NonHazCity3

Strategic solution for managing hazardous substances in buildings and construction materials: procurement, building certificates and restrictions

Best practice cases and learnings

NHC3: Output O2.2

Interreg
Baltic Sea Region

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The NonHazCity strategic solution for managing hazardous substances in buildings and construction materials: procurement, building certificates and restrictions. Best practice cases and learnings.

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Contents

1. Introduction

The NonHazCity 3 project assists municipalities, entrepreneurs, and individuals in constructing and renovating buildings using tox-free materials to protect both health and the environment. While substances like arsenic and asbestos have been phased out, a wide range of other hazardous chemicals are still commonly found in many construction materials. Moreover, new harmful substances continue to be identified as scientific understanding evolves. The project focuses on those hazardous substances that are still legally permitted in construction but have been scientifically shown to pose risks to human health or the environment. Infrastructure construction is excluded from the project.

The project targets decision-makers in construction, renovation, and building purchases, including residents, companies, and local governments. It emphasises the importance of choosing materials free from hazardous substances throughout the building's life cycle—from production and construction to maintenance, demolition and possible re-use of materials.

NonHazCity 3 (NHC3) promotes a comprehensive understanding of these choices, benefiting both human health and the environment while offering economically viable alternatives. It raises awareness among residents, companies, and municipalities about making informed decisions and introduces both problems and solutions. Given the similarity of these issues across the Baltic Sea region, the project fosters collaboration and knowledge sharing among different towns and regions. The project was implemented from January 2023 to December 2025.

The purpose of the project has been to produce solutions for the construction sector that take hazardous substances into account and reduces them. The solutions in the NHC3 project are divided into practical and strategic solutions (See Figure 1.) The practical solutions are reflected in a separate document (*Output 2.3: The NHC guide for design & construction of tox-free, circular & climate friendly municipal buildings*). **This document introduces and discusses the piloting of NonHazCity 3 strategical solution and sub-solutions, and the pilot experiences related to these.** A key component is the reflection on The NonHazCity strategic solution document which the project released prior to piloting and is available on the Interreg Baltic Sea Region project web page.

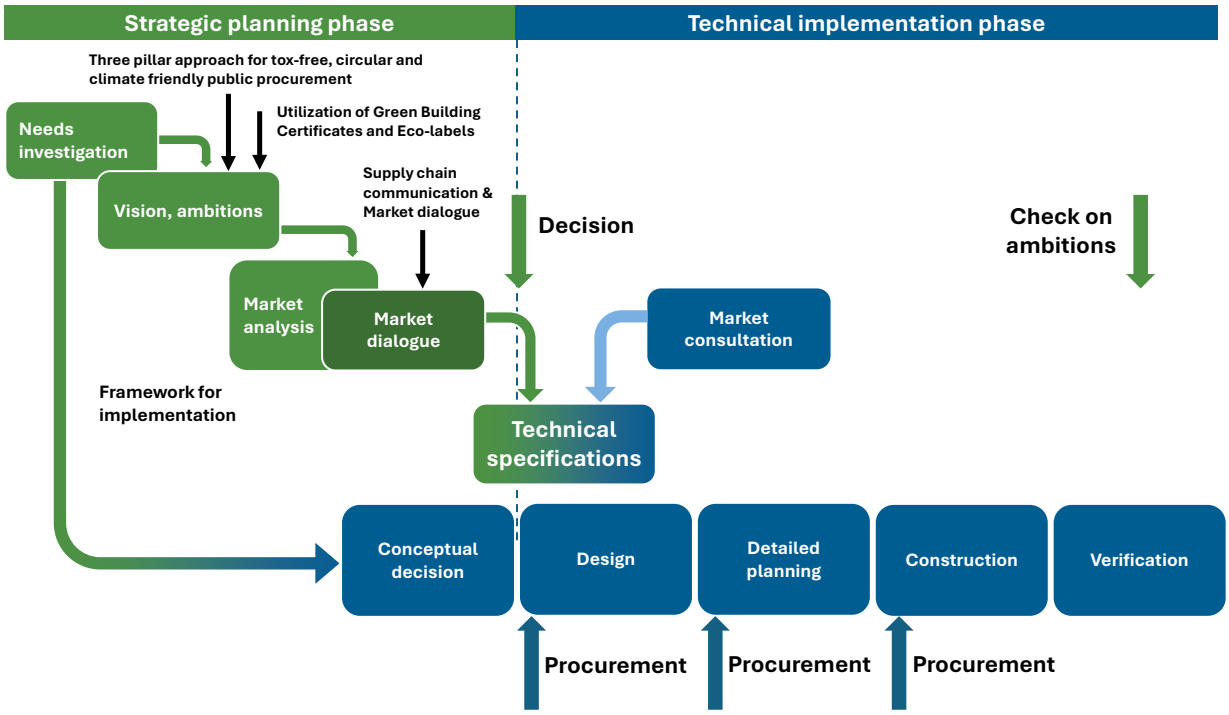


Figure 1. Interrelation of the strategic planning and technical implementation phases to the steps in construction.

This document outlines the piloting of strategic solutions, their subsequent refinements, and their implementation in municipalities to enhance the efficiency of management procedures.

A strategic solution is formed by the strategic management process (the upper level of the strategic management process diagram in Figure 1), which includes three steps:

1. Needs investigation
2. Vision and ambitions, and
3. Market analysis and dialogue.

The document discusses these steps more fully in chapter 2. As a whole, the described strategic management process is supported by three sub-solutions, which are:

- The three-pillar approach for tox-free, circular and climate friendly public procurement.
- Utilisation of Green Building Certificates and Eco-labels.
- Supply chain communication and market dialogue.

In this document, we present the experiences from our project pilots at different phases of the aforementioned management process steps, testing and utilising the three sub-solutions mentioned above.

In the chapters describing the experiences from the municipalities, this document provides the **activity descriptions of the pilots** and descriptions of the **tested strategic management processes and methods**. The **case profiles** contain the relevant background information on the piloting

organisations and their development work, as the full profile descriptions are released at the project website, and available to the public. In the chapters describing the piloting experiences, the document provides **a compilation of answers** on the feedback to the suggested and utilised solution and **inputs to the solution** through describing **the best practice cases and learning experiences.**

As the project deliverables and outputs are closely interlinked, and provide viewpoints with a different reach, it is noteworthy to mention that **a compilation of quantified results** from the piloting experiences are to be expected within output 2.5 (*Best practices of NonHazCity pilots on tox-free, circular and climate-neutral buildings in BSR cities*).

This document focuses on the experiences and best practice cases that reflect and further shape the proposed strategic solutions. The best cases and insights are presented in a manner that facilitates easy replication. Information on best practices was gathered from partner municipalities through regular meetings, plan collections, and a series of interviews, focusing on piloting plans and implementation. This process enabled project partners to compile and reflect on feedback regarding the implemented solutions.

The NHC3 project rests on a three-pillar approach, which has been the starting point for the project and utilised throughout the project activities:

- **Tox-free construction** is a construction that avoids hazardous substances in materials or finishes and therefore reduces the impact that buildings have on human health and the 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 and minimises waste and maximises resource efficiency. It promotes recycling, reusing, refurbishing, and sharing, while prioritising 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 NHC3 three-pillar approach involves setting higher standards for municipal construction than national laws require at the moment, often necessitating changes in daily routines and using new products or methods.

2. Case profiles of the municipalities and their construction and development projects

The following case profiles (short case summaries) on the next page present municipalities that piloted the NonHazCity3 strategic solution and sub-solutions. More detailed descriptions of the municipalities and their activities can be found on the project's website.

Stockholm, Sweden

Stockholm, the capital of Sweden, had 995,574 inhabitants at the end of 2024. The city tested NHC3 solutions in a project by 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.

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 modernising 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, prioritising eco-friendly materials, energy-efficient windows, and waste sorting.

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 tox-free buildings.

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 tox-free materials, energy efficiency, and circular construction. An architectural competition emphasised these principles and prioritised wood use, improved indoor conditions for children, and a low CO_2 footprint.

Detailed description on the NHC3 website

Västerås, 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 tox-free, 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 prioritises renewable and reused materials. It targets Miljöbyggnad Silver certification, with Gold-level goals for energy, circularity, and chemical safety, monitored via the BVB system.

Detailed description on the NHC3 website

Helsinki, Finland

Helsinki, the capital of Finland, had 686,595 inhabitants as of March 31, 2025. City of Helsinki tested the NHC3 solutions by updating the instructions for architects, engineers, and contractors so that hazardous substances in construction materials are considered sufficiently. The new instructions will help ensure that future buildings in Helsinki are safer for both residents and the environment.

Detailed description on the NHC3 website

3. The strategic planning phase of a municipal construction project

The municipal construction process in this project is divided into two phases. This document focuses on the strategic phase, as outlined in Figure 1, and the experiences gained from testing and piloting solutions in various municipal construction projects. **The strategic planning phase includes needs investigation, setting the level of ambition, market analysis, and supply chain communication. Since each project is unique, these steps may overlap or be adapted based on specific circumstances.** This document provides a more detailed account of how these steps were piloted in practice, while the original framework is further elaborated in the NonHazCity Strategic solution document.

3.1 STEP ONE: Needs investigation

In this document, NHC3 strategic solution of needs investigation refers to the process of identifying and understanding the requirements and expectations for a project. It involves gathering information from stakeholders, analysing their needs, and determining the essential elements that must be addressed to ensure the project's success. This process helps create a focused plan that becomes an integral part of the construction project.

The needs for a construction project can be identified in various ways, as suggested in the NonHazCity3 Strategic solution document. In practice, a needs investigation is suggested to contain some main elements, which aim to provide an overall description, what the requirements and expectations for the project are, and making it understandable for stakeholders involved in the process at any of its phases.

A description of the **background** should include details about the selected individual construction project (e.g., a pilot-project house) or a group of buildings of the same type (e.g., pre-schools planned for future construction in a municipality). If a technical pre-feasibility study has been conducted, it is advisable to summarise the results in the needs investigation summary. **An overview of the needs from key stakeholder groups**, such as the municipality units, end-users, and property managers, should be included. Stakeholders can be further analysed to justify their interests and motivations. This analysis helps participants in the building process to better cater to stakeholders' needs and for them to make informed decisions when conflicting interests arise. It is also highly recommended to set up **a cross-functional implementation team**, as it can more easily cater to the needs of stakeholders at different stages of the building process with increased efficiency and reflection on different fields of expertise, improved decision-making and adaptability. Within the NHC3 project, partners also made use of the developed **checklists** to support their efforts in project implementation.

The following chapter describes the experiences from the NHC3 piloting actions with three municipalities sharing their insights on the Needs investigation, and how it was implemented in practice. We hope the experiences from the project partners will aid in replicating the step in other construction projects aiming to incorporate elements from the NHC3 project.

Experiences from municipalities in needs investigation

The following section presents three municipal case examples to illustrate **Step 1: Needs Investigation**. This step demonstrates how each construction project engaged with and tested the NonHazCity Strategic solution. The examples are based on interviews conducted with project partners and are also reflected in the pilot activity descriptions, which are discussed in greater detail in Chapter 4. The cases are presented in the following order: **Västerås**, **Holbæk**, and **Riga**.

In **Västerås**, the project piloted strategic management processes and methods in the construction of a preschool building. The city aimed to create a tox-free, climate friendly preschool, emphasising sustainability and flexibility in its design and construction. By incorporating criteria from ready set standards, certificates and eco-labels, this approach sought to reduce environmental impact while ensuring economic feasibility. For example, the city aimed to utilise pre-used products as much as possible. As a criterion, the contractor was required to log all products used in the construction into the BVB (Byggvarubedömningen) logbook, with the goal of having at least 20% of the products assessed as “Recommended” and allowing a maximum of 5% in BVB category “To be avoided”. Within the building itself, the city required flexibility. In case childcare needs in the municipality would change, the building was required to be repurposed with low costs, and the plans needed to reflect the requirement. Hence, the architects designed a preschool that rather easily can be changed into a home for persons with special needs. The foundation of the building will be constructed using concrete, chosen due to its cost-effectiveness and suitability for the topographic conditions. The bearing structure is to be made of wood, a deliberate choice to reduce the building's carbon footprint. The building's orientation was adjusted by 90 degrees from the original plan due to topography. Initially, the building was designed to stretch from east to west, which would have also resulted in a significant solar load from the south. By rotating the building to stretch from south to north, the solar load was reduced, minimising the need for sun shading materials. This new orientation also aligned better with the topographic conditions.

Holbaek had a similar aim and background: the pilot project, Jyderup kindergarten, – prioritises life cycle assessment (LCA), social, economic, ecological quality, and resource efficiency. The building was constructed using simple, natural materials and features large canopies. The facades are made of wooden columns arranged in a modular system. The design of the building includes large canopies primarily to capture sunlight and protect the indoor environment from overheating during warm months. These canopies also shield the windows and facades, enhancing the building's durability and extending the lifespan of the materials. The facades are made from salt-impregnated pinewood, which eliminates the need for hazardous wood protection treatments. For the roof, a combination of flat roofing felt, and grass was selected. Inside the building, natural and long-lasting materials such as wood and linoleum were prioritised.

Both examples show that key decisions regarding primary materials and building placement were made early in the project, based on the specific requirements and characteristics of the design.

In the **Riga**, the importance of a cross-functional project team was clearly demonstrated. To ensure a comprehensive and coordinated approach, the implementation team was composed of representatives from various municipal departments. This included a construction engineer, a procurement expert, and specialists from the municipal residential property technical maintenance department. Their collaboration ensured that activities were aligned and effectively managed throughout the project. The municipality has to follow strictly defined guidelines related to financing and reporting in each of their projects.

To address stakeholder needs, the team organised planning meetings with all relevant internal parties. These sessions focused on defining criteria for tox-free materials, promoting circular practices on the construction site, and identifying climate-friendly solutions. The Riga project consisted of modelling a tox-free, circular, and climate-friendly renovation of Soviet-era apartment buildings. In collaboration with Latvian partners—Baltic Environment Forum Latvia, NOMAD Architects, and the Ecodesign Centre—the municipality also provided training for staff involved in planning, procurement, and oversight of construction and renovation projects. This capacity-building effort helped embed sustainable practices into municipal operations.

While Riga focused on internal capacity, the Västerås project team emphasised stakeholder needs, particularly the health of children and staff. The project aimed for Miljöbyggnad Silver certification, with architects committed to using circular and reused products wherever possible, aspiring to exceed Miljöbyggnad Gold certification. Building materials shall be logged in the BVB logbook, with a goal of having at least 20% assessed with the status as “Recommended”. This approach ensures that the materials meet high criteria set for hazardous substances. The floors will be PVC-free. This was decided early in the project, and the decision was also supported by prior NHC3 dust sampling conclusions from existing daycare facilities. Sampling results are discussed in more detail in the publication “Occurrence of substances of concern in Baltic Sea Region buildings, construction materials and sites”, available at the project website.

In summary, these municipal examples illustrate the diverse approaches taken to address the needs investigation phase in construction projects. Each municipality prioritised sustainability, health, and compliance with regulations, while also focusing on innovative solutions to enhance the durability and environmental impact of their buildings. These examples also highlight the importance of collaborative planning, where municipal departments and stakeholders were actively involved in communication and teamwork to ensure that the solutions aligned with environmental goals.

3.2 STEP TWO: Setting vision and ambition

During the strategic planning phase, municipalities are encouraged to define the level of ambition for their construction projects. The NonHazCity Strategic Solution supports this by promoting higher standards for building materials—evaluated through a three-pillar sustainability perspective—than those required by national legislation. While an initial vision and ambition may be set early on, these can evolve during the needs assessment and prioritisation stages.

To support the adoption of more ambitious targets, municipalities can apply complementary instruments such as planning guidelines, economic incentives, and informational tools. However, both financial and political constraints often pose challenges to the successful implementation of sustainable construction initiatives. Limited funding is a common barrier, particularly for projects aiming to exceed minimum legal requirements. One way to address this is through political commitment, for example, for adopting a green building certification for the project.

The tools used in setting the level of ambition could be such as suggested in the NonHazCity Strategic solution document.

- Requirements of the Green Public Procurement (GPP) criteria and sustainable building certificate.
- Requirements of eco-labels in developing technical specifications and award criteria, and in verifying compliance.

Within the NHC3 project, the partners also utilised the NHC3 Checklist for incorporation of Green Public Procurement criteria, which can be found from the project website.

Experiences from municipalities in setting the vision and ambition

The following section presents three municipal case examples illustrating **Step 2: Setting Vision and Ambition**, highlighting how this step was approached in construction projects where the NonHazCity Strategic solution was applied. The examples are based on interviews with project partners and are also reflected in the **pilot activity descriptions**, which are introduced more fully in Chapter 4 of this document. The first example is from Stockholm, followed by Holbæk, and finally Helsinki.

Stockholm reported its starting points in setting the level of ambition of the three-pillar approach as following:

- **TOX-FREE ASPECTS:** Indoor air quality is usually regulated through ventilation flow where there are national standards for both new- and pre-existing buildings. Building materials only need to fulfil national/EU-legislation. To make sure that the ambition is higher than that, many companies use certification schemes like Miljöbyggnad, BREEAM or Nordic Swan, so that building materials must be checked for hazardous substances as well as catalogued in a logbook. Stockholm City's approach to controlling for hazardous substances is to prioritise controls closest to residents. If materials are incapsulated, the impact of hazardous substances are not as high on humans or the environment. They are also harder to physically reach and control for at the building site.

- **CIRCULAR ASPECTS:** While there are currently no legal requirements for circular construction at the national, regional, or local level, the City is actively exploring this area through several independent pilot projects. Insights from these pilots are being used to encourage all municipal building companies to voluntarily integrate circular requirements into their tendering processes.
- **CLIMATE ASPECTS:** There are national laws concerning energy consumption, which are set to be possible to fulfil throughout the whole country. As a result, they are very easily achieved, and Stockholm has set their own more ambitious local energy requirements for 55 kWh/m2 per year. This is technically achievable, and the Stockholm housing companies aim for even lower energy consumption levels as a way of future-proofing their housing stock and reducing future heating costs.

Stockholm municipality requires its municipal companies to build an increasing number of solar panels on both new buildings and on its pre-existing housing stock. Each company can have higher internal goals.

All companies in the city can/should use the City's electricity deal that is water- and solar-power only.

When using Miljöbyggnad, energy consumption is one of the parameters that must be considered. Radon gas is another parameter.

Climate emissions: Since January 2022 there is a national law requiring disclosure of climate calculations of new construction projects to the municipality and national authority Boverket (Swedish National Board of Housing, Building and Planning). Even before its introduction of an LCA-disclosure requirement, it aimed for a maximum accepted level for climate emissions that would be set in July 2025. This has spurred the market towards reducing emissions, even though the requirements related to maximum levels have been delayed.

The City has worked on capacity building and educational measures, which has led to two municipal building companies setting their own voluntary goals, aiming for much lower maximum levels than the national law. Familjebostäder is the leading company in the process.

Holbaek, on the other hand, mapped out the legal requirements related to the implementation of the three- pillar approach accordingly:

- **TOX-FREE ASPECTS:** Construction products intended for permanent installation in buildings are regulated under the Construction Products Regulation. Together with REACH (the EU's regulation concerning the registration, evaluation, authorsation, and restriction of chemicals), this ensures that information, such as safety data sheets detailing the hazardous substances contained in construction products, accompanies the products. This information allows for the assessment of hazardous substance content in construction products.
- **CIRCULAR ASPECTS:** As of 2025, Denmark is strengthening its building regulations to support circular construction. New rules include mandatory selective demolition for buildings over 250 m^2, requiring materials to be sorted and documented for reuse or recycling. This supports the reuse of valuable components and reduces construction waste. Additionally, Denmark promotes design for disassembly, encouraging buildings to be constructed in ways that allow future reuse of materials. These principles are supported by the voluntary sustainability class in the building code, which includes circularity criteria such as the use of recycled materials and modular design.
- **CLIMATE ASPECTS:** The climate impact must be calculated in kilograms of CO2 equivalents per square meter per year, following the DS/EN15978:2012 standard. This calculation covers a period of 50 years from the completion notification of the construction. The modules included in the calculation are:
    - A1: Raw materials
    - A2: Transport
    - A3: Manufacturing
    - B4: Replacement (excluding transport and replacement process)
    - B6: Energy consumption for operation
    - C3: Pre-treatment of waste
    - C4: Disposal
    - D: Potential for reuse, recycling, and other recovery

Helsinki's activity report stated on their set level of ambition the following:

Proposed improvements for current instructions for architects, engineers and contractors include the following:

- The building materials and products used in the project must meet certain minimum requirements (CE marking or national approval). This should be taken into account both in the planning and implementation phase of the project. If necessary, it must be possible to verify compliance.
- **TOX-FREE ASPECTS:**
    - In principle, the building materials and products used in the project must not contain SVHC substances (Substances of Very High Concern). The customer must separately approve the use of construction materials or products containing SVHC substances.

- All building materials used in internal surface structures and fixed furniture must be M1 classified building materials according to the list maintained by Rakennustieto.
- Exterior cladding and exterior coating materials and products must not contain SVHC substances, substances hazardous to aquatic organisms or persistent organic compounds, so-called POP compounds.
- When choosing materials and products, the primary options are Nordic Swan eco-labelled, or EU-labelled or equivalent Type 1 eco-labelled materials and products certified by a reliable third party when the cost impact is not significant.

Stockholm emphasises local requirements and voluntary certifications to ensure high standards in tox-free, circular, and climate friendly aspects. Holbaek focuses on compliance with EU regulations and mandatory lifecycle climate impact calculations for new buildings. Helsinki sets ambitious goals above legal requirements, proposing improvements for building materials and products to enhance sustainability and environmental performance.

In summary, these examples highlight the importance of tailored strategies and proactive measures in achieving more sustainable construction goals, showcasing how municipalities can lead by example in promoting healthier, more environmentally friendly building practices.

3.3 STEP THREE: Co-operation with the markets

In this document, there are two separate yet overlapping methods of co-operation with the markets distinct.

By supply chain communication this document refers to ensuring that the suppliers understand requirements for building materials and products and are able to provide information on them, particularly during construction projects. This involves estimating future material and equipment requirements based on project schedules, construction supply management data and market trends. Key stakeholders include municipalities and their respective departments and units, municipal companies and agencies, material suppliers, construction companies, and architects.

Market dialogue is a proactive interaction with suppliers to inform them of upcoming needs and requirements of an upcoming procurement[1]. It helps clarify technical requirements during tendering, ensuring realistic and achievable goals within time and budget limits. This process involves needs assessment, preparation, and various communication forms to facilitate discussions.

Key distinctions:

- Supply chain communication focuses on building materials and products during construction projects, involving a broader range of stakeholders. It focuses on the flow of information concerning sustainability aspects along the supply chain from resource extraction over production to final use stage.
- Market dialogue is a proactive process aimed at refining requirements and ensuring realistic project goals, primarily before or during the tendering phase.

Decisions on technical requirements from the planning phase to be brought into the construction within the NHC3 three-pillar context could be e.g. adjusted level of ambition or a defined vision and requirement for green-certification or use of (certain) green- certification system. This is discussed in more detail on the NonHazCity Strategic solution document.

Within the NHC3 project, the partners utilised the developed Checklist for advancing supply chain communication and Checklist for a market dialogue strategy for communication.

[1]Brataas G., et.al. (2022) Requirements Engineering in the Market Dialogue Phase of Public Procurement: A Case Study of an Innovation Partnership for Medical Technology. REFSQ 2022: Requirements Engineering: Foundation for Software Quality, pp.159-174.

Experiences from municipalities in co-operation with the markets

The following section presents three municipal case examples illustrating **Co-operation with the markets**, detailing how this step was conducted for the construction project where the NonHazCity Strategic solution was tested. The examples were drawn from interviews with the project partners and reflected also in **pilot activity descriptions**, introduced more fully in chapter 4 of this document.

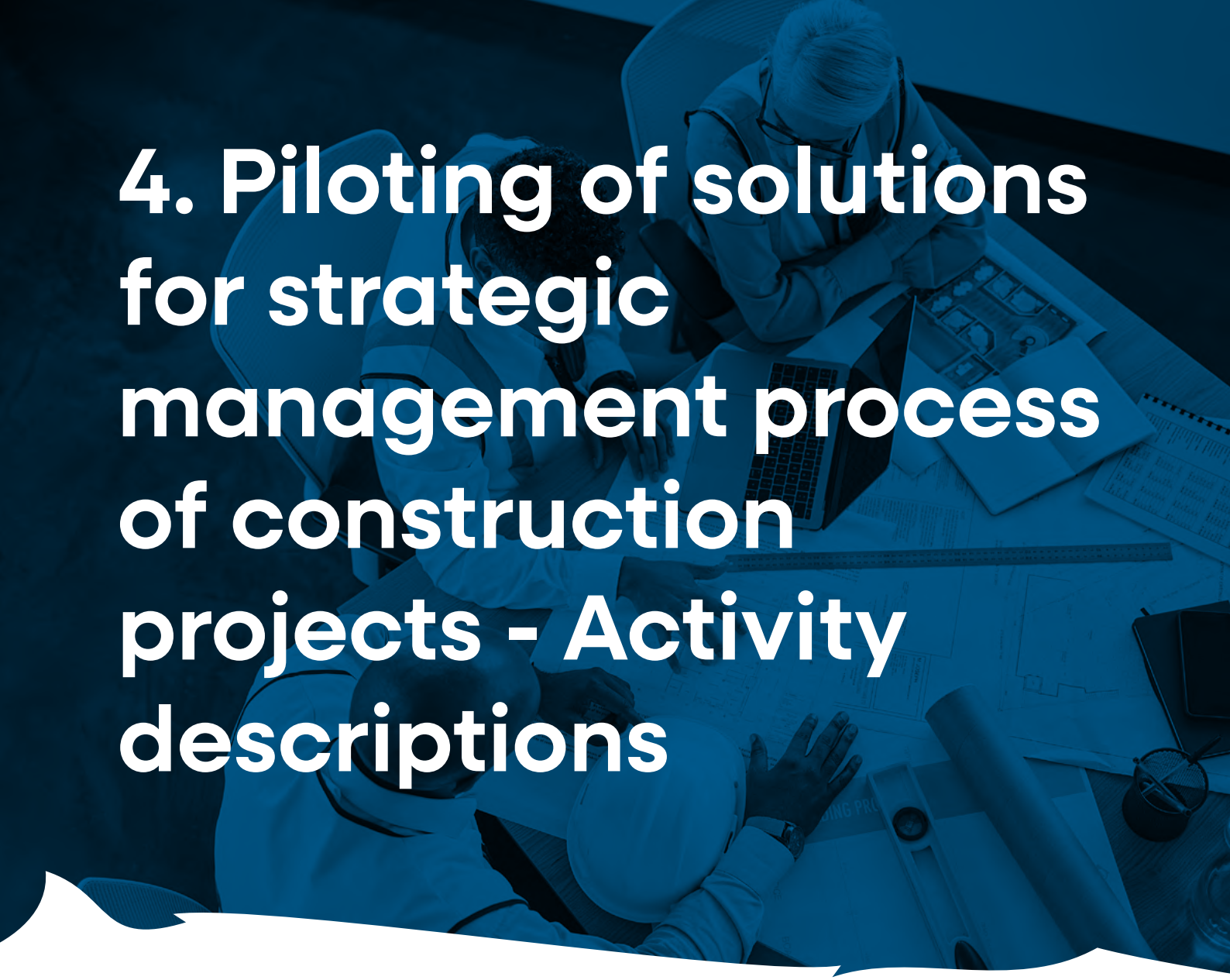
First, an example from Stockholm and Västerås are presented, followed by Tallinn.

In summary, these municipal examples illustrate the diverse approaches taken to address the co-operation with markets in construction projects.

Both **Stockholm** and **Västerås** emphasise the importance of ongoing market dialogue throughout the project lifecycle. Mostly there is no need for a separate market dialogue event to search for new solutions controlling for hazardous substances or suggestions from the markets, as the products and processes can be controlled for harmful substances in the BVB-system. The utilisation of continuous dialogue as well as a standardised system ensures that suppliers and stakeholders are continuously reminded about projects' sustainability requirements and goals, and the vision is clear and shared among all stakeholders. Both municipalities utilise certification systems (Miljöbyggnad) to facilitate clear communication with suppliers and utilise the BVB (Byggvarubedömningen) system in doing so.

In Tallinn, the city issued an open invitation for a face-to-face market dialogue event via the national procurement portal (riigihanked.riik.ee). The event was intended as a general discussion, not tied to a specific procurement. However, due to a lack of registrations, the event was cancelled and replaced with an online questionnaire. The results revealed several challenges in the Estonian market related to tox-free, circular, and climate-friendly construction criteria, particularly in terms of their validation. Material producers noted that clients often struggle to verify whether products meet the required standards. This highlights the need for procurement criteria to be measurable, verifiable, and ensure equal and transparent evaluation. One key insight from Tallinn's market dialogue efforts was that criteria development should proceed in small, impactful steps. Future consultations are expected to be more effective when linked to specific construction procurements, as this may increase supplier interest. A central challenge remains: how to encourage participation in such consultations without breaching public procurement regulations, which prohibit offering advantages to participants.

Since market dialogue events are not yet common practice in Estonia, many stakeholders are uncertain about their value or educational benefit, which may further limit engagement.



4. Piloting of solutions for strategic management process of construction projects - Activity descriptions

The NHC3 project has identified three sub-solutions to managing procedures for construction materials and sites. The previous chapters described the steps of the strategic planning process: **needs investigation**, **vision and ambitions**, and **market analysis and dialogue**, followed by experiences from the piloting related to these.

The three identified sub-solutions to help develop the management process of construction projects in a less harmful direction are as follows:

1. The three-pillar approach for tox-free, circular and climate friendly public procurement.
2. Utilisation of Green Building Certificates and Eco-labels
3. Supply chain communication and market dialogue

These sub-solutions can be utilised in various steps of the strategic planning process. The sub-solutions act as tools that aid the construction process towards a less hazardous direction. As the steps of a strategic planning process can be taken in any kind of construction process, the sub-solutions are tools to direct the processes towards the goals set.

During the NHC3 project, these sub-solutions were piloted at various construction related cases. The following chapters provide **activity descriptions** from the piloting, focusing on the **best practise cases and learnings**. The activity description is provided in a general context, as detailed descriptions of the pilot profiles have been covered previously. For the best practise cases and learnings, we present selected cases from the piloting. These selected cases provided most clear examples and narrative on utilising each of the sub-solution, describing and emphasising the learnings that can be extracted and replicated.

The project partners began with pre-selected construction or development cases, which served as practical settings to pilot management process solutions. The final cases are detailed in Chapter 2. Each partner aimed to reduce the use of hazardous substances within their case.

Each municipality used a **Roadmap template** to guide their activities. This tool helped align their efforts toward common goals, while still allowing flexibility to adapt to local contexts. Since the pilot cases varied in size, priorities, budgets, and implementation teams, they offered a diverse and valuable testing ground for the proposed management process solutions.

Each pilot incorporated elements of the sub-solutions in a way that best suited its specific context. Not all partners applied every element, but each selected those most relevant to their needs. This flexible application supports the project's broader aim: to develop **a replicable solution** that other municipalities can adopt to improve their construction processes, particularly in reducing hazardous substances.

Throughout the process, pilot partners benefited from shared insights across the different case teams. To guide the work, all municipalities were provided with:

- **The NonHazCity3 Strategic solution documen**t, which described the solution to be piloted and **Checklists**
- **a Roadmap Template** to support planning and implementation

These checklists, documents and templates were used to promote a systematic approach and ensure that the pilots aligned with the project's overall goals. The roadmap template was filled in, followed up, and reflected with participating municipalities. During the piloting, the developed supporting documents and templates were made public and are available on the project website.

4.1 Piloting of three-pillar approach for tox-free, circular and climate friendly public procurement

The three-pillar approach was integrated across all key steps of the strategic management process:

1. **Needs investigation**
2. **Vision and ambition setting**
3. **Market analysis and dialogue**

During the **needs investigation** phase, partners identified sustainability goals and stakeholder expectations related to tox-free, circular, and climate-friendly construction. In the **vision and ambition** phase, they aimed to exceed national regulatory requirements by embedding more ambitious **criteria into their procurement processes.**

To ensure these criteria were realistic and achievable, partners engaged in **market dialogue**—or used elements of it—to consult suppliers early on, assess market readiness, and refine their approach.

Finally, in preparation for the **tendering process**, the pilot cases developed requirements aligning with the three pillars.

The three-pillar approach aims to support public procurement to achieve tox-free, circular and climate friendly construction materials and buildings. The three-pillar approach in construction process is previously presented in Chapter 1.1. **As a sub-solution, the approach aims to support the construction projects in taking into consideration the selected viewpoints throughout the construction project, in each of the steps from an idea, all the way to a ready project and beyond.**

Best practice cases and learnings on working with the three-pillar approach

As described in the chapters regarding case profiles of the pilots in the project, the piloting taking place in Tallinn, Riga, Västerås and Stockholm provided most clear examples and narrative on utilising the three-pillar approach. These were considered as most suitable to be presented, providing inspiration and practical angles for municipalities and other actors interested in replicating construction processes and the three-pillar approach within.

Stockholm's approach to tox-free, circular and climate friendly construction materials is based on their long experience with green building certificate system Miljöbyggnad (MB) and the use of nationwide logbook-system, **specifically** BVB (Byggvarubedömningen). Miljöbyggnad (MB) exists in two major **variations**: one for new construction, and one for existing buildings. Projects that **present documentation about the fulfilment** of the requirements can after a third-party review be awarded certificates at three levels: bronze, silver or gold. Since the bronze-level requirements of the MB system are based on the Swedish Building Regulations and then added to, they can credibly show which projects fulfil and/or go beyond minimal level (silver- and gold-levels) requirements. Today the use of MB is voluntary by the City's municipal housing companies, but its use has become an integral part of how to practically go beyond minimum law requirements.

To support climate emissions reductions, contractors must demonstrate how they have calculated emissions for the city's projects. However, national law only requires documentation of a standardised lifecycle assessment but does not set a limit for the carbon footprint. Like in the NHC3 project, the city may set its own stricter limits for emissions. The calculations for the materials' emissions are made in several steps throughout the planning process. Best-case practice is where early in the design phase, project economy (specifically cost of materials) is put next to calculated emissions from different design choices. With this comparison, the emission limit set early on at the planning- and procurement is both practically as well as economically feasible. Each phase can be checked, ending with the actual buildings' results, all with the aim of allowing reducing overall emissions.

As the BVB (Byggvarubedömningen) system is already in place and actively used in Sweden, it is possible to follow up on the materials used in each of the building- or renovation projects. The system allows suppliers to check if their products meet specific sustainability criteria, enabling more systematic substitution and provide documentation for the fulfilment and application of certification schemes like Miljöbyggnad, BREEAM or Nordic Swan. Access to documentation also allows easier reuse of materials later on, if the materials are known and documented utilising a logbook function from the building phase.

The practice of the BVB logbooks has developed over several years. Early on it only required information from a handful of product groups, but as more building material has become available, the demand for documentation has grown accordingly. The use of problematic ("to be avoided") products have overall been reduced and their specific use nowadays has to be justified. The City has been able to prioritise materials closest to residents meet the highest standards. Built-in materials that do not affect in-door air quality are not motivated to meet such high standards. Physical control on the building site is also more difficult.

The legislation and national requirements concerning elements such as energy consumption need to be possible to fulfil throughout the entire country. As Stockholm is located in the middle-southern parts of Sweden, the city has made its own energy efficiency requirements stricter than the national requirements. When using certification schemes such as Miljöbyggnad, energy consumption is one of the parameters that must be considered and when the city then requires more ambitious, gold-level requirements are used.

In NHC3 case project in Oldmästaren, the municipal housing company aimed for a total gold level certification on the Miljöbyggnad scheme, for as many of the categories as possible, studying the process and sharing insights. In the procurement texts, the city had requirements on reduced climate emissions, fulfilling the life cycle assessment required by law, but setting voluntary limits for end-project emissions. The calculation framework, documentation and methods were therefore familiar for the building companies answering to the tender. This allowed more advanced claims or goals to be invited in the tender texts as well, as the required or referred methods and requirements were familiar. Taking a known requirement level and adding something to it was described as not leading to too many insecurities (financial risks) for either property company (owner) or construction company (partner or sub-contractors). The procurement text therefore allowed for other aspects of circularity to be included, and supportive goals and ways of justifying these were also possible to be

set in the contracts. Different municipal housing companies for example set their own goals on minimising unnecessary waste in reducing the amount of materials bought and brought to the building site in case of calculation errors. These materials usually end up in either as waste or need to be sold back to the producer – in any case producing emissions in logistics. There are also other goals, which are not demanded by law, such as goals set for recycling of mineral masses and handling of earth-materials from land preparation activities before construction.

In **Tallinn**, the three-pillar approach was incorporated into the activities in each of the steps and piloting of solutions, showing especially in keeping the sustainability criteria broad and flexible during initial stages, such as architectural design competitions. This approach allows architects and designers to propose innovative solutions that contribute to climate friendliness without being constrained by overly specific requirements. The city of Tallinn tested the use of the three-pillar approach especially in setting the design procurement criteria.

One of the key strategies has been to keep the criteria broad and flexible during the initial stages, such as architectural design competitions. This approach compensates marked readiness and allows architects and designers to propose innovative solutions without being constrained by overly specific requirements. For example, the criteria for reducing hazardous substances, enhancing circularity, and lowering CO2 footprints were kept broad to encourage creative solutions from the participants. For example, the participants were free to express how they'd answer to broad, yet ambitious and clear criteria for the building, such as:

- long service life of the building, materials, products and technical systems
- durability and wear resistance of the materials and products used
- optimality of operating and maintenance costs

In sustainably constructed buildings, considerations extend beyond mere energy efficiency or low maintenance costs. At the design phase, the choice of construction methods and materials were aimed to minimise negative impacts on the natural environment. Tallinn ended up with an intelligent modular use of wood as the primary building material, which reduced the building's associated carbon footprint compared to using steel or concrete. Additionally, the design considers the impact of indoor climate on users' health, aiming to use low-toxicity materials. Interior surfaces utilise wood or tiles, with focus on non-toxicity. As the indoor air quality is often impacted by foam insulation used in technical systems, the technical systems of the building were placed in the attic, reducing the impact on indoor air.

In supporting circularity, the city of **Tallinn**, just as **Riga**, aimed at maximising resource efficiency. The project encountered firsthand conflicting interests of circularity and tox-free materials, as the previously used materials were difficult to be categorised by their level of toxins, as the origins or original materials were not always fully known and would have required testing. Testing of each material would, however, result in being highly expensive. Advocating recycling, reusing, refurbishing, and prioritising easy repair, upgradability, and disassembly may sometimes result in conflicting with the aim of having less hazardous substances and materials, when the materials and their contents are not recorded or known.

In **Riga** the municipality procurement processes are tightly tied to favour most inexpensive and economically competitive offers. The costs are strictly monitored. As the pilot project was aiming to incorporate three-pillar approach into the procurement criteria, the process was straining, and it was considered difficult to set a monetary value to all three pillar elements during the limited timeframe of the procurement process and renovation phase. The three-pillar goals were lacking support from the municipality, unless firstly justified with economic benefits at the present moment instead of distant future. The market readiness to produce solutions compatible of framed with the three-pillars point of view were not as high as expected. These types of requirements are not as commonly set as they are in Sweden for example, where the schemes, standards and catalogues for evaluating different aspects of the materials or stages of building process are part of the operating framework. The project had access to the BVB catalogue, but many of the products were not available at the Latvian market. A tool similar to the BVB catalogue was not available in the Latvian context. The NHC3 project was considered breaking the ice and allowing for a channel to introduce the three-pillar approach and why these points of views would be beneficial to consider.

As Riga concentrated on renovating an existing building, it was natural to focus on the circularity aspects and reuse as much of the existing materials. The project was able to justify for the most direct impactors of indoor air quality, such as paints to be evaluated and selected more carefully, as these are easier to evaluate with available information and have no large impact on the final project budget. Elements such as windows affecting the energy consumption and operating costs of the building were also justified from the purely economic angle. Therefore, these had an excellent cost-benefit ratio in the present moment.

The unfamiliarity with the environmental requirements, hazardous substances and related products was seen to influence the project also at the stage of selecting the final materials: as the budget and material evaluations were made, the costs were originally considered to be higher and the

work more complex, as the evaluator was not familiar with the new products and was used to a certain way of operating. The project was able to have another evaluation from an employee more familiar with the available products and options, and skilled in foreign languages, making it easier to interpret the BVB catalogue set as an example.

In **Västerås**, the project set high environmental standards for procurement, which were communicated to suppliers. This ensured that materials used in the construction contained less hazardous substances and met the project's sustainability goals. The procurement process involved setting ambitious targets for environmental performance. Suppliers were required to meet these targets, which included criteria for tox-free circular and climate friendly construction.

The project team conducted a sustainability workshop where they presented the goals and requirements to stakeholders. This workshop helped in aligning everyone with the project's objectives and ensuring commitment to high environmental standards.

The project team shared a material catalogue (utilising BVB) with the construction company early in the project and shared a vision of prioritising products marked with the label as “Recommended”. This supports the selection of products that meet the project's standards. One of the challenges mentioned was the financial constraints associated with wooden structure, instead of traditionally used concrete. The project team worked closely with suppliers to find cost-effective solutions while maintaining high environmental standards.

Practical obstacles related to circularity, such as storage and guarantees, were addressed through continuous dialogue with suppliers. This ensured that suppliers were aware of the project's needs and could provide materials that supported circularity. The open and constant dialogue with the suppliers enabled the suppliers to suggest innovative solutions to meet the project's requirements, such as measuring hazardous substances per square meter and optimising material use.

To reduce climate impact from the construction, the Västerås case opted for a wooden frame construction, reducing the carbon footprint of the building. Wood, being a renewable resource, has much lower footprint than concrete. All products shall be logged in BVB by weight. This will give a figure of hazardous substances per built square meter. This approach makes it possible to compare with other buildings and to set goals in future projects. After the tender was released, a workshop was conducted to view and set goals for climate, circularity and hazardous substances, ensuring all stakeholders were aligned with the project's environmental objectives. Once the design process started and the more precise plans were made, the orientation of the building was changed for better utilisation of the topographic conditions, solar load and manage rainwater and ground water more efficiently. The placement of the building on the plot was also reviewed so it would require less excavations. These decisions helped in achieving a Miljöbyggnad gold rating for climate with minimal additional effort.

On circularity, the project emphasised the reuse of materials. One example was keeping all windows the same size to facilitate future reuse. Products shall be assessed by BVB and logged in BVB. The targets of at least 20% Recommended and max and 5% To be avoided ensures the use of sustainable and circular products.

The pilot case aims to avoid hazardous substances in building materials to ensure a healthier environment by measuring and reducing hazardous substances. Continuous engagement with stakeholders ensures that the tox-free construction goals are met and maintained throughout the project.

Financial aspects are a major challenge to managing the project, especially as wooden frame construction is often more expensive than traditional methods, but also due to wooden construction material prices fluctuating.

As working with the three-pillar approach and setting more ambitious goals for the construction process than normal, the project is considered to be inspirational for those participating in the planning and building of it. The personal involvement and commitment of all stakeholders posed a major factor in the success of the pilot.

During the piloting phase, a significant challenge was acknowledged regarding the use of reused materials: the difficulty of storing them for extended periods due to high costs and limited storage space. This issue is a broader barrier to planning for circularity in construction projects. Additionally, the current legal framework requires finalised technical drawings at the time of building permit applications. This poses a challenge for incorporating reused materials, as their availability and condition are often uncertain at that stage, making it difficult to include them in the design plans.

To support circular practices, one practical solution is the standardisation of certain building elements—such as window dimensions—which would simplify the integration of reused components into new projects. However, without corresponding adjustments to the legal and regulatory framework, achieving a high degree of circularity in construction remains difficult.

Summary on the pilot learnings related to the three-pillar approach for tox-free, circular and climate-friendly public procurement of construction materials & buildings

To summarise the best learnings for easy replication, we advice to consider:

- **For setting stricter climate targets than national requirements:** Use lifecycle assessments to compare material costs and emissions, aiming to lower overall emissions. Consider, if any of the national requirements are set low considering your local climate conditions, level of ambition or other supporting element. Require contractors to document and show how they calculate their climate emissions – to ensure the set ambition level is also gained.
- **To enhance resource efficiency:** use modular and sustainable materials and consider reusing and recycling materials both during the building phase as well as at the end of the buildings or it's elements life cycle. For example, standardise elements like window sizes, to facilitate the reuse of materials and reduce complexity. Address any conflicting interests between circularity and tox-free goals by ensuring that materials are well-documented and tested for hazardous substances.
- **To Set high environmental standards for procurement:** Conduct sustainability workshops to align stakeholders with project objectives. Use material catalogues to guide suppliers in selecting approved materials. Measure and document the used materials and pay attention to the amounts of hazardous substances.
- **For utilising Flexible and Broad Criteria:** Consider keeping the procurement or marked dialogue criteria broad and flexible during initial stages to encourage innovative solutions. Allow architects and designers to propose solutions that contribute to climate neutrality without being constrained by overly specific requirements. Adapt criteria based on market readiness and feedback.
- **For encouraging Engagement:** Engage with suppliers and stakeholders to discuss material selections and their costs and benefits. Provide additional support to suppliers unfamiliar with certification requirements. Use open dialogue to address challenges and find innovative solutions. Ensure internal alignment within the municipality to support the three-pillar goals. Conduct workshops or training to educate internal and external stakeholders on the three-pillar approach and its benefits.
- **To utilise Checklist for incorporation of Green Public Procurement criteria and Roadmap-template which can be found from the project website.**

4.2 Piloting of Utilisation of green building certificates and eco-labels

The sub-solution on utilisation of green building certificates and eco-labels emphasises the importance of green building certificates and eco-labels in promoting sustainable construction practices. The different certification systems, like the Nordic Swan, DGNB, LEED and BREEAM aid to measure and compare the sustainable performance of the buildings. This applies also to the certified materials and eco-labelled materials (e.g. the Nordic Swan eco-label). By utilising certificates and eco-labels, the activities support resource efficiency and lifecycle approach. As the materials are known, it is easier and safer to care for them during their entire lifecycle.

From the NHC3 project perspective, the building certificates and eco-labels support the sustainability aims especially with their focus on:

- **Chemical Requirements:** Meeting strict chemical requirements to minimise and avoid the use of hazardous substances in building materials and products.
- **Lifecycle Approach:** Ensuring buildings and materials meet strict requirements throughout their lifecycle, from resource extraction and production to construction, use, and recycling stages.
- **Resource Efficiency:** Promoting resource efficiency, reduced climate impact, tox-free circular economy, and conservation of biodiversity.

Best practise cases and learnings on utilising green building certificates and eco-labels

During the piloting phase, it was observed that green building certifications were applied at four distinct levels, with the sub-solution divided into the following elements:

- Full certification of the building
- Designing or renovating in accordance with certification criteria, without formally applying for certification
- Selective use of elements from a certification scheme, without fulfilling all requirements for full certification
- Use of certified building materials

As detailed in the case profiles, the pilot projects in Stockholm, Helsinki, Tallinn, Riga, Holbæk, and Västerås provided valuable opportunities to test and draw inspiration from green building certifications and eco-labels. These cases offered clear examples and narratives illustrating how different aspects of certification schemes were applied in practice. Collectively, they demonstrate a range of approaches aligned with the four levels outlined above.

In **Stockholm**, the utilisation of green building certificates and eco-labels has been a fundamental part of their construction projects, ensuring that sustainability criteria are met and that all stakeholders are aligned with the project goals. Stockholm has over several years integrated green

building certificates, such as the Miljöbyggnad certification system, into its construction process. This system spans 15 indicators, includes requirements for a logbook to track materials and their compliance with sustainability standards. The city has emphasised the importance of these certifications in promoting sustainable construction practices and ensuring the outcomes meet expectations. For Stockholm, following the silver level of the certificate is a normal procedure. For the piloting, the team aimed for gold level, setting the level of ambition high, and aiming for best available techniques. Going for full certification allowed them to compare their practices between full-scale third-party evaluation and internal evaluation with no third party involved.

A key element of Stockholm's strategy is the use of BVB (Byggvarubedömningen) logbook-system, which mandates that suppliers list their products and adhere to specific sustainability criteria. This system has streamlined communication between the city and the market, ensuring that all parties understand the requirements and expectations. It also enables the use of consistent criteria and verification methods in the procurement processes. By employing a tool to ensure these criteria are understood throughout the building process, the certification processes are a strong motivator in contact with partners. BVB is a tool for monitoring the construction process to ensure that both certification and limiting the use of hazardous material requirements are met.

Despite the structured approach, Stockholm has previously encountered challenges—particularly with smaller companies that were unfamiliar with certification requirements or the BVB tool. To address this, the city has since invested additional resources in dialogue and support, helping professionals from companies better understand the expectations. In earlier cases, there were instances where third-party assessors failed projects due to non-compliance with required procedures by individuals or companies. This resulted in wasted investments in both process and administrative costs. This may generate public scepticism and reduce trust in the value of environmental investments overall. Recognising that this is not a desirable outcome, the city has placed particular emphasis on improving communication with the supply chain and market actors—an approach that is further detailed in the chapter Piloting of Supply chain communication and market dialogue.

In **Helsinki**, green building certificates and eco-labels have influenced especially the views on chemical safety and sustainability. As described at the Chapter 4.1 on supply chain communication and market dialogue, Helsinki's approach involved revising and enhancing the city's construction guidelines with a specific focus on chemical safety.

Although the City of Helsinki has experience with eco-certified building projects, it is not financially feasible to utilise full building certification in all its projects. Therefore, it is important to broadly apply the benefits of the certifications e.g. eco-labelled construction products. The city conducted a comprehensive review of existing guidelines related to construction and renovation, identifying areas where new criteria related to hazardous substances could be added. The green building certificates and eco-labels, especially the Nordic Swan and range of M1 certified products provided the city a good starting point to compare their guidelines against. The eco-labels and certified products and processes provided the city employees an organised approach in setting criteria and comparison in reducing the use of SVHC (Substances of Very High Concern) and POP (Persistent Organic Pollutants) substances at the building processes and materials.

Helsinki emphasised the importance of clear and well-justified guidelines, as these will guide the city building and construction processes beyond the projects reach. The guidelines have references to external justifications, such as regulation, explanations on eco-labels and certificates, which help in gaining acceptance from various stakeholders.

Just as **Helsinki**, both **Riga** and **Tallinn** were inspired by certification and eco-labels but considered the certification of an entire building to be too costly for the benefits provided, or too restraining on the building project budget. Riga, Helsinki and Tallinn aimed in utilising certified materials, or materials that meet the same standards as the certification implies and gained positive experiences with their approach in various steps of the management and construction processes. However, as it is not necessarily a mainstream activity in some areas and product categories to require eco-labels, it was found that not all market actors are familiar with the eco-labels and their implications. This also resulted in slow or strained communications between the municipality and the suppliers or other stakeholders.

Summary on the pilot learnings related to utilisation of green building certificates and eco-labels

To summarise the best learnings for easy replication, we advice to consider:

- **Benefits of certification of the building:** Certifications like the Nordic Swan provide third-party verification that sustainability goals are truly met, reducing the risk of greenwashing or underperformance. Certification systems offer structured tools and metrics that help track, compare, and improve building performance over time.
- **For costs and benefits:** Engage in open dialogue with suppliers and stakeholders to discuss material selections, costs, and benefits. Adapt material selection to local market conditions – this will also help keeping the emissions and costs from transportation down. Consider using certified or eco-labelled materials or those that meet the same standards as the certification implies if certification for the entire building is out of reach. For procurement criteria, consider examples from eco-labels and certified products, such as the Nordic Swan and M1 certified products, to reduce for example the use of SVHC (Substances of Very High Concern) and POP (Persistent Organic Pollutants) substances.
- **Tracking materials and their compliance with selected sustainability requirements:** When integrating only parts of a certification or when requiring the use of certified materials, require the use of a logbook to track materials and their compliance with sustainability requirements – from planning to implementation, this facilitates clear communication and compliance.
- **For revising construction guidelines:** Conduct a comprehensive review of existing guidelines related to construction and renovation to ensure a systematic and continuous path. Identify areas where new criteria can be added – is for example hazardous substances considered in your existing guidelines?
- **To keep the communication clear and understandable:** Ensure all stakeholders understand the requirements and expectations related to the set criteria or related green building certificates and eco-labels. Consider a separate event for training, seminar or dialogue to go through the set criteria, certificates or eco-labels – this also encourages smaller businesses to participate.
- **To utilise a Checklist for incorporation of Green Public Procurement criteria, which can be found from the project website.**

4.3 Piloting of supply chain communication and market dialogue

The sub-solution Supply chain communication and market dialogue aims to enhance collaboration and smooth operations. This chapter provides a more comprehensive and detailed description of the pilot activities, building on the broad introduction found in Chapter 3.3.

An effective collaboration helps to reduce delays and bottlenecks, which aids the projects to optimise resources. When all stakeholders work together with the same aim, tasks can be completed more efficiently. The collaboration among architects, engineers, contractors, and suppliers ensures that the project meets the requirement/objectives set for the project, as well as answers to the needs of the users and buyers. Each stakeholder brings their expertise, contributing to the overall quality of the construction.

By utilising active and targeted means of communication, such as supply chain communication and marked dialogue, the project has higher chances of continuous improvement and alignment with market capabilities. Collaborative environments foster innovation. Stakeholders can share ideas and develop creative or novel solutions to challenges that arise during the project.

By conducting market dialogue sessions, the activity fosters understanding and shaping of needs and technical requirements, simultaneously ensuring they are realistic and achievable within time and budget constraints.

Generally, conducting market dialogue refers to communication with external stakeholders. During the piloting, the NHC3 project also realised that there can be a need for an internal market dialogue in the implementing organisation itself. In the municipal building projects, there can be personnel from several different organisations acting under the umbrella organisation of the municipality. These different units, departments, organisations or activities may have a different understanding for example of the three-pillar approach. As the step referring to Needs investigation has most likely activated the different units considered as users of the construction or renovation project, the internal market dialogue gathers the different actors in charge of producing services or activities to implement the project. These units benefit from sharing views on the content, aims and implementation channels to incorporate the three-pillar approach.

Best practise cases and learnings on supply chain communication and market dialogue

As the chapters regarding case profiles already describe the main characteristics of the construction projects in the NHC3 project, this chapter focuses on **Best practise cases and learnings** the insights on working with the testing of the solutions have revealed. The piloting taking place in Stockholm, Tallinn, Holbaek, Helsinki and Riga provided most clear examples and narrative on utilising the supply chain communication and market dialogue. These were considered as most suitable to be presented, providing inspiration and practical angles for municipalities and other actors interested in replicating such activities.

Since the pilot cases varied in size, priorities, budgets, and implementation teams, they offered a diverse and valuable testing ground for the proposed management process solutions.

Each pilot incorporated elements of the sub-solutions in a way that best suited its specific context. Not all partners applied every element, but each selected those most relevant to their needs. This flexible application supports the project's broader aim: to develop **a replicable solution** that other municipalities can adopt to improve their construction processes, particularly in reducing hazardous substances.

The piloted elements of the sub-solution on supply chain communication and market dialogue were:

- Continuous market dialogue
- Market dialogue events, market surveys, consultations or direct supplier engagement
- Internal stakeholder alignment
- Communication of long-term goals externally
- Providing education and support for suppliers
- Considering alternative engagement strategies

In **Stockholm**, the City has used supply chain communication and market dialogue to ensure that sustainability criteria are met and that all stakeholders are aligned with project goals. Stockholm has emphasised continuous market dialogue, not just as a preliminary step but as an ongoing process throughout the project lifecycle. This approach ensures that the market is prepared to meet the city's sustainability requirements. The city has engaged in national-level discussions and maintained regular communication with stakeholders, including construction companies, suppliers, and certification bodies.

One key aspect of Stockholm's approach has been the use of the BVB (Byggvarubedömningen) system, which requires suppliers to list their products and meet specific sustainability criteria. BVB is a tool to support in the supply communication processes, as all the required information on the materials are found from the system catalogue, and the system allows different actors to communicate through the system with each other. This system has facilitated clear communication between the city and the market, ensuring that all parties understand the requirements and expectations. The city has used the Miljöbyggnad building certification system, which includes requirements for a logbook to track materials and their compliance with sustainability standards.

Externally, the city has communicated its long-term ambitions to the market, ensuring that both large and small construction companies are aware of the standards they need to meet. This has included detailed procurement texts that specify the sustainability criteria and the verification processes that will be used to ensure compliance.

Despite the structured approach, Stockholm has faced challenges, particularly with smaller companies that may not be familiar with the certification requirements. To address this, the city has provided additional support and clarification to these companies, ensuring they understand what is required. Moreover, the city has adapted its strategies based on feedback from the market. For instance, when certain sustainability criteria were not met, Stockholm engaged in supply chain communication to understand the reasons and to find solutions. This iterative process has allowed the city to refine its requirements and improve compliance over time.

In **Tallinn**, the implementation of supply chain communication and market dialogue in a structured way are a novelty part in construction projects, particularly in integrating sustainability criteria. The city has utilised these strategies aiming to align with environmental goals and stakeholder expectations.

Tallinn's approach to market dialogue has involved organising consultations and engaging with stakeholders such as material manufacturers and construction companies to discuss the integration of sustainability criteria in construction projects. The initial criteria were kept broad and flexible to encourage innovative solutions and support the dialogue.

Internally, Tallinn has emphasised the importance of regular discussions and meetings to align the project team with the sustainability goals. These meetings have been crucial in ensuring that all team members understand the project's environmental objectives and their roles in achieving them. Externally, the city has faced challenges in engaging the market, particularly when there is no

specific procurement linked to the consultations. To address this, Tallinn has conducted online questionnaires to gather feedback from companies on environmentally friendly materials and certifications. Although the response rate was low, the feedback provided valuable insights into the market's readiness and the potential for using specific certifications like M1 for indoor air quality.

Holbaek's approach to market dialogue involved reaching out to manufacturers and local businesses to discuss the integration of sustainable construction materials. However, the municipality faced challenges in engaging these stakeholders. Manufacturers were hesitant to participate, fearing that the municipality's involvement might lead to scrutiny and control over their processes.

Despite these challenges, Holbaek attempted to foster dialogue by inviting manufacturers to meetings and site visits. Unfortunately, the response was limited, and the market dialogue did not proceed as planned. This experience highlighted the need for a different approach, possibly involving architects or other intermediaries who might be better positioned to engage with manufacturers. Architects, with their expertise and connections, could perhaps facilitate better communication with manufacturers and help integrate innovative, sustainable materials into construction projects.

During the piloting activities, Holbaek noted the importance of clear communication and data management. The municipality discovered that the quality of data on construction materials was limited. The issues concerned unreadable receipts and resulted as lack of quality assurance compared to the three-pillar approach. This realisation led to efforts to improve data collection and management processes, ensuring that future projects have better documentation and traceability of materials.

Helsinki's approach to market dialogue involved revising and enhancing the city's construction guidelines with a specific focus on chemical safety, which was noted to gain less attention prior to the project. The process began with internal consultations involving various city departments, including ATT (Asuntotuotanto), Heka (Helsingin kaupungin asunnot Oy), and Stara (the city's construction service). These consultations aimed to identify and implement improvements in existing guidelines, so that the learnings from the NHC3 project would be incorporated in the existing processes.

The city conducted a comprehensive review of existing guidelines related to construction and renovation, identifying areas where new criteria related to hazardous substances could be added. This included expanding the M1 classification requirement to fixed furniture and introducing new criteria for SVHC (Substances of Very High Concern) and POP (Persistent Organic Pollutants) substances.

To gather feedback on these proposed changes, Helsinki conducted a market survey. The survey targeted architects and contractors, asking for their input on the new guidelines and their current practices regarding chemical safety and environmental standards. Each new criterion added to the guidelines was supported by factual justifications, which helped in gaining acceptance from various stakeholders. In supporting the supply chain communication, the city also recognised the need for better data management and quality assurance, particularly in collecting and verifying safety data sheets for construction materials.

Even if market dialogue is not a new process to the City of Helsinki, they did face several challenges in market dialogue efforts. One significant challenge was the low response rate to the market survey, which highlighted the need for more effective engagement strategies to ensure higher participation from stakeholders. Reminders and follow-ups were not successful in raising the response rate significantly. Even with a low response rate, the survey however revealed that knowledge about SVHC substances was relatively low among contractors, indicating a need for further education and communication.

Additionally, as a large and complex entity, the city encountered difficulties in aligning its internal processes and ensuring that all relevant departments were on the same page. This was compounded by staff changes, which slowed down the process of updating the guidelines.

In **Riga**, the piloting focused on renovation of individual apartments, making it a smaller-scale initiative compared to full-scale construction. Given the limited scope and a tight budget, a comprehensive market dialogue was deemed impractical, as it would have delayed implementation. Instead, the team focused on internal stakeholder alignment, consultation and direct supplier engagement which proved to be a decisive factor in navigating supply chain communication and material selection.

From the outset, the project team established a shared understanding of the pilot's sustainability goals—particularly the emphasis on tox-free materials. This internal consensus enabled the team to engage in a focused and efficient dialogue with the supplier, exploring feasible material options within the constraints of local availability.

Although the supplier was initially unfamiliar with the BVB catalogue and eco-labelling practices, the team's unified stance helped guide the conversation. They collaboratively identified alternative materials with similar environmental properties that were accessible in the local market. Procurement rules prevented the specification of exact brands or distributors, so the team described the required material characteristics in detail, ensuring alignment with the three-pillar approach.

A key challenge emerged when the initial cost estimator resisted the use of unfamiliar materials. Here again, internal alignment played a pivotal role: the team collectively decided to involve another estimator who was willing to explore new solutions. This strategic internal shift not only accelerated decision-making but also reinforced the project's commitment to innovation and sustainability.

Ultimately, the Riga pilot demonstrated that even in the absence of a full market dialogue, clear internal alignment can drive effective supplier communication, overcome resistance to change, and ensure the successful implementation of sustainable practices.

In **Västerås**, the municipality has utilised supply chain communication and active dialogue with the contractor and other parties involved to ensure that sustainability requirements are fulfilled and that all involved parties share the project's objectives. Västerås has placed strong emphasis on maintaining an ongoing dialogue with everyone in the project, not just at the project start but throughout the entire duration of the project. This method helps ensure the project meets the city's environmental ambitions. The city has also taken part in discussions at the national level and kept continuous contact with key stakeholders such as contractors, suppliers, and certification organisations.

Summary on the pilot learnings related to supply chain communication and market dialogue

To summarise the best learnings for easy replication, we advice to consider:

- **For continuous market dialogue:** Maintain ongoing communication throughout the project lifecycle, not just as a preliminary step. This ensures that sustainability criteria are met, and all stakeholders remain aligned with project goals.
- **For structured implementation:** Integrate sustainability criteria through consultations – and consider keeping the initial criteria broad and flexible to encourage innovative solutions. Organise internal discussions at a municipality with different units to ensure some internal market dialogue for agreement on sustainability criteria implemented.
- **For adaptation to local conditions:** Keep in mind, that the market conditions or climate are not the same regardless of location. Organise consultations and engage with various stakeholders to discuss the integration of suitable sustainability criteria for your location.
- **For alternative engagement strategies:** When facing challenges in engaging a stakeholder, consider a different approach, like engaging architects or other intermediaries instead who might be better positioned to facilitate communication. Improve data collection and management processes to ensure better documentation and traceability of materials.
- **For informed participation and broad supplier network:** Provide additional support and clarification to smaller companies unfamiliar with certification requirements. Consider providing education for staff and stakeholders.
- **Availability of data:** Verify that the data collection system ensures complete documentation and traceability of material composition, including hazardous substances.
- **To utilise Checklist for advancing supply chain communication and Checklist for a market dialogue strategy for communication, which can both be found from the project website.**

5. Conclusions

The piloting activities conducted within the NonHazCity3 (NHC3) project have demonstrated that strategic solutions for managing hazardous substances in construction can be both actionable and scalable. The three sub-solutions or elements of sub-solutions —the three-pillar approach, utilisation of green building certificates and eco-labels, and supply chain communication and market dialogue—were successfully tested across diverse municipal contexts, each offering valuable insights and pathways for replication.

1. Strategic Solutions Are Scalable and Adaptable

The piloted solutions proved effective across municipalities with varying levels of experience, resources, and regulatory environments. Whether a municipality was a forerunner in sustainable construction or just beginning to explore these practices, the strategic tools and frameworks offered a flexible foundation for action. The ability to apply elements of the solutions, supported by the utilisation of checklists and roadmaps— allowed for both structured implementation and local adaptation, making it easier for municipalities to tailor the approach to their specific context and needs.

2. Municipalities Took Concrete Steps Toward Tox-Free Construction

Each participating municipality advanced its practices during the piloting phase. Some revised internal guidelines, others introduced new procurement criteria, and many engaged in deeper market dialogue than before. These steps—though varied in scale—collectively represent meaningful progress toward reducing hazardous substances in construction and promoting healthier, more sustainable built environments.

3. The Three-Pillar Approach Supports Holistic Sustainability

The integration of tox-free, circular, and climate-friendly principles into procurement and planning processes helped municipalities address sustainability in a comprehensive way. While challenges such as market readiness and cost constraints were encountered, the approach provided a clear direction and rationale for setting higher ambitions.

4. Market Dialogue and Internal Collaboration Are Key Enablers

Successful implementation was often driven by effective communication—both externally with suppliers and internally across municipal departments. Market dialogue helped clarify expectations

and assess feasibility, while internal alignment ensured that sustainability goals were embedded throughout the project lifecycle.

5. Certification Systems and Eco-Labels Enhance Transparency and Accountability

Green building certificates and eco-labels served as valuable tools for verifying compliance, guiding material selection, and communicating sustainability goals. Even when full certification was not pursued, elements of these systems were widely used to strengthen procurement and design decisions.

The NHC3 piloting has shown that strategic planning, when supported by practical tools and collaborative processes, can significantly enhance the sustainability of municipal construction projects. These experiences offer a replicable model for other municipalities in the Baltic Sea Region and beyond, contributing to a broader shift toward healthier, more resilient, and environmentally responsible building practices.

6. Executive Summary

This document has introduced and discussed the piloting of NHC3 strategical solution and sub-solutions, and the pilot experiences related to these. We have presented experiences from NHC3 project pilots at different phases of management process steps, testing and utilising the strategic management process comprising of three steps:

1. needs investigation
2. vision and ambitions, and
3. market analysis and dialogue.

As well as the three sub-solutions, which are:

- The three-pillar approach for tox-free, circular and climate-friendly public procurement of construction materials and buildings
- Utilisation of green building certificates and eco-labels
- Supply chain communication and market dialogue as a tool for improvement of the strategic management processes of construction projects

In the previous chapters, this document has provided a comprehensive overview of the steps, sub-solutions, project activities, and piloting experiences. It presented activity descriptions of the piloting activities, focusing on best practice cases and key learnings. The selected cases offer clear examples and narratives on utilising each sub-solution, highlighting the lessons that can be extracted and replicated. To enhance clarity and narrative flow, we have included only the most distinct pilot experiences, as some were quite similar across municipalities.

	Västerås	Holbaek	Riga	Stockholm	Helsinki	Tallinn
Step one, Needs investigation	E	E	E			
Step two, Setting vision and ambition		E		E	E	
Step three, Co-operation with the markets	E			E	E	E
Three-pillar approach	E		E	E		E
Utilisation of green building certificates and ecolabels	E	E	E	E	E	E
Supply chain communication and market dialogue		E	E	E	E	E

E = Used as an example in the document

Elements of the steps and sub-solutions piloted

Table 1. Overview of Pilot implementation across cases.

To summarise the piloting experiences and findings, this document highlights each step and sub-solution, along with how the municipalities implemented them. An overview of the pilot implementation across sites is presented in Table 1. The summary aims to help readers identify sections and elements they can replicate or consider in their own organisations, while also pointing out potential challenges to avoid.

6.1 Strategic management process steps

Step One: Needs investigation

How to proceed:

- Identify and understand the requirements and expectations for the project.
- Gather information from stakeholders and analyse their needs.
- Create a focused plan that aligns with the objectives of the construction project.

Municipality experiences implementing the step:

- **Västerås:** Emphasised sustainability and flexibility in the design and construction of a preschool building, using concrete for the foundation and wood for the bearing structure to reduce the carbon footprint.
- **Holbaek:** Prioritised life cycle assessment, social, economic, ecological quality, and resource efficiency in the Jyderup kindergarten construction project. Utilised natural materials and large canopies to enhance durability and environmental impact.
- **Riga:** Working in an environment of strictly defined guidelines on financing and reporting, the project selected representatives from different parts of the municipality to the dedicated implementation team. The team held planning meetings to work out criteria for tox-free materials, circularity, and climate friendly solutions, creating a focus on internal capacity and stakeholder needs.

Step Two: Setting vision and ambition

How to proceed:

- Set higher demands on building materials than national laws require.
- Use complementary instruments like planning documents, economic incentives, and information instruments to support ambitious targets.
- Address financial and political constraints to implement sustainable construction projects.

Municipality experiences implementing the step:

- **Stockholm:** Set local energy requirements stricter than national laws. Aligned such goals with other well-known voluntary rules, in the case of Stockholm, Miljöbyggnad Gold. Required municipal companies to build solar panels and mandated the use of green electricity deals like water- and solar-power only electricity.
- **Holbaek:** Mapped out legal requirements related to the three-pillar approach, including regulations on construction products, climate impact calculations, and mandatory lifecycle assessments.
- **Helsinki:** Proposed improvements for current instructions for architects, engineers, and contractors, emphasising the use of eco-labelled materials and products, and setting ambitious goals above legal requirements.
- **Västerås:** The project's goal has been to at least meet the municipality's environmental goals regarding climate, HS and sustainability. The municipality requires at least Miljöbyggnad Silver, but in this project, it will be possible to achieve Gold.

Step Three: Co-operation with the markets

How to proceed:

- Ensure suppliers understand requirements for building materials and products.
- Engage in proactive market dialogue to clarify technical requirements already during tendering.
- Use long-term ambitions, feedback loops, and expert opinions to meet technical requirements.

Municipality experiences implementing the step:

- **Stockholm:** Emphasised continuous market dialogue throughout the project lifecycle, using the BVB system to facilitate clear communication with suppliers and ensure compliance with sustainability standards.
- **Västerås:** Utilised continuous dialogue and standardised systems to ensure suppliers and stakeholders were informed about sustainability requirements, using BVB and the certification system Miljöbyggnad.
- **Tallinn:** Conducted online questionnaires to gather feedback from companies on environmentally friendly materials and certifications, addressing challenges in engaging the market.

- **Helsinki:** Revised and enhanced construction guidelines with a focus on chemical safety, conducted a market survey to gather feedback, and streamlined and guided internal processes.
- **Riga:** Focused on open dialogue with suppliers, emphasising the importance of tox-free materials and adapting material selection to local market conditions.

6.2 Sub-solutions of the strategic management process

The three-pillar approach for tox-free, circular and climate friendly public procurement of construction materials and buildings.

How to proceed:

- **Set stricter targets to the three-pillar aspects than national requirements** and ensure these are referred to from market dialogue to procurement, implementation and review. Require documentation to ensure the set ambition level is also gained.
- Use lifecycle assessments and engage with suppliers and stakeholders to compare material costs and emissions. Use modular and sustainable materials and consider reusing and recycling materials both during the building phase as well as at the end of the buildings or it's elements life cycle.
- Consider keeping the procurement or marked dialogue criteria broad and flexible during initial stages to encourage innovative solutions.

Municipality experiences implementing the sub-solution:

- **Stockholm:** Set stricter three-pillar targets than national requirements, used lifecycle assessments, and emphasised modular and sustainable materials.
- **Tallinn:** Kept sustainability criteria broad and flexible during initial stages, used modular wood construction to reduce carbon footprint and to ensure tox-free material use.
- **Riga:** Focused on circularity and reuse of existing materials, faced challenges in setting monetary value to three-pillar aspects.
- **Västerås:** Set high standards in the procurement stage, conducted sustainability workshop, and used wooden frame construction to reduce carbon footprint. Included stronger goals on BVB recommended products and BVB products to be avoided to ensured tox-free material use.

Utilisation of green building certificates and eco-labels

How to proceed:

- Promote sustainable construction practices through green building certificates and eco-labels. Keep in mind the entire lifecycle of the building. Utilise certified materials or those meeting the same standards if full building certification is not feasible. Add your learnings to your organisation's guidelines – to ensure systematic and continuous implementation.
- Ensure all stakeholders understand the requirements and expectations related to the set criteria or related green building certificates and eco-labels.

- Require the use of a logbook to track materials and their compliance with sustainability standards.

Municipality experiences implementing the sub-solution:

- **Stockholm:** Integrated green building certificates like Miljöbyggnad into construction projects, used the BVB system to track materials and ensure compliance with procurement demands.
- **Helsinki:** Revised construction guidelines with references to eco-labels and certificates, emphasising chemical safety and sustainability.
- **Tallinn:** Inspired by certification and eco-labels, aimed at using certified materials or those meeting similar standards.
- **Riga:** Considered certification of an entire building too costly, focused on using certified materials and adapting to local market conditions.
- **Holbaek:** Utilised green building certificates and eco-labels to ensure sustainability criteria were met in construction projects.
- **Västerås:** Emphasised sustainability in procurement processes and adding more product details in the BVB logbook.

Supply chain communication and market dialogue as a tool for improvement of the strategic management processes of construction projects

How to proceed:

- Enhance collaboration and smooth operations to reduce delays and bottlenecks. Utilise continuous market dialogue or separate events to shape needs and technical requirements as well as to take into consideration the local market conditions. Ensure documentation and traceability of materials.
- Foster innovation through collaborative environments and continuous improvement. Consider keeping the initial criteria broad and flexible to encourage innovative solutions.
- Provide additional support and clarification to smaller companies unfamiliar with certification requirements. Consider providing education for staff and stakeholders.

Municipality experiences implementing the sub-solution:

- **Stockholm:** Emphasised continuous market dialogue throughout the project lifecycle, used the BVB system to facilitate clear communication with suppliers and ensure compliance with sustainability standards.
- **Tallinn:** Organised consultations and engaged with stakeholders to discuss sustainability criteria, keeping initial criteria broad and flexible to encourage innovative solutions.
- **Holbaek:** Faced challenges in engaging manufacturers, highlighting the need for different approaches like involving architects to facilitate communication.
- **Helsinki:** Revised construction guidelines with a focus on chemical safety, conducted a market survey, and faced challenges in aligning internal processes.
- **Riga:** Focused on open dialogue with suppliers, emphasising the importance of tox-free materials and adapting material selection to local market conditions.