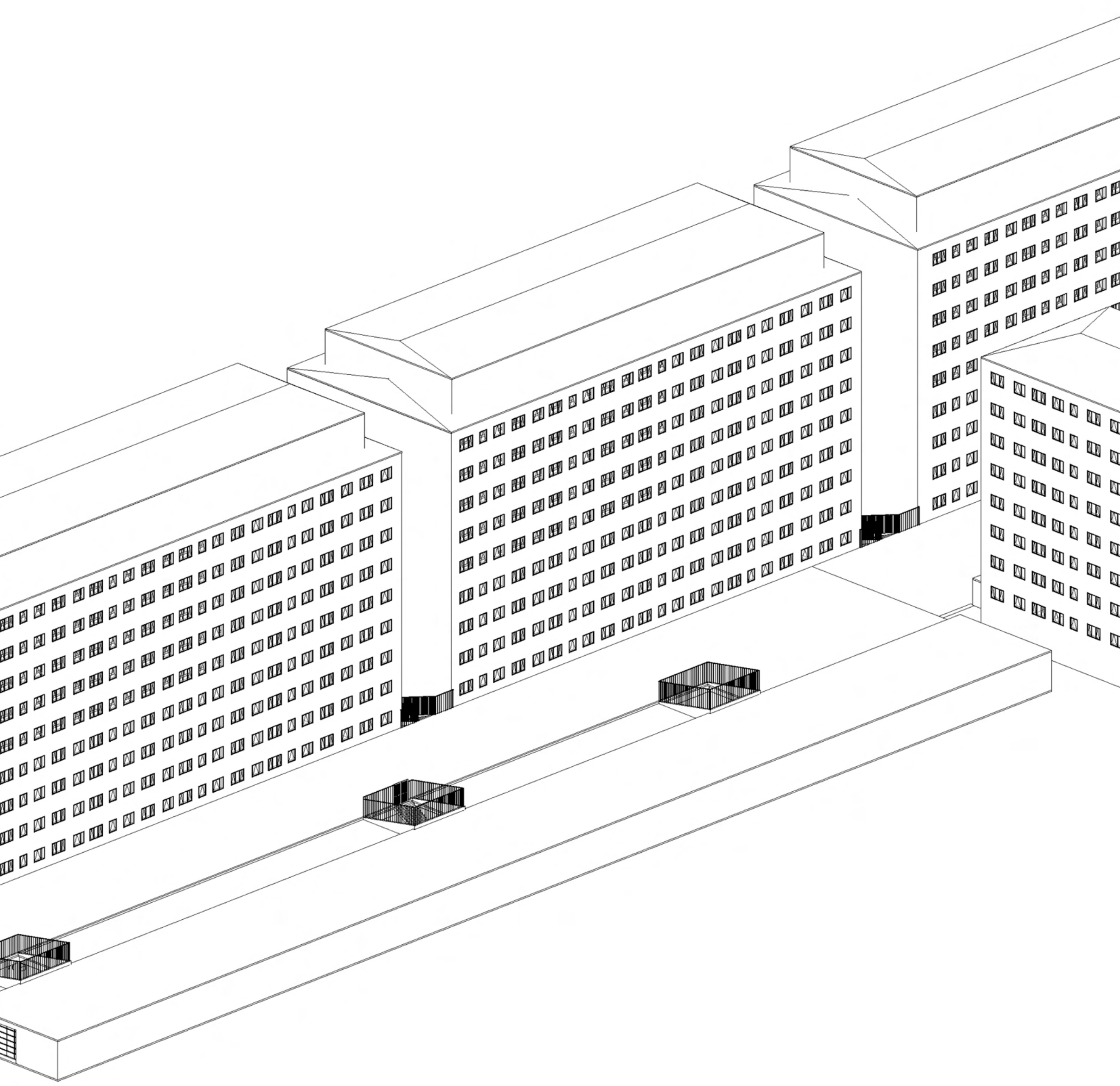
REIMAGINING HAMMARKULLEN

ADAPTIVE REUSE OF A BASEMENT THROUGH URBAN COMMONS AND SPATIAL JUSTICE



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Chalmers School of Architecture
Department of Architecture & Civil Engineering

MASTER THESIS 2025

Examiner: Marco Adelfio
Supervisor: Jessica Lundin, Emilio Da Cruz Brandao

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ADAPTIVE REUSE OF A BASEMENT THROUGH URBAN COMMONS AND SPATIAL JUSTICE

CHALMERS
UNIVERSITY OF TECHNOLOGY

Society, Justice, Space
Chalmers School of Architecture
Department of Architecture & Civil Engineering Master's Program:
Architecture and Planning Beyond Sustainability
Examiner: Marco Adelfio
Supervisor: Jessica Lundin + Emilio Da Cruz Brandao

ABSTRACT

This thesis explores how neglected urban infrastructures can be reimagined as urban commons to advance social sustainability, spatial justice, and community resilience. Taking an abandoned basement parking facility in Hammarkullen, Gothenburg, as its test case, the study challenges prevailing demolition-oriented planning logics and examines adaptive reuse as a socially and environmentally responsible alternative.

Grounded in the theoretical frameworks of urban commons and spatial justice, and supported by concepts of adaptive reuse, resilience, and socio-technical systems, the research combines spatial and contextual analysis, policy review, interviews with local stakeholders, and insights from case studies. The design approach emphasizes incremental transformation, collective governance, and the integration of productive systems such as hydroponics.

While the project is site-specific, it offers a broader provocation: that neglected infrastructures, often dismissed as liabilities, can be repositioned as infrastructures of inclusion and resilience. In doing so, the thesis suggests pathways for architectural and urban practice that extend beyond technical solutions toward socially anchored transformation.

Keywords:
Urban Commons; Spatial Justice; Adaptive Reuse; Resilience; Hydroponics; Socio-Technical Systems; Circular Economy; Hammarkullen

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I extend my gratitude to my friends, whose curiosity and interest in my thesis gave me the feeling that I was doing something worthwhile. Their questions and discussions motivated me to continue and reminded me that my work had value.

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To all of you who have supported, encouraged, or inspired me along this journey, I am truly grateful.

AUTHOR BACKGROUND

NITHIN JACOB

THESIS MOTIVATION

For me, it was important that my thesis addressed a real-life scenario with the potential to contribute meaningfully to society. I have always seen myself as a practical person, with ideas rooted in reality, and I wanted my project to reflect that. Choosing the Hammarkullen basement case gave me the opportunity to explore something entirely new, hydroponics and its social potential while working within a diverse community context in Gothenburg. At first, I was uncertain about starting this journey since it was an area I had never explored before, but the challenge became my motivation. The process allowed me to learn, adapt, and engage with ideas outside my previous experience, which made the work both exciting and rewarding. This project was not only just about design but also about understanding people, place, and possibilities. And the support of my supervisors and examiner were invaluable in helping me navigate this path, turning what initially felt daunting into a meaningful and enriching experience.

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2023 – 2025 Master's program
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- Key Projects for Sustainable Development in a Local context

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Chapter One -
INTRODUCTION

1.0 Problem Statement

Across many cities, large-scale modernist housing developments face disinvestment, underuse, and stigmatization. Spaces once designed for efficiency, such as basement parking facilities, have become redundant due to shifting mobility patterns and urban lifestyles. Left abandoned, these infrastructures often turn into zones of neglect, insecurity, and social fragmentation.

In Hammarkullen, Gothenburg, a former basement parking facility now lies underutilized, raising the dilemma of demolition versus reactivation: demolition risks erasing material resources and latent social potential, while neglect reinforces marginality.

Planning approaches often address sustainability in fragmented ways, focusing on environmental technologies, social programming, or economic viability in isolation. Rarely are these dimensions integrated within a holistic framework that accounts for governance, access, and collective agency.

This thesis argues that applying the dual lenses of urban commons and spatial justice provides a critical framework for rethinking abandoned spaces, not as voids, but as potential infrastructures of inclusion, collective benefit, and resilience.

"Do you feel that abandoned spaces in Hammarkullen are a threat or an opportunity?" "It feels like both... they are unsafe as they are, but at the same time, they could become something useful, something shared."

— Extract from resident interview

In Hammarkullen, the abandoned basement facility embodies this tension: a space of neglect, yet also a latent resource for community engagement and cultural programming. The challenge extends beyond physical design to questions of governance and equity: who decides, for whom, and to what end? By situating Hammarkullen's basement as a test-bed, this thesis explores how abandoned infrastructures can be repositioned as shared urban commons that prioritize social sustainability, foster community resilience, and offer transferable lessons for other urban contexts.

1.1 Purpose

The purpose of this thesis is to explore how neglected urban infrastructures can be reactivated through the principles of urban commons and spatial justice, with social sustainability and justice as the primary focus. Using Hammarkullen's abandoned basement facility as a test site, the project demonstrates how research-informed reactivation processes, drawing on insights from local actors, can produce spaces that are socially inclusive, collectively governed, and resilient, while also considering environmental regeneration and economic feasibility.

Beyond the local intervention, the thesis aims to generate transferable insights for architectural practice, showing how speculative, context-sensitive design can test new models of socially equitable, environmentally conscious, and adaptive urban transformation.

1.2 Aim

The thesis aims to:

Bridge theory and practice by applying urban commons and spatial justice as conceptual frameworks to the reactivation of an abandoned basement facility in Hammarkullen,

Challenge conventional redevelopment logics of demolition and top-down planning by demonstrating research-informed, phased, and context-sensitive alternatives.

Develop a context-specific reactivation framework for Hammarkullen that integrates social inclusion, collective governance, environmental sustainability, and economic feasibility, while generating transferable principles and methodological lessons for architectural practice.

1.3 Thesis Question

How can neglected urban infrastructures be transformed into urban commons to advance social sustainability, spatial justice, and community resilience, and what insights can a case study of Hammarkullen's basement provide for broader urban design and architectural practice?

Objectives

1. Examine theoretical frameworks: Investigate how urban commons and spatial justice can guide the reactivation of neglected infrastructures, prioritizing social sustainability and equitable access.

2. Analyze the local context: Study Hammarkullen's basement through spatial analysis, site observation, and community insights to identify opportunities for socially inclusive and collectively governed use.

3. Integrate research into design: Use insights from the site and local actors to inform speculative, modular, and staged design proposals that explore equitable and resilient spatial strategies.

4. Evaluate functional options: Test different programmatic scenarios (e.g., community facilities, cultural uses) through comparative analysis and case studies to assess potential for social inclusion, collective stewardship, and environmental considerations.

5. Reflect on transferability: Identify principles and methodological insights from Hammarkullen that can inform architectural practice in other urban contexts.

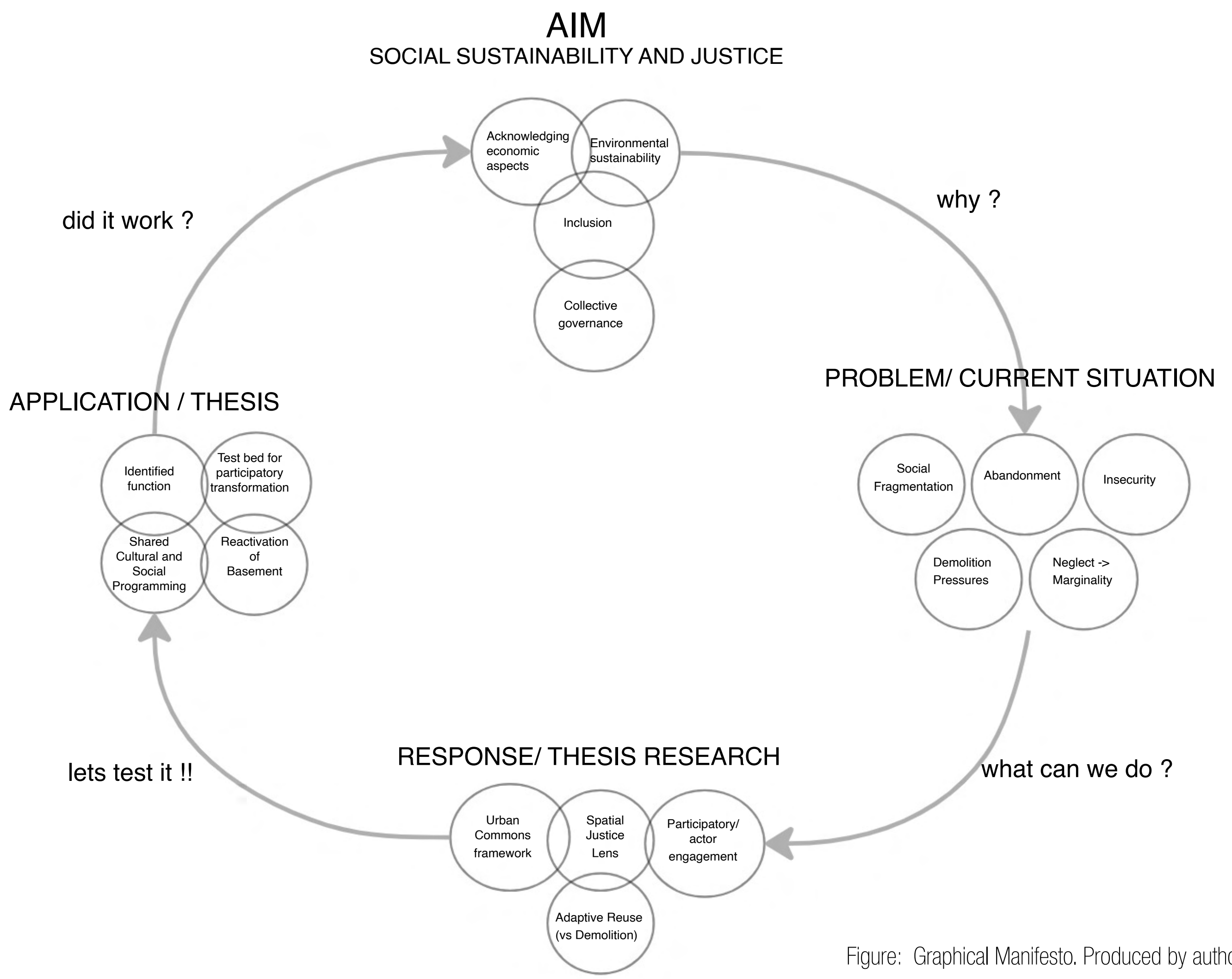


Figure: Graphical Manifesto. Produced by author.

1.4 Methodology

This thesis adopts a design-driven and cyclical approach, combining research for design (gathering knowledge to inform design decisions) with research by design (using speculative design explorations to generate new knowledge). The process unfolded in cycles rather than a linear sequence, moving between theoretical study, contextual analysis, and design experimentation.

Anchored in the frameworks of urban commons and spatial justice, the methodology positioned research not only as a tool for understanding context but also as a means of testing how principles of collective governance, equitable access, and shared resources could be translated into design strategies. Each step of the process was therefore interpreted through these theoretical lenses, ensuring that design decisions remained tied to broader questions of justice and inclusion.

At the same time, the methodology acknowledges its boundaries. Within the scope of an academic master's thesis, participation was necessarily partial: semi-structured interviews and prior engagements informed the work, but the process stops short of full co-design or community authorship. Similarly, the design outcomes are presented as speculative and narrative provocations rather than finalized technical solutions, with the intention of sparking dialogue and providing a foundation for future participatory and governance processes

Spatial and Contextual Analysis

The project began with an investigation of Hammarkullen's spatial, demographic, and infrastructural conditions. Mapping exercises explored residential density, mobility networks, and land-use typologies, revealing patterns of fragmentation and disconnection. Read through the lens of spatial justice, these mappings highlighted unequal access across the neighborhood, while the perspective of the urban commons identified the basement's potential as a hinge space capable of connecting fragmented building typologies and community clusters. Actor-network thinking further guided the identification of relationships between people, programs, and spaces, extending the analysis from physical form to social interdependencies.

Engagement with Local Actors

Semi-structured interviews with housing company representatives, community organizers, and local residents provided insights into redevelopment intentions, everyday challenges, and local aspirations. While time limitations restricted extensive participatory workshops, the research was grounded in the author's previous engagements in Hammarkullen through design-build projects and studio collaborations. Informed by participatory and pluriversal design theory, these conversations were framed as opportunities to surface diverse perspectives that might otherwise remain excluded. Through spatial justice, this step directly addressed the question of whose voices are heard in shaping urban futures, while the commons framework pointed toward possibilities of shared governance and co-stewardship.

Policy and Regulatory Review

A critical review of Swedish environmental regulations and building codes assessed how demolition practices intersect with sustainability objectives. Guided by theories of adaptive reuse and the circular economy, the review emphasized the environmental, social, and economic implications of material preservation. Comparative studies of demolition versus reuse highlighted the hidden costs of teardown strategies while underscoring the broader societal benefits of maintaining existing structures. Connecting this review to the framework of the urban commons positioned the basement as a shared resource whose value extended beyond private ownership, while the lens of spatial justice revealed how regulatory choices shape who benefits and who loses from redevelopment. These insights directly informed the project's design decision to pursue adaptive reuse and collective functions rather than demolition-based redevelopment.

Comparative Functional Analysis

A comparative matrix of potential reuse scenarios was developed to test different programmatic directions for the basement. Options ranging from community facilities to urban agriculture were evaluated against the project's overarching goals of sustainability, inclusion, and resilience. The method was explicitly framed through the urban commons, examining how each option could support collective use and shared stewardship, while the lens of spatial justice guided evaluation of equity, accessibility, and fair distribution of resources. This dual perspective clarified the rationale for prioritizing urban hydroponics, which could simultaneously produce shared value and foster inclusive community participation.

Case Study Analysis

Urban hydroponic farming initiatives in Sweden were analyzed as reference projects, focusing on their operational models, financial structures, and strategies for community integration. Informed by resilience theory and socio-technical systems thinking, the analysis revealed interdependencies between technological infrastructure, economic feasibility, and social acceptance. Interpreted through the urban commons, hydroponics was framed as a shared productive resource requiring governance and equitable access. From the perspective of spatial justice, these initiatives were considered as potential tools for empowerment and participation, rather than simply technical solutions. This framing reinforced the feasibility of testing hydroponics within the Hammarkullen basement as both a sustainable and socially just intervention.

Design through Narrative and Staging

The final stage of the methodology integrated analysis and theory into a speculative design proposal. Storytelling methods and fictional personas were used to narrate the design across temporal stages, showing how the basement could evolve over time. This narrative method, informed by actor-network mapping and narrative design theory, emphasized process over final form, presenting design as an evolving relational system. Understood through the lens of the urban commons, the narrative redistributed authorship of space by integrating multiple imagined voices. Through spatial justice, it visualized scenarios of more equitable access, governance, and inclusion, demonstrating how design could provoke critical discussion of justice-oriented futures.

Methodological Position

By interweaving empirical research, theoretical grounding, and speculative design, the methodology critiques dominant redevelopment logics (such as demolition) and proposes an alternative architectural mode of inquiry. The approach embraces iteration, situated knowledge, and subjectivity, acknowledging design as both a tool of analysis and a provocation. Within this framing, the project positions architecture not solely as the production of built form, but as a means of testing, visualizing, and advancing principles of the urban commons and spatial justice.

1.6 DELIMITATIONS

Structural Feasibility

The structural capacity of the basement parking facility lies outside the scope of this thesis. While site observations indicated the presence of added supports, suggesting potential limitations in load-bearing capacity, the building does not present an immediate safety risk. In line with this, the design proposal assumes no new structural loads. A comprehensive structural analysis, requiring the expertise of structural engineers, is beyond the remit of this architectural thesis. The project therefore focuses on spatial strategies, programmatic possibilities, and social implications rather than technical construction detailing.

Extent of Participatory Engagement

This thesis recognizes that participatory processes are essential when working toward spatial justice. However, within the framework of an academic master's thesis, participation has been necessarily limited. The project did not include extensive co-design workshops or long-term collaborative engagements. Instead, community perspectives were incorporated through semi-structured interviews with local actors, complemented by the author's prior involvement in Hammarkullen through design-build and studio-based projects. These engagements provided grounded insights into local aspirations and challenges, yet the work does not claim to represent a co-authored process. Rather, the thesis should be understood as a speculative and propositional contribution that can inform, and be further developed within, future co-design and governance dialogues. In this way, the process is participatory in its grounding but not participatory in its authorship.

Speculative and Narrative Dimension

The design proposal is presented through speculative and narrative methods, including fictional personas and staged visualizations. The outcomes are therefore not offered as finalized or construction-ready design solutions, but as provocations to imagine alternative futures for the site. This deliberate choice allows the project to foreground questions of governance, commons, and justice, dimensions that often remain underexplored in technical design outputs. However, this also means that the project does not provide detailed construction documents or technical feasibility studies, as these are beyond its intended scope.

Replicability and Transferability

The project does not seek to provide a universally replicable model for adaptive reuse. Its proposals are grounded in the unique physical, cultural, and social conditions of Hammarkullen, making them inherently site-specific. Nonetheless, the design framework and insights developed, particularly regarding the potential of adaptive reuse to advance urban commons and spatial justice, may hold transferable value for other urban contexts. The thesis should thus be read as a situated investigation that generates conceptual and methodological lessons, rather than a generalized blueprint for reuse.

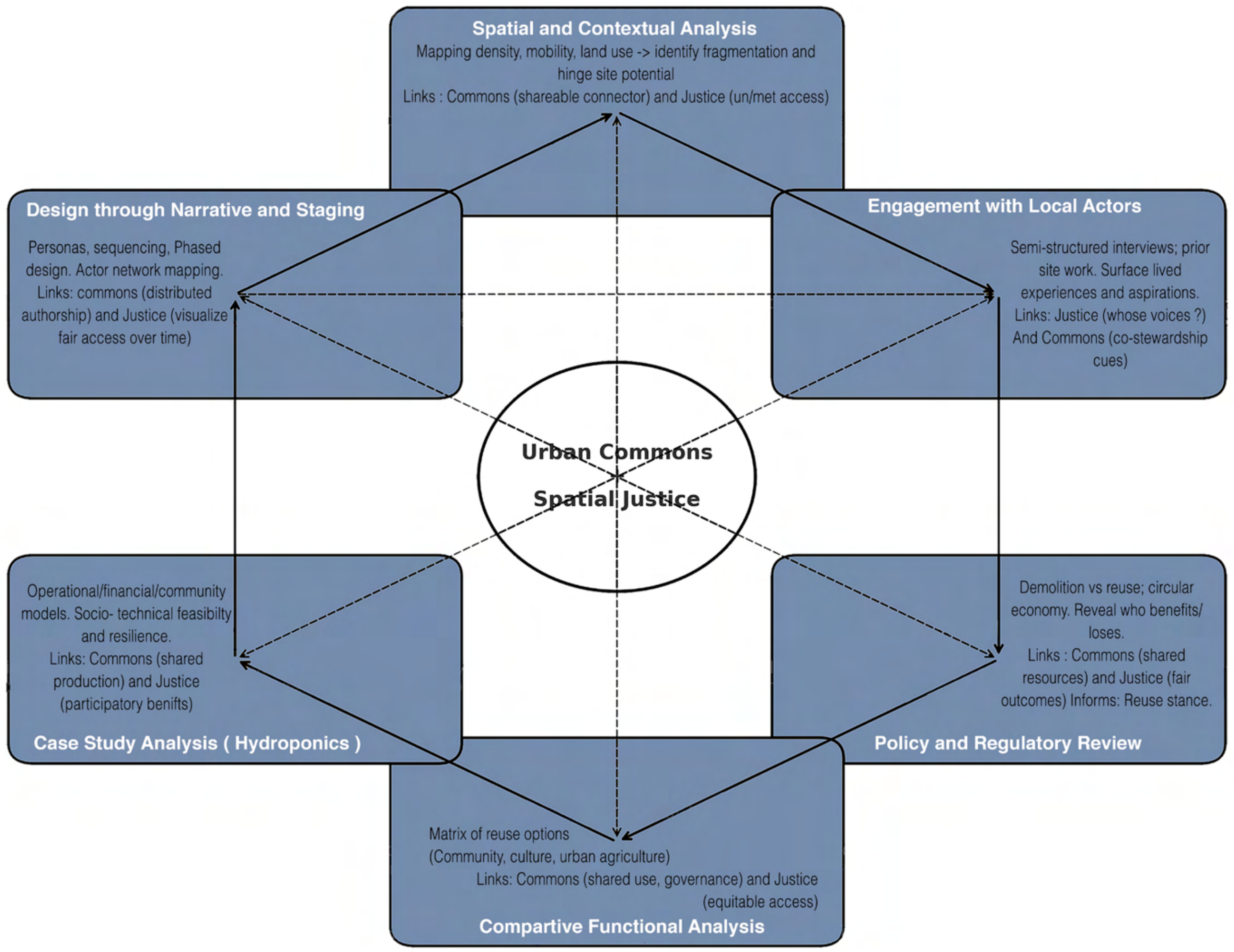


Figure: Research methodology framework. The process is structured as a cyclical sequence of six steps, continuously guided by the theoretical anchors of Urban Commons and Spatial Justice. Solid arrows show the main workflow, while dashed arrows emphasize iteration and feedback loops.

Chapter Two - FRAMEWORK

2.0 INTRODUCTION

The theoretical framework of this thesis establishes the foundation for analyzing and reimagining Hammarkullen's abandoned basement facility. It provides the concepts and lenses through which neglected infrastructures can be understood not as failures, but as opportunities for collective transformation. Two primary perspectives "urban commons and spatial justice" form the backbone of this inquiry, ensuring that questions of governance, access, and equity are central. These are complemented by theories of adaptive reuse and the circular economy, which emphasize sustainability and material conservation, and by resilience and socio-technical systems thinking, which foreground adaptability and the integration of social and technical dimensions.

Together, these frameworks generate a critical lens for this thesis: they not only help interpret the challenges of abandonment but also guide the design decisions and speculative proposals for reactivation. The Hammarkullen basement becomes a test-bed for applying these theories in practice, illustrating how neglected urban spaces can be transformed into infrastructures of inclusion, justice, and resilience.

2.1 URBAN COMMONS

The concept of the commons, historically tied to shared natural resources, was reframed by Elinor Ostrom *(1990)*, who demonstrated that communities can successfully govern common resources through collectively developed rules. Applied to urban environments, the commons shifts focus from ownership to use value, emphasizing shared access, co-stewardship, and continuous negotiation *(Harvey, 2012; Stavrides, 2016)*.

Urban commons are not static, they are social processes that require ongoing collaboration. They are produced through everyday practices of sharing and cooperation, where communities reclaim spaces for collective benefit. In this light, the basement is not a leftover void but a latent commons-in-the-making, a resource whose value lies in its capacity to host shared activities and strengthen social ties.

Yet commons are not automatically inclusive. Huron *(2015)* warns that governance systems may unintentionally reproduce exclusion, benefiting only those already empowered. This means that designing for the commons involves more than making space available, it requires careful attention to rules, access, and representation.

For this thesis, the commons framework directly shaped design strategies:

Introducing hydroponics and cultural programming as activities that create shared value.

Using modularity and flexibility to ensure the space can evolve with community needs.

Proposing co-stewardship models, where governance is distributed across residents and local actors rather than imposed top-down.

By framing the basement as an urban commons, the project grounds itself in principles of collective governance, equitable sharing, and social negotiation, ensuring that reactivation is more than a physical intervention, it is a process of collective city-making.

2.2 SPATIAL JUSTICE

Urban commons must also be evaluated through the lens of justice. Henri Lefebvre's *(1996)* concept of the "right to the city" stresses that urban space is socially produced and should be open to all. Building on this, Soja *(2010)* defines spatial justice as the fair and equitable distribution of resources, opportunities, and rights in and through space. Fainstein *(2010)* further argues that justice is not only about redistribution but also about recognition and representation, giving voice to marginalized groups who are often excluded from decision-making.

This perspective is critical in Hammarkullen, a neighborhood historically stigmatized within Gothenburg. If the basement is to be reactivated, spatial justice demands that it not replicate existing inequalities. For example, a program serving only certain groups might reinforce segregation rather than inclusion. Justice requires attention to accessibility, visibility, safety, and inclusivity, ensuring that benefits extend to those most vulnerable to neglect.

In practice, spatial justice influenced the design process in three ways:

Access and inclusion: improving visibility, creating safe routes, and reducing barriers to entry.

Representation: incorporating insights from interviews and past community engagements.

Equity in programming: balancing community, cultural, and productive uses to ensure broad relevance.

When paired with commons theory, spatial justice ensures that governance is not only collective but also equitable. This integration strengthens the ethical basis of the thesis: reactivation must be both shared (commons) and just (justice)

2.3 ADAPTIVE REUSE AND CIRCULAR ECONOMY

Adaptive reuse is the practice of reprogramming existing structures rather than demolishing them, conserving embodied energy and extending the life of materials *(Douglas, 2006; Bullen & Love, 2011*). Circular economy perspectives complement this by advocating for regeneration, repair, and reuse instead of wasteful cycles of demolition and rebuilding *(Stahel, 2019)*.

For this thesis, adaptive reuse and circular economy are understood as more than environmental strategies, they are also social and political acts. Demolition often erases not only physical resources but also social and cultural value, disproportionately affecting marginalized communities. Reuse, by contrast, sustains continuity and opens opportunities for collective re-appropriation.

In Hammarkullen, this principle justifies the decision to preserve the basement rather than demolish it. It ties directly to the urban commons framework, which treats the basement as a shared resource to be adapted collectively, and to spatial justice, which highlights that preserving the structure maintains opportunities for equitable access. Adaptive reuse here becomes a way of keeping resources in circulation, ecologically, socially, and politically.

2.4 RESILIENCE AND SOCIO-TECHNICAL SYSTEMS

Resilience, in urban terms, emphasizes adaptability and the ability to "bounce forward" after disruption rather than simply return to the past *(Davoudi et al., 2012; Meerow et al., 2016)*. This means designing systems that can evolve incrementally, learn from feedback, and respond to changing conditions.

Equally important is the recognition that infrastructures are socio-technical systems. Technologies such as hydroponics are not neutral: their success depends on governance, maintenance, and community participation *(Smith & Stirling, 2010)*. Without the social dimension, technical solutions risk exclusion or failure.

This perspective shaped three design strategies:

1. Phased implementation, starting small and scaling based on feedback.

2. Modularity and flexibility, allowing the space to adapt to changing needs.

3. Hydroponics as a socio-technical commons, integrating technology with collective governance and shared use.

Linked back to commons and justice, resilience highlights that adaptability must be both collective and equitable. The basement is envisioned not as a finished product but as a living system, continuously reshaped by governance, participation, and use.

2.5 SYNTHESIS

The theoretical frameworks converge to form an integrated toolbox for design:

Urban Commons anchors the project in shared use, governance, and collective stewardship.

Spatial Justice ensures that these commons are equitable, inclusive, and attentive to representation.

Adaptive Reuse and Circular Economy ground the project in environmental responsibility and continuity, positioning sustainability as both ecological and social.

Resilience and Socio-Technical Systems embed adaptability, phasing, and community technology integration.

Applied together, these lenses frame Hammarkullen's basement not as a residual void but as a test-bed for socially just, sustainable, and resilient urban transformation. They provide the conceptual foundation for the methodology and design strategies that follow, ensuring that each design decision is anchored in questions of commons, justice, and long-term adaptability. In doing so, this chapter directly responds to Objective 1 by examining how the theories of urban commons and spatial justice, together with supporting concepts of adaptive reuse and resilience can guide the reactivation of neglected infrastructures in ways that prioritize social sustainability and equitable access.

2.6 REFERENCE PROJECTS

The theories of urban commons, spatial justice, adaptive reuse, and resilience was better understood by looking at how they have been tested in practice. While each case emerges from its own context, together they illustrate how neglected or underused infrastructures may be reclaimed and governed collectively.

Prinzessinnengarten

Prinzessinnengarten began in 2009 as the transformation of a vacant lot at Moritzplatz into a community garden. Rather than leaving the site idle until redevelopment, residents and volunteers established a collectively managed urban farm that hosted food production, education, and cultural events *(Wendler, 2014)*. Operated as an urban commons, the garden demonstrates how bottom-up initiatives can reclaim space, establish shared rules of use, and generate both ecological and social value.

However, the case also highlights tensions of spatial justice. Although the project created new opportunities for participation, its survival has repeatedly been threatened by municipal land sales and real-estate interests (*Clausen, 2015)*. This shows that commons are not inherently secure or inclusive: they depend on governance structures that protect long-term access and representation. For Hammarkullen, Prinzessinnengarten demonstrates how reactivated spaces can function as living commons, but also warns that without institutional support, they risk marginalization or displacement.

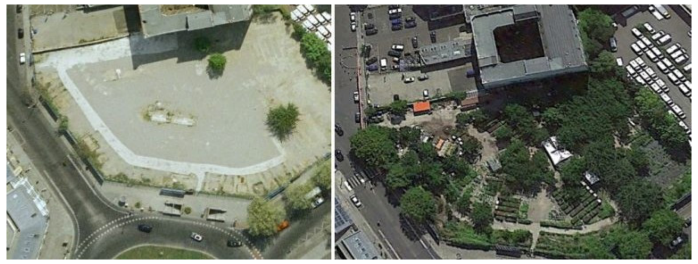


Image: Prinzessinnengarten at the Moritzplatz site before and after development (source: Prinzessinnengarten Kollektiv Berlin 2022)

Image: Prinzessinnengarten sites use raised planting beds and other temporary or transferrable containers so they can take up land temporarily. (source: Prinzessinnengarten Kollektiv Berlin 2022)

NDSM wharf

The NDSM Wharf illustrates adaptive reuse at a large scale. Once one of Europe's largest shipyards, the site was abandoned in the late 20th century, leaving behind vast industrial halls. Rather than demolition, artists and cultural groups occupied and repurposed the structures, gradually transforming them into flexible studios, cultural venues, and experimental spaces *(Lehtovuori & Ruoppila, 2017)*. This represents adaptive reuse, conserving industrial heritage while creating a new commons for cultural production.

From a commons perspective, NDSM shows how governance can emerge through practice, as users collectively negotiated access and shared use without centralized planning. At the same time, the case exposes challenges of spatial justice: as the site grew in popularity, it attracted investment and tourism, raising concerns about gentrification and exclusion *(Patti & Polyak, 2015)*. For Hammarkullen, NDSM demonstrates both the power and fragility of reusing large infrastructures: while adaptive reuse can foster creativity and resilience, maintaining equity requires deliberate strategies to guard against market-driven pressures.

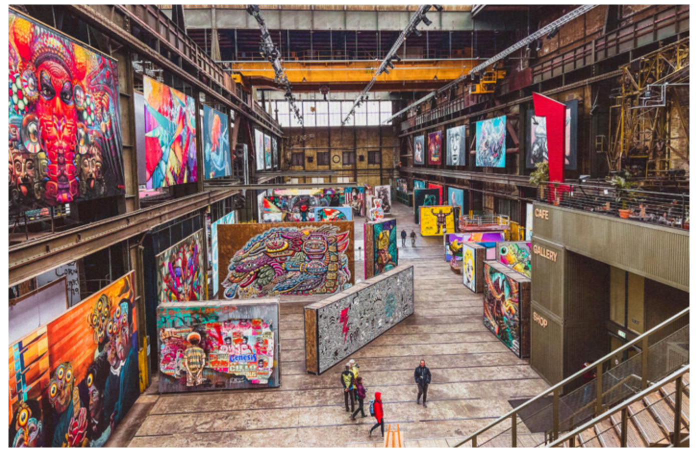


Image: STRAAT Museum in NDSM wharf , which is the largest street art museum in the world. (source:https://www.solosophie.com/ndsm-wharf)

Granby Four Streets Community Land Trust, Liverpool

The Granby Four Streets Community Land Trust (CLT) in Liverpool offers an example where residents resisted top-down demolition by taking collective control of their neighborhood. Faced with derelict housing and government neglect, they formed a CLT to renovate abandoned Victorian terraces, restore them for affordable housing, and manage them under community governance *(World Habitat, 2015)*. This represents an application of adaptive reuse not only as a technical strategy but also as a social and political act of resistance.

The CLT model reflects the logic of the urban commons, where land and housing are held collectively for long-term benefit rather than private speculation. Importantly, the project embodies spatial justice by directly addressing exclusion and giving marginalized residents both the right to remain and a voice in shaping their future *(Thompson, 2015)*. Granby shows that when commons and justice are combined, adaptive reuse can counteract displacement, produce equitable outcomes, and build resilience at the neighborhood scale.

Image: Granby street and after redevelopment work (Source: Image Captured by Colin Lane)

For Hammerkullen, these examples emphasize both potential and pitfalls. They show that neglected infrastructures can indeed become commons that foster inclusion, but they also warn that without deliberate attention to justice and governance, such projects may reinforce inequalities or succumb to market pressures.

Chapter Three -

POLICY, REGULATIONS AND RENEWAL: THE BASEMENT UNDER REVIEW

THE CASE- The Basement
Once a structure of purpose, now forgotten.
Buried below the surface, unseen and unused.

Over time, a decision was made: Demolition was approved.

But years have passed.
The demolition has not been carried out.
A door opens for imagination.

The Question Emerges
What if this space is not an end ? But a beginning?

"Why must this space be demolished?"

This deserves to be questioned.

Addressing the Critical View of Demolition

3.0 HAMMARKULLEN PARKING FACILITY AND CURRENT PLANS

Figure - The vehicle entrance and exit to the basement is adorned with a mural depicting the vibrant Hammarkullen Carnival. This location marks the starting point of the carnival procession, underscoring its cultural significance. Preserving this mural is essential to maintain the community's cultural heritage. (Captured by the author)

The current plan by the housing company responsible for the Hammarkullen parking facility involves full demolition of the structure. However, despite securing a permit for deconstruction some time ago, no further action has been taken *(Personal interview, Bostadsbolaget, 2025)*. The facility, particularly its basement parking, remains unused, raising questions about the efficiency, sustainability, and long-term logic of such an approach. In light of Sweden's strong commitment to climate action and circular economy principles, it is necessary to critically assess whether demolition is truly the best way forward. This analysis explores national policies, environmental goals, economic implications, and alternative strategies, making a case for rethinking how we treat the built environment.

3.1 POLICY AND REGULATORY REVIEW

A. POLICY LANDSCAPE - WHAT DO SWEDEN'S CLIMATE AND CONSTRUCTION POLICIES SAY?

Sweden has introduced regulations like the "Act on Climate Declarations for New Buildings" (effective from January 2022), which requires developers to calculate and report the embodied carbon emissions of new constructions. This includes emissions not just from material production and construction, but also from maintenance and eventual deconstruction or demolition *(Boverket, The Swedish National Board of Housing, Building and Planning)*.The aim was to raise awareness around the total climate impact of buildings and to encourage low-carbon materials and design strategies that consider the building's full lifecycle.

This act marks a clear shift in how Sweden approaches construction. It reflects a strong commitment to reducing emissions by acknowledging the full carbon footprint of a building, not just during use, but across its entire lifespan. While the regulation currently focuses on new buildings, it still sets an important precedent: we must begin considering the total lifecycle impact of all construction activities, including what happens at the end.

HOW DEMOLITION CONTRADICTS THE INTENT OF THE CLIMATE DECLARATION ACT

Even though the act does not directly regulate demolition practices, demolition clearly incurs a significant carbon cost that goes against the spirit of the regulation. This includes:

- Energy consumption during the demolition process itself *(Korol, E., & Dudina, A. ,2023).*
- Emissions from transporting large volumes of demolition waste *(Liu, J., Huang, Z., & Wang, X., 2020).*
- Most importantly, demolition results in the loss of embodied carbon already invested in the structure—the energy and emissions used to produce and assemble its materials in the first place *(Pomponi & Moncaster, 2017).*

Reference Project: The Marks and Spencer Oxford Street Store Demolition Blocked by the UK Government

Given the significant environmental costs associated with demolition, the decision to demolish well-established structures is increasingly being scrutinized. This is especially true in cases where heritage buildings or structures with high embodied carbon are involved. A notable example of this shift in perspective can be seen in the UK, where the government recently intervened to block the demolition of the iconic Marks and Spencer flagship store on Oxford Street.

This decision came in response to growing pressure from activist campaigners and professionals within the built environment, highlighting the potential environmental impact of demolishing such a significant building. The original plan, proposed by architects Pilbrow & Partners, aimed to replace the heritage store with a new 10-storey office and retail building, but it would have released almost 40,000 tonnes of embodied carbon into the atmosphere *(SAVE Britain's Heritage Press Release, 2024).*

Figure- Source, Buildington, Uk

Why Is 40,000 Tonnes a Big Deal?

To put it in perspective:

- It's the same as driving a petrol car - 280 million kilometers Considering Emission per kilometer: 143 grams/km *(Age Co. (n.d.))*
- Or about 25,000 round-trip flights from London to New York Considering 1.6 tonnes of CO2, carbon footprint per passenger *(Imolore, 2024)*

For a single building project, this is a massive carbon cost upfront before it even opens.

Why Was It Blocked?

The decision to block it was climate-driven and preservation-driven:

- Campaigners argued it's better to retrofit and reuse the building
- "Demolish and rebuild" = waste of carbon + heritage loss
- Retrofitting could retain much of the structure, preserving both material and embodied energy *(SAVE Press Release, 2024)*

B. CIRCULAR ECONOMY IN THE BUILT ENVIRONMENT: A MISSED OPPORTUNITY?

> *Architecture tells a story, of who we were and who we are.*
> *Preservation helps us keep these stories close to our hearts.*
> *In these timeless structures, we find a sense of place,*
> *a connection to our roots, and a glimpse of history's face.* - *Khanderia, S. (2023)*

Reusing existing buildings isn't just about preserving old structures, it's actually one of the smartest ways to reduce carbon emissions. It's the first step in a broader decarbonization strategy and is seen as one of the most effective tools in the fight against climate change (*Khanderia, S. ,2023).* This implies that instead of demolishing and rebuilding, keeping existing buildings reduces the release of greenhouse gases and avoids the carbon that would otherwise be "embodied" in new construction.

This idea fits perfectly with the circular economy principles being adopted across Sweden and much of Europe, especially within the building sector. More and more, there's a shift toward designing with reuse in mind, thinking ahead about how materials and structures can be dismantled, repurposed, and reused rather than discarded. It's about reducing waste and valuing buildings as material banks (*Khanderia, S. ,2023)* that still have a lot to give, even after their initial purpose has changed.

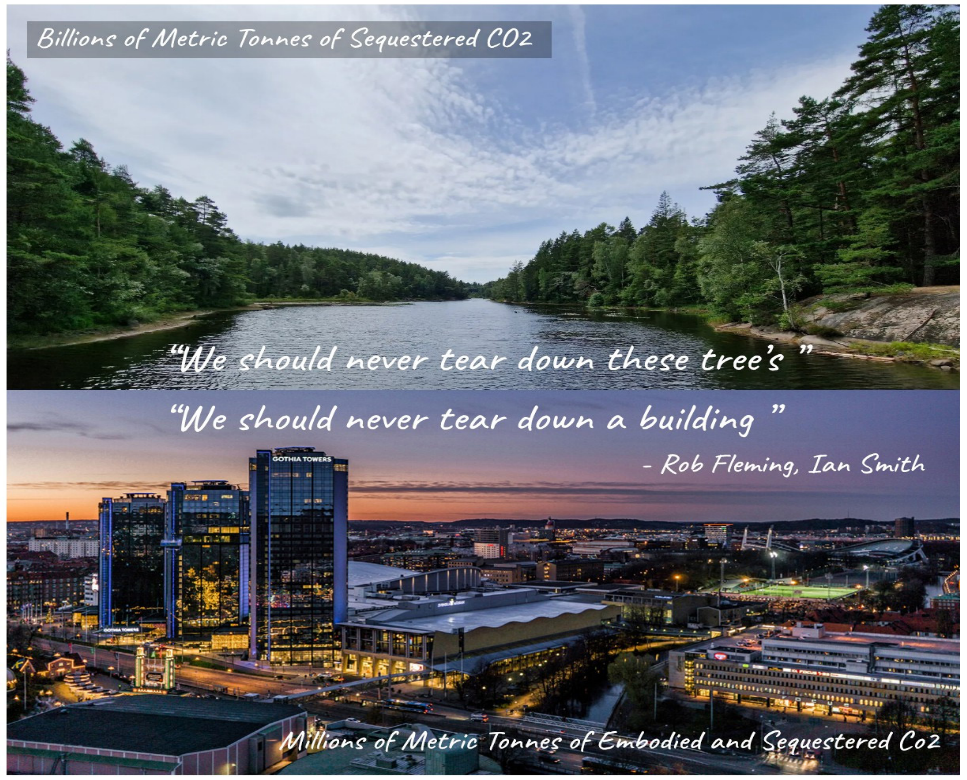


Figure- Source, Created by Author (Adapted from Khanderia, S. 2023)

I recently came across an inspiring idea in a blog by Khanderia (n.d.), which discussed the concept of Preservation Sustainability. As Khanderia notes, “Ian Smith Design Studio in Philadelphia brings together three crucial elements: historic preservation, sustainability, and social justice.” It is a unique and thoughtful approach that recognizes the importance of maintaining historical integrity while promoting environmental responsibility and advancing social equity.

The philosophy behind it is simple but powerful:

- Every time we demolish a building, we erase part of our shared history (*Khanderia, S. 2023*). So these structures are more than just walls, they hold stories and cultural meaning that shape our communities.
- Demolition isn't just about physical loss, it's also a climate issue. (*Khanderia, S. 2023*). As it generates massive amounts of embodied carbon, which could have been avoided by choosing to reuse what already exists.
- There's also a strong social angle. Instead of spending resources on tearing things down, we could redirect that energy and funding into supporting communities that have historically been left behind (*Khanderia, S., 2023*). In this way, preservation can be a tool for equity too.
- And maybe most importantly, it's a call to act now (*Khanderia, S. 2023*). The choices we make today, about what we keep and what we discard, will define how inclusive, sustainable, and connected our future cities are.

This perspective really reinforces the idea that buildings are not disposable, they're opportunities to build smarter, fairer, and more sustainably

Reference Project: Partake Kitchen

Partake Kitchen is an adaptive reuse project I found especially inspiring. The original building, which dates back to 1942, has been transformed into a dual-purpose space, a ghost kitchen and a public food hall. These kinds of kitchens are often referred to as “virtual kitchens,” “cloud kitchens,” or “shadow kitchens,” but most people know them as ghost kitchens: shared cooking facilities where chefs can prepare meals for delivery or on-site pickup through third-party apps *(Addison, 2022)*.

What's impressive about this project is its strong commitment to sustainability and reuse. The building has achieved both LEED Gold (for new construction) and WELL Gold certifications. The entire structural shell was preserved while the interior was fully refitted with updated mechanical, electrical, and plumbing systems. As noted in *USGBC Circular Economy Series, Part 2 (n.d.)*, “98% of the building's total surface area, including the entirety of the exterior enclosure, exterior wall assemblies, and interior structural walls were reused, earning the project points for exemplary performance under the building and material reuse category of Material and Resources (MR) credits for LEED.” It's a perfect example of how we can reimagine old spaces to serve modern needs without losing their original integrity or adding unnecessary carbon to the environment.

Figure : Public food hall at Partake Kitchen. (Source: partakecollective.com)

C. SWEDEN'S CLIMATE GOALS: ARE DEMOLITION PRACTICES IN LINE WITH 2045 TARGETS?

As stated by *GoClimate (n.d.)*, “Sweden's long-term climate goal is to reach net-zero greenhouse gas emissions by 2045,” and after that, move toward negative net emissions. To get there, emissions from within the country must be reduced by at least 85% compared to 1990 levels *(Naturvårdsverket, 2023)*.

This is not something that can be tackled by just one sector, it requires a holistic and cross-sectoral effort. Construction and demolition, being major contributors to embodied carbon and material waste, play a key role in this *(Yi, Y., Liu, J., Lavagnolo, M. C., & Manzardo, A. (2024)*. The built environment has a significant footprint, both through the energy used in operating buildings and the emissions from producing and transporting materials.

So I'd argue that continuing with traditional demolition practices, without considering their environmental cost, goes directly against this national goal. We need to rethink how we build, reuse, and dismantle structures. Whether it's new construction or taking down existing ones, every decision needs to be seen through the lens of aligning with Sweden's larger climate ambitions.

D. ECONOMIC IMPLICATIONS:

Demolition and deconstruction both come with financial implications. While demolition is typically quicker and often seen as more straightforward, it still involves the cost of tearing down the structure and managing the resulting waste *(Chung, E. 2024)*. Building anew using fresh materials also brings its own set of expenses, both financial and environmental.

Deconstruction, while offering a more sustainable alternative, involves increased time and labor. It requires skilled workers for careful dismantling, higher upfront costs for sorting and salvaging, and logistical challenges in handling and storing materials. There's also the risk of damaging reusable elements if not managed properly.

However, despite these challenges, deconstruction presents a more responsible path forward. Unlike demolition, which often treats materials as waste, much of which ends up in landfills, deconstruction values them as resources *(Delta Institute. 2018)* .This aligns more closely with Sweden's long-term climate goals and the principles of a circular economy.

Environmental Preservation

One of deconstruction's strongest arguments lies in its contribution to environmental preservation. By salvaging and reusing materials, it reduces the demand for manufacturing new components, thereby lowering emissions associated with material production and transport(*Cochran, B., 2022)*.

In the specific case of the Hammarkullen basement, this potential must be assessed with care. An intensive study would be necessary to determine how existing materials could be reused.

Figure : Deconstruction Process vs Demolition Process (Source: historictacoma.org)

Social Value

Deconstruction can also provide social benefits, particularly through community engagement and local job creation. Collaborating with local organisations or hiring skilled labor from the area can strengthen local economies and promote sustainable practices. *(Delta Institute. 2018)*

That said, the social value of deconstruction is highly context-dependent and open to debate. Not all structures carry cultural or architectural significance worth preserving, and the potential for long-term community benefit is not always guaranteed. In some cases, the impact might be temporary or symbolic rather than practical.

So, while deconstruction holds promise for social value, it isn't a one-size-fits-all solution. The case for its implementation must be weighed carefully, especially when the structure in question, like the basement in Hammarkullen, may not have enough reuse potential to justify the added effort and cost. In this case, the basement walls are made of reinforced concrete designed to retain soil, making them difficult to salvage or repurpose. Additionally, the roof consists of ribbed slabs, which pose structural and practical challenges for reuse due to their size, embedded reinforcement, and potential wear.

3.2 DECONSTRUCTION COST CONSIDERATIONS: AN APPROXIMATE OVERVIEW

Demolishing an underground basement parking facility is a resource-intensive process. The demolition of construction and demolition waste (CDW), particularly structures like underground facilities, involves complex handling of diverse materials, some of which may be hazardous. In Sweden, environmental legislation such as the *Waste Ordinance (SFS 2020:614)* and guidance from the Swedish Environmental Protection Agency *(Naturvårdsverket)* require the careful sorting, recovery, and safe treatment of construction waste and hazardous materials. These regulations, combined with the technical challenges of selective demolition, significantly increase project complexity and cost *(Naturvårdsverket, 2024a, 2024b; Boverket, 2024a, 2024b).*

Phase	Description	Breakdown	Estimate (SEK)	Total
A	Demolition Permit Building area (4,760 m²)	Base fee Area-based surcharge 5,000–10,000 SEK per 1,000 m² (x5) Complexity surcharge (structural support, shoring plans, review meetings)	15,000–25,000 25,000-50,000 10,000–30,000 SEK	
				50,000 – 105,000
B	Environmental Assessment *Länsstyrelsen - Assessment of Environmentally Hazardous Activities*	Consultant hourly rates: 1,200 – 1,800 SEK/hour Site survey: 6–8 hours Lab testing coordination: 4–6 hours Reporting & documentation: 6–8 hours Project management/admin: 2–4 hours		
			18–26 hours x avg. 1,500 SEK = 27,000–39,000 SEK	27,000 – 40,000
C	Safety & Compliance Inspections	Safety engineer or byggarbetsmiljösamordnare (BAS-U) hourly rates: ~1,200 – 1,600 SEK/hour Site inspection & review: 6–8 hours Documentation: 3–5 hours Safety plan coordination: 4–6 hours		
			13–19 hours x avg. 1,400 SEK = 18,200 – 26,600 SEK	18,000 – 30,000
D	Admin, Planning & Legal	Professional service rate: 1,200 – 2,000 SEK/hour (say architects, engineers, legal advisors) Structural engineer consultation: 6–10 hours Legal documentation review: 4–6 hours Coordination/admin: 4–6 hours		
			Total: 14–22 hours x avg. 1,600 SEK = 22,400 – 35,200 SEK	22,000 – 40,000
A. TOTAL				117,000 - 215,000 SEK
The cost figures mentioned are based on general assumptions and should be considered indicative for the study. For a precise cost assessment, it is essential to directly consult the byggnadsnämnden (building committee) or the plan- och byggkontoret(planning and building office).				

Phase	Description	Breakdown	Estimate (SEK)	Total
A	Labor & Equipment *Source: Assumptions based on Byggnads (Swedish Building Workers' Union)*	Hourly wage: 250 SEK/hour Working hours/month: 160 hours Workers: 15–18 Duration: 2.5 months 250 SEK/hour × 160 hours = 40,000 SEK/worker/month Considering 15 workers for 2.5 months	600,000 × 2.5 = 1,500,000 SEK	
				1,500,000 SEK
B	Excavation & Groundworks *Source : Assumptions based on Maskinuthyrama i Sverige rental prices and standard demolition durations for large-scale basement structures*	Excavators/Hydraulic Breakers (3 nos x 10,000 rent/day x 45 days) Dump Trucks (5 nos X 5000 rent/day x40 days) Loaders (2 x 7000 rent/day x 30 days) Cranes (5 x 10,000 rent/day x 5 days) Fuel & Misc.	1,350,000 1,000,000 4,200,000 50,000 100,000	
				3,920,000 SEK
C	Utility Disconnection			
		Say Lump Sum Cost		50,000- 100,000 SEK
D	Hazardous Material + Contingency *(Cost assumptions for handling hazardous materials are based on general guidelines from Naturvårdsverket (Swedish Environmental Protection Agency). Actual costs may vary depending on site-specific conditions and material types.)*	Testing & Surveying Removal & Disposal (if present) Other Unforeseen Issues: 50,000 SEK	20,000 – 50,000 SEK 80,000 – 250,000 SEK 50,000 SEK	
B. TOTAL				2,150,000 – 3,400,000
The cost figures mentioned are based on general assumptions and should be considered indicative for the purpose of this study. The actual costs may vary depending on factors such as project complexity, material availability, site conditions, and other unforeseen variables..				

Phase	Description	Breakdown	Estimate (SEK)	Total
A	Waste Sorting & Recycling	Basment Dimensions: Length = 145 meters Width = 35 meters Total Floor Area = 145 m × 35 m = 5,075 m² Ribbed Slab Thickness: 40 cm (0.40 m) Outer Wall Thickness: 60 cm (0.60 m) Column & Beam Volume: Assumed to be 10% of the total volume of the roof slab. Total Concrete Volume=2,030m³+734.4m³+203m³=2,967.4m³ Total Waste=2,967.4m³×1.6= 4,747.8tonnes	4,747.8 tonnes × 600 SEK/tonne	
				2,848,680 SEK
B	Transport & Disposal Fees	Assumed Rate: 200 SEK per tonne (for a transport distance within 7 km)	4,747.8tonnes×200SEK	949,560SEK
C. TOTAL				3,798,240SEK
The cost figures mentioned are based on general assumptions and should be considered indicative for the purpose of this study. The actual costs may vary depending on factors such as project complexity, material availability, site conditions, and other unforeseen variables.				

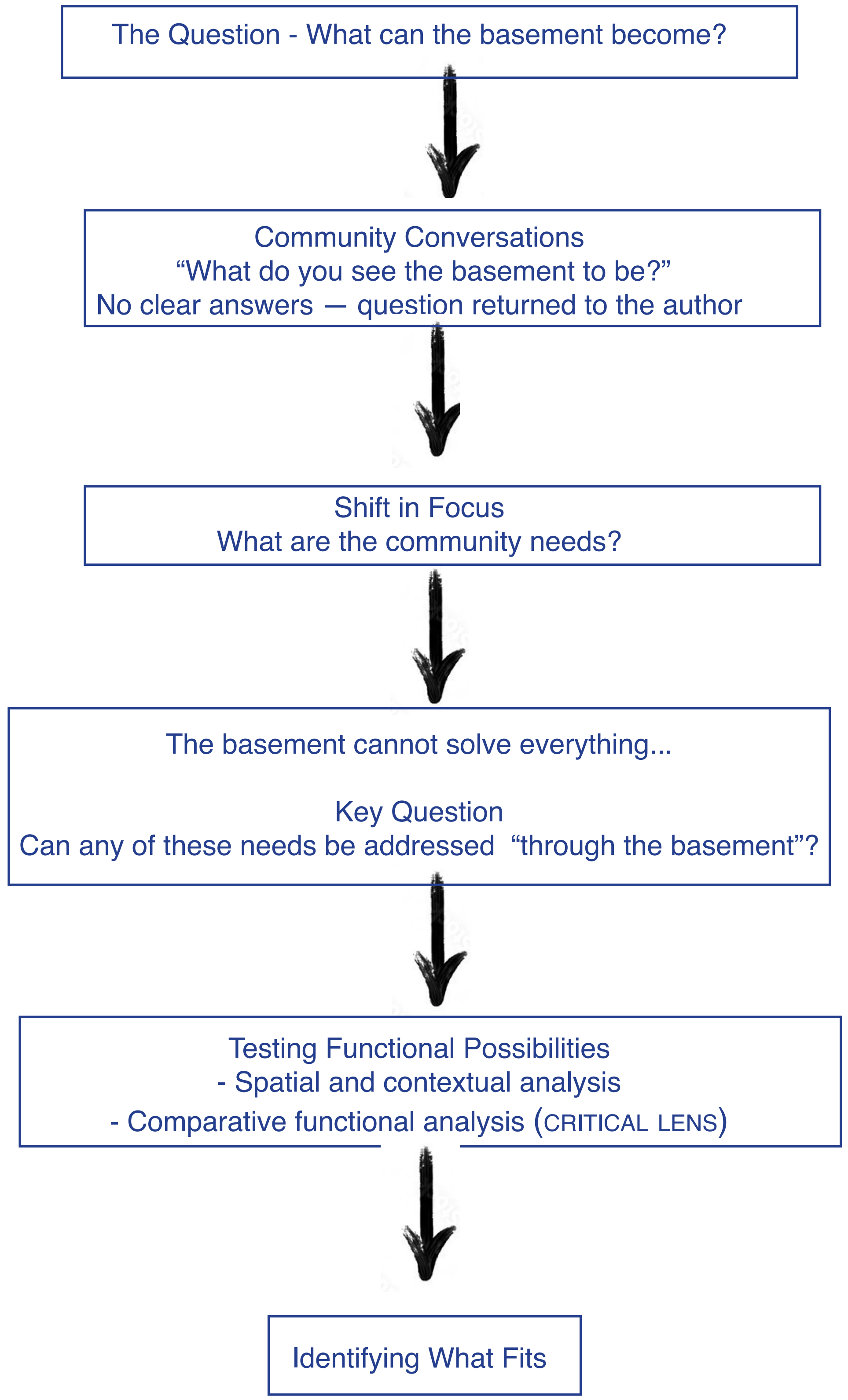
Phase	Description	Breakdown	Estimate (SEK)	Total
A	Waste Sorting & Recycling	Volume to be Backfilled: Area of basement = 35 m × 145 m = 5,075 m² Depth to be backfilled = 4 meters (the height of the basement). Volume to be backfilled = Area × Depth = 5,075 m² × 4 m = 20,300 m³ Total cost for backfilling³	20,300 m³ × 100 SEK/m³	
				2,030,000 SEK
B	Transport & Disposal Fees	Landscaping and clean-up	100,000 SEK – 150,000 SEK (Lump sum)	150,000SEK
D. TOTAL				2,180,000 SEK
The cost figures mentioned are based on general assumptions and should be considered indicative for the purpose of this study. The actual costs may vary depending on factors such as project complexity, material availability, site conditions, and other unforeseen variables.				

Phase	Description	Breakdown	Estimate (SEK)	Total
A	Environmental Impact Monitoring	Monitoring Focus Dust: Regular monitoring for particulate matter in the air to prevent excessive dust pollution. *(Naturvårdsverket (Swedish Environmental Protection Agency,2023)* Noise: Monitoring noise levels to comply with local regulations, especially in residential or sensitive areas. Water Runoff: Ensuring that runoff from demolition activities does not contaminate local water bodies or cause erosion.	50,000 SEK -100,000 SEK	
				50,000 SEK -100,000 SEK
B	Insurance and Contingency:	typically 10-15% of the total project cost	10% of 12 million SEK (approx)= 1,200,000 SEK	1,200,000 SEK
E. TOTAL				1,250,000 – 1,300,000 SEK
The cost figures mentioned are based on general assumptions and should be considered indicative for the purpose of this study. The actual costs may vary depending on factors such as project complexity, material availability, site conditions, and other unforeseen variables.				
GRAND TOTAL (A+B+C+D+E) =				**9,495,240 SEK - 10,893,240 SEK**

It would cost around 11 million SEK to demolish the structure. This raises an important question: why spend millions on deconstructing when we could repurpose that same basement into a vibrant community asset, one that drives local economic growth and enhances overall wellbeing? Isn't every brick saved an investment in our sustainable future?

Chapter Four -

HAMMARKULLEN: SITE AND CONTEXT ANALYSIS



4.0 WHERE IS THE BASEMENT LOCATED?

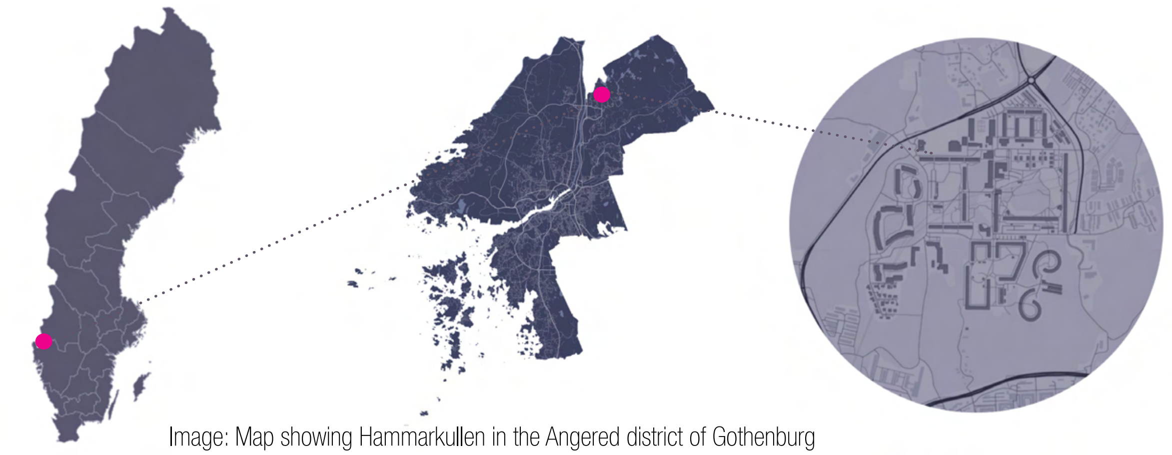


Image: Map showing Hammarkullen in the Angered district of Gothenburg

The above image shows where the project is located by presenting three maps that gradually zoom in. The first map shows Sweden and highlights Gothenburg on the west coast. The second map focuses on the city of Gothenburg itself. The third map zooms further into Hammarkullen, a neighborhood located in the Angered district in the northeastern part of the city.

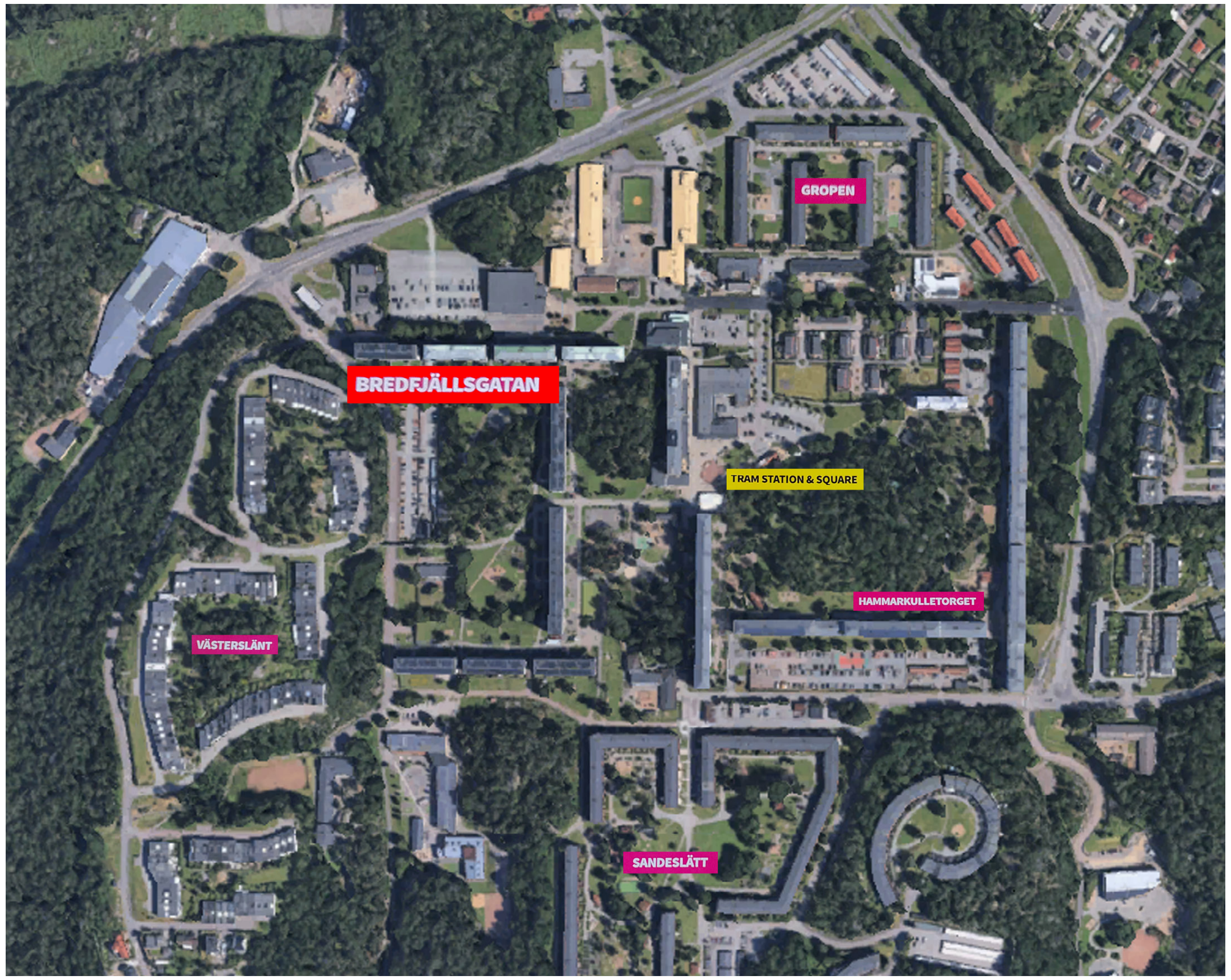


Image : In this aerial view of Hammerkullen, the red-highlighted area indicates the location of the basement facility at Bredfjällsgatan

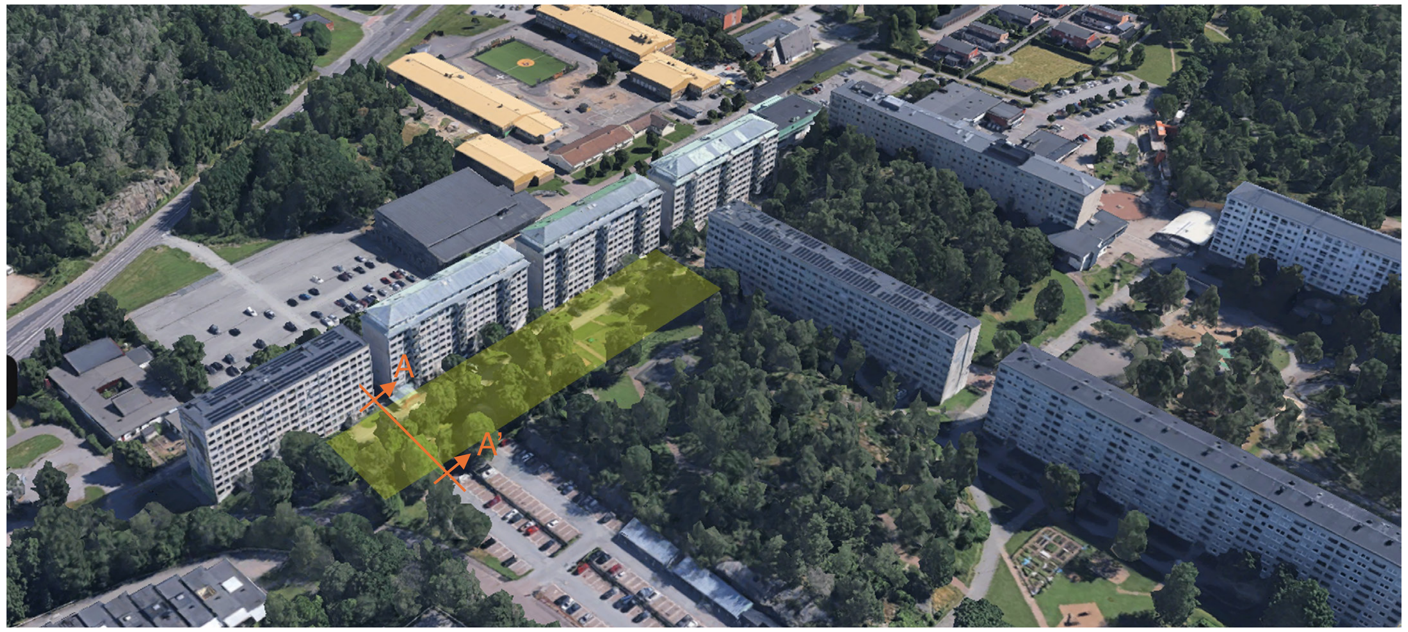


Image : In this aerial view of Hammerkullen, the Yellow -highlighted area show the location of the basement with an orange sectional line

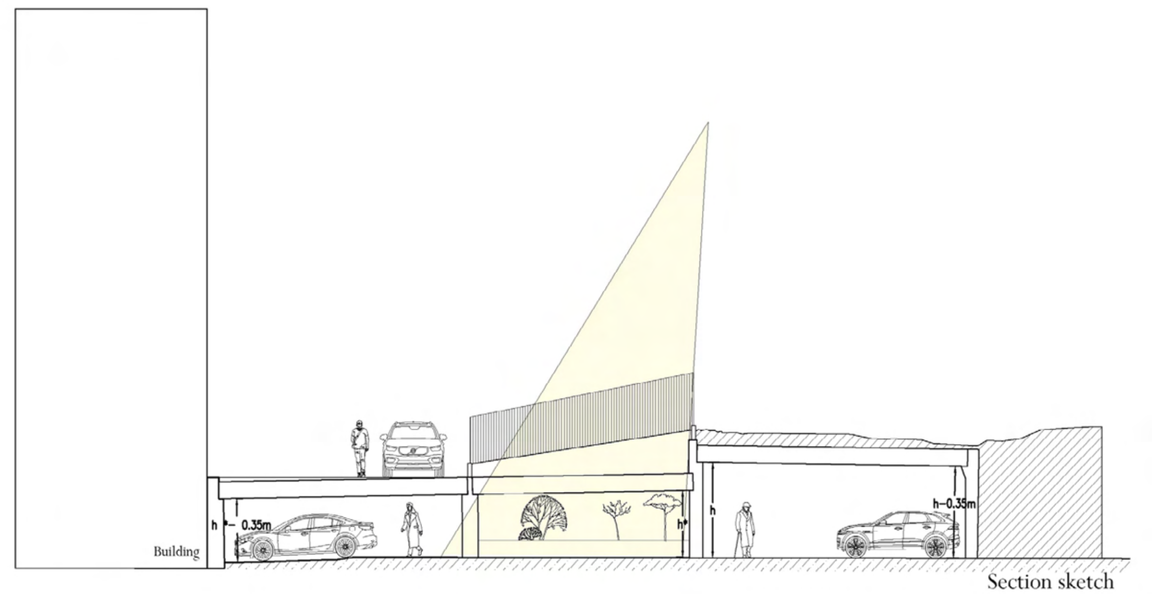


Image : Section A-A'

Section A–A': Cut through the basement structure showing its spatial relationship to the adjacent residential building. The sketch illustrates how the two structures are nearly connected, with only a narrow gap or wall separating them. The section reveals the basement's sunken position below the shared surface level, which currently serves both as a vehicular and pedestrian thoroughfare. Above part of the basement, a landscaped area is shown functioning as a small playground, indicating a layered use of space. The drawing emphasizes the basement's embeddedness within the urban fabric and its proximity to active community infrastructure.

Image 1 : A photograph taken from above the basement site, showing it covered by a landscaped area equipped with children's play equipment and an open ground. The image captures how the basement remains hidden beneath an active surface layer of everyday public life.

Image 1

Image 2 : A view showing the ground above the basement structure. This area includes a paved road used for movement, with people passing through, and also functions as an access point to the surrounding residential buildings. While the basement lies hidden underneath, the surface plays an active role in daily life as a circulation and connection space.

Image 2

Image 3 : Shows the pedestrian entry from the tram station, which is through a set of steps and is the closest access point for most people arriving by public transport.

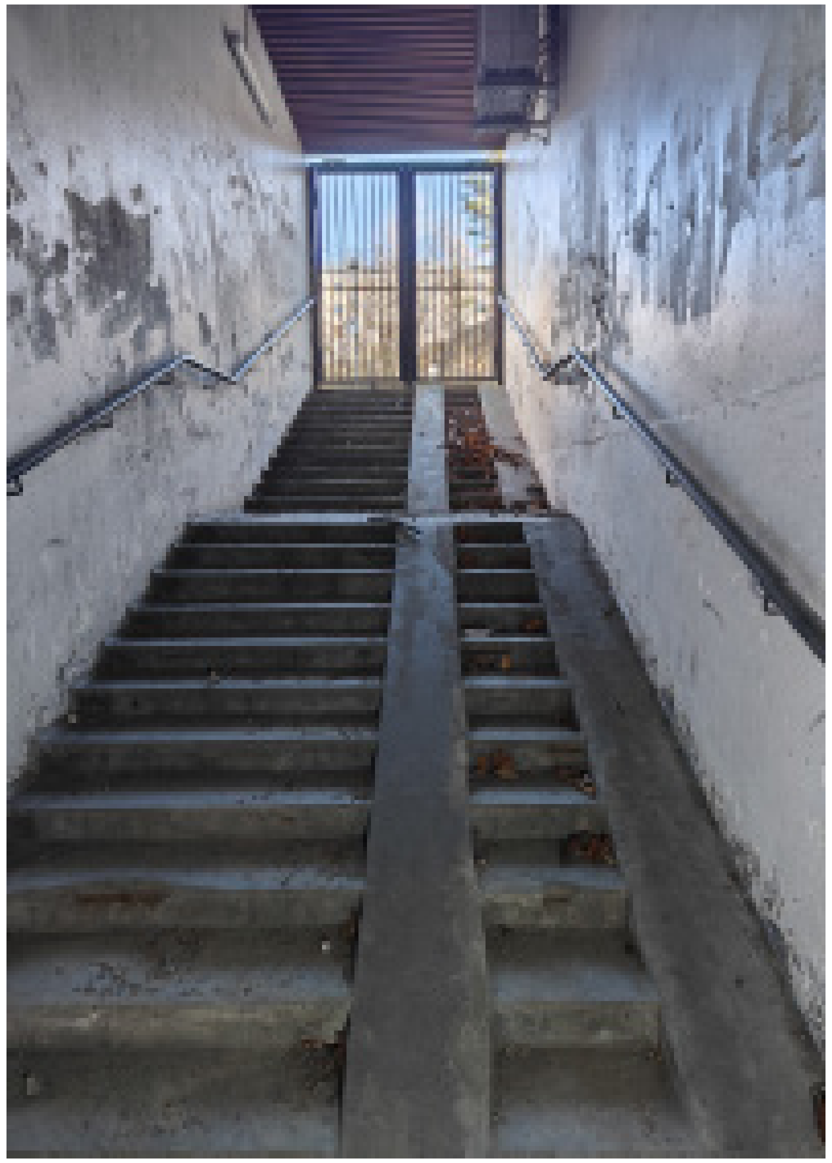


Image 3

Image 4 shows the only vehicular entrance into the basement — it's located on the other lower side of the site.

4.1 DEMOGRAPHICS

8988
RESIDENCE

234,000 SEK/year
Average Income

433,000 SEK/year
Gothenburg average
Income

18–20%
UNEMPLOYMENT

5-7%
UNEMPLOYMENT IN GBG

80% of the population
has an immigration
background

57% were born abroad.
Many residents arrived
as refugees.

30 % of families in
Hammarkullen receive
social benefits

2,236 apartments
Some original buildings were demolished or
reduced in size in the late 1990s to create a more
open environment.
Smaller-scale housing (569 small houses, 94%
built in the 1960s and 70s)

Sources for the demographic data of Hammarkullen include Wikipedia and the official statistics of Göteborgs Stad

4.2 BUILDING FUNCTIONS

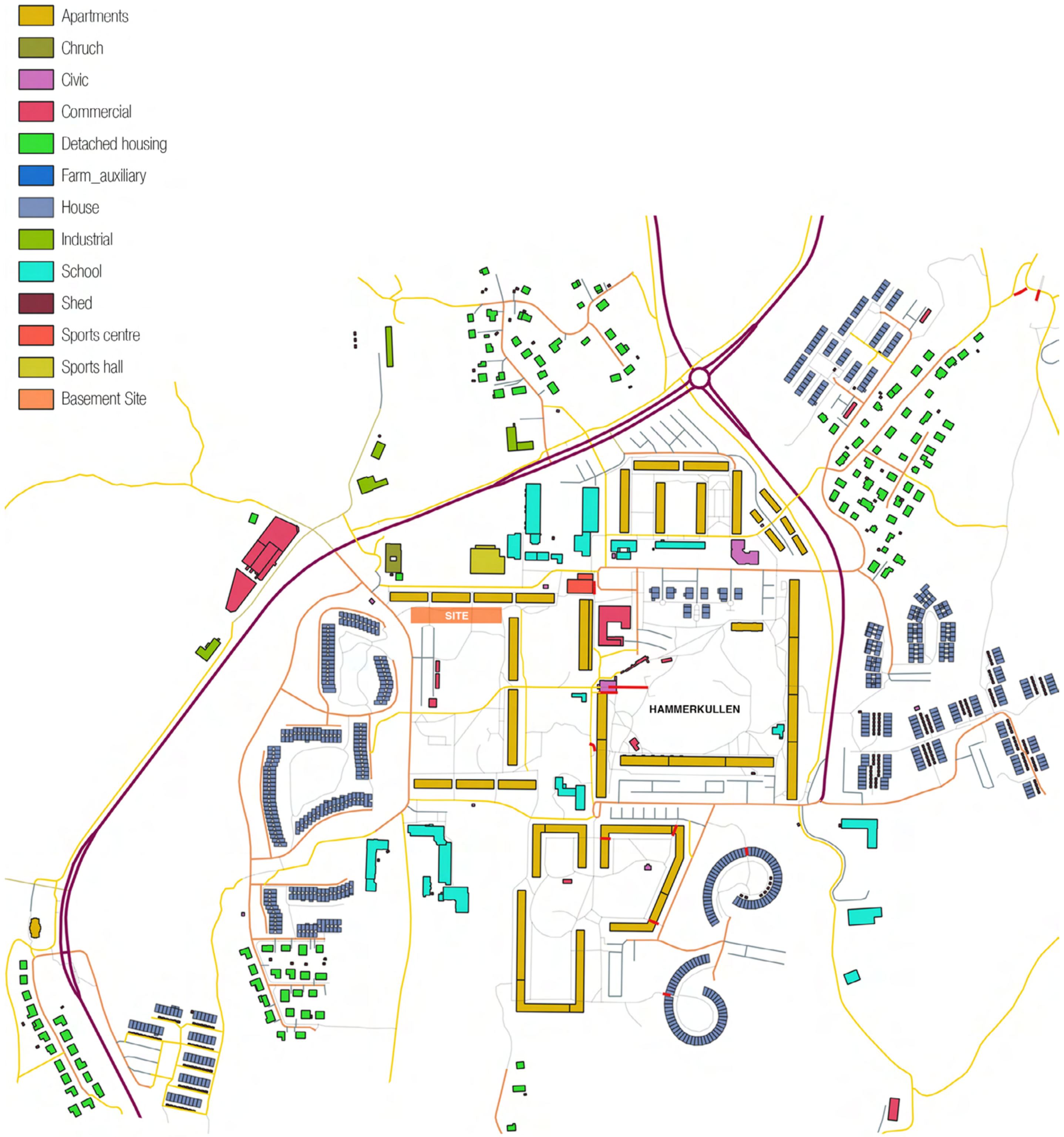


Figure : Plan View Showing Building Functions and Access Routes in Hammarkullen, Gothenburg. (Created by the author using QGIS, based on data from OpenStreetMap)

MOVEMENT NETWORK

Footway
Cycleway/ Limited Access Road
Residential Muncipal Roodway
Service Road (Parking)
Steps
Main Muncipal Roodway
Unclassified

4.3 LAND USE DIAGRAM

Figure : Plan View Showing Land Use Pattern in Hammarkullen, Gothenburg. (Created by the author using QGIS, based on data from OpenStreetMap)

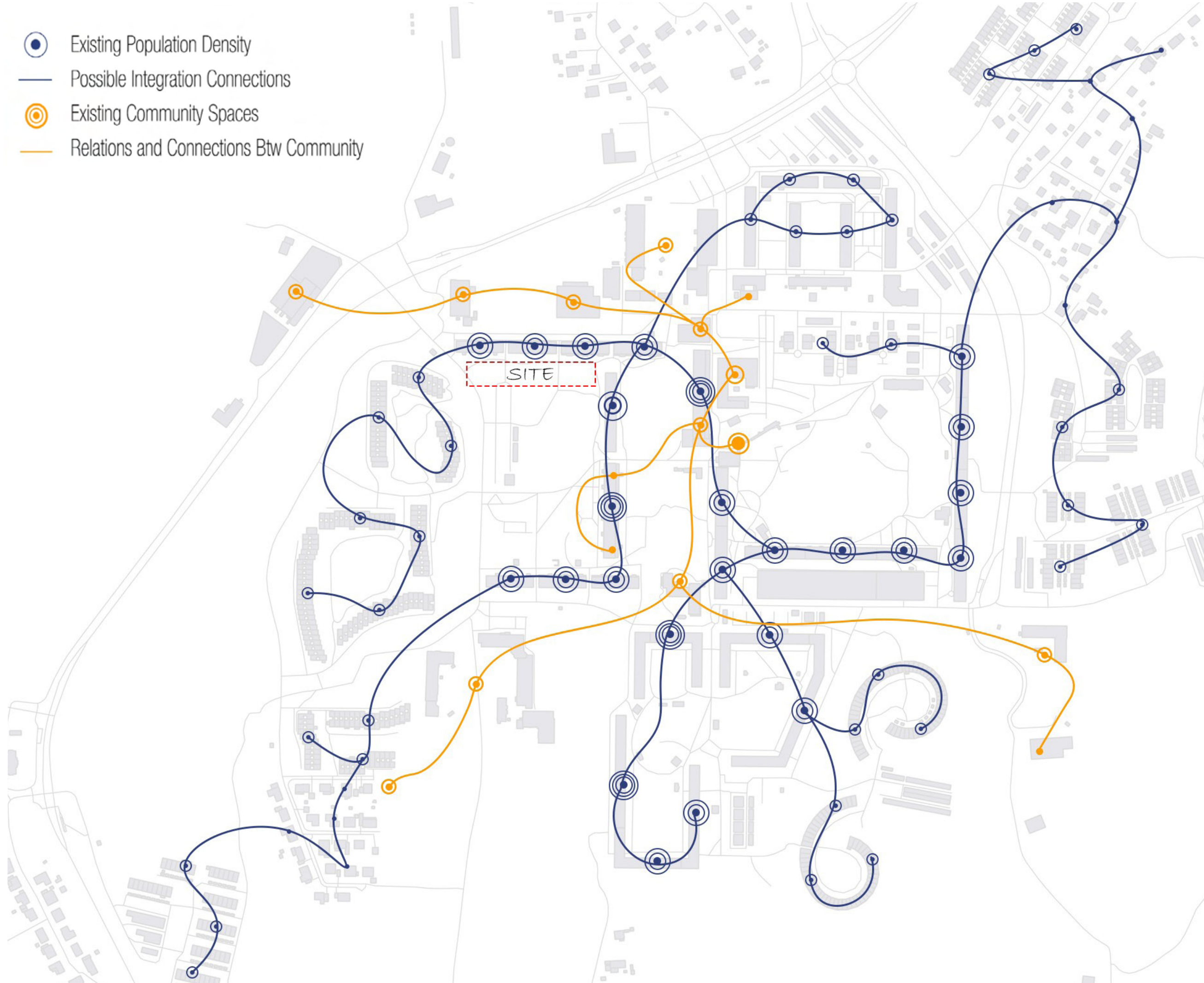


Figure : Mind Mapping Analysis of Residential Density and Community Access in Hammarkullen (Created by the author)

Why did I conduct a mind mapping analysis in Hammarkullen?

The mind mapping analysis as part of the basement renovation study in Hammarkullen was done to better understand the spatial and social dynamics of the area. The goal was to explore how the built environment, movement routes, and distribution of community functions relate to residential density and population concentration.

Insights from the Mind Mapping Analysis and Demographics

The mind mapping analysis revealed that the central area of Hammarkullen is the most densely populated, primarily due to the concentration of high-rise apartment buildings. In contrast, the selected site is located slightly outside this core area. While it maintains proximity to some apartment clusters, it is not situated within the densest zone. This positioning of the the site serves as a transitional or "in-between" space, between the high-density center from the adjacent areas of attached and single-family housing on the western side.

This intermediate location gives the site a unique spatial importance. It has the potential to act as a bridge between different housing typologies, enhancing social cohesion and avoiding the isolation of smaller housing units from the larger apartment communities. Moreover, the site is embedded within a network of community facilities, reinforcing its potential as a connector and a catalyst for local engagement. The site's location outside Hammarkullen's busiest area allows for a new community space without overburdening existing infrastructure, with good accessibility via road networks.

Hammarkullen is often described as a culturally vibrant and diverse district, as evidenced by events like the Carnival of Hammarkullen, where global traditions co-exist and participants from various backgrounds come together to express a shared, evolving identity built on diversity. The area is also known for being friendly, tolerant, and inviting (*Owusu K. & Ross J., cited in Jones, 2012).* While demographic data indicate lower average incomes and a higher reliance on social support compared to Gothenburg overall, the area benefits from strong community engagement and essential local amenities, as noted in my analysis. Therefore, developing community-focused spaces in Hammarkullen presents a valuable opportunity to leverage its positive cultural dynamics and community spirit, rather than discarding existing areas. These spaces can also enhance the sense of belonging for both existing residents and newcomers, fostering a stronger and more inclusive community.

4.4 WHAT PEOPLE THINK OF THE BASEMENT? – INTERVIEWS

Key Findings and Implications

Interview 1 – Housing Organization Representatives

Initial interviews with representatives from the local housing company, conducted at Bredfjällsgatan in Hammarkullen, revealed several key issues concerning the current state and potential of a vacant basement facility. Additional context was provided by a property coordinator from the same organization.

-The basement facility is currently unoccupied, with unclear reasons behind its disuse.

-The housing organization has expressed interest in exploring strategies for activating or repurposing the space.

-A previously considered proposal to build above ground was abandoned due to concerns over structural instability.

-Notably, a demolition permit has already been approved for the basement, though its feasibility remains uncertain due to the proximity of surrounding buildings and potential regulatory constraints.

-The surrounding residential buildings lack appropriate waste segregation and recycling infrastructure, leading to issues with littering and waste mismanagement.

-It was suggested that behavioral change, in addition to infrastructural solutions, is critical to improving these conditions.

-Littering extends beyond designated waste areas into corridors and public spaces, indicating systemic issues that require both physical and social interventions.

-Existing basement laundry areas are in poor condition and reportedly subject to misuse, raising concerns about current maintenance and management strategies.

-The neighborhood faces a problem with pigeon overpopulation, worsened by residents feeding the birds.

-Concerns were raised about planned façade upgrades that include open balconies, which could exacerbate the pigeon issue.

Implications for Project Development

These conversations emphasized the need to carefully assess the implications of demolition, particularly from a sustainability perspective. Any redevelopment plan must also consider waste management, behavioral design strategies, and the potential to improve both social and environmental conditions. The interviews also highlight that consideration of community needs and input is essential for creating a meaningful and lasting transformation of the space.

Interview 2 – Community Organizer

This interview was conducted during a community architecture studio with a local resident involved in initiatives supporting women and cultural expression in Hammarkullen.

-A women's organization provides opportunities for women to generate income through food preparation and sales.

-Due to restrictions on home-based cooking for commercial purposes, they rely on renting kitchen spaces at a local activity center, which is often fully booked.

-People in the community grow vegetables together in shared garden boxes and later use them to cook meals. This helps bring people together and makes food a more central part of community life.

-The interviewee emphasized the potential of a visible and accessible central community space that could showcase food culture.

-The idea of rotating themes, including cultural exhibitions, cooking classes, and live food preparation, was suggested as a way to activate the area and engage residents.

-Experience with mobile kitchens during events was described as both successful and efficient.

-There is strong interest in integrating cooking facilities, possibly outdoors, into community centers or public spaces to provide a complete cultural experience, from storytelling to tasting and participation.

Quote (Anonymized)

"If people don't receive the right information about what's happening here, they won't appreciate it. Many young people think there's more to do in the city center, but there's so much to discover here too."

4.5 COMPARATIVE ANALYSIS OF RENOVATION APPROACHES:

Table: Brainstorming-based evaluation of spatial reuse options for the large vacant basement in Hammarkullen

Function	Environmental Impact	Community Engagement	Economic Viability	Long-Term Potential	Scalability Potential	Existing Function in Hammarkullen?	Remarks
Storage Facility	Low	Low	Moderate	Low	Low	No	Minimal activation; underutilizes space.
Event space	Medium	High	Variable	Medium	Medium	Yes (at Folkets Hus etc.)	Risk of overlaping activities unless uniquely programmed.
Workshop area	Medium	Medium	Moderate	Medium	High	Partially	It could extend the existing functions (e.g., youth programs).
Indoor community garden	Medium	High	Low to Moderate	Low	Moderate	Yes (outdoor spaces exist)	Uncommon for basements; needs artificial lighting and meet other required conditions
Cultural exhibition space	Medium	High	Moderate	Medium	Medium	No (cultural venues exist but no dedicated space)	Could be combined with food or other functions.
Second-hand goods	High (positive - reuse)	Medium	Medium to High	High	Medium	Yes	Popular in the city
Hydroponic farming	High (positive)	High	Debated	High	High	No	Strong sustainability value; Highly scalable.
Repair café / Fix-it hub	High (positive)	Medium	Moderate	Medium to High	Medium	Yes (Fixoteket)	Overlaps with existing Functions
Community kitchen	Medium	High	High	Medium	Medium	Yes (rented space in Activity House)	High demand; limited access to facilities now.
Children's playroom	Low	Medium	Low	Low to Medium	Low	Yes	Already available; not suitable for basement scale.
Bunker / Emergency Shelter	Neutral	Low (daily use)	High initial cost	Low	Low	Yes	Already available

Insights

The process of brainstorming and conducting a comparative analysis revealed a variety of potential uses for the basement space, each with its unique set of advantages. Several of the proposed functions are already present within the Hammarkullen area, and it is crucial to avoid redundancy or direct competition with existing community resources. The primary objective is to identify a function that not only aligns with sustainability goals but also generates long-term value and fosters meaningful community engagement. Among the options considered, hydroponic farming emerged as a particularly compelling choice.

Chapter Five -

TOWARDS A USE: HYDROPONICS

Hydroponics Identified
Is it truly suitable?

↓

Market & Sustainability Assessment- Addresses tood security, Meets local market needs, Aligns with sustainability goals

Based on: Market research + benefits of hydroponic systems

↓

But then... Critical Question:
If hydroponics is so promising,

Why hasn't it scaled in Sweden yet?

↓

Need for Deeper Understanding
System-level barriers
Implementation challenges
Case Studies (Sweden-specific)
- Learning from existing examples
- Identifying obstacles & patterns

↓

System Thinking: Implementation Pathways
- Stakeholder/actor network mapping
- Speculation on roles, collaborations, and flows

↓

Outcome: Feasibility Reflection
- What could go wrong?
- What must be addressed?
- How could it possibly work?

5.0 TOWARD SUSTAINABLE URBAN FARMING: A STUDY OF HYDROPONICS

This research explores how hydroponics can be effectively implemented in Sweden, with a focus on its practical application in the basement space in Hammarkullen. In this way, the study supports the implementation phase by identifying key factors, opportunities, and challenges specific to the Swedish context, helping to justify design decisions and to guide the process.

Why Hydroponics? Is Hydroponic Farming Sustainable?

The global food system faces significant challenges, including food loss and waste, which have a profound impact on sustainability. According to the *Food and Agriculture Organization of the United Nations (2011)*, "approximately one-third of all food produced globally for human consumption, about 1.3 billion tonnes, is lost or wasted each year." This issue is divided into two categories: food loss, which occurs during production, harvest, post-harvest, and processing, and food waste, which is more prevalent in industrialized nations, where consumers and retailers discard edible food *(FAO, 2011)*. Addressing these challenges requires innovative farming methods that reduce waste and optimize resource use, such as hydroponic farming.

These issues arise due to the traditional methods of producing, processing, and distributing greens, which often involve longer supply chains. According to *Kader (2002)*, when supply chains are extended, crops are often harvested before full maturity and treated with extra pesticides to preserve their appearance and freshness. Since prematurely harvested crops are more resilient to handling and transportation, this practice compromises both their flavor and nutritional quality *(Kader, 2002)*.

Moreover, transportation is often associated with significant environmental impacts, including high emissions that damage both the environment and the produce itself. The concept of "food miles" has been widely studied, quantifying the environmental impact, particularly greenhouse gas emissions, that result from transporting food over long distances *(Weber & Matthews, 2008)*.

These challenges highlight the need for more sustainable and localized farming methods, such as hydroponics, that can mitigate the negative effects of long supply chains.

FIGURE: Value Chain of traditional Agriculture vs Value chain of hyroponic production (Source : Adapted from AUC students. (n.d.). Energy, Climate & Sustainability Blog)

Shortening supply chains and improving food security within urban environments can significantly boost cities' self-sufficiency in food production. This becomes especially important during times of crisis, such as wars or pandemics like COVID-19, which can disrupt traditional supply systems. Another key advantage is the ability to produce food all year round, even in the cold Nordic climate. Hydroponic systems, especially indoor setups, offer a controlled environment that allows for continuous food production regardless of outdoor conditions *(Dace, 2022)*.

Among the other benefits is the efficient use of limited urban space, which is a common challenge in cities. Hydroponic systems, particularly vertical farms, make it possible to grow more food per square meter by stacking plants in layers. This opens up opportunities to use rooftops, walls, and other underused urban spaces in a smart and productive way. *(Benke & Tomkins, 2017)*

In the context of Hammarkullen, two major benefits of hydroponic farming stand out: its potential to create economic opportunities and strengthen social engagement. Urban hydroponic farms can generate local employment, supporting residents through job creation and contributing to the area's economic development.

In addition to economic benefits, hydroponic initiatives can serve as important platforms for education and community engagement.*(Benke & Tomkins, 2017)*. They offer opportunities for residents, especially youth, to learn about sustainable food systems, environmental awareness, and nutrition On a practical level, it also provides the local population with affordable, fresh produce that can be picked up just a short walk from their homes.

5.1 HOW HYDROPONICS WORKS: METHODS AND TOOLS

There are different types of hydroponic farming systems, each with its own method of delivering nutrient-rich water to plants without the use of soil. In the context of the Hammarkullen basement, it was crucial to understand how these systems function in order to determine which ones could be effectively adapted for early-stage implementation.

DEEP WATER CULTURE

Deep Water Culture (DWC) is a highly efficient hydroponic system in which plant roots grow in a continuously oxygenated, nutrient-rich water solution. The plants are supported in net pots placed above a water-filled reservoir, while an air pump and air stone deliver oxygen to the nutrient solution. This direct access to both oxygen and nutrients promotes rapid plant growth and high yields. The system's simple design, with minimal components, makes it easy to set up and maintain while using significantly less water than traditional soil-based farming methods *(Virginia Cooperative Extension, n.d.)*.

One of the main advantages of DWC is its ability to accelerate plant growth because roots have constant exposure to oxygen and nutrients. This leads to healthier plants and greater productivity. Additionally, DWC systems require little to no growing media, such as coco coir or rockwool, reducing the need for extra substrates. The high water-use efficiency of this method also makes it especially beneficial in areas where water availability is limited *(Virginia Cooperative Extension, n.d.)*.

However, DWC systems come with challenges. Proper aeration is essential, as insufficient oxygen can cause root rot. Water temperature also needs to be monitored, as warmer water can reduce oxygen levels. Additionally, regular checks are required to ensure that pH and nutrient levels remain balanced. Finally, DWC systems rely on electricity to power aeration, making them vulnerable to power failures. Despite these challenges, DWC is considered one of the most effective methods for hydroponic farming due to its efficiency and productivity *(Khatri, Kunwar, & Bist, 2024)*.

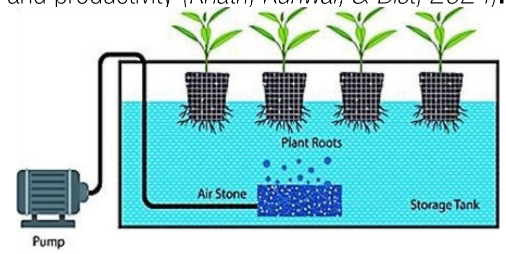


Fig : DWC System (Source: https://nosoilsolutions.com)

NUTRIENT FILM TECHNIQUE

The Nutrient Film Technique (NFT) is a type of hydroponic system in which a thin, continuously circulating layer of nutrient solution flows through narrow channels, allowing the plant roots to absorb nutrients efficiently *(Mullins, Vallotton, Latimer, Sperry, & Scoggins, 2023)*. The excess solution drains back into the reservoir for reuse, making the system highly efficient in its use of water and nutrients. The steady flow provides consistent oxygen and nutrient access, promoting healthy and rapid plant growth. NFT systems are scalable for commercial production and are particularly suitable for lightweight crops such as lettuce and herbs. However, they require precise control of flow rate and channel slope, making them more complex than Deep Water Culture (DWC) systems and vulnerable to pump failures or uneven nutrient distribution. Additionally, NFT is less suitable for plants with large root systems, unlike DWC, which can support a wider range of species *(Mullins et al., 2023)*.

Fig : NFT System (Source: https://www.agrowtronics.com)

FLOOD AND DRAIN SYSTEM (EBB AND FLOW SYSTEM)

The Ebb and Flow method, sometimes called the Flood and Drain system, is a flexible hydroponic technique in which nutrient solution is intermittently pumped into the root zone and then allowed to drain back into a reservoir *(Mullins, Vallotton, Latimer, Sperry, & Scoggins, 2023)*. Plants are usually grown in containers or trays filled with inert media such as clay pebbles or perlite, which support the roots while allowing efficient water circulation. A submersible pump connected to a timer controls each flooding cycle, ensuring that plants receive nutrients and moisture at consistent intervals. Once the timer shuts off the pump, gravity allows the solution to drain away, bringing in fresh oxygen to the root zone during the drying period.

This intermittent flooding process allows the roots to benefit from both nutrient absorption and oxygen exposure, promoting healthy growth. *(Shrestha, A., & Dunn, B. ,2017)* One of the main advantages of the Ebb and Flow system is its flexibility in accommodating a variety of plant sizes, including those with larger root systems *(Shrestha, A., & Dunn, B. ,2017)*, which is more difficult in systems like NFT. It also allows better control over feeding schedules and prevents issues like water stagnation.

However, compared to NFT and DWC systems, Ebb and Flow setups can be more complex due to the need for accurate timing and proper drainage design. Like NFT, it is vulnerable to pump failures, which can dry out roots quickly. Additionally, the growing medium used in Ebb and Flow systems can retain water longer, potentially leading to overwatering if not carefully monitored. Unlike DWC, where the roots are continuously submerged in oxygenated water, Ebb and Flow offers periodic access, which can be slightly less efficient in promoting rapid growth. Still, its adaptability and ability to support a wider range of plants make it a valuable method for small-scale and diverse hydroponic applications (*Shrestha, A., & Dunn, B. ,2017 April*).

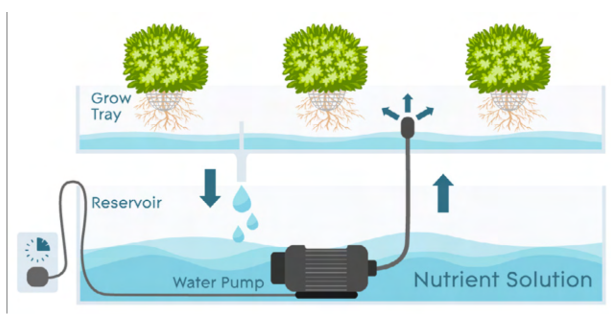


Fig : EBB and Flow System (Source: https://www.agrowtronics.com)

DRIP SYSTEMS

Drip Irrigation Systems are among the most adaptable hydroponic methods and are commonly used in both small-scale and commercial setups. In this system, a slow and steady supply of nutrient-rich water is delivered directly to the plant roots through drip emitters. These emitters are connected to a network of tubes and can be adjusted to suit different plant needs *(Jones Jr., J. B., 2016)*. A growing medium such as coco coir, rockwool, or perlite is usually used to help retain moisture between each drip *(Gruda, N. ,2009)*. The system can either recirculate the leftover water back to the reservoir or let it drain away depending on the setup.

One of the main advantages of the drip system is the level of control it offers. Each plant can receive a customised amount of nutrients, which is helpful for growing different kinds of produce like tomatoes, strawberries, peppers, or cucumbers, plants that require more support and nutrients than leafy greens (*Barker, A. V., & Pilbeam, D. J., 2015*). Compared to NFT systems, which are better suited for lighter plants like lettuce, drip systems can support heavier crops and more complex root structures. And unlike DWC systems, where roots are fully submerged, drip systems avoid the constant water contact, which helps reduce the risk of root rot and allows for better oxygenation.

That said, the system does have some drawbacks. One issue I came across in my research is that the emitters can get clogged over time, especially if the nutrient solution isn't filtered properly. (*Jones Jr., J. B., 2016)*.This means the system needs more maintenance compared to DWC or NFT. Also, if it's set up as a non-recovery system, it can waste water and nutrients unless carefully managed. Still, the ability to target plants individually and support a wider variety of crops makes the drip system a strong choice, especially for setups aiming to grow fruiting plants efficiently.

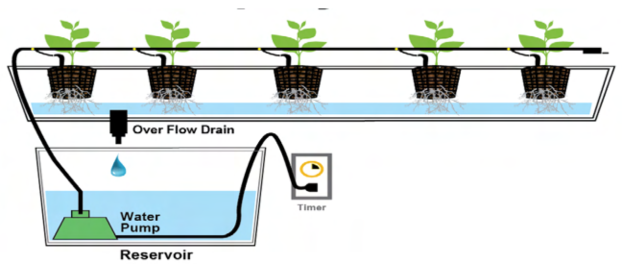


Fig : Drip Systems (Source: https://growshop-bg.com)

AEROPONICS

Aeroponics is an advanced hydroponic technique in which plant roots hang freely in the air and are periodically sprayed with a fine mist containing nutrient solution. Because no growing medium is used, the roots are fully exposed to oxygen while still receiving the nutrients they need, resulting in rapid absorption and accelerated plant growth *(Jones Jr., 2016)*, especially compared to systems such as DWC or NFT.

One of the biggest advantages of aeroponics is how oxygenated the root environment is. This helps boost growth rates and improve overall plant health. It's also extremely water-efficient, using less water than most other hydroponic methods *(Bugbee, B., 2004)*. But from what I've found, it's definitely more complex to set up and maintain. The system depends heavily on timing and proper mist delivery, if something fails, like a clog or power cut, the roots can dry out quickly. It's also more expensive due to the specialized equipment and sensors needed*(Jones Jr., J. B. 2016)*.

This system is often used for herbs, leafy greens, and even some fruiting plants in high-tech environments (*Barker, A. V., & Pilbeam, D. J., 2015*). While it offers high precision and impressive results, it's not as beginner-friendly as drip or DWC systems and is best suited for controlled setups where maintenance and cost aren't major concerns.

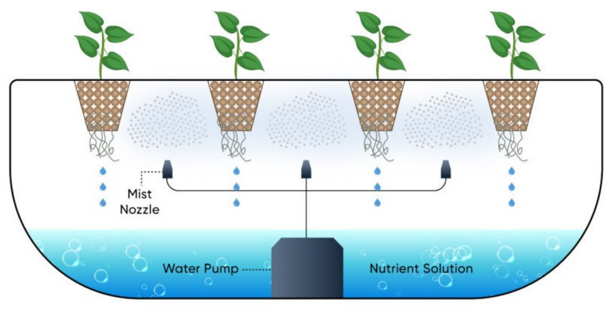


Fig : Aeroponic Systems (Source: https://ponicslife.com)

5.2 UNDERSTANDING THE COMMON SYSTEMS AND PROCESSES IN HYDROPONIC METHODS

Hydroponic agriculture being the practice of growing plants without soil, necessitates a carefully engineered environment where plants receive essential resources directly. These resources, including light, carbon dioxide, water, and nutrients, all entail associated costs *(Jones, 2016)*. While traditional greenhouses can harness natural sunlight, controlled environment agriculture, particularly vertical farms, relies heavily on specialized equipment to optimize plant growth.

NUTRIENT DELIVERY SYSTEMS

A key component of hydroponic farming is the precise delivery of nutrient-rich solutions directly to plant roots. As explained in the previous sections, various methods exist to achieve this. These systems are often designed as closed loops to maximize water and nutrient efficiency, recirculating the solution to minimize waste *(Savvas & Passam, 2002)*.

ILLUMINATION TECHNOLOGIES

For indoor hydroponic facilities, artificial lighting is fundamental. High-Intensity Discharge (HID) lamps, fluorescent lights, and increasingly, Light Emitting Diodes (LEDs) are utilized to provide the necessary photosynthetic radiation *(Barbosa et al., 2015)*. Research suggests that specific light wavelengths, particularly in the red and blue spectrum, are most effective for plant growth *(McCree, 1972)*. However, although these wavelengths are beneficial for plants, prolonged exposure to red and blue LED lighting can be uncomfortable or straining for human eyes, an observation commonly mentioned in user experiences.

CLIMATE REGULATION SYSTEMS

Maintaining a stable and optimal climate is crucial in hydroponic environments. This involves controlling temperature, humidity, and air circulation based on the specific requirements of the cultivated crops *(Jensen & Malter, 1995)*.

CARBON DIOXIDE MANAGEMENT

Enhancing carbon dioxide (CO_2) levels within controlled environment agriculture can significantly boost photosynthetic rates and overall plant productivity *(Wittwer, 1986)*. Therefore utilizing compressed CO_2 or CO_2 generated from other sources, are important considerations for optimizing growth, particularly in enclosed vertical farms.

GROWING SUBSTRATES

Common examples include rockwool, perlite, vermiculite, coco coir, and clay pebbles *(Gruda, 2009)*. The selection of growing medium depends on its water retention capacity, aeration properties, and compatibility with the specific hydroponic technique.

WATER SOURCE AND MANAGEMENT

The quality and management of the water source are critical in hydroponics. Water must be free of harmful contaminants, and its pH and electrical conductivity (EC) need to be carefully monitored and adjusted to ensure optimal nutrient availability to the plants *(Marschner, 2012)*.

THE PRODUCTION PROCESS

The hydroponic crop production process is generally divided into three key stages: germination, transplanting, and harvesting. While these steps may vary slightly depending on the system type, such as Deep Water Culture (DWC) or Nutrient Film Technique (NFT), the core structure remains consistent *(McKee, 2017; Sedacca, 2017)*.

Germination typically occurs outside the main hydroponic system, in a controlled environment optimized for sprouting. Seeds are placed in a growing medium like rockwool or peat, which retains moisture while allowing air circulation. This stage requires warmth (above 21°C), high humidity, and moderate light *(MaximumYield Inc)*. Germinating seeds separately helps avoid risks associated with introducing pests or diseases into the main system, and also ensures that environmental conditions are tailored to the early developmental stage *(McKee, 2017; Rytterborn, 2019)*.

After one to four weeks, depending on the plant type, seedlings are transplanted into the hydroponic system *(Rytterborn, 2019)*. In DWC systems, roots are submerged in oxygenated, nutrient-rich water, while NFT systems deliver a thin film of water along channels where roots are exposed to both nutrients and air. The transplanting stage marks a shift in environmental needs, plants now require stronger lighting, lower humidity, and a carefully balanced nutrient mix to support vegetative growth *(McKee, 2017; MaximumYield Inc., n.d.-b)*.

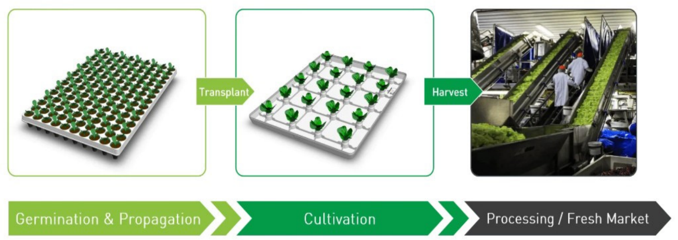


Fig : Production steps (Source: https://www.botmanhydroponics.)eu/

Finally, in the harvest phase, crops are collected once they reach maturity, usually within four to eight weeks post-transplanting *(Sedacca, 2017)*. Fast-growing varieties such as lettuce, microgreens, and herbs are often selected for hydroponic production because they mature quickly and offer strong market returns (*McKee, 2017*). Harvested plants are often packaged on-site and immediately distributed, allowing for a streamlined farm-to-customer process.

While it's technically possible to germinate and grow in the same system, it's uncommon in commercial setups because the environmental needs of the plant shift significantly between stages. Separate systems also help reduce cross-contamination and support a more efficient production cycle *(MaximumYield Inc.,; Rytterborn, 2019; McKee, 2017)*. By dividing the production into distinct phases, hydroponic farms can better manage plant health, growth speed, and overall productivity.

5.3 MARKET STUDY - THE DEMAND FOR LOCAL FOOD PRODUCTION IN SWEDEN'S FRUITS AND VEGETABLES MARKET IN SWEDEN

This case study will explore the market dynamics, import dependence, and the opportunity for domestic food production in sweden.

Market Dynamics & Consumer Behavior

Kommerskollegium (2024) reports that overall Swedish consumer spending on fresh fruits and vegetables has risen steadily since 2016. Even though produce prices spiked sharply, especially for vegetables (up about 10.3% in 2022 and 16.3% in 2023), shoppers continued to buy fresh fruits and vegetables. The higher prices did lead to a small drop in volumes: in 2023, the volume of vegetables sold fell about 6%, while fruit sales actually grew roughly 3.7% *(Kommerskollegium, 2024)*. This suggests that Swedish consumers showed a stronger willingness to continue purchasing fruits over vegetables when faced with price increases. Notably, by early 2024, total fruit and vegetable sales were up by 3.3%, indicating a market recovery. These trends suggest that although Swedish consumers are sensitive to price, they still prioritize fresh produce, particularly fruits, even during periods of inflation.

According to De Brun Skantz *(as cited in Dahlberg & Lindén, 2019)*, Swedish consumers showed an unexpected readiness to pay for vertically grown greens, which reflects both their environmental awareness and openness to new innovations.

Sweden's Reliance on Imports and Vulnerabilities.

Historically, Sweden has imported approximately 1 million tonnes of fruits and vegetables annually. However, in 2023, this figure dropped to 887 thousand tonnes, mainly due to reduced imports from European countries *(Kommerskollegium, 2023)*. A significant portion of Sweden's produce imports now comes from developing countries, including bananas (74% of banana imports), along with smaller quantities of oranges, apples, mandarins, and potatoes *(Kommerskollegium, 2023*).

Sweden's high import dependency makes its fresh produce market vulnerable to external risks, such as price fluctuations, logistical disruptions, and changes in international trade policies. Disruptions in transportation or an increase in tariffs could lead to higher prices or reduced availability of certain fruits and vegetables. Additionally, the reliance on long-distance supply chains raises concerns regarding sustainability, environmental impact, and food security.

While Sweden traditionally sourced much of its produce from nearby European countries, the share of imports from developing countries increased from 21% in 2019 to 24% in 2023 *(Kommerskollegium, 2023)*. A key reason for the decline in European imports could be linked to the 2022 price shocks, when energy costs, transportation costs caused production and distribution challenges across Europe. Extreme weather events, like droughts and floods, also negatively affected European agriculture during this period, reducing crop yields and making exports more expensive.

So probably to maintain supply and control rising costs, Sweden increasingly turned to developing countries, where production costs were lower and where certain fruits and vegetables could still be sourced more affordably. However, this shift also contributed to the overall increase in fresh produce prices, due to longer transport distances, greater logistics complexity, and higher environmental costs associated with imports from farther away.

This dynamic highlights an opportunity for Sweden to strengthen its local food production through methods like hydroponics. And by growing more fruits and vegetables locally, Sweden could improve food security, reduce environmental impact, and limit its vulnerability to external shocks in the global supply chain.

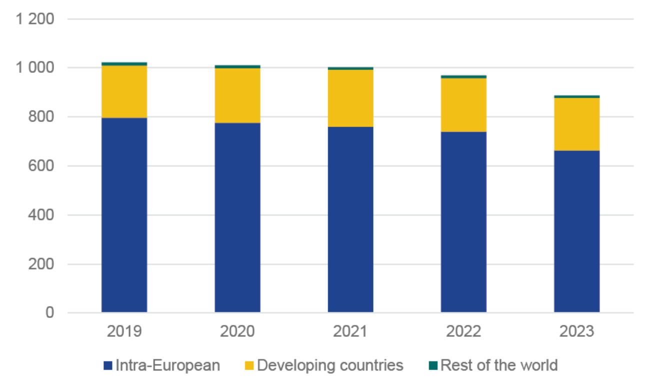


Figure. Imports of fresh fruits and vegetables to Sweden by supplying region (thousand tonnes). Source: UN Comtrade (2024).

The Organic and Local Opportunity

Sweden relies heavily on imports to meet consumer demand for fresh fruits and vegetables due to its cold climate, which poses challenges for year-round domestic food production, especially for crops like cucumbers, citrus fruits, and tomatoes *(Jordbruksverket, n.d.; USDA Foreign Agricultural Service, 2023*). Traditional farming methods are limited by the country's short growing season, long winters, and limited daylight during the colder months *(Jordbruksverket, n.d.)*. Climate adaptation is becoming increasingly important for Sweden's agricultural sector *(Lantmännen, 2023).* Recent harvest years have highlighted the growing complexity of weather patterns, with farmers experiencing both drought and excessive rainfall, underscoring the need for more resilient climate adaptation strategies *(Lantmännen, 2023).* Projections indicate an increase in mean annual precipitation across Sweden, but more significantly, a rise in the frequency of extreme weather events like droughts and heavy rainfall, posing a considerable challenge to agricultural stability *(Wits.WorldBank.org, 2020)*. To overcome these challenges, vertical farming and hydroponic systems offer promising solutions. Hydroponics provides a controlled environment that mitigates the risks associated with Sweden's natural conditions, allowing for consistent, high-quality production of fresh, organic vegetables year-round *(Nordic Council of Ministers, 2020)*.

Sweden imports approximately 50% of its vegetables and about 90% of its fruits annually *(Kommerskollegium, 2023).* Key products like tomatoes, cucumbers, peppers, and strawberries are commonly sourced from Spain, the Netherlands, and developing countries *(UN Comtrade, 2024)*. This raises the question:

What Crops Can Be Grown Using Hydroponic Systems?

Hydroponic systems are used across the world to grow diverse crops such as leafy vegetables (like lettuce, kale, and spinach), aromatic herbs (including basil, coriander, and mint), as well as fruiting plants like tomatoes, cucumbers, peppers, and strawberries *(Pure Greens, n.d.)*. Emerging technologies even enable the hydroponic cultivation of crops like blueberries and raspberries under specialized conditions *(Barbosa et al., 2015)*. Many of these crops are among the fruits and vegetables that Sweden heavily depends on imports for, highlighting a direct opportunity to localize production.

Why Are Fruits Less `Commonly Grown Hydroponically?

While hydroponic systems are well-established for vegetables and leafy greens, fruit production remains less common. One primary reason is that hydroponic fruit cultivation is perceived as more labor-intensive and technically demanding. Fruit-bearing plants often require more complex care, including: Manual or artificial pollination, Longer growing cycles, Larger space requirements compared to leafy greens (*Maximum Yield, 2017)*

Pollination, a critical step in fruit production, must often be manually assisted or supported by introducing bumblebees into indoor systems. Research shows that bumblebees can adapt to greenhouse and vertical farming environments and provide effective pollination *(Velthuis & van Doorn, 2006).*

In controlled hydroponic environments, natural pollinators like bees can be integrated into greenhouses. Alternatively, manual pollination techniques, such as using vibrating tools (e.g., electric toothbrushes) or airflow systems, are used to stimulate flower pollination *(López et al., 2012)*. As technology advances, innovative practices will likely continue to emerge and develop to make pollination more efficient and reduce labor challenges, making hydroponic fruit production increasingly feasible.

Insights from the Study

Hydroponics has the potential to fill many of the vulnerabilities that the Swedish food market faces. To fully realize this opportunity, different groups need to focus on key areas. Investors and entrepreneurs should prioritize growing crops with high import dependence and strong local demand, like leafy greens, berries, tomatoes, and cucumbers. Policymakers can support this shift by introducing policies and incentives that encourage the development and wider adoption of sustainable hydroponic farming across Sweden. Researchers also play an important role by continuing to develop ways to make hydroponic systems more energy-efficient, particularly by improving technologies such as LED lighting and climate control. Together, these efforts can make hydroponic farming a strong and sustainable part of Sweden's future food supply.

A bumblebee hive box placed inside a greenhouse at Wishwell Farms in Ohio. The box supports natural pollination of crops like tomatoes and cucumbers, helping improve fruit set and yield. (Image source: Screenshot from a YouTube video by Jason Wish, documenting operations at Wishwell Farms.)

5.4 CASE STUDY: URBAN FARMING ACTORS IN SWEDEN

PLANTAGON

Plantagon International represents one of the earliest and most innovative efforts in integrating urban farming within the existing city infrastructure of Sweden. Founded in 2008 by Swedish entrepreneur Hans Hassle and the Onondaga Nation, the company aimed to revolutionize food production through technologically advanced solutions like vertical farming and agritechture *(Dahlberg & Lindén, 2019; Agritecture, 2019).*

Plantagon's core mission was rooted in addressing the future challenges of food security. As CEO Owe Pettersson explained, with 10 billion people expected to inhabit the Earth by 2050, 80% of them in urban areas and 80% of arable land already utilized, the existing model of food production was deemed unsustainable. Plantagon's proposition was to embed food production within the city as part of its infrastructure rather than rely on food imports *(Dahlberg & Lindén, 2019).*

A notable example of Plantagon's innovation was its transformation of a basement formerly used as an archive for the newspaper Dagens Nyheter into a vertical farm, the CityFarm in Stockholm. Equipped with ZipGrow towers and reusing district heating, the farm demonstrated significant resource efficiency—using less than 1% of the water required by conventional farming and producing carbon-negative operations by recycling 86% of the energy used *(Dahlberg & Lindén, 2019).*

Despite its technological expertise, Plantagon struggled financially. A $40 million flagship skyscraper project in Linköping, named the World Food Building, broke ground in 2012 but was eventually shelved due to repeated delays and escalating costs. While the company held over 60 patents and promoted a closed-loop, sustainable farming system, production costs remained high. For example, the cost of producing greens in the basement facility exceeded 100 SEK/kg, making profitability difficult without eliminating intermediaries like retailers who demand high mark-ups (Dahlberg & Lindén, *2019*).

In 2019, Plantagon filed for bankruptcy, primarily due to cash flow problems. Attempts to raise capital through crowdfunding (raising over €420,000 from 477 investors) were insufficient to sustain the business. The collapse was not due to a lack of vision or technology but rather a failure to successfully commercialize and scale their innovations (Agritecture, 2019).

Insights from the case study -

Plantagon's journey gives us a lot to learn from. Their idea of "agritechture", mixing architecture and agriculture was very forward-thinking. They showed how food production could be part of the city, using smart and sustainable systems that were carbon-negative and saved a lot of water and energy.

But even with all this innovation, making the business work financially was a big challenge. The costs were high, and depending on middlemen like grocery stores made it hard to be profitable. That's why doing a proper feasibility study early is so important.

It also seems like Plantagon may have been a bit ahead of their time. Their ideas were great, but the market and infrastructure weren't quite ready. One key takeaway is that scale really matters. Their small basement farm cost over 100 SEK/kg to run, while a larger, purpose-built facility like the one they planned in Linköping could have brought that cost down to around 20 SEK/kg, due to better design and efficiency.

Another lesson is about sales. Selling through grocery stores didn't work well because of the high markups. A direct-to-consumer approach might have worked better. Even though the company shut down, they left behind a lot of valuable knowledge and patents that can still inspire and support future urban farming projects.

In the end, Plantagon shows how big ideas need to be balanced with practical planning, especially when it comes to finances, scaling, and how to reach to customers.

LJUSGÅRDA

Founded in 2017 by three childhood friends in Tibro, Sweden, Ljusgårda began as a garage project experimenting with hydroponic systems. Their initial success with basil cultivation led them to invest in professional equipment, including systems from ZipGrow and LED lighting from Heliospectra. By early 2018, they had relocated to a renovated 7,000 m² industrial facility, transforming it into a state-of-the-art vertical farm *(Dahlberg & Lindén, 2019*).

Ljusgårda employs a combination of hydroponic vertical farming and advanced automation. A notable feature is their use of Constructor's Pallet Shuttle system, typically used for pallet storage, adapted here for plant cultivation. This semi-automated system consists of four deep-stacking sections, each 37 meters deep with four cultivation levels, allowing for efficient space utilization and controlled growing conditions *(Constructor, n.d.)*.

Seeds are initially germinated in plug boards containing coconut fiber and peat, placed in cultivation pallets, and moved into a high-humidity heating room. After a day, these pallets enter the Pallet Shuttle system, where they receive 18 hours of light daily. After approximately two weeks, when seedlings reach about 8 cm, they are transferred to vertical cultivation tubes for another 2-3 weeks before harvest. The harvested greens are then washed, packaged, and delivered to retailers within 24 hours, ensuring freshness *(Constructor, n.d.)*.

Sustainability was central to Ljusgårda's operations. They utilize 100% renewable energy sources, and their controlled environment agriculture (CEA) system allows precise regulation of light, temperature, humidity, and nutrients. The integration of Heliospectra's ELIXIA LED lighting system enables them to adjust light spectra to optimize plant growth, improve yield, and ensure consistent quality year-round *(Heliospectra, 2018*).

Initially, Ljusgårda supplied local ICA stores, with demand quickly surpassing expectations. Their ability to fine-tune the taste profile of their arugula, adjusting factors like light and nutrients, allowed them to meet consumer preferences effectively. By 2021, they aimed to produce 1,000 tonnes of greens annually, positioning themselves as market leaders in Sweden *(Dahlberg & Lindén, 2019)*.

Their marketing efforts have also been recognized internationally. In 2023, Ljusgårda won the "Best Product Marketing" award at the Vertical Farming World Awards for their "Supernormal greens" campaign, highlighting the sustainability benefits of their produce, which reportedly has 50% less CO2 equivalent emissions compared to conventionally grown salad *(Food Supply, 2023)*.

Fig : Vertical farming system in Ljusgårda (Source : OCS. (n.d.). Ljusgårda. https://www.ocs.se/referenser/ljusgarda)

Insights from the case study -

Ljusgårda's development shows the value of iterative, phased scaling in building a successful and sustainable innovation. Starting in a garage, the company tested its concept by selling early batches locally and used customer feedback to refine taste, texture, and growing methods. This gradual, hands-on approach enabled them to reduce risk and base scaling decisions on real-world insights.

Their strategy also involved delayed but well-timed technology investment. Rather than automating from the outset, Ljusgårda waited until their product and market fit were validated. Only then did they introduce advanced technologies like the Pallet Shuttle system and Heliospectra's LED lighting, ensuring that resources were directed toward proven growth potential.

Innovation extended to the adaptation of existing technologies, such as repurposing warehouse pallet systems for plant cultivation. This not only enhanced scalability but also reduced development costs. Their use of Controlled Environment Agriculture (CEA) allowed precise regulation of growing conditions, enabling consistent year-round production with minimal environmental impact.

Sustainability remained central throughout. By relying entirely on renewable energy and using significantly less water than traditional farming, Ljusgårda demonstrated that environmental responsibility can align with profitability. Moreover, their responsiveness to customer feedback, adjusting flavor profiles based on preferences, helped strengthen market relevance and consumer trust. Finally, their international marketing award reflects the impact of authentic storytelling and transparent branding in building a credible identity around sustainability.

Fig : Salad packet produced by Ljusgårda. (Constructor, n.d.)

GRÖNSKA

Grönska is a vertical farming company in Sweden that started in 2014. It was founded by three friends, Petter Olsson, Robin Lee, and Natalie de Brun Skantz, after they got inspired by vertical farming in Japan (*Dahlberg & Lindén, 2019*). They began by experimenting in a basement using LED lights to grow plants indoors. Natalie later joined the project, bringing in her background in finance and marketing, and her previous research in urban farming from her master's thesis *(Dahlberg & Lindén, 2019)*.

At first, Grönska focused on producing greens in a vertical farm in Stockholm. But in 2021, they changed direction and decided to share their technology instead of just producing food themselves *(Swedish Cleantech, 2020)*. Now, they run two sites: a small one in Hammarbyhöjden and a much bigger one in Huddinge, which is around 900 square meters. The Huddinge site can grow about 1.3 million plants a year *(Grönska, n.d.)*. Their system is only partly automated. They focus on making the most time-consuming parts more efficient, rather than automating everything. *(Dahlberg & Lindén, 2019)*.

They earn money in several ways. They sell fresh greens to Swedish supermarkets like ICA, Coop, and Urban Deli (Dahlberg & Lindén, 2019). They also have a product called GrowOff Microfarm. It's a small hydroponic system that can be used in places like restaurants and shops (Grönska, n.d.). On top of that, they offer a subscription service where customers receive seeded pods and help with maintenance *(Vinnova, 2020)*.

Even though it costs more, they use paper bags instead of plastic to package their greens (Dahlberg & Lindén, 2019). Their systems use fewer resources, such as 95% less water, and no pesticides (Grönska, n.d.). They claim their technology is easy to use, with automation for lighting, watering, and temperature, all controlled via phone. So even people with no farming experience can grow herbs, leafy greens, or flowers *(Grönska, n.d.)*

One good example is their work with Coop. They installed 20 GrowOff units in Coop's store in Hagastaden, Stockholm. This made the store self-sufficient in growing its own herbs and greens and gave customers a new experience, seeing their food grown in the store *(Livsmedelsnyheter, 2021)*.

Insights from the case study -

Their approach to automation is smart. They don't try to do everything with machines but focus on making key steps faster and easier. This lets them grow while keeping things affordable *(Dahlberg & Lindén, 2019)*. This means that not every task needs to be fully automated to reduce costs or scale up production.

Another takeaway is how they've diversified their business model. Besides selling greens, they provide GrowOff units and subscription services, which adds steady income and builds customer relationships *(Grönska, n.d. ; Vinnova, 2020)*. Their partnership with Coop shows the value of making farming visible and local, creating a connection between customers and the food they eat *(Livsmedelsnyheter, 2021)*.

Lastly, Grönska is proof that sustainability and business can go hand in hand. Even though they pay more for eco-friendly packaging and energy, their long-term strategy aligns with growing interest in clean, local food *(Swedish Cleantech, 2020)*. Their user-friendly technology makes it possible for anyone, even with no background in farming, to become a grower *(Grönska, n.d.)*.

Fig: The GrowOff system works in three simple steps: Insert the pre-seeded pod (delivered through a subscription), and the system begins watering. After 3–5 days, peel off the film once the seeds sprout. In 20–50 days, harvest fresh herbs, salads, or flowers (Grönska ; Vinnova, 2020)

Fig: GrowOff Microfarm Installed in a Commercial Setting (https://www.gronska.org)

FUTUFARM

Established in 2016 by Harrie Rademaekers and Anders Nilsson, FutuFarm is a Swedish company based in Halmstad that specializes in implementing vertical farming systems. Unlike companies that focus solely on producing greens, FutuFarm positions itself as a food-tech enterprise, providing modular farming solutions to various stakeholders interested in producing their own crops *(Dahlberg & Lindén, 2019)*.

FutuFarm collaborates with the American company Freight Farms to distribute container-based vertical farming units in Northern Europe. Initially, they offered the Leafy Green Machine (LGM), a 30 m² container equipped with ZipGrow towers and growth-monitoring technology, capable of producing "approximately 1,000 small heads of lettuce or 45 kg of basil per week" *(Dahlberg & Lindén, 2019)*. The LGM has since been succeeded by "The Greenery," a redesigned container farm offering a 70% increase in growing space. This fully equipped unit costs around $105,000 USD, approximately 1,100,000 SEK *(Dahlberg & Lindén, 2019)*.

These systems are designed for ease of use, requiring only water and electricity connections. The entire operation can be managed via smartphone, demanding about 20 hours of work per week. FutuFarm's target customers include educational institutions, grocery stores, and restaurants seeking to produce fresh greens on-site *(Dahlberg & Lindén, 2019)*

A notable example is the ICA Maxi store in Halmstad, which installed an LGM on its roof in February 2019. This setup allows the store to offer a diverse range of fresh greens grown just steps away from the shelves, enhancing sustainability and product freshness *(Dahlberg & Lindén, 2019)*.

Insights from the case study -

FutuFarm's approach showcases how modular vertical farming systems can transform urban agriculture. By utilizing standardized, transportable units like Freight Farms' container-based systems, these farms can be easily set up in various locations, adapting to different urban environments. This scalability allows for the gradual expansion of farming operations, meeting the increasing demand for local, sustainable food sources.

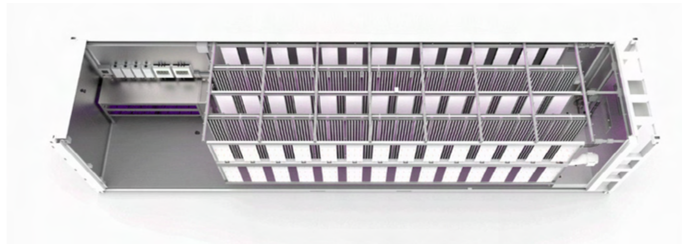


FIG: Interior of container farm, featuring vertical hydroponic growing towers suspended from overhead rails. (Source: https://www.futufarm.com)

Fig : FutuFarm Systems installed in Faroe Islands where the climate is rough and access to fresh crops is distant. (Source: https://www.facebook.com/futufarm)

KAJODLINGEN

Kajodlingen is an urban farming initiative situated on a pier in central Gothenburg, Sweden. Founded by Jonas Lindh and William Bailey in 2015, the farm produces approximately 2,000 kg of greens annually using a modern adaptation of traditional soil farming methods *(Dahlberg & Lindén, 2019)*.

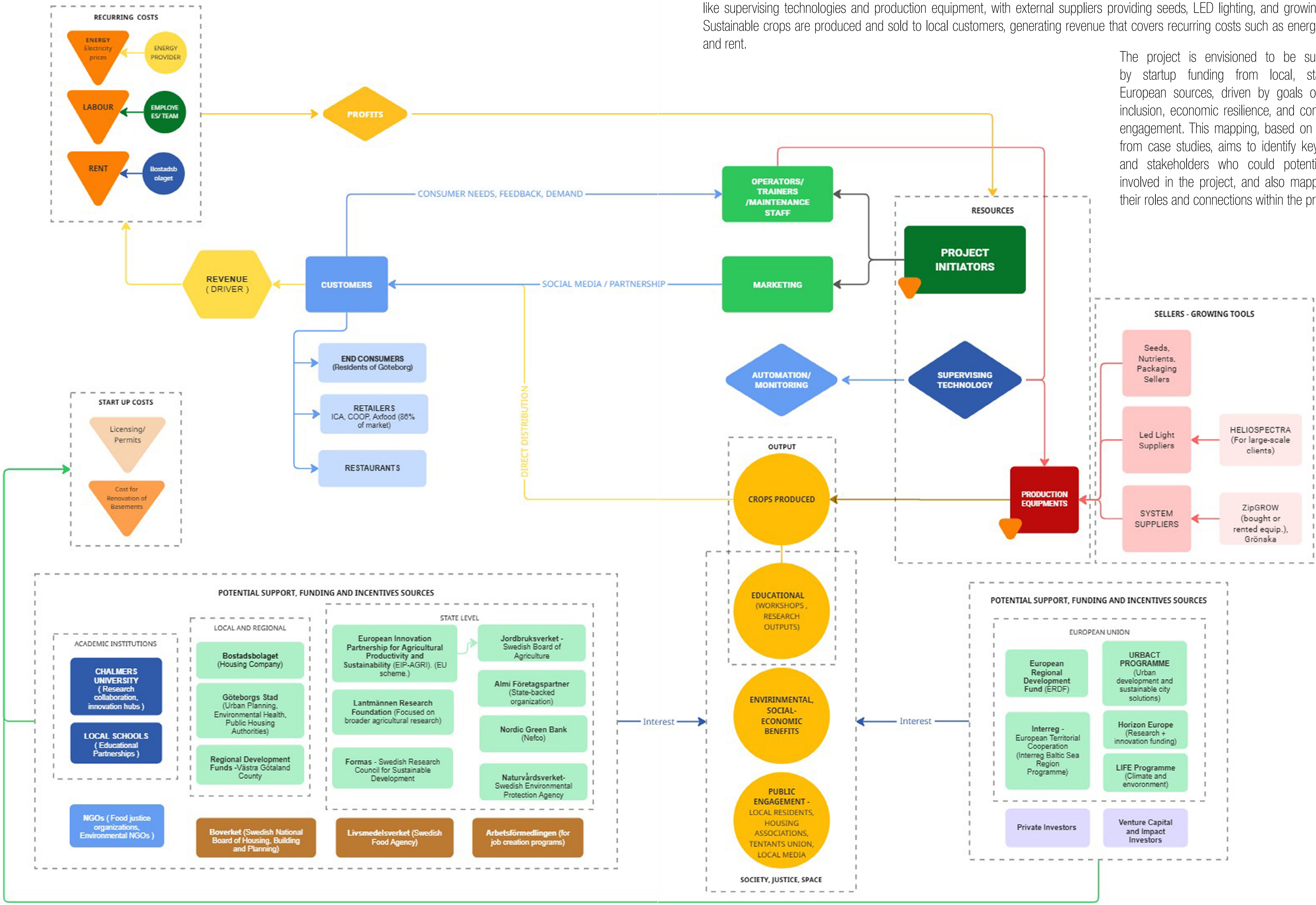
Operating on an area of about 600 m², Kajodlingen produces crops such as leafy greens, root vegetables, and fruits using a mix of open-air plots and sheltered pallet systems *(Dahlberg & Lindén, 2019)*. To extend the growing season, they employ a homemade vertical farming setup with shelves and lights for indoor germination during colder months. This indoor setup allows seeds to sprout and develop into seedlings in a controlled environment, which is particularly useful in Gothenburg's chilly early growing season. Once the seedlings are strong enough, they are transferred to the outdoor pallets for continued growth, benefiting from wind protection even during the colder months *(Dahlberg & Lindén, 2019)*. Initially targeting restaurants, Kajodlingen shifted focus to direct consumer sales due to challenges with restaurant supply demands. They now offer weekly subscription baskets of seasonal greens, typically weighing about 1.8 kg and priced at 250 SEK. Deliveries are made by bicycle to nearby customers, eliminating transportation-related environmental impacts *(Dahlberg & Lindén, 2019)*.

During summer, customers can pick their own greens, fostering a connection between urban residents and food production. Kajodlingen has also established a rooftop farm atop the Clarion Hotel Post in Gothenburg, supplying the hotel's restaurants with fresh produce and utilizing the restaurants' food waste as fertilizer, creating a sustainable, circular syste. This collaboration not only provides fresh ingredients for the hotel but also serves as an educational platform for sustainable practices *(Grow Here, n.d.)*. The visibility and accessibility of the farm foster community interest in sustainable food production and education.

5.5 A STAKEHOLDER MAPPING OR ACTOR NETWORK MAPPING

This stakeholder and actor network mapping outlines key elements of a hydroponic farming project, beginning with the project initiators — operators and marketing teams — who connect the farm's produce to the community. The project relies on core resources like supervising technologies and production equipment, with external suppliers providing seeds, LED lighting, and growing tools. Sustainable crops are produced and sold to local customers, generating revenue that covers recurring costs such as energy, labor, and rent.

The project is envisioned to be supported by startup funding from local, state, or European sources, driven by goals of social inclusion, economic resilience, and community engagement. This mapping, based on insights from case studies, aims to identify key actors and stakeholders who could potentially be involved in the project, and also mapping out their roles and connections within the project.



5.6 CONCLUDING ARGUMENT: JUSTIFYING THE ADDED COST OF RENOVATION AS A SUSTAINABLE ALTERNATIVE TO DEMOLITION

The Pitfalls: Profitability Challenges

Hydroponic farming offers clear environmental advantages, but its economic model remains fragile, particularly in its early stages of implementation. Energy and labor account for the majority of operational costs, with international case studies showing energy consumption can reach around 55% of total costs, while labor accounts for roughly 25%. In Sweden, where labor costs are among the highest in Europe, this presents a decisive barrier to profitability. Companies elsewhere have attempted to address this through automation, which can reduce the reliance on manual labor but requires significant upfront capital investment. This creates a paradox: automation lowers costs in the long term, but in the short term it often increases financial vulnerability, especially for smaller or community-oriented projects that cannot absorb high initial expenditures.

Many large-scale ventures, particularly in the United States, have collapsed under the weight of such costs, having expanded too quickly without stabilizing their operational models. This highlights the risks of rapid scaling in hydroponics, where enthusiasm for technological promise sometimes outpaces financial and social feasibility.

For the Hammarkullen basement, these pitfalls underscore the importance of incremental development. By starting small, testing systems in real conditions, and scaling up only as local capacity, governance structures, and technical expertise grow, the project avoids the mistakes of overextension.

From a resilience perspective, this incrementalism allows for "learning by doing" *(Davoudi., 2012)*, reducing exposure to risk and ensuring that the system can adapt as challenges emerge. At the same time, situating early hydroponics as part of a commons-based framework ensures that the benefits "knowledge, access, and produce" are distributed even before profitability is achieved, reframing value in social and ecological terms rather than purely financial ones *(Meerow, Newell, & Stults, 2016).*

Sustainable Crop Choices vs Profitability

The dilemma in hydroponic farming is not simply about costs, but about what kind of value is prioritized. Competing with mass-produced leafy greens often results in low margins, making financial sustainability difficult. Instead, long-term viability depends on balancing profitability with the kinds of crops that are most relevant to both the local community and the wider market.

On one hand, niche, high-value crops, such as premium herbs or strawberries can justify the higher production costs of hydroponics and create unique market opportunities. On the other hand, growing everyday produce that Sweden currently imports, such as tomatoes or cucumbers, can reduce dependency on external supply chains while improving local food security. This dual approach allows production to serve both economic and social needs: generating income while addressing the everyday food requirements of residents.

In this sense, sustainability refers not only to environmental efficiency but to the ongoing relevance of production. By aligning crop selection with community needs, affordability, and local market demand, the Hammarkullen basement project creates value that is social and ecological as much as financial. Framed through the urban commons and spatial justice, this approach ensures that benefits are distributed fairly, supporting both collective resilience and long-term viability.

The Need for the Shift from Top-Down to Bottom-Up Initiatives

Traditionally, many hydroponic farming projects have been driven by large-scale entrepreneurs or organizations with top-down control, prioritizing profitability and rapid expansion. While efficient in scale, this model often overlooks local needs and risks reproducing inequalities. From the perspective of spatial justice, such approaches restrict access and decision-making to a limited group, excluding those most affected by the outcomes *(Soja, 2010).* Similarly, without shared governance, these projects struggle to become genuine urban commons, since commons depend on collective stewardship, negotiation, and equitable participation *(Ostrom, 1990; Stavrides, 2016).*

By contrast, a bottom-up model aligns more closely with both theory and practice. In the Hammarkullen Basement Project, involving residents, municipal actors, academic partners, and industry experts reflects a commons-based approach, where resources and responsibilities are distributed rather than centralized. This not only enhances legitimacy but also strengthens resilience, as diverse perspectives and skills allow the project to adapt over time *(Davoudi, 2012).* Active community involvement also transforms the basement into a space of co-production, embedding local knowledge and ensuring that benefits extend beyond profit to include cultural, social, and ecological value.

In this way, a bottom-up strategy operationalizes the principles of the urban commons and spatial justice, promoting both sustainability and inclusivity while reducing the risks of top-down failure.

The Hammerkullen Basement Opportunity: A Localized, Sustainable Approach

The Hammarkullen project in Gothenburg exemplifies how vertical farming can be embedded in local communities as both a productive and educational resource. The neighborhood's diversity is a strength: residents bring different cultural practices, skills, and ideas that contribute to a commons-based approach, where knowledge and responsibilities are shared rather than centralized *(Ostrom, 1990; Stavrides, 2016).* With municipal support, the project gains not only infrastructure but also legitimacy, enabling local experimentation with hydroponics as a participatory and inclusive process.

The objective is not limited to financial profitability. In line with spatial justice, the project prioritizes equitable access to healthy food, opportunities for local employment, and representation of marginalized voices within the neighborhood *(Soja, 2010.* By reusing basement space owned by the housing company, the project also demonstrates the principles of adaptive reuse, conserving embodied resources and transforming a neglected site into a productive civic hub *(Bullen & Love, 2011).*

This localized strategy also reflects resilience thinking: starting small, testing multiple models, and allowing systems to evolve incrementally rather than pursuing rapid expansion. Profitability may take time, but the social, environmental, and educational benefits, such as food literacy, cultural exchange, and collective governance, can prove transformative, both for Hammarkullen and as a transferable model for other urban contexts.

Chapter Six -

MODULAR FUTURES:

RECLAIMING THE BASEMENT STEP BY STEP

Research to Action
Inputs from previous studies
(Hydroponics viability, Stakeholder insights)

How as an architect can i speculate the transformation?
Core Principle: Modular Design
- Start small
- Allow flexibility for future development
-Design adapts based on community needs over time.

Narrative Tool: Fictional Characters
Characters explain the *why* behind each decision
They reflect community needs and challenges.

Phase 2 & Beyond: Speculative Development
How the basement *could* evolve
New uses, partnerships, and community co-creation

Vision of Full Reclamation
A possible future when the entire space is active.

Takeaway:
Implementation is not a fixed blueprint
It is a ‘flexible, evolving strategy’ guided by local relevance and imaginative speculation

6.0 IMPLEMENTATION: PHASED REACTIVATION

The reactivation of Hammarkullen's abandoned basement is envisioned as an incremental, participatory process unfolding across three interconnected phases. Implementation is framed not as a fixed blueprint but as a flexible framework that adapts to context, feedback, and capacity over time.

Phasing reflects both research insights and site-specific constraints. From a resilience perspective, incremental development allows the project to "learn by doing," beginning with small, reversible interventions before scaling up. From an adaptive reuse standpoint, it enables structures to be tested, adjusted, and repurposed without the risks of immediate large-scale investment.

Equally, phasing aligns with principles of the urban commons: governance, stewardship, and collective use must be cultivated gradually. Spatial justice underpins this approach by ensuring that access and benefits are distributed fairly, starting with basic safety and visibility, then evolving toward production, cultural programming, and knowledge exchange.

To convey the lived experience of this transformation, implementation is narrated through fictional personas who embody different community perspectives. Their stories illustrate how each phase might be perceived, while design decisions remain grounded in site analysis, interviews, and lessons from hydroponic and community-led reuse. Each step is explicitly tied back to the theoretical framework, ensuring the process is both imaginative and academically grounded.

6.1 IMPLEMENTATION RATIONALE

6.1.1 Phase 1 – Reclaiming and Making Safe

Phase 1 addresses the baseline condition of neglect. According to spatial justice *(Soja, 2010)*, access and safety are prerequisites for equitable use. Cleaning and lighting reduce insecurity, while insulation and greenhouse conversion transform environmental liabilities (cold courtyards) into assets for collective benefit.

By introducing community-accessible greenhouses with planter boxes, the basement begins its shift from "abandoned void" to urban commons, where residents reclaim ownership through everyday cultivation. The small-scale hydroponics system is deliberately chosen as an incremental and resilient step, testing feasibility while allowing the community to observe, learn, and participate without requiring full-scale investment. Transparent glass walls extend this ethos by making production visible, reinforcing accessibility and trust, while maintaining hygiene standards.

This phase thus establishes visibility, trust, and initial community ownership, the social and physical foundations required for any further development.

Steps taken in Phase 1:

1. Cleaning & Lighting

Research: Interviews revealed safety as a key community concern. Site analysis highlighted poor visibility and decay.

Theory: Spatial Justice – reducing exclusion and fear by making the basement accessible and safe.

Urban Commons – preparing the space as a potential shared resource by reclaiming it from abandonment.

2. Insulation & Greenhouse Courtyards

Research: Basement's cold airflow from three courtyards made the space unsuitable for cultivation. Case studies of urban farming (e.g., Prinzessinnengarten) showed greenhouses as effective first-step tools for reactivation.

Theory: Adaptive Reuse – transforming existing courtyards into productive spaces.
Resilience – small-scale ecological systems provide flexibility and incremental growth.

3. Community Planter Boxes

Research: Prior engagement in Hammarkullen showed the importance of visible, small entry-points for community trust.

Theory: Urban Commons – residents co-steward the space through shared cultivation.

Spatial Justice – ensures representation by allowing diverse residents to grow what matters to them.

4. Hydroponics Pilot (Deep Water Culture)

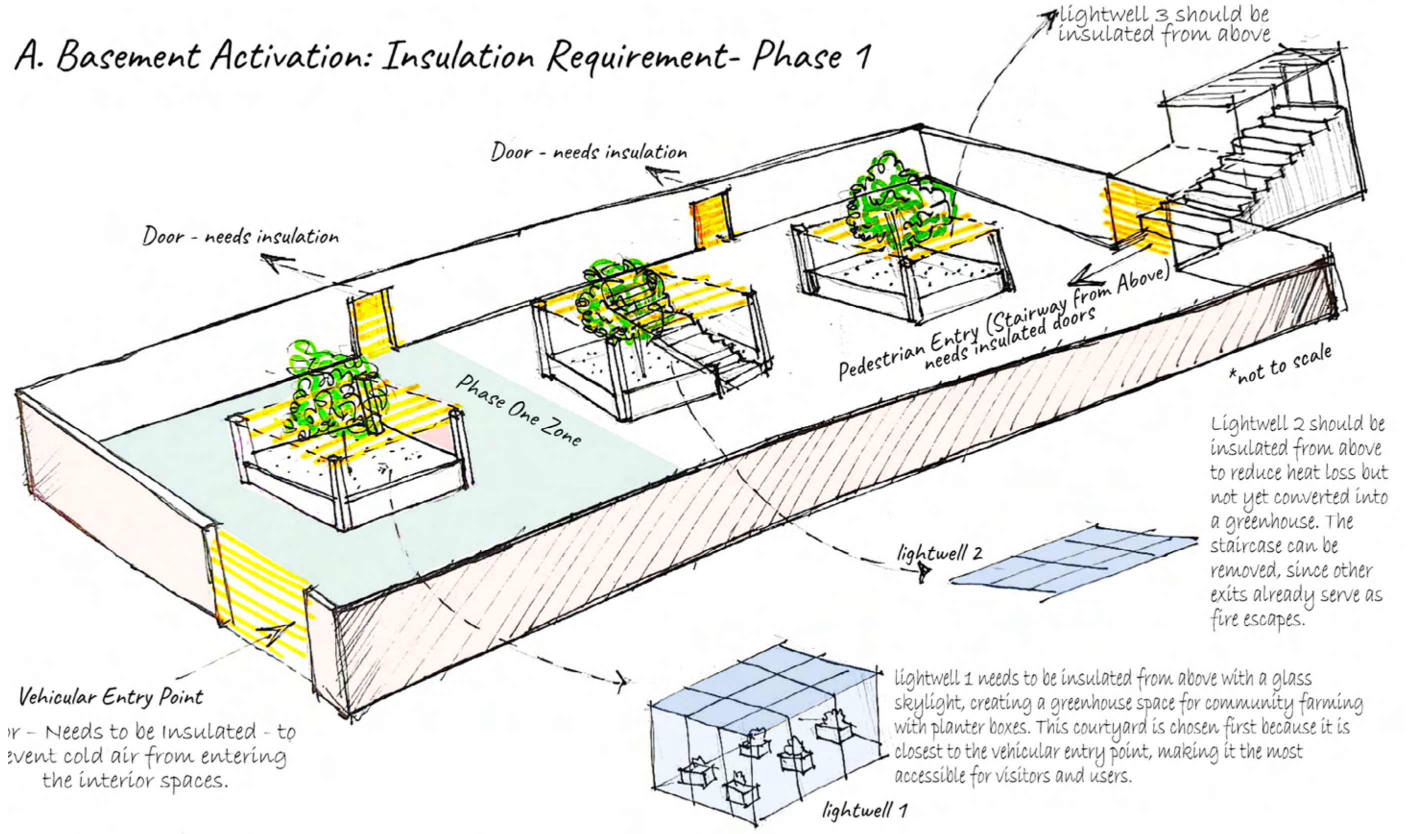
Research: From hydroponics studies, DWC is the simplest to set up, making it feasible for a first phase.

Theory: Socio-technical Systems – success depends not only on the technology but also on training and community participation.

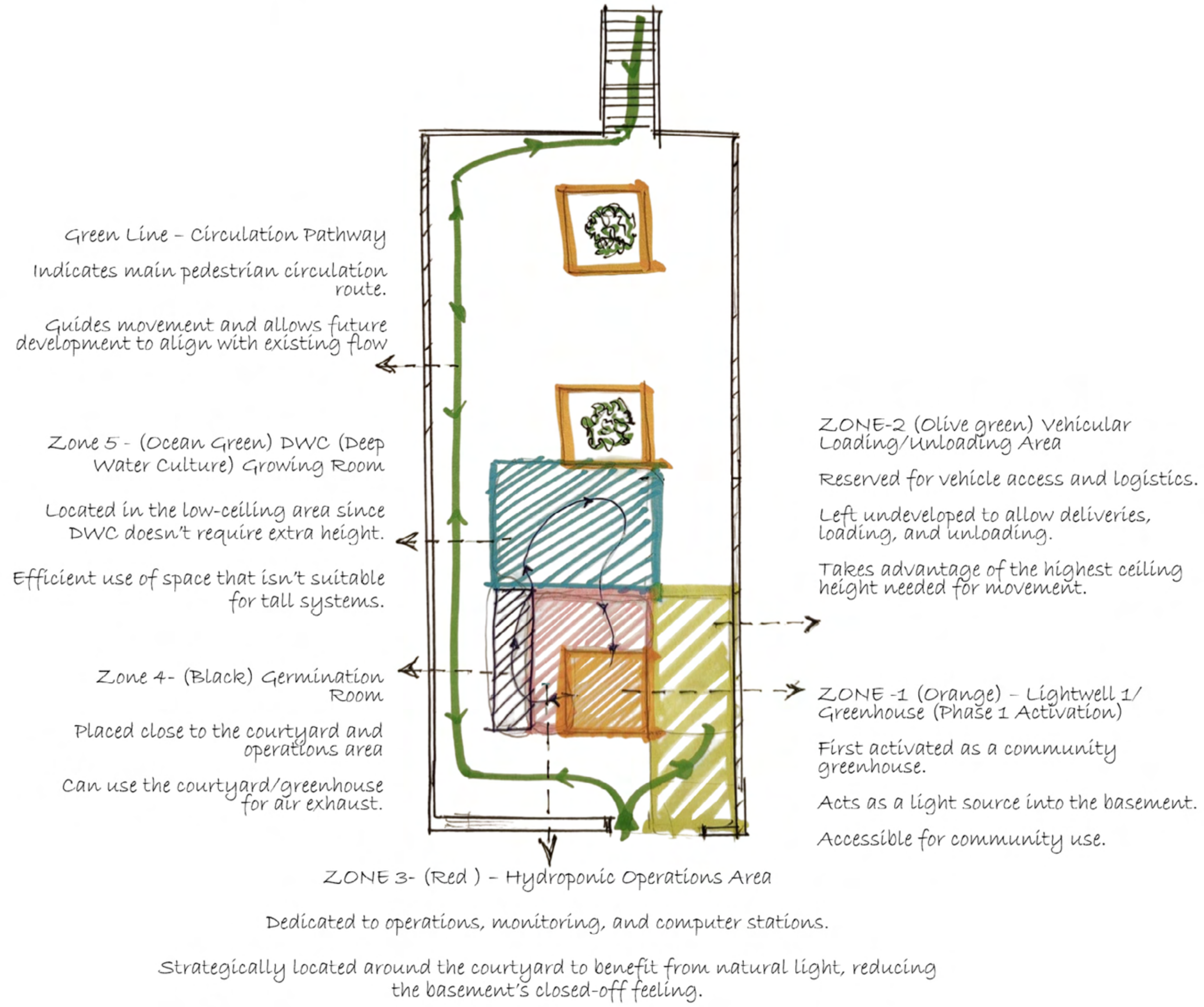
Urban Commons – knowledge and production are shared as collective value.

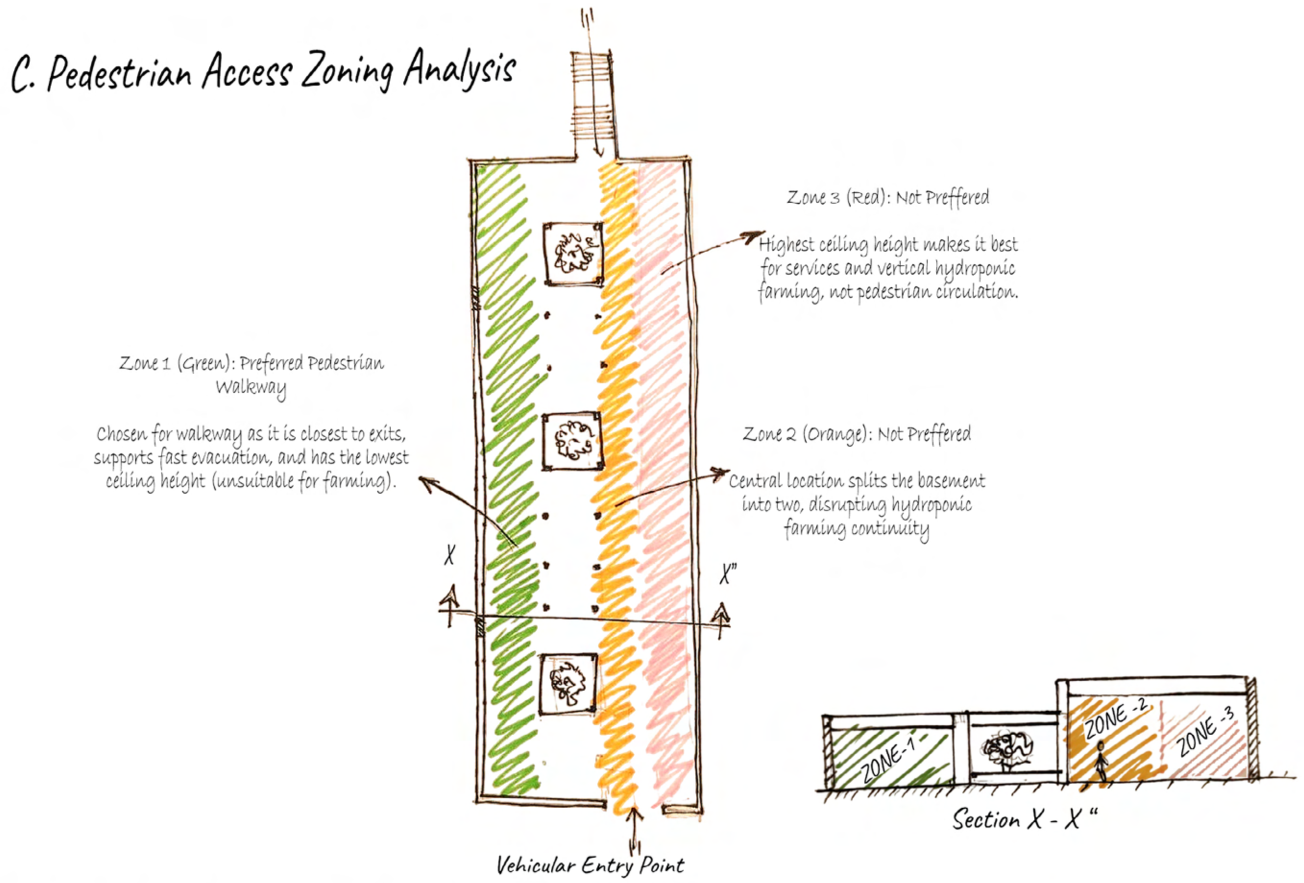
Spatial Justice – first jobs go to local residents, supporting equitable economic opportunities.

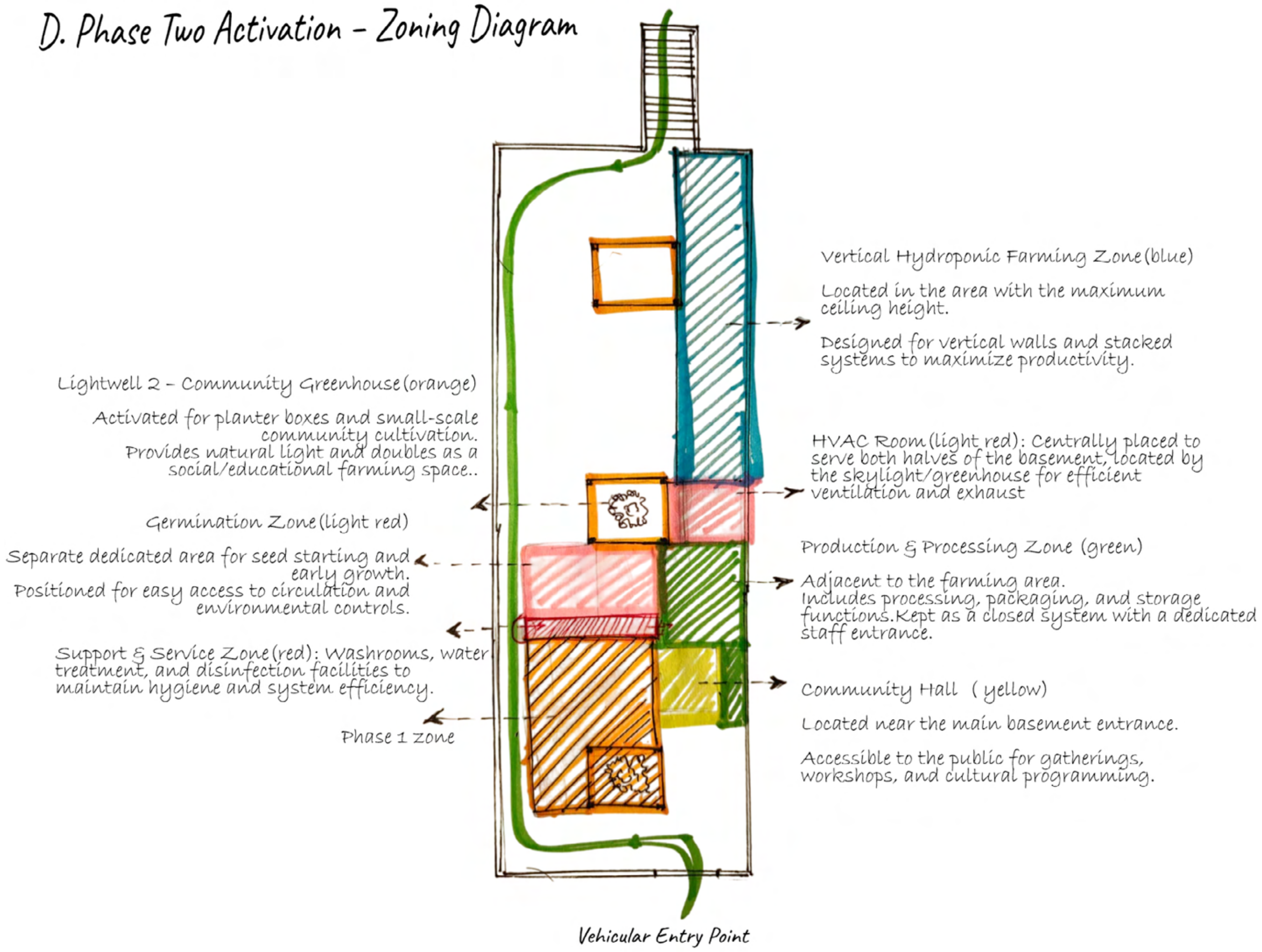
A. Basement Activation: Insulation Requirement- Phase 1



B. Functional Zoning Analysis Diagram Phase -1







6.1.2 Phase 2 – Scaling Production and Integrating Community

Phase 2 represents the project's transition from pilot activation to scaled production and community integration. Building on the trust and visibility established in Phase 1, this stage expands hydroponics into larger, higher-ceiling areas of the basement, introduces vertical green walls to maximize yield, and incorporates limited automation to reduce physically demanding labor. Crucially, it also adds supporting facilities such as meeting rooms, kitchen, washrooms, and a disinfection area, ensuring that the basement functions not just as a technical space but as a dignified workplace and community hub.

From a theoretical perspective, this phase deepens the commons dimension by coupling production with collective infrastructure for social interaction and governance. At the same time, spatial justice is advanced by ensuring equitable working conditions, safe environments, and recognition of Hammarkullen as a productive contributor to Gothenburg's wider food system. Scaling outward by distributing produce beyond the neighborhood, repositions Hammarkullen from a marginalized periphery to a city-scale actor, challenging stigma and fostering resilience through broader economic and social connections.

Steps taken in Phase 2:

1. Expansion into High-Ceiling Areas

Research: Site analysis identified higher-ceiling sections as better suited for large-scale hydroponic installations and vertical systems. Case studies (e.g., Ljusgårda in Sweden) demonstrated the efficiency of vertical farming in maximizing yield per square meter.

Theory: Adaptive Reuse – strategic use of existing spatial qualities for new productive functions.

Resilience – incremental scaling ensures learning and adaptability without overextension.

2. Worker Facilities (Meeting Room, Kitchen, Washrooms, UV Disinfection)

Research: Interviews revealed that job creation was a key local aspiration, but safe, dignified, and hygienic working conditions are necessary for sustainable employment and crop production.

Theory: Spatial Justice – fair treatment of workers, ensuring rights, comfort, and safety.

Urban Commons – support facilities encourage collective use, shared meals, and informal governance.

3. Community/Workshop Space

Research: Previous community engagements in Hammarkullen emphasized the importance of shared cultural and educational activities as entry-points for broader participation.

Theory: Urban Commons – a shared hub where knowledge, training, and exchange can occur.

Spatial Justice – representation is addressed by opening space for diverse voices and activities.

4. Vertical Green Walls & Automation

Research: Case studies showed vertical systems as efficient in dense urban contexts. Automation was identified as a way to reduce repetitive or physically exhausting tasks, making jobs more sustainable.

Theory: Resilience + Socio-technical Systems – balancing technology with human labor, ensuring that systems remain adaptable and socially inclusive.

5. Distribution to Gothenburg

Research: Hydroponics case studies emphasized the need to move beyond local-only sales for economic viability. Scaling outward helps stabilize production costs and revenue.

Theory: Spatial Justice – Hammarkullen shifts from being a stigmatized "problem area" to a contributor to the wider urban community.

Urban Commons – knowledge and produce circulate beyond the site, redistributing value more broadly.

6.1.3 Phase 3 – Diversification and Transferability

Phase 3 marks the project's evolution from a neighborhood-scale production hub into a diverse, resilient, and transferable model. Building on the stability achieved in Phase 2, this stage introduces more advanced hydroponic systems such as drip irrigation, allowing for the cultivation of fruiting crops like tomatoes, cucumbers, and strawberries. Beyond production, Phase 3 emphasizes value addition and knowledge transfer: a community kitchen is introduced for processing produce into collective meals or value-added goods, and a small retail point is established within the basement.

Most importantly, this phase initiates a culture of replication , through equipment sales and skills training, residents can bring hydroponic practices into their homes, courtyards, or community spaces. In this way, the basement no longer functions as a single isolated project but becomes a seedbed for distributed urban commons across Hammarkullen and beyond.

Theoretically, Phase 3 strengthens both the urban commons and spatial justice dimensions: knowledge and resources are redistributed, collective governance expands beyond the basement walls, and community agency is embedded in everyday food production. From a resilience standpoint, diversification of crops and community uses ensures adaptability to changing social, environmental, and economic conditions.

Steps taken in Phase 3:

1. Drip Irrigation Systems (Fruiting Crops)

Research: Drip irrigation supports fruiting crops (tomatoes, cucumbers, strawberries), addressing local and city market demand.

Theory: Resilience – diversification reduces dependency and strengthens adaptability.

Urban Commons – broadens benefits, making production relevant to more residents.

2. Community Kitchen for Value-Added Goods

Research: Interviews highlighted resident interest in collective cooking; case studies showed value addition offsets high hydroponic costs.

Theory : Spatial Justice – inclusive food access and cultural exchange.

Urban Commons – shared kitchen fosters co-production and community identity.

3. Basement Store & Market Integration

Research: On-site sales reduce distribution costs and increase visibility.

Theory: Adaptive Reuse + Commons – basement becomes a civic hub for food circulation.

Spatial Justice – ensures affordable access to healthy local produce.

4. Equipment Sales & Training ("One Farm to Many Farms")

Research: Case studies show sustainability depends on decentralization and knowledge transfer.

Theory: Urban Commons – expands from a centralized to distributed model.

Spatial Justice – empowers diverse residents by democratizing production knowledge.

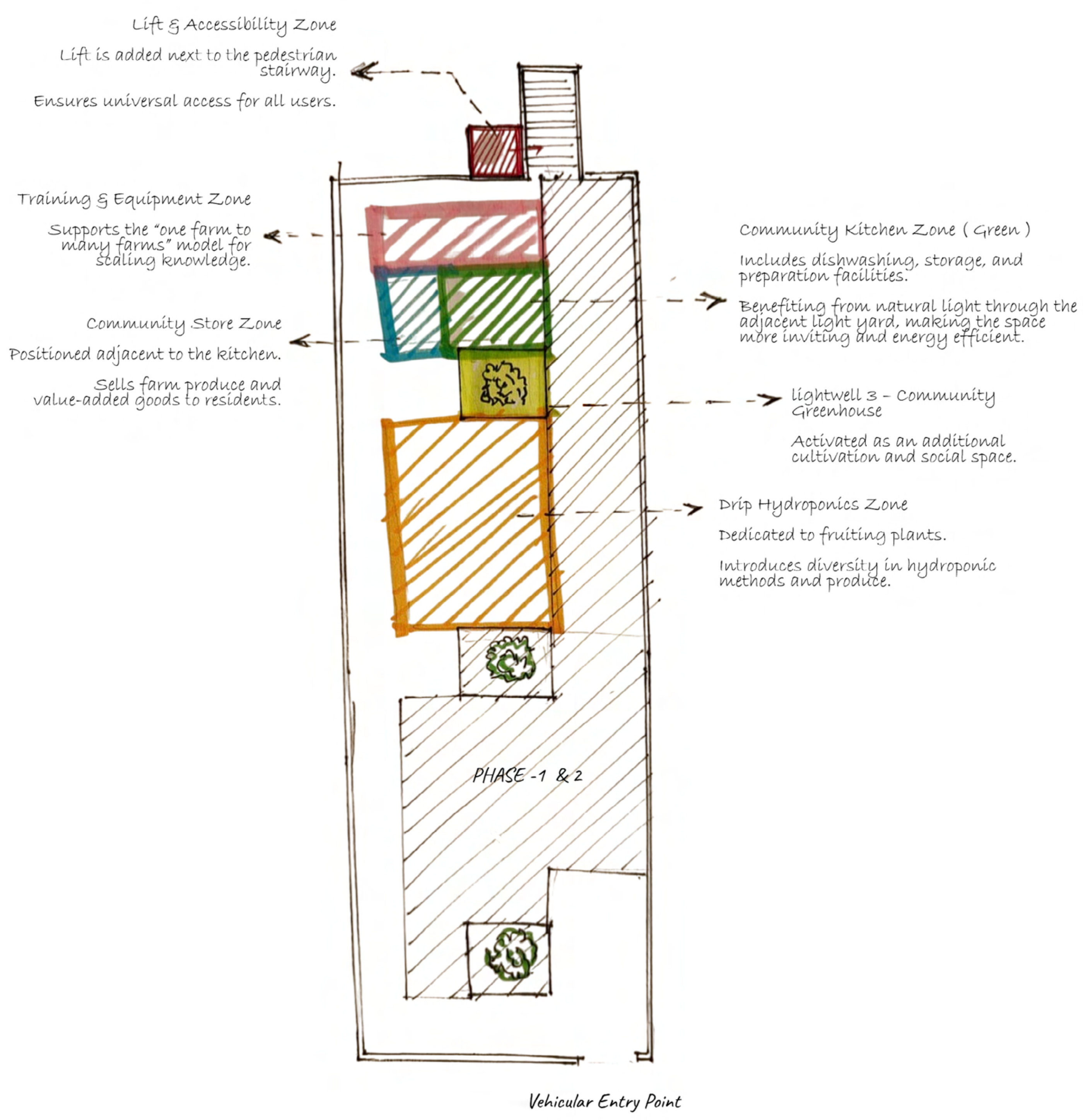
5. Cultural & Educational Hub

Research: Projects like NDSM Wharf and Granby CLT show symbolic value combats stigma.

Theory: Spatial Justice – Hammarkullen gains recognition as a contributor.

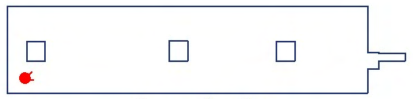
Resilience – education and cultural programs strengthen long-term adaptability.

E. Phase Three Activation – Zoning Diagram



6.2 Design Story - A Walkthrough

Phase 1- The Beginning – A Basement Full of Forgotten Things



Camera key Map

Leo (Curious Resident):“It’s colder than I thought down here. Is this really where the hydroponic farm is going to be?”

Dr. Hydro: “Yes. It might not look like much now, but this basement has great potential. First, we need to bring it back to life — starting with the lights.”

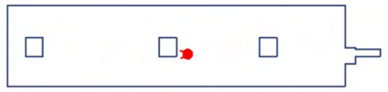
Karin (Community Voice) (looking around thoughtfully):
“I see a lot of old furniture, rusted tools… even leaves from the courtyard above. This place has been forgotten for years. Who’s responsible for cleaning all this?”

Dr. Hydro: “That’s part of the plan. We’ll work with the housing association to clear out all the debris. Step one is light, step two is cleanup.”

Karin: “But how do we make this place welcoming for the community?”

Visual 1 : A rendered image of the basement

Sealing the Cold – Rethinking the Courtyard



Camera key Map

Leo (looking up): “Okay… so this is why it feels like a fridge down here. That opening just pulls all the cold in, huh?”

Dr. Hydro (nodding and pointing upward): “Exactly. This open-to-sky courtyard plays a big role in pulling down the outside temperature. For vertical farming, we need to keep the interior warmer than outside — so we have to do something about this.”

Karin (Community Voice) (thoughtfully): “And it’s not just the cold… I’ve seen people drop litter down here. It doesn’t feel safe or respected.”

Dr. Hydro: “You’re right. That railing isn’t enough. The plan is to remove the railing, and cover the courtyard with an insulated glass structure almost like a skylight, but more than that.”

Klara (eyes lighting up): “Like… a greenhouse?”

Dr. Hydro (smiling): “Exactly! A greenhouse. It will trap warmth, allow light into the basement, and create a visual connection from the street above. It also stops litter and adds another layer of security.”

Karin (pointing at the steps in the courtyard): “What about these stairs in the central courtyard — will they still be needed?”

Dr. Hydro: “We’ll remove the stairs to make way for the greenhouse roof. But don’t worry — the basement already has four separate entrances, which is more than enough for fire safety.”

Leo (impressed): “So you’re turning this cold, open void into a glowing heart of the farm? That’s quite the upgrade.”

Dr. Hydro (with a grin): “It’s where warmth begins — the first real step in transforming this basement into something alive.”

Visual 2 : A rendered image of the basement

First Light: The Entrance Greenhouse

Camera key Map

Leo (peering through the glass): "Wow… look at this place now! I can't believe this used to be a cold, empty courtyard. It actually feels… alive."

Dr. Hydro (smiling, pointing up): "It's the glass roof — triple-glazed and insulated. It keeps the warmth in during winter and shields from overheating in summer. See those vents? They open automatically when it gets too warm."

Karin (walking along the edge): "And the aluminum frames… clean and precise. People can now see inside from all four sides — no more hidden corner for trash or neglect."

Dr. Hydro: "Exactly. And the exhaust fan system ensures fresh air flows through, preventing mold and stale pockets. A healthy space, for plants and people."

Leo (spotting someone tending to a planter): "Are those… community garden boxes? So anyone can grow something here?"

Karin (nodding): "Yes! People from Hammerkullen are already taking part planting herbs, flowers.… It's becoming a shared hobby, a reason to gather."

Dr. Hydro: "It's more than a garden — it's a sign. A sign that this basement is no longer forgotten. It's being reclaimed by the people."

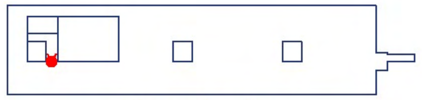
Karin (smiling): "Word's spreading. Everyone's talking about the greenhouse. For the first time, they don't see this place as abandoned."

Leo (grinning):"Then maybe it's time, right? Time to start the hydroponic farm — the first phase?"

Dr. Hydro: "Absolutely. The ground is ready — and the people are, too. Let's plant the future.

Visual 3 : The Entrance Greenhouse

Monitoring & Research Room - Visual 4



Camera key Map

Leo (walking in,): "This feels like we just stepped into a sci-fi lab!"

Karin (looking around):"So this is where you mix the nutrient solutions?"

Dr. Hyro:"Yes. This is the nerve center. Every drop of water and every milligram of nutrient is monitored and adjusted from here."

Leo (peering at the digital dashboard):"You can actually see the plant data live?"

Dr. Hyro: "Exactly. pH, EC, temperature, light exposure — it's all logged and analyzed. This helps us fine-tune growth conditions for each crop."

Karin (looking into the greenhouse): "The natural light coming in here… it's really calming."

Dr. Hyro:"That was intentional. The proximity to the greenhouse makes the space feel connected to the crops. It's not just a lab — it's a living system."

Leo (excited): "This is where science and food meet! I love it."

Nutrition Tank Area -Visual 5

Camera key Map

Leo (looking up, puzzled): "Wait… last time we were here, the roof slab was exposed. Now I don't even see it — what changed?"

Dr. Hyro : "Ah, good eye. We've added a second false ceiling beneath the original slab. It creates a clean, insulated buffer zone."

Karin: "Insulated? Against what?"

Dr. Hyro: "Moisture, mainly. The original slab still suffers from dampness and minor leaks, common in basements. This new ceiling layer, made with PVC panels, resists moisture and keeps the space hygienic."

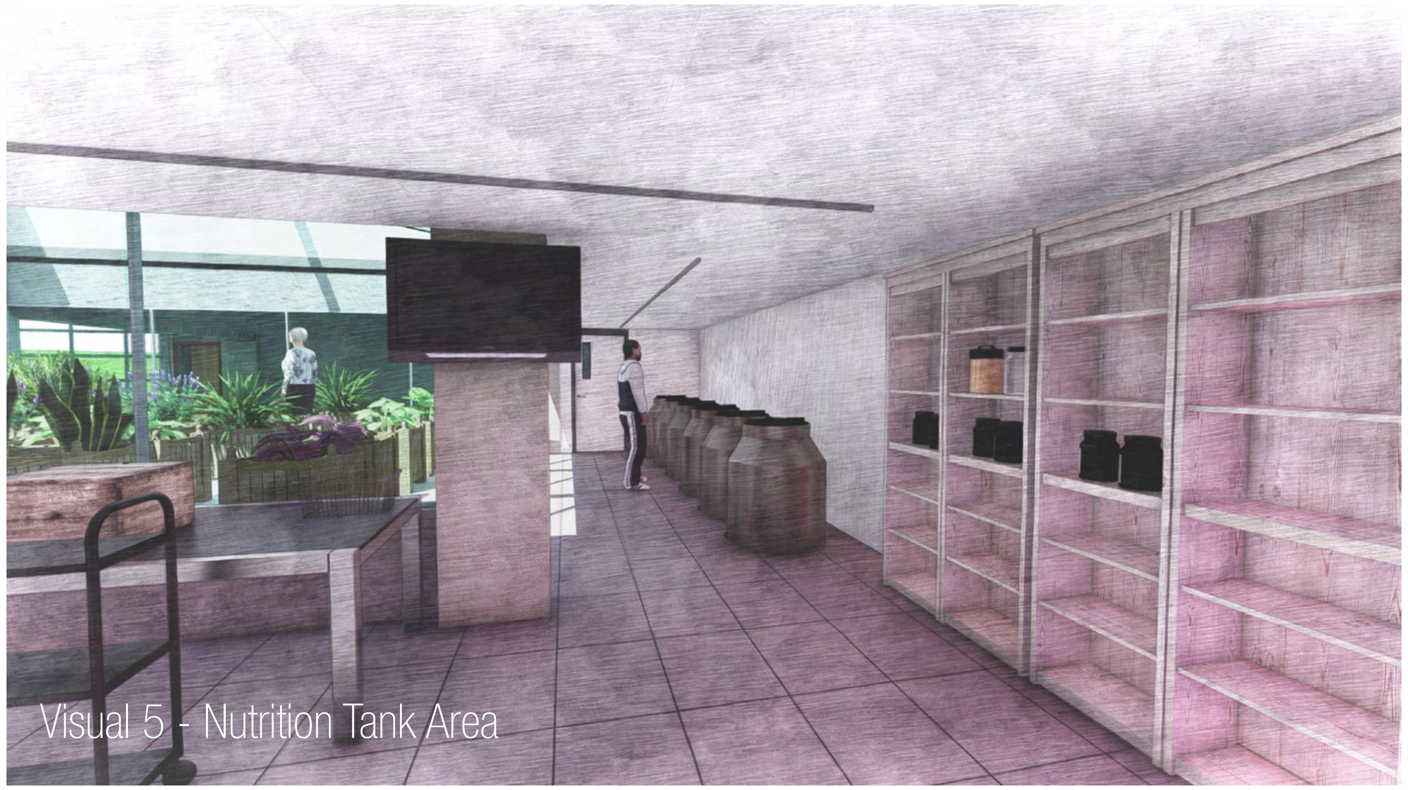
Leo (pointing at the piping):"And all the HVAC stuff is hidden up there?"

Dr. Hyro:"Exactly. Most of the ventilation and exhaust systems are tucked just above the ceiling. Plus, we've designed it for easy maintenance access — we can pop panels open without disrupting operations."

Karin (turning toward the tanks):"So this room is like the brain and lungs of the system."

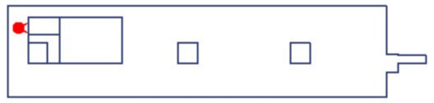
Leo: "And all of it flowing right into the greenhouse next door."

Visual 4 - Monitoring & Research Room



Visual 5 - Nutrition Tank Area

Germination Room -Visual 6



Camera key Map

Leo (watching the kid): “Why have a whole room just for tiny plants?”

Dr. Hyro (smiling):“Because germination is delicate.
These baby plants need specific conditions — think of it like a neonatal unit for crops.”

Karin:“What kind of conditions?”

Dr. Hyro:“Well, we keep the temperature between 20–25°C, depending on the crop. That’s their comfort zone for sprouting.”

Leo:“Like a cozy incubator.”

Dr. Hyro: “Exactly. And humidity is crucial too — we aim for around 60–80%, which helps the seeds crack open and root. But it’s not just about warmth and moisture…”

Karin (noticing the lights): “These lights look different — not like in the greenhouse.”

Dr. Hyro:“Good eye. We use low-intensity LEDs or fluorescent lights, around 12–18 hours a day. Seedlings don’t need strong light — just enough to get started.”

Leo:“What are those fans for?”

Dr. Hyro: “Air circulation. It mimics natural breezes, which strengthens the stems and prevents diseases like damping-off.”

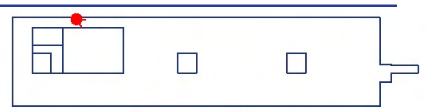
Karin (smiling at the kid’s wonder): “And people can watch all this?”

Dr. Hyro: “Yes — through the glass wall only. No entry. It keeps pests and pathogens out, but still allows everyone to learn from the process.”

Leo:“So this room sets the pace for everything that follows.”

Dr. Hyro: “Exactly. Strong starts mean healthy crops later. And thanks to this setup, we can begin the next batch while the older ones are already growing in the DWC system.”

Transition to DWC System -Visual 7



Camera key Map

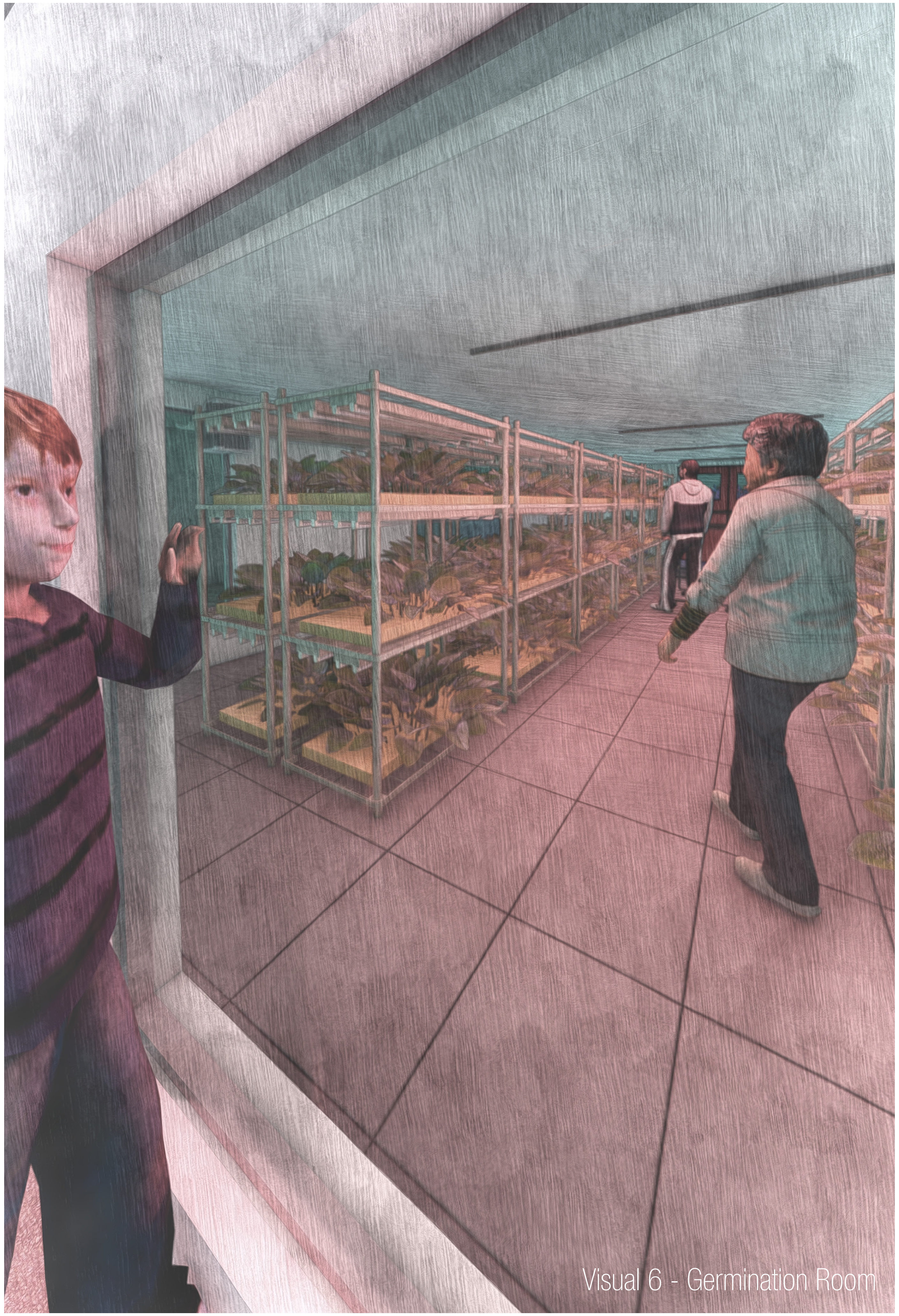
Karin: “And then the seedlings move into here?”

Dr. Hyro:“Yes, this is our DWC — Deep Water Culture — zone. As soon as roots and true leaves appear, they’re transferred into net pots here.”

Leo:“Why did you place this setup in the middle of the basement?”

Dr. Hyro:“This area has stable ceiling height — about 2.4 meters. For DWC, horizontal spread is more important than vertical space. The higher ceiling zones are saved for future stages needing more height.”

Karin (nodding): “Makes sense. Efficient use of space.”
Dr. Hyro: “Also, DWC is beginner-friendly and stable, perfect for our pilot phase.”



Visual 6 - Germination Room

First Harvest – Everyone Celebrates (Visual 8)

First Harvest – Everyone Celebrates

Leo (excited): “Look at all these greens! We really did it!”

Karin (laughing):“It smells so fresh! The community will love this.”

Dr. Hyro (smiling): “This is just the beginning. Time to share it with everyone.” [They take a picture in front of the leafy greens harvest]

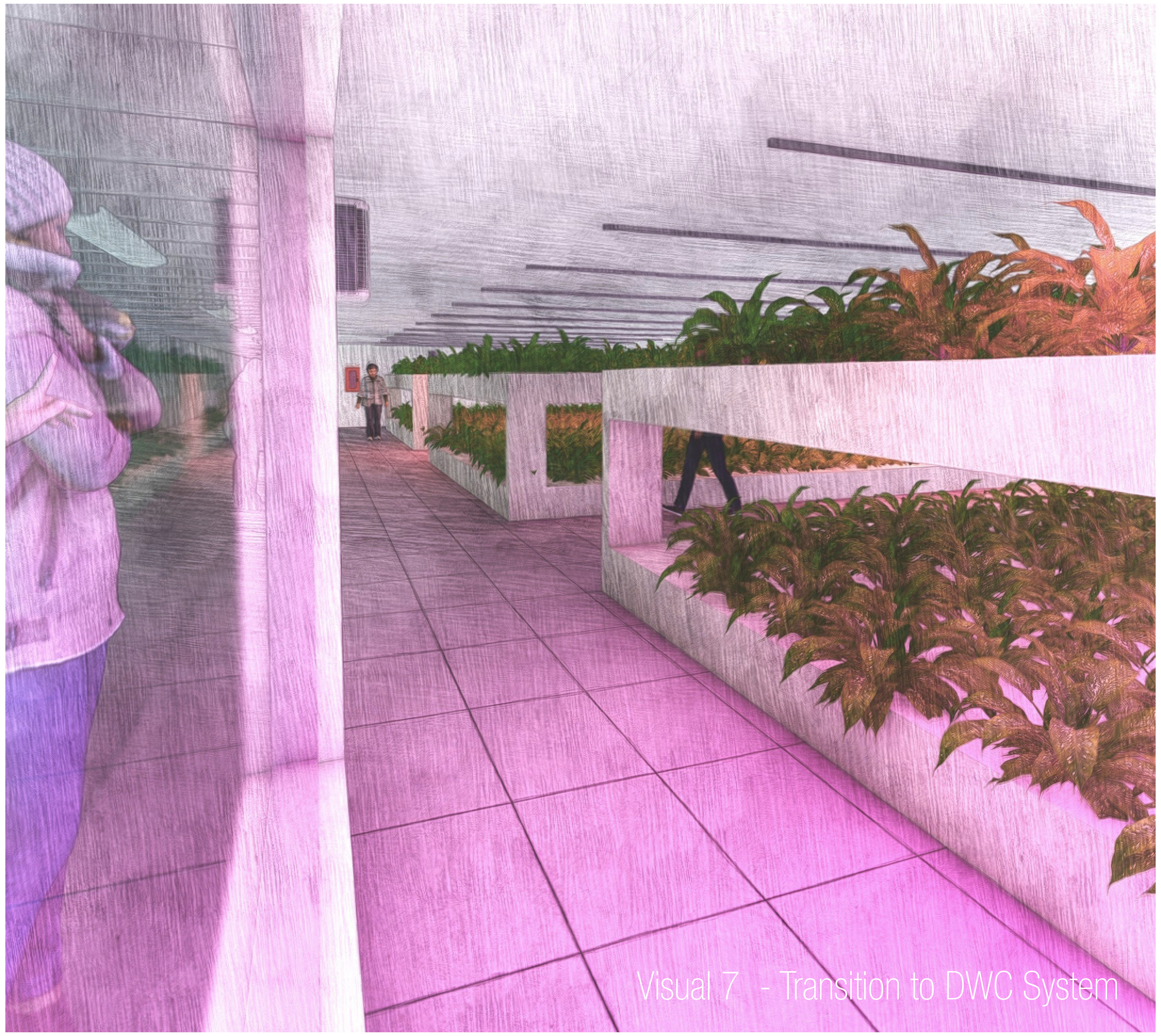
Selling the Produce and Gathering Feedback (Visual 9)

Karin (handing over a bag): “Fresh greens — grown right below us.”

Resident:“Tastes great… could be a bit crisper.”

Leo:“Time to fine-tune?”

Dr. Hyro: “Yep. I’ll tweak the nutrients — better flavor and texture each time.”



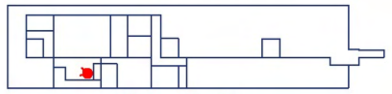
Visual 7 - Transition to DWC System

Visual 8 - First Harvest – Everyone Celebrates

Visual 9 - Selling the Produce

PHASE - 2

The Heart of the Hub -Visual 10



Camera key Map

Leo (looking around the tall hall): "This space feels completely different from the rest of the basement."

Dr. Hyro (gesturing to the high ceiling): "That's because this side has the maximum ceiling height — almost 3.7 meters. We've reserved it for functions that benefit from openness — like this multi-use hub."

Karin (watching a school group setting up): "Workshops, school visits, fika breaks — all happening in one space?"

Dr. Hyro (nodding): "Exactly. The team uses it for meetings, meals, and breaks... and we also invite local schools and organizations. It's a space for both rest and learning — a bridge between our work and the wider community."

Leo (looking around):"Is this where everyone enters? Staff and community?"

Dr. Hyro (shaking head): "No, this hall is mostly for visitors and public events — workshops, school tours, things like that."

Karin (curious): "So how do the people working here enter the farm area?"

Dr. Hyro:"They use a separate staff entrance. First, they head into a zone with toilets, lockers, and changing rooms."

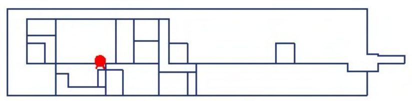
Leo:"Like a lab protocol?"

Dr. Hyro (nodding):"Exactly. Before entering any cultivation area, they go through a sanitation room. It's equipped with UV-C disinfection lights and air showers — to remove dust, microbes, or pests from clothing and skin."

Karin:"That's strict."

Dr. Hyro:"It has to be. Maintaining a controlled, sterile environment is critical in hydroponics — even small contaminants can damage a crop.

Break & Recharge- Visual 11



Camera key Map

Karin:"Nice! Even a kitchen?"

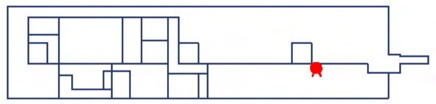
Dr. Hyro: "Yes. A small pantry for fika, lunch prep, or a warm meal. It's not just about growing food — it's about making the workplace human."

Leo (smiling as he grabs a cup):"This place really grows more than plants, huh?"

Visual 10 - The Heart of the Hub

Visual 11- Break and Recharge

Wall of Greens - Visual 12



Camera key Map

Leo: “Whoa… these are all plants? On walls?”

Dr. Hyro (nodding): “We’re piloting vertical wall hydroponics. The high ceilings let us grow more without using more floor space — it’s all about maximizing yield, not footprint.”

Karin:“So people actually go in between the walls to check and fix things?”

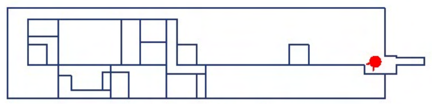
Dr. Hyro: “Yes, the panels slide apart along rails. It creates enough space for maintenance and inspections.”

Leo: “But won’t planting those baby crops from the germination room take forever on these walls?”

That’s where tech steps in. See those rails? They guide the panels to the robotic loading unit at the far end.”
[Points toward the robotic system loading seedlings.]

“Each vertical panel follows the rail to the station, where it’s automatically planted. Once loaded, the panel bends in three parts to curve along the track — then loops back to the end of the stack, making room for the next one. It’s a seamless cycle — no manual work needed

Watching Innovation in Motion - Visual 13

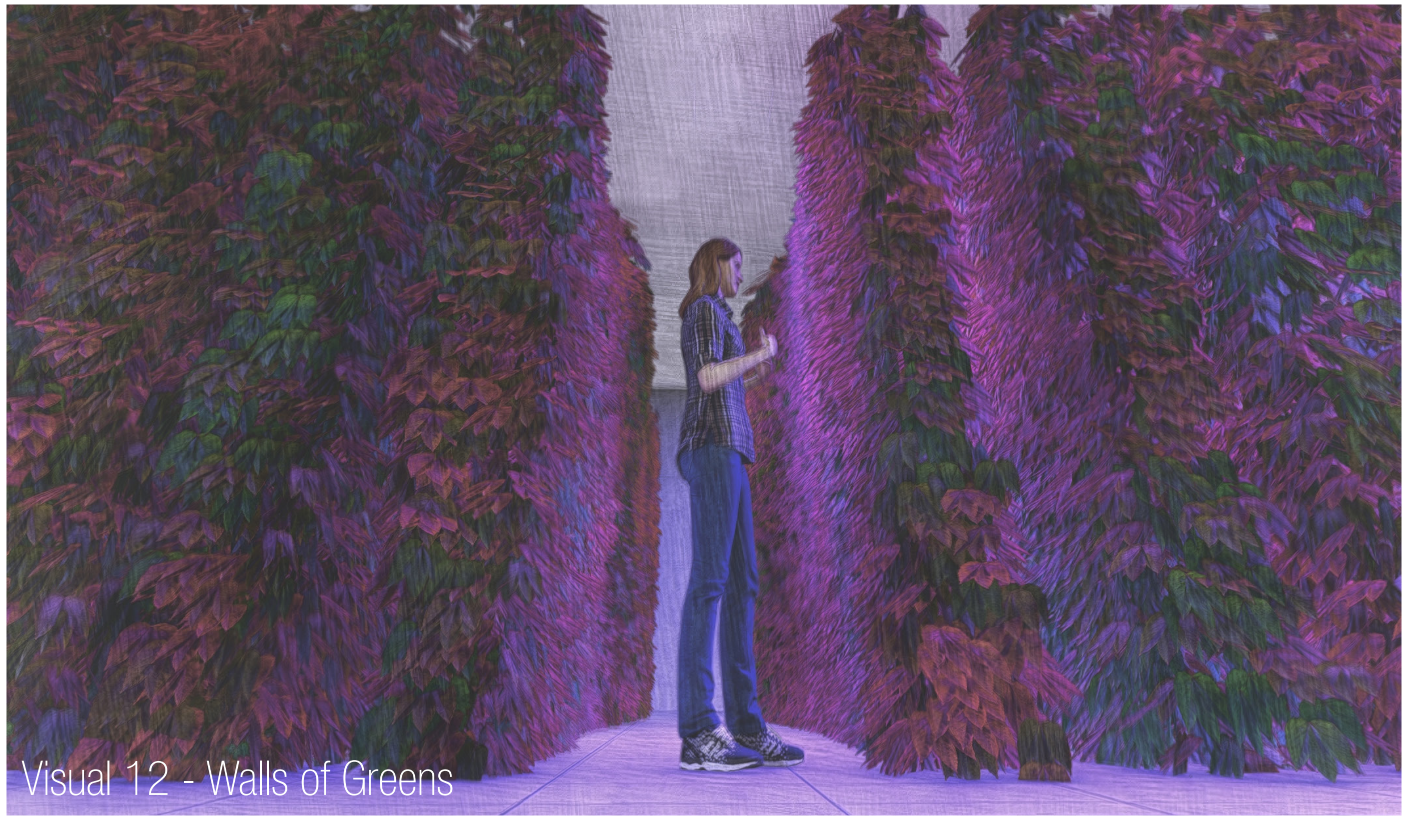


Camera key Map

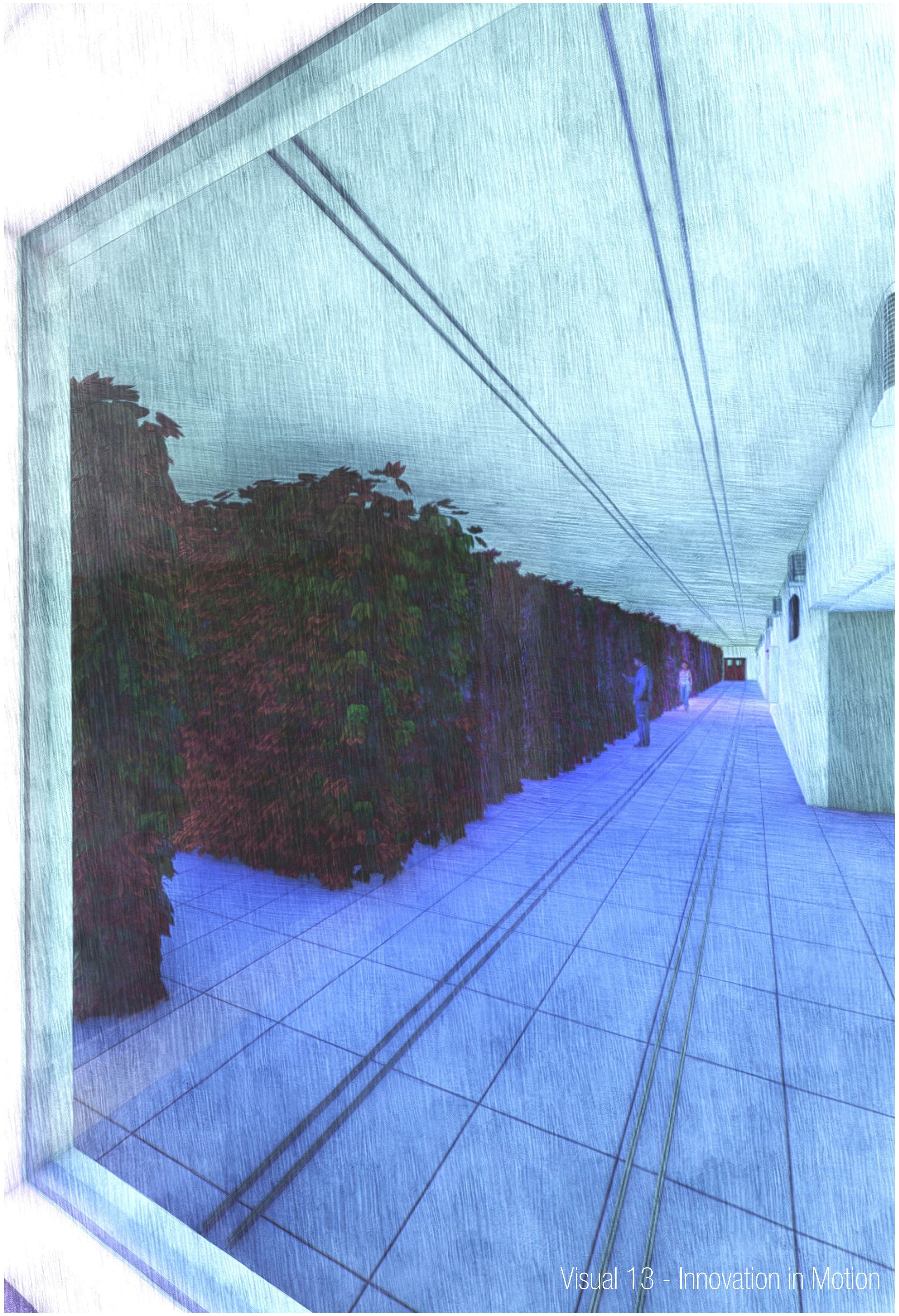
Leo:“That’s genius. This deserves a patent!”

Karin (peeking through the observation window):
“You can actually watch the whole system in motion from here. It’s like green ballet.”

Leo (smiling): “Pretty cool to see it all working.”

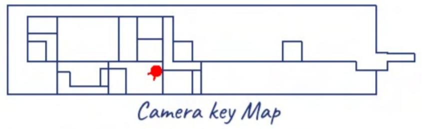


Visual 12 - Walls of Greens



Visual 13 - Innovation in Motion

The Processing Line - Visual 14



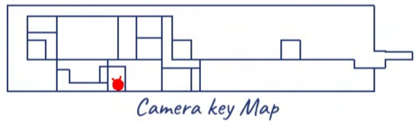
Leo:"This place looks like a mini factory!"

Dr. Hyro:"It kind of is. With the yields we're getting, we had to step up the workflow.
First, produce is sorted and quality-checked here."

Karin:"Then it goes to that room with the misty fog?"

Dr. Hyro: "Exactly. That's our washing zone — filtered water jets clean the greens. From there, conveyor belts take them straight to packing. Minimal handling, maximum hygiene."

Cold Storage Room - Visual 15

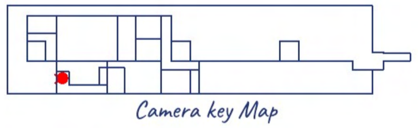


Karin:"So, everything gets shipped right away?"

Dr. Hyro:"Mostly, yes. Same-day delivery is the goal —
but we still need a cold store for short-term holding. Temperature's tightly controlled to keep everything crisp."

Leo:"Looks more like a high-tech pantry!"

Loading Bay & Distribution - Visual 16



A truck being loaded via a small ramp; crates marked for delivery.
Staff guiding the process.

Leo (grinning): "There goes the first batch — straight from under our feet to the city."

Dr. Hyro (smiling): "From basement roots to city plates — quite the journey, huh?"

Karin: "Hammerkullen's farming future just got wheels."

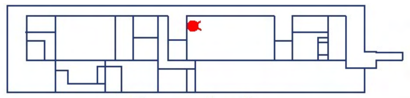
Visual 14 - The Processing Line

Visual 15 - The Processing Line

Visual 15 - Loading Bay & Distribution

PHASE - 3

Fruiting the Future - Visual 17


Camera key Map

Karin (observing): “These aren’t just leafy greens anymore…”

Dr. Hyro (nodding): “Right — we’ve entered phase three. Now we’re growing fruiting crops: tomatoes, cucumbers, strawberries… a more diverse harvest.”

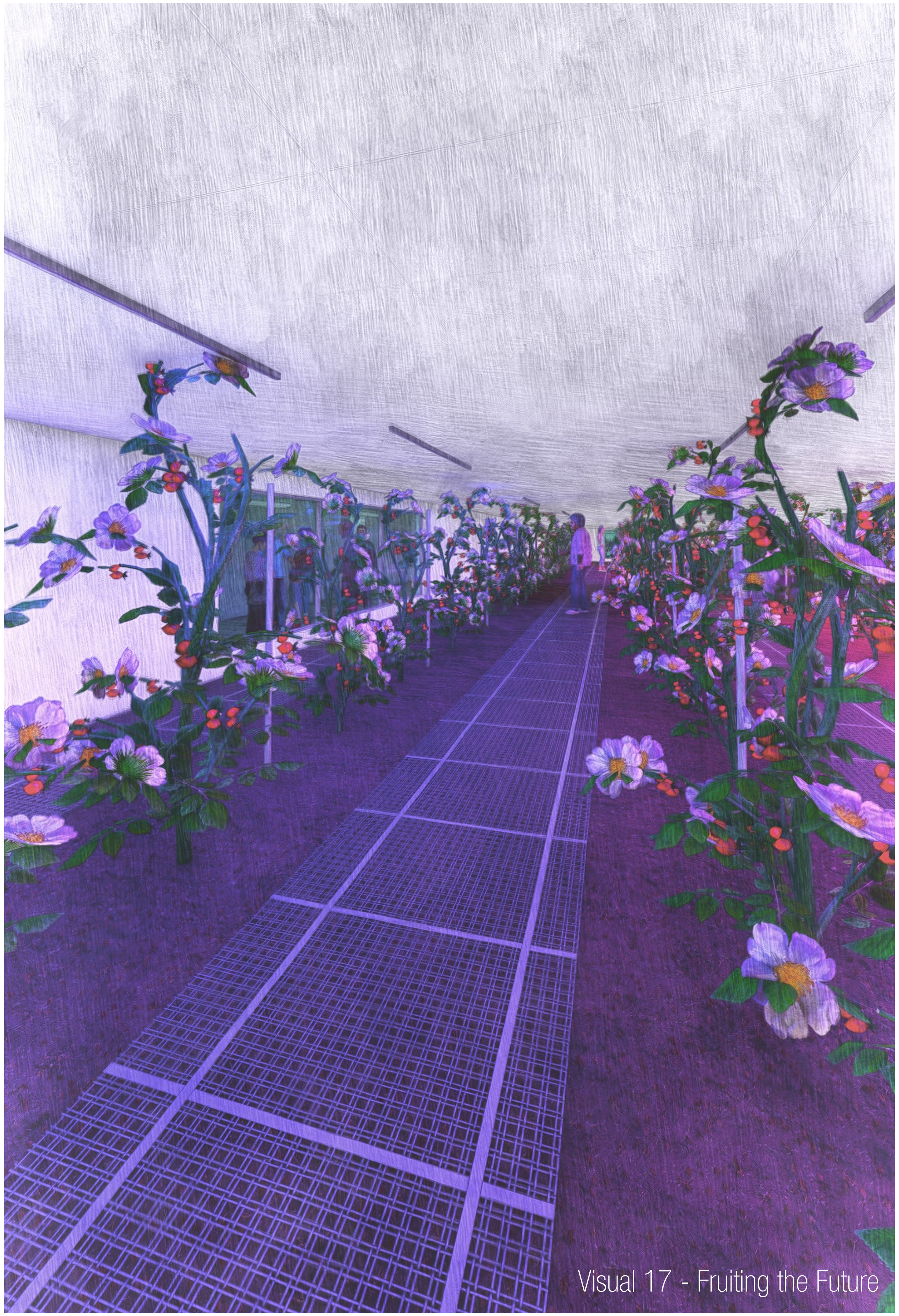
Leo (noticing the system):“What’s with the pipes? They’re just dripping water slowly.”

Dr. Hyro: “That’s drip irrigation — it delivers water directly to each plant’s roots. No flooding, no waste. Just precise, steady hydration.”

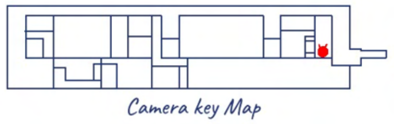
Karin:“Efficient, and perfect for these kinds of plants.”

Dr. Hyro:“Exactly. Fruiting crops need consistency. With this, we can grow high-quality produce with less effort.”

Leo (smiling as he sees flowers and fruits forming):“And now people can actually watch the tomatoes grow from the outside window… It’s like a farm and a show all in one.”


Visual 17 - Fruiting the Future

From One Farm to Many - Visual 18



Camera key Map

Leo (noticing the grow systems): "Wait, these are working too? Like, real crops inside?"

Dr. Hyro (smiling): "They sure are. These are compact hydroponic units running on NFT systems — Nutrient Film Technique. You see those tanks below? That's where the nutrient solution flows through shallow channels to feed the roots."

Karin:"So people can actually buy these for themselves?"

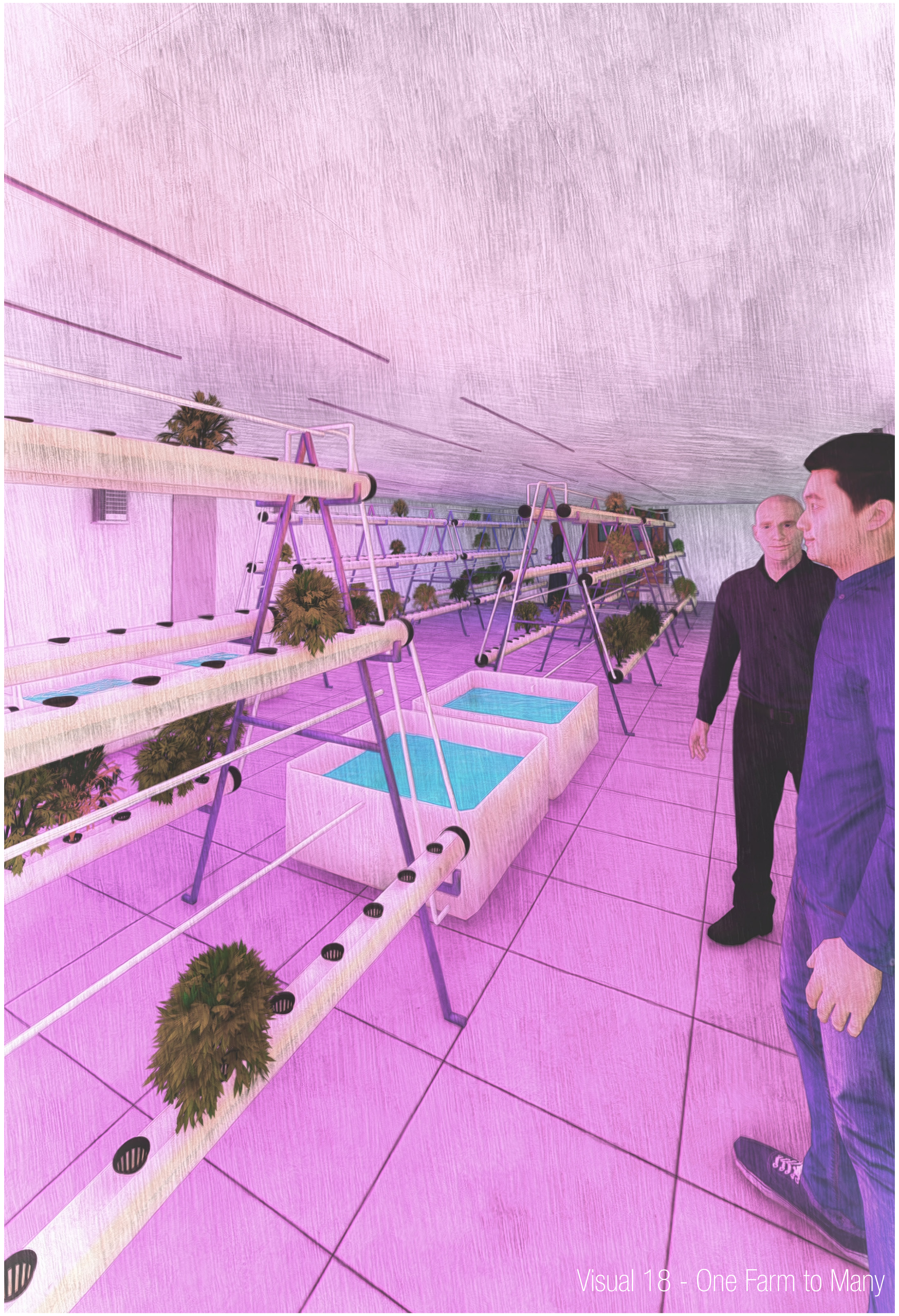
Dr. Hyro: "Yes. They can be designed in a way to suit different places — backyards, balconies, rooftops, even indoor spaces. Anyone can grow their own food with just a little room."

Leo:"And these aren't just demos? They're actually producing crops?"

Dr. Hyro:"Absolutely. These units are growing food right now. Visitors stop to watch them in action — it's part of showing what's possible."

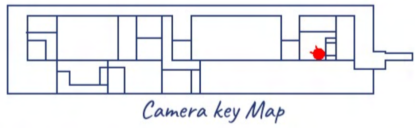
Karin (smiling): "It's amazing how this has grown — now others can start their own little Farms."

Dr. Hyro:"That's the vision. And we support them with regular seed and nutrient deliveries — so the cycle keeps going."



Visual 18 - One Farm to Many

A Kitchen Full of Possibilities - Visual 19



Karin (looking around):"This… is a basement kitchen? It doesn't feel like one at all."

Leo (pointing toward the open window):
"Yeah, with that giant window to the courtyard, it almost feels like you're outside!"

Dr. Hyro (nodding):"That's the idea. One major challenge of putting working spaces underground is making sure people want to work there. So every workspace — whether it's the kitchen, offices, or labs — connects visually to the greenhouse. Natural light from the skylight makes a huge difference."

Karin:"It's a clever way to keep things lively. Must really help with those long work hours."

Dr. Hyro:"Exactly. A glowing blue lab all day could be exhausting. But here, people feel connected — to the sun, the crops, the outdoors."

Leo (noticing jars and bottles):"So what's happening here in the kitchen? Looks like more than just lunch prep."

Dr. Hyro: "This is the community kitchen — managed by a local association. It's designed to help people from the neighborhood turn farm produce into value-added products."

Karin:"Value-added?"

Visual 19 - Community Kitchen

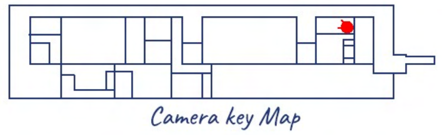
Dr. Hyro:"Taking fresh crops and transforming them into something with a longer shelf life or a higher market value. Like turning tomatoes into sauces or chutneys. Leafy greens into pesto, pickled mixes, or ready-to-cook meal kits. Even juices and fermented products."

Leo: "So the farm doesn't just feed people — it helps them create businesses too?"

Dr. Hyro:"Yes. It's about building local capacity. The products made here are sold in nearby markets, cafés, and shops — boosting both the local economy and food culture."

Karin (smiling):"It's smart. Food security and creativity… all in one."

The Local Farm Store - Visual 20

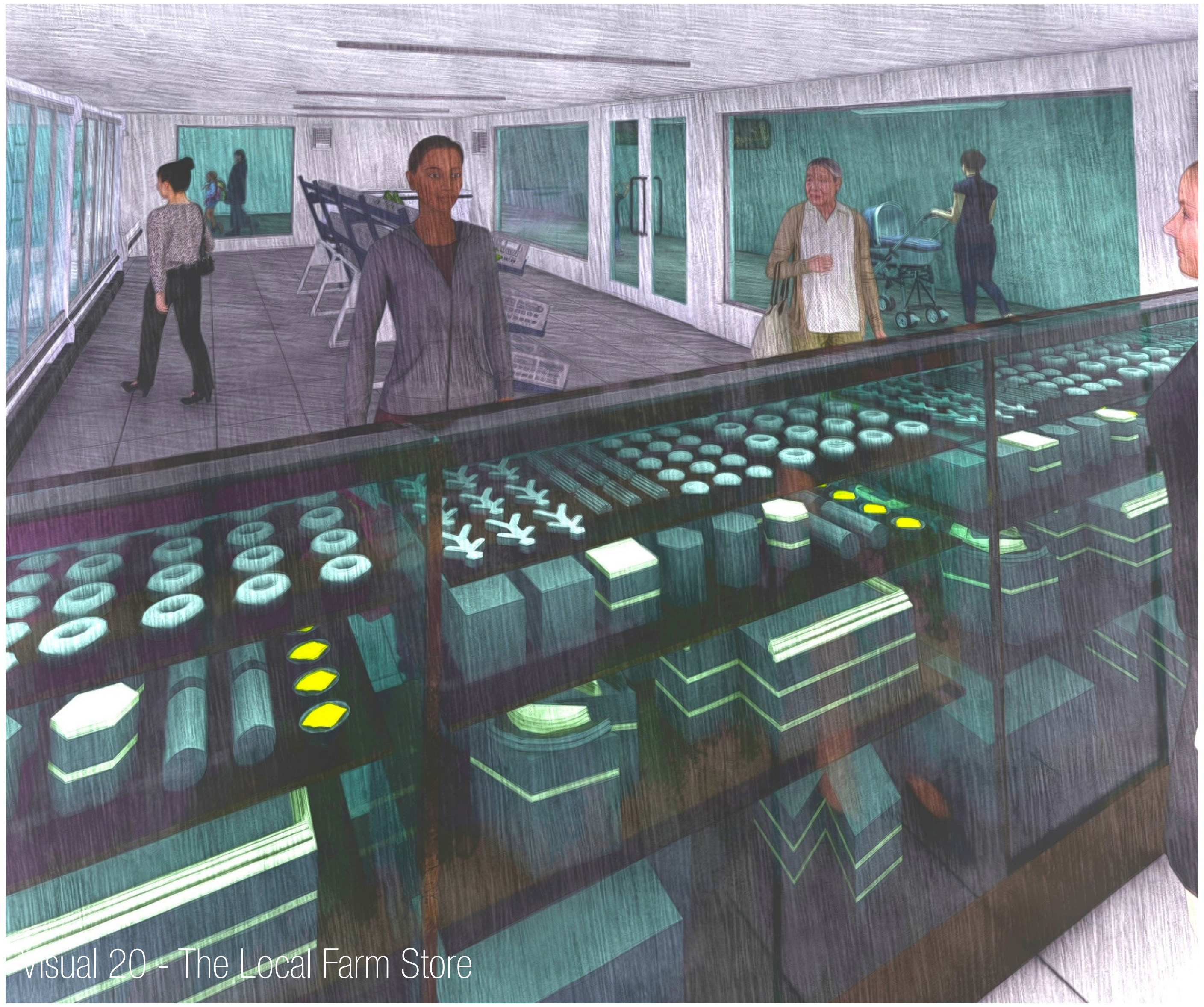


Leo:"This place looks amazing. It's all from the basement farm?"

Karin:"Yeah the fresh produce and even the sauces and juices they make in the community kitchen."

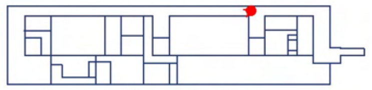
Leo (grabbing a jar): "Tomato chutney, pesto, and even fermented drinks... They've got everything."

Karin:"The best part is, it's all made right here. Local production, local processing, and now local sales."



Visual 20 - The Local Farm Store

The Vistors Pathway - Visual 21



Camera key Map

Leo (walking slowly): “This walkway… it’s like a gallery of ideas and life. You get to see how everything works — and how it’s all come together.”

Karin (reading a panel): “They’ve explained everything so clearly. Even if you’ve never heard of hydroponics, you walk out of here knowing what it’s about.”

Leo (admiring a mural):“And these Wall arts — they feel so connected to the neighborhood. It doesn’t feel like a lab; it feels like Hammarkullen.”

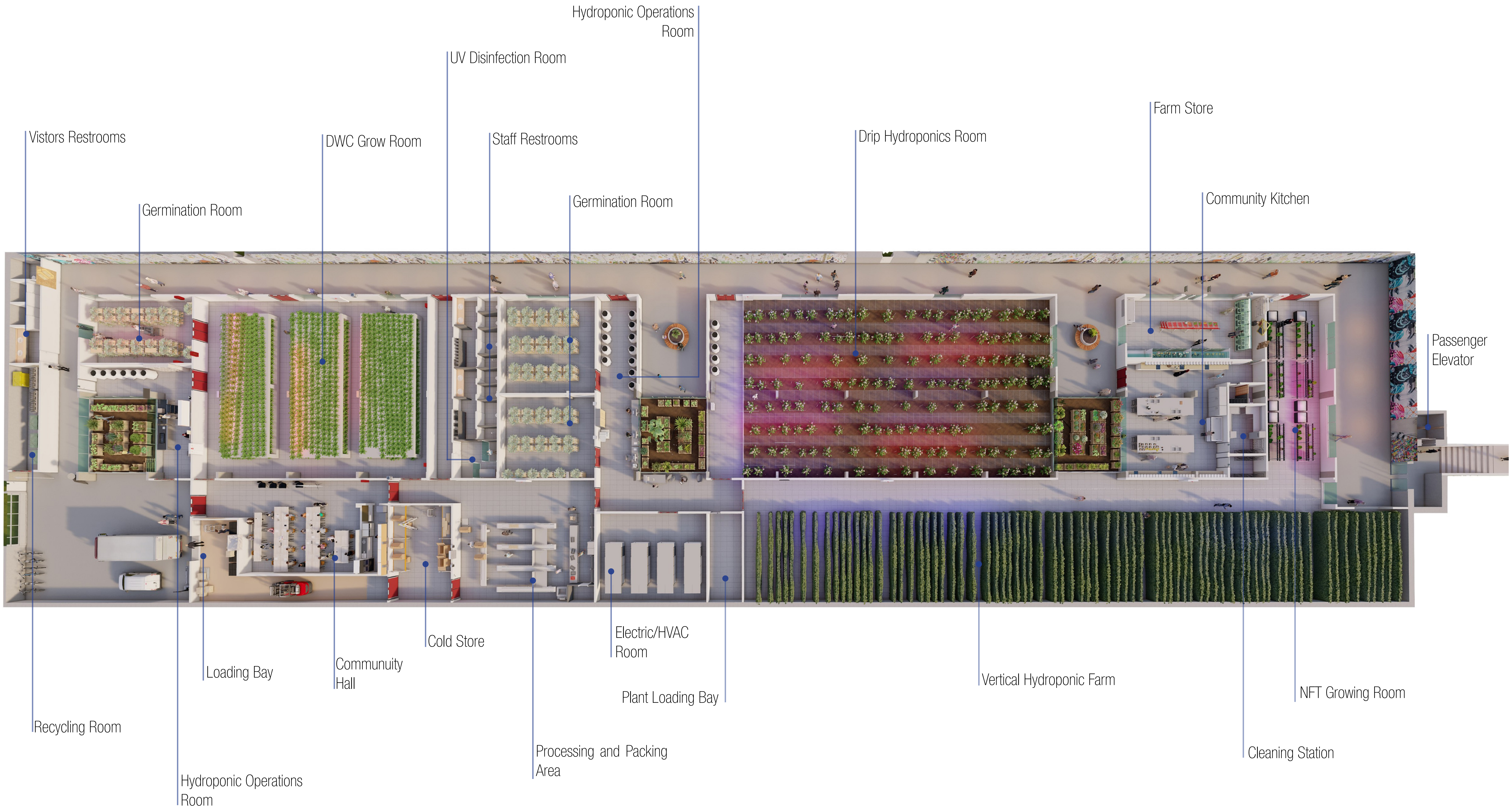
Karin (smiling):“That’s the point, right? The science, the food, the culture — all rooted in the same place.”

Leo:“And now everyone can access it — with the lift, the toilets, the whole path. It’s not just functional; it’s welcoming.”

Karin:“It’s more than just a basement farm now. It’s a place that grows knowledge, pride, and food — all in one.”

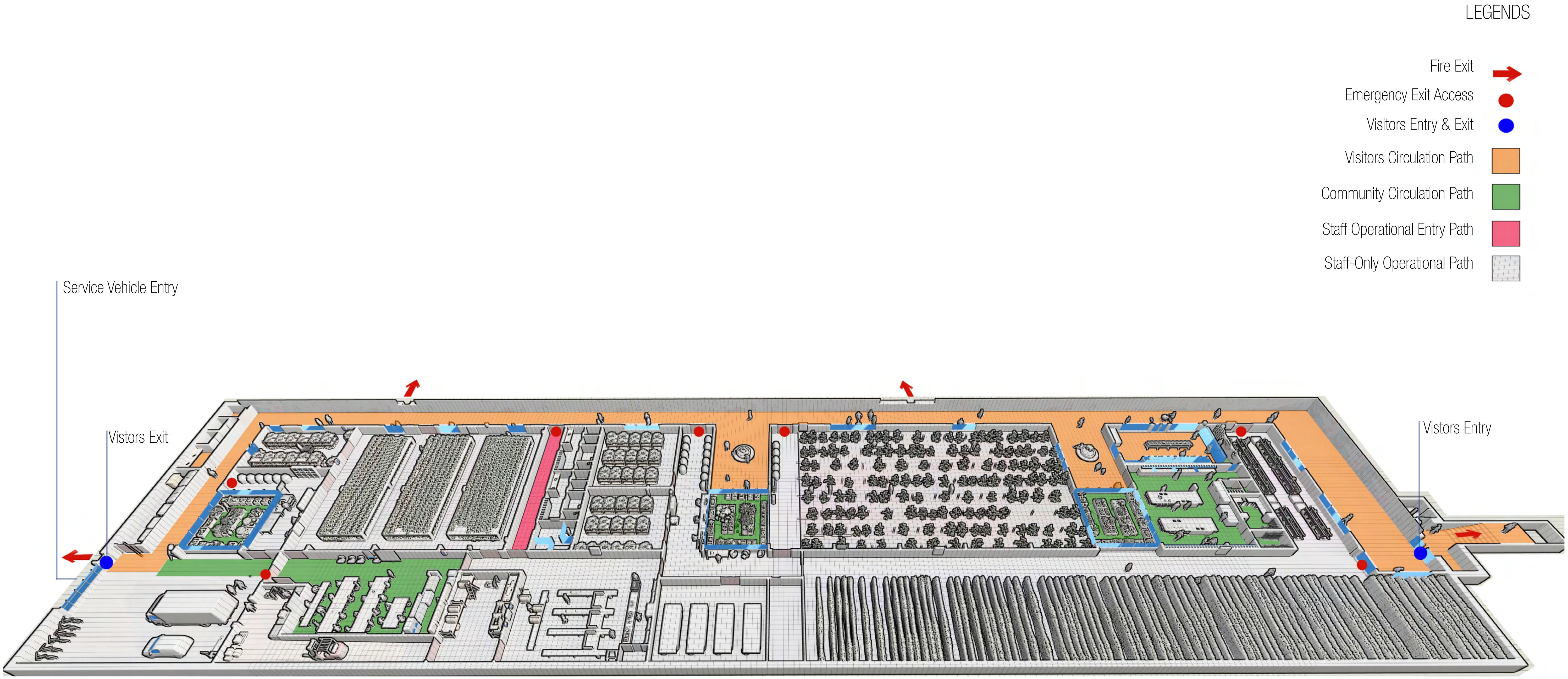
Visual 20 - The Vistor Circulation Path

6.3 SPECULATIVE FLOOR PLAN



This sectional drawing illustrates the full transformation of the basement space through each phase of the project.

6.4 SPECULATIVE CIRCULATION FLOOR PLAN



The circulation path plan outlines the organized movement throughout the basement, distinguishing routes for staff, visitors, and community members. Staff paths cover access to operational areas, including the hydroponic farm and service zones. Visitors have a separate route for tours, with views into growing spaces and educational displays. Community members access the community kitchen and community hall through the designated visitors' path. The plan also includes service vehicle entries, fire exits, and accessible routes to ensure safety and smooth operations for all users.

Invitation to the Reader

You are invited to speculate too.

How would you continue the story?
How might you envision the activation of the basement?
What could happen next — and what should happen next?

DISCUSSIONS

This thesis has explored the transformation of Hammarkullen's abandoned basement into an urban commons guided by the principles of spatial justice, adaptive reuse, resilience, and socio-technical systems thinking. The implementation chapter demonstrated the design through phased interventions, but here the discussion reflects on the critical reasoning that underpins those decisions and traces them back to the theoretical framework.

First, the decision to avoid demolition and instead pursue adaptive reuse directly responds to theories of the circular economy and embodied energy *(Bullen & Love, 2011)* . Rather than treating the basement as obsolete, it was reinterpreted as a resource "materially, socially, and symbolically". From a justice perspective, demolition in stigmatized neighborhoods often reinforces exclusion, sending the message that spaces and communities are disposable. By reusing the basement, the project counters that narrative, aligning with Lefebvre's (1996) call to recognize residents' "right to the city." This suggests that the value of neglected spaces lies less in their form than in their capacity to catalyze new governance models.

Second, the phased strategy reflects resilience theory *(Davoudi et al., 2012; Meerow et al., 2016)*. Instead of imposing a finished design, the project advances through incremental steps that allow for learning, feedback, and adaptation. This echoes Ostrom's (1990) finding that commons governance emerges through practice rather than prescription. For example, the greenhouse courtyards and community planter boxes in Phase 1 are not simply aesthetic or technical moves; they are strategic entry-points for collective stewardship and trust-building, necessary preconditions for more complex hydroponic systems later.

Third, the social dimension of hydroponics was deliberately emphasized. Case studies of commercial vertical farms often highlight profitability struggles, yet this project frames hydroponics as a commons-based socio-technical system. Glass walls, community training, and transparent processes turn technology into a shared learning resource rather than an opaque industrial tool. This repositions hydroponics as a means for empowerment and collective identity, not just food production.

Finally, the discussion highlights the tension between profitability and justice. While high energy and labor costs make hydroponics economically fragile, reframing value in terms of food security, cultural exchange, and educational impact justifies investment even in the absence of immediate profits. Here, the project contributes a critical reflection: sustainability must be understood not only in ecological or financial terms but also in terms of social continuity, equitable access, and long-term empowerment.

Conclusion

This thesis set out to answer the research question:

How can neglected urban infrastructures be transformed into urban commons to advance social sustainability, spatial justice, and community resilience, and what insights can a case study of Hammarkullen's basement provide for broader urban design and architectural practice?

The Hammarkullen case shows that neglected infrastructures can be reactivated by:

1. Applying adaptive reuse as a strategy to preserve embodied resources while reframing stigmatized spaces as assets.

2. Using phased implementation to align with resilience thinking, enabling incremental growth and avoiding the risks of premature expansion.

3. Embedding commons-based governance by creating entry-points for collective use and stewardship, such as community greenhouses, shared planter boxes, and value-added/community kitchens.

4.Ensuring spatial justice through attention to access, safety, inclusion, and fair distribution of benefits, thereby countering historical patterns of marginalization.

5.Reframing hydroponics as a socio-technical commons, where technology is embedded in social learning and collective responsibility rather than isolated industrial practice.

Together, these insights demonstrate that urban design can move beyond technical problem-solving toward socially anchored transformation. Neglected spaces, often dismissed as liabilities, can become infrastructures of inclusion, justice, and resilience when design is guided by theoretical frameworks and grounded in local conditions.

While grounded in Hammarkullen, these lessons demonstrate principles that can guide architectural practice in other marginalized or overlooked urban contexts.

Final Reflections

While framed around a single basement in Hammarkullen, this thesis raises broader questions for architecture and urban planning. Most importantly, it challenges the assumption that peripheral or stigmatized neighborhoods are blank slates awaiting external solutions. Instead, they contain latent resources, "physical, social, and cultural" that can be reclaimed through collective processes.

The reflections extend in three directions:

For practice: Architects must recognize their role not only as designers of form but also as facilitators of commons-based processes. This requires patience, humility, and willingness to work with incremental, evolving, and sometimes could even mean imperfect transformations rather than complete, top-down solutions.

For policy: Municipal frameworks often privilege demolition and new construction over reuse. To enable just and sustainable reactivation, policies must recognize the social and ecological value of existing infrastructures and create funding models that support incremental, community-led transformation.

For theory: This thesis has shown that urban commons and spatial justice are not abstract ideals but practical tools for guiding design decisions. At the same time, adaptive reuse and resilience provide operational logics " phasing, modularity, and socio-technical integration, that make commons-based justice feasible in practice.

Ultimately, the Hammarkullen basement is not just a local intervention. It is a provocation for rethinking how architects and planners approach neglected spaces elsewhere. What if such spaces were not erased but reimagined as commons? What if justice, not efficiency, was the starting point of design?

In this light, the project demonstrates that the value of architecture lies not only in creating buildings but in cultivating more inclusive, sustainable, and resilient ways of inhabiting the city.

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Images

All images and graphic material have been produced by the author, if not indicated otherwise.

AI Tools Used

ChatGPT (OpenAI) was used only for proofreading purposes. All research, analysis, and conclusions are fully my own work.

Appendix : Digital Supplement

Scan the QR code to access a digital walkthrough video of the proposed transformation of the Hammarkullen basement facility. The video provides a complete visualisation of the space once all design phases have been implemented, offering a holistic view of the project beyond the written material.

TQRCG

“Even the most overlooked spaces can become grounds of possibility.”

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