goals.
- A new method was introduced: logging all products in kilograms to calculate hazardous substances per built m². This goes beyond standard practice, where only products (not quantities) are recorded in the Byggvarubedömningen (BVB) logbook. The aim is to eventually quantify the total weight of hazardous substances in a building. An update to the BVB database is hoped for, to automate this calculation.

Process:

- A sustainability workshop was held in the beginning of the project, setting goals for chemicals, circularity and climate footprint. This goal-setting meeting was held before the formal start-up workshop to establish ambitious environmental targets. The use of BVB and the Miljöbyggnad certification was already decided on political level
- The sustainability workshop involved around 60 participants (the key representatives in the project, for example the construction company, architects and landscape architect, representatives from City of Västerås), ensuring that everyone understood the project's importance and was fully aligned.
- The construction company, architects, and city representatives then worked closely to meet these goals in a financially viable way. Challenges included:
  - Higher costs of a wooden frame compared to conventional concrete.
  - Difficult ground conditions require extensive excavation and filling.
- Current status: design drawings are nearly complete. The project now awaits political approval for funding, involving three departments: rentals, investment, and building permits. Due to the city's financial situation, the decision is expected after summer 2025.

Solutions tested:

- BVB database was used; products with weight and position were included in the logbook.
- A product catalogue was shared with workshop participants and proved useful for the construction and architect teams.
- A Step-by-step Guide was reviewed during team meetings, but it was not used by the construction and architecture teams, as they already follow established internal procedures.
- Fact sheets were found to be too basic for the experienced professionals involved, using them would have added unnecessary work without improving outcomes.

Success:

A key success was the strong commitment from both the construction company and architects, who saw the project as a flagship example for future promotion. The construction company prioritized high environmental standards in the tender and expected the same from partners. The architect was equally committed, taking sustainability seriously and refusing to compromise.

Another success was the personal dedication of the hand-picked team, whose expertise and motivation ensured smooth and effective collaboration.

No failures:

No major failures were identified during the process. The project functioned as a well-oiled machine, with all parties highly engaged, motivated, and collaborative. Everyone contributed valuable ideas and insights, making the experience both productive and enjoyable. The strong team spirit and shared commitment to sustainability were key to the project's success.

Learnings & future improvements

- Raising ambitions: the project showed that it is possible to set even higher environmental goals going forward.
- CO_2 reduction plan: Västerås aims to reduce the city's carbon footprint by 10% annually. This supports stricter targets for CO_2 in buildings.
- CO_2 calculation methods: a key learning was the variation in how emissions are calculated and evaluated in different countries.
- Circularity challenges: while appealing in theory, circularity faces real-world obstacles, such as quarantees, and storage of reused materials (e.g. windows) before construction starts. This calls for early planning—like designing buildings with uniform window sizes to simplify reuse, reduce costs, and improve flexibility.

2.4. The construction and verification phases of a municipal construction project

After having the detailed technical project ready and approved, the municipality as contracting authority can procure the construction company to perform construction/refurbishment/extension works.

The most important aspects to be considered:

Procurement of the construction works

Procurement should define criteria for the construction project manager and technical specifications for implementation. Depending on the project's specifics, selection may require relevant experience from the project manager. Depending on the building type and national or municipal green procurement requirements, technical specifications may include criteria for indoor air quality impacts of materials, on-site waste management, and use of legally sourced timber and wood products.

Roles and responsibilities

During construction, all involved actors must have clearly defined roles and responsibilities for implementation, supervision, and control. The construction company and subcontractors must follow the approved plans and purchase materials as specified. Regular checks are essential to ensure materials meet tender requirements. Ongoing dialogue between the municipality, contractors, consultants, and suppliers is essential to manage implementation and handle any deviations or material substitutions.

TALLINN

> Monthly meetings are held with the architects to ensure continuous alignment with the NHC3 three-pillar approach (chemicals, climate, circularity). These meetings place a strong emphasis on addressing the environmental impacts of the project, while also integrating these considerations into the overall technical design. The goal is to ensure that both sustainability and technical aspects are consistently prioritized throughout the process.

Quality control

To achieve tox-free, circular, and climate-friendly goals, quality control must be maintained throughout the construction process. Clear roles and responsibilities for quality supervision should be established from the start, both at the municipality (e.g., construction boards, property departments) and within the construction company (general contractors, subcontractors). Failure to meet quality standards can negatively impact the project's final outcome.

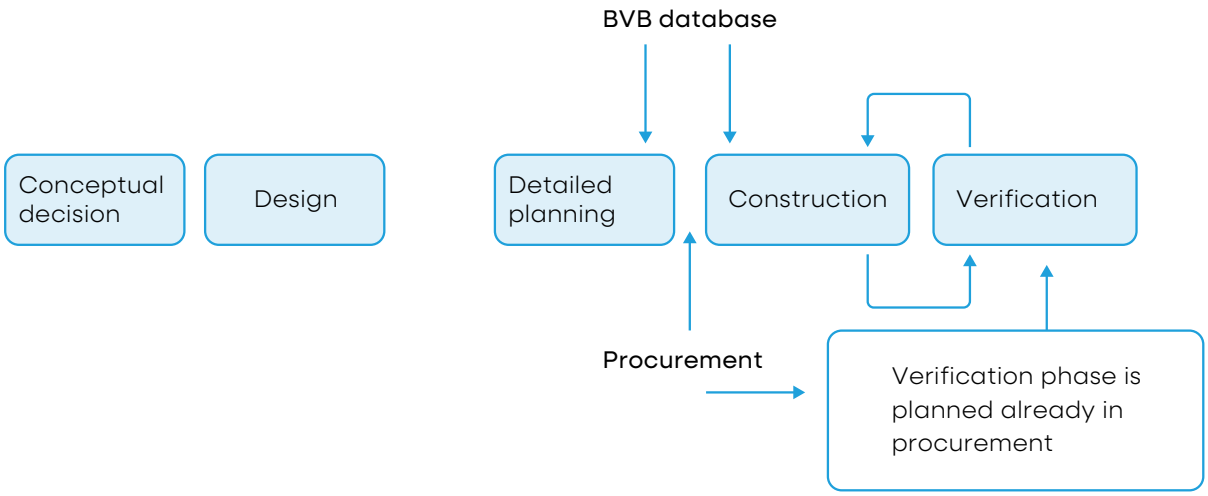
Verification

Construction, refurbishment, and extension are complex processes involving multiple actors. In addition to regular quality control, final verification of results is essential. Verification procedures, including methods and tools, should be outlined in the contract between the contracting authority and the construction service provider. The municipality can also hire an external provider for additional tests, such as air quality, airtightness, energy performance, or thermal bridge detection. If the building is pursuing eco-certification (e.g., Nordic Swan, BREEAM, LEED, DGNB), the certification institute will perform the verification

2.4.1. Best practice examples of construction and verification phases

2.4.1.1. The quality of new apartments with Miljöbyggnad gold level certification guaranteed with verification process in Stockholm

The quality of the new apartments was ensured through the implementation of Miljöbyggnad Gold level certification, carried out by the municipal housing company Familjebostäder in Stockholm. This high standard was guaranteed through a rigorous verification process, ensuring compliance with environmental, health, and energy performance criteria.



Ensuring quality through Miljöbyggnad Gold certification

For the apartment building project, Miljöbyggnad Gold level certification was selected to ensure a healthier indoor environment and high standards in sustainability. This certification, recognized for its rigorous requirements, involves third-party assessment and thus comes with increased costs. To justify this ambition, it was essential for decision-makers to have confidence that the selected contractor could meet the elevated standards.

Implications for project delivery

The pursuit of Gold level certification significantly raised expectations across several aspects of the project:

Procurement and planning:

- During the detailed planning phase, higher sustainability and health-related requirements were defined. These were embedded into the subsequent public procurement process, including clear mechanisms for compliance verification.

Communication and oversight:

- The certification target demanded enhanced communication, more thorough documentation, and stricter on-site evaluation compared to standard projects.

Material transparency:

- While the municipality cannot mandate specific materials, it can set criteria. To support this, the contractor is required to log all building materials in the BVB (Byggvarubedömningen) logbook to ensure transparency and alignment with tox-free and circular principles.

Verification and collaboration

Unlike standard projects, where environmental inspections are conducted internally by the construction company, this project required a more robust oversight model:

- Familjebostäder conducted monthly site visits and maintained ongoing dialogue with the contractor.
- Their sustainability team created and implemented internal checklists, tailored to different roles and phases of the project—both during design and construction.

Outcome and learning

The project has now achieved preliminary approval for Miljöbyggnad Gold certification, validating that higher standards for non-toxic, chemical-free, and circular construction are indeed feasible within Stockholm's municipal housing context. Moreover, the process itself became a valuable learning opportunity. The experiences gathered in planning, procurement, and verification are now informing future projects and helping refine the city's sustainability practices.

Stakeholder engagement

Stockholm, like most Swedish municipalities, faces a housing shortage, prompting strong national and city-level goals to build more affordable, tox-free rental apartments that enhance the municipal housing stock.

Tenants are seen as key stakeholders, and municipal housing companies maintain regular contact with them. As part of the planning process, City developers are legally required to present building plans publicly and gather feedback from local residents, ensuring that community voices are heard and considered.

Success:

High GPP standards and reliable delivery

The project's success came from clear, tested GPP requirements that construction companies were prepared to meet. This gave decision-makers confidence and ensured the certification process stayed on track.

The project became a model of continuous learning, where verification and evaluation throughout the process fed directly into future planning and design.

What did not work:

Circularity as challenge

Finding and using products which are possible to de-mount, are modular and/or in parts possible to recycle remains a practical challenge.

As for this specific project, no clear failures were identified, which is a positive outcome.

STOCKHOLM: Miljöbyggnad certification costs

Why certify?

Green certification, like Miljöbyggnad, helps demonstrate building quality and sustainability to stakeholders. It provides clear standards but can add complexity and cost to a project. While valuable for long-term assurance, certification may conflict with project managers' budget or time constraints.

Official costs (EUR) of Miljöbyggnad version 4.0. for new construction projects (costs for 2025):

- **Small multi-family home (<5,000 m²): 9,850**
- **Large multi-family home (>5,000 m²): 10,660**
- **Small office (<5,000 m²): 13,000**
- **Large office (>5,000 m²): 14,000**

Note: Extra fees apply for multiple buildings or delays.

Original source: Avgifter i Miljöbyggnad - Sweden Green Building Council

Internal Costs

Costs vary depending on internal coordination. When the team is aligned and documentation is planned early, extra costs are minimal. Without this, certification can lead to delays, extra work, and risks. Regular internal check-ins help avoid issues and ensure timely documentation.

Lessons learned - early experience with Miljöbyggnad in Sweden

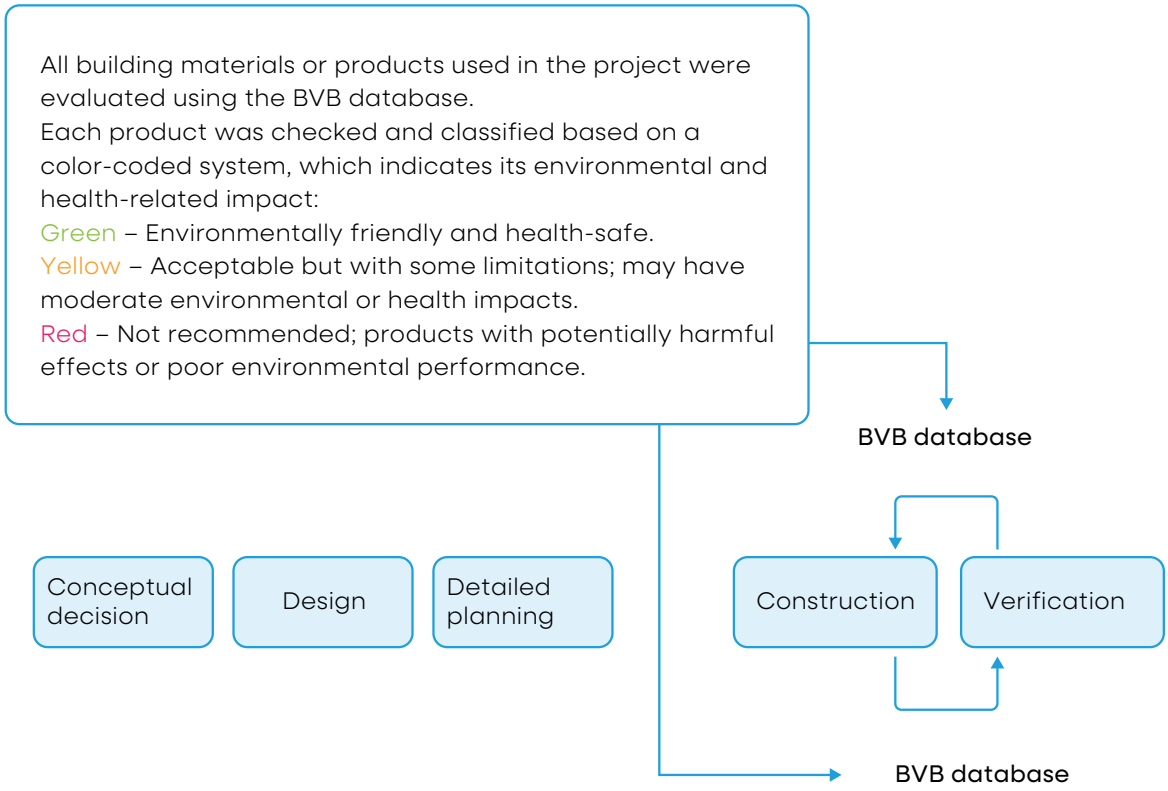
Early Miljöbyggnad certification projects in Sweden faced challenges due to inexperienced internal teams, contractors, and project managers. Many lacked routines and support for collecting required documentation, which often led to issues only being discovered during the verification phase.

Without dedicated environmental or certification specialists, project managers—focused on financial and technical priorities—often deprioritized documentation. While environmental aspects are now more integrated into projects, they still don't carry the same weight as other core issues.

Experience shows that not all projects—or project managers—are suited for certification. Success relies on strong early communication and clear routines for documentation. Certification projects require a shift from "business as usual," which not every team is prepared to make.

2.4.1.2. Using the BVB database in the kindergarten construction verification process in Holbaek to assess the chemical content of materials to be used

This case describes the use of the BVB database in the Holbæk pilot case to ensure safe and sustainable material choices in kindergarten construction. This was done as part of a construction verification and sustainability assessment process.



Material selection and DGNB certification

- The kindergarten was designed and constructed with the goal of achieving DGNB Gold certification, with a particular focus on environmental performance.
- All materials used in construction were cross-checked against the BVB database, which classifies materials with green (Recommended), yellow (Accepted), or red (To be avoided) markings based on health and environmental criteria.
- Although the project team initially did not emphasize toxicity criteria, the DGNB certification process provided clear specifications, helping ensure that the materials used met required thresholds. This structured approach supported better material choices than initially anticipated.

Verification and challenges

- To ensure alignment between contract specifications and the actual materials used, the contractor provided receipts and documentation — although there were many low-quality photocopies, making verification difficult.

- Manual checks were carried out by a project member (Pernille), who faced challenges due to:
  - Poor document quality,
  - Variability in product naming between Swedish and Danish markets (even among sister companies),
  - She needed to consult manufacturers' websites for confirmation.
- The process was time-consuming and error-prone, highlighting the need for improved data quality and digital documentation in future projects.

Insights from BVB use

- Despite the difficulties, BVB assessments confirmed that the materials used were generally of high quality.
- Some materials received Accepted or To be avoided ratings, but market alternatives were limited or non-existent — especially given the constraints of the architectural design.
- It was noted that with the materials used, a Nordic Swan Ecolabel level would not have been achievable, but the choices were reasonable given the context.
- BVB provided increased confidence in the sustainability of the project's material use.

Success:

BVB use provided valuable insights: despite the manual effort, **using the BVB database helped confirm that safe, high-quality materials were used.** While best suited for pilot projects or targeted checks, it added value by supporting compliance with health and environmental standards.

What did not work:

A key lesson was the low quality of data received from contractors. Since the tender did not specify a submission format, contractors uploaded unstructured receipts—often blurry and hard to interpret. This made verification difficult and time-consuming, highlighting the **need to require standardized data formats in future tenders for better quality assurance.**

Lessons learned

Template improvement: A recommendation emerged to add specific requirements in tender templates to improve data input quality from contractors, enabling better quality assurance.

Market dialogue: Attempts at early-stage market dialogue were met with hesitation from manufacturers, who perceived the municipality's involvement as controlling. It was suggested that architects might be better suited to conduct these dialogues, acting as intermediaries.

New material risks: The team acknowledged the uncertainty surrounding new ecological materials, especially regarding long-term durability and potential issues like moisture and fungal growth.

- **Digital Product Passports:** The municipality is now focusing on the upcoming Digital Product Passport for construction products. This tool, which will include detailed chemical content information, is seen as a more scalable solution. A national process is underway to define how it will support EU compliance.

2.5 Summary - practical steps for tox-free, circular & climate-friendly construction projects

The guide emphasizes a systematic approach to the entire building process — from early concept to final verification. Following this approach helps municipalities align with tox-free, circular, and climate-friendly goals, even when national legislation only defines minimum standards.

1. Conceptual decision phase

- Set high ambitions: Go beyond legal requirements; define measurable goals for toxicity, circularity, and climate friendliness.
- Select certifications: Choose appropriate standards (e.g., Miljöbyggnad, DGNB, Nordic Swan) to guide and verify progress.
- Conduct end-user needs assessment: Engage future users early to shape the building's function and quality.
- Form a cross-functional team: Assign clear roles, especially for overlooked areas like chemical safety and circularity.

Best Practices:

- Auraplan Architects (in Hamburg) adapted its project concept to overcome budget and structural limits.
- Riga focused on healthy materials within existing procurement constraints.
- Västerås aligned high goals with smart design and material choices.

2. Design phase

- Market consultation: Gather supplier input to set realistic and innovative procurement specifications.
- Sustainable design procurement: Use open or competitive dialogue processes to select qualified architects.
- Detailed design development: Focus on low-toxicity materials, energy efficiency, and circular design features.

Best Practice:

- Tallinn piloted a 3-pillar design approach (recommendations in toxicity, circularity and climate) and selected designs via a sustainability-focused competition.

3. Detailed planning phase

- Technical drawings & documents: Finalize construction details, including wall, floor, and roof structures.
- Use product databases: Tools like Byggvarubedömningen (BVB) help evaluate and document materials.
- Tender specifications: Include specific material and sustainability requirements to guide contractors effectively

Best Practice:

- Västerås introduced material quantity tracking to assess hazardous substances per m^2, setting a new standard.

4. Construction & verification phase

- Procure construction services: Include criteria for sustainable materials, indoor air quality, and waste management.
- Define roles & quality control: Ensure responsibilities for implementation and quality are clearly outlined.
- Ongoing verification: Conduct regular checks; use tools like BVB for material tracking and third-party certification for performance validation.

Best Practices:

- Stockholm used Miljöbyggnad Gold certification for strict oversight and contractor accountability.
- Holbæk relied on BVB to assess material safety but faced documentation challenges, revealing the need for better digital tools and market alignment.

To build tox-free, circular, and climate-friendly buildings, municipalities must combine strategic vision with technical expertise. The guide's value lies in showcasing how real-world pilots turned these principles into practice—highlighting both successes and practical lessons.