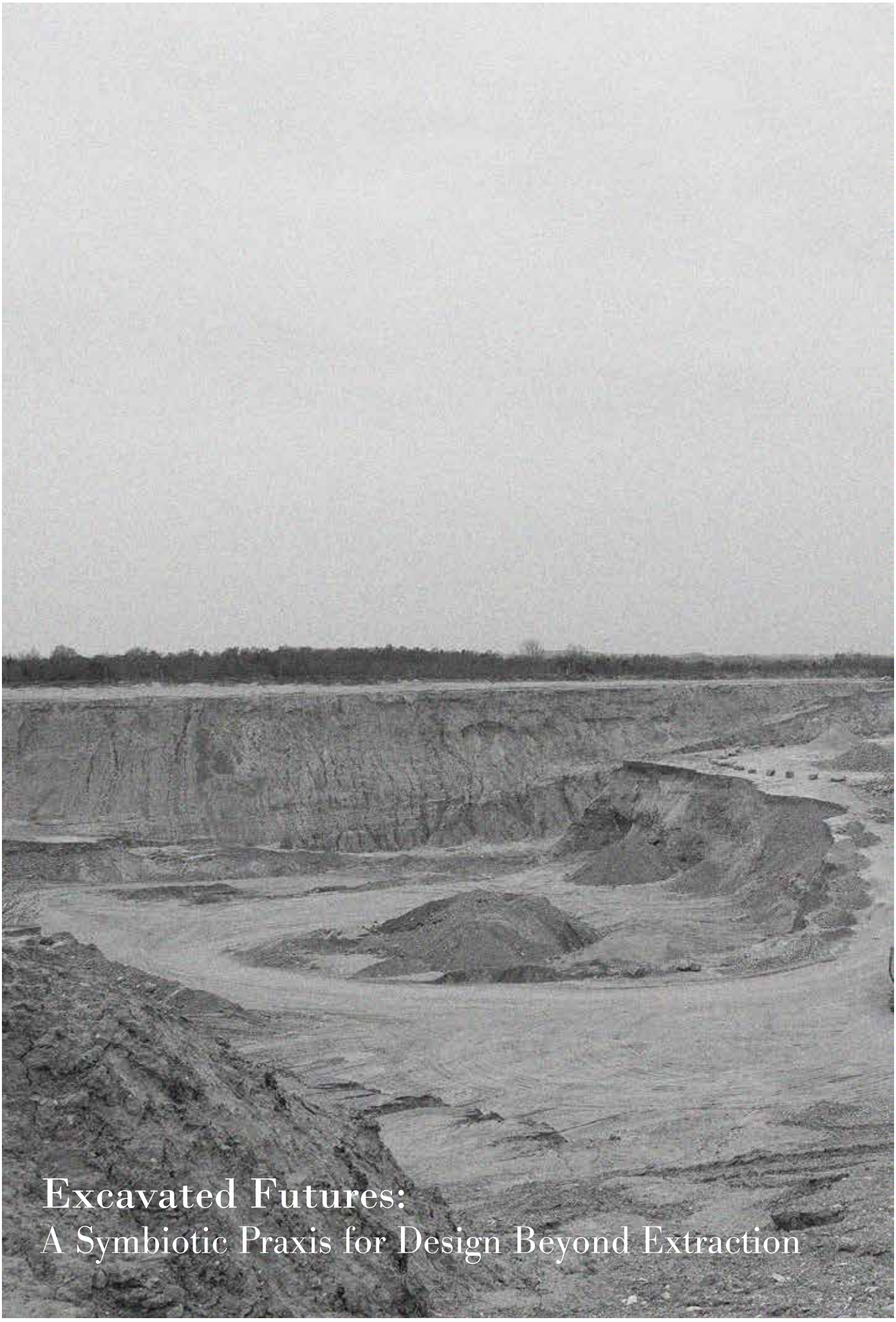

Excavated Futures:
A Symbiotic Praxis for Design Beyond Extraction

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We are also grateful to Karl Martin, Innovation Director at Sweco Denmark and Head of The Planetary Project, for the valuable conversations that helped shape our thinking in the early phases of the thesis.

"Everybody lives downstream"

– Robin Wall Kimmerer in Braiding Sweetgrass

Jacob Bundgaard Nielsen

Michael Korsgaard Gad

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Appendix 4

Abstract

With humanity gaining a level of dominion over Earth, resulting in modifying its entire atmosphere through terraforming (earth-shaping), this leaves serious questions to reassess our way of habitation. Despite minerals on our planet being finite and a circular economy only at 7% globally, the project speculates on the role of architecture in both supporting the environment during ecological crises and by extending the notion of circularity itself. Instead, through a speculative methodology, architecture is seen as a regenerative force embedded within ecological and material systems.

Hereby, the research investigates non-extractive architecture as a means to reimagine construction in ways that do not impose environmental harm. Instead of minimizing offsets and damage, it is envisioned how to foster material economies and social infrastructures rooted in regeneration, stewardship and symbiotic interdependence. Finally, architecture isn't situated as the end point, but as part of metabolistic processes, enabling it to nourish soil, ecosystems and communities across multiple lifecycles.

Through speculative methods like science fictioning and narrative building, the traditional tool LCA (Life Cycle Assessment) is shifted from optimizing for efficiency to entanglements (Life Cycle Assemblages). By emphasizing health of entire sites rather than materials, the role of design adopts non-human perspectives to promote futures of co-existence between species in an attempt to foreground a critical lens upon Western society. In the speculative nature, the project combines questionss about the Anthropocenic human state in a utopia where thermal comfort, co-existence and alternatives to the neo-liberal economy emerges.

With other factors such as climate, migration and political ecology, the culmination of the research lies in the act of expanding architectural thinking toward planetary interdependence. Circularity is reframed from economic metric, to a relational ethic, an ecological worldview. This is supported by alternative biogenic materials, a culture shift in the maintenance of the built environment and lastly socio-spatial configurations in which communities take on roles of stewardship rather than extraction. Through this lens, the project envisions architecture as compost: a living, decaying, and renewing practice in service of the Earth.

Glossary

Anthropocene
A proposed geological epoch marking the period when human activity began significantly shaping Earth's climate, ecosystems, and geology.

Anthropocentrism
A worldview that places humans at the center of value and decision-making, often at the expense of ecological systems.

Bioregional
Any geographical area defined not by political boundaries but by ecological systems.

BECCS
(Bioenergy with Carbon Capture Storage)
A proposed climate mitigation technology that captures and stores carbon emissions from bioenergy production.

Circular economy
A regenerative system that minimizes waste by designing products, materials, and processes for continuous reuse and recycling.

Cosmology
Framework through which people understand the origins, structure, and meaning of the universe, often shaped by cultural, spiritual, and relational worldviews.

Cosmotechnology
The entanglement of cosmology and technology, highlighting how technological practices are shaped by cultural, spiritual, and philosophical understandings of the world.

Eco-centric ethics
A moral framework that places intrinsic value on all living beings and ecosystems, not just humans. It emphasizes the rights of nature and prioritizes the health of the planet as a whole, challenging human-centered approaches.

Embodied climate-impact
The total carbon emissions and environmental effects associated with the entire life cycle of a product, service, or process—including material extraction, manufacturing, transportation, usage, and disposal—rather than just its operational emissions.

Geoengineering
Large-scale technological interventions aimed at manipulating Earth's climate to counteract global warming.

Deficit
A shortfall or imbalance, often referring to resource depletion, ecological overshoot, or economic shortfalls.

Degrowth
A movement advocating for the intentional downscaling of production and consumption to prioritize ecological and social well-being over economic growth.

Ecology
The study of relationships between living organisms and their environments.

Ecosystem
A network of organisms interacting with their physical environment in a dynamic and interdependent system.

Efficiency
The optimization of resource use to minimize waste and maximize output, often framed within sustainability or economic models.

Industrial ecology
A systems-based approach to industrial production that mimics natural ecosystems, emphasizing resource cycling and waste reduction.

Indigenous knowledge systems
Knowledge systems and ways of living rooted in long-standing relationships with specific lands, emphasizing balance, reciprocity, and ecological stewardship.

Interdependency
A condition in which different systems, species, or economies rely on each other for stability and function.

Moratorium
A temporary halt or suspension of an activity, often to allow time for review, protection, or decision-making.

Metabolism
The material and energy flows within a system, often applied to cities and economies as a metaphor for resource consumption and waste production.

Non-extractive
A design or economic approach that avoids depleting natural resources, instead emphasizing reuse, sufficiency, and regeneration.

Overshoot
The state in which human consumption of resources exceeds Earth's capacity to regenerate them, leading to ecological degradation.

Paradigm
A dominant framework or model that shapes how problems are understood and addressed within a field of thought.

Pluralistic
An approach that values diversity of perspectives, knowledge systems, and ways of being, recognizing that multiple truths can coexist within complex systems.

Pluriverse
A worldview that embraces the coexistence of many worlds, ontologies, and ways of knowing, challenging universalist perspectives and emphasizing relationality and diversity.

Polycrisis
The convergence of multiple, interconnected crises (economic, ecological, political) that amplify systemic risks.

Prosperity
A holistic measure of well-being that extends beyond economic wealth to include social, ecological, and cultural factors.

Post-growth
A framework that envisions economies and societies thriving without dependence on perpetual GDP growth.

Regenerative
A design principle that goes beyond sustainability to actively restore ecosystems, communities, and resources.

Safe sink
A system or process that safely absorbs and neutralizes waste or emissions without causing environmental harm.

Science fiction
A genre and method that uses speculative narratives to explore possible futures, technologies, and social systems, often serving as a tool for critical reflection and imaginative design.

Social tipping points
Moments of rapid societal change triggered by cumulative shifts in behavior, policies, or environmental conditions.

Speculation
A forward-looking approach that explores alternative futures, often through design, fiction, or theoretical scenarios.

Societal metabolism
The analysis of how societies consume, process, and dispose of materials and energy within economic and ecological limits.

Stewardship
The responsible management and care of natural and built environments to ensure long-term sustainability.

Sufficiency
To meet one's needs

&

a design approach that minimizes resource use, prioritizing need over excess within ecological limits.

Symbiotic
A mutually beneficial relationship between organisms, systems, or communities that enhances resilience and cooperation.

Sympoietic
A concept from systems theory describing self-organizing and co-evolving systems without centralized control.

Technisity
A concept referring to the culturally embedded nature of technology—how technical systems are shaped by social, political, and philosophical contexts. It contrasts with the view of technology as neutral or universal.

Technodiversity
The recognition and cultivation of multiple, culturally rooted technological practices and innovations. It challenges the dominance of Western, industrial technology by valuing diverse ways of knowing, making, and relating to tools and systems.

Technoscience
An approach that acknowledges the inseparability of science and technology, emphasizing how they co-produce knowledge and shape society. It critiques the idea of objective science by highlighting its entanglement with power, culture, and innovation.

Terrestrial
Relating to land-based ecosystems, organisms, and environments, often contrasted with marine or extraterrestrial contexts.

Motivation

Cognitive Dissonance in the Age of Collapse
Here, at the end of education at Aalborg University, it seems like a natural moment for reflection. Throughout our studies, we've been introduced to methodologies being iterative and reflective, gaining new insights, whether technical, social or contextual - they continuously inform and reshape both the design and our understanding of problems themselves. This applies both to this individual project, but also as semesters have passed, gaining a wider understanding of our field.

Where this has left us though, is in a space that is overshadowed by the often-unseen shadow of construction - the reality that construction in one place almost always implies destruction elsewhere. To loan the words of Charlotte Malterre-Barthes; *"to build is to destroy"* (Malterre-Barthes 2025).

A practice that infinitely has based its existence on resources and extraction is therefore facing an existential crisis. Rather than the challenge of poly-crises, architecture must ultimately concern itself with the penultimate room to maneuver - one of sufficiency.

Unsurprisingly, the building industry remains one of the largest contributors to the climate crisis, despite decades of 'sustainability' efforts. At large, current practice fails to address the underlying systems, and logic of construction - one that relies on continuous resource consumption, waste production, and material-intensive expansion. The urgency of the climate crisis demands a shift beyond sustainability as optimization and towards a fundamental rethinking of material flows, land use, and architectural sufficiency.

Gaining this knowledge has brought us the experience best described as cognitive dissonance, concerning the externalities of construction and working with 'sustainability', not to mention even being. As Socrates expressed, *"I know that I know nothing"* (Plato, 1997, p. 21d). In this spirit, we have found ourselves in moments of uncertainty - fundamentally questioning parts of what we have learned, and whether we are even asking the right questions, and using the right tools, as they often appear insufficient in addressing today's complex and systemic crises.

Departing from this ethical dilemma, and with a sense of moral obligation, this functions as the driver of the thesis, which is why we engage in a speculative discourse; to question the role of the architect in other futures. As Mark Wigley argues for an architecture less engaged with a depletive economy, it *"must at least return a gift of the architect and take the risk of seeing what might come after architecture"* (Wigley 2021, cited in Foote et al. 2023).

Intention

Design for Discussion
The main objective of the thesis project is to engage in the discussion of how architecture can become part of a thriving ecology, rather than causing further destruction - even if it means radical changes to western cosmology and existence. Bringing attention to the fact that we might have to unlearn what we think we know.

The thesis project questions traditional architectural methods hence the speculative approach, using the tools we have at hand in new and reflective ways. As this often includes tools such as design criterias, it is important to underline that the thesis project does not claim to make any universal manifesto for a regenerative design process, nor a blueprint for future architectural design. Rather it seeks to use architecture and design as a speculative tool to explore future scenarios, emphasizing the necessity to move to a long-sighted systematic planning beyond architecture.

Readers Guide

Guide to the Thesis Format and Flow
The thesis is split in three parts (I, II, III) for reading clarity.

Part I lays the academic foundation of methodology, theory and the joining of discourse with other scholars, practice etc. Here, the outlining of the problem is central, as well descriptions of current practice.

Part II resembles a systemic break within the thesis to create clarity for the speculative methodology. In this part, facts, fiction, storytelling and design weave together.

Hereby, we invite the reader to have an open mind.

Part III consists of a critical reflection synthesis, summarizing the thesis while opening up for further discussion. Additionally, appendixes are placed here, including excerpts of the design process, technical measures etc.

Burgundy break pages are emerging throughout the report to summarize previous chapters.

A **glossary** is provided to improve clarification for emerging terms throughout the project (page 6-7). This can also be seen as a quick way for the reader to situate themselves within the topics of the thesis.

Illustrations are authors own unless others are credited.

In the speculative nature of the project, subsequent speculations follow throughout the report, asking **"what if?"** to circle around the futuring aspects of the methodology, but also to bring the reader into the process of developing a speculative approach.

What if..?

ill. 1 Format of sub-speculations

Framework

Unbuilding the Future: Toward Post-Extractive Architecture
In response to the ethical dilemma concerning the current architectural and urban design practice, this thesis adopts a speculative and interdisciplinary methodology to question the future role of the designer. By critically examining the dominant efficiency-oriented approaches to sustainability, the project reveals how these approaches often sustain growth-dependent paradigms that directly counteract ecological regeneration. Rather than optimizing systems that are inherently extractive, this thesis initially asks: What if we radically changed our cosmology (see glossary)? What new forms of architecture and urban life could emerge if we redefined our foundational relationships to nature, materials, and one another- not only as humans, but as part of a more-than-human world?

The project engages with architectural practices and theories of material, social and ecological character, aiming to develop design strategies for a post-extractive future. These strategies are tested through speculative design scenarios and storytelling, which function both as tools of critique and enables imagination for alternatives to reconfigure architectural practices.

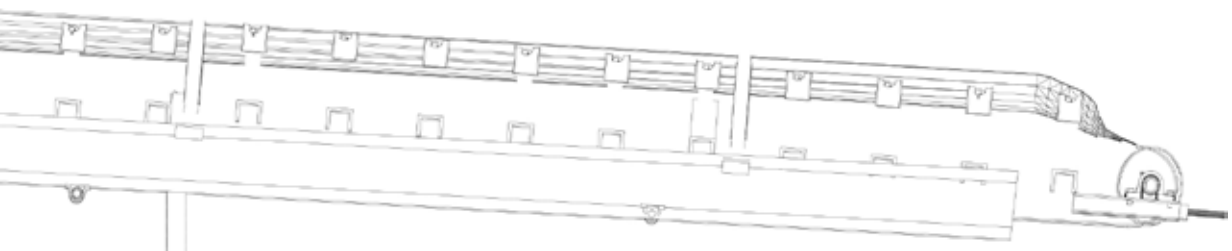
Interdisciplinary Approach
Speculative research plays an important role in interdisciplinary inquiry by allowing scholars to resist pre-determined futures and explore alternatives that challenge existing paradigms. Rather than adhering to traditional methodological structures, speculative methods introduce the possibility of reshaping disciplinary constraints through unexpected alliances and collaborations (Lury et al., 2018). Therefore, this project is rooted in the collaboration between architectural engineering and urban design, while seeking inspiration in other epistemologies (fiction, indigeneous science etc.). Regarding the interdiscplinary collaboration, each provides specific competencies; architectural engineering contributes knowledge of energy-, indoor climate- and structural performance, as well as materials and spatial experience. Urban design expands the view to include land use, social structures, and environmental systems across scales.

Speculating Beyond Extraction
Ultimately, this thesis contributes to an ongoing discourse around 'non-extractive architecture' by proposing that the current role of the architect and urban designer is not only to build, but also to envision, question, and narrate possible futures. Through speculative scenarios, it provides a space for resistance against predetermined paths and opens up alternative pathways that prioritize planetary health, social equity, and collective agency. In doing so, it calls for a new architectural cosmology - one that is not based on what we can take, but on what we can give back.

The thesis includes these steps of science fictioning, architectural engineering and an 'eco-centric' design process to develop its own methodology. Step by step, a coherent scenario is built up through short loops of storytelling, analyzing and design (as shown in **Part II**). Hereby, the design scenario is the outcome of the continual testing and application of the methodology, as a way of critizing current practices and speculating upon what might become. Rather than offering fixed solutions, the thesis positions design as an engaging method for discussion and debate, opening space for new architectural perspectives and knowledge. The thesis foregrounds conceptual and symbolic dimensions over technical feasibility.

ill. 2 Diagram of initial thesis framework

PART I



ill. 3 Conveyor belt, 1:50

INTRODUCTION

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PART II

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Chapter Outline

PART I

Speculative Methodology
This chapter introduces the role of speculation in thinking and design. It argues that speculation is not an exercise in free imagination, emphasizing the epistemological implications in a speculative methodology.
Based on empirical constraints of a site, Speculation inquiry asks *"what might become possible?"*. The aim of this question is to explore alternative futures and challenge assumptions, calling for discussion and critical engagement - rather than fixed solutions.

History
This historical chapter gives a brief overview of distinct periods in time. Linking these periods to data of the increasing energy consumption, despite improvement in energy efficiency tells a story of a changing technicity and ultimately a change of cosmology - hinting there was a world within ecological limits before the current modus operandi and anthropocentrism - asking might this become possible again?

Problem Background
This chapter provides a diagnosis of the current modus operandi and serves as an epistemological foundation for this thesis. It presents relevant concepts and underlying systems of capitalism, extraction and energy use - that might give an understanding of some of the issues with the current building practice and the direction it is heading. This chapter further explores some of the solutions widely proposed, such as circular economy and a building moratorium - respectively, arguing for a more radical alternative and a vision for what might come after. Finally, it introduces the site - an excavation landscape - as a testbed and chosen for its potential for estrangement.

State of the Art & Research Question
This chapter explores some relevant and most recent movements, practices and literature within non-extractive architecture and science fiction. Ultimately, it argues for a future where actions and decisions are connected to the landscape, building a reciprocal ethic. This provides the foundation for the problem statement.
Furthermore, theories of technicity are explored and their role in regenerative design and metabolism in architecture and urban design.

PART II

Entering Speculative Futures
This chapter, the first of two within this part of this thesis, provides an introduction to the speculative scenario, and the applied tools from science fiction. Further, this chapter frames the future scenario with a sequence of events occuring on a global to a local scale. This - novum - provides the foundation for the analysis presented as part of the storytelling.

The Institute of Soil Regeneration
In other contexts this chapter might be named 'presentation', which gives the notion of a final solution or product being presented. However, this was never the intention with this thesis, but to explore alternative futures and calling for discussion. Therefore, this chapter presents an alternative future through narrative and design. The design scenario changes the purpose of old extractive infrastructure to become the framework of a regenerative pedagogy for the Institute. Further, the concept of radical biological circularity has far-reaching and multi-dimensional implications in material economies, social infrastructures, and ecological dynamics.

PART III

Critical Reflection Synthesis
This chapter, the only one in this third part of this thesis, provides a conclusion to our problem statement. A critical reflection unfolds our thoughts on the thesis, including the speculative methodology and the speculative future conducted.

Appendix
This supporting body consists of a compressed recollection of the design process, followed up by engineering aspects and investigations of the project.

ill. 4 Fuel station, 1:50

SPECULATIVE METHODOLOGY

This chapter introduces the role of speculation in thinking and design. It argues that speculation is not an exercise in free imagination, emphasizing the epistemological implications in a speculative methodology.
Based on empirical constraints of a site, speculative inquiries asks "what might become possible?". The aim of this question is to explore alternative futures and challenge assumptions, calling for discussion and critical engagement - rather than fixed solutions.

On Speculating

The Role of Speculation in Thinking and Design
To speculate is bound upon thinking and reflecting. Those are at least some of the relations to the worded definition. Within design and research, though, speculation is often tied to ask questions, questions that are linked to other futures and their possibilities. In the book 'Speculative Research: The Lure of Possible Futures' it is laid out how this forward-looking approach is inherently tied to the actualities of existing conditions within the world, currently pointing towards a problematic future. With escalations in social-natural, techno-scientific, and political-economic developments, it becomes increasingly more imperative to ask questions of how to operate within these (Wilkie et al. 2017).

Questioning the Logics of Managed Futures
Hereby, the exploration of speculative questioning within society tasks itself by taking critical account of the calculated logics and rationales that are already managing societal futures. By doing this, alternative approaches can be developed and sensibilities can be investigated to emerge within future possibilities. Essential to everything that this encompasses is, that the working ways within speculation demand new habits and practices of attention, invention, and experimentation (Wilkie et al. 2017).

The Polycrisis and the Default of Business-as-Usual
With multitudes of crises, coined a polycrisis, we've arrived at a planetary problem of climate change, in the age of the Anthropocene, also referred to as the 'Capitalocene' (Moore 2015, cited in Wilkie et al. 2017). Despite the weight of these critical urgencies as externalities of the Capitalocene, Wilkie et al. argue that default approaches to these transformative futures still seem to generate 'business-as-usual' logics, ultimately reducing the question of futures to simple matters of anticipation, calculation and management. This is the central issue, because futures are reduced to forecasting and risk management, etc. - ways in which society conceptualises risk and uncertainty, ultimately negotiating present and futures. This eventually presupposes futures as a prolongation of the present. With this idea of time moving linearly, along *'a modern arrow of progress'* (Wilkie et al. 2017 p.4), it implies that present conditions ultimately in some way or form, still are preserved in the future state. (Wilkie et al. 2017) To put it differently; this forces an uneven relationship in letting critical practices emerge on wider scales. Although the definition of something as critical in the first place implies that it is not a widespread, mainstream or common notion of dealing with 'futures'.

> "*It appears that we inhabit a peculiar time, somewhat suspended in its own frantic movement, where the future has never been more present, yet the present keeps prolonging itself, insisting, with its own order of continuity, on a time that does not quite seem to pass.*"
>
> (Wilkie et al. 2017, p. 1)

Speculation as a Problematic Force
To quickly touch on other definitions of speculation as opposed to thinking and reflection that already have been mentioned, the word 'speculation' positions itself as a possible catalyst making up for many of the underlying forces that have equipped this deadlock of unfortunate character (Wilkie et al. 2017).

It is a phenomenon that is ever-present within irrational and irresponsible excesses of contemporary high frequency financial trading practices, market dynamics and stock exchanges (MacKenzie 2006, cited in Wilkie et al. 2017). According to Pemmaraju (2015, cited in Wilkie et al. 2017), these are practices that seek to bring profit from volatile fluctuations of markets and uncertain futures. This positions speculation as a term of

abuse in modern history, bordering on suspect practices of exploitation and uncertainty (Ericson & Doyle 2004, cited in Wilkie et al. 2017).

Reclaiming Speculation as a Critical Practice

These connotations naturally inflect on the perception of the word 'speculation', posing a danger that cultivating speculative thought is strictly tied to turning uncertainties into profit (Wilkie et al. 2017). To depart from this danger, Wilkie et al. outline in the book that there is importance of other modes of speculation, exactly because of the dangers that are connected to the aforementioned practices (Wilkie et al. 2017). The power then lies in reclaiming the word, to finally make sensitive and productive contrasts to those practices by which speculation have been captured. This makes space for an exploration to seek the promotion of a different sense of speculation, a more creative and responsible sensibility may even be cultivated. (Wilkie et al. 2017).

In large, speculative research and design futures experiment with the unexpected eruptions of the (im)possible of social, political, economic, philosophical, and ecological events that can't be fully anticipated or forecasted - to open up possible futures unmanageable in advance (Wilkie et al. 2017).

Speculation in Literature and Architecture

In contrast to the capturing of contemporary financial practices, speculation has rich history within literature, most common within the genres of SF (Wilkie et al. 2017), for example: Science Fiction, Speculative Fiction, Social Fiction, Space Fantasy, Slipstream Fiction, Surrealist, Solar etc.

In Joel Letkemanns 'Elaborate Strategies of (In)Direction: Science Fictioning in Architectural Education', Tom Moylan is cited to make the point of literary utopias and their rise in the 1970s. Moylan here argued that they took upon ever more critical perspectives, making use of the SF conventions as these are useful to explore socio-political possibilities (Moylan 2014, cited in Letkemann 2022).

In extension of this, the speculative angle is hereby sought to challenge dominant user-centred and functionalist assumptions in the built environment - emerging instead with a sensibility altering aesthetic and technical processes, propositions and outcomes (Wilkie et al. 2017)

Speculation as Design for Debate, Not Solutions

Within architecture, speculation as a genre isn't new, but has existed for centuries. As mentioned earlier, speculation has here been the critical medium, not only to explore alternatives, but to investigate the values and assumptions that are related to everyday lives, technologies and consumerism (Dunne and Raby 2013). Finally, speculation is often more tied to ask questions, rather than providing answers, researching through design, instead of for it. This means to design for debate rather than production and to ponder on the implications of a technology rather than its application. And lastly, to make us think instead of making us buy (Dunne and Raby 2013).

To speculate is then to take the risk of developing a practice by engaging with (im)possibilities that are dormant in the present, making available and experimenting with possibilities for the impending of alternative futures (Wilkie et al 2017).

Introduction to Speculative Thinking

Speculation as Method: Beyond Free Imagination

Speculation is not an exercise in free imagination but a structured approach that requires training and conceptual clarity within specific constraints (Hendrickx, 2017). It is a method that challenges existing frameworks by posing questions that foster new thinking, rather than merely extending current knowledge. Hendrickx argues that the quality of a question determines its potential for generating insight; if a question merely reinforces what is already known, it restricts the possibility of novel perspectives. Speculation can be evaluated based on its possibility to produce meaningful consequences for thought (Hendrickx, 2017).

A key characteristic of speculative thinking is its engagement with empirical constraints. Rather than detaching from reality, speculation remains grounded in observations and experiences, by composing a situation into its different elements and how they relate and matter. This interplay between empirical conditions and conceptual inquiry is crucial for creative thought, allowing speculation to function as a productive method (Debaise, 2006).

The Political and Relational Nature of Speculative Thought

Interpretation is different from speculation. Interpretation assumes a situation is something understood objective and separate from its observer (Hendrickx, 2017). Whereas speculation is looking at the relation between the components of a situation, including the observer itself (Hendrickx, 2017). In other words speculation changes both the observer and the situation itself - as an ongoing interactive process - it's a two-way relationship.

Speculation inquiry asks, "what might become possible?" (Hendrickx, 2017). This shift in perspective enables deeper engagement with complex issues, often requiring answers in the light of empirical evidence elsewhere. Acknowledging that the choice of speculative approach influences both process and outcome, Hendrickx highlights the inherently political dimension of speculation: if reality is not fixed, then how should it be reimagined? What conceptual tools allow us to think about reality differently, and what ethical responsibilities arise from these alternative framings? (Hendrickx, 2017).

From Speculative Thinking to Speculative Methodology

Introduction to Speculative Thinking in Architecture
For speculative thinking to evolve into a methodology, it must adopt a structured approach that integrates speculation into a systematic research framework. This involves organizing the research process around speculation; employing science fictioning into architecture, as a critical way to explore alternative futures by speculative design and storytelling (Letkemann, 2022). The concept of estrangement, derived from science fiction studies, can be used to highlight how making the familiar seem strange and enables new ways of thinking about architecture (Letkemann, 2022). Science fictioning is therefore seen as a tool in architecture to critically rethink the discipline's future (Letkemann, 2022).

Speculative Methodology and Its Epistemological Implications
A central concern of speculative methodology is how knowledge is produced through speculation (Letkemann, 2022), including the methods, strategies, principles, and theories that shape this process. It carries epistemological and methodological implications, influencing both the frameworks used and the ways in which speculative inquiry generates new understandings. (Letkemann, 2022)

The Integrated Design Process (IDP) at Aalborg University
At Aalborg University the Integrated Design Process (IDP) is commonly used, as a traditional approach to conducting a design research within Architecture and Design (Knudstrup, 2004). IDP is a performance driven process that is refined through feedback and iterations. The end product is usually 'innovative' and grounded in reality, combining architecture, design, functional aspects, with more measurable performance criteria such as (energy efficiency, sustainability, indoor environment, technology, and construction, etc.). (Knudstrup Ny, 2004)

A critique of this perhaps very linear notion of design and efficiency can be summarized by lending the notion explained by Bruno Latour *"the problem with buildings is that they look desperately static. It seems almost impossible to grasp them as movement, as flight, as a series of transformations"* (Latour & Yaneva 2017, p. 103). In the article 'Give Me a Gun and I Will Make All Buildings Move: An ANT's View of Architecture' Latour critiques the traditional notion of architecture as a static product, instead advocating for its recognition as part of a network of relations (Latour, 2004).

Speculative Methodology vs. IDP: A Conceptual Approach
In contrast to this IDP, speculative methodology tends to be more conceptual and exploratory. It's less concerned with immediate feasibility and more focused on challenging existing norms, provoking debate, and inspiring new ways of thinking about architecture and society (Dunne and Raby, 2013). Rather than converging on a practical ready-to-build solution, speculative methodologies often aim to generate thought experiments, design fictions, and conceptual frameworks that serve as provocations or critiques. They might influence future research directions or spark dialogue about what architecture could become, rather than providing a clear path for immediate construction. (Dunne and Raby, 2013)

Research Methodology

The way the researcher wants to achieve research goals

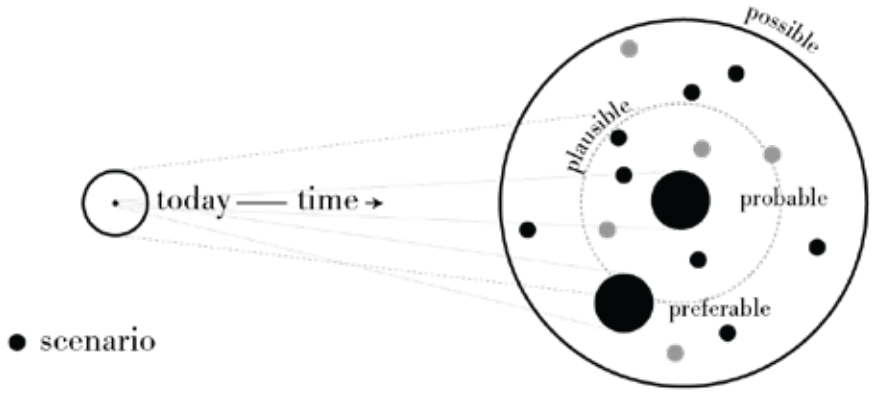
It derives from researcher epistemology and ontology (worldviews)

Research Methods

Different investigation techniques or tools

Derives from research methodology

Carrying out experiments, tests, surveys and so on



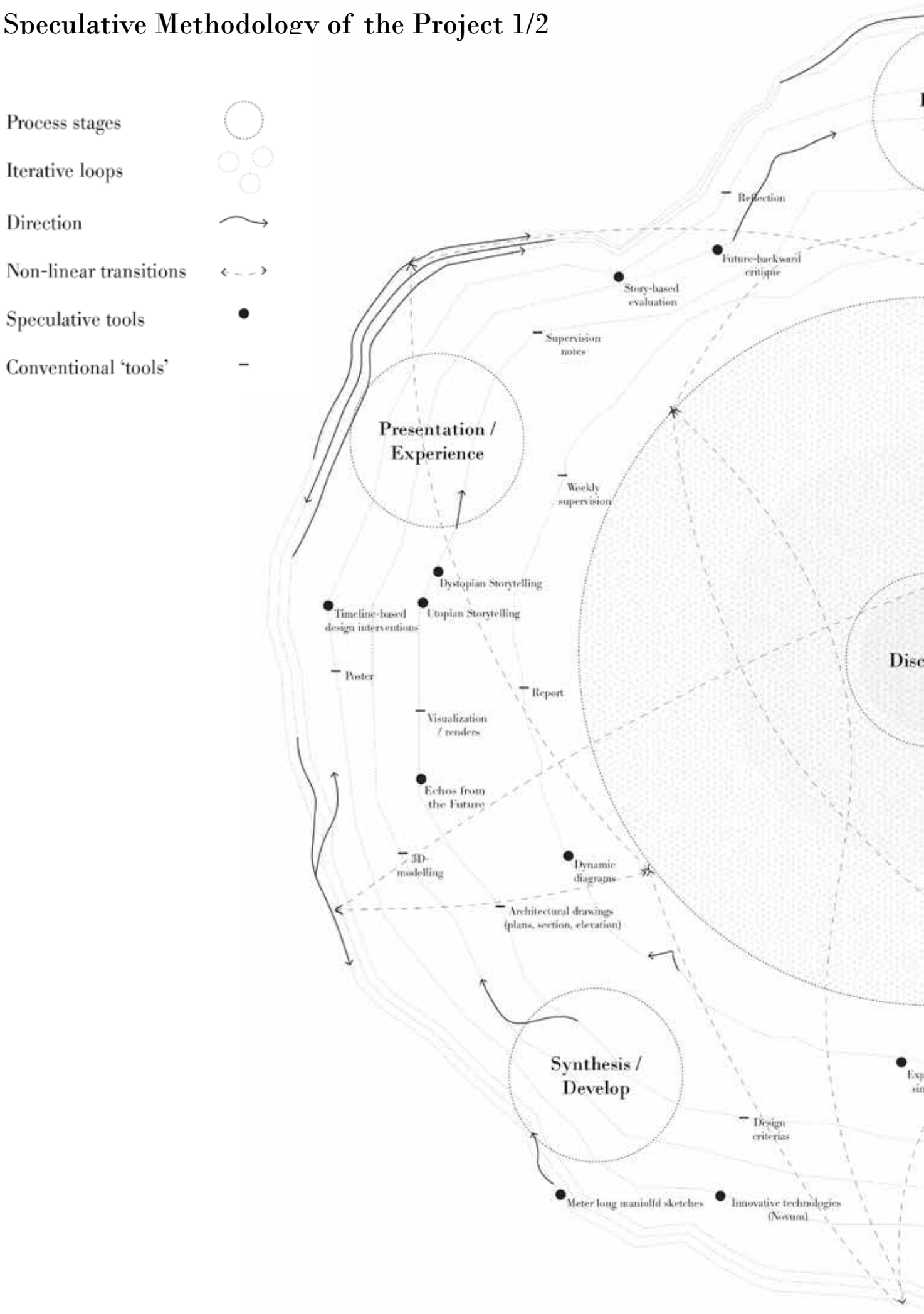
ill. 5 Adaptation of the Futures Cone. Based on: Voros (2003), via Dunne & Raby (2013), via Revell (2015), as seen in ResearchGate (2024)

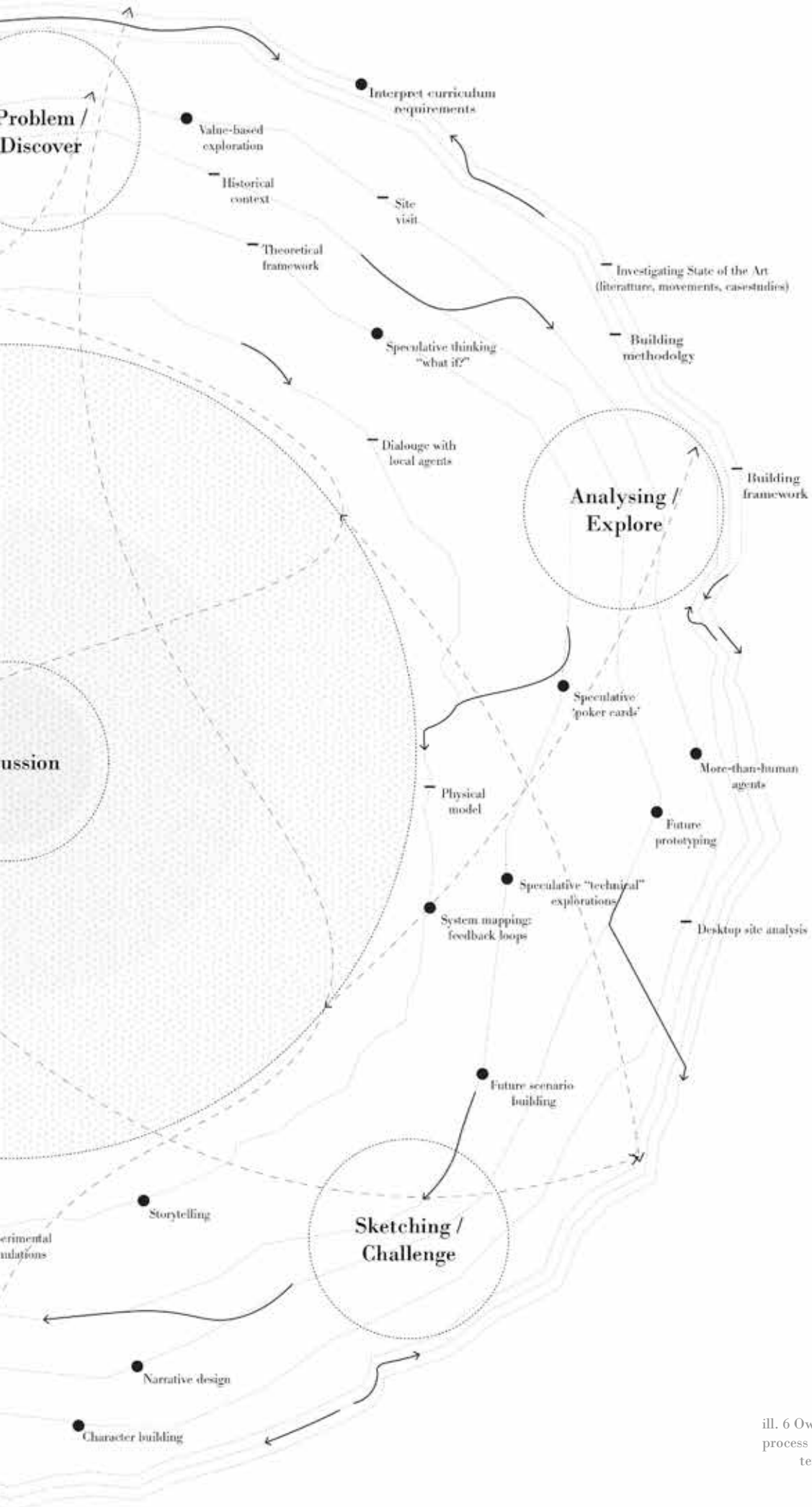
Beyond the IDP: A Speculative Methodology for Radical Futures

To address the urgent need for radical sustainability and systemic change - which can be argued is beyond the traditional design approach of the IDP - this thesis adopts a speculative methodology. Though it still retains the collaborative, iterative, and interdisciplinary approach of the IDP, the aim and the process is fundamentally different. The design process is not guided by technical problem-solving, and might even discard the use of optimization tools. Such tools - as LCA, Bsim, Be18, karamba - often lack the potential of radical imagination, as they are programmed based on pre-assumptions on respectively sustainability, thermal comfort, energy performance and structural capacity. The speculative methodology might ask what lies beyond; is LCA sufficient? Is thermal comfort necessary? and is 'energy demand', as the word implies, a human right - and more importantly what might become possible if we change such assumptions? By designing not only for the present but from the future, this methodology seeks to create a space where radical ideas can be tested within realistic empirical constraints. Further this helps speculation to remain grounded in architectural practice. Although it might be difficult to imagine how structures might carry the exposed forces without thorough calculation, the method might lead to larger structures, more material use and assumes availability of various processed materials. As the curriculum requires the student to master such tools or competences, they could be used outside their original purpose; to question, rather than finding answers.

With a speculative methodology, each process is unique - illustration 6 on the following page shows how the methodology does not follow a phased and linear structure, but involves a non-linear, looping exploration and always returns to "what if?" questions. The stages of the IDP (problem, analysis, sketching, synthesis, presentation) has been interpreted into a unique speculative methodology for this thesis, centered around the potential for exploring alternative futures, challenge assumptions, calling for discussion and critical engagement. The illustration holds speculative and more conventional tools applied throughout the process.

Speculative Methodology of the Project 1/2





ill. 6 Own speculative methodology and design process showcasing the non-linear process centered aorund the potential for discussion

Glossary of Speculative Methodology within the Project 2/2

This is an expanded glossary for the speculative methdology diagram on the former page.

Process Stages
The diagram is structured around distinct process stages, each representing a different mindset, purpose and role we undertook - ranging from designer and storyteller to researcher and author. These roles shifted depending on the tools applied.

Iterative Loops
The loops illustrate how the process was highly iterative and non-linear. Each loop is unique and differs in size; multiple loops can occur simultaneously and not every stage is involved in each loop. For example, we often had sort loops between analysis/exploration and sketching/challenging as we built our scenario. Weekly supervisions had us take a full loop - leading us through synthesis/development and presentation/experience, followed by an evaluation and back to problem/discovery.

Direction / Movements
The arrows indicate that movement between phases is intentionally non-linear. Sometimes we jumped back to a former loop to restart or reframe entirely. This back-and-forth movement was a natural part of our speculative process.

Non-Linear Transitions
Transitions between phases are fluid and can jump to any phase. Rather than following a fixed path, we moved freely between stages based on what was needed - whether that meant jumping ahead, looping back, or working across multiple stages.

The Conventional Tools
Conventional Tools are often applied in architecture and urban design as part of the IDP and can also be used in speculative methodology, though their application varies. For example, we spent little time on 3D modeling until the last month, as other tools like sketching and storytelling were faster to explore speculations and develop scenarios.

The Speculative Tools
Speculative tools are tools rarely seen in architecture, urban design or part of the IDP. Here is a list of speculative tools and how they were applied in this thesis:

Speculative Thinking: “what if?” shifts focus from ‘what is’ to ‘what might be?’ - prompting open alternative possibilities and imaginative hypotheses unconstrained by current systems or constraints.

Value Based Exploration: asks “what if?” starting from prioritized values like regeneration, degrowth, or care, exploring what might happen to build environments, systems, or societies if these values were central.

Speculative ‘Poker Card’ frees the mind from assumptions to explore speculative scenarios, often incorporating other tools.

More-Than-Human-Agents function both as character building and analytical perspectives, making them a tool to explore futures beyond the human viewpoint.

Future Prototyping is tangible or semi-tangible representations - models, visualizations, narratives - that anchor speculation in something we can feel or see, enabling testing of future scenarios.

System Mapping: Feedback Loop is used not just to describe present systems but to imagine how future systems might behave, change, or fail.

Storytelling writes from inside a future, combining narrative with future prototyping and speculative objects to create logic and culture for speculative systems, telling stories through characters during both process and presentation.

Narrative Design structures how a story is told and how people move through it, helping the storytelling's focus on content.

Character Building makes speculative design personal by creating lenses into future worlds, revealing how policies, technologies, or environments shape daily life.

Experimental Simulations bring future systems into the present to be felt, tested, or questioned, critiquing assumptions and provoking reflection or debate.

Novum introduces scientifically plausible innovations that transform the story world, such as new technologies or radically repurposed systems.

Meter-Long-Manifold-Sketches map complex ecological, social, material, and systemic interrelations over time and space.

Dynamic Diagrams visualize how change unfolds across time, space, and systems, often used in transition design, systems thinking, and future prototyping.

Echos From The Future anchors imagination in tangible storytelling, translating abstract systems or transitions into human or more-than-human experience, fostering empathy, clarity, and critical reflection

Time-Line Based Design uses time as a central structuring principle, turning it into a narrative framework for unfolding transitions rather than treating it as linear or passive.

Utopian Storytelling imagines hopeful, regenerative, or transformed worlds, focusing on 'what could go right?'

Dystopian Storytelling explores dark, undesirable futures by asking 'what if we fail to act?'

Story-Based Evaluation evaluates future experiences through narrative, revealing impacts beyond technical metrics.

Future-Backward Critique reverses the timeline, asking what systemic shifts must occur to realize a specific future.

Initial problem statement

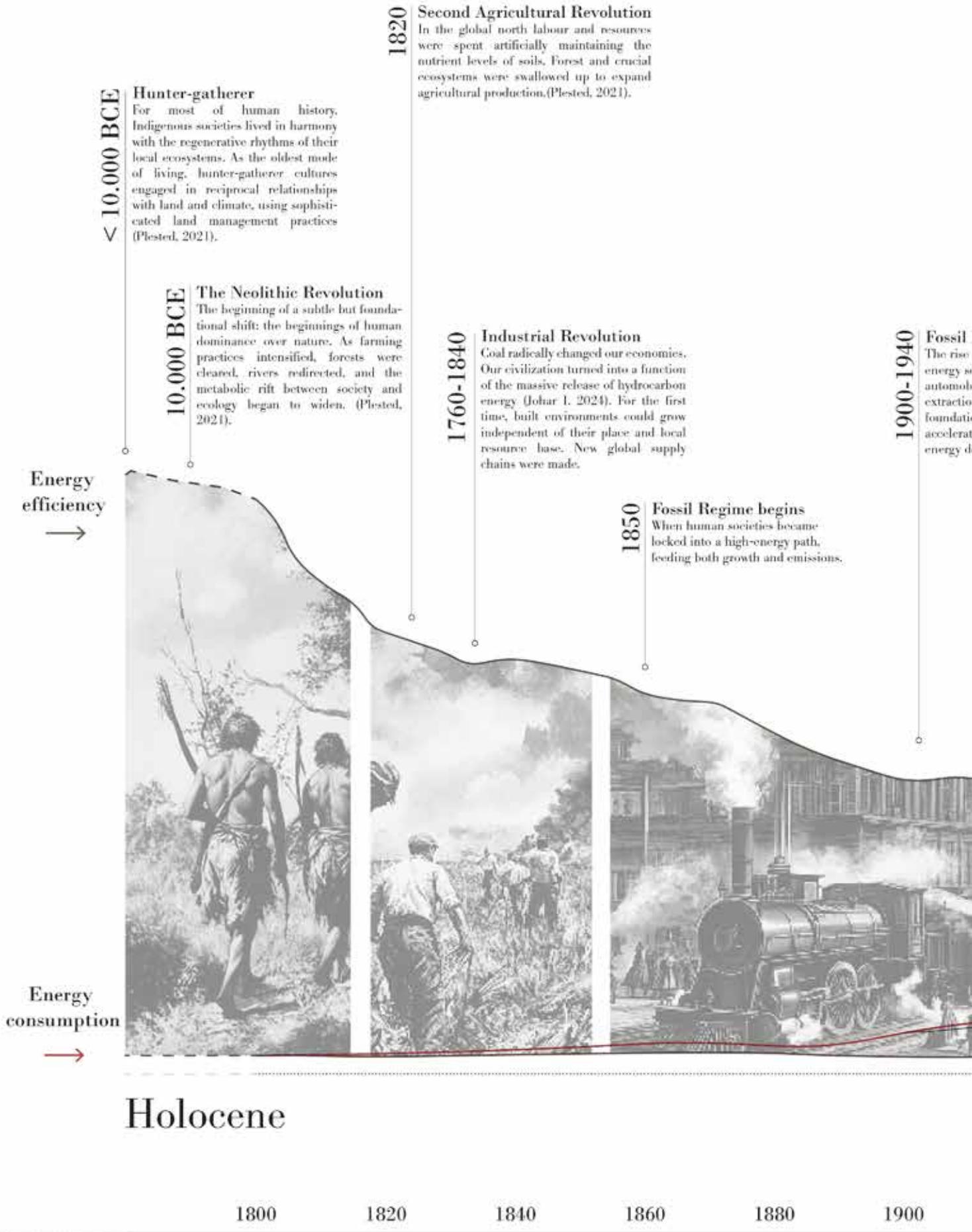
How can speculative design question and reframe modus operandi within the built environment to foreground ethical thought in construction practices and foster regenerative co-existence?

ill. 7 Lighting tower, 1:50

HISTORY

This historical chapter gives a brief overview of distinct periods in time. Linking these periods to data of the increasing energy consumption, despite improvement in energy efficiency tells a story of a changing technicity and ultimately a change of cosmology - hinting there was a world within ecological limits before the current modus operandi and anthropocentrism - asking might this become possible again?

ill. 8 Diagram of improved energy efficiency and increased consumption, Adapted from Reduction Roadmap (2024), combined with AI-generated images created with Midjourney (see Appendix 4 for prompts)



Degrowth by Design or by Disaster?
Planned transition (building stop, rewilding)?
Unplanned collapse (resource wars, climate migration, cascading failure)?

2025-

1945-1950

The Great Acceleration
Coal, oil, natural gas enabled the mass production of materials like concrete, steel, and glass - materials which were shipped to every corner of the Earth. (Steffen et al., 2015).

1979-2015

Scientific Recognition and Global Policies
- First IPCC Assessment report
- First world climate conference
- Kyoto protocol
- Planetary Boundaries Frame- work
- Paris Agreement

2020

Efficiency Lost to Growth
Global increase in energy demand was greater than all the installed renewables over a year.

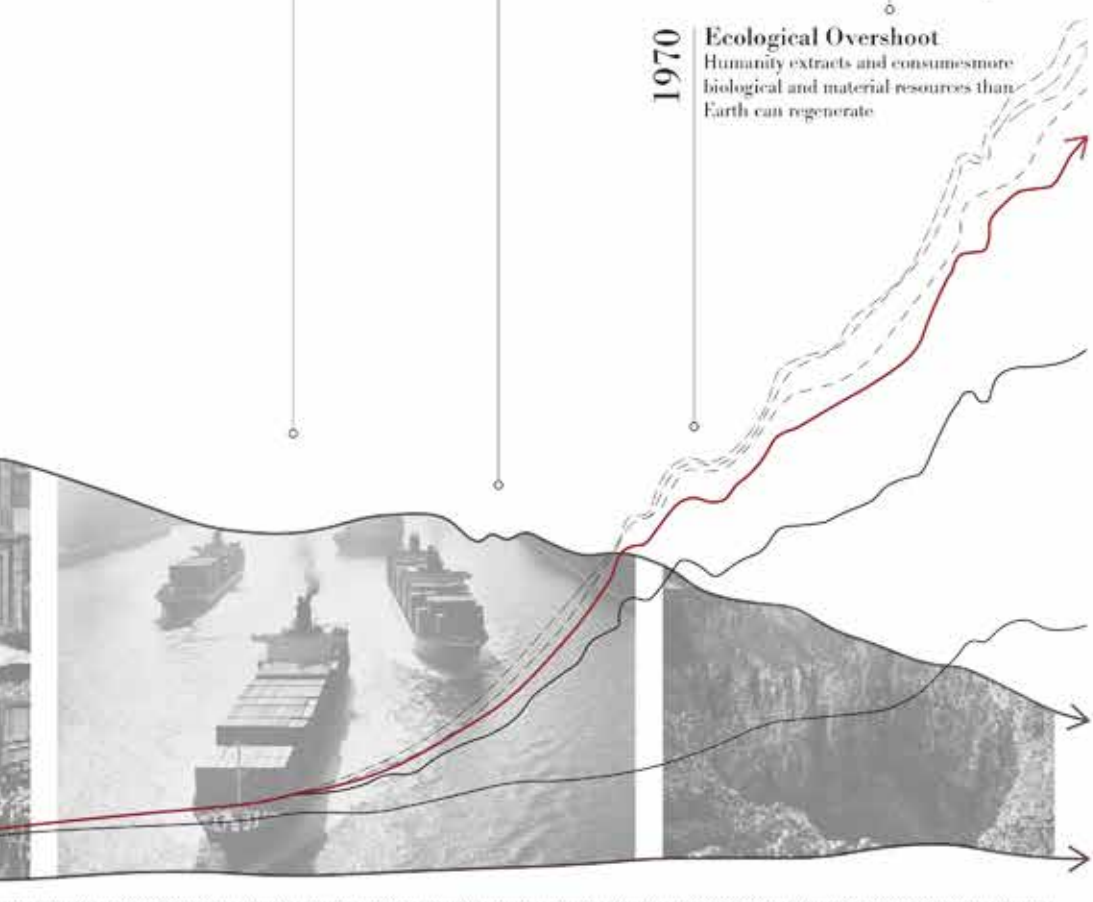
Modernity
of oil as the dominant
ource, the mass production of
iles, intensified colonial
n of raw materials and the
ons for consumer economies,
ing material throughput and
ependence.

1970–1990

Globalization & Neoliberal Growth
Global economic integration accelerates energy consumption" or "Neoliberal growth paradigm spreads

1970

Ecological Overshoot
Humanity extracts and consumesmore biological and material resources than Earth can regenerate



Renewable energy

Fossil fuel

Biomass

Anthropocene

1920 1940 1960 1980 2000 2020

How Did We Get Here?

The Long Arc of Ecological Disruption
The diagram on the former page illustrates a historical timeline of key turning points in the relationship between humans and nature, along humanity's growing dependence on energy sources.

For most of human history, humanity relied on biomaterials as the dominant source of energy. This changed dramatically with the Industrial Revolution, which marked a fundamental societal shift. It transformed economies rooted in agriculture and handicrafts into industrialized systems driven by fossil fuels as coal and later oil and natural gas.

The timeline also highlights the energy intensity of the global economy, showing that while energy efficiency has improved by 36% since 1990, total energy consumption has increased by 68% in the same period (Reduction Roadmap, 2024). This underscores how efficiency gains can be offset by increased energy consumption.

Even though we started implementing renewable energy sources, the increase in global energy demand outpaced all newly installed renewable energy capacity from 2019 to 2020. (Johar I., 2024)

Today, fossil fuels account for approximately 80% of global energy consumption. As architect and founder of Dark Matter Labs Indy Johar notes: *"We have to get rid of nearly 80% of our energy source, if not more and replace it. That is fundamentally a different type of civilization. We are talking about something of the order of reimagining what we have built in the industrial revolution and reimagining the world forward and we have to do it perhaps in 20 years"* (Johar I., 2024).

Case: Half-Earth Socialism

ill. 9 The book, Half-Earth Socialism

Title: Half-Earth Socialism: A Plan to Save the Future from Excinction, Climate Change and Pandemics

By: Drew Pendergrass and Troy Vettese

Type: Book

Year: 2022

Genre tags: Non-fiction, political theory, environmental science, utopian studies, climate futurism

Keywords: Climate change, degrowth, eco-socialism, political ecology, utopian planning, energy transition, anti-capitalism

"Utopias are meant to free one's conception of the possible, but demi-utopias like BECCS are fictional futures imagined to safeguard the status quo."

(Vettese and Pendergrass, 2022, p. 64)

To find inspiration for an approach to scenario building that remains within empirical constraints - a literature study of the The Book Half-Earth Socialism by Troy Vettese and Drew Pendergrass was conducted.

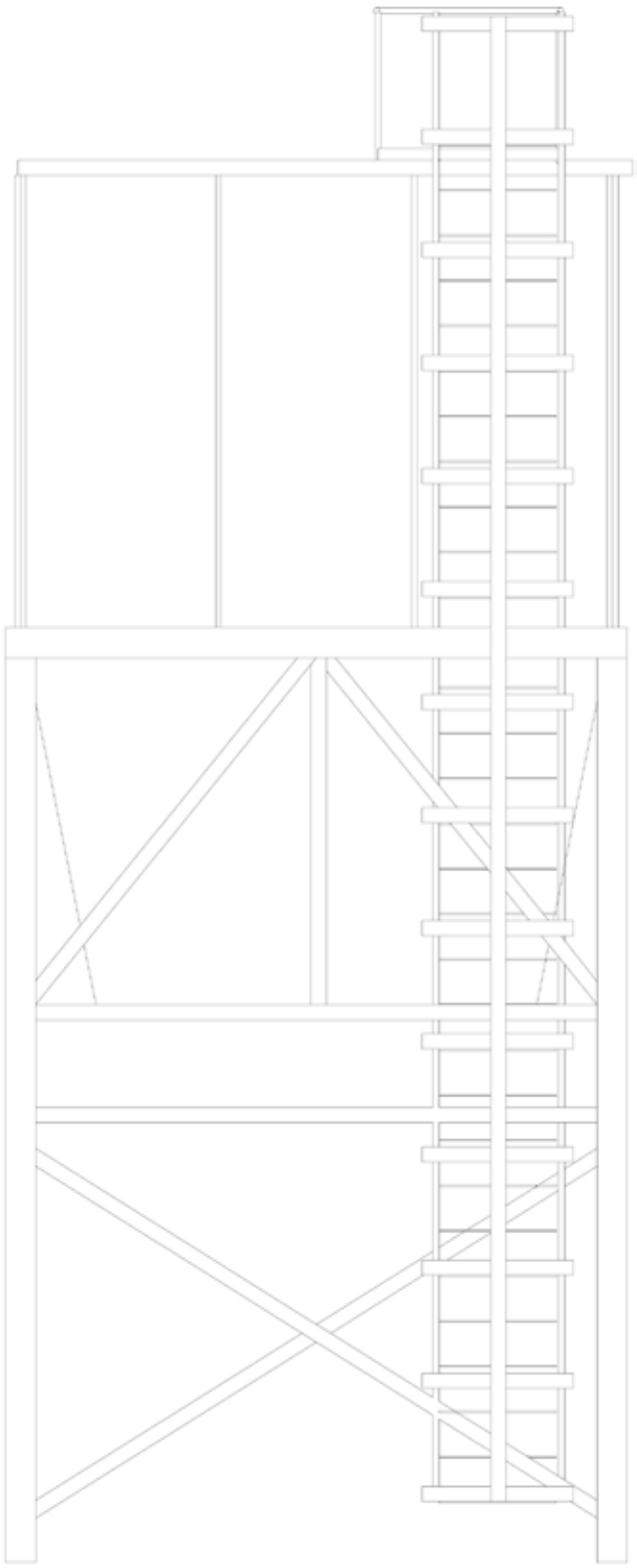
Degrowth, Natural Geoengineering and Democratic Ecological Planning
The book offers a plan to save the Earth from 3 distinct consequences of the destruction caused by humanity: a plan to save the future from the sixth mass extinction, climate change and pandemics (Vettese and Pendergrass, 2022). With a scientific approach the book remains skeptical of tech-solutions such as geoengineering, BECCS, nuclear power, lab-grown meat and carbon markets and offsets (Vettese and Pendergrass, 2022). The authors critique the ideology that technological innovation alone - without addressing consumption, inequality, or capitalism - can solve the ecological crisis. They argue that this view obscures the need for political and systemic transformation (Vettese and Pendergrass, 2022). Instead they offer an alternative approach - which emphasizes planned degrowth, 'natural geoengineering' to draw down carbon through rewilding half of the Earth, and democratic ecological planning - as a contrast to these tech solutions (Vettese and Pendergrass, 2022).

World Building Through Narrative
The method of world building through narrative is applied by continuously highlighting suggestions of this radical yet plausible transition. This envisioned shift includes global cooperation, public participation and scientific tools - particularly linear programming - to fairly allocate resources within planetary limits (Vettese and Pendergrass, 2022). Central to this transition are proposals for new patterns of land distribution (such as rewilding half the planet), a dramatic reduction in energy and material consumption in the Global North, a global shift toward plant-based diets, and the implementation of energy quotas to ensure sufficiency and equity (Vettese and Pendergrass, 2022). The book ends in a utopian scenario or a socialist climate fiction to illustrate what such a world might feel like, not just how it would function. It serves to make the radical change feel tangible, testing the futures we might build.

From Abstract Policies into Urban and Achitectural Solutions
Although Half-Earth Socialism does not explicitly address architecture or urbanism, its proposals for radical systemic transformation carry significant spatial, material, and aesthetic implications that align with principles of non-extractive architecture.

Conclusion
Based on the history of environmental science and its intersection with politics, the authors build up argumentation for a radical change of society. By this, the book ends in a utopian scenario that remains within ecological constraints, and demonstrates how a liveable future requires a fundamentally different relation to the Earth.

This has informed our approach to scenario building through speculations that remain grounded within empirical constraints. Furthermore, it demonstrates the viability of storytelling not only as a way to describe how a speculative future functions, but also to describe how it feels - its atmosphere, materiality, and social interactions - in ways that are both tangible and desirable.



ill. 10 Aggregate hopper, 1:50

PROBLEM BACKGROUND

This chapter provides a diagnosis of the current modus operandi and serves as an epistemological foundation for this thesis. It presents relevant concepts and underlying systems of capitalism, extraction and energy use - that might give an understanding of some of the issues with the current building practice and the direction it is heading. This chapter further explores some of the solutions widely proposed, such as circular economy and a building moratorium - respectively, arguing for a more radical alternative and a vision for what might come after. Finally, it introduces the site - an excavation landscape - as a testbed and chosen for its potential for estrangement.

Overshoot and the Urgency of Systemic Transformation

Living in Overshoot: A Planet Exceeding its Limits
We now live in a time of ecological overshoot. Since 1970, humanity has entered and remained in a state of global ecological overshoot - extracting and consuming more biological and material resources than Earth can regenerate each year (fig. x) (Reduction Roadmap, 2024). In Denmark, this ecological deficit began before records began in 1961. Reduction Roadmap, 2024)

The Earth Overshoot Day, which marks the day when our use of resources exceeds what Earth can regenerate, happened in 2024 on August 1 globally, while in Denmark on March 16. (Reduction Roadmap, 2024). This Earth Overshoot Day occurs earlier and earlier each year.
'The Planetary Boundaries Framework' argues that Earth is way outside its safe operating space, as 6 out of 9 limits are transgenned, which risks destabilizing Earth's systems, known as irreversible tipping points (Richardson et al., 2023). Importantly, these categories are interconnected - named; the polycris - and addressing only one of these problems, might create unintended consequences (Reduction Roadmap 2024).
The categories outside of the safe operation space are climate change, novel entities, biogeochemical flows, freshwater change, land system change and biosphere integrity. (Richardson et al., 2023)The urgency is growing to avoid irreversible tipping points

From Degeneration to Regeneration: The Case for Systemic Solutions
For this reason several people, groups, movements and non-profit organisations have called for change. Among these is HouseEurope, engaged with social and ecological transformation of our buildings - arguing for new legislation, as the current system is designed to demolish and build anew (House Europe, n.d.).
Similarly, does the Danish movement Byggestop bevægelsen, argue for a temporary building moratorium in order to rebalance the Danish building practice with planetary boundaries. (Byggestopbevægelsen, n.d.)

A non profit organisation called Reduction Roadmap, have made a scientifically based roadmap for such a transition of the Danish building practice. They argue that merely reducing harm is not enough in a world of overshoot - but actively mitigating emissions and regenerating biocapacity is urgent to repay the ecological deficit accumulated by our current degenerative system. They call for systemic solutions to meet a state of absolute sustainability (Reduction Roadmap 2024).

Absolute sustainability refers to the state where all human impact is within or in balance with the Earth's resources. This concept is also known as the planetary boundaries, which define the safe operating space for humanity (Reduction Roadmap, 2024).

ill. 11 Logo of Reduction Roadmap. Source: https://reductionroadmap.dk/.
Reduction Roadmap is a non-profit association working to translate the Paris Agreement, Montreal Agreement and Planetary Boundaries into industry-specific targets in Danish Construction based on latest international research (Reduction Roadmap 2024)

ill. 12 Logo of Byggestopbevægelsen . Source: https://byggestopbevaegelsen.dk/

Byggestopbevægelsen is a Danish movement attempting to bring the danish building industry within planetary boundaries, to create good, affordable housing for everybody by imposing a temporary halt no construction nationally. (Byggestopbevægelsen, n.d)

ill. 13 Logo of HouseEurope! . Source: https://www.houseeurope.eu/

HouseEurope! is the European Citizens' Initiative for new EU-laws to make renovation and transformation more easy, affordable and social. (House Europe, n.d)

ill. 14 Planetary Overshoot adapted from Reduction Roadmap (2024)
Picture is authors own


1970
Overshoot
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
2019
2022
Ecological deficit
Ecological reverse
Ecological footprint
Biocapacity

Green on the Surface, Extractive at the Core

The Cost of Building: Rethinking Architecture in an Age of Extraction
As there are no infinite resources on a finite planet (Reduction Roadmap, 2024), continuous extraction of non-renewable materials cannot support long-term development (UCMP, n.d.). For architects and designers, this raises critical questions about how we source, use, and value materials. Resource extraction is a major driver of CO2 emissions and ecosystem degradation, with new technologies pushing extraction into deeper and more remote territories (UCMP, n.d.). Since 1970, global material extraction has tripled - and it's expected to double again by 2060 (UNEP, 2019). This acceleration is closely linked to population growth, rising GDP, and increasing expectations of comfort and consumption (UNEP, 2019). This puts increasing pressure on design disciplines to rethink what and how we build.

ill. 15 Increase in mineral material demand to reach net zero by 2025. Adapted from Johar (2024), Indy Johar Presents Dark Matter Labs I IN FOCUS: RESEARCH, combined with author's own picture

Our material economies and our mining economies are responsible for 80% of our biodiversity destruction. Industrializing economies are increasingly responsible for a growing share of material extraction. The construction sector alone is responsible for 40-50% of this share due to the building of housing, construction and infrastructure (Brady et al., 2025) and approximately 30% of global CO2 emissions. (Reduction Roadmap, 2024). In Denmark, material use for housing alone accounts for 32% of the total share (Reduction Roadmap, 2024). This exceeds the material use for both manufacturing and agrifood sectors, which typically has more media exposure. The building sector holds the greatest impact and the greatest responsibility.

The Net-Zero Paradox: Mining Our Way Into Crisis
Net Zero has become the goal of efficiency and a central narrative of climate policy. Yet it often means offsetting emissions rather than reducing them. Worse, it relies on vast new infrastructure - batteries, solar panels, more insulation etc.

This reflects what Indy Johar implies, we must replace our use of fossil fuels, which accounts for 80% of our energy source. (Johar I. 2024). The demand for such a transition requires a significant increase in material extraction and processing. Meeting net-zero targets by 2050 would require six times more material extraction. (Johar I. 2024)
Production and processing of these materials are mostly located in countries of instability, corruption and conflict. Also, their locations often overlap with Earth's most vital carbon sinks and where the need for restoration is greatest. (Johar I. 2024)

This raises a key contradiction: how can we solve ecological collapse by deepening extractive dependency? We cannot mine our way out of a material crisis.

What if...
mining and extraction stopped?


Current energy demand
To reach net-zero by 2050,
the mineral demand will increase 600%

The Current Efficiency Practice

Beyond Relative Sustainability: Why LCA and Efficiency Alone Fall Short
The current methodology for measuring Global Warming Potential (GWP) is the Life Cycle Assessment (LCA). Unfortunately this tool has its shortcomings, as it emphasizes relative sustainability, which refers to efforts that gradually reduce the environmental impact of one build m2, while it does not consider how many square meters are being built. Neither does it account for the amount of occupants, the buildings relevance, its impact on other planetary boundaries or off-site biodiversity (Reduction Roadmap 2024).

This approach focuses on efficiency and improvements of technology and processes. This includes reducing material waste in production, using low-emission materials, energy-optimizing during operation and reusing materials (Reduction Roadmap 2024). Relative reductions might appear ambitious, but are insufficient to reach absolute sustainability in a growth-centric society, as energy consumption appears to increase (fig xx). (Reduction Roadmap 2024)

Nothing is sustainable in a world of overshooty, merely reducing harm is not enough - but actively reducing environmental impact and regenerating biocapacity is necessary (Reduction Roadmap 2024). For that reason, certifications as DGNB can not be claimed as being sustainable.

197 countries worldwide have signed the Paris Agreement, with the goal of limiting the global temperature rise to 1.5°C above pre-industrial levels (McCauley et al., 2024). Humanity is currently emitting 47 Gt CO2e/year, while the planetary limit for emissions is 2.54 Gt CO2e/year to avoid catastrophic tipping points (Petersen, Ryberg and Birkved, 2022). To stay within this limit a 95% reduction in overall co2 emission is required. (Reduction Roadmap, 2024). The timeframe to reach this reduction and the safe operating space is between 2 and 6 years. This means we must achieve this goal between 2026 and 2030.

A roadmap for the building industry with specific annual CO2 targets for new construction based on climate science, shows that If we keep building at the current pace, new buildings must emit no more than 0.3 kg CO2e/m²/year by 2030 (Reduction Roadmap, 2024).

Despite examples in Denmark of buildings reaching an LCA as low as 3,6 kg CO2e/m²/year, this remains technically and logistically unachievable. More importantly, without limitations of growth, such as legislation or systemic transformation, isolated improvements in efficiency rarely lead to absolute reductions (Reduction Roadmap 2024). Historically, efficiency gains have been offset by increased consumption. As illustrated in ill. xx, although global energy efficiency has improved by 36% since 1990, total energy consumption has simultaneously increased by 68%. This underscores a crucial point: relative efficiency gains alone are insufficient - they must be coupled with structural reduction to avoid further overshoot of planetary boundaries. (Reduction Roadmap 2024)

ill. 16 Comparison of Danish building regulation (BR23) carbon limits with Reduction Roadmap projections. Adapted from Reduction Roadmap (2024), Beyond the Roadmap: A transition plan for the Danish building industry, combined with author's own illustration.


87% scenario
67% scenario
50% scenario
Safe operating space
New legislation
Old legislation
14
12
10
8
6
4
2
0
7,1
6,4
5,8
5,8
2020
2021
2022
2023
2024
2025
2026
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2036

The Efficiency Trap: Why More Efficient Means More Consumed

The issue of solely focusing on efficiency is explained by Jevons Paradox - also known as rebound effect. It illustrates that gains in efficiency often increase total consumption (Giampietro & Mayumi, 2018). As processes become more efficient and cost-effective, individuals and industries tend to increase their energy consumption, counteracting the savings achieved through efficiency improvements. If heating becomes cheaper, we heat more. If cars use less fuel, we drive farther. This phenomenon shows that without limits on consumption, efficiency improvements alone are insufficient (Giampietro & Mayumi, 2018). This is not merely a technical issue. It reflects a cultural refusal to limit consumption. Sustainability without restraint becomes a green mask for continued growth.

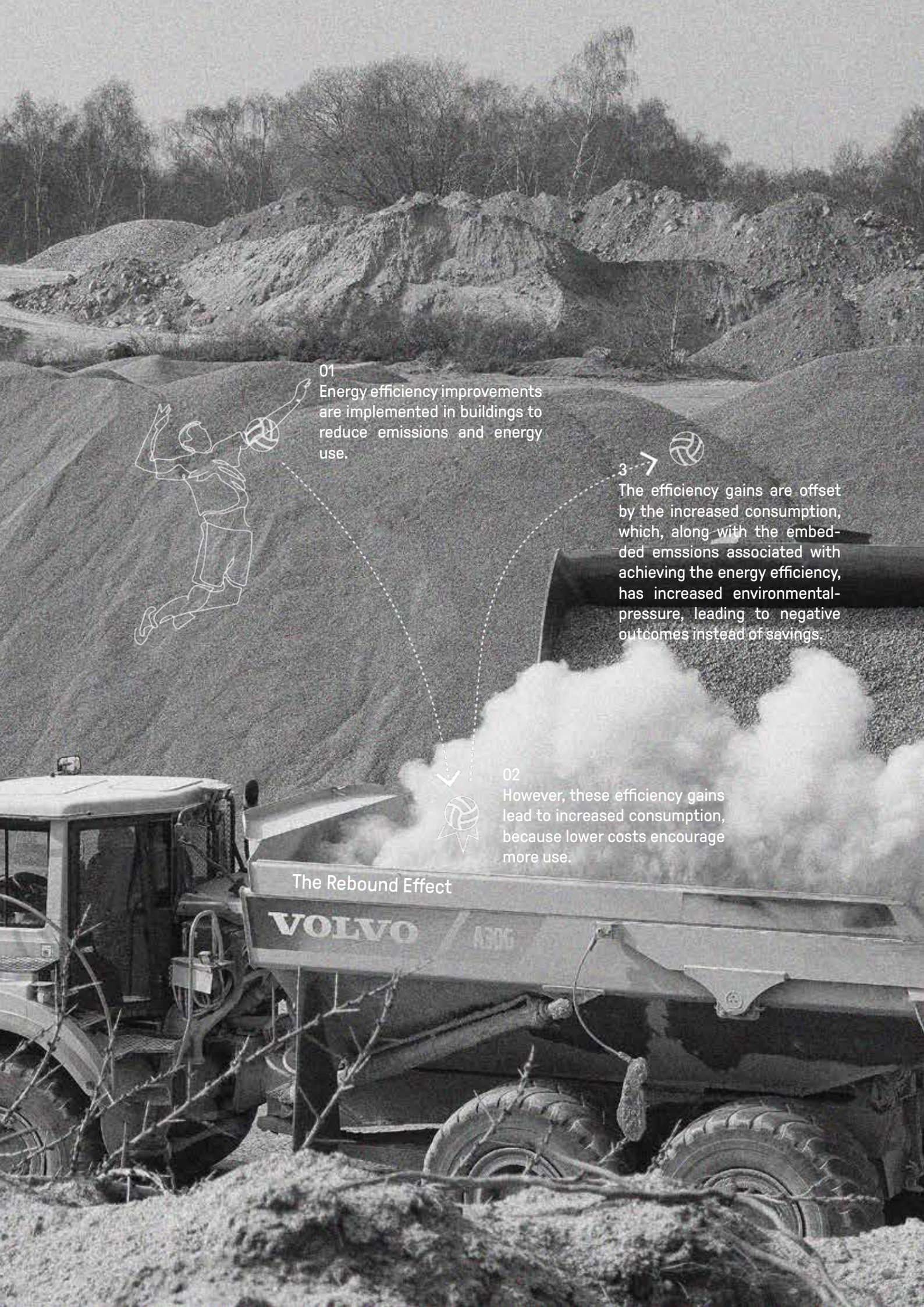
False Solutions: How Tech Fixes Deepen the Crisis They Aim To Solve

This contradiction is also reflected in the growing interest in technological solutions such as geoengineering, Bio-Energy with Carbon Capture and Storage (BECCS), and nuclear power. As Half-Earth Socialism states, these strategies not only fail to address the root causes of ecological breakdown, but actively threaten to worsen it (Vettese & Pendergrass, 2022). Geoengineering interventions like Solar Radiation Management (SRM) seek to change planetary systems with unknown side effects. BECCS, an important technology included in the concept of net-zero, demands massive land use for biomass production, undermining biodiversity and other vital systems (Vettese & Pendergrass, 2022). Nuclear energy, which is often seens as "carbon neutral", may have higher impact than first thought, when taking into account the full life-cycle emissions, such as extraction of uranium. Further, it carries a 50% risk of a disaster on the scale of Fukushima every 62 years (Vettese & Pendergrass, 2022).

All three solutions are technological quick fixes, without fundamentally challenging capitalism's drive for growth and extraction. Rather than reducing harm, they risk deepening ecological instability.

ill. 17 The Rebound Effect

A display of how improvements in energy savings have led to an increase in total building area, increasing consumption
Picture is authors own


01
Energy efficiency improvements are implemented in buildings to reduce emissions and energy use.
02
However, these efficiency gains lead to increased consumption, because lower costs encourage more use.
3
The efficiency gains are offset by the increased consumption, which, along with the embedded emssions associated with achieving the energy efficiency, has increased environmental-pressure, leading to negative outcomes instead of savings.
The Rebound Effect
VOLVO

The Physics of Growth: Why Decoupling Is a Delusion

Limiting consumption becomes particularly challenging within a growth-driven, capitalistic society, which is characterized by a strong correlation between economic growth and material footprint, with correlation coefficients ranging from 0.86 to 0.99. (Reduction Roadmap 2024). This relationship suggests that as economies grow, so does their material and energy demand. To understand this it requires insights from both economics and thermodynamics. Lotka's Wheel, inspired by Alfred Lotka's work in thermodynamics and evolutionary biology, illustrates how energy use drives economic growth in a continuous cycle. (Giampietro & Mayumi, 2018)

This concept highlights the increasing energy demands necessary to sustain industries, cities, and technologies. Additionally, historical economic activity locks in future energy consumption due to the persistent feedback loop between capital investment and energy use. (Giampietro & Mayumi, 2018)

Growth is not neutral. Under capitalism, Gross Domestic Product (GDP) has become a proxy for progress. Yet studies show a strong correlation between GDP growth, material extraction, and emissions (Lynge et al., 2024).

Decoupling - the idea that we can grow GDP while reducing emissions - has not happened at the necessary scale, anywhere. Absolute decoupling is a statistical illusion. We cannot grow forever on a finite planet.

"In fact, the environmental crisis itself could be considered an inevitable consequence of capitalist overproduction, where to much of nature has been humanized, to the point of destabilizing capitalism itself"

(Vettese and Pendergrass, 2022, p. 131)

ill. 19 Growth cycle
Endless growth demonstrating overconsumption is caused by high correlation between GDP, CO2 emissions, material usage and environmental degradation - a process described by the analogy of Lotkas Wheel


Gross Domestic Product (GDP)
&
Technological Innovation
GDP growth leads to increased material footprint (correlation 0.99)
Material Footprint
Increase of material footprint leads to higher energy usage (correlation 0.86)
Energy Usage
Higher energy usage results in higher CO2 emissions (correlation 0.96)
CO2 Emission
Higher CO2 emission leads to more innovation
A Self-Reinforcing Growth Cycle

The Case for a Building Moratorium

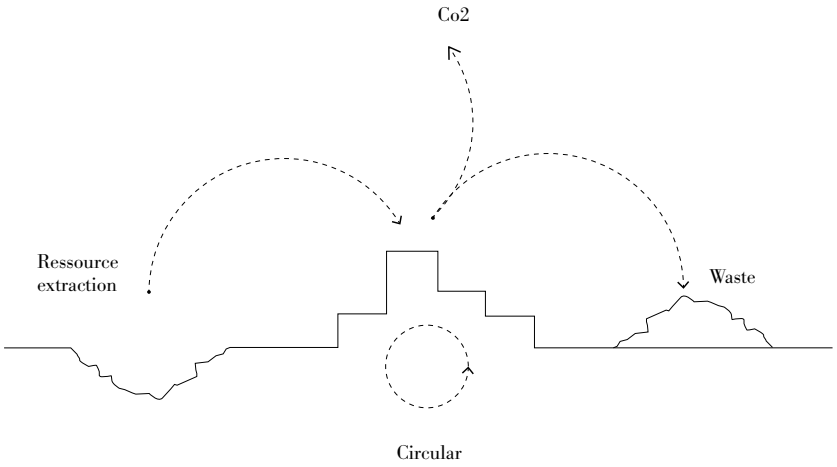
Confronting Overconstruction: A Scientific and Ethical Call to Pause
To tie this together: In order to meet the Paris Agreement, the reduction roadmap shows that using an LCA methodology we would have to reduce the Global warming potential of new build square meters by 95%, if we build at the current pace (Reduction Roadmap, 2024). Currently there is no technological evidence for this to become possible and no planned legislation for this to occur. However, there is another possibility. To reduce the amount we build by 95% as shown in illustration 15 (Reduction Roadmap, 2024).

By this the Reduction Roadmap provides a scientific foundation for a new movement to emerge - a movement advocating for a building moratorium. One that is both possible and ethically necessary for Denmark to fulfill its obligations to meet the Paris Agreement. The building sector has not only a challenge of material extraction, but a fundamentally ethical dilemma. The houses we build are poor quality, the working culture is bad and we accelerate the climate crisis too fast. (Dalgaard et al., 2025).

Beyond the Loop: Unpacking the Limits of Circularity in Architecture
While a building moratorium might come with challenges for some in the industry, the authors of 'Bevaringsværdig Byggebranche', argue that it might engage more employees, as transformation and maintenance comes with a lot of work.. and less materials (Dalgaard et al., 2025, p. 107).
One strategy could be aiming towards a circular economy. There 114 different definitions of how a circular economy is conceptualized, but they are still facing challenges due to, among other things, misunderstanding (Usto 2023).

In his PhD thesis Safe Sink Tectonics, Usto builds on the idea of circular ways of thinking. He proposes a material-centered architectural theory grounded in industrial ecology and tectonics. His concept of (im)material metabolism outlines how the built environment can act as an urban sink - a system that stores and slows material flows through different spatial and temporal scales (Usto 2023). Usto introduces the idea of safe sinks - building components or layers that delay waste and enable future reuse. These concepts are explored more fully in the theory chapter. (Usto, K 2023)

As Usto hints, while circular economy ideas - like reusing, recycling, or extending the life of materials - are often seen as sustainable and positive, they do not fundamentally question or challenge the underlying system of economic growth and continuous consumption (Usto 2023, p. 11). Circularity can still operate within the same capitalist framework that drives extraction, production, and profit, just in a more "efficient" way - taking it back to the Javon's Paradox. Even though these urban and architectural design principles might not alone be radical enough, they might be when paired with sufficiency.
Illustration 19 is inspired by a diagram in Usto's PhD dissertation, Safe Sink Tectonics (Usto, 2023), but redrawn to emphasize that "circularity", contrary to its name, is majorly a linear process, as materials ultimately ends up as waste. Currently, only 7,2% of the global economy is circular (Johar I. 2024). Denmark as the most circular economy in the overdeveloped economies is 4% circular (Johar I. 2024).
The real challenge is how do we go from 4% to 90%?



ill. 20 Diagram showcasing that circularity largely is a 'metaphor' concerning material flows
Author's own drawing, based on Kemo Ustos original in Safe Sink Tectonics (Usto, 2023)

Designing for Less: Architecture in a Post-Growth Civilization

While a temporary building moratorium will be a crucial step in reducing immediate environmental impact (Reduction Roadmap, 2024), it must be followed with a vision for what happens after. We should not rely solely on renewable energy sources, as reaching net zero would require more extraction that far exceeds planetary boundaries (Johar I. 2024). Neither on technological solutions such as geoengineering, BECCS or nuclear power, as it in its current states causes more threats to ecology (Vettese and Pendergrass, 2022). Circular economy as well, might not be radical enough. (Usto, K 2023)

A vision for returning within planetary boundaries is to transition from a growth-based economy to one of degrowth. The project latches onto this idea, a social movement (Gorz 1975, Kallis 2022, Latouche 2022 cited in Sachs Olsen 2021) that per its name rejects the obsession with economic growth, *"[seeking] out alternative ways of organizing society in which social and ecological flourishing matters most"* (Sachs Olsen 2021 p. 705).

These ideas are embodied in an architecture where politics center around transforming socio-ecological imaginaries (Sachs Olsen 2021). An architecture of degrowth is hereby focusing on planetary care, rooting in a feminist-inspired, relational care approach to architecture (Fitz et al. 2019 cited in Sachs Olsen). This care is defined by connectedness and interdependency (Puig de la Bellacasa 2017, cited in Sachs Olsen).

This shift fundamentally questions our current system and opens the possibility for an entirely different type of civilization (Johar, I. 2024). Such a transformation would require reimagining the very foundations laid during the industrial revolution and envisioning a new world forward. And crucially, this transformation must happen within the next two decades. (Johar I. 2024)

From a degrowth perspective, energy-efficient buildings alone cannot solve the climate crisis if the built environment continues to expand, as the total demand for resources and energy would still rise (Kallis et al., 2015)

In this context, a critical question emerges: What does architecture become in an age of radical material scarcity?

A Departure from Dominant Narratives: A New Epistemology

A Crucial Form of Resistance

As the ever-changing surroundings of the climate are constant and fundamentally unpredictable, it forces an introspective approach of how we leave our imprint on the world - or relate to it.

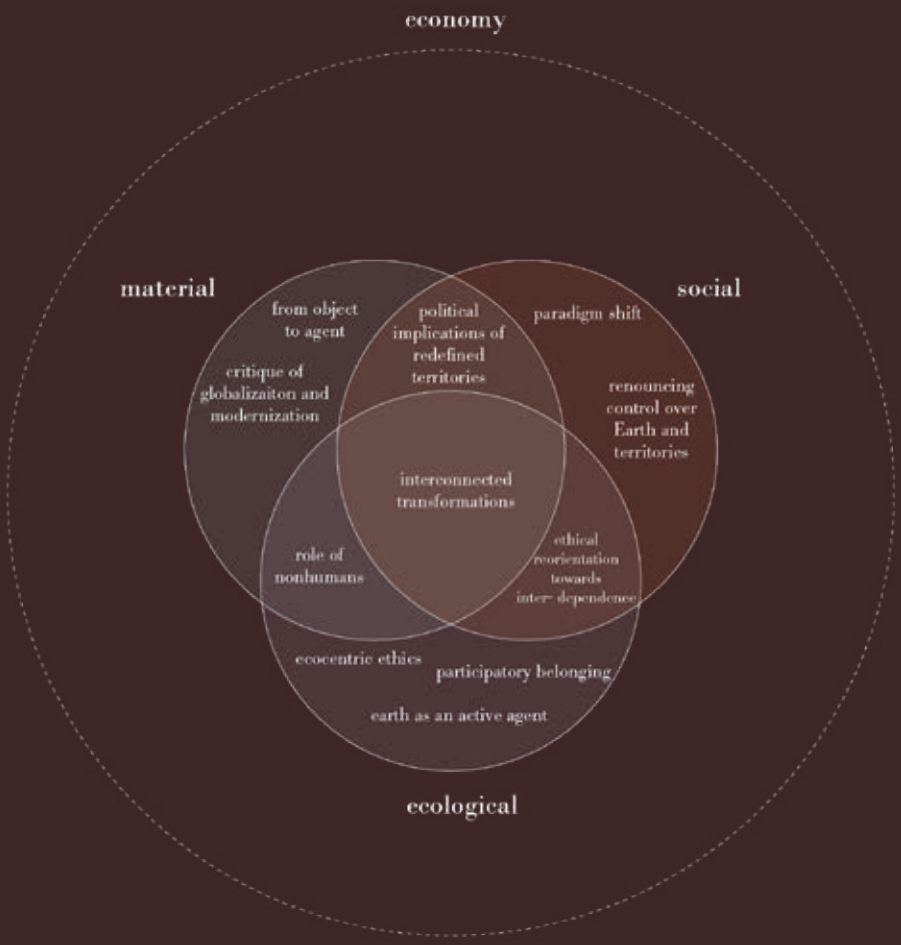
With *"[climate change pointing towards] a reality that is unthinkable and uncontrollable [existing and acting outside of human thought]"* (Krarup 2021, p. 191) it is worthwhile to reconsider man's relationship with being. Seeing the situation differently can allow for a departure from inevitable forces and dominant narratives.

New Attachments to Earth

One way to do this is by adopting an understanding that goes 'from a world of objects to a world of agents', a necessary outlook in the time of the Anthropocene. As suggested by Bruno Latour: *"belonging to a territory is the phenomenon most in need of rethinking and careful re-description; learning new ways to inhabit the Earth is our biggest challenge. Bringing us down to earth is the task of politics today"* (Latour, 2018).

With *"all forms of belonging [...] undergoing metamorphosis"* (Latour 2018, p. 19), - he proposes the *"terrestrial as a new political actor"* (Latour, 2018, p. 40), introducing the networks of action that objects or agents participate in, alongside humans.
Recognizing the *"earth system"* as an actor, it requires an ecological, participatory mode of belonging, one that fosters respect and co-creation rather than domination (Latour 2018).

With a critique of globalization and modernization, ecological perspectives are called upon, perspectives that transcend anthropocentrism and the extractivist narratives of progress (Latour 2018).



ill. 21 venn diagram of an 'eco-centric' ethic

"Creativity has proved a powerful tool for seducing, provoking and persuading us to drive 4x4s, buy into the latest fashion trends and drink water that comes from the other side of the world. If creative communications have persuaded us to consume in a way that impacts our planet for the worse, then it can be used to inspire us to try out things that have a more positive impact on the environment"

(Ramchamdani 2017, cited in Krarup 2021)

A New Existentialism

Together, these perspectives illustrate a glimpse into the profound shifts required to reconfigure social, political, and material relations. An advocacy for a paradigm shift in ethical thought - one that integrates environmental considerations into the core of moral philosophy (McDonald 2014, cited in Krarup 2021). This ecocentric perspective challenges anthropocentric viewpoints by acknowledging humanity's integral role within the broader ecological system. Resistance may be found in giving up and renouncing control of the Earth and its territories.

Instead of reinforcing the self-imposed dominance of the Anthropocene, an alternative is to reposition humanity as one actor among many in a complex, interdependent web of life. With ecocentric ethics and new notions of 'nature' it may be a solution to *"embrace a weird speculative reality"* (Krarup 2021, p. 195), one that disrupts established narratives and fosters new possibilities for co-existence.

From Ecological Thinking to Institutional Reimagining

Living in Degrowth: Between Design and Disaster

How these profound shifts will eventually take place is the question. As is a common understanding within degrowth movements and ecological economies, we either get it by *"design or disaster"* (Hickel 2022), or as Indy Johar puts it; *"we're already living in degrowth"*, referring to the fact that the majority of S&P100 companies, if having to price social environmental costs, aren't viable (Johar 2022b).

Being on this path to systems failure isn't a surprise with politics and authorities seeming out of place to understand the problem complexity and its scope (Guattari 2019). With the idea of *"everything [having to] change radically, [while] nothing changes"* (Latour & Schultz 2022, p. 12), how can we transition within disruption and embody the possibilities for co-existence? How can we produce human existence in new historical contexts (Guattari 2019)?

Volatility as Opportunity: A Chance for the Anthropocene

Indy Johar sees the current state ot the world as a possibility for transformation, a transformation that is rooted in its extreme volatility. With foreseeable changes to crises in climate, food, inflation, and migration, we're faced by a major scale of transition, inarguably shifting the economic geographies (Johar 2022a).

Ending Dominion: Revisiting Our Relationship with the World

These signals or tipping points can be seen as occurring from an 'old' world view; a view where we've enslaved land to our needs, exercising ownership and extraction to it - yet these are things that are coming to the ends of their lifecycles (Johar 2022 b). Reaching this end, is one of the reasons why reconfiguring our relation to the world is a necessity, to face our exploitative habits, and fix them. To leave the current relationship, bound upon dominion and controlling, and instead to be in a relationship with the world, embracing its finity, rather than using it (Johar 2022a,b).

Ultimately, these aspects can no longer be accepted, returning our problem of how we as humans relate to each other, how we see the future, and how we relate to our matter (Johar 2022b). Exactly the definition of relating to matter, even in itself, presents a problem of perceiving the world as the English language by definition, is delimiting moral inclusion; reducing nonhumans to an it, lacking the words for the simple existence of another living being (Kimmerer 2020). To learn this grammar of animacy could be the start of restraining our mindless exploitation of land (Kimmerer 2020); as Johar extends, the english language is noun based, concerning itself with objects, raising the questions of if we own nature, a piece of soil, or even trees (Johar 2022b)? Compared with relational languages, which refers to *"flowing"* and *"in process"* instead, reminds us of our kinship in the world (Kimmerer 2020).

The past 400 years have been pinned on these exact ideas of objecthood, individuality, and theories of control, cultivating responses to symptoms rather than structures, leaving space for a cultural revolution and transformation (Johar 2022a).

Reimagining Governance Beyond the Human

To meaningfully democratize these places that have become subject to human control, it's necessary to reimagine governing structures, democracy and social imaginaries. This means that a recoding of social imaginaries is required, leaving the existing and governing order; to make the world look anew; to see the next world (Johar, 2022a).

By reimagining governance, this allows for different ways for society to govern, taking a position of operating where everything is entangled, for example by seeing trees or soil as infrastructure. Ultimately, this raises the question of wether ecosystems could govern themselves, becoming self-sovereign; landing at a place where we aren't owners and enslavers of things, but in treaty with them (Johar, 2022b).

Toward Sympoietic Futures

In an attempt to try and move slowly forward - to lay the bricks with crumbling mortar - it is once again underlined how crucial it is for the project to absorb a speculative approach. To imagine some speculations as conducive to building more livable futures, Donna Haraway's statements in 'Staying with The Trouble' are adopted. Herein, she too extends how we need to 'reconfigure our relations to earth. This requires *"sym-poiesis, or making with, rather than auto-poiesis, or self-making"* (Haraway 2016) where one might think the latter is synonymous with the general perception of architecture. This perspective foregrounds collaboration and interdependence as fundamental to planetary survival.

By attempting this, it may be possible to imagine new social and technical configurations enabling convivial living (Kallis & Vansintjan 2022), *"[to] forecast [a] future still contingent"* (Dewey 1954, cited in Sachs Olsen 2021).

Exploring alternative societal structures and systems raises the question of not only politics, but rather a transformation of the political (Sachs Olsen 2021). This is done by taking a step back, to cut the path beyond the realities of the world - towards a world that has yet to take shape. This can allow for creating sympoietic relations, supporting multiple agencies and species, and putting forward an experimental co-existence where communities are engaged by long-term stewardships. Ultimately, shifting from a short-term vision to a long-term vision is inherent to speculative thinking, redefining the role of the architect in a post-extractive world where speculative design scenarios unfold.

What if... we treated soil as infrastructure?

Case: Reunion

To explore how speculative fiction can inform an architectural futuring, a literary study on Vandana Singhs 'Reunion' was conducted. In the S(F), Singh foregrounds how reframing existing technologies through a non-Western worldview can be combined in storytelling.

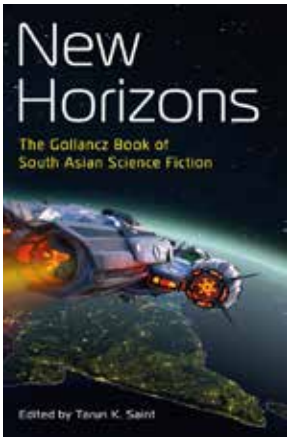
Reunion: Healing Futures Through Architecture
Written by the New-Delhi born Singh, the novella (short fiction, speculative fiction, science fiction etc.) revolves around an image of architecture proceeding from different images of, and concerns about the future (Letkemann 2023), best exemplified in how Mumbai in the story is referred to as being 'underwater' and '[a] Great Turning' having happened (Singh 2022). Shortly put, Singh outlines how communities are able to 'heal' in the wake of the unraveling of systems which the industrial civilization had attempted to 'control' and which they called 'succes' (Singh 2022).

In her story, communities settle outside the drowned streets of the city of Mumbai, with the main character, Mahua, joining a citizens group to clean the city. In the unfolding of the fiction, the settlements which Mahua has been part of creating , coined 'bastis', are described as experimental and scattered throughout the country. Individually they house up to 50 people, with multiple families under one roof and described as a marriage of modern and ancient building techniques (fx with mud, straw rice). Within these bastis, people cook in large common kitchens whereas gardens grow inbetween the settlements and on their roofs. The networked bastis are connected by green corridors with each settlement being embedded with sensors and conventional agriculture being replaced by 'farming towers'. Agricultural lands would instead return to wilderness.

Insinuating some form of collapse and new settlements as a result of this, an entirely different taxonomy prevails throughout Reunion, community is served ahead of capital. This is part of Singhs futuring, emphasizing humans relationships with eachother, putting a marginalized voice and more than human-perspectives forward, cultivating an alternative relationship to technology (Letkemann 2024).

Secondly, Singh explores the concept of 'climate modelling', making the characters unfold how any form of 'complex systems modelling' only is a good idea if one is *"trying to figure out future trends for a company"* (Singh 2022 p. 350). Instead, Singh extends with the idea that climate is inside us, that humans are part of the Earths system, humans being influencers and influenced by climate - hinting that only looking at data from a distance, makes us miss something - the deeper, embodied interconnections between people and the Earths's systems. That such tools always will be insufficient for grasping the full complexity of climate as lived and entangled.

Singh represents an indigenous voice, in this case one from India, and in her world building, she disassociates the Western conception of technology as being synonymous with linear progress. This presents the technologies put forward (urban gardening, 'sun towers', networked settlements etc.), and displays them as concrete options for a perhaps better life after 'the Great Turning'. Ultimately, Singhs story has proven an anomaly within science fiction, having wrestled the futurity apart from mere technical novelties (Letkemann 2024).



ill. 22 Cover of 'New Horizons: The Gollancz Book of South Asian Fiction'

Title: Reunion (published in 'New Horizons: The Gollancz Book of South Asian Science Fiction')

By: Vandana Singh

Type: Novella

Year: 2022

Genre tags: SF, speculative fiction. science fiction, eco-fiction

Keywords: Climate migration, reconciliation, ecological memory, post-climate crisis, collective healing, speculative technology, indigenous science

Reunion shows an example of cosmotechnologies; reframing existing technologies, inventing new ones and centering the experience of diverse cultures in technologies of community and collaboration instead - making architecture central to new ways of being in the world (Letkemann 2024). Singh experiments with futuring within indigenous traditions, ultimately arriving at a story that doesn't present itself as science fiction at all; all the technologies in the story already exist, but seem new when joined together in a different cosmological paradigm, imagined from and for very different futures (Letkemann 2024).

Reunion and Singh both signify cautious optimism of technology, but stays with the question of considering the context and power related to it. This is exemplified by the flooded city of Mumbai and the vacant skyscraper as a symbol of modernization - questioning the idea of the city and its technology for the community in itself. Singh extends the notions of community to more than human species, embodied partly in a digital infrastructure to foreground equitable governance rather than shareholder value.

Ultimately, Singh being an architect herself, demands a critical perspective to become aware of how much existing technology is intrinsically linked to the singular world view of neoliberal capitalism. Thus, an emphasis is put on the technology of collaboration instead as a viable practice in the future, implying that this social technology is the one thing making all other technologies possible (Letkemann 2024).

Conclusion

The literature study of Reunion can be seen as an inspiration to use speculative fiction as a valid and powerful tool within the projects design methodology. Rather than only using fiction for inspiration, it is seen as a method for constructing grounded, culturally situated futures. Further, Singh's work demonstrates how architecture can be central to reimagining life after ecological collapse - not through radical new technologies, but through reassembled and culturally embedded practices.

Estrangement as Strategy

ill. 23 Stenrand village and Gammelrand concrete facility

estrange

[es·trange] ***verb***

2: to remove from customary environment of associations

(Merriam-Webster.com, n.d.)

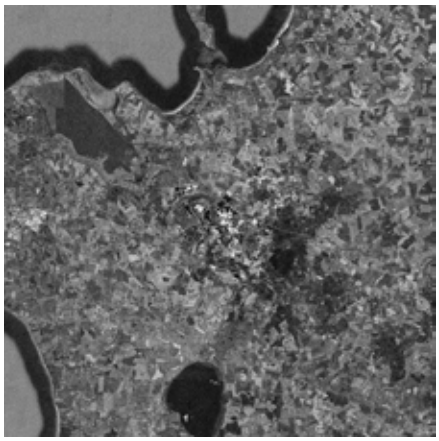
"Architects – trained to make the building machine lurch forward – may know something about how to put it in reverse"

(Easterling 2020, p. 4)

Situating the Site Through Speculative Lenses

Applying the methodology of SF is centered around estranging the reader's experience of their own present, making the reader aware of the ways in which their own world could be different (Letkemann 2022). In short, it is a tool that is useful for reconfiguring the relation of the reader to their present while still holding a space for exploration of possible futures (Letkemann 2022).

With this in mind, it is sought for the situation (site) of the project to embody some of the aforementioned practices relating to efficiency, extraction, biocapacity and material economies. This allows for ways to reveal present day practices and behaviours anew to the reader. For other considerations about site, please see appendix 1.



ill. 24 North-Western Zealand

ill. 25 'Productive' landscapes within Kalundborg Municipality

"As marketers, financial experts, planners, and politicians develop buildings, they also detonate buildings and landscapes"

(Easterling 2020, p. 1)

Excavating Meaning: Landscapes of the Anthropocene

Rather than using the wording 'choice' of site, the methodology and build up of the project has inflected a direction towards landscapes that are synonymous with the anthropocene and human dominion. Building on the application of estrangement, mentions of a building moratorium and the finity of minerals, a site on Zealand, Denmark, have emerged.

The site, located in the rich soils of North Western Zealand, reveals its deep time having been formed through the glacial layers, making the soil very rocky and gravelly, suitable for resource mining.

Depending on the lens from which the site is perceived, one of many foregrounds how it is a site that permeates technological dominance, perhaps not more evident than being a literal hole in the ground, a proof of digging.

Stenrand, as is the name of the small village adjacent to its namesake industrial endeavour, is the origin of site, a contrast of a roughly 1 kilometer long stretch with sporadic housing along, contrasted by a concrete production area of 190.000 square meters.

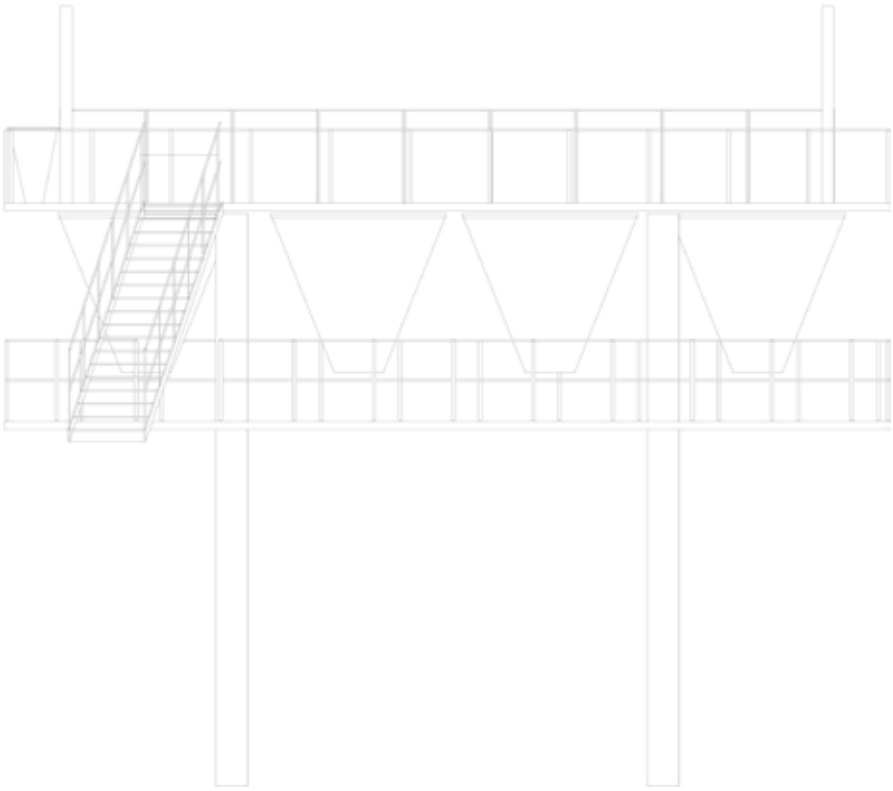
Stenrand as Ground for Non-Extractive Futures

With the estrangement of site ready to unfold, the project seeks to use the site as an embodiment of the repercussions of human activity, underlining the fragility of our common habitat. As have been laid out out, the project concerns itself with the fact that it isn't possible to consume ourselves out of a crisis of overconsumption. With an extended notion of this being that construction and architecture isn't neutral (Malterre-Barthes 2024), the fundamental incentive of site is to bring a message forth: to stop construction and start building.

Stenrand and its surrounding landscapes are a representative case revealing the removal of topsoil and habitat, forbidding the land of capturing carbon, while simultaneously erasing cultural and biological memory of the land (Malterre-Barthes 2024). With these actions, energy intensive materials are harvested. becoming petroleum based products, causing irreversible changes to the landscape along the way. Therefore, the role of the site in the project is to foreground a counterattack to the harm which is done by the construction sector, being resource intensive, wasteful and profit oriented (Malterre-Barthes 2024).

Proceeding with the idea of *"buildings today [being] unsustainable by design"* (Malterre-Barthes 2024) the project arrives at a space recognizing that we as students, and perhaps as practitioners are ill-equipped to fathom where materials come from, the landscapes from which they originate and the embodied impacts of their forthcoming through multiple processes (Leib 2020). This positions the project within post-growth discourses, advocating for a collective shift to non-extractive lives, lives that aren't dependent on ecosystem ruptures. The accumulation of these points are united within the term 'non-extractive architecture' which is presented and discussed later on.

Furthermore, a more thorough dive into site, analysis and relations occurs in the chapter **'Framing the Fiction'** where the site will be reintroduced in a more fictive nature.



ill. 26 Aggregate hopper, 1:100

STATE OF THE ART & RESEARCH QUESTION

This chapter explores relevant practices and recent movements, within non-extractive architecture. Ultimately, it is argued for a future where actions and decisions are connected to the landscape, building a reciprocal ethic. This provides the foundation for the problem statement.

Case: Hedeskov Center for Regenerative Practice

ill. 27 Hedeskov Center for Regenerative Practice
Credit: Johan Dehlin

Architect: Djernes & Bell

Location: Djursland, Denmark

Type: Restoration and transformation of historic school & regenerative agriculture to research centre

Area: 500 sqm / 180 ha

Year: 2022-2025

Keywords: Inspirational resource measures, exemplary value, collaboration, regenerative material strategy, reuse, bioregionalism, stewardship

To reference contemporary practice, the project looked upon Hedeskov Center for Regerative Practice by the architects Djernes & Bell. It is an interesting and inspirational blend of programming, mending architecture and agriculture, harnessing experimental practice with human sciences.

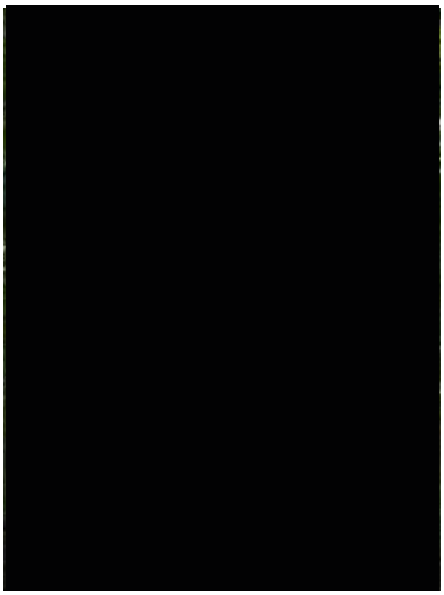
Living Lab for Biocentric Design
Placed in Djursland, Denmark, the former village school is turned into a living lab for regenerative practice. The purpose of the centre is to create long-term value for humans and nature through regenerative processes and practices.

The transformation is a manifest of a place-based approach, an architecture that is connected to place, ecology and people. In detail, this for example means that the renovation primarily is based on biobased materials such as chalk, wood fiber isolation, clayboards, hemp and Danish grown wood. Furthermore, local materials such as moraine clay, dunham fibers and timber are joined with local construction methods to embrace the vision of aligning regenerative agriculture with contemporary issues concerning sustainability challenges (Djernes & Bell 2025).

On a larger scale, this means that Hedeskov is involved in responsible land use and stewardship, cultivating land and forestry without chemical or mechanical disturbance - working with the principles of letting land cultivate on natures own terms, rebuilding soil organic matter and restoring degraded soil biodiversity, increasing CO2 absorption from the atmosphere (Hedeskov 2025).

With the building working as a 'living lab', consisting of a diverse group of people with varying backgrounds and skillsets, this continually informs what regeneration is about (Hedeskov 2025). The labs material experimentation is exemplified by how Hedeskov tracks data about materials hygroscopi and their relation to user experience. At heart is a multigenerational aim, as well as concepts of reciprocity and human sciences (Hedeskov

ill. 28 Plant fibres mapping
Credit: Djernes & Bell



ill. 29 Hedeskov
Credit: Hampus Berndtson

Case: Potteries Thinkbelt

Architect: Cedric Price

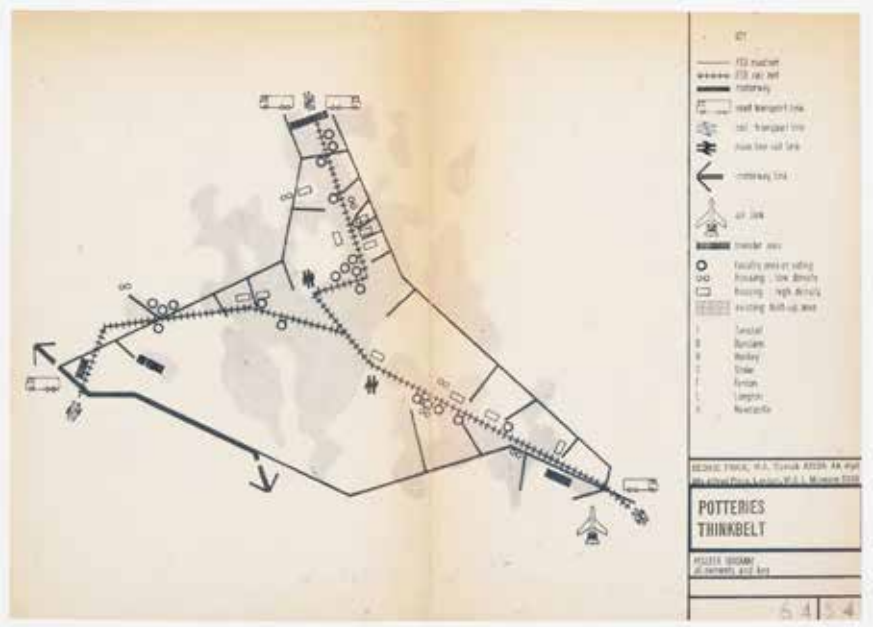
Location: Staffordshire, United Kingdom

Type: Infrastructural reinterpretation for network of educational facilities

Area: 100 square miles

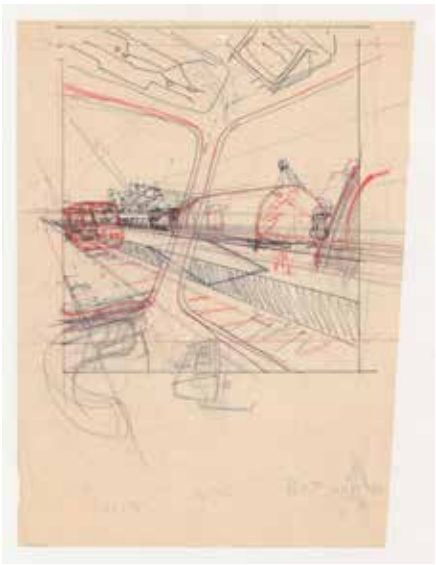
Year: 1964. unbuilt

Keywords: mobile university, adaptive reuse, rail infrastructure, educational utopia, radical architecture, flexible learning, temporary structures



ill. 30 Potteries Thinkbelt: Master diagram
Credit: Cedric Price fonds
Collection Centre Canadien d'Architecture/Canadian Centre for Architecture, Montréal © CCA

ill. 31 Photomontage of a perspective sketch of Madeley Transfer Area for Potteries Thinkbelt, Staffordshire, England
Credit: Cedric Price fonds
Collection Centre Canadien d'Architecture/ Canadian Centre for Architecture, Montréal © CCA



ill. 32 Potteries Thinkbelt: Perspective and detail
Credit: Cedric Price fonds
Collection Centre Canadien d'Architecture/ Canadian Centre for Architecture, Montréal © CCA

At a different scale on the spectrum, the British architect, Cedric Price emerges. Despite being an unbuilt and 'older' project (1964), a lot can be learnt from the foresight and visionary thinking of Price regarding possible futures.

Reprogramming Ruins: Cedric Prices Mobile Pedagogy

Potteries Thinkbelt is a project that aimed to supersede the de-industrialization of landscapes consisting of underused train networks. Price conceived the 'emptiness' and lack of functions as a possibility to suggest a 'circular university'. More specifically, Price designed at set of mobile units moving around the existing train network, sheltering classrooms, laboratories and other educational programs. More interestingly, time and program were joined as a pedagogical element for the university; meaning that classes lasted the time of the train to go from one station to another, discarding classic zoning proposals withing education design. (Hidden Architecture n.d.)

At the core, Price mended architectural design with system logics and the reappropriation of old infrastructures or ruins. The programming was speculative in the ways upon which it was hinged to past uses and functionality, sitting in a landscape of uncertainty and prefabrication. The perspectives are many when trying to learn from Price, yet the project also wants to extends Prices appreciation of landscape, as he thought there was beauty in existing industrial landscapes, territories of man-made temporary processes. Ultimately, the proposal is a construction of a system rather than a fixed image, using ruins as bases for new structures, mutating over time, balancing architecture and landscape, natural and artifical, new and existing. (Hidden Architecture n.d.)

Conclusion

Deducing which elements to incorporate further, bioregional principles of Hedeskov are sought to be combined with Prices's pedagogy and systems thinking of infrastructures.

Non-Extractive Architecture?

Architecture Otherwise: Ethics, Sufficiency, and the Built Environment
Non-extractive architecture rests upon the idea of rethinking the balance between built and natural landscapes. To accommodate this wicked problem, one can borrow David Leatherbarrow's elaboration of architecture being oriented 'otherwise' (Leatherbarrow 2008, cited in Usto 2023). Generally, non-extractive architecture raises the question of future material economies together with technology and policy roles (Grima & Belenky 2025). At the core is a wish for an inspection of the architect's responsibility as an agent of change and transformation. This consideration points towards alternative modes of practice within 'the dominant paradigm of architecture' (Grima & Belenky 2025) - in the search for an ethical one (Pelletier & Pérez-Gómez 2014).

It is, therefore, a necessity to arrive at *"a new understanding of what it means to shape the designed environment"* as Grima and Belenky underline how architects can accept roles of long-term stewardship of the built environment and the natural landscape (Grima & Belenky 2025).

With this introspective approach, non-extractive architecture is concerned with everything that surrounds energy efficiency (Grima & Belenky 2025). This bases it upon sufficiency rather than efficiency, rooting it in how materials are sourced, used, and consequently discarded or dismantled.
Overall, this consumption-critical approach to architecture is aligning with the ongoing discourse around a construction halt (Oien 2025), the national industry-wide initiative to reach Earth's safe operating space (Reduction Roadmap), and circular economy in urban development (Nielsen & Jensen 2024).

By being part of a counterculture that suspects growth for growth's sake, it is sought to work with closed-loop material cycles, redistributive principles and to leverage natural resources. Simultaneously, these are tools used to aim for collective prosperity, prioritizing ecological health over short-term economic gains, and ultimately gaining the perception that technological advancements shouldn't happen at the cost of environmental degradation.

To sum up, non-extractive architecture ultimately seeks to exist in a non-extractive economy, serving urban self-sufficiency (Grima & Belenky 2025).

"If architects are to play a role in the complex world of the twenty-first century… [they] must ponder [on] strategies to disclose their disciplines potential for embodying an ethical intentionality"

(Pelletier & Pérez-Gómez 2024, p.3)

ill. 33 Diagram showcasing the 20x multiplication of material extraction in billion tonnes. Based on Luke Jones' in 'Carbon Tectonic' (Jones 2021)
Picture is authors own


(Billion tonnes)
Resource extraction
20-fold increase
60
40
20
0
1900
2020
Past century

Post-Extractive Practice?

To depart from non-extractive architecture means to arrive at an understanding of extraction as its own ecology. In the paper, 'Post-extractive Material Practice: The Case of Quarried Stone', Jonathan Foote, Urszula Kozminska and Nikola Gjorgjievski lay out an array of interesting perspectives on the repercussions of extraction, and what kinds of possibilites this self-imposed constraint presents for architecture in a new light.

ill. 34 gravel processing plant with conveyors and hoppers

Extraction as an Ecology
Extraction is an ecology of interconnectedness, where material extraction sits at the multifaceted entanglements of landscape, construction, socio-cultural and economic contexts. With the fact of 6 out of 9 planetary boundaries being exceeded, one would think this would encourage architects to be stewards, but the opposite seems to be ever more apparent (Foote et al. 2023)

With most buildings consisting of concrete and materials from other continents, the hyper-industrialization has reduced the general understanding of materials localities, undermining the materials inherent cultural aspects and their connection to the environment (Foote et al. 2023).

From Soil to Commodity
Through time, extraction has been seen as a technical issue where technology could serve the human demand (Foote et al. 2023). By exploiting the space beneath the earth, soil and its contents has ultimately become commodified. As Mark Wigley writes *"seemingly static buildings are actually pieces of mining equipment, actively devouring the planet as buildings rise in one place, a deadly net of holes, gaps, cracks, collapses, deficiencies, floods and famines appear elsewhere"* (Wigley 2021, cited in Foote et al. 2023).

Externalized Damage and the Culture of Displacement
With extraction relying on capital, it presupposes maximizing economic benefit at the cost of biodiversity loss and environmental degradation. Despite this chain of effects, these impacts of extractivism are rarely seen in the developed world, having become familiar with 'cheap architectures' (Grima 2022). This phenomenon is tied to a fundamental displacement reasoning, intentionally burying the aftereffects under the umbrella of globalization and commodity chains (Leib 2020).

This puts forward the notion of 'externalities' (Grima 2022), coined by Joseph Grima, it describes the problem of where materials arrive from and the lack of considerations about material origins. As have been made clear so far, a post-extractive future is a necessity - and with this, an architecture that can't keep overlooking the impact of material exploitation.

Ecology, Care, and Response
To proceed, architecture has to look outside of the profession. Philosopher, Tim Morton, is introduced in the paper, raising the possibilities of habits and practices of care in relation to the resources of Earth; to consider less modern concepts of extraction. By focusing on extraction as an ecology of architecture, here being the actions and consequences it produces, a more profound responsiveness emerges as a crucial tool to move beyond simple solutions (Morton 2007, cited in Foote et al. 2023).

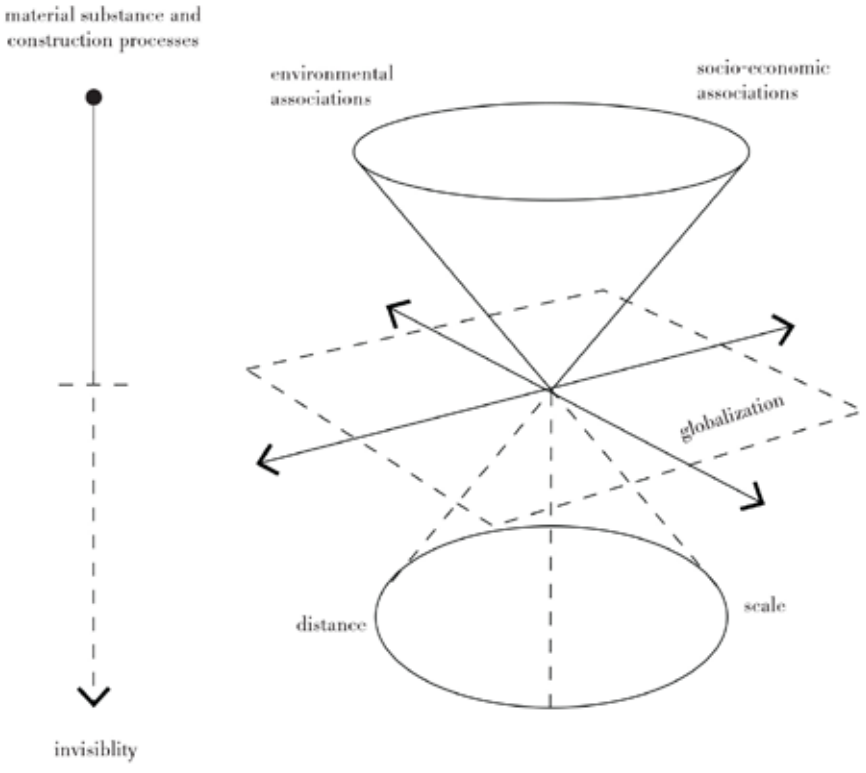
Inherently, this approach puts forward the question of construction's reliance on natural resources. Instead, we should be *"advocating for more ecological patterns of architectural production"* (Foote et al. 2023, p. 12) holding the possibilities to act against climate change, biodiversity loss and pollution (Foote et al. 2023), as per UN SDGs goal 12.

Sites of Extraction as Plural Spaces

With construction, extraction and movement of resources follow, and sites of extraction presents themselves as discrete spaces (Islam et al. 2022). They're hallmarks epitomizing the scale of human production; rearranging landscapes, populations, economies and ecologies of continents. Hereby, as any site, sites of extraction are always plural, referring to the people, sites linked to production, processes, infrastructure etc. Yet, the plurality naturally extends to the destruction of habitats and food sources of non-human beings etc. (Islam et al. 2022).

Land as Limit: Reforming Construction Culture

In the book Material Cultures: Material Reform, it is put forward how more responsible approaches to construction has to deal with the limits of the land in which a site is situated, hinged upon regenerative agriculture, responsible quarrying and long term vision for resource convervation and its production. Secondly, it it proposed to consider land uses; to move towards collective governance, stewardship and socially valuable production rather than private ownership; ensuring distribution of fair shares created by workers and ecological systems (Islam et al. 2022). This links to a culture of repair and a shift towards regenerative resources, to ultimately interrogate the consequences of material choices on people, landscapes and ecosystems, close to hand and across borders (Islam et al. 2022).



ill. 35 Displacement logic, how associations diminish through distance and scale imposed by globalization.
Own illustration based on Grimas notion of 'externalities'

From Extractivism to Ecosystemic Plurality
With an eco-centric point of view, an emphasis is put on an understanding of living systems and how these are interconnected across scales and time perspectives, as well as with different actors and tools.
By considering some of the aforementioned externalities, alternatives to extractivism can start to occur. Shifting architectural design approaches towards ecosystem plurality and interconnectedness puts forward post-extractive material strategies (Foote et al. 2023).

"In a consumer society, contentment is a radical proposition. Recognizing abundance rather than scarcity undermines an economy that thrives by creating unmet desires. Gratitude cultivates an ethic of fullness, but the economy needs emptiness"

(Kimmerer 2020, p. 111)

Before moving on, it should be clear that this approach values 'multiplying viewpoints' over 'a single vision' (Latour 2018, cited in Foote et al. 2023). This is crucial to place the designer in a position of extensive awareness within the scope of design choices, choices that ultimately are rooted in multi-scalar and multi-local entanglements (Foote et al. 2023).

This starting point is born from the ripple effects of globalization and construction. The complexity of distance and scale is masking the environmental and socio-economic connections tied to building materials and construction processes (Foote et al. 2023) Despite the challenges that will always occur when only viewing resources as commodified entities, ecological thinking states that the consequences of our material choices inevitably are spread over time (Foote et al. 2023).

Tracing the Material Afterlife
With this in mind, one can start to reevaluate the time-frame of an architectural project. Post-extractive use of resources requires reconsideration to account for what is taken and what is left behind. Limiting ourselves to measuring embodied carbon is not enough, rather the entire life cycle of the material should be treated; from extraction, processing, production, construction to other uses and performance such as maintenance, repair and reuse (Foote et al. 2023).

Entering Geological Time
It is an approach that considers the changes in the landscape, allowing the designer to enter a geological time perspective and engage with the life cycle of the quarry and its wider reaching traces to its ecosystem (Foote et al. 2023).

This bears the question of not only addressing the current environmental and social impacts, but also foreseeing futures - taking into account the afterlife of quarries (Foote et al. 2023).

Extending this line of thought, and tracing it back to the extractive logics that has constituted the quarry in the first place, Mark Wigley argues for an architecture less engaged with a depletive economy, it *"must at least return a gift of the architect and take the risk of seeing what might come after architecture"* (Wigley 2021, cited in Foote et al. 2023).

The Afterlife of Quarries: Policy vs. Possibility
Foote et al. raises the question of how to return this skeptical gift, since existing policies regarding quarry landscape regeneration (Jorba et al. 2010) often delimit the territory to be filled up, looking the same as before excavation. Currently, in Denmark, policy demands aftercare plans of such quarries where they often resurrect as different nature, due to characteristics that are very rare in the controlled Danish landscapes (Hansen 2021), making flourishing possible *"on infrastructures of human disturbance"* (Bubandt and Tsing 2018, cited in Foote et al. 2023). Despite good

intentions, public access is not always a prerequisite (Hansen 2021). Yet, despite this recycling of quarries, seeming beneficial to the environment post-extraction, policy naturally compounds what once was a brutal act against the natural environment by foreclosing many possible futures for these spaces (Shafaieh 2021).

Instability as Strategy

As productive landscapes shrouded in mystery, it would only be fair not to erase these aspects from peoples realities. More often than not, due to the geographical and site-specific conditions constituting quarry activity, there is a collective memory and social fabric embedded along the eroded boundaries of extractive landscapes.

Despite social and ecological fabric being tied to these landscapes, the observation of post-extraction ecologies contends one with the question of wether not doing anything in itself might be priced as a valuable act. This line of thought connects with the eco-centric point of view, laid out earlier with strong emphasis on Latours writings on ecological thinking. For extraction sites, this means that it might be necessary to look for less anthropocentric approaches, treating the extractivist ruins as a new kind of topography, allowing the territory to unfold its own wild dynamics. Ways of practicising this approach concerns extracting less and controlling less, leaving space for instabilities and multi-species existences (Foote et al. 2023).

Toward Disappearing Architecture

Using the term post-extraction, doesn't solve all wicked problems; one must still face the challenge of waste connected to the design of buildings. Although, as Mark Wigley puts it, *"in the most optimistic ecological scenario, architecture would be so generous that it would disappear"* (Wigley 2021, cited in Foote et al. 2023).

This lays the foundation for a design philosophy that is pinned by future scenarios of disassembly and reuse scenarios. In a broader context, this means that there is a space for reversible tectonics and different approaches to landscape. This exploration should assess the environmental and socio-cultural impacts, while rethinking the underlying systems currently supporting the act of building; economy, business models and supply chains (Foote et al. 2023).

Reimagining Building Potentials

As architecture being intrisically linked to extraction it has never been more reasonable to ask the question of what new potentials of buildings are. They're catalysts for change, as cliché as it may sound. Despite the miniscule probability of a moratorium on construction and quarrying, it is still necessary to investigate the materials used for architecture and embrace *"an approach to the designed environment that takes complete responsibility for itself"* (Grima 2021).

Conclusion

Therefore, it is sought to envision an 'inverted' future, a future where this extensive awareness can take place at a much greater extent in the architectural practice - a practice that would be much more aligned with the socio-economic and ecological entanglements it sits within.

"... the design challenge of the future must not solely address the spatial problem of the building, but the opened landscape as well." (Foote et al. 2023, p. 17-18).

(Foote et al. 2023, p. 17-18)

Re-Storying?

Restorying the Wounded Landscape: Toward a Cultural Ecology of Restoration
Being ecological scars, to recontextualize the words of the botanist Robin Wall Kimmerer, quarries display *"an abusive relationship"* (Kimmerer 2021, p. 9), land that shows its bruises. Furthermore, it displays a broken land, a broken relationship to land. In her book 'Braiding Sweetgrass', Kimmerer introduces the notion of 're-story-ation' as a way to move forward meaningfully, implying that healing and restoration of land isn't enough. The formulation is borrowed from the agricultural ecologist, Gary Nabhan, who dwells on the vitality of 'reading' the landscape, as an entity not only to convey ethical heritage of a community, but the reciprocal relationship to the surroundings, reminding people of their responsibilities to add to life, not to deplete it (Nabhan, 1991).

The main points of Nabhan are based on the efforts of restoring degraded landscapes, but first and foremost to acknowledge the duality of human power, that we create as well as we destroy (Nabhan 1991). Therefore there is a space that allows for people to participate in healing the wounds left on earth. Yet, Nahban is hesitant of technological sophistication, and points to the risk of this as becoming 'another' professional pursuit that excludes people in mind from actually being capable of participating in effective grassroots community actions (Nabhan 1991). Thus, as mentioned already, it is not only about restoring landscapes, but the cultural diversity of the human communities in those landscapes, to encourage living and working like natives of the particular homeland, Nabhan argues that true restoration is to re-story; to make lessons of legends, festivals and seasonal rites (1991).

But what would make this possible at a larger scale? In his article, he writes that humans can be participants in the processes that historically has nurtured landscapes, but only will if it has cultural meaning. Restorying essentially allows roots of ecological restoration to grow, also in our consciousness, *"so that the floods of modern technological change cannot dislodge us from the Earth"* (Nabhan 1991, p. 4)

So, if our relation to land can't be healed without hearing its stories, who will tell them?

What if... soil could tell it's own stories?

Reciprocity

Moving on from relations to land, it seems fitting to return to the landscapes from which materials and life emerges. In her book, 'Reciprocal Landscapes: Stories of Material Movements', Jane Hutton, how adopting a different perspective within the material world, starts with treating materials as protagonists with their own agency (Leib 2020).

Reciprocal Landscapes: Rethinking the Origins of Materials
Throughout most of contemporary practice and design, design teams place great emphasis on materials, considering their relations to each other in specific arrangements. More uncommon is the practice of considerations about material origins, production and labor, the past life and source landscape of said material - leaving a cognitive gap (Leib 2020).

This renders the unequal relationship between landscapes of production and consumption, raising the question of an urgent inspection of our relationships with the material world. Ultimately, this means that we as architects must face the ecological unequal consequences that already propel our design and construction industries (Leib 2020).

In more detail, this pluralistic perspective promotes materials as continually changing, rather than finite forms and entities, understanding that they're not only shaped by us, but also other people, species and landscapes (Leib 2020).

This point of view is further extended by ph.d and art historian Marianne Krogh, labeling it as a necessity to communicate the stories and futures, inherently tied to the protagonist, being material, that always has shaped any form of settlement (Krogh 2023).

By reframing material flows to material movements, Hutton advocates that it is possible to humanize the material trajectory, to frame the people, labor and ecosystems embedded within it - underlining the socio-ecological processes.

Ultimately, with a changed relationship to materials and their far-reaching entanglements wether it being use or misuse of resources, this manifests a deeper sensibility toward our common origin, geological time and production processes (Drewniak 2024).

Therefore, is it possible to imagine an architecture that can give us the tools to live on a damaged planet, inflecting its journey in a more positive direction (Drewniak 2024)? To tell the story of a place shaped by people living by an ethic of reciprocity to their best ability (Hutton 2020)?

Conclusion
Ultimately, it is sought to promote a future where actions and decisions are connected to the landscape, building a reciprocal ethic, acknowledging the often distant landscapes and communities entangled in the processes of globalization. Departing with this knowledge, the project seeks to rethink ownership, seeing land, buildings and materials as partners in treaty, rather than objects to be owned.

Problem Statement

What if architecture operated beyond extraction – how would this reshape the material economies, social infrastructures, and ecological dynamics already shaped by past extraction?

Subquestions:

Methodology: How can scenario building help construct narratives - and storytelling of a possible transition from today's reality to this speculative future?

Ecological dynamics: How does architecture actively take part in the process of regenerating biodiversity & ecosystem health?

Material economies: How can materials align with non-extractive principles?

Social infrastructures: How do societal structures shift in a regenerative future?

Design Hinges: Futures Poker Cards

Speculative Card Game of Futures
The following summary presents the accumulated aspects from which the design will aim to account for. Each card is a prompt from which the project seeks to address in its future scenario, therefore, these 'design criterias' also acts as storytelling elements in **Part II**. For further elaboration on this applied method, see **Appendix 1**.

The cards are listed in a non-hierarchical order (in the way we have been dealt our hand).

Hinge #1
Reciprocal Material Agreements"

By 'taking' a material from one zone - contribution must be made by pollinating corridors in return (fx)

Hinge #2
Decomposable Architecture

Architecture becomes a temporary treaty with the land - an agreement to return to the earth, shaped through decomposable materials and sustained by the care and maintenance of its occupants

Hinge #3
Self-Regulating Facade Technology

Biogenic facades with adaptive pores respond to interior temperatures - opening for ventilation as spaces cool, enabling passive climate control (Bundgaard & Gad, 2053)

Hinge #4
Protest Against Extraction

Societal and cultural revolution looms as a result of cognitive dissonance and consensus reality, resulting in protests against extraction

Hinge #5
Extractive Infrastructures as New Pedagogies

Past extractive paradigms are unlearned, launching the dismantling of harmful infrastructures to be repurposed for new pedagogies fostering cultures of care

Hinge #6
Climate Migration

Shifting geographies displace communities, making space for architectures of collective healing, putting ecological memory at the heart of reconciliation

Hinge #7
Multi-Species Governance

Decision-making expands beyond the human, embracing uncertainty, supporting threatened species, and treating ecological agents as co-governors of inhabitable futures

Hinge #8
Degrowth by Disaster

As environmental tipping points converge, dominant notions of prosperity collapse, giving rise to post-consumerist values centered on collective well-being, creative labor, and slower, more fulfilling lives

Hinge #9
Community with Soil

Soil is reframed as a living system, interwoven with human life, carbon cycles, and care. It becomes a site of repair, reciprocity, and ecological justice

Hinge #10
Extreme Energy Scarcity

A new existential condition emerges as energy production declines. Former comfort norms give way to adaptive living, reshaping values shaped by abundance in an increasingly resource-scarce world

Hinge #11
Bioregions as Frameworks

Design aligns with ecological boundaries - watersheds, soil types, and species - rather than political borders. Bioregional thinking revives local knowledge, grounding new ethics of care, place, and interdependence

Reanimating Our Relationship with Soil

Beyond Human Premises: Rethinking Power with Soil

At this point, one might ask how to proceed with the accumulation of topics dealing with speculative futures, ecological concerns and non extractive practices.

As it already has been laid out, soil is foregrounded as a focal point, yet this approach might produce biased perspectives or skewed understandings of power, referring to the foregrounding of 'a singular perspective'. Yet, when soil is thriving, who and what isn't? Perhaps the singular viewpoint of soil is actually multiscalar and manifold referring to the fact that only 1% of soil microorganisms have been identified (Puig de la Bellacasa 2019). Contrary to the mentioned hesitancy though, one might arrive at a conclusion that it might not be a biased position at all, considering that the human species is now the major geologically shaping force (Islam et al. 2022, Tønder 2020, Soper 2020). The decentering of the humanist subject is of utmost fairness, and actually a necessary condition to proceed. Instead of acknowledging past paradigms, the project adopts the perspective *"that a necessary condition for something is not necessarily its cause"* (Malm 2017, cited in Soper 2020), referring to speculation, continuous consumption and extraction.

In the book, 'Power in the Anthropocene', Lars Tønder specifically highlights that an expanded analysis of power within a new materialism is characterized by the both analytical and political benefits, underlining the need to break with the existing social scientific frameworks. Hereby, he points out that by excluding the diversity of natural forces, humans will be left with solutions that proposes to govern society on purely human premises, not taking into account the influences of the surrounding context, from which the power functions (Tønder 2020, p. 31-32). Instead, he arrives at the notion that power is not something only people have, but that it is something that emerges in the interaction between the human and the non-human (Tønder 2020).

How could this shift be emphasized then? In the following section, the philosopher Maria Puig de la Bellacasa is presented, bringing various examples and thoughts of how our affection towards the living substance could take place in her article 'Re-animating soils: Transforming human-soil affections through science, culture and community'.

"Without fertile soil. what is life?"

(Shiva 2008, cited in Puig de la Bellacasa 2019)

ill. 36 Stratification of soil

Compost, Care and the Politics of Soil

Bellacasa points out that affirming humans as being soil entangles them in substantial commonness, developing a sense of shared aliveness. With exact point of reference in 'anthropocenic soils', it is underlined how the shift from soil as *"another objectified natural resource brought to exhaustion by a deadly human-centred productionist ethos"*, can start to cultivate a sense of human-soil entangled and intimate interdependency (Puig de la Bellacasa, p. 391).

The article positions itself within an emerging advocacy, caring for soil beyond agricultural and industrial value, highlighting that the matter can reveal living worlds within it, but also a spirit, contradictory to associations often being about the matter as inert, invisible, neglected and uninteresting. These rich perspectives are part of a formation of new ecological cultures of care for the non-human world (Puig de la Bellacasa).

"... if we helped nature do its work, if we stopped disturbing soils, or if we could re-engender them, they could 'save' humanity from unbridled climate change by storing carbon"

(Ohlson 2014, cited in Puig de la Bellacasa 2019).

Simply put, soil regeneration can catalyze 'salvation', not only repairing the soil as an object of human care but perhaps also something bigger, beautifully hinted at by Maria with the question *"what is repaired as soil is repaired?"* (Puig de la Bellacasa, p. 396).

As an agent, soil is a concealed, yet vital 'bioinfrastructure' (Bellacasa 2014, cited in Bellacasa 2019), begging the question that knowing soils better could enable better care, shifting soils towards living worlds with an intrinsic value for themselves beyond human use. With topsoil depletion for over a century, ways of 'using' it have long broken with the reciprocal, regenerative cycle that has sustained the biosphere through most of earths history (Islam et al. 2022). Being the largest terrestrial store of carbon, healthy soil biomes are incredibly complex and integral to (plant) life, yet these are capabilities that are at risk due to exploitation and misuse (Islam et al. 2022), offering a space for the renewed affection for soils, invoking science to support better care (Puig de la Bellacasa).

It is a medium connecting various forms of life, forms which are dependent on it; making soil embody a down-to-earthness of daily interdependent interspecies living (Puig de la Bellacasa). Furthermore, Bellacasa brings the aspect of eco-social justice into play, extended with the care and repair of earth as an essential aspect of care and repair of people. Amidst a polycrisis and neglect of the Earth, stories of everyday care need to be told - and this can be done with soil, as a multispecies community. This accounts for people to become soil growers, rather than soil consumers; an eco-ethical requirement of sorts, ensuring eco-social reproduction, an eco-poiesis - a more than human collective maintaining everyday livingness (Puig de la Bellacasa). Reciprocal relationships, ones of giving back to the soil, returns organic waste in the form of compost recirculating allegedly 'dead' materials into lively material processes (Puig de la Bellacasa). With soil being the ultimate recycler of matter and natural renovator, other scholars have also used its agency in storytelling, Haraway uses the term 'Children of Compost' in an imagination 500 years from now where 'communities of healing' settle in devastated landcapes creating 'sympoietic' more than human relations.

"... [this] is also an intervention in debates around changes in more than human relations in an atmosphere of environmental debacle. In ecological cultures permeated by the imaginaries of the Anthropocene it is difficult not to see the combined mobilisation of science, technology and economic appropriation of the natural world as a manifestation of human destructiveness, a source of unstoppable ecological deadliness."

(Puig de la Bellacasa 2019, p. 392)

The project seeks to fathom decomposition as 'life politics' and the power of 'resurgence', relating to the forces of life growing back beyond annihilation (Tsing 2016, cited in Puig de la Bellacasa 2019).

Building a Design Framework

Designing with Place

In regenerative design, place is not just a passive background but an active participant. From an ecological perspective, each place is a unique system shaped by the long-term interactions between natural and cultural forces - climate, soil, vegetation, water, wildlife, customs, economies, and traditions (Gorissen et al., 2024). Thus, regenerative architecture must begin by listening to the place, reading its ecological trauma, which is unique for each place, and therefore responding with unique design strategies that work with ecological succession rather than against it. Ecological succession being a gradual process through which ecosystems evolve from bare landscapes to complex and relatively stable climax communities (Millison, 2020).

Cosmotechnics and Situated Technology

From a design perspective, this connects to the ideas of technodiversity and cosmotechnics, as described by Yuk Hui (Letkemann, 2024). Instead of seeing technology as something universal and neutral, these ideas suggest that technology should be rooted in specific places, cultures, and ways of understanding the world. This means designing and building in ways that reflect local values, environments, and beliefs. As Letkemann (2024) suggests, architecture-as-technology should be reconsidered beyond the extractive, linear logic of Western modernity, toward a situated, culturally embedded, and morally aware practice rooted in local cosmotechnics.

Reversible Tectonics and Material Cycles

Within this framework, reversible tectonics can be applied as an architectural strategy. It is not only about disassembly, but about constructing material systems that are involved in long-term regenerative cycles. This acknowledges that buildings are not permanent objects but temporary configurations within a broader ecological metabolism (Fannon. et al. 2022). As Bjørkskov (2025) argues, a building can enable or participate in a regenerative process, but not be regenerative in itself. Usto's (2023) concept of the safe sink expands on this by introducing material categories within a building's lifecycle - walls, furniture, details, even urban storage webs - that hold materials temporarily before re-entering cycles of reuse or ecological integration. (Usto 2023)

Stoffwechsel: Historical Roots of Regenerative Thinking

This systemic approach is deeply rooted in architectural history. Gottfried Semper's theory of Stoffwechsel (material exchange or metabolism) frames architecture as a cultural process rooted in the symbolic, practical and cultural exchange of materials (Semper, 1989). His four elements of architecture - the hearth, earthwork, framework, and enclosure - reveal how material form is always linked to social rituals, craft, and place. Semper's Bekleidungstheorie (theory of dressing) further emphasized that enclosure arises not from structural necessity, but from cultural practices of cladding, highlighting the expressive and adaptive nature of materiality.
Contemporary theorists build on this idea. In The Architecture of Persistence (Fannon et al., 2022), architecture is framed not as a static object but as a persistent system - a dynamic, long-term process. The authors propose a metabolic perspective, where buildings are seen as systems that consume, transform, and adapt over time. This shift aligns architecture

more closely with ecological thinking, emphasizing continuity, change, and material care rather than final form.

Beyond Metrics: Toward Relational Sustainability

These approaches meet in a form of architectural technicity that refuses to see sustainability as a matter of metric optimization alone. As Letkemann (2024) argues, metrics like U-value and GWP, while useful, still operate within the logic of minimizing harm without addressing the underlying cosmological assumptions that cause ecological crises. Regenerative design, by contrast, becomes a speculative, systemic and site-specific practice that replaces architecture in dialogue with its ecological and cultural base.

Soil as Bioinfrastructure

To build regeneratively is to ask not only what materials we use, but how, where, and why they are used. The perspective of soil plays an important role here. As Puig de la Bellacasa (2019) proposes, soil is not just still ground, but a complex bioinfrastructure - a web of interspecies relations, unseen metabolic life, and ecological potential. Its degradation signals not just ecological decline but a breakdown in relational ethics. Designing in relation to soil means designing for decomposition, for care, and for the regenerative cycles that sustain life (Puig de la Bellacasa, 2019; Islam et al., 2022).

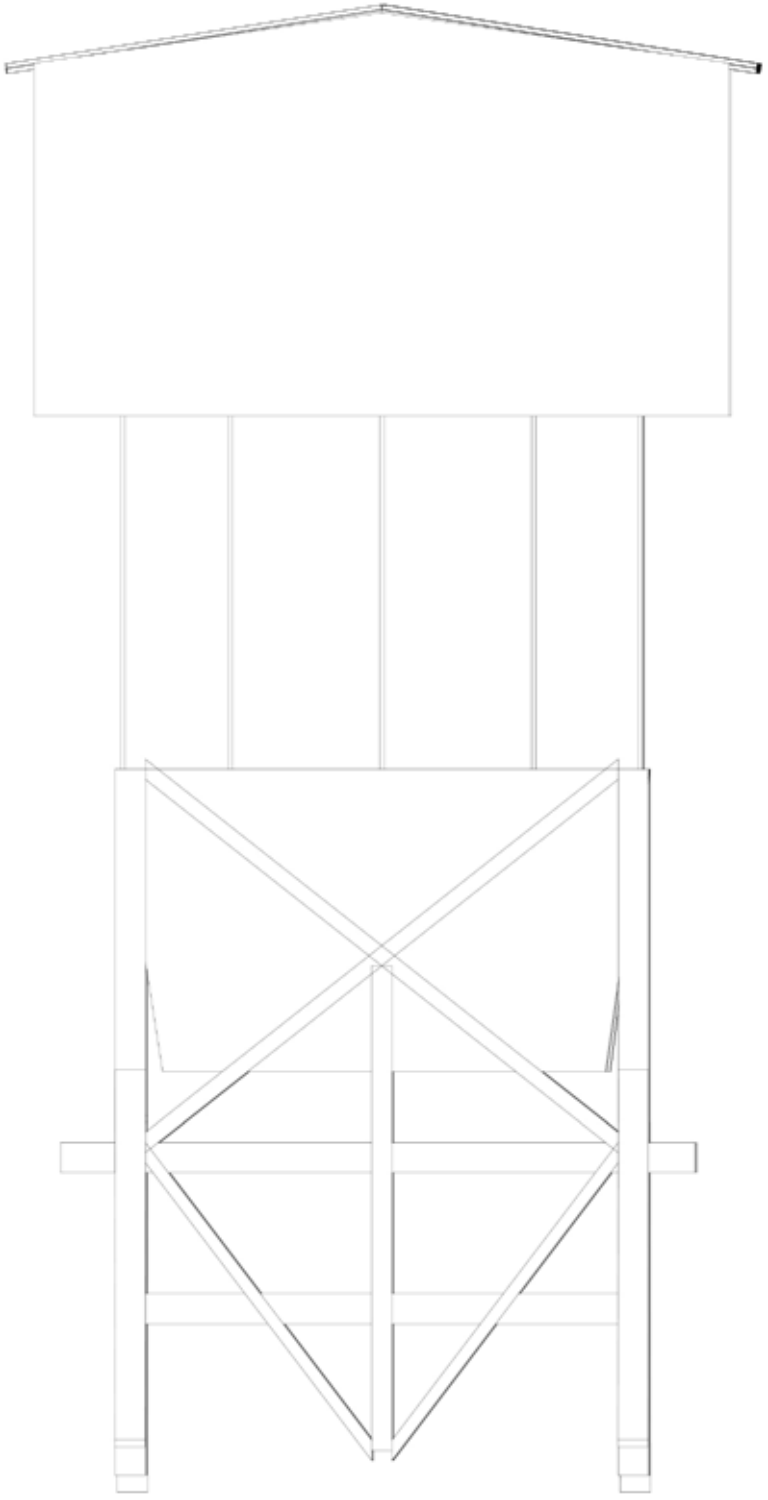
Permaculture and Regenerative Ethos

Permaculture, with its ethics of care for earth, people, animals and fair share, translates this ecological ethic into a design methodology (Holmgren, 2002). Its principles originate from indigenous knowledge systems that promote reciprocal, cyclical, and multispecies living (Gorissen et al., 2024). These traditions offer foundational insights for rethinking architecture beyond extractive modernism and into regenerative futures.

Toward a Regenerative Framework

Thus, the integration of place-based regeneration, cosmotechnical thinking, Stoffwechsel, reversible tectonics, and persistent systems forms a framework for architecture as systemic practice. Here, design becomes a means to metabolize and negotiate between culture, matter, and ecological repair. Not to restore a static past, but to enable dynamic, evolving futures - futures that may be uncertain, but are grounded in care, locality, and the co-creation of livable worlds.

PART II

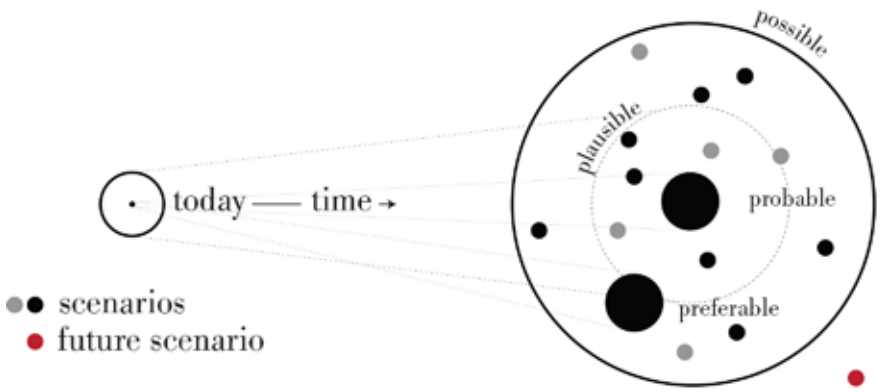


ill. 37 Gravel hopper, 1:75

ENTERING SPECULATIVE FUTURES

This chapter, the first of two within this part of this thesis, provides an introduction to the speculative scenario, and the applied tools from science fiction. Further, this chapter frames the future scenario with a sequence of events occuring on a global to a local scale. This - novum - provides the foundation for the analysis presented as part of the story-telling.

Framing the Fiction



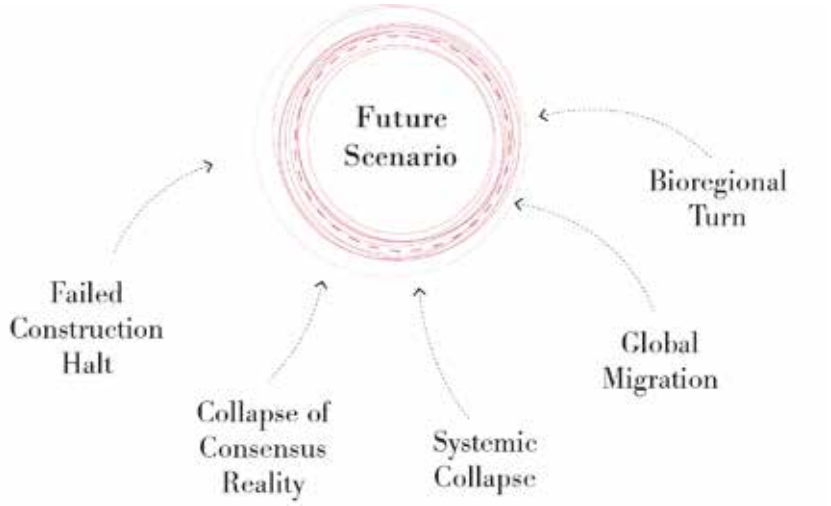
ill. 39 Adaptation of the Futures Cone. Based on: Voros (2003), via Dunne & Raby (2013), via Revell (2015), as seen in ResearchGate (2024)

Disclaimer
To apply the fictional narrative that the methodology proposes, one would argue as it being crucial to create clear distinctions between fact and fiction. At this point, it should be clear for the reader to understand their engagement with this constructed scenario. Yet, this is where the peculiar aspects of SF distinguish themselves greatly from the traditional IDP methodology. Much contemporary SF, even ones that present utopias as possibilities, are ambiguous and precarious (Letkemann 2022). This underlines ambiguity as an essential part of science fictioning in design education. As mentioned, speculative design is not about prediction or realism, but about asking "what if?", to provoke thought and question the status quo.

Letkemann draws on these ideas through Emmons and Phinneys argument of the architect as a speculative storyteller, saying that the core practice of doing architecture *"exists across the ambiguous dimension of reality and fiction… [architectural drawings]... tell the story of a world that may be, that could be, that might not or even ought to be; but is not, and will never be."* (Emmons & Phinney 2017, cited in Letkemann 2022).

The speculative process hereby intentionally destabilizes the line between what is and what could be, blurring the boundaries and leaving space for reflection and critical engagement.

Application
The project uses a speculative narrative set in a post-collapse future, explaining how present-day concepts (ranging from social-natural, techno-scientific, and political-economic) might evolve. While the storyline is fictional, it builds upon real-world sources such as The Climate Impact Lab, Earth.org to ground the framework in current environmental discourse.



ill. 40 Future object: future scenario (SF) as result of 'Futures poker cards'

Novum

In SF, the novum produces an image of a different world, laying out a foundation for how architecture (being the topic in this project) might be understood or critiqued. Hereby, the novum is an element of a fiction setting it apart in time and space from the reader; presenting the world of work as different from the readers (Letkemann 2022).

novum

[no·vum] ***noun***

a new feature, a novelty

(YourDictionary, n.d.)

In short, the introduction of a novum prompts to imagine new worlds, making new possibilities available, also to the reader's consideration. Hereby, the novum is not a definite arrival for any future, but rather a way to imagine futures and making them available for collective consciousness, ultimately inflecting on the way we work in the present. This can be conducive, as existing practice is predicated on past practices, only seizing to reproduce its past failures (Letkemann 2022). As is inherent to the practice of architecture today, it seems mostly to occupy itself with projects of sustainability; largely material efficiency and energy. This leaves other significant aspects like politics, economy and society right beneath the surface (Letkemann 2022), opening entirely new worlds that also are ripe for investigation.

For this project, it is sought to *"supersede the narrow futurisms of western technological rationalism"* (Letkemann 2022, p. 92) by seeking inspiration from indigenous principles and knowledge.

Character Building

Finally, to apply the methodology within SF, it has been necessary to create a character, to let the fictional world unfold. Creating a character helps to ground the storytelling and to start 'worldbuilding'. In this case, the projects main character is Kim, a biologist, who is supported by emerging side characters grounded in a multi-species outlook and climate feedback effects. Together they form the narrative from which both analysis, design and presentation is undertaken.

Echoes from futures

Kim

42

Biologist

Copenhagen

2040

23. 07. 2040

COGNITIVE DISSONANCE @ OFFICE DESK

I have a feeling that people will start to walk away soon… based on their gut feelings. I feel like there are more questions than answers. There has to be limits to growth? It should be possible to collaborate rather than to compete?

As humans we're so powerful in doing harm, what if we we're more powerful in doing repair?

For what I've heard from friends and colleagues recently, there is a hunger… A hunger in the mainstream. People are hurting and are hungry for reconnecting with humanity. Maybe they want to be part of a story? Maybe together we could strive for a collective prosperity - a space of hope?

Surely there should be more productive ways of being together… this might even mean to get out of the system of production… the economy has been such a narrow and limited way of organising life.

What could a new world be like?

What words can we use?

Maybe there is a framework that could mobilize people… perhaps… Unlearning?

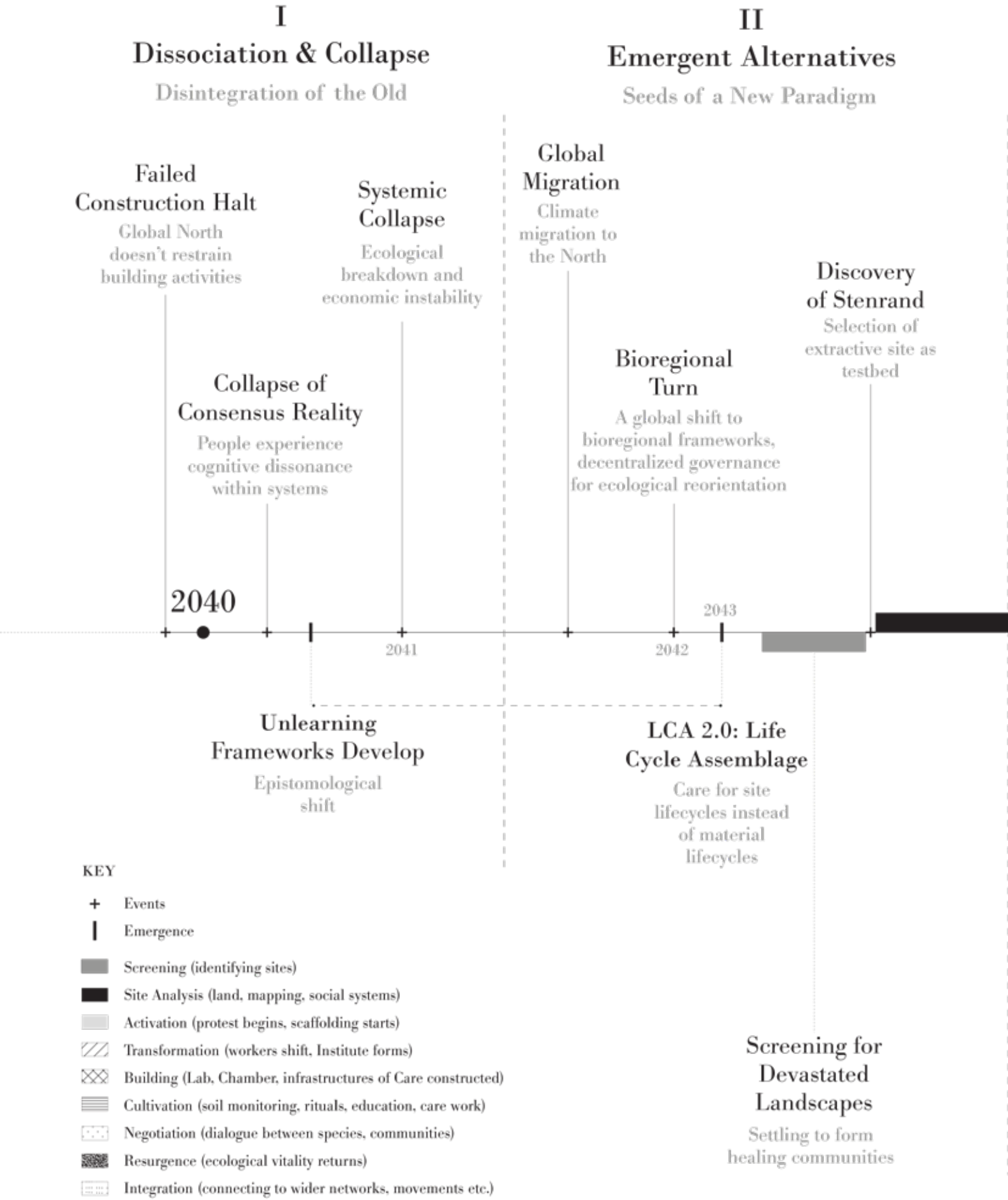
I am no longer just a biologist..

I am a systems leaver.

Kim

ill. 41 Kim at her desk

Timeline of Speculative Futures



III
Resistance & Reclamation

Turning Point

IV
Regeneration

A New Culture

Wider Revolution of Care Emerges

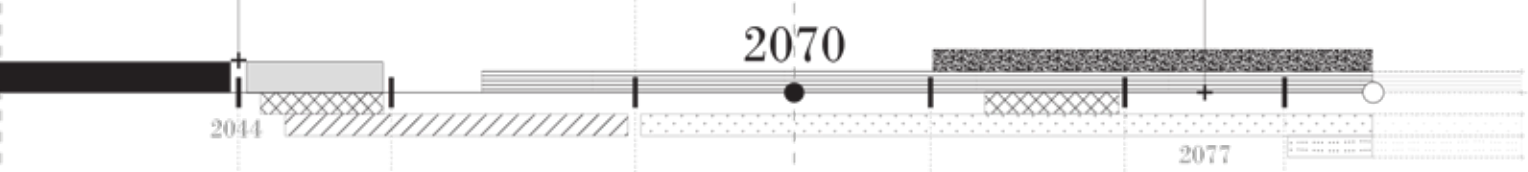
Movements foregrounding non-human agents materialize

Foresight Chamber Arises

Ongoing negotiation and co-existence between human and non-human actors

Assemblages of Care

Ecological cultures are settled in anthropocenic landscapes



Protest Begins

Scaffolding extraction infrastructures

Slow Regeneration

Care practices, architectural negotiation; bionutritious instead biodegradeable

Soil Monitoring Lab is Formed

Monitoring soil (site) health and engaging in regenerative care

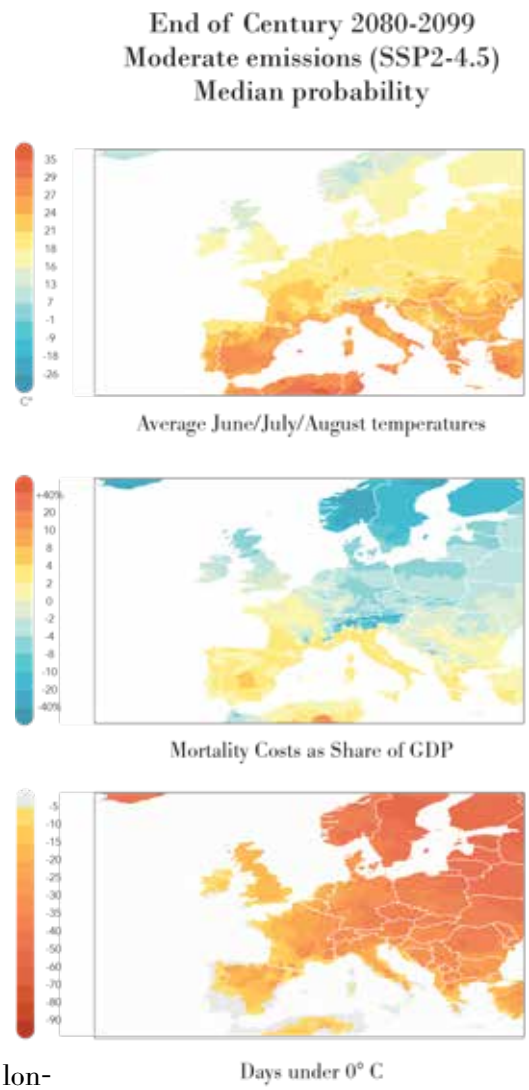
Formation of Institute of Soil Regeneration

Protest has become constructive collective

Institutional Interconnection

Formally active Institute, linked to similar institutions globally

2041 Systems Failure



ill. 42 Impact map (2024) by Climate Impact Lab

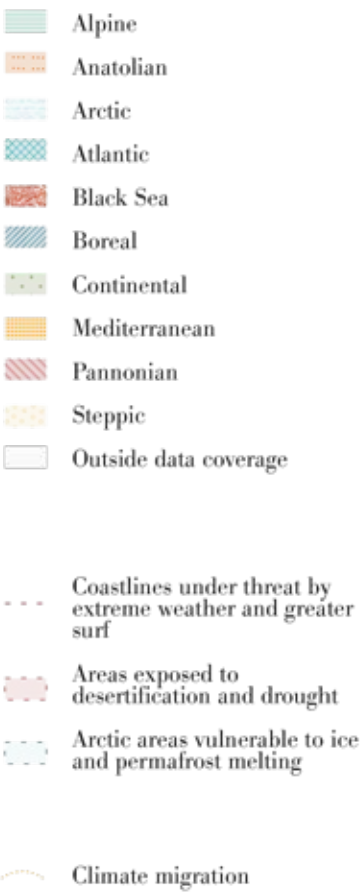
In the north, winters had shortened by more than a month. Frost no longer crusted the fields in early November. Children no longer woke to iced windowpanes. In Denmark, the numbers were at first celebrated - energy costs fell, mortality dipped, and someone in an office traced a 6% rise in GDP with quiet pride. Kim, however, noticed how big changes happened beneath the surface. Soil health - the very foundation of life - was threatened Elsewhere, the consequences were more visible.

Even though countries like Denmark kept sending emergency aid, money, and supplies, the consequences were too vast. The global average temperature had risen by 3°C, but the shock came from local extremes - sharp, unpredictable spikes that made the soil uncultivable. All except for corn.

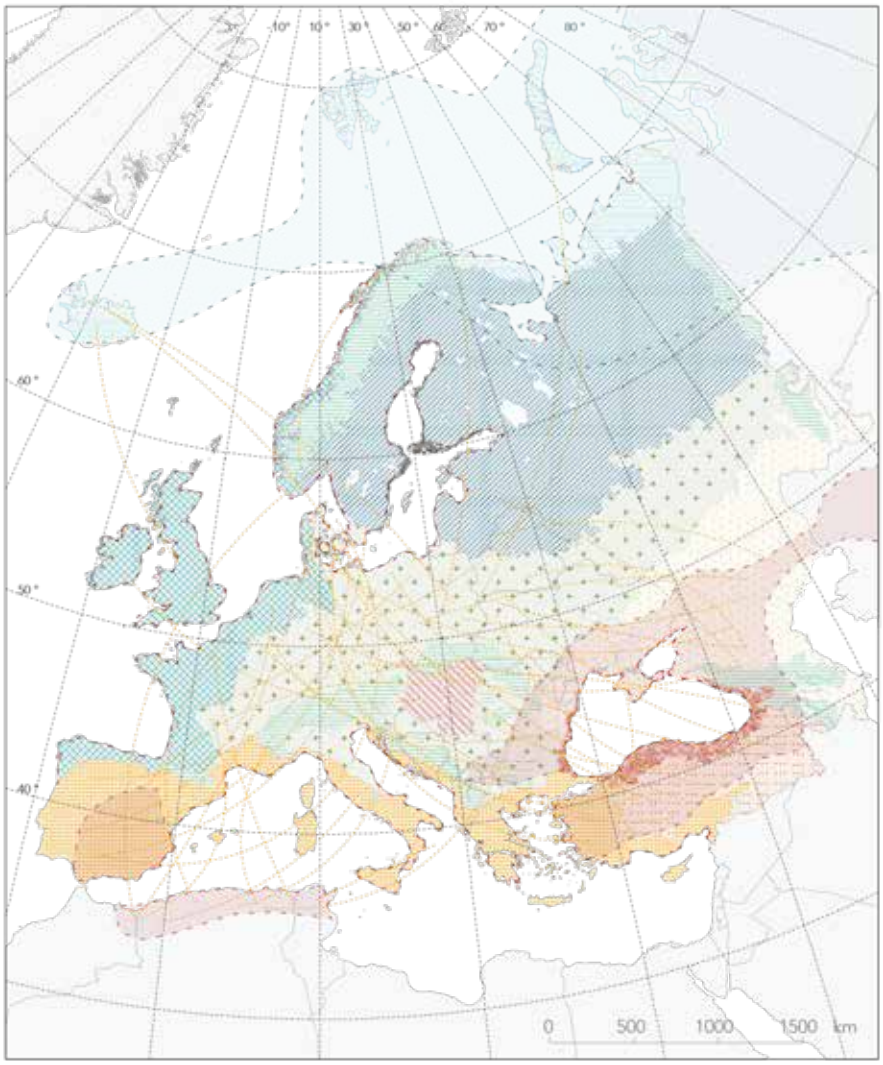
The land became uninhabitable. Those who couldn't afford to migrate remained trapped in places where the sun didn't hold back, and where suffering became the daily weather Back in Denmark, something shifted.

People were finally confronted with the ruptures firsthand - not just through a constant coverage of distant television images - as Kim found that even crops and drinking water was highly poisoned.
People had enough. Something had to change. A cultural revolution began to take shape. First it started with demonstrations, protests and later barracating of critical infrastructure.

2042 Towards Bioregionalism



ill. 43 Status of biogeographical regions in Europe from 2016 (EEA, 2017)



ill. 44 'Climate threats' based on map by Emmanuelle Bournay, 'Atlas environment 2007 du Monde diplomatique', Paris. (SPIEGEL 2011)

The cultural revolution had its breakthrough on a very special day in June 2042, as temperatures once again broke global records.
A treaty was signed that day - one which redefined governance not by political borders, but by natural features. They were named bioregions and covered most of the Earth. Almost every country took part.

It suddenly became much easier to make decisions that benefited the environment. In fact, local cultures - and even labour itself - began to reorganize around the work of regenerating broken ecosystems. Or labour.. as it was once called. A new kind of hedonism, where people lived among other species and devoted themselves to the act of care.

And care was desperately needed. The ecosystems were in such poor shape that it would take decades to restore them.

Capital transformed aswell. It was no longer tied only to growth, but became a trade of care - between communities, and even between species. Materials were slowly traded within bioregions and harvesting was repaid with nurturing.

2043 LCA 2.0: Life Cycle Assemblage

Explaining the 'Novum'

The Governance of the bioregions found that many of the tools were outdated and insufficient for these communities. One of the first to be questioned was the tool used to measure "sustainability." Kim played a vital role in its transformation. She asked a simple but radical question:

What if LCA accounted for the ecological lifecycles of sites and its actors, rather than only materials?

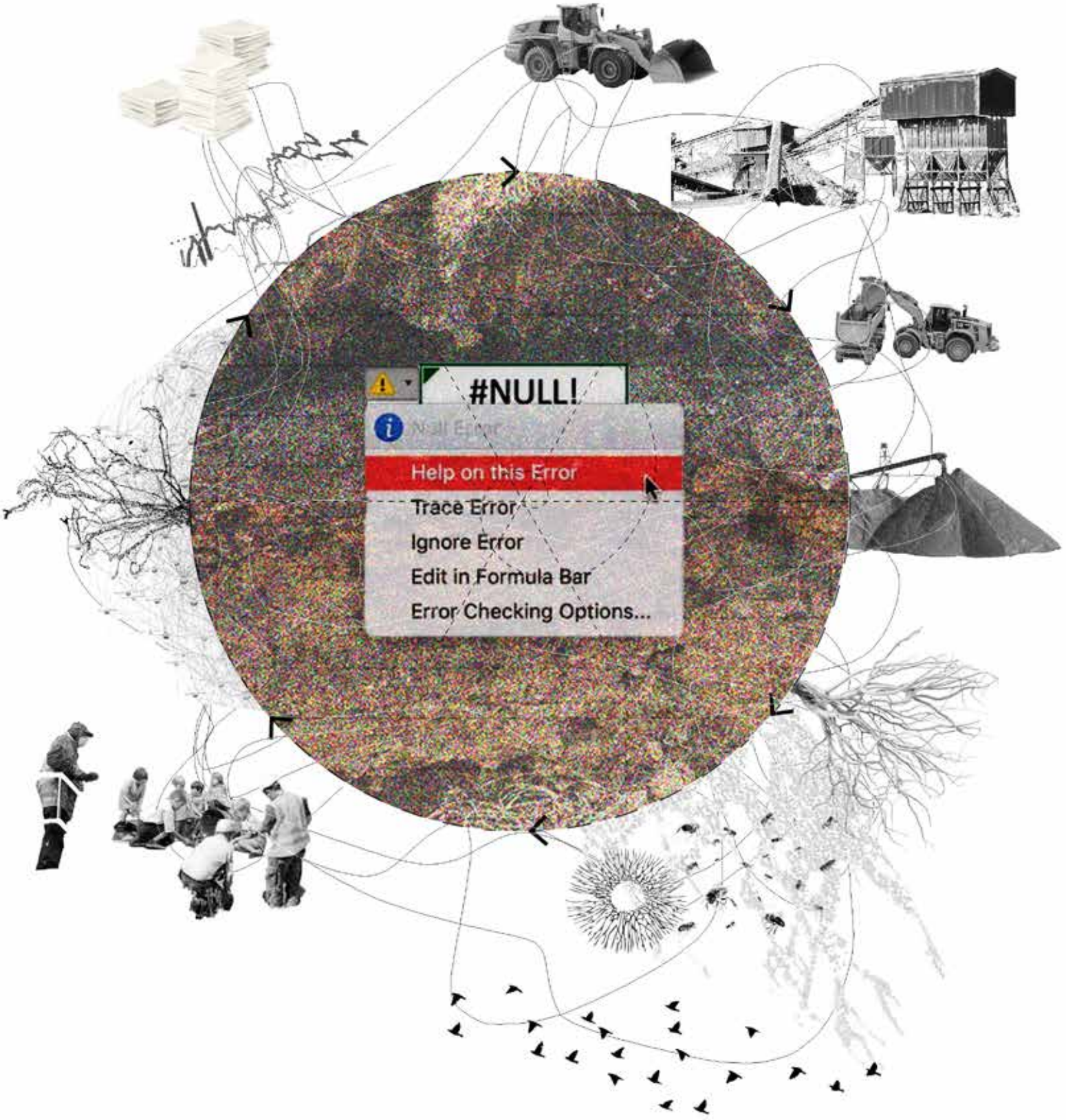
LCA 2.0 would radically change how we treat and perceive localities, fostering social equity, co-existence, and a regenerative economy.

The answer became Life Cycle Assemblage - or simply, LCA 2.0. Kim was sincerely hopeful. This wasn't just about urban development anymore - it was about shifting perception. She believed LCA 2.0 could transform how entire societies relate to land, to other species, and to each other.

In the age of collapse and in the wake of LCA 2.0, purposes shifted from co-existence and care, rather than extraction and growth.

As Kim would frame it; as each place held completly different ecological characteristics and different combination of soil types - wether, the heathlands of Jutland, the moraine hills surrounding Northwest Zealand or the South Funen Archipelago - each place needed its own approach to co-living and stewardship.

This is where LCA 2.0 proved its strength. It naturally distributed the responsibility across communities and made governance relational and grounded in place.


#NULL!
Help on this Error
Trace Error
Ignore Error
Edit in Formula Bar
Error Checking Options...

ill. 45 LCA 2.0

2043 Children of Compost: Earthy Rebirth

With bioregional frameworks becoming priority, place was now the thinking fuel rather than power, letting the natural boundaries of watersheds, soil, and habitats demand relational thinking.

Kim, with little background in urban planning, teamed up with Sofia to begin mapping the bioregions touching upon Denmark. Together, they identified three distinct zones, each shaped by the unique characteristics of the Danish landscape.

Through new common grounds forming through the collapse's feedback effects, the destruction of habitats was transformed into earthly rebirthing. Future kin started to inhabit broken places, both as climate refuges, but also to grasp new relationships with the world. The quarries of Denmark, or the Atlantic and Continental bioregions, serving as symbols of past extraction, became potentials for regenerative practices.

Bioregional economies improved democratic functioning within societies by encouraging self-sufficiency and ultimately shifted public interests towards biodiversity conservation and a more sustainable use of resources (Bove 2021). The economy, with bioregions at heart after the collapse, granted citizens more authority and incentive to stop depleting land.
With the emergence of LCA 2.0 from bioregional thinking, the application meant that Denmark went from being carved up by borders, to being linked together by the living territories on its ground. With several ecoregions established, a geopolitics of living things could emerge, giving the terrestrial a voice. By doing this, space for ecosystems was created, yet this also meant that existing land uses had to be restructured for new regional economies to emerge. Presupposing that existing land had to give way, the landscape became a ledger, underlining how LCA earlier had served industrial purposes, but now it was a tool for radical and ecological self-governance.

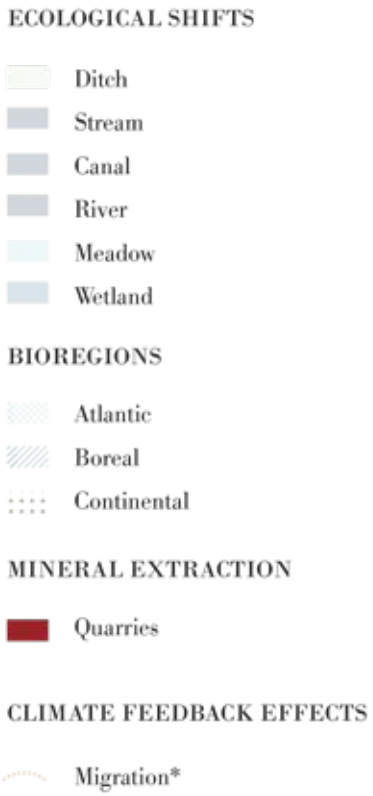
People from places around the world who had been most exposed to extreme climate disruptions migrated to the North. Often, they brought with them deep knowledge of how to restore nature, and their role became vital in the transition. By this, people from across the globe - future kin - started a process of collective healing putting ecological memory at the heart of reconciliation.

KIM, Biologist
SOFIA, Urban Planner
Unlearning Framework Unit #3

INITIAL SCREENING MAP

Dynamics of watersheds, quarries and migration

MAPPING
bioregional boundaries, resource extraction impact and human migration corridors



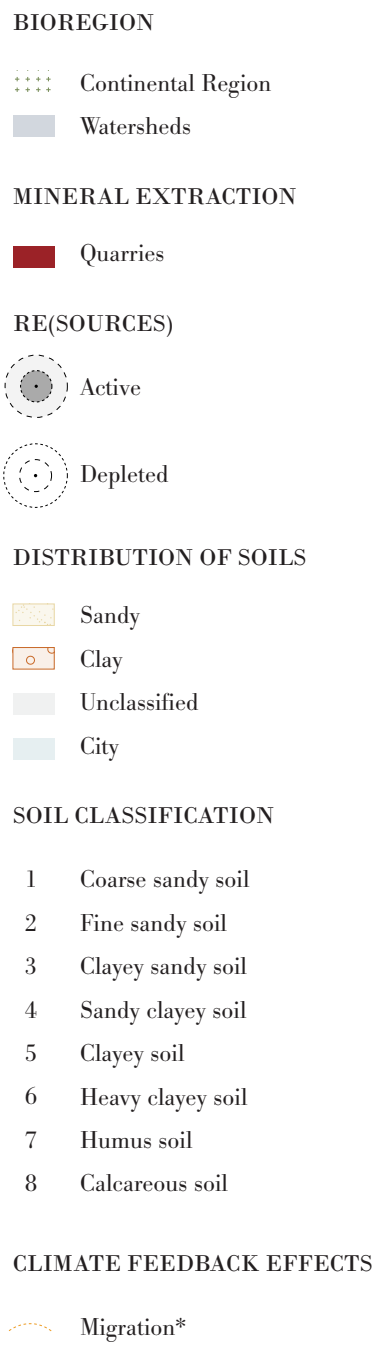
ill. 46 Bioregional map of Denmark


Screening
Event
Skagerrak
Aalborg
Kattegat
Aarhus
JUTLAND
Samso Belt
Kalundborg
Copenhagen
Odense
Great Belt
ZEALAND
FYN
0
25
50km

2043 Pursuit of Devastated Landscapes

Kims mapping of Zealand's quarry landscapes through a bioregional lens reveals how the extractive sites shaped and disrupted the region's natural rhythms. By looking beyond boundaries, her approach uncovered the connections between mined areas and the surrounding ecosystems, opening up possibilities for healing and thoughtful stewardship. Showcasing the imprint of human activity on land, it invited a deeper understanding of how guiding future efforts to balance use and care.

With the depletion of landscapes and some quarries still being active, Kim and Sofia started preparing roles for newcomers to regenerate.



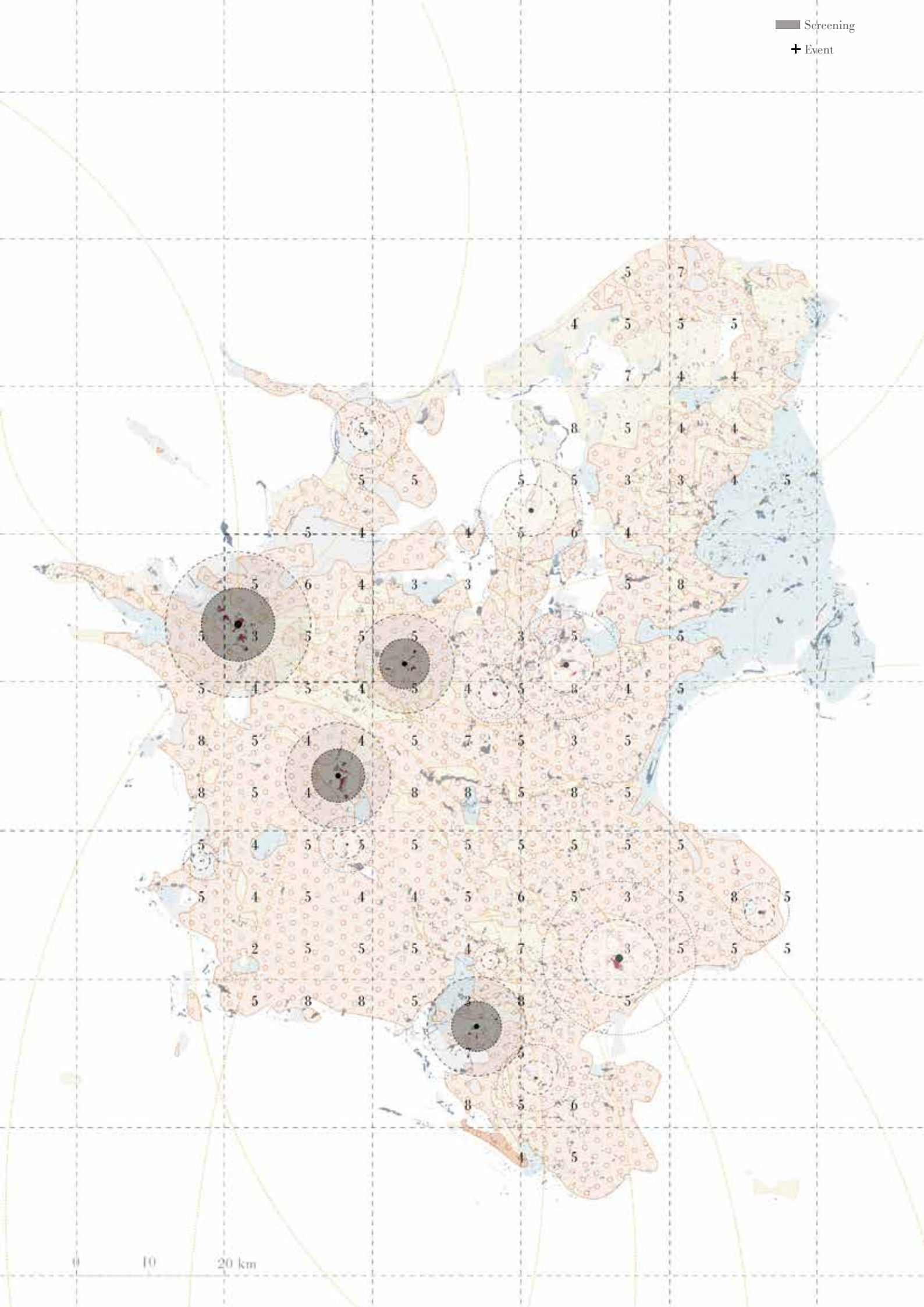
KIM, Biologist
SOFIA, Urban Planner
Unlearning Framework Unit #3

FOCUSED SCREENING MAP

Watersheds, soil types, quarries and migration routes

MAPPING
Landscape dynamics, resource distribution, ecological connectivity, human movement

ill. 47 Soil classification and screening of quarry activity on Zealand


Screening
Event
0
10
20 km

2043 Screening for Extractive Practices

A detailed screening of the quarries and extractive practices showed the carving of the local landscape, interrupting natural flows and habitats. Ones closer to wetlands and streams showed problematic, as they would poison the water running through other parts of the bioregion on Zealand.

The rich soils of Stenrand and its surroundings shows the density of the past measures of succes, despite these scars left behind, there was potential for ecological recovery.

KIM, Biologist
SOFIA, Urban Planner
Unlearning Framework Unit #3

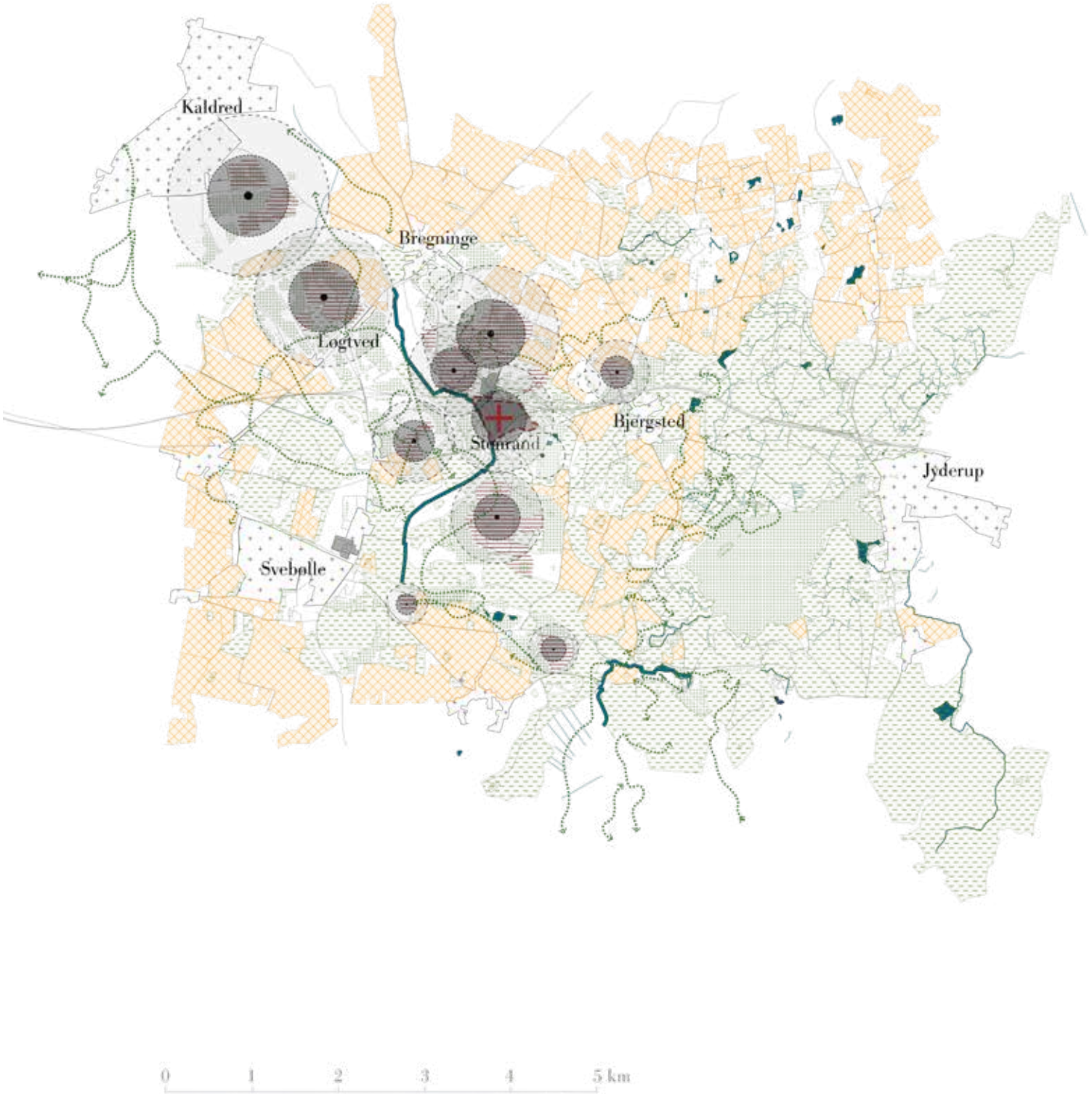
DETAILED SCREENING MAP

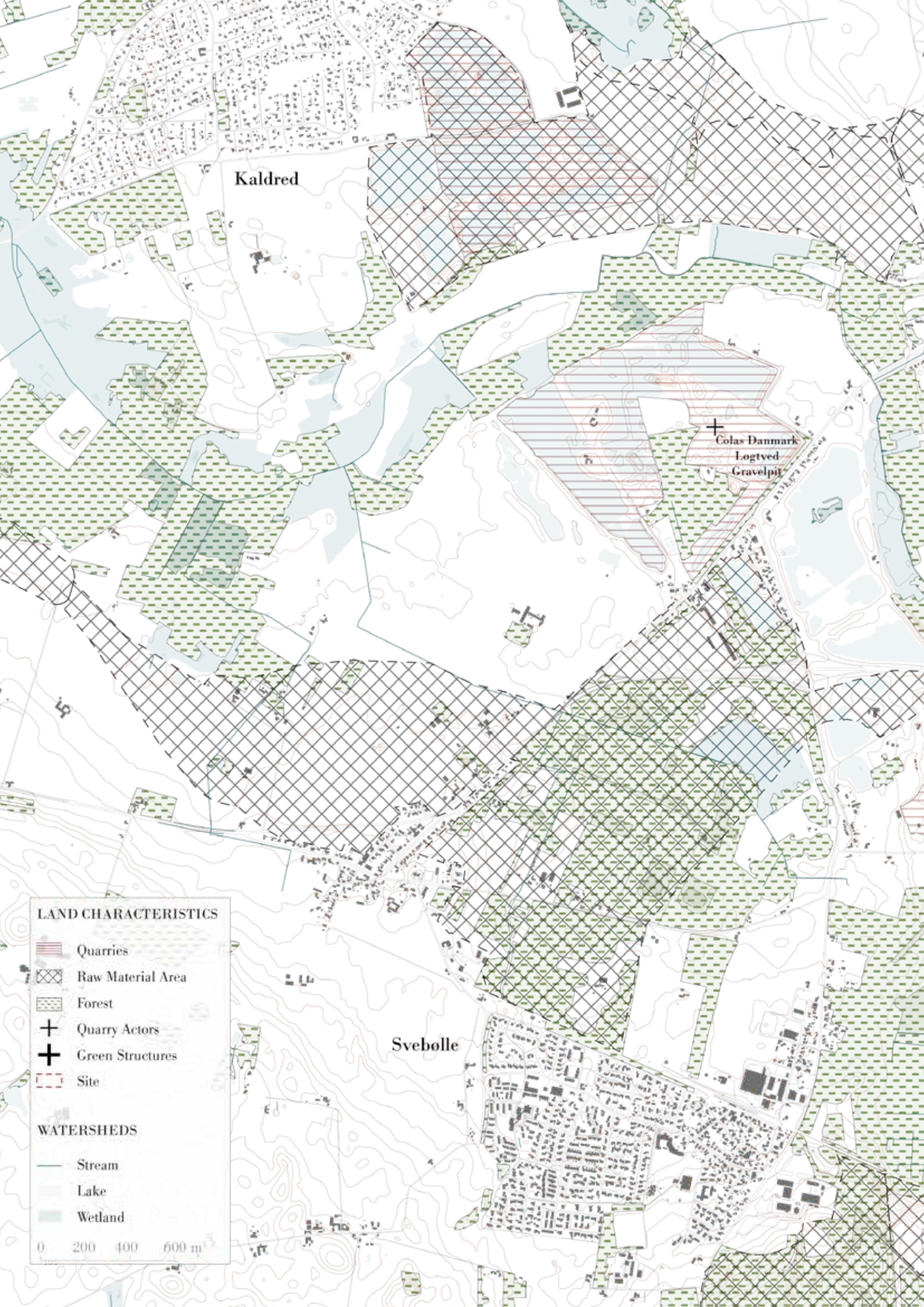
Land use, watershed boundaries and quarry status (active vs depleted)

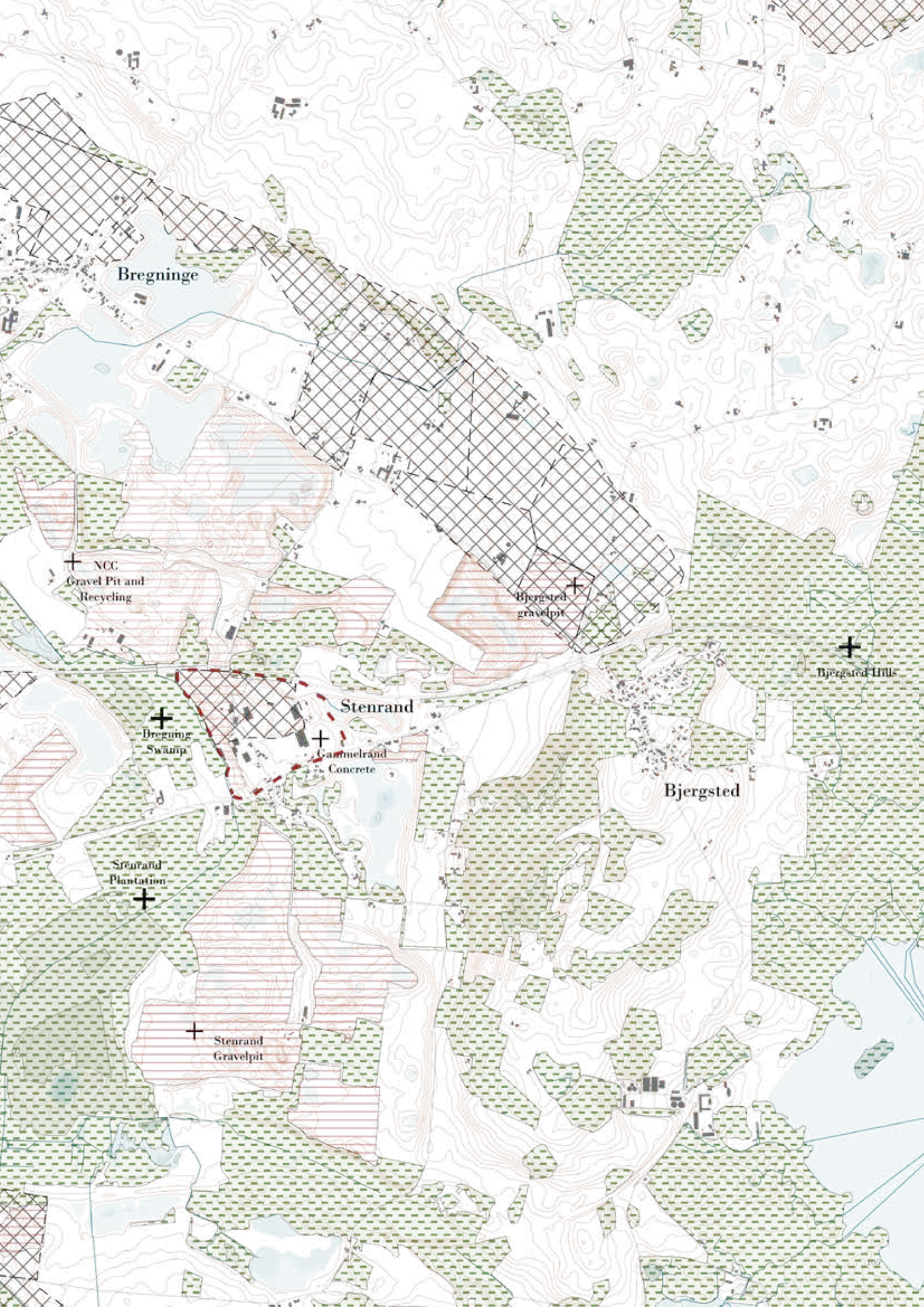
MAPPING
land management, resource lifecycle, environmental impact

ill. 48 Local characteristics of Stenrand and its context

Screening


Kaldred
Bregninge
Logtved
Bjergsted
Stenrand
Jyderup
Svebølle
0
1
2
3
4
5 km


Kaldred
Colas Danmark
Løgtved
Gravelpit
Svebølle
LAND CHARACTERISTICS
Quarries
Raw Material Area
Forest
Quarry Actors
Green Structures
Site
WATERSHEDS
Stream
Lake
Wetland
0 200 400 600 m


Bregninge
NCC
Gravel Pit and
Recycling
Bjergsted
gravelpit
Bjergsted Hills
Stenrand
Bregning
Swamp
Gammelrand
Concrete
Bjergsted
Stenrand
Plantation
Stenrand
Gravelpit

Landscapes of Slow Violence

Stenrand as a Case Study in Extraction, Time and Terrain

ill. 49 1864-1899
Høje målebordsblade
CC by Dataforsyningen

The site is marked by few houses and parcels of land (marked in black), adjacent to Dejgvad swamp and Bregning stream. Main enviromental characteristics are the swamp and hilly landscape.

ill. 51 1901+
Lave målebordsblade
CC by Dataforsyningen

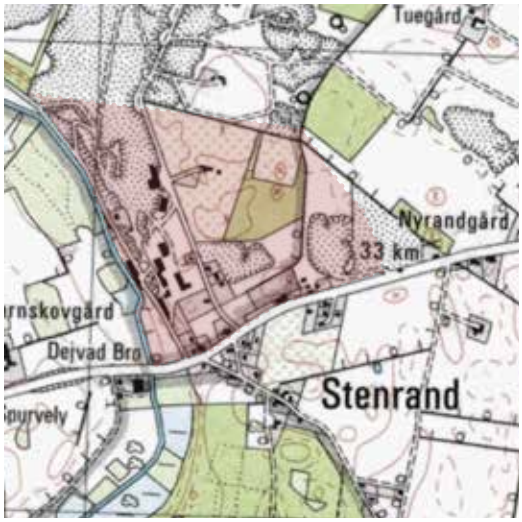
The first entity of sand appear on site, hinting at the beginning of the stone crushing plant Gammelrand, formally moving to Stenrand in 1932.

ill. 50 2012
CC by Dataforsyningen

The last green patch is reclaimed on site to make space for the ready-mixing concrete area. South east to the site a former gravel pit is turned into lakes and a sloped landscape. The characteristics have changed towards a open scar in the land

ill. 52 2014
CC by Dataforsyningen

The central area of the site undergoes further refinement, with additional ground being leveled and compacted for industrial use. The site has slowly turned into a monument for industrial progress.



ill. 53 1953-1976
Topo 4cm
CC by Dataforsyningen

The forces of the industrialisation starts to excavate more of the land, simultaneously Gammelrand has expanded with a workshop, a production hall and emerging gravel pits. Concurrently, Stenrand experiences more inhabitants along the main artery, Gl. Skovvej.

ill. 56 1980-2001
CC by Dataforsyningen

Emergence of a big pipe hall and a block hall for concrete production, along with administration office in the far east of the site. South-east to the site, more excavation has occured, while to the north, the Kalundborg highway has cut through.

ill. 54 2018
Map data: Google, Landsat / Copernicus

Continued industrial expansion shapes the site with more defined infrastructure and surface coverage. The spatial imprint of resource extraction grows more visible and permanent.

ill. 55 2021
Map data: Google, CNES / Airbus

South of the site, excavation starts at Stenrand Plantation displaying the continous nature of raw material extraction, dictating the continuity of natural ecosystems. Stenrand is now terraformed, not only by reconfiguration of geology, but also through social and economic life.

Stenrand

sten [stone] sb.

1. solid, hard and most often dense and heavy mineral material which occurs in large and small pieces in the earth's crust and i.a. used as building material, eg granite, flint or marble

rand [border] sb.

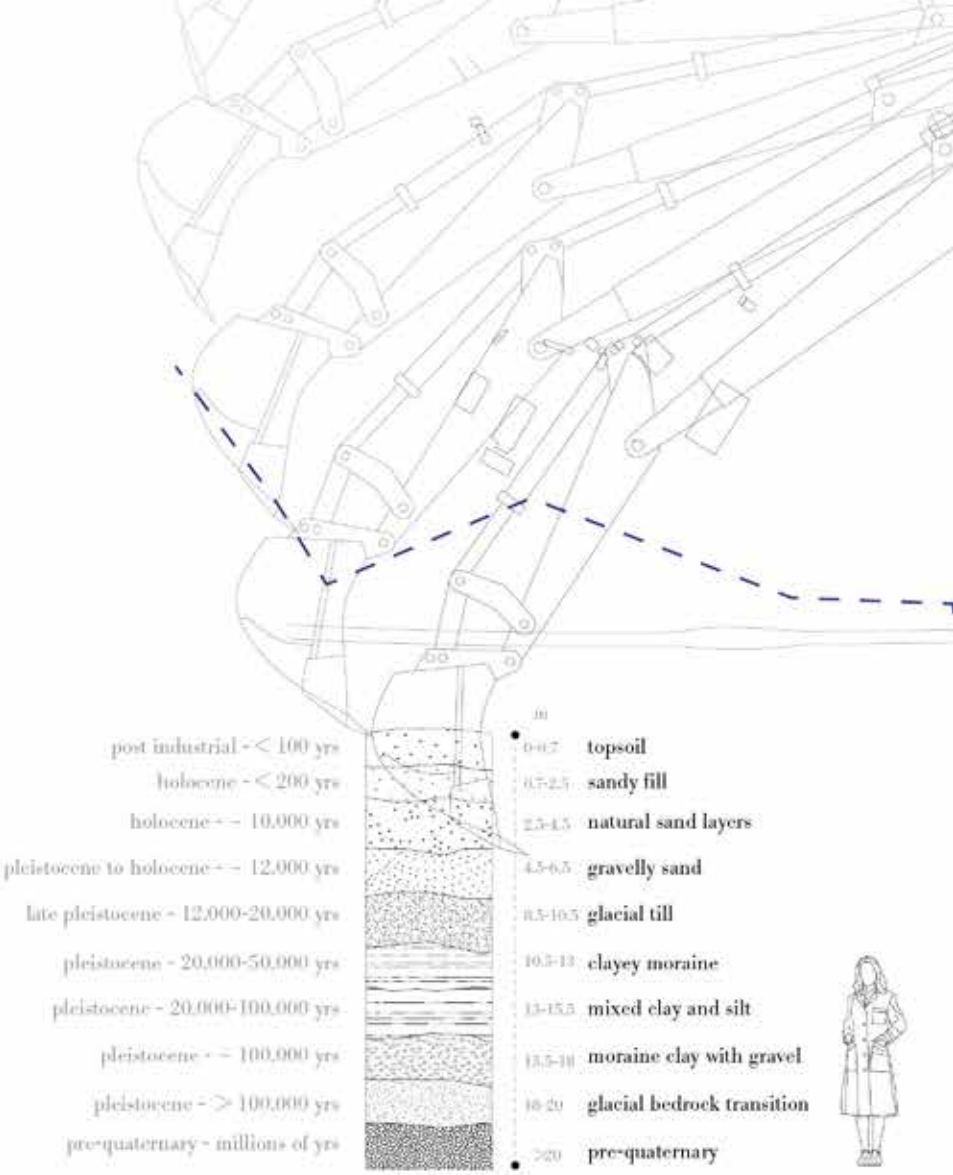
1. solid, hard and most often dense and heavy mineral material which occurs in large and small pieces in the earth's crust and i.a. used as building material, eg granite, flint or marble

2. border delimiting a recess or container above

3. transition to a dangerous or unpleasant situation

ill. 57 Boulders at Stenrand

Collective Memory



1. 1895 - Bregning Stream and swamp as natural characters of the landscape
2. 1900-30 - Bjergsted Hills
3. 1930-60 - Bjergsted Hills
4. 1930 - The start of Gammelrand stone crushing plant
5. 1940 - View of Stenrand and early extraction
6. 1986 - Cultural gathering, motorrace at Stenrand
7. 1986 - Cultural gathering, motorrace at Stenrand
8. 1990 - Gammelrand builds their administration

(Kalundborg & Bjergsted Lokalarkiv)

In the otherwise rare danish landscape of hilltops, Stenrand reveals itself beneath. Kim had never been in one of those landscapes before, so when she arrived to conduct soil tests, she had never felt so tiny. While conducting analysis around the rocky edges of Stenrand, it struck her that she was standing between soil stratas, epochs of time that should have never met. What she started to uncover was the sites layered trauma in deep time, a change in the ecology with which it itself couldn't keep up to speed. Having dug in the local archives too, Kim had found that destruction of one livelihood, had created another (image 4, 5, 6), and the middle ground between these were the land, the soil.

With its eroded banks and depleted grounds, the landscape of Stenrand holds memories across time and species, being a testament to the collective memory that the Earth holds. Kim left wondering if the constant movements of digging, excavating and terraforming soon would be replaced with collective healing and regeneration.

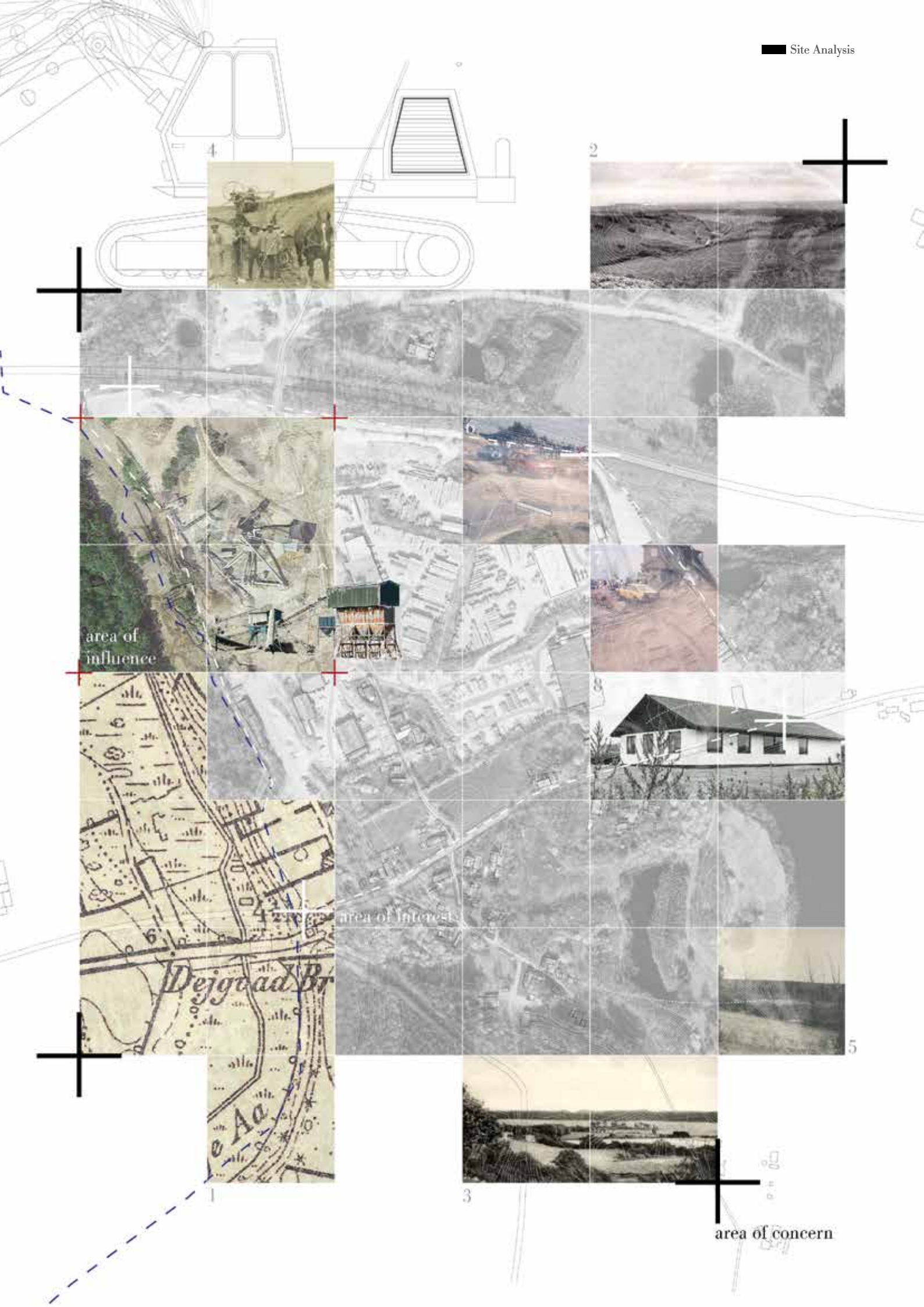
KIM, Biologist
Stenrand Soil Survey Group

LAND MEMORY

Community Stories, Soil Layers and Archives

MAPPING
(non)-human memories of land, history, identity

What if... the gatherings remained – not to dominate the soil, but to honor and regenerate it?


4
2
area of influence
area of interest
8
5
1
3
area of concern

Cultures of Abundance

ill. 58 Harvested earth

ill. 59 Boulder storage

ill. 60 Waste accumulation

ill. 61 Concrete tile accumulation

ill. 62 Refined mass

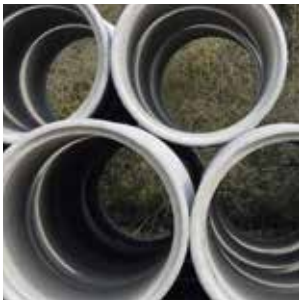
ill. 63 Reservoir

KIM, Biologist
LARS, Activist
Stenrand Undercover
Practice Assessment Unit

ANTHROPOCENIC INFLUENCES

Site conditions. material abundance, human infrastructure, relentless soil change

COLLAGE
resource extraction, perpetual production, soil flux, landscape alteration



ill. 64 Manhole repository

ill. 65 Piled wealth

Infrastructures of Human Disturbance

ill. 66 Transporting gravel

ill. 67 Dropping off gravel

ill. 68 Gas station

ill. 69 Aggregate hopper, containing

ill. 70 Conveyor belt, stockpiling gravel and soils

ill. 71 Fragmentation of Earth strata

ill. 72 Systems for extraction

ill. 73 Engineering earth

ill. 74 Displacing gravel and soil

Earth in Flux

ill. 75 Sedimentary

ill. 76 Stratified

ill. 77 Scarred

ill. 78 Metamorphosis

ill. 79 Fertile

ill. 80 Depleted and manipulated

ill. 81 Fragmented

ill. 82 Merging masses

ill. 83 Mosaic of matter

Feral Growth

ill. 84 Birch, persistence

ill. 85 Undergrowth

ill. 86 Reclamation

ill. 87 Fragmentation

ill. 88 Resilience

ill. 89 Tenacity

ill. 90 Emergence

ill. 91 Bark

ill. 92 Wild fringes

Building Archives

A
Pipe factory

Footprint 2819 m²
Structural system Frame

B
Concrete casting plant

Footprint 1046 m²
Structural system Frame

C
Blacksmith workshop

Footprint 605 m²
Structural system Frame

D
Mechanic's workshop

Footprint 759 m²
Structural system Frame

E
Warehouse

Footprint 496 m²
Structural system Frame

F
Concrete block factory

Footprint 1635 m²
Structural system Frame

G
Warehouse

Footprint 608m²
Structural system Frame

H
Tile factory

Footprint 1835 m²
Structural system Frame

I
Warehouse / office

Footprint 614 m²
Structural system Frame

J
Administration

Footprint 336 m²
Structural system Frame

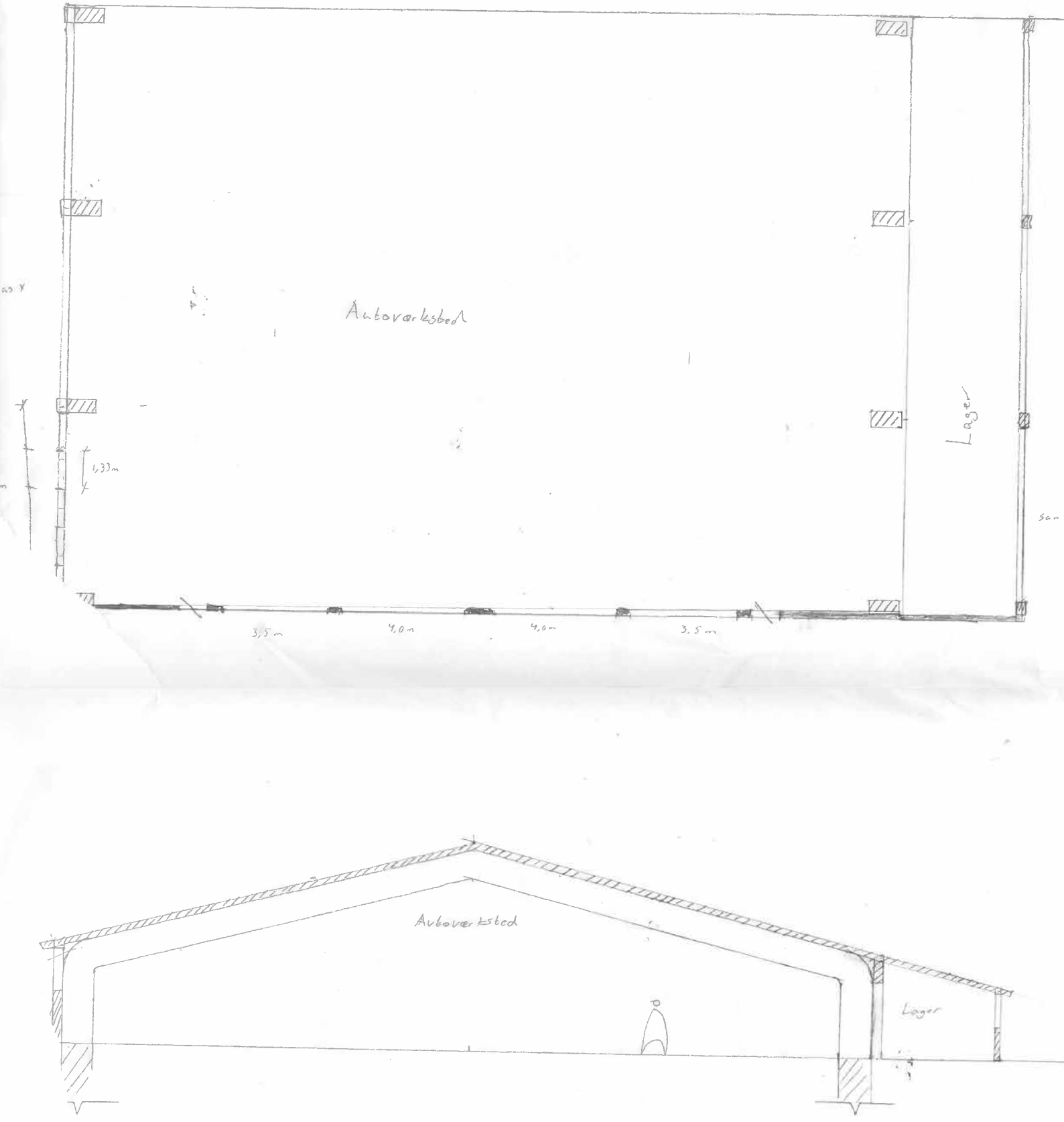
KIM, Biologist
ERLING, Lorry Driver
Stenrand Terrain Survey Group

Building Stock Survey

Orthographic Record & Footprint Mapping,
Tracing of 10 Structures

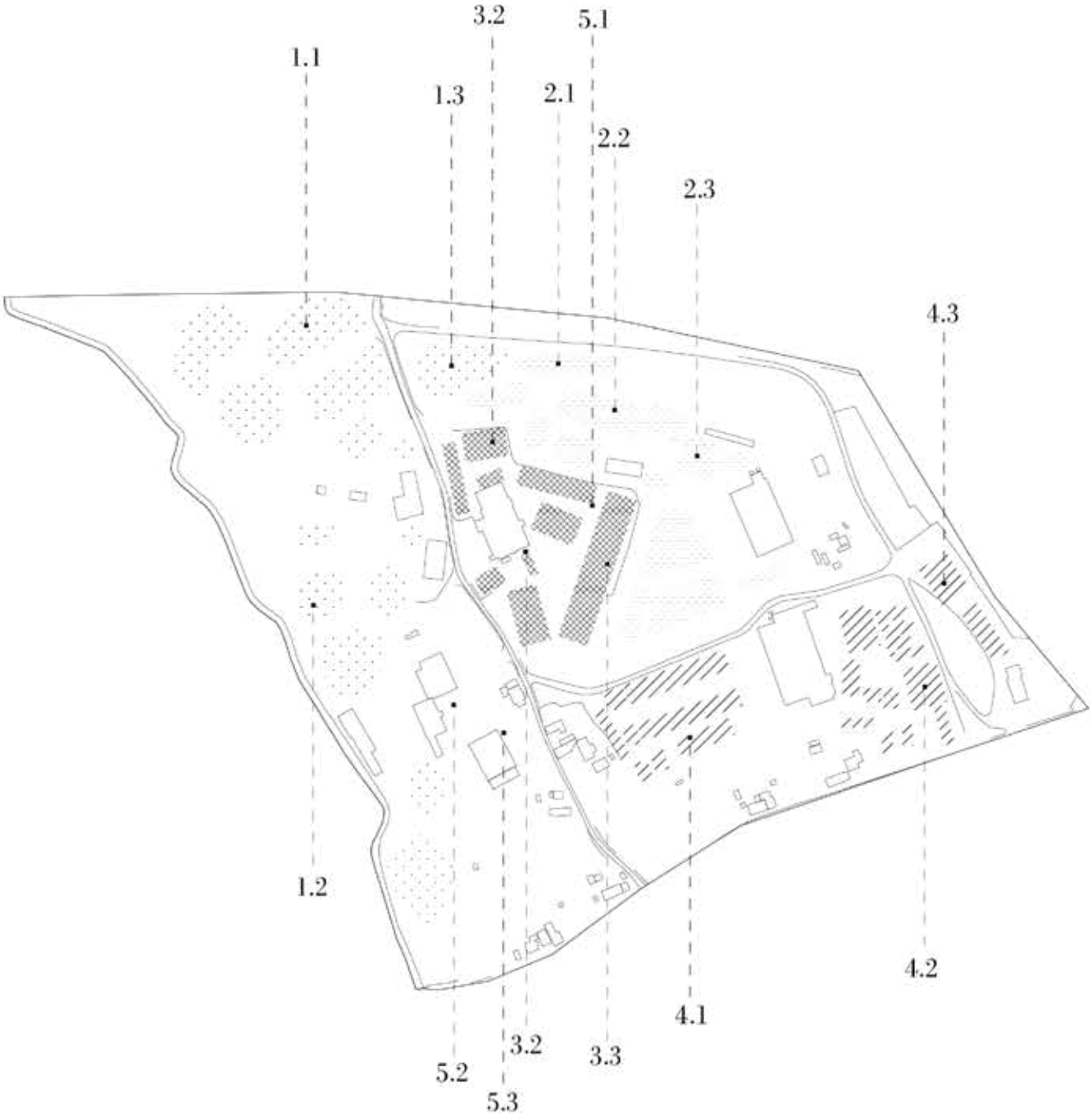
MATERIAL REENTRY
beams recovered from building D

ill. 93 Orthographic photos of facility at Stenrand
CC By Dataforsyningen



ill. 94 Measurement and survey of the mechanics workshop

Material Archives

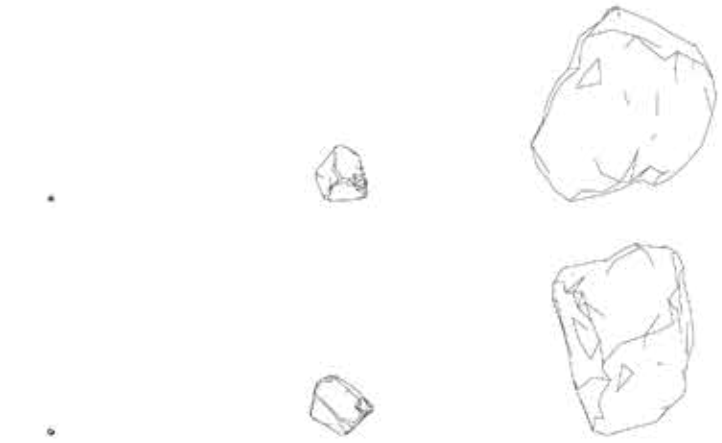


KIM, Biologist
JACK, Concrete Engineer
OMAR, Climate Refuge
Stenrand Terrain Survey Group
Recovered Site Fragments

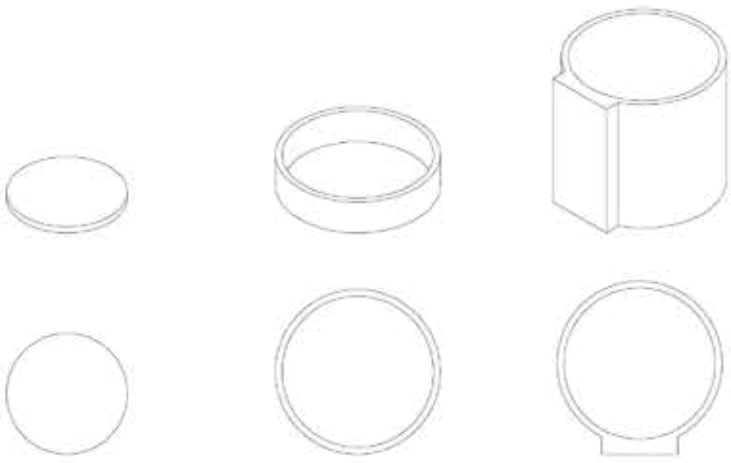
Landscape Fragment Survey

Mapped Elements to Re-enter Landscape Logic

MATERIAL DIAGRAM
cataloguing past extractive elements
for future reinterpretation



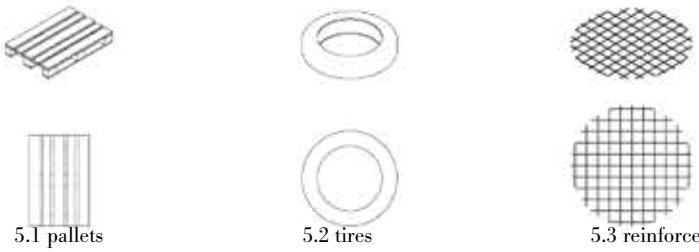
1.1 gravel
1.2 cobbles
1.3 boulder



2.1 cover
2.2 short sewer pipe
2.3 sewer pipe

3.1 leca block
3.2 funda block
3.3 insulation block

4.1 cobblestone
4.2 tiles
4.3 paving stone



5.1 pallets
5.2 tires
5.3 reinforcement steel

Species Mapped: Tracing Local Biodiversity

ill. 96 Areas for targeted biodiversity efforts across Denmark
Dark spots indicate targeted efforts.
Kalundborg area marked in red.
Drawing based on Aleksandrina Mitsevas graphic for Biodiversitetsrådet (2024).

ill. 95 Spotting map,1.2, 1.3 and 1.4 from Arter.dk (n.d.)

ill. 97 Biodiversity proxy score at Stenrand, Kalundborg

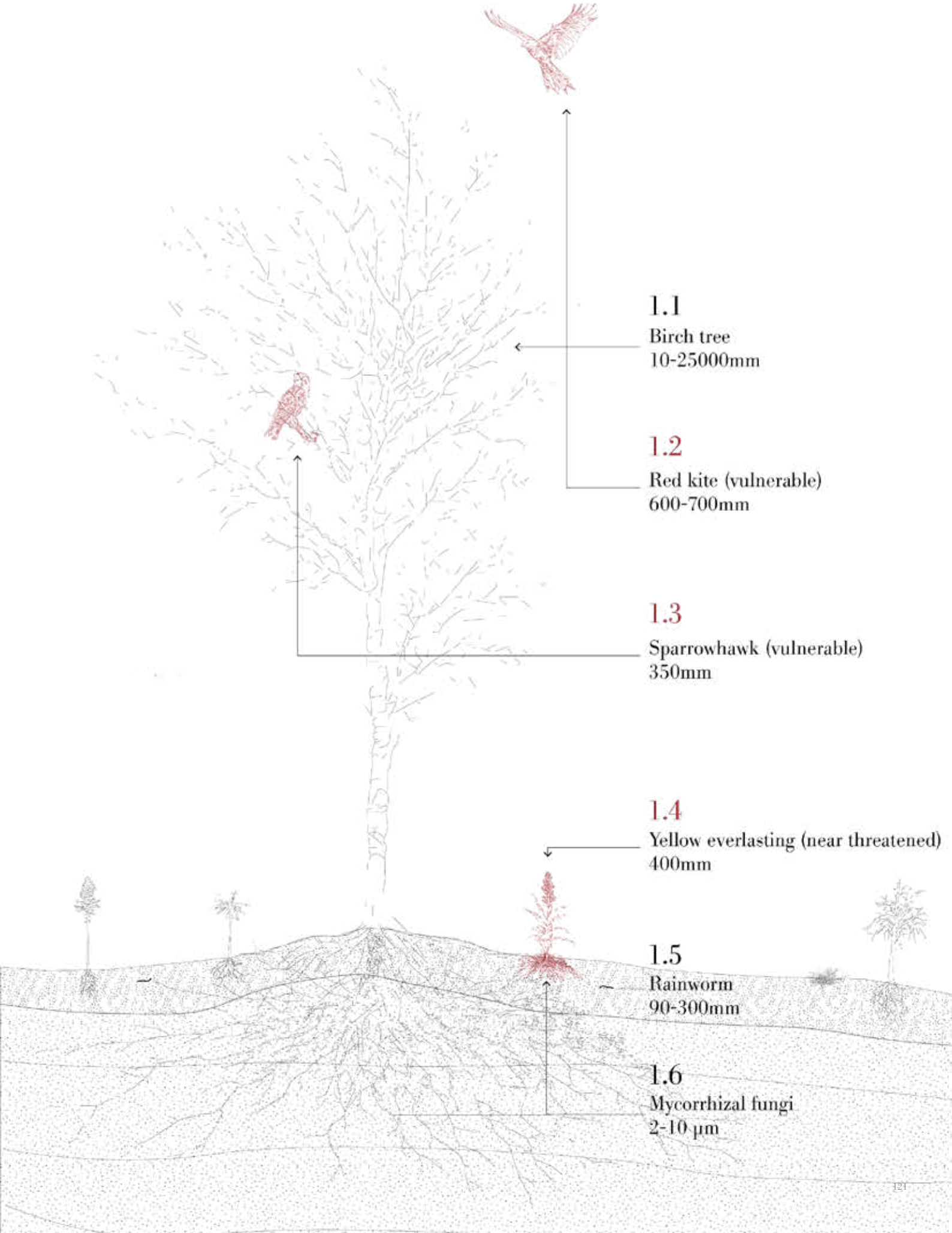
Dark spots indicate high scores of species.
Red spot indicates site perimeter.
Drawing based on De Digitale Naturkort 2021 "Biodiversitetskortet" by Miljøstyrelsen (n.d.), from Geodata-info.dk

KIM, Biologist
Omar, Climate Refuge
Stenrand Terrain Survey Group

SPECIES INVENTORY

Habitat types & Rarity Index, Flora & Fauna

DIAGRAM
thriving and threatened species in and around borders of depletion


1.1
Birch tree
10-25000mm
1.2
Red kite (vulnerable)
600-700mm
1.3
Sparrowhawk (vulnerable)
350mm
1.4
Yellow everlasting (near threatened)
400mm
1.5
Rainworm
90-300mm
1.6
Mycorrhizal fungi
2-10 µm

Functional Territories

ZONES

- Extraction
- Concrete production
- Supporting functions
- Residential

(BUILT) FUNCTIONS

1 Pipe factory
2 Concrete foundry
3 Blacksmith workshop
4 Car repair shop
5 Warehouse
6 Concrete block factory
7 Warehouse
8 Tile factory
9 Administration
10 Packing facility
11 Element factory
12 Gravel processing plant

(LANDSCAPE) FUNCTIONS

1.1 Storage
2.1 Waste storage
3.1 Gravel storage

MOVEMENTS OF SOIL

- Excavation
- Moving (preparing for sorting)
- Sorting
- Moving (for production & foundry)
- Collecting (final form)

RE(SOURCES)

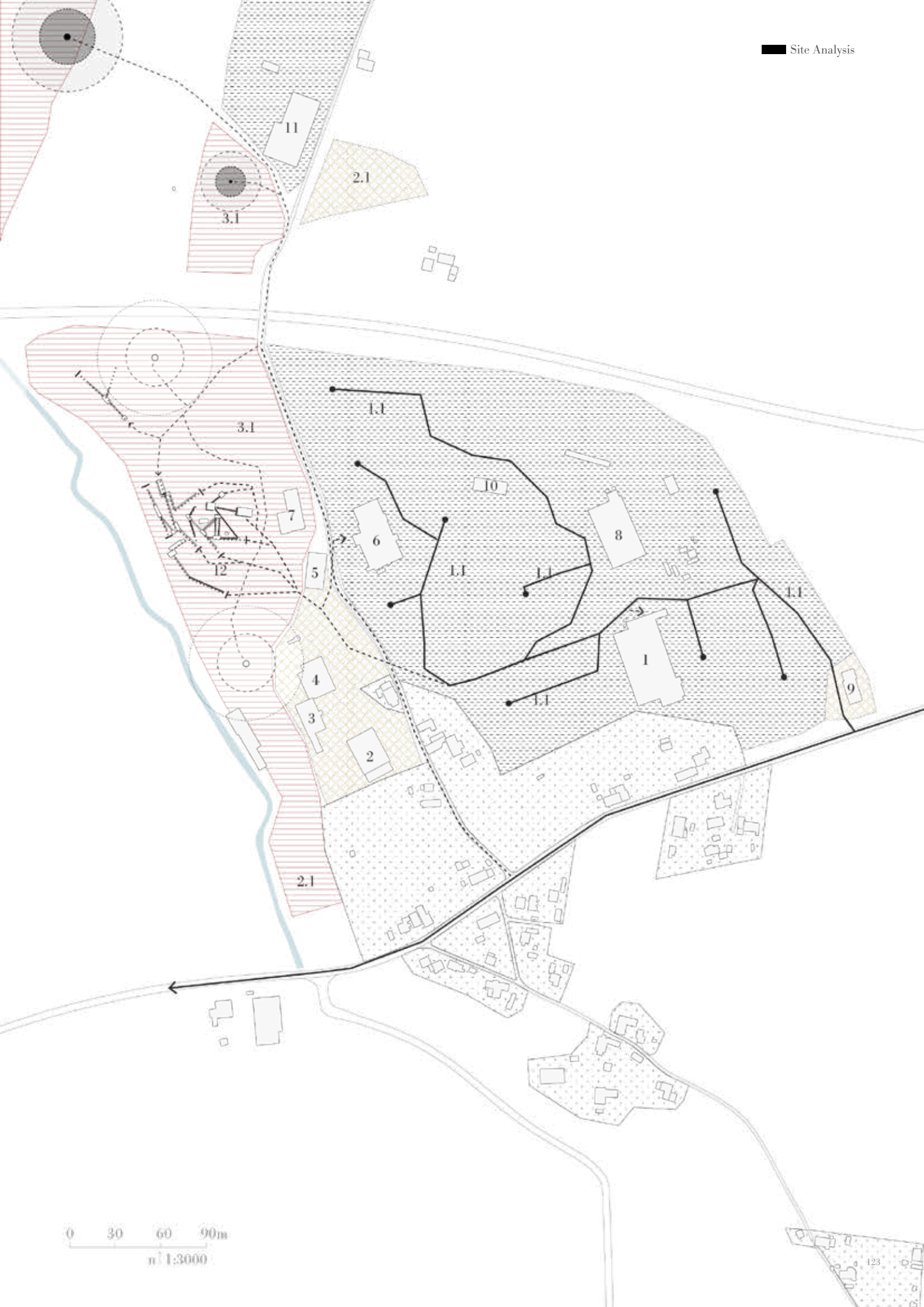
- Active
- Depleted

KIM, Biologist
ERLING, Lorry Driver
Stenrand Terrain Survey Group

FULL SITE ANALYSIS

Zones, Functions, Resources & Earth Movements

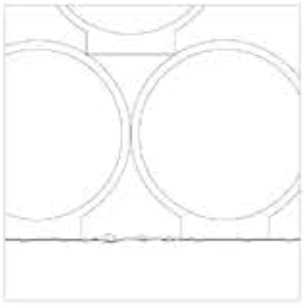
MASTER DIAGRAM
taxonomy of extractive logics and landscape roles


11
2.1
3.1
3.1
1.1
10
7
6
8
12
5
1.1
1.1
1.1
1
4
3
2
1.1
9
2.1
0
30
60
90m
n 1:3000

Inspection of Stenrands Soils

suffocation

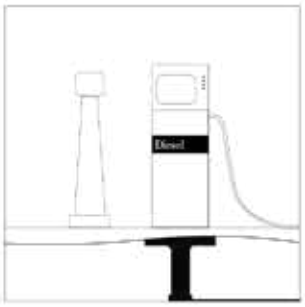
1.1 compacted by machinery



1.2 buried under load

1.3 disrupted and exposed

contamination

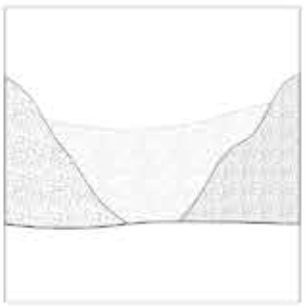


1.4 contaminated ground

1.5 erosion in motion

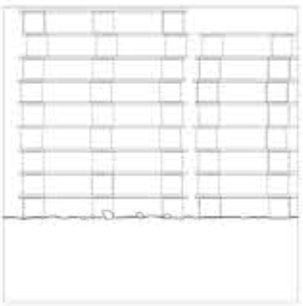
1.6 suffocated by debris

unstable and eroding



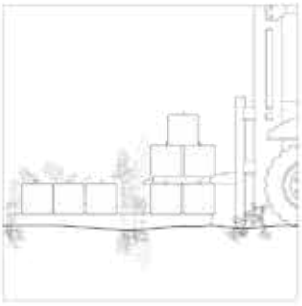
1.7 unstable retaining ground

1.8 sealed and impermeable



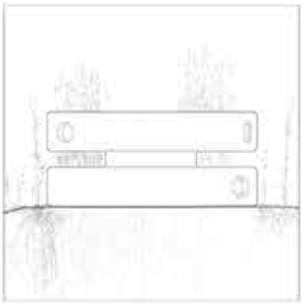
1.9 structural load zone

opportunistic growth



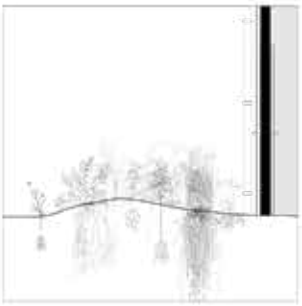
2.0 cracked but breathing

2.1 rooted edges



2.2 feral growth

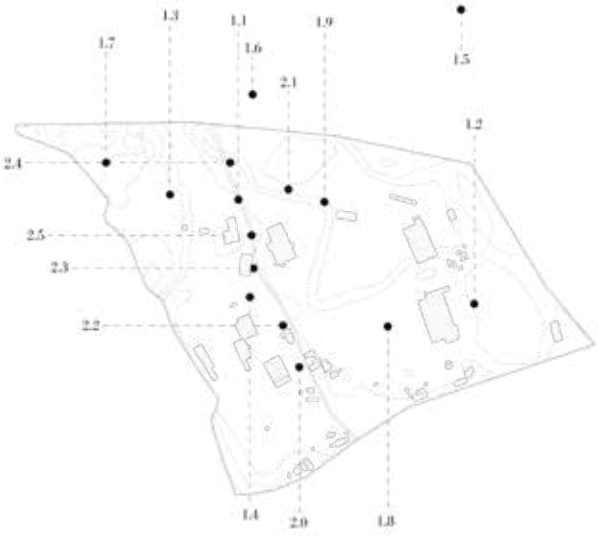
edge resilience



2.3 wild edges of industry

2.4 pioneer species holding ground

2.5 roadside rewilding



KIM, Biologist
ERLING, Lorry Driver
Stenrand Soil Survey Group

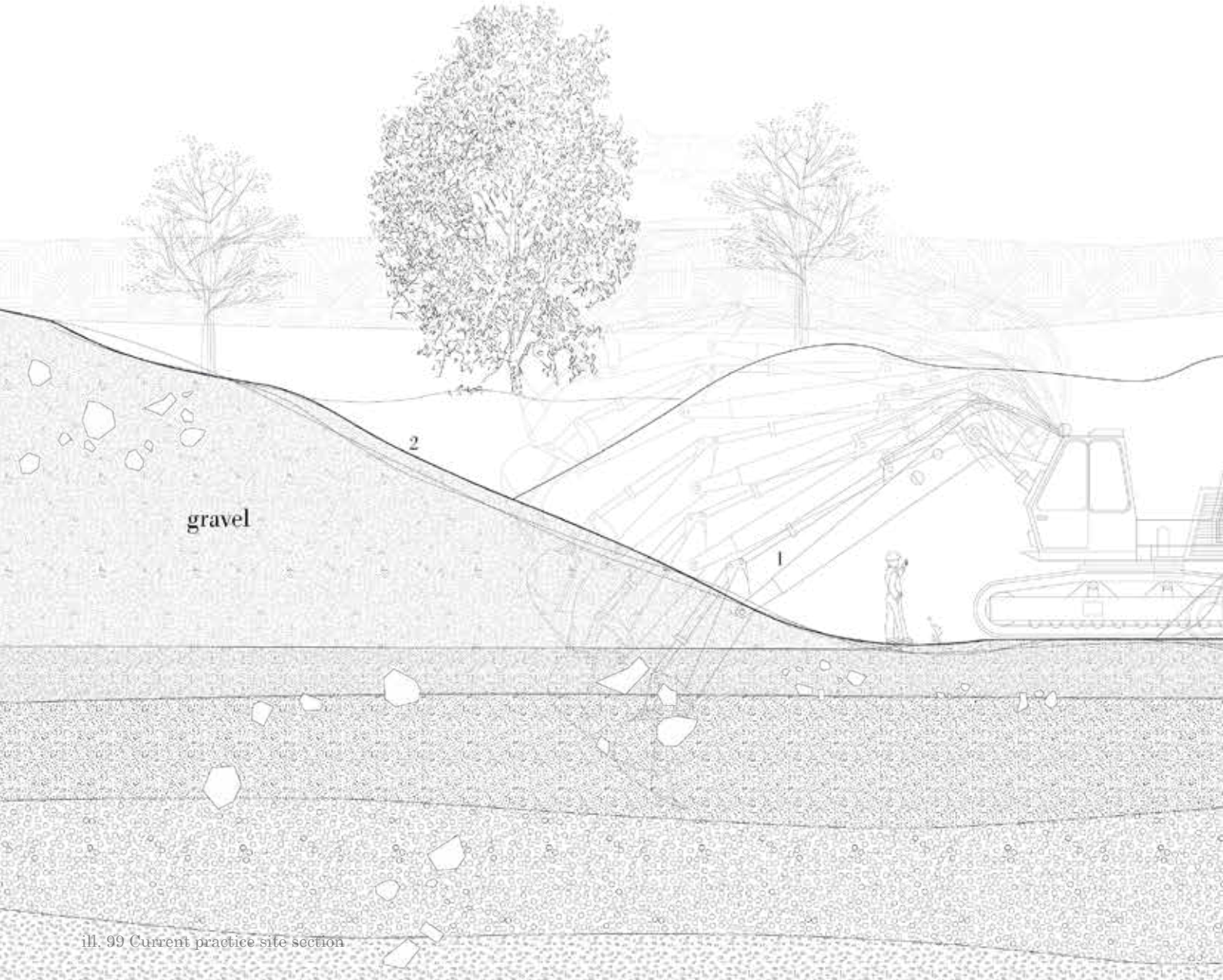
SOIL SECTION ANALYSIS

Subsurface Composition & Site Stratigraphy

X-RAYS
contamination layers, growth horizons & regenerative zones

ill. 98 Stethoscope figure of soil x-rays

Terraforming in Progress



ill. 99 Current practice site section

0 2.5 5 7.5m

1:25

TERRAFORMING

1 Excavation

2 Exposure

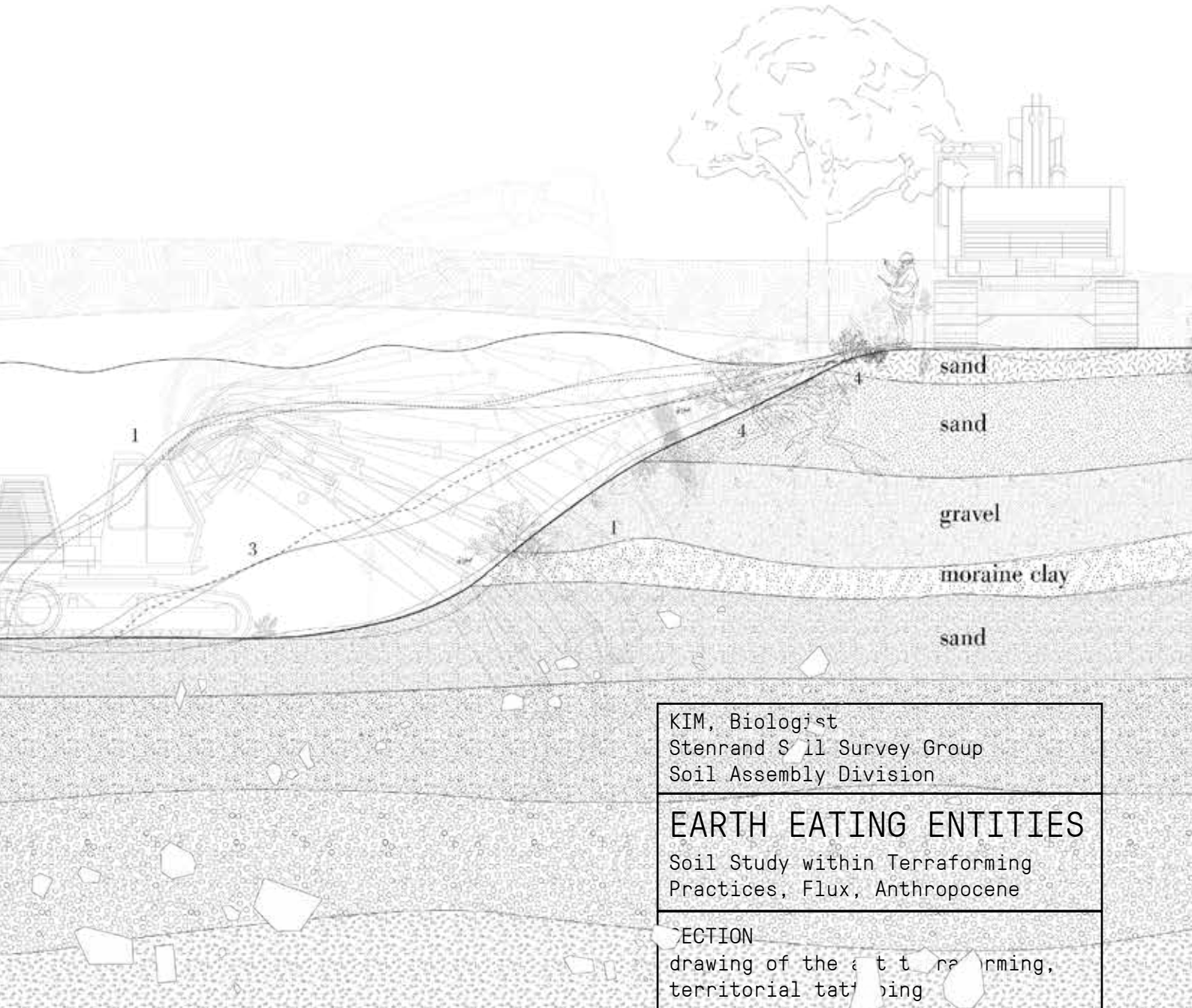
3 Erosion

4 Natural succession

TOPOGRAPHY

Pre extraction topography level (1950s)

ill. 100 Section line



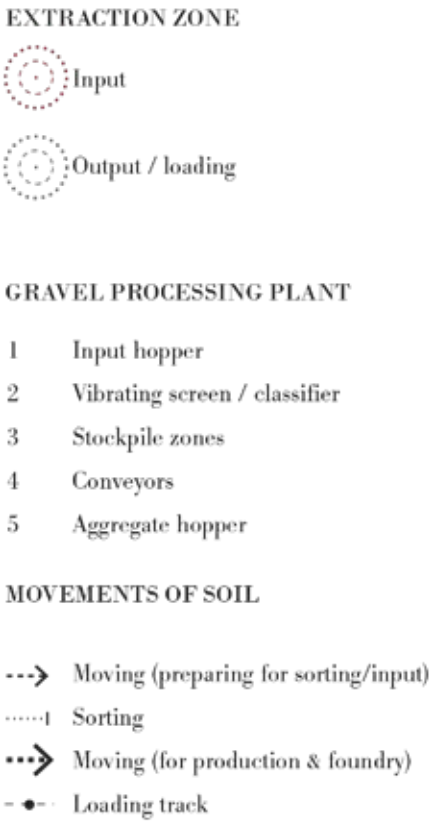
KIM, Biologist
Stenrand Soil Survey Group
Soil Assembly Division

EARTH EATING ENTITIES

Soil Study within Terraforming Practices, Flux, Anthropocene

SECTION
drawing of the act of terraforming, territorial tattooing

Extractive System Logics



After Kim, Lars, Sofia and other systemleavers spoke to the local workers of Stenrand they would kindly let them do all kinds of site mappings and even participate in some of them. Jack, the concrete engineer would even explain how the logics of the extractive systems work.

As materials - soil, rock, stone and gravel - were extracted just north of the site, they were transported to the two inputs of the system. From here they were moved into the system, divided by size and type, crushed into minor pieces and eventually stored before leaving for further production.

The process was efficient, optimized and required fuel and only little manpower to run. One person would constantly be working, as flint stones were screened out due to their sharpness and poor bonding qualities.

KIM, Biologist
JOHN, Concrete Engineer
Stenrand Field Research Unit
Process Mapping

GRAVEL WORKS

Movement & Material Study

MASTER DIAGRAM
analysis of extractive logics and circulation


Site Analysis
0 10 20 30m
1:1000

(Un)planning for Regeneration

Kim knew this stood in direct opposition to the principles of the new Life Cycle Assemblage. soil - and even mineral materials - could no longer be treated as commodities. The act of crushing stone into concrete, forcing metamorphosis through violence, had lost its logic under the new treaty.

The process tormented both landscape and matter: emitting carbon, depleting the earth, and destroying biodiversity. Kim came with a radical idea:

What if the extractive infrastructure were repurposed as the framework for a new pedagogy of soil regeneration - one that could form the foundation of an institute?

By that, Kim started planning for repurposing the extractive infrastructure to learn from soil - home to all living. As there, in a teaspoon of healthy soil is a billion bacterias, thousands of fungi, with only 1% of soil microorganisms having been identified. Kim saw the opportunity as ripe, to reclaim the extractive infrastructure and bend them towards regeneration.

Kim knew from princples of permaculture, that designing from patterns to details would be crucial, and so she began.

The conveyer belts could move the soil in all its stages from different spaces of the Institute, from where it could be both monitored, studied and eventually returned into nature as compost, spores or seeds spread in the wind.

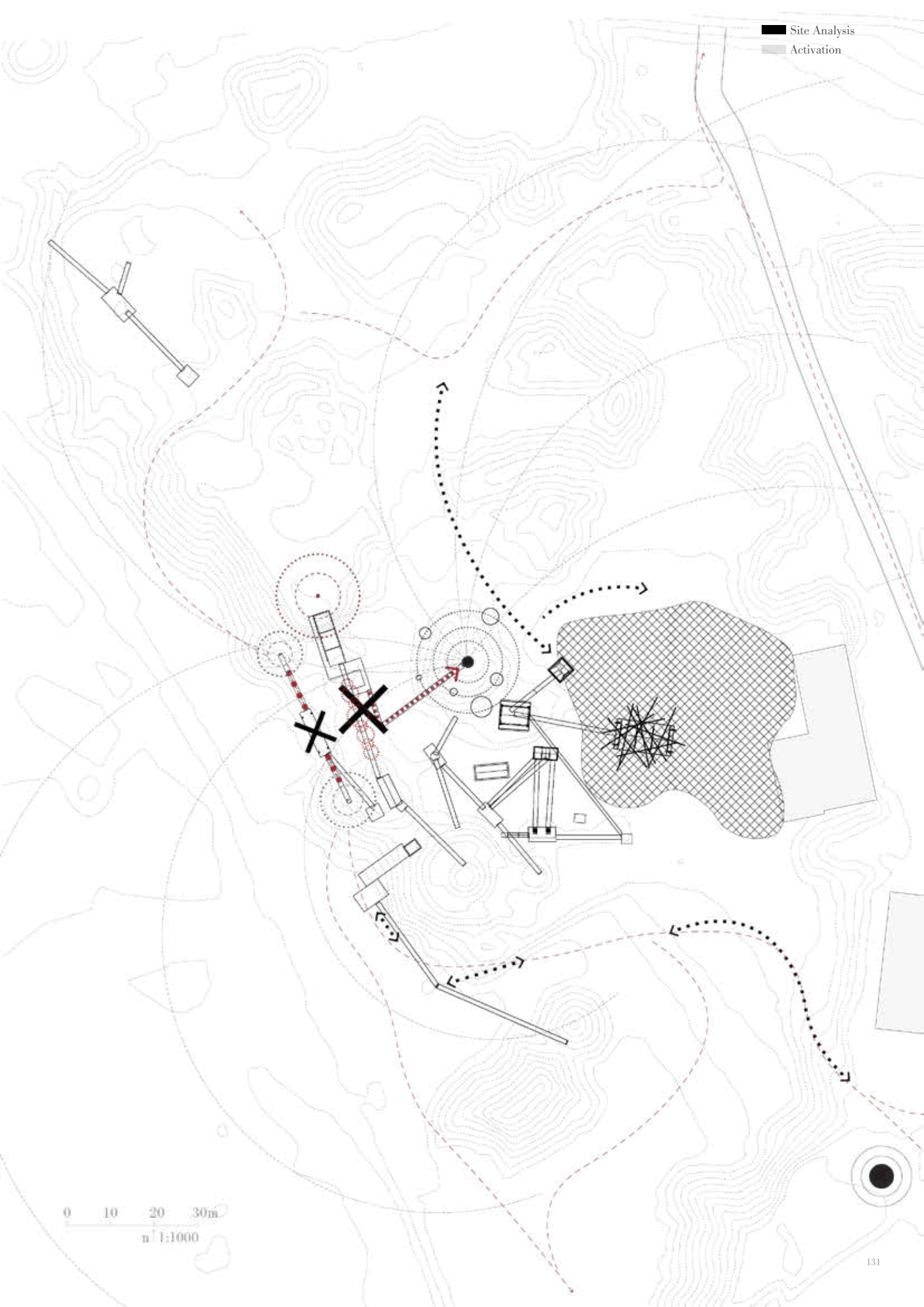
With the final field registration, Kims Institute could start to unfold.

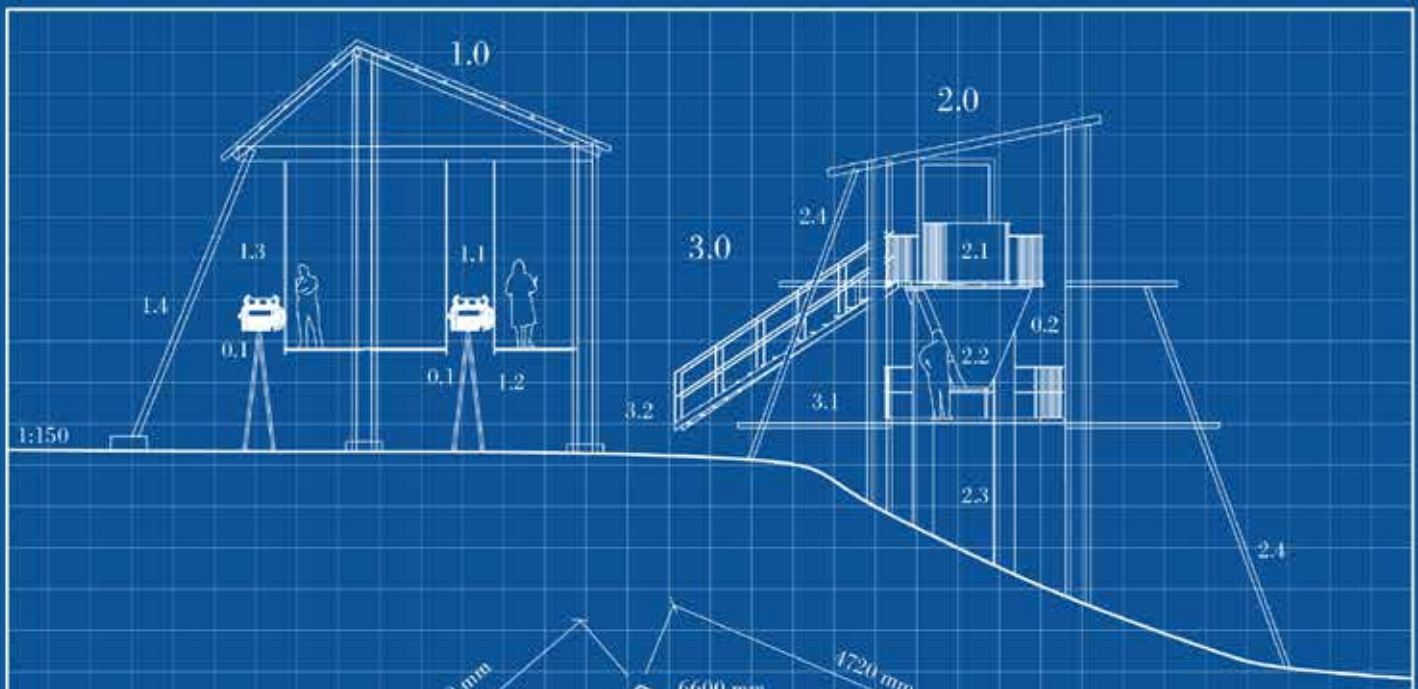
KIM, Biologist, Systems Leaver
Stenrand Field Research Unit
Soil Assembly Division

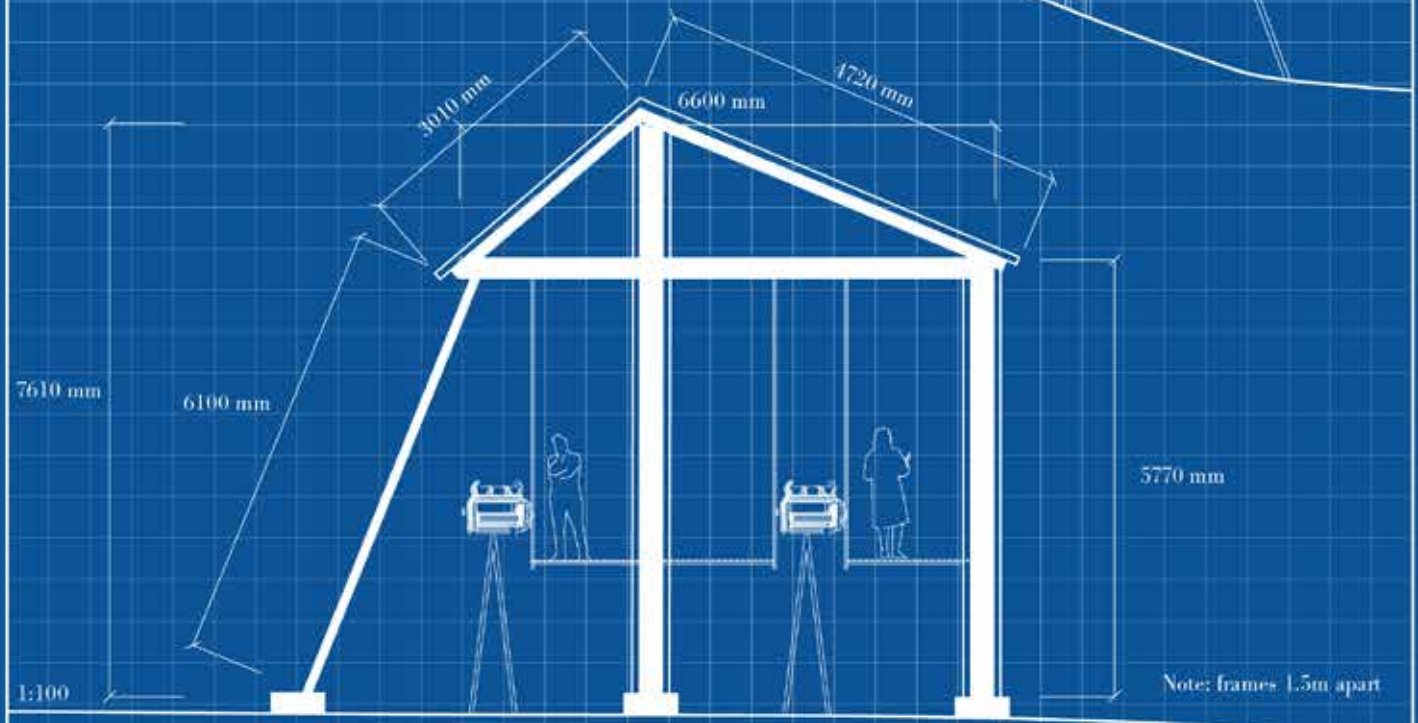
Institute of Soil Regeneration

Regeneration Field Thinkscape

MASTER DIAGRAM
all elements and key


Site Analysis
Activation
0 10 20 30m
1:1000





KIM, OMAR, ERLING, JACK, SOFIA
Stenrand Field Research Unit
Protest and Soil Regeneration Division

28. 05. 2044

BARRICADING & PROTESTING

SOIL LAB

~~CONSTRUCTION~~ PROTEST DRAWING NO. 6
barricading existing extractive machinery as sacffold for future laboratory

Appendix 2 for further documentation

1:40

Protesting: Barricading Extraction, Scaffolding the Lab

0.0 Existing machinery
0.1 Conveyor belt
0.2 Hopper

1.0 Soil Lab (thermal zone 1)
1.1 Sample zone
1.2 Soil experimental zone
1.3 Soil prep zone

2.0 Compost lab
2.1 Compost sensing zone
2.2 Compost container (hot, vermi, bokashi)
2.3 Compost distribution pick-up zone
2.4 Living research skin

3.0 Open air drying and prep zone
3.1 Passive drying of soil on racks
3.2 Seedlings with compost test

Acts of Repair
The mist was slowly disappearing above the deep scars of Stenrand. It didn't look like something they had seen before, the scaffolding. But it came to nature because of necessity. All their groundwork had led to this, the protest against the running machines.

A faint smile touched Kims lips. She felt proud for gathering a collective of people around such an absurd act of protesting. What's more, she too was surprised to see the teamwork flourish so well. With Erling and Omar cracking a laugh, she remembers just how short time ago Omar had arrived, and also the fact that Erling used to run these machines, but now he was aiding others in the build of the barricade.

What they had ended up with was a monument of resistance, born from all their groundwork earlier on, categorizing, mapping and observing the extractive logics and practices at Stenrand.

Kim felt lucky to oversee the early seeds being planted in the ruined landscape. And though the machines still loomed nearby, for the first time, the land seemed to listen.

ill. 101 Scaffolding of aggregate hopper and conveyor belts

ill. 102 Institute of Soil Regeneration construction drawing #6

Echoes from futures

Omar

31

Climate Refugee

Sudan

Today I helped putting up parts of the scaffolding, my hands still remember the trade, more than I thought. The timber, the joints, the rhytm is the same. Old ways still work. It's not that different to back home, though the sun hits at a different angle here.

What is different though, is our relationship to land, it has shifted. The ways of working with it is more connected to how we live, how we build, and how we care for each other and the places we depend on. All of this is evident in how these materials are sourced. To barter the beams and columns we have to care for the forest cycles around Stenrand by planting. And for the interior (which we'll hopefully get to after the protest is a success), we'll receive mycelium insulation, and in return, we'll pollinate some corridors too!

It feels good to be part of something again. Instead of just surviving, we're building. Protesting, too, but with our hands as well as our voices. It seems people here listen. They ask and we learn from each other. What we're building is not just a shelter or a lab. It belongs to this place. The land. It's made to last with the seasons, not against them.

I think it will hold. Not because it's perfect, but because it will be cared for. Slowly. Like all good things. With so many jobs gone, all we really have now is time, and we're finally using it well.

ill. 103 Visualisation, 'build of scaffold' for the Soil Lab

Emergence
Activation
Transformation
Building

Echoes from futures

Kim

42

Biologist

Copenhagen

2044

We just set up the barricade here at Stenrand. I think you can call it a protest. It really helped to gather with like-minded people, problems seem smaller then.

I managed to convince Erling, a former machinery coordinator at the concrete production here, to help us with the logistics of it all. He knows all the details of the site and the practices of the machinery, and luckily he's willing to unlearn, just like us.

We're trying to halt the production. Hopefully this is the first step in letting this ecosystem heal, to let the soil rest and evolve at its own paces.

ill. 104 Axonometic drawing of The Institute of Soil Regeneration

THE INSTITUTE OF SOIL REGENERATION

A New Ground for Knowing Otherwise

The Institute of Soil Regeneration was both a reformist response to a collapse of consensus reality and ecosystems. Through Kim's protest at Stenrand, a new community emerged. New practices of listening to the land were cultivated through her Soil Lab and it's corresponding Foresight Chamber. Here, the patchwork community of Stenrand meets anew with local species and the soil, creating regenerative more-than-human relations. Multi-species governance finds place within the industrial remnants, shifting the agency of past harmful practices into ones of co-existence and care.

Through time, Kims acts compounded into a symbiosis which not only restored and healed the ecological scar, but instead re-storied the deep past of the soils layered trauma and memory. Instead, the Institute served as scaffolding for a fragile foundation, one supporting both the 7th generation and the community's long-term healing.

Echoes from futures

Erling

65

Former Machinery Coordinator

Kalmarberg

2044

I spent years and years running this plant pouring the concrete, breaking the ground, feeding the machines. Back then we thought we we're building the future.

Now I'm here with the young ones, repurposing the scaffolding onto the infrastructures we once called progress.

They bring the fire, I bring the tools and the memory.

This protest isn't just theirs, its mine too. I helped build the damage, now I help hold up the resistance.

Let the machines sleep. Let the land breathe. It's time.

ill. 105 Visualisation, 'build of scaffold' for the Compostarium

Where Futures Take Root

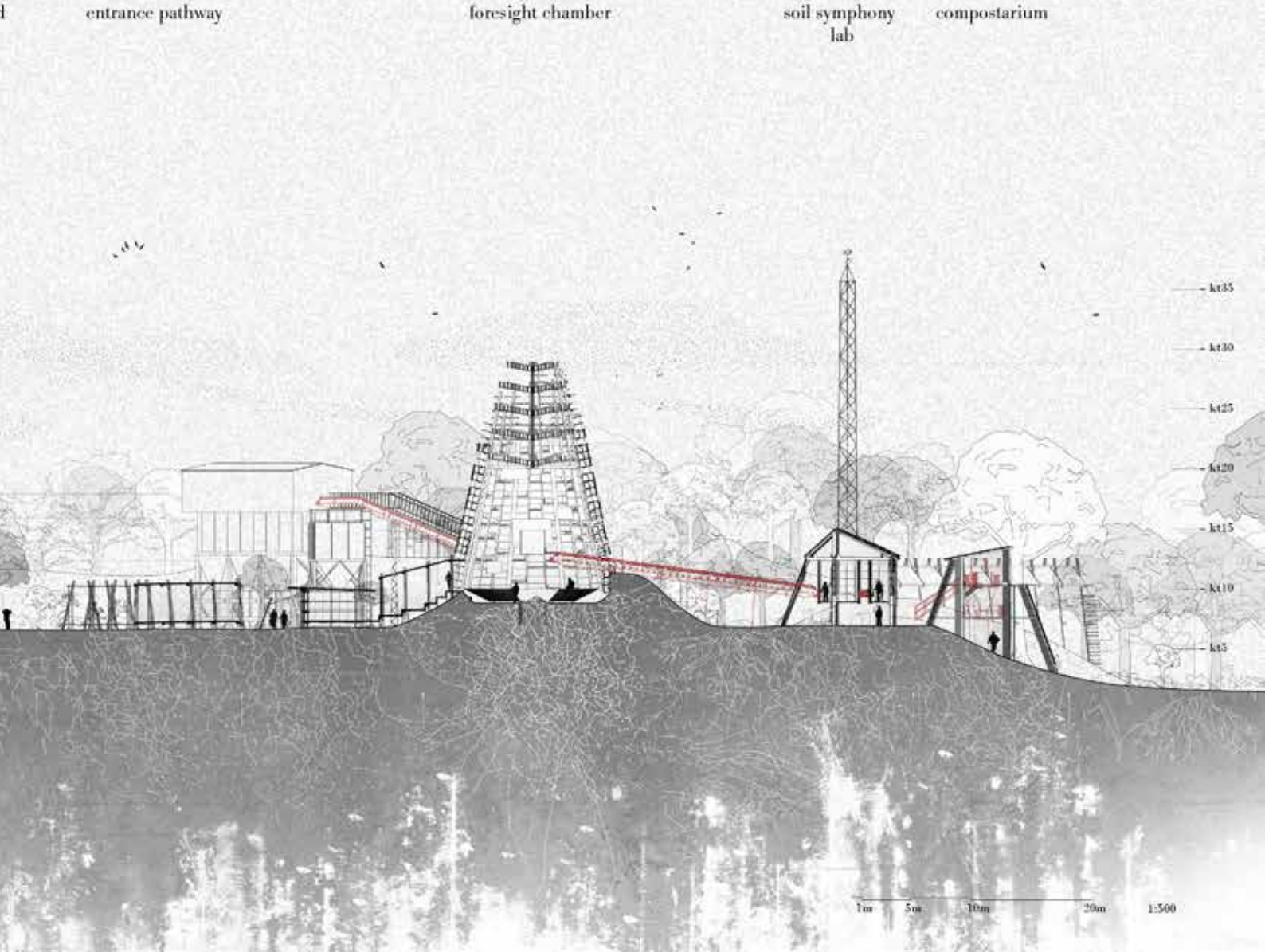
The Institute functions as an actor for soil and ecosystem regeneration, knowledge sharing, and multispecies negotiation.

Through the initial restraining of Stenrands past extractive infrastructures, their shift in agency helped form new grounds upon the ones they had been depleting.

Conveyor belts, aggregate hoppers and other ruins became sources of life instead of taking it. Existing belts at site carefully move soils for consultations in the Foresight Chamber, while others are sliding into the Soil Symphony Lab for inspection, testing and monitoring. Aggregate hoppers functions as compost containers and experimentariums, elsewhere others become seed banks.

With time, the composting acts of the community and the architecture helps the nurturing of the bioinfrastructure beneath the ground, helping the nature at Stenrand do its work, storing carbon and taking root to create feral dynamics and support the slow, ongoing processes of ecological regeneration.

ill. 106 Site section, 'Institute of Soil Regeneration', 1:500



Protest Becomes Laboratory: Scaffolding New Symphonies of Use

Echoes from futures

Mycorrhizal fungi

2732 years old

Nutrient exchange specialist

Topsoil remnants at Stenrand

2047

The belts run slow. Energy is rationed. It's dim and just warm enough, Kim is wearing the jacket inside her coat, yet comfort doesn't mean warmth anymore, it means attunement.

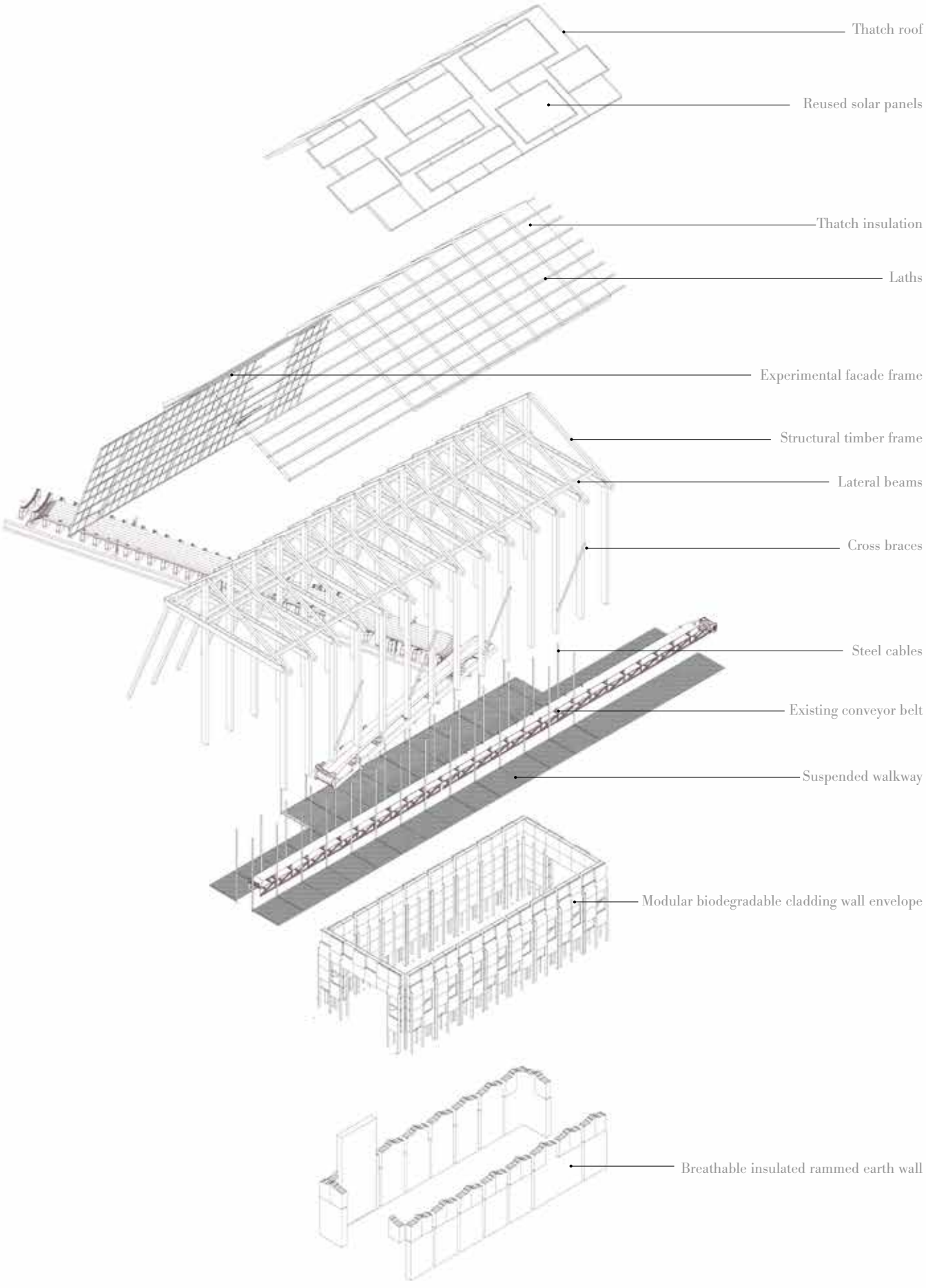
Thermal comfort is less about control now, it's about consent with the climate.

Lars and Jack are scrambling in the back, preparing a new soil batch for the Foresight Chamber. They don't rush, time moves differently these days.

And you're finally listening. The LCA 2.0 - your new tool, it translates what we've been whispering for centuries, site health, species integrity, our interconnectedness. You're figuring out how to care without needing to be in charge.

Soon in the Foresight Chamber, you'll consult the batch. You'll hear from us, the voices you once plowed over.

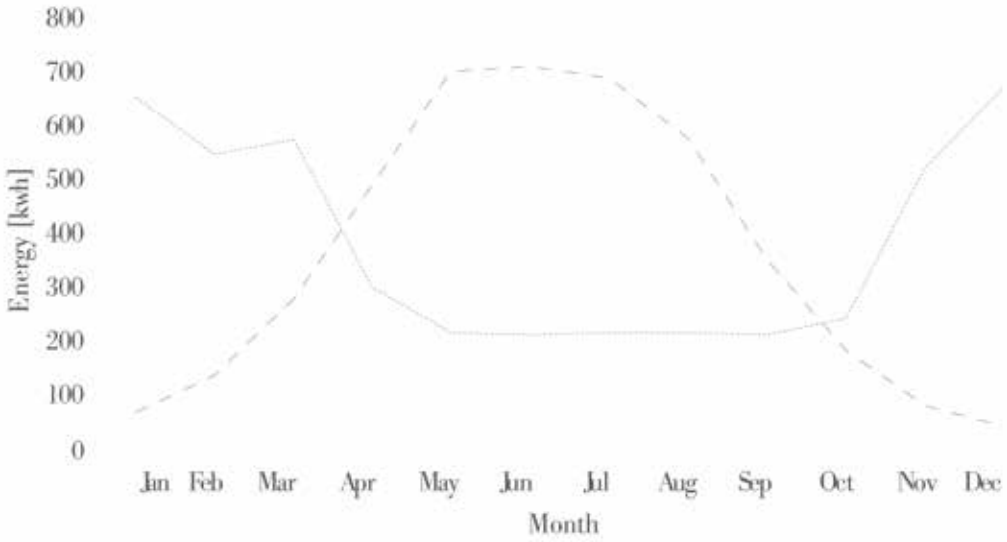
ill. 107 Interior render of the Soil Symphony Lab



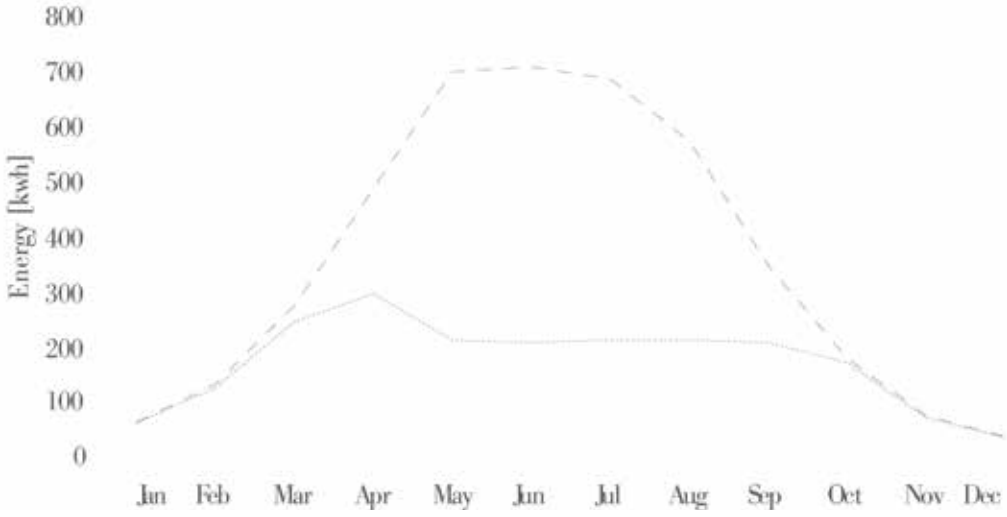
ill. 108 Exploded axonometry of the Laboratory

Monthly Energy Balance:
Demand vs. PV-Supply,
(BR18 Assumptions)

The energy demand has been calculated using an energy performance assessment in BE18, while the energy supply has been calculated separately. The full calculation can be found in Appendix 2.



Monthly Energy Balance:
Constrained to PV-Supply capacity



— — — Energy supply

---------- Energy demand

ill. 109 Simulations of energy supply

Slowing Down: A New Architectural Ethic of Energy and Existentialism
The foundational ideas of the scaffolding was resting on paradoxes of scarcity and abundance. Whats more is that Kim had learned from Omar, who was carried North by the heat, that there could be great value in imposed limits. With these learnings, the space within the Soil Lab constantly negotiated with the rhytms of the land and the ecological margins.

Kim and her colleagues had no problems at all slowing down, in fact, they felt the flourish and freedom through voluntary limitation. The power of slowing down was not in resignation, but in intention, Omar had told Kim. Thermal comfort was instead about learning to move with the climate, rather than trying to conquer it. Negotiating with the seasons rather than dominating them. Kim began to see that freedom might not lie in constant control, but in choosing to live within boundaries, finding an ease. Hereby, activites within the Lab followed ecological patterns, reducing heating input, energy use and expectations of thermal comfort.

Echoes from futures

Lars

51

Corporate exec. turned activist

Copenhagen

2048

I just returned from composting. It seems the soil is pulsing with life and so are we. By repairing it we repair ourselves.

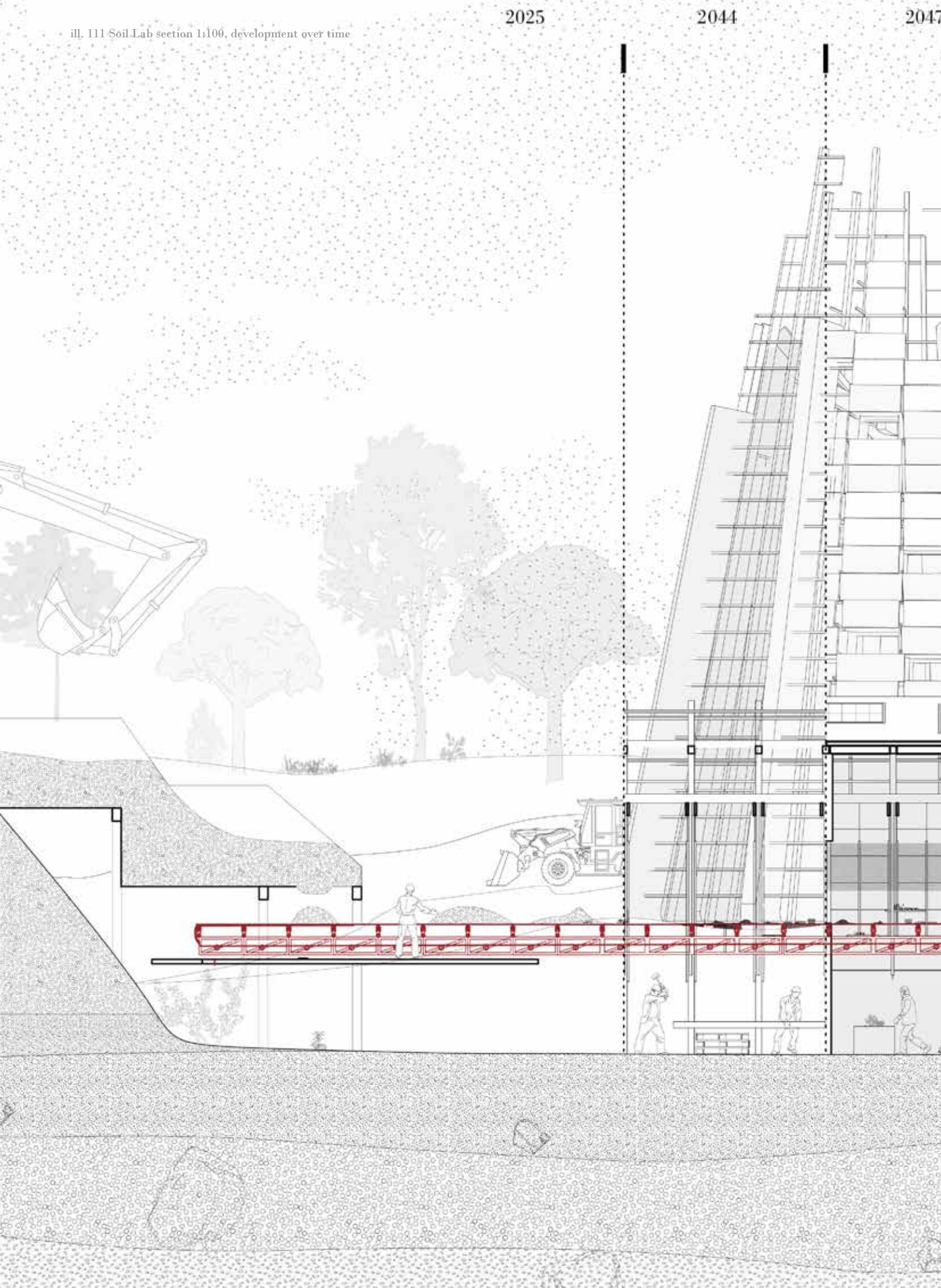
Now the gentle hum of the hologram screen is whispering stories of resilience and renewal. Louder than what the belts once did.

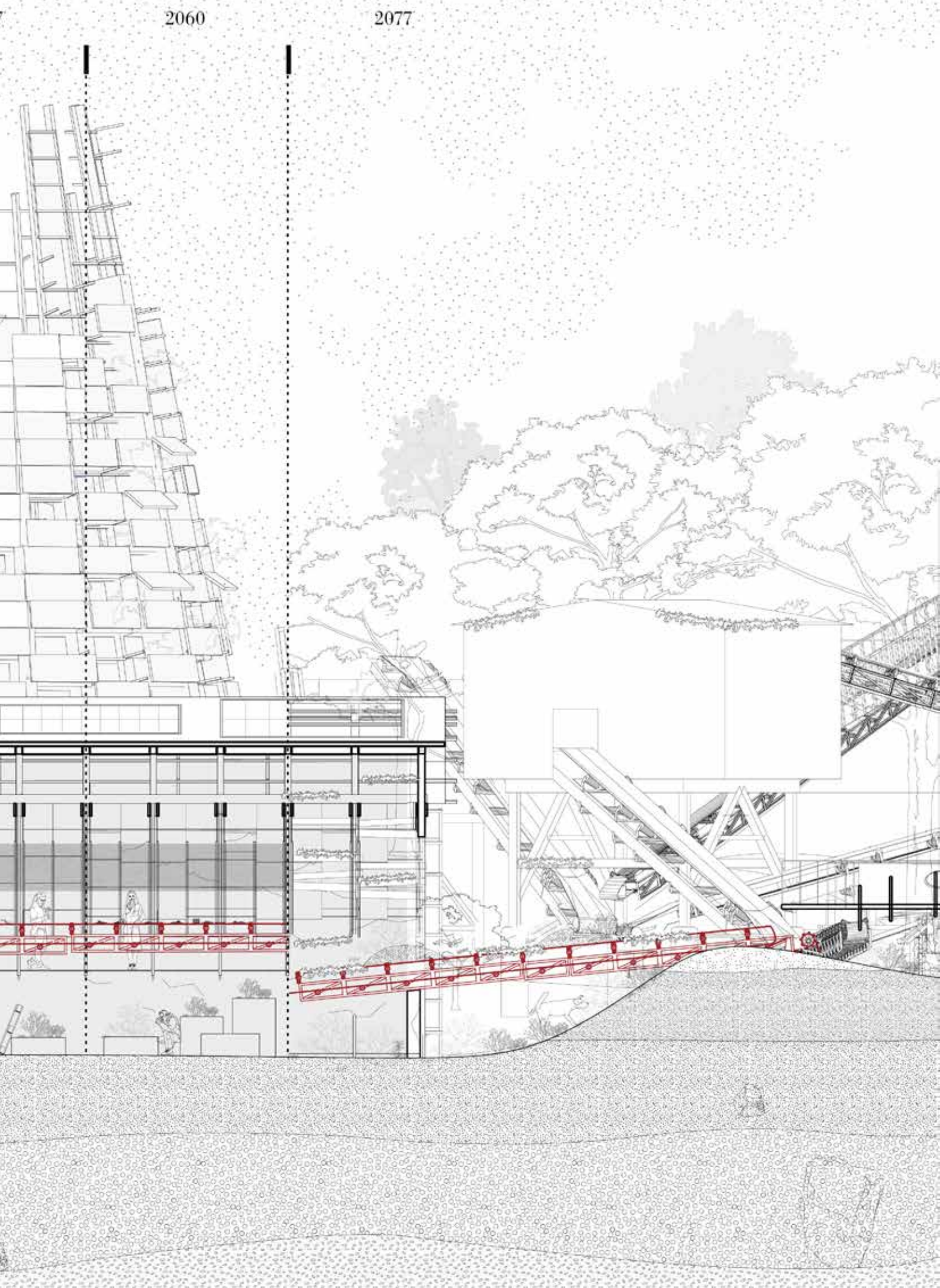
Despite all this data, all our gestures balance between soil health and social healing. It's not really science, it's the art of unlearning old fragments and embracing new ways of solidarity.

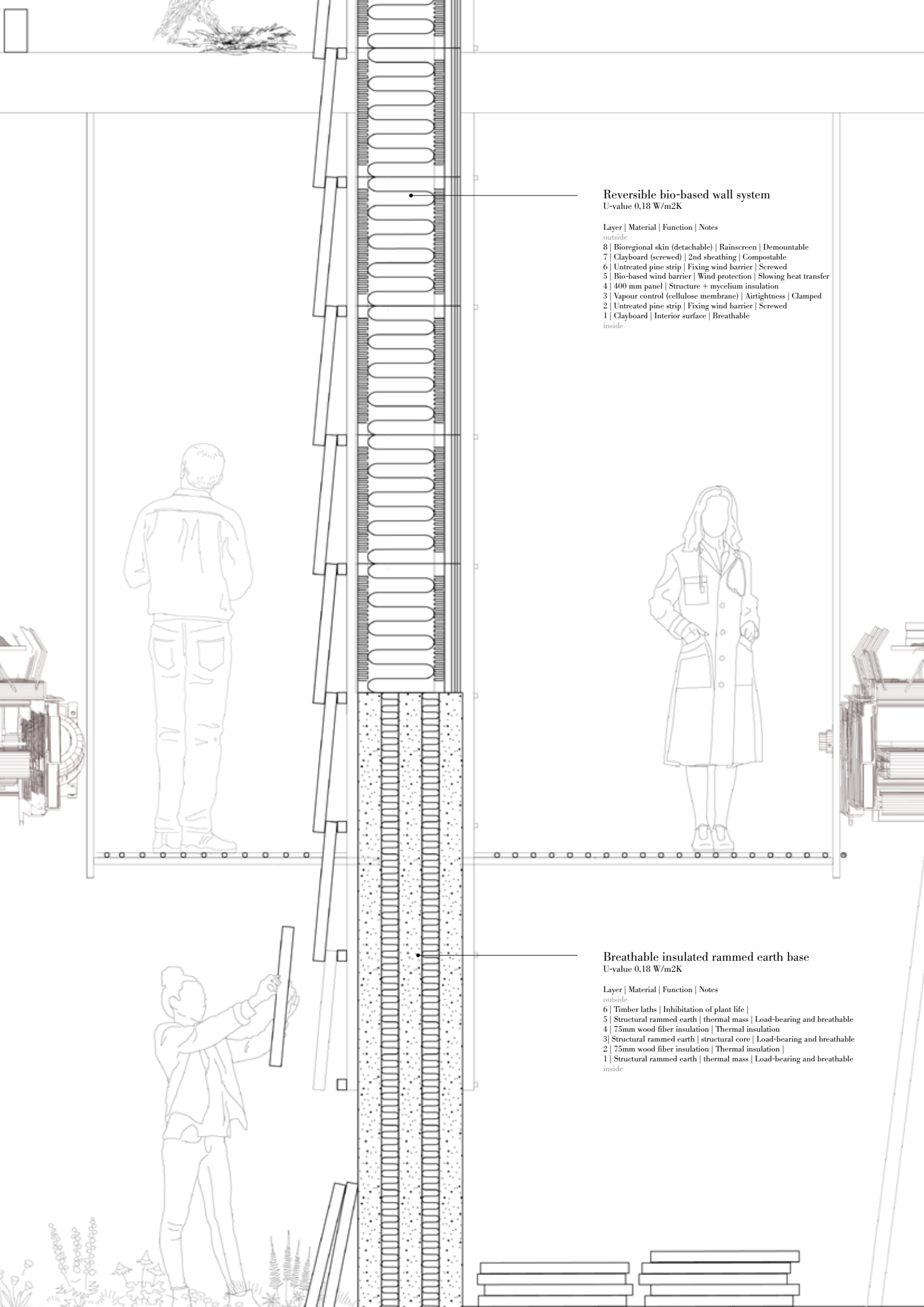
Our collective and its micropolitical acts ripple outwards. Brief talks, pauses and careful listening, slowly making space for something different. The joy we find is subtle, but real. It is born from slowly rebuilding trust and from the shared feeling that both the earth beneath us and the people beside us are healing.

ill. 110 Visualisation, hologram of site health monitoring and LCA 2.0

ill. 111 Soil Lab section 1:100, development over time




2060
2077



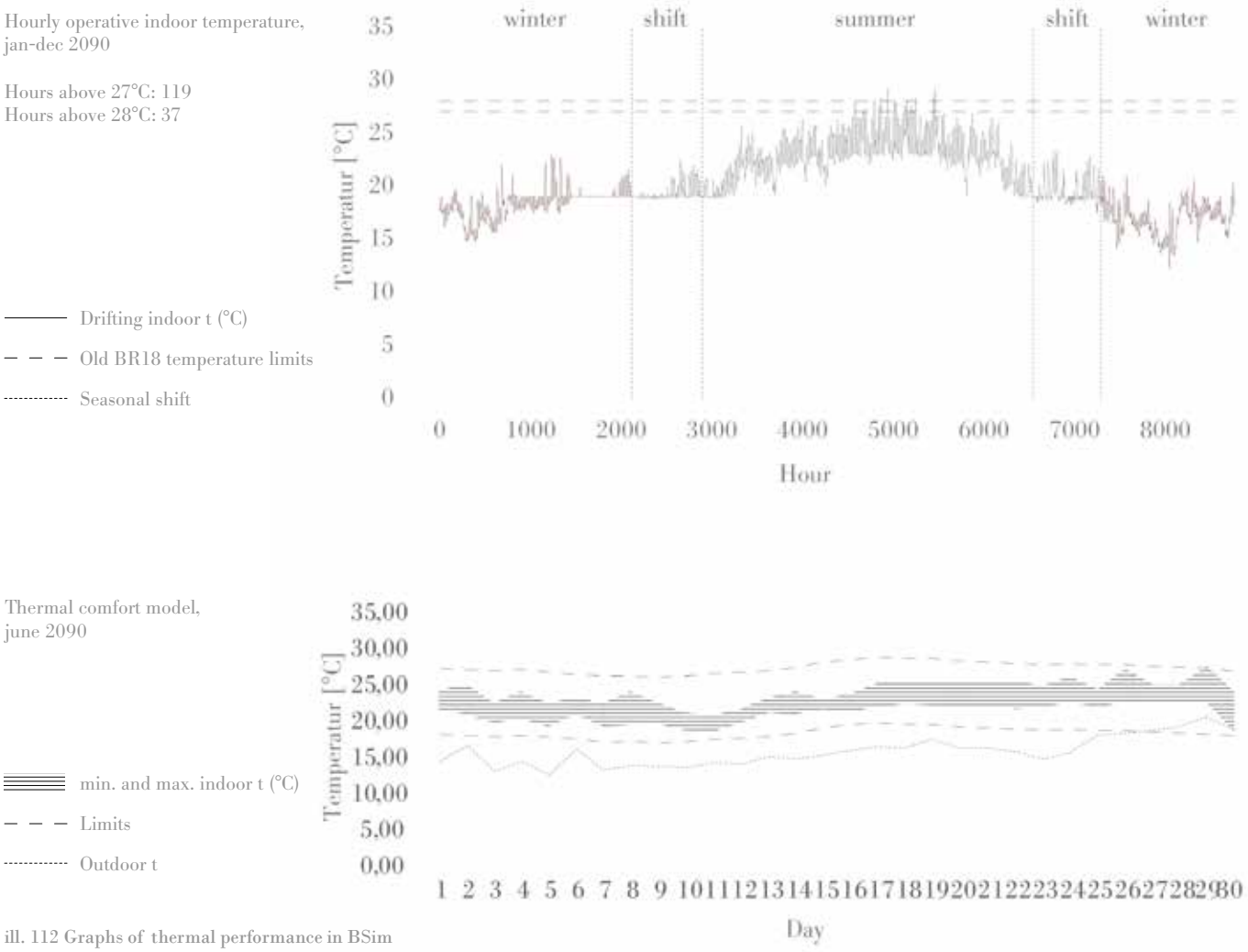
Reversible bio-based wall system
U-value 0,18 W/m2K

Layer | Material | Function | Notes
outside
8 | Bioregional skin (detachable) | Rainscreen | Demountable
7 | Clayboard (screwed) | 2nd sheathing | Compostable
6 | Untreated pine strip | Fixing wind barrier | Screwed
5 | Bio-based wind barrier | Wind protection | Slowing heat transfer
4 | 400 mm panel | Structure + mycelium insulation
3 | Vapour control (cellulose membrane) | Airtightness | Clamped
2 | Untreated pine strip | Fixing wind barrier | Screwed
1 | Clayboard | Interior surface | Breathable
inside

Breathable insulated rammed earth base
U-value 0,18 W/m2K

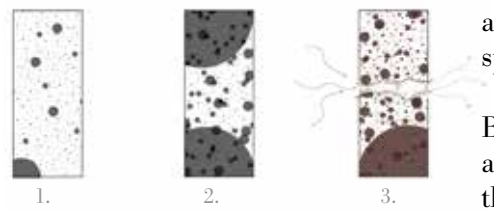
Layer | Material | Function | Notes
outside
6 | Timber laths | Inhibitation of plant life |
5 | Structural rammed earth | thermal mass | Load-bearing and breathable
4 | 75mm wood fiber insulation | Thermal insulation
3| Structural rammed earth | structural core | Load-bearing and breathable
2 | 75mm wood fiber insulation | Thermal insulation |
1 | Structural rammed earth | thermal mass | Load-bearing and breathable
inside

Thermal Performance of Speculative Wall Systems



ill. 112 Graphs of thermal performance in BSim

From the paper: "Pine-Cone Infused Rammed-Earth Structure (Bundgaard J., Gad M., Kim B., 2053)



Earth Bound Material Discovery and Innovation

1. Soil (clay and silt)

2. Rammed earth (sand and clay)

3. Pine cone injected rammed earth

ill. 114 Adapted from Permaculture Soils Perspective (Oregon State University Ecampus, 2017)

ill. 113 Lab wall construction, 1:20

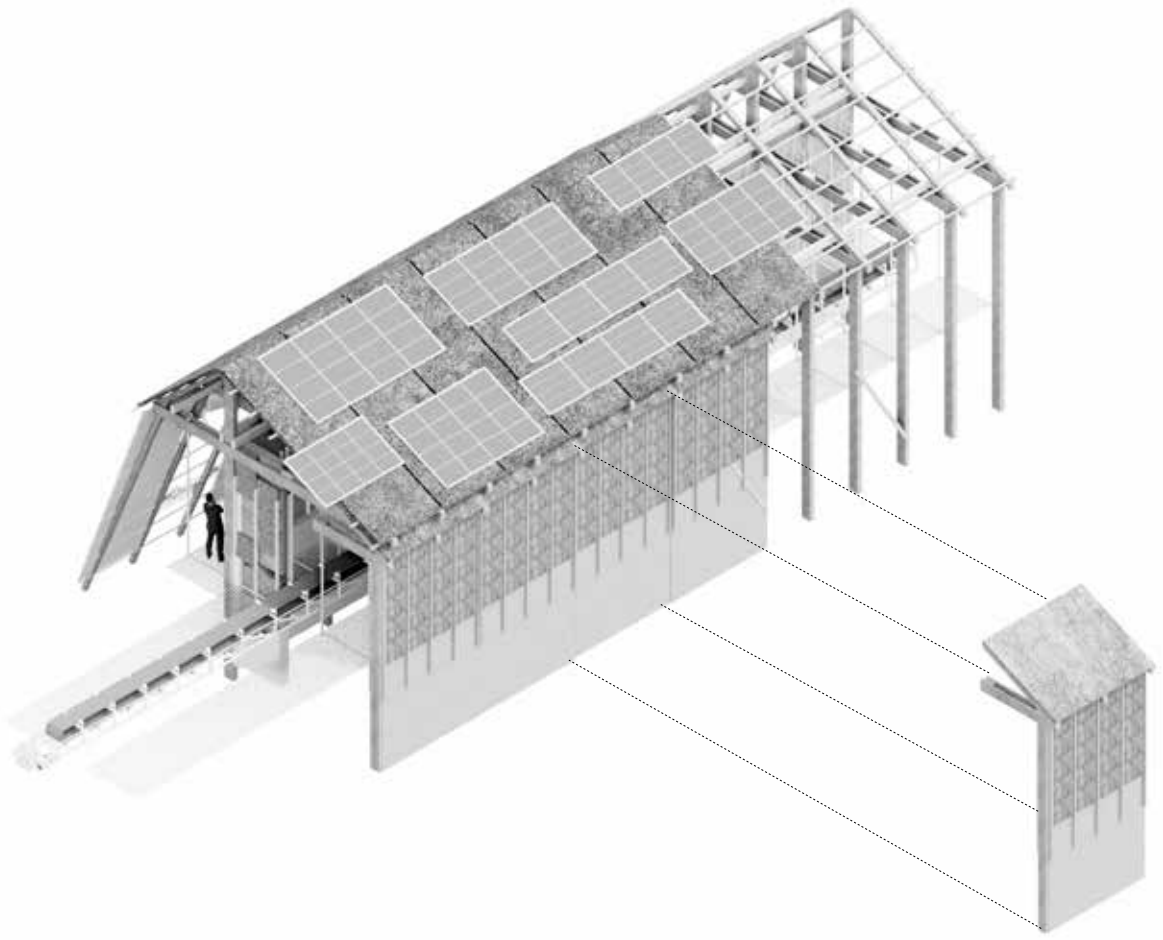
Breathing Walls, Moving Bodies

The effects of slowing down soon began to show. In the first year of monitoring the building's thermal performance, it showed that indoor temperatures followed the natural rhythm of the seasons. In winter, the rooms were colder, but this suited the Institute's new approach, which encouraged more physical activity and movement between indoor and outdoor spaces. As a result, people simply kept their coats on.

Between the scaffolding's frames, a rammed earth wall slowly took shape as the base, topped by a modular wall system on the first floor. What made this wall special was a simple yet clever detail: pine-cone pores mixed into the earth. These pores weren't just decorative—they opened naturally at around 19°C, letting the wall breathe with the changing temperatures.

As summer came, the team watched closely. Using an adaptive thermal comfort framework, they discovered the wall was performing beautifully, offering just the right amount of natural ventilation to keep the indoor air fresh and comfortable. Beyond this, they measured air change rates, tested air quality, and even projected how the wall might hold up under future climate scenarios, details carefully recorded in appendix 3.

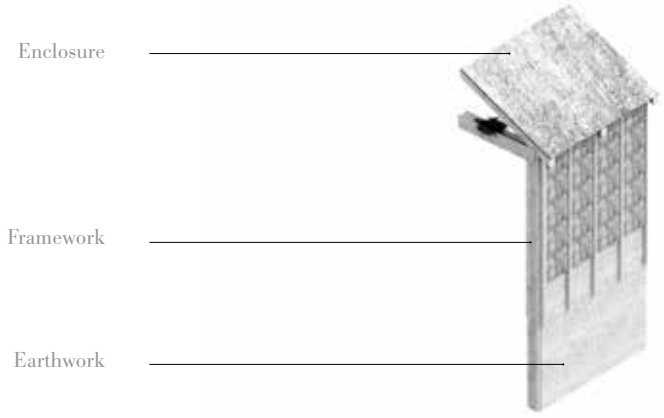
Metabolic Fragment



The wall was not just a structural solution. It became a prototype - a sort of condensed manifesto of ecological principles. It proved its thermal logic, breathability, and material composition. The approach was replicated elsewhere - and created a family of kin-structures. From a single wall to the framing of entire spaces, the logic expanded. A reversal of the permaculture adage 'from pattern to details' - here, the detail became the pattern.

ill. 115 Axonometry of Lab with wall excerpt

Kin Structures and Tectonic Repetition

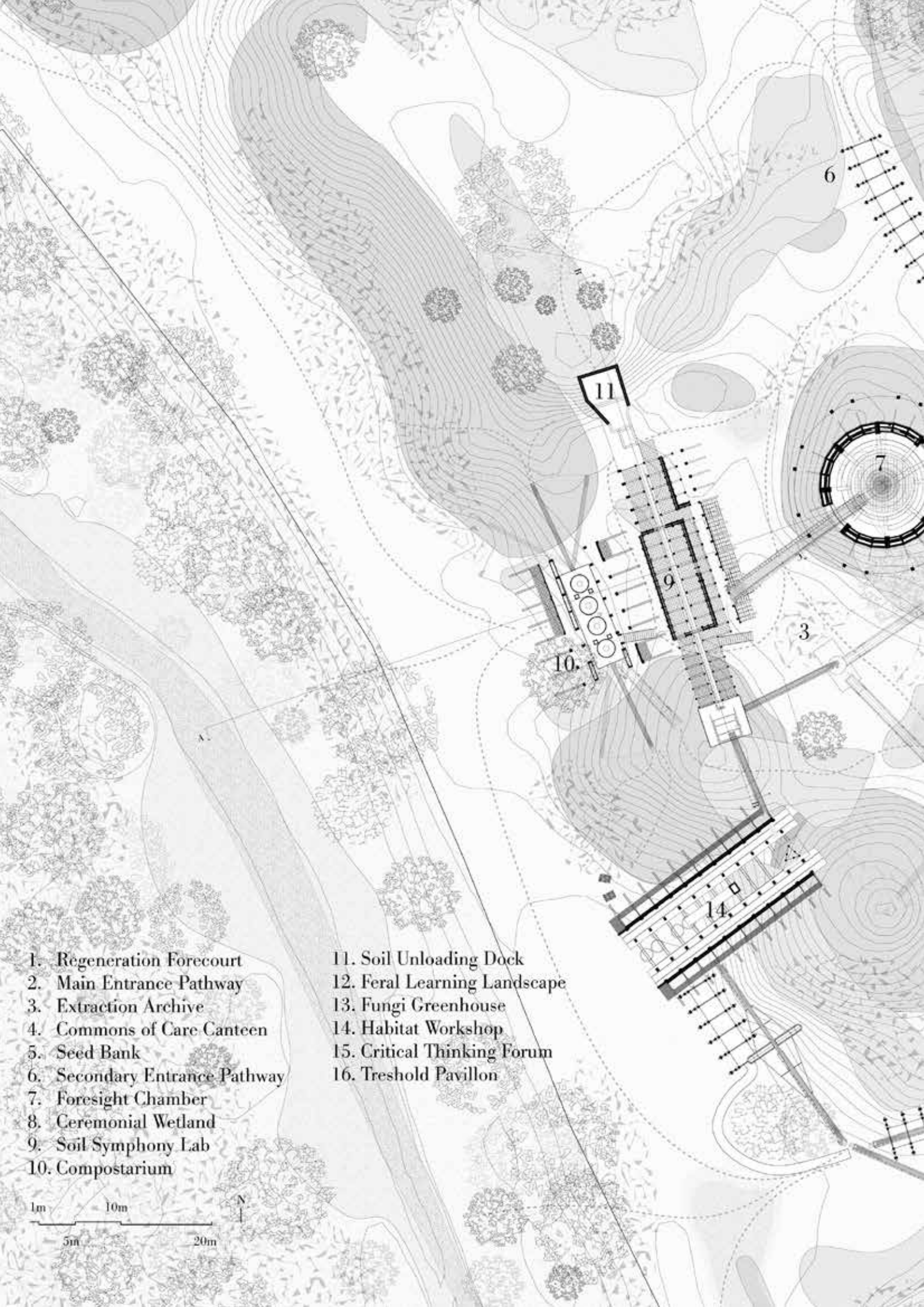


Soil Symphony Lab fragment

Unlearning Studio fragment

Decomposable Hallway fragment

ill. 116 Axonometric sections of modules, Kin Structures



1. Regeneration Forecourt
2. Main Entrance Pathway
3. Extraction Archive
4. Commons of Care Canteen
5. Seed Bank
6. Secondary Entrance Pathway
7. Foresight Chamber
8. Ceremonial Wetland
9. Soil Symphony Lab
10. Compostarium
11. Soil Unloading Dock
12. Feral Learning Landscape
13. Fungi Greenhouse
14. Habitat Workshop
15. Critical Thinking Forum
16. Treshold Pavillon

1m 10m 5m 20m N

ill. 118 Site plan 1:500

The Foresight Chamber:
Architecture as Remedy, Skin as Governance

Echoes from futures

Sparrow hawk

6

Guardian of small birds

Native to Europe

2060

ill. 119 Visualisation, gathering in the Foresight Chamber for multi-species governance

The eventual decomposition of the Chamber is synonymous with a collaborative, interspecies regenerative practice throughout the Institute on site. Co-existence is contantly negotiatied with the goal of increasing the many different life cycles of the site and its actors.

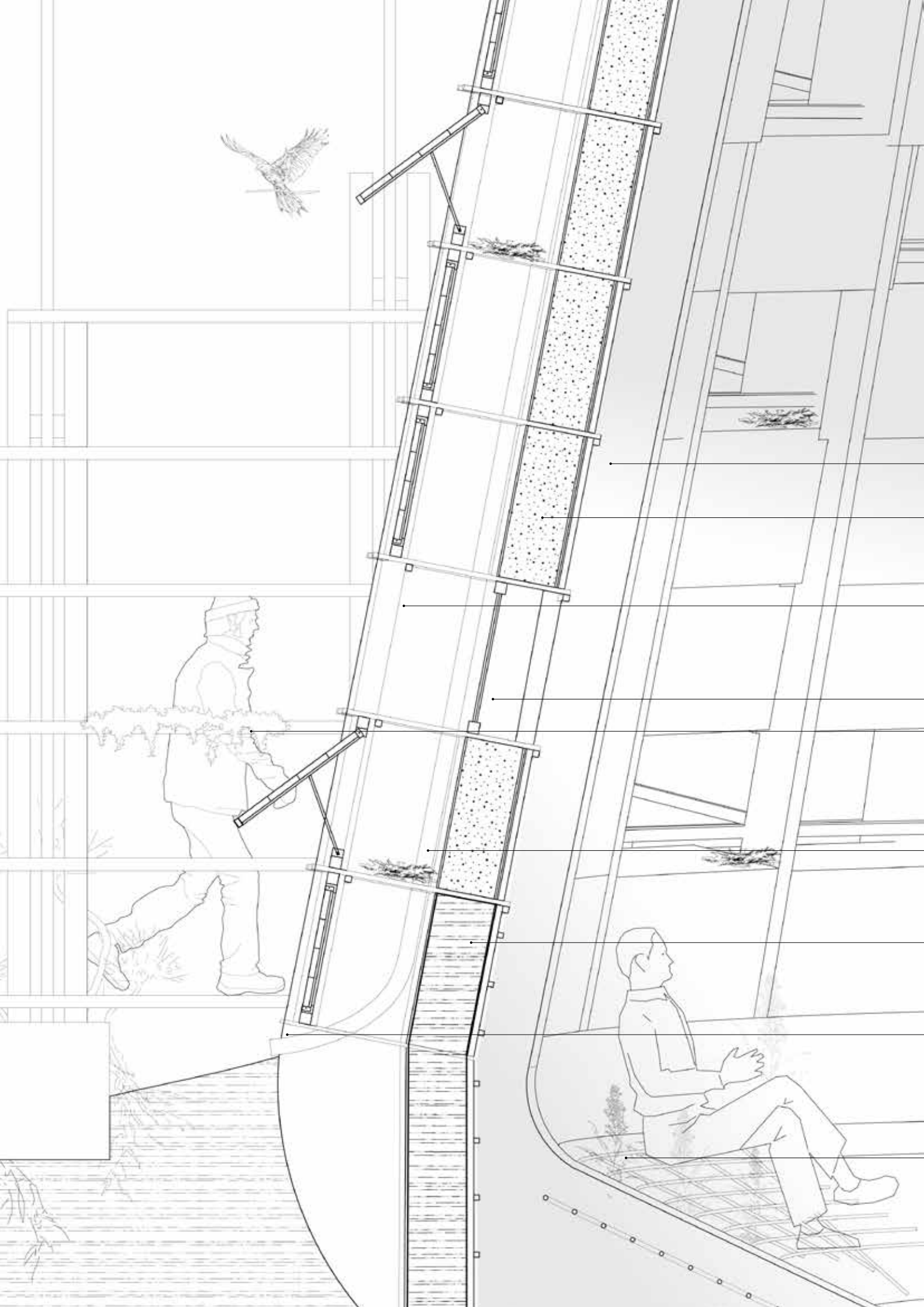
It is a bit weird seeing these people settle here, they stopped using some of the machines but some of them are still running. Normally they use the really big machines to dig and tear down, but this group, they use them in another way! I'm used to sweeping away when the rattle of the machinery started, but nowadays it has been replaced by a dozing slumbruous buzz. The belts run so slow that there is space for all here!

They we're so kind to build this chamber where the edges are inhabitable, there's space for us! I overheard that with time, the belt will pour enough soil within the chamber so that it will nourish the old depleted ground beneath the gravel mound - and I think its true! Those mycorrhizal fungi grow everywhere, and apparently its a good sign, a sign of life! But what they meant was that it is a space that returns to the ground over time, returning to the soil, just like when we build nests of twigs!

They said something about returning the promise of the building, so that it restores and simultaneously lets us tell the stories of Stenrands ecology together! In here they listen to us, and we speak together, discussing our perspectives as well as theirs. Sometimes we don't agree, but we are learning to co-exist more than before.

It is amazing what can be unpacked from a patch of soil. With this space, we increase both the soil health, together, but also our own.

It really seems that they're learning from us after all.



The Inhabitable Skin:
Material Interfaces for Soil and Species Health

Reused timber frames from mechanic workshop

Seed tank (insulating properties)

Pollen injected skin of natural parts

Glazing

Inhabitable envelope

Inhabitable envelope

Breathable rammed earth wall

Gutter nurturing the soil with runoff water

Terraced landscapes as habitats for plants and seating for human

ill. 120 Detail wall section, 1:20

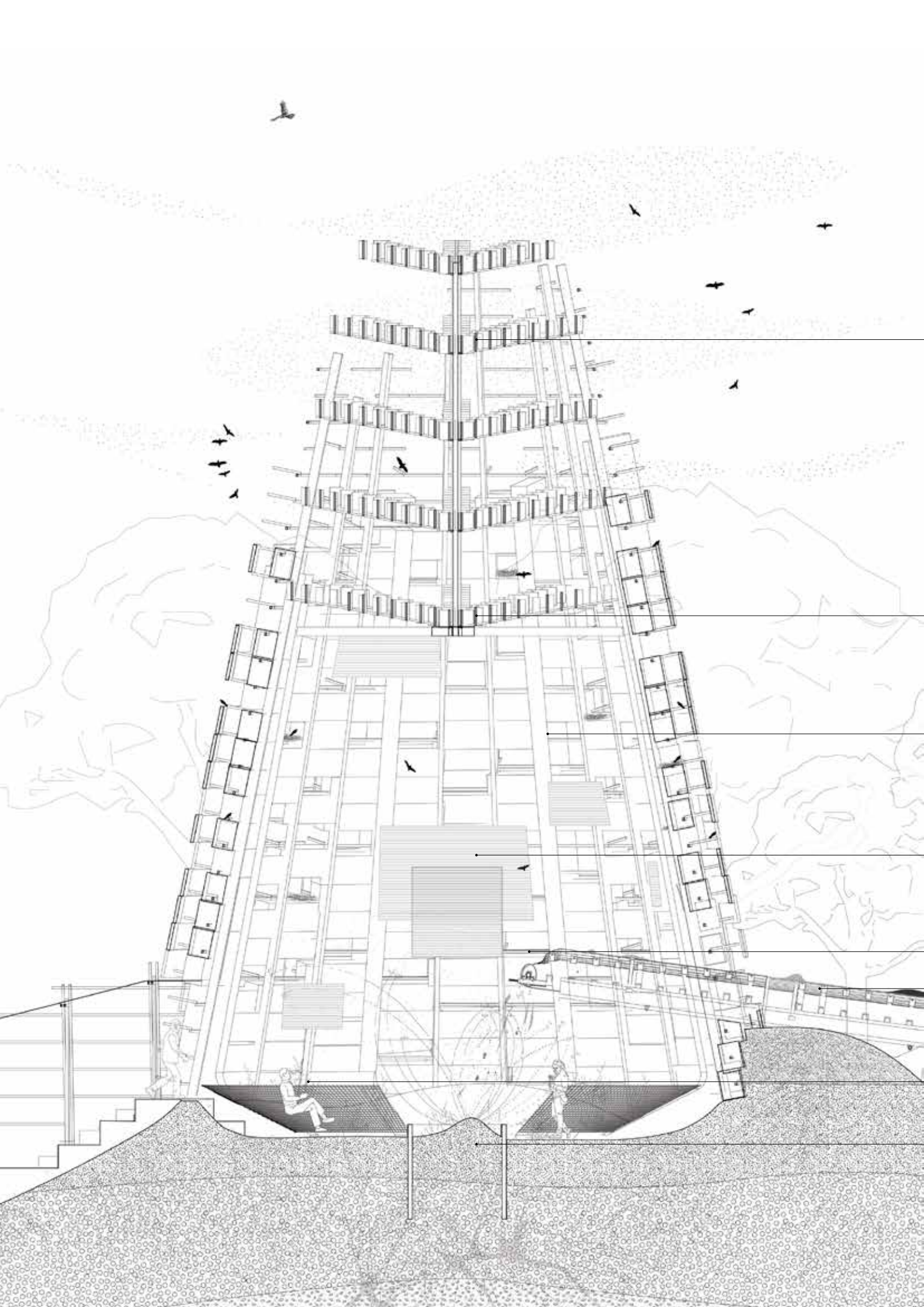
ill. 121 Reclaimed steel offering support structurs for plants to climb

ill. 122 The seating arrangement offers suboptimal comfort for humans, negotiating their own to remove them from anthropocentric viewpoints when discussing soil health in the in the Chamber

Architecture for More-than-Human Governance

Finally, the Institute evolved. As the culmination of the kin-structures, the Foresight Chamber marked a significant stepping stone - as a space centered around soil and built for co-existence, where a new form of regional governance began to take shape. In the presence of more-than-human beings - plants, animals, fungi - collective decision-making took place, embracing a multispecies community and extending far beyond human interests alone.

The chamber became a site for negotiating complex ecological and social futures, where decisions were shaped in ongoing dialogue with the diverse species inhabiting the space. It highlighted a radical rethinking of agency and responsibility. One that suggested a future where architecture no longer imposed itself upon nature, but instead acted as a facilitator of reciprocal relationships between all inhabitants of the place.



Seeding Decay: Architecture as a Catalyst for Regeneration

ill. 124 Detail of seed dispersing roof

ill. 125 Inhabitable skin

ill. 123 Section of Foresight Chamber and soil delivery from conveyor belt, 1:100

A Living Structure that Shelters and Renews
Elevated above the treetops, at the upper part of the Chamber, the seed tanks were exposed to high-altitude winds. These winds helped in dispersing the seeds of pioneer species across the degraded landscape, supporting ecological regeneration.

The building envelope was clad with locally sourced, borrowed materials such as birch, bark, and reed, from the surrounding landscapes. The offset and open cladding provided nesting opportunities for birds, which plays a vital role in initiating the buildings gradual decomposition. By extracting materials for nest-building and through the natural effects of their excrement, the birds contribute to the biological processes of decay.

Sheltered from harsh conditions, the internal environment provided good conditions for the establishment and development of threatened plant species. The base of the chamber was layered with reclaimed steel grating, offering a supportive structure for climbing plants to take root and grow.

Biological Circularity and Maintenance

Architecture as Bionutrition instead of Biodegradation
Throughout the scheme of the Institute, the concept of biological circularity activated both the architecture and its occupants in a regenerative process. Humans have found a way - or rather, felt obligated - to care for living matter throughout its entire lifecycle. This was a kind of alternative hedonism, where purpose was found not in extraction, but in the slow, shared rhythms of natural systems.

Materials were cultivated and cared for during growth. What can be spared was borrowed, chosen based on their properties and ability to circulate in natural flows. Here, materials were no longer passive components, but temporal participants - temporarily stewarded, not owned.

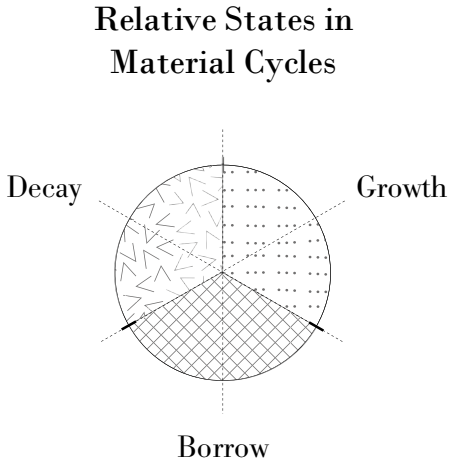
As such, the buildings required more work - or more care. Every part had its own lifecycle and needed to be nurtured and maintained. This introduced a new architectural logic: reversible tectonics. Materials were assembled in ways that allow for disassembly, reuse, and ultimately return - without losing their integrity. Joints were designed to be undone.

Humans were no longer just users. They became custodians, maintainers, and co-agents - responsible for guiding materials through cycles of growth, use, and decomposition. Architecture became a practice of long-term commitment.

ill. 128 Soil Lab facade, belt connection to the Chamber

ill. 126 Willow bark facade panels

ill. 127 Birch bark facade panels



LCA 2.0 - A Nutritional Turn

Ealuation critereas of LCA 2.0:

Soil enrichment - Does it decompose into plant-available nutrients?

Microbial support - Does it host or sustain fungi, bacteria, or other life?

Habitat creation - Does it shelter insects, birds, or native species?

Hydrological buffering - Does it retain or slow water, supporting life cycles?

Thermal & moisture regulation - Does it help balance indoor and outdoor ecologies?

Carbon storage - Does it sequester carbon naturally, without harm at end-of-life?

Beyond Impact: Embracing Life Cycle Assemblages in Architecture

As architecture truly took part in living systems, its evaluation changed. Tools like Life Cycle Assessment (LCA) were outdated, built on linear models of extraction, use, and disposal they merely meaussred reduction of harm, not ecological contribution.

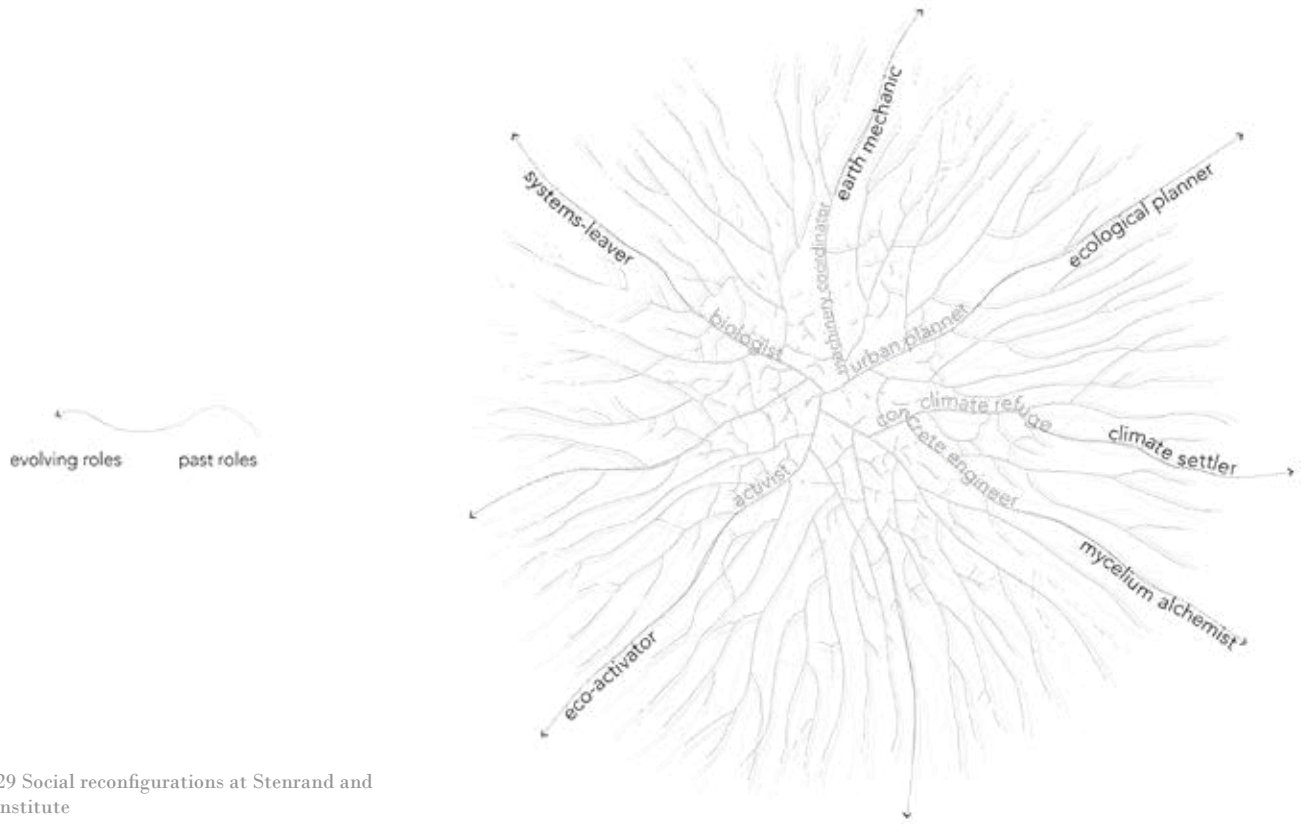
To match the ethos of biological circularity, the new LCA 2.0 valued life cycle assemblages over life cycle assessments. Not only what a material avoided destroying, but what it actively nourishesd.

As materials were living participants rather than passive objects, the assessment included not only their footprint, but for their generosity. LCA 2.0 reframed architecture through a regenerative lens: materials were borrowed, not owned; architecture were not a boundary, but a metabolic interface.

Here, circularity was no longer a technical loop but a biological cycle - aligned with natural rhythms of growth, use, and decomposition. The entire site became part of the system: from microbial networks in the soil to fungal life in insulation, to moisture held in walls, to future compostable decay.

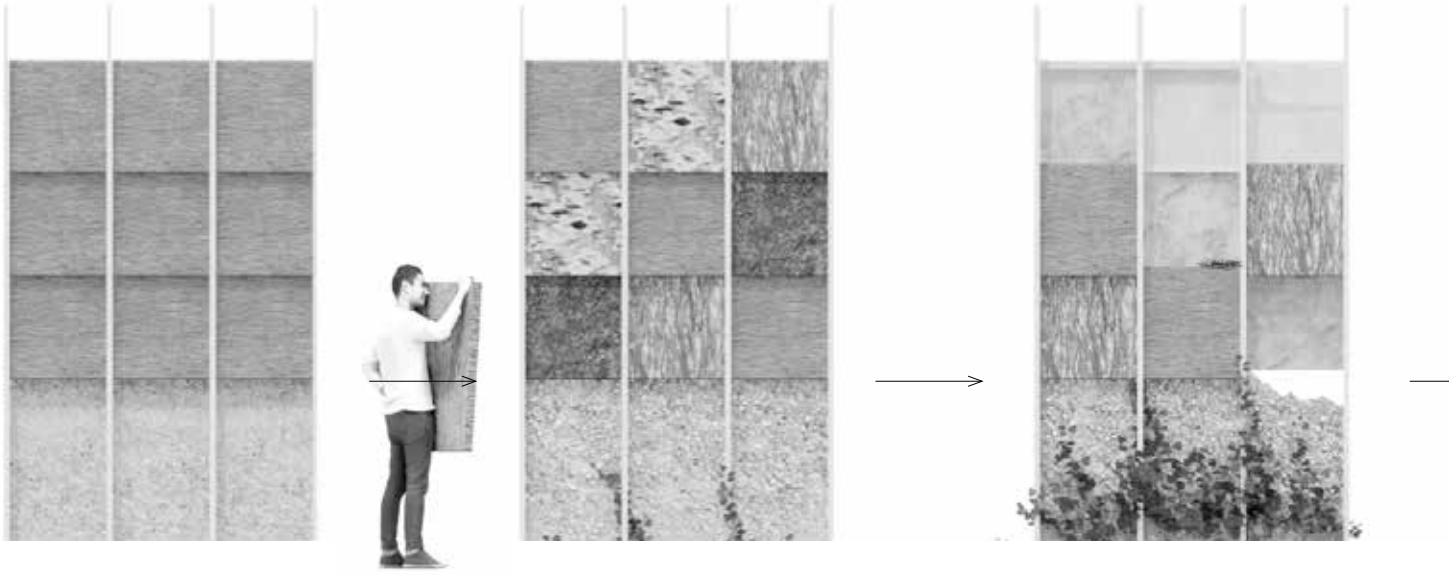
Humans were not outside of this cycle, but within it - as stewards, custodians, and collaborators. Even in regenerative systems, resources remain finite. Sufficiency became a design principle: working with what grows, what returns, and what decomposes well.

The new metric were nutritional score: an evaluation of materials contribution to the ecosystem before, during, and after use. Rather than calculate only emissions, the score asks: what does this material give back?

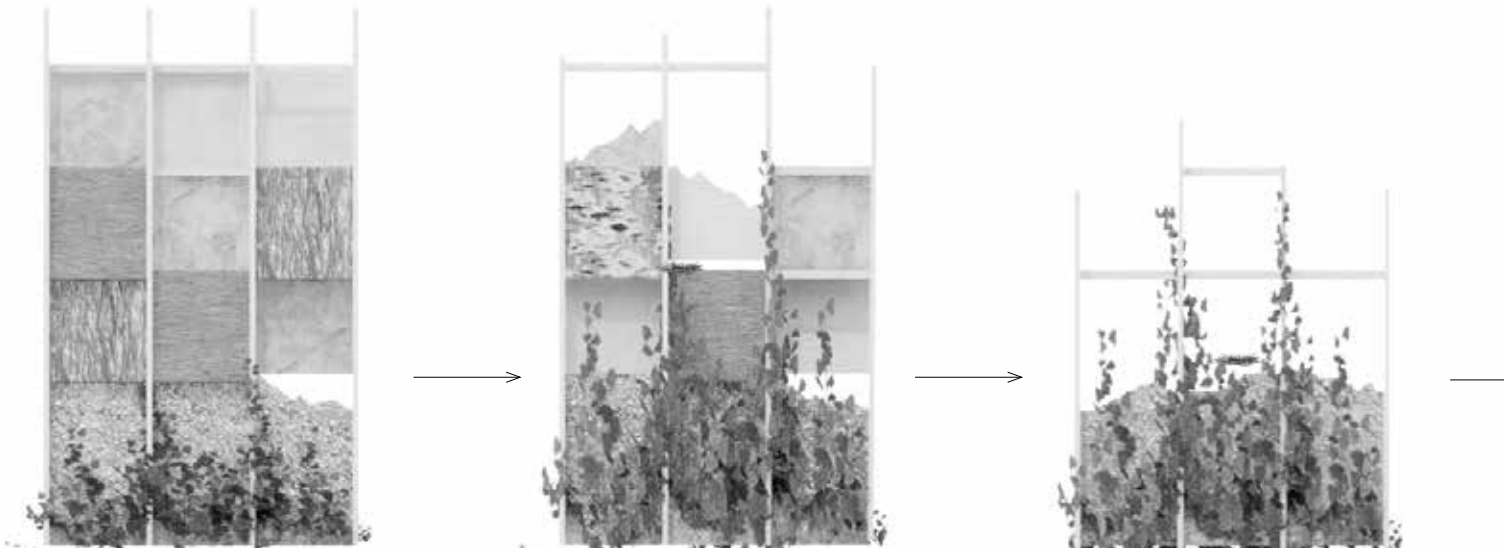


ill. 129 Social reconfigurations at Stenrand and the Institute

The Building Envelope:
A Living Habitat and Decaying Agent

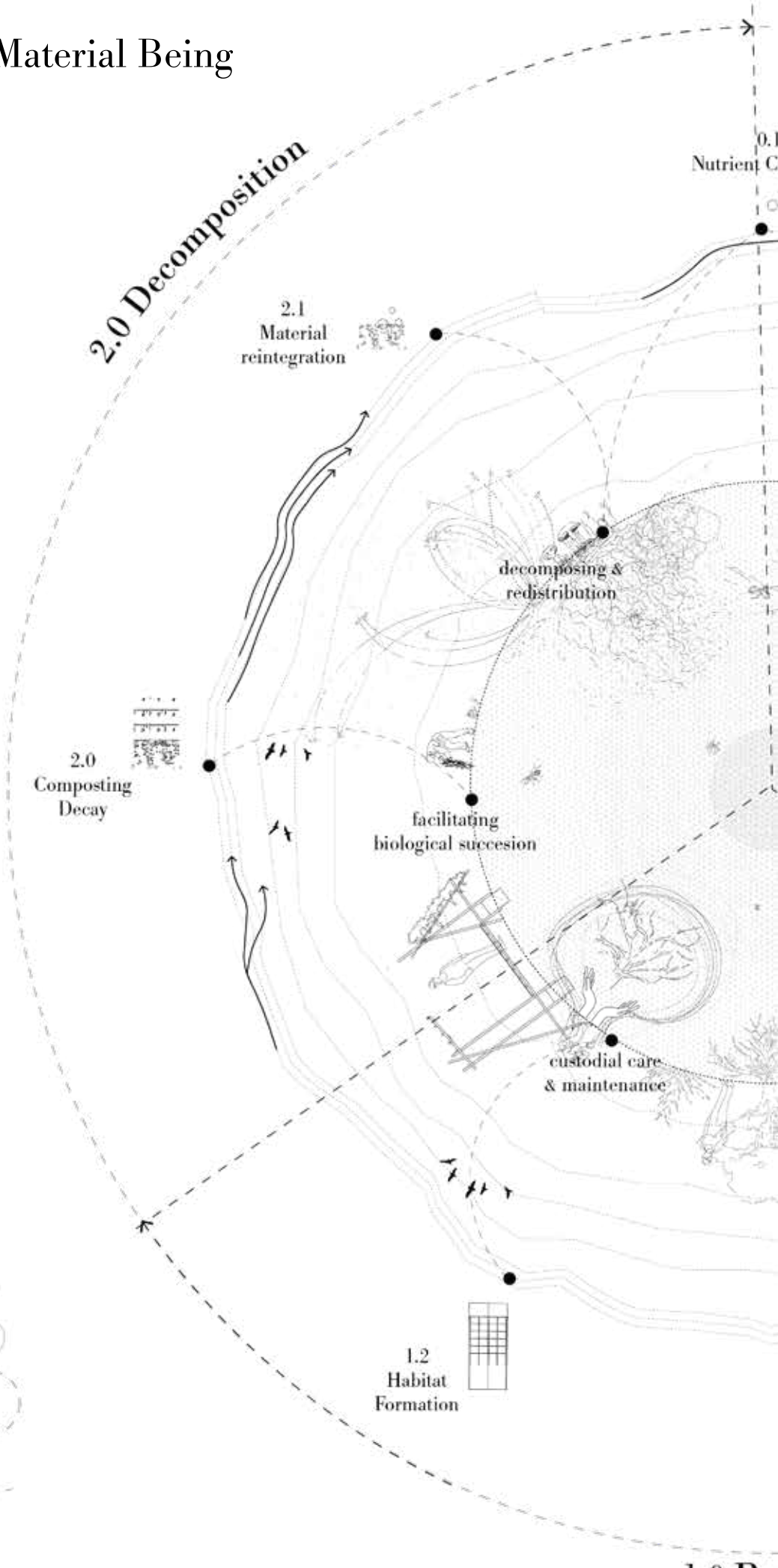


The Envelope as Ecosystem: Shelter, Decay and Renewal
The building envelope - with its untreated cladding - changes character, as maintenance is frequently needed. Simoustanly, it becomes habitat for more-than-human species over a period of co-inhabitation. Later the envelope loses its properties to shelter humans, but it does not lose its value, rather it starts adding value as it enters a state of decomposition, nurturing the soil and becoming habitats for even more species.

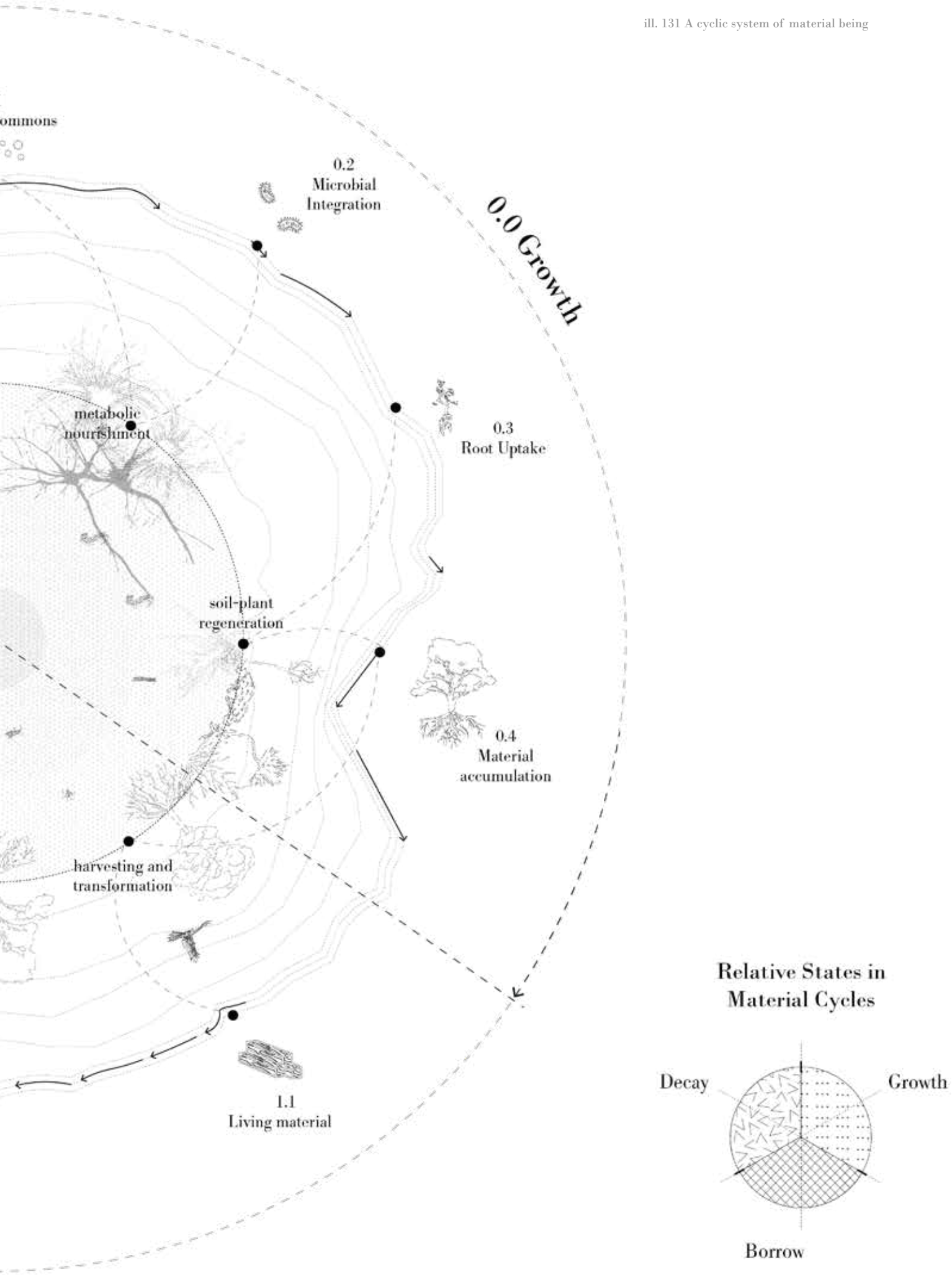


ill. 130 Cycles of building/material states

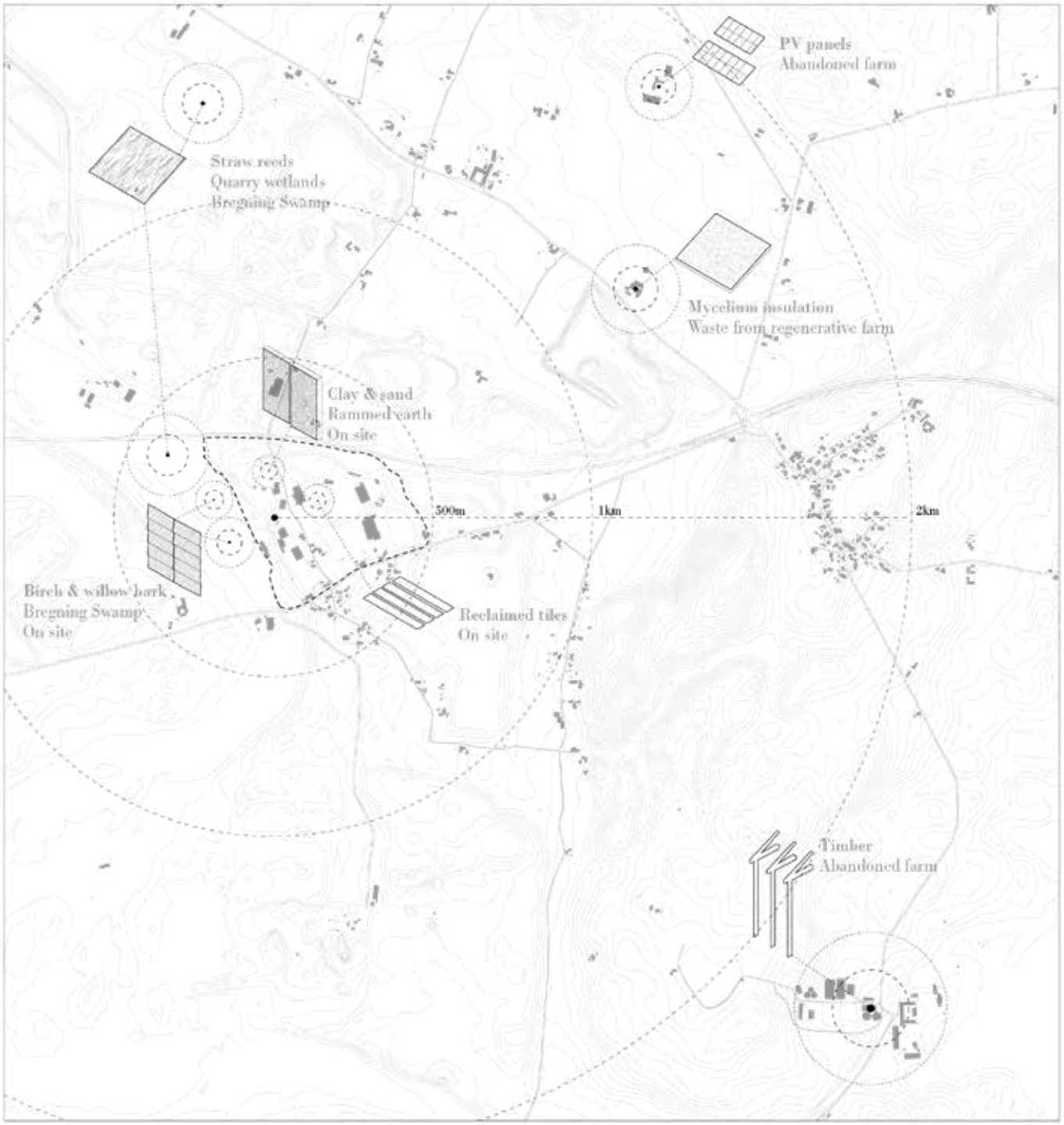
A Cyclic System of Material Being



ill. 131 A cyclic system of material being



Assemblage of Landscapes



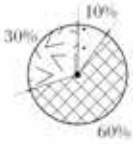
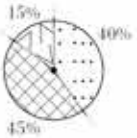
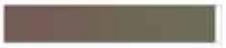
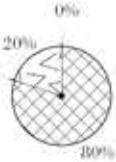
Bioregional Design

An overview of the harvested materials across the Institute, reveals that architecture is inherently linked to agriculture. By these means, buildings are assemblages of landscapes, always bearing a trace of history and leaving footprints. An orientation towards biogenic materials cultivates attentiveness about lifecycles, care and maintenance. In order for the built Institute to enable regenerative processes, perceptions of the lifecycles of matter are extended. Instead, in order to regenerate depleted soil and ground, nutrition is an added metric, past the (initial) functionality (shelter etc.) being for humans. Bioregional design in this sense, produces a less harmful practice, less externalities and deals with the terms of the land and its cycles.

SITES OF SOURCING & RETURN

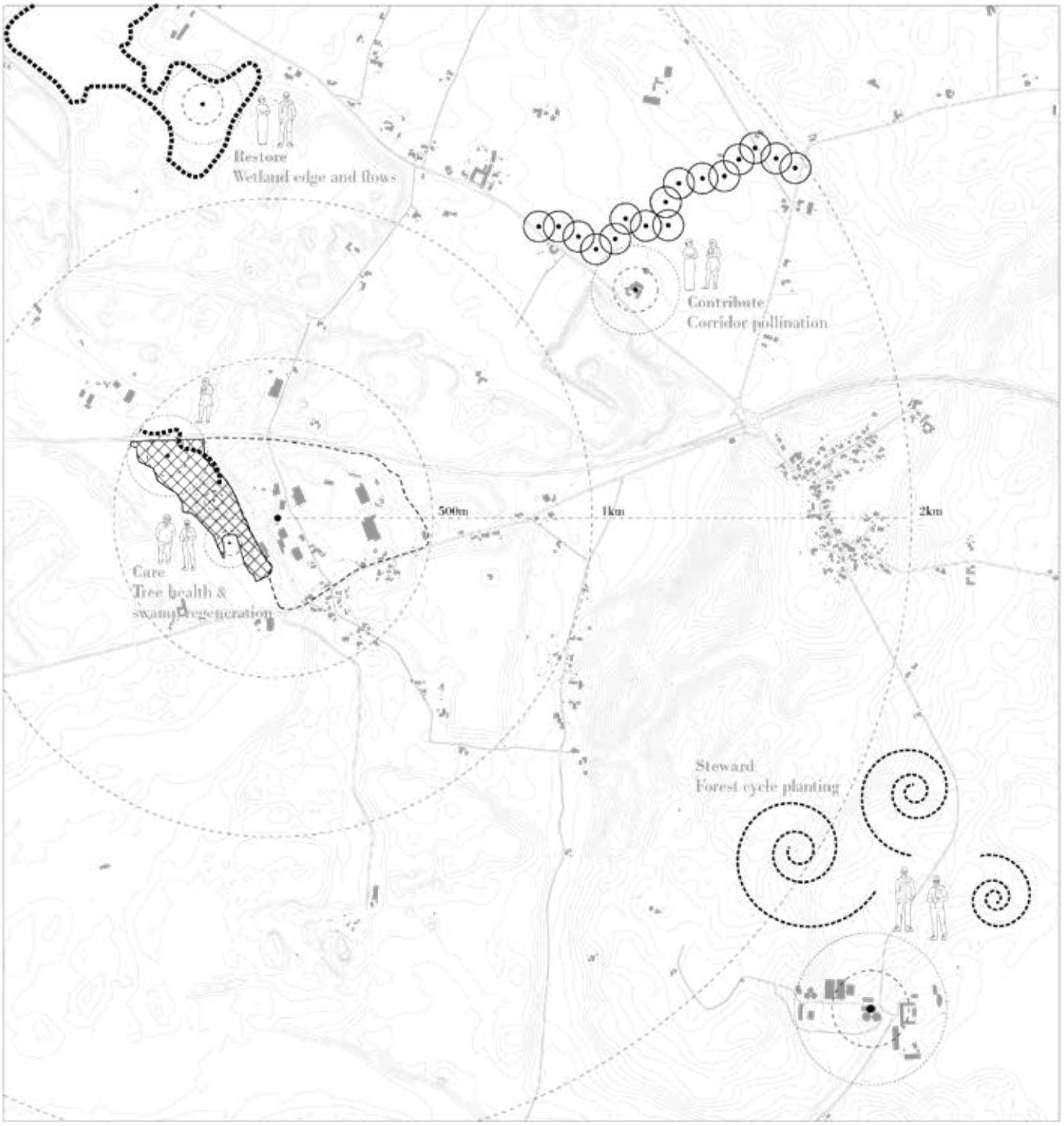
Sourcing / Restoration

ill. 132 Material gathering in and around Stenrand, 2044

Material / Component	Lifecycles	Ecological Function	Nutritious Score
			0-100%
		Generates energy No contribution to soil Problematic e-waste	
Reclaimed pv-panels	500 years		0%
		Compostable Adds organic matter Moisture regulation Habitat for insects	
Straw & reed roofing	22 years		75%
		Inoculates soil with fungi Breaks down into humus Can host microbial life	
Mycelium insulation	40 years		95%
		Slow-decaying Habitat for insects/fungi/birds Mostly carbon storage	
Timber	165 years		20%
		High integration into soil cycles Short lifecycle Supports biodiversity	
Birch & willow cladding	1-10 years		95%
		Regulates moisture Thermal mass Habitat for burrowing insects	
Breathable rammed earth	85 years		70%
		Thermal mass Possible moss/lichen habitat	
Reclaimed tiles	250 years		5%

ill. 133 Record of the various materials' lifecycles and nutrition levels

Landscapes of Assemblage

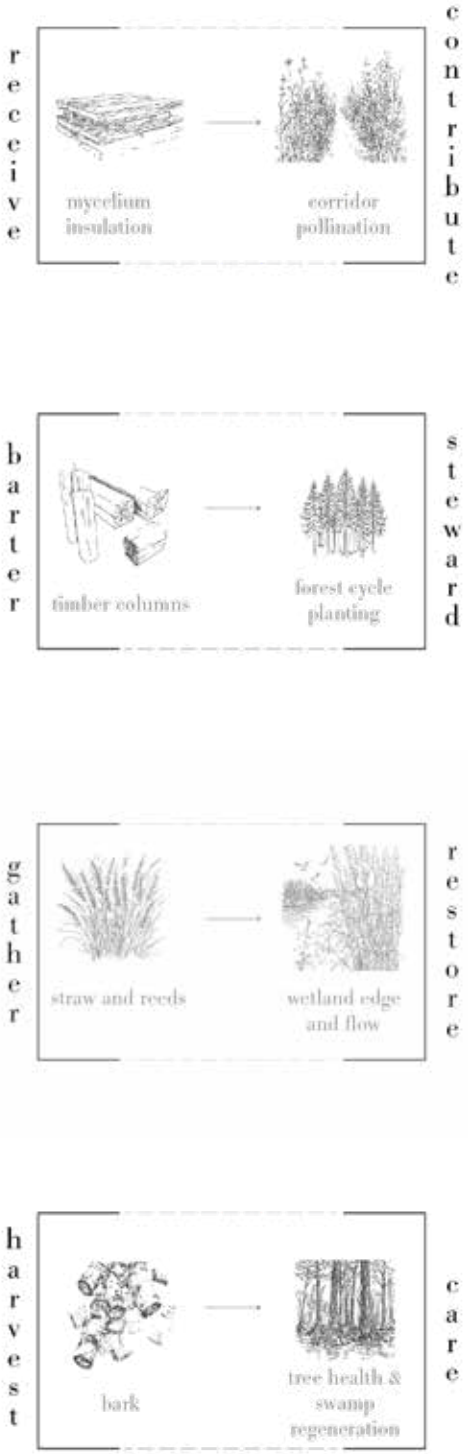


ill. 134 Acts of stewardship and logics of 'eco. social' contracts in relation to 'harvest of materials'

Bioregional Design

With the notion of interconnectedness, practices and cultures started supporting kinds of futures envisioned for generations to come. Unlearning past relationships to land, where solidarity was at heart instead; where material access was gained through care, not capital. Seeing humans as nature was the first step to regenerate ecosystems and reorient economies. The intertwining of humans and nature produces landscapes of assemblage; of co-dependence and a new solidarity.

Reciprocal Material Agreements

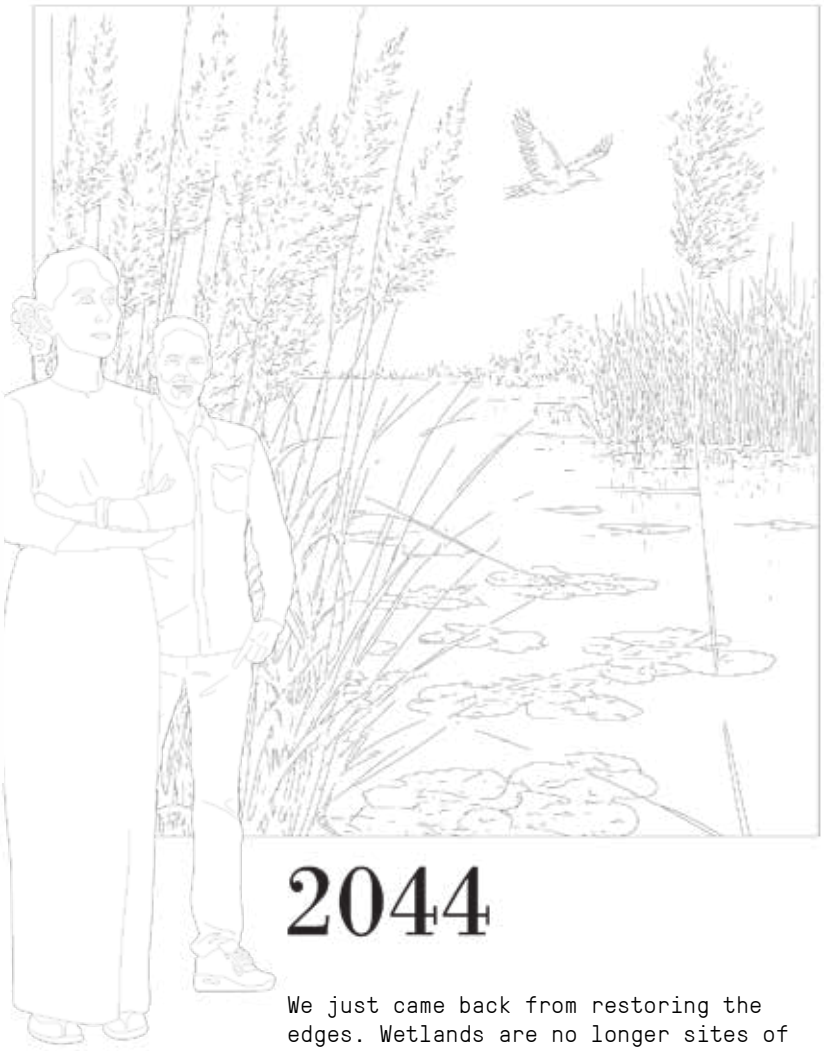


ill. 135 Ecological reciprocity, material agreements

Butterfly-Effect of Reciprocity

Where there once were extractive and depleted landscapes, they have returned to landscapes of nourishment and care.

Every time a material is harvested, bartered or loaned by a community, circles of care emerge from its origin landscape, wether through stewardship contributions, restoration or other acts of care.



2044

We just came back from restoring the edges. Wetlands are no longer sites of extraction, but co-managed commons! We didn't just take, we gave back. Design changed when we did.

ill. 136 Kim and Lars after returning the reciprocal agreement through wetland restoration, harvesting reeds

Regeneration Forecourt

Its so confirming. Our collective grows everyday despite so much collapse behind us. But this time our growth doesn't happen at the cost of our own source of life.

2 unlearners arrived this morning and committed to the eco-social contract. I told them that the Regeneration Forecourt was once a fuel station, but now the only fuel it serves is fuel for thought. I told them that it might be a bit more misty than we are used to, due to the lesser radiation we're getting. But it simply makes us appreciate the smaller moments, being attentive to the rhytms around us.

The structures are still here, not erased, just re-used, softened a bit by the weather and with slightly different intentions. The wild has come back, as a co-inhabitant, nothing dangerous.

It's not that different. Our surroundings just don't revovle around human urgency anymore. We're less extractive now, more observant. We've stepped back a bit, letting other sources of life in, and that step back has kind of created this.

They wen't down to the Institute after signing. I explained that while it is an eco-social contract, it isn't a law, it's just a learning. A practice. Co-authored, continuosly revised, shaped by the seasons and watersheds, whatever teachings of soil that we gather in the field, in the Lab or in the Chamber.

There is something special in watching land and people recover together. And that is the difference: this life feels worth living. Not perfect, not pure, but deeply entangled. This is a place where knowledge composts, and from it, something real grows.

The Institute rises behind us, now visible, but never central. The work continues everywhere.

With care

Sofia

Echoes from futures

Sofia

63

Urban Planner

Søborg

2074

ill. 137 Entry point towards the Institute


Diesel

I'm standing here at the edge of the new wetland, bundle in hand, watching others fold their sediment into the water. The Chamber and Institute behind us are now tangled in wild overgrowth, nature quietly reclaiming what we built.

This space, born from bioregional care, has become a ceremonial ground where the three ecologies meet in solidarity. Today, we compost smaller sediment bundles back into the watershed, honoring the endless cycles of life and renewal.

But this time, the ceremony is for Kim. Though she's gone, she lives on in this soil, in the work we shared with the Institute and LCA 2.0. Usually, we gather here to unlearn and become present, to feel the land breathing around us. Today, we did it to remember her.

This work reminds us that architecture is not just about structures, but about nurturing relationships, with land, with communities, and with time. Our greatest challenge, and responsibility, is to design in ways that restore and sustain these living systems, rather than dominate or erase them.

In the soil, in the sediment, in the wetland's slow unfolding, we find a quiet resistance to the extractive rhythms of modern life, a call to build solidarity not only between humans, but across all ecologies.

The earth holds her still.

Echoes from futures

Jack

41

Concrete engineer

London

2077

ill. 138 Sediment bundles for ceremonial composting

ill. 139 Visualisation of Ceremonial Wetland

Sensing the Bioregion:
Monitoring, Feedback, and Territorial Intelligence

Regional Networks of
Multi-Species Governance

~~MINERAL EXTRACTION~~
REGENERATION

Resting Soils

Emerging Cultural Initiatives

Interdependencies in Regeneration
In a even more far fetched future, multiple landscapes experience migration and regeneration. Through time, these satelittes of care connect regionally, nationally and bioregionally to continually share knowledge from multi-species governance and discussions about improvements for soil as the new primary store of carbon after the collapse of the Atlantic Ocean (AMOC).

ill. 140 Diagrams of the interconnectedness of soil, society and policy across scales

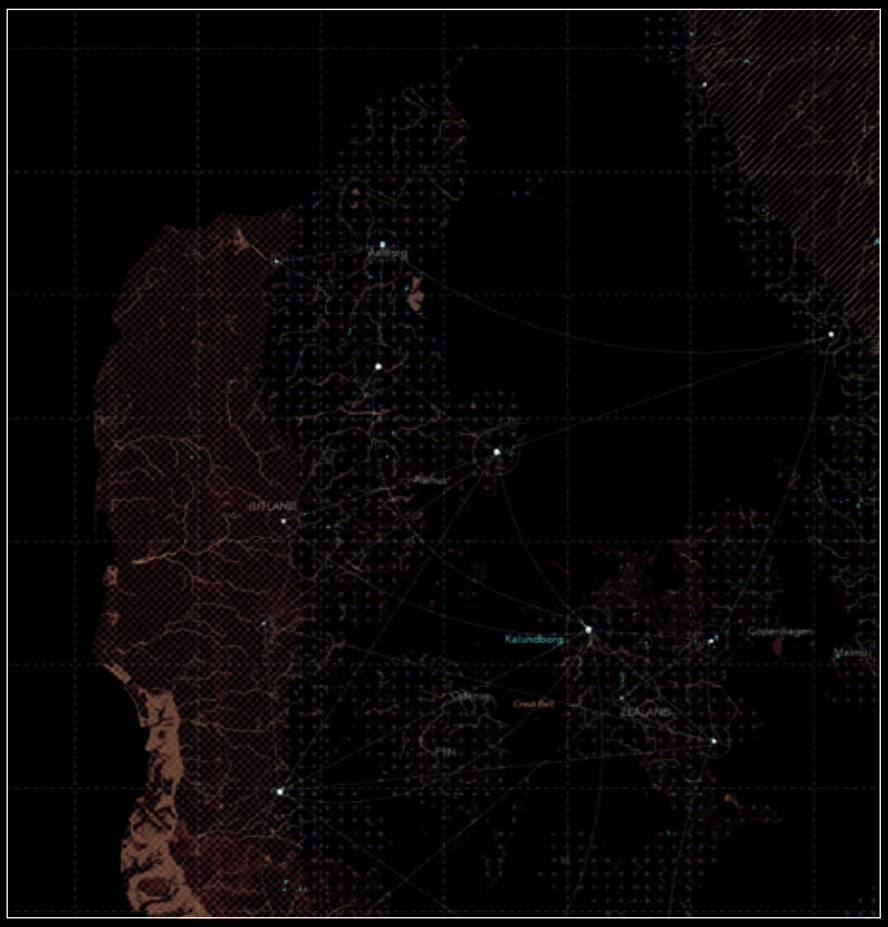
Atlantic & Continental Institutions of Regeneration

BIOREGIONS

- Atlantic
- Boreal
- Continental

~~MINERAL EXTRACTION~~
REGENERATION

- Regenerating Landscapes
- Emerging Institutions & Initiatives

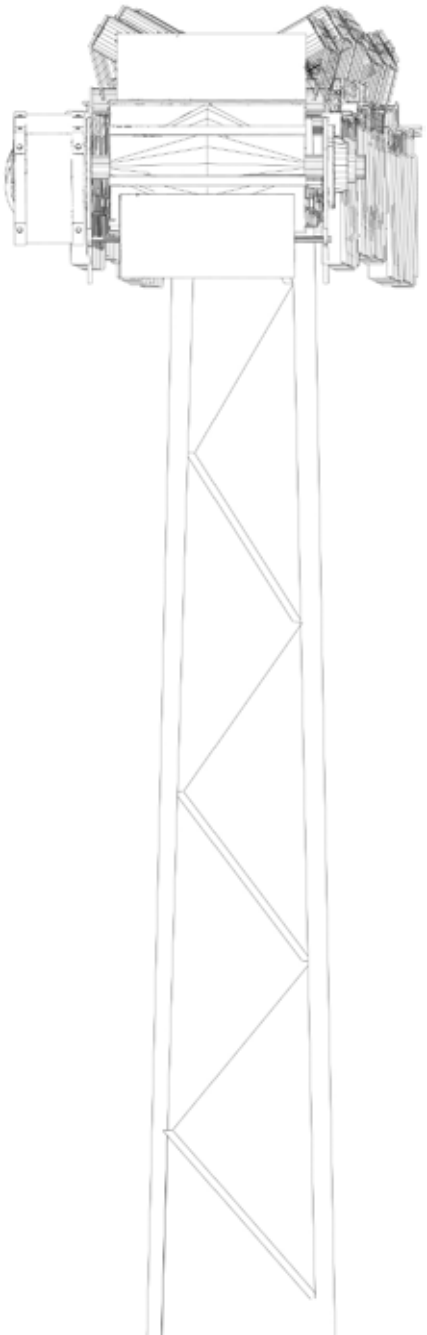


Institutional Interconnection within European Bioregions

- Institutions for Collective Governance & Regeneration
- Alpine
- Anatolian
- Arctic
- Atlantic
- Black Sea
- Boreal
- Continental
- Mediterranean
- Pannonian
- Steppic
- Outside data coverage

- Uninhabitable areas due to desertification and drought
- Critical sea levels due to ice and permafrost melting

PART III



ill. 141 Conveyor belt, 1:20

CRITICAL SYNTHESIS

Conclusion

The Institute of Soil Regeneration is not an answer, nor a solution, nor a finished design. It is rather an accumulation of existential questions and speculations that nourishes the ground at Stenrand, as well as the project's theoretical foundations. What it produces is fuel for thought by presenting critical approaches to Western cosmologies.

With the methodology of scenario building and storytelling, the project leaps into a future where the constructed narrative escapes from normative forces and implications of the neoliberal economy. By leaping, alternative material economies, social infrastructures, and ecological dynamics are explored, arriving at non-extractive architectures and landscapes.

Attempting to depart from Western points of view, the initial crux of the project has been 'to build, not to build'. It combines a reductionistic mindset with a speculative methodology to address the apparent deadlock in climate action, quietly drawing on principles from Indigenous wisdom, resulting in a reevaluation of architecture's technicity. By framing architecture as compost, architecture in itself becomes central to new ways of being.

Integrating these dynamics of nature within an architectural technicity, it foregrounds the projects awareness to reproduce existing lifestyles and world views. Contradictory to these, notions of energy, comfort and materials are instead viewed as limited, and augmented by future climate scenarios, providing the space for a new existentialism. Instead, increased comfort and contemporary living standards are addressed through exposure to natural cycles, lending architecture the role of guiding humans to co-exist with the more than human, becoming stewards of the landscape. Comfort is redefined, instead of constant climate control it lies in shared warmth, shelter and meaningful maintenance.

This is unfolded with the presentation of a 'more' symbiotic co-existence between human and non-humans, where the architecture mediates social conditions relating to multi-species governance, ceremonial gatherings, and acts of care and maintenance.

Furthermore, the project questions existing ideas of lifecycles through the reframing of LCA with the help of the speculative fiction methodology. Shifting from an efficiency-based tool, the project's methodology foregrounds LCA 2.0 instead, a tool that optimizes for entanglements. By accounting for the lifecycles of entire sites, rather than a single material, the interconnectedness of all living beings in an age of environmental degradation is embraced.

By adopting non-human perspectives from indigenous science, new configurations of both material, social and ecological aspects are married with ideas of reciprocity, exemplified by reciprocal material agreements, foregrounding eco-social justice. These are unlocked by emerging social infrastructures based on care and stewardship rather than ones of extraction and depletion. With a shift towards 'more caring' communities, the project builds on the notion of micro-political collectives, bound in reform and cultural revolution.

Together, these comprise The Institute of Soil Regeneration, being synonymous with one of 'the missing institutions' necessary to navigate the ecological crisis. In the nature of the methodology, the fictional story develops a global network of emerging institutions to restore ecological health and to produce human existence in new historical contexts.

Reflection & Perspective

Actuality and Methodology
With the project unmistakably being born from climate sorrow and cognitive dissonance, it grapples with societal tendencies at the surface level. Attaining the slightest information will explain the deep paradox of power, how organizational hegemony weighs on the shoulders of individuals, making ourselves believe we're at fault for the skewed power distribution and carbon footprints of systems bigger than ourselves.

Yet, hereby it seems that exactly a speculative approach within an academic context provided the tools to leap this, allowing ourselves to forget the world for a while, while still working hard on a future that will never come.

Despite the working ways of the methodology and our current limited knowledge of it, the methodology still has it shortcomings in its somewhat 'rejection', in lack of a better word, of current conditions within society, yet, taking that leap has been found to be integral to the methodology, in order to perform 'other' futures.

Although the project has ended up exhibiting more of a post-human and dystopian sentiment, new social imaginaries, social dreaming and the birth of utopias have never been more relevant and urgent in attempts to keep mobilizing people towards a cultural revolution.
Prior to more established phases of the project, there were thoughts about how communication holds the key to inform and enter a dialogue. What is meant by this, is that it has been a concern in which way the project has been communicated. Ones based more on ideas of dialogue and collaboration between agents and actors (Reduction Roadmap fx), rather than ones of rebellion and revolution might've seem fit, depending on who is the messenger and the sender. Nevertheless, within the SF universe, dystopia is a method, and it can be said that the project still communicates community and collaboration.

With much of the project building on speculative futures and the externalities of material extraction, it appeared as a presentable opportunity to use the speculative methodology to introduce a speculative device or technology that exactly would work within the constraints of material availability and the locale of a site (thinking of full mycelium structures, using only trees as tectonic concept etc.). Yet, these more 'radical' approaches weren't pursued. An answer to this perhaps lies in us using speculation as a tool for the first time, despite all design being linked to speculation. Eventually, being a novice within the workings of the methodology naturally extended the design process as a result of endless questions. Getting to grips with a new methodology has proved hard, especially when it postpones and forces one to constantly dwell on speculation. Hereby, the project would have benefited from diving deeper into the methodology earlier on, working more structured towards speculations rather than constantly asking 'what if?'

As an accumulation of this, the 'end result' is quite normative within architecture and less speculative about technology, emphasizing the power of community and collaboration.

Process

As visible in the project, it has centered around 'big problems' and concepts, almost to the extent of paralyzing itself from further progress due to an overload of information and 'potential problems to solve'. Hereby, it has been a constant tension between defining the problem and concern before doing analysis, combined with developing a speculative narrative and fiction simultaneously. Therefore, the project has to some extent concerned itself even more with the problems and concerns laid out earlier and less with the site itself. Yet, this perhaps also encapsulates how the general approach and critique within the project is more angled towards systemic frameworks and legislation rather than a specific site which has inherent specific qualities, conditions, and tangibles. Although it should be mentioned that a site ultimately is a physical constitution of a set of frameworks and legislation which eventually produces a 'space'.

Eventually, the construction of our critical position has proved more important than applying 'usual' spatial intelligence of architects, inherently tied to place and 'space production'.

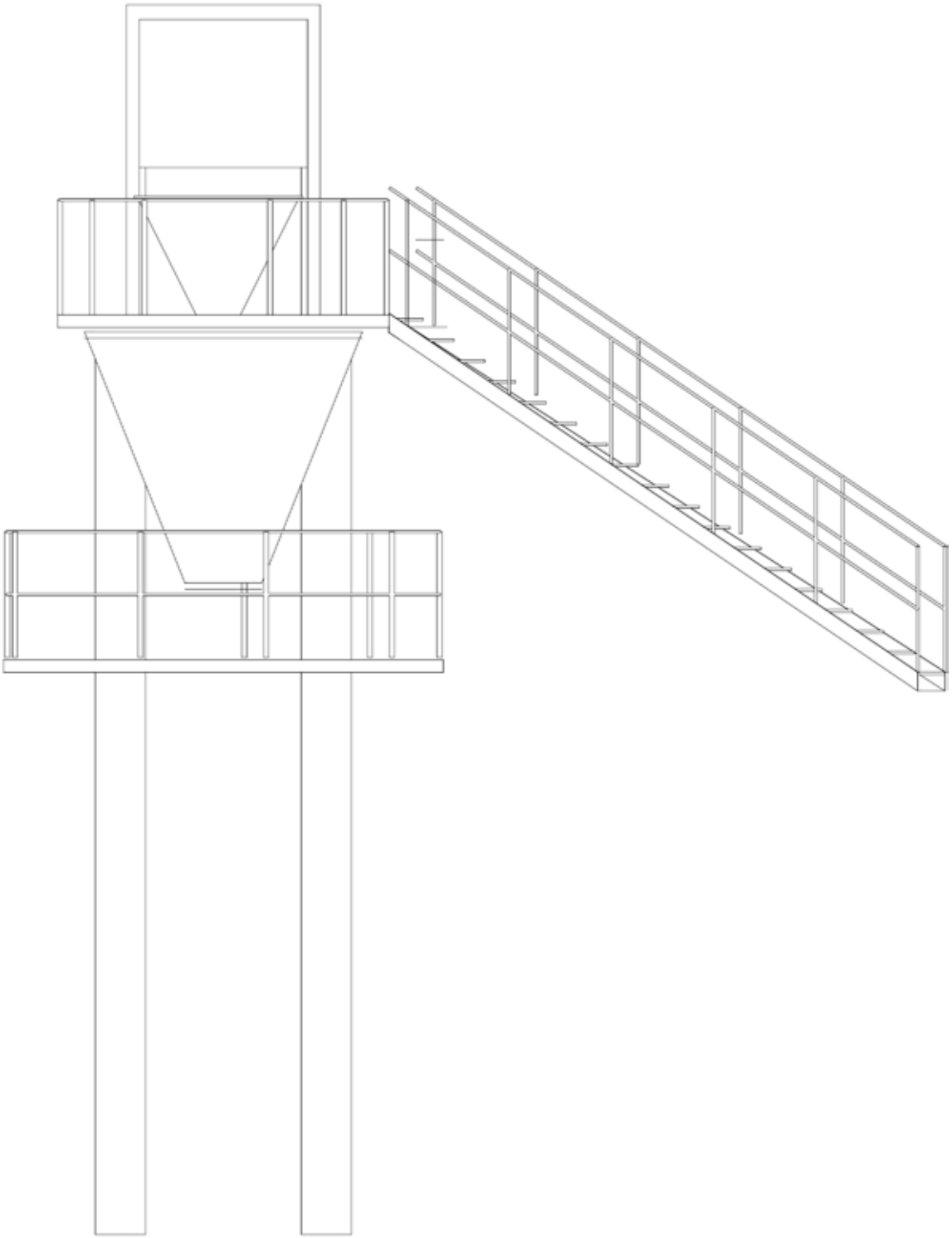
Personal

Despite leaving Aalborg University with an increased consciousness it seems that the future of architecture and space 'production' should be more tied to competencies from which there are very little training for, bearing that architecture by design has an invoked usual affection for the superficial and shallow (generalizing a bit here), best conceived by what the public notion of what architecture and design in general is. Instead, architects should be trained *more* in exploring current construction materials, supply chains, and regulatory systems to develop post-extractive material strategies that can operate within the drastic (hypothetical) 95% reduction in new construction - adhering to a global building growth limit of only 2–5%. Such a reduction points toward a radical transformation and a fundamentally new society - one which, in our view, based on a newly acquired fraction of insight into the world of speculation and fictioning, calls for more focused education in precisely this field. A cultural revolution must begin with a generation of speculators. A different kind of speculators.

Though, releasing more academics might be self-contradictory in a world that no longer needs less harm, but active regeneration. It places academics as thinkers - not doers - and we place ourselves within this contradiction.

We speak of a world filled with work that multiplies without meaning, where more and more people experience cognitive dissonance. We know the facts, yet the system is unable to act on them.

Even the idea of a generation of speculators risks becoming just another illusion if left inside academia. Slowing down - whether in life or for speculation - is not withdrawal, it's re-engagement. But if speculation isn't grounded in practice, it becomes part of the problem.



ill. 142 Hopper, 1:50

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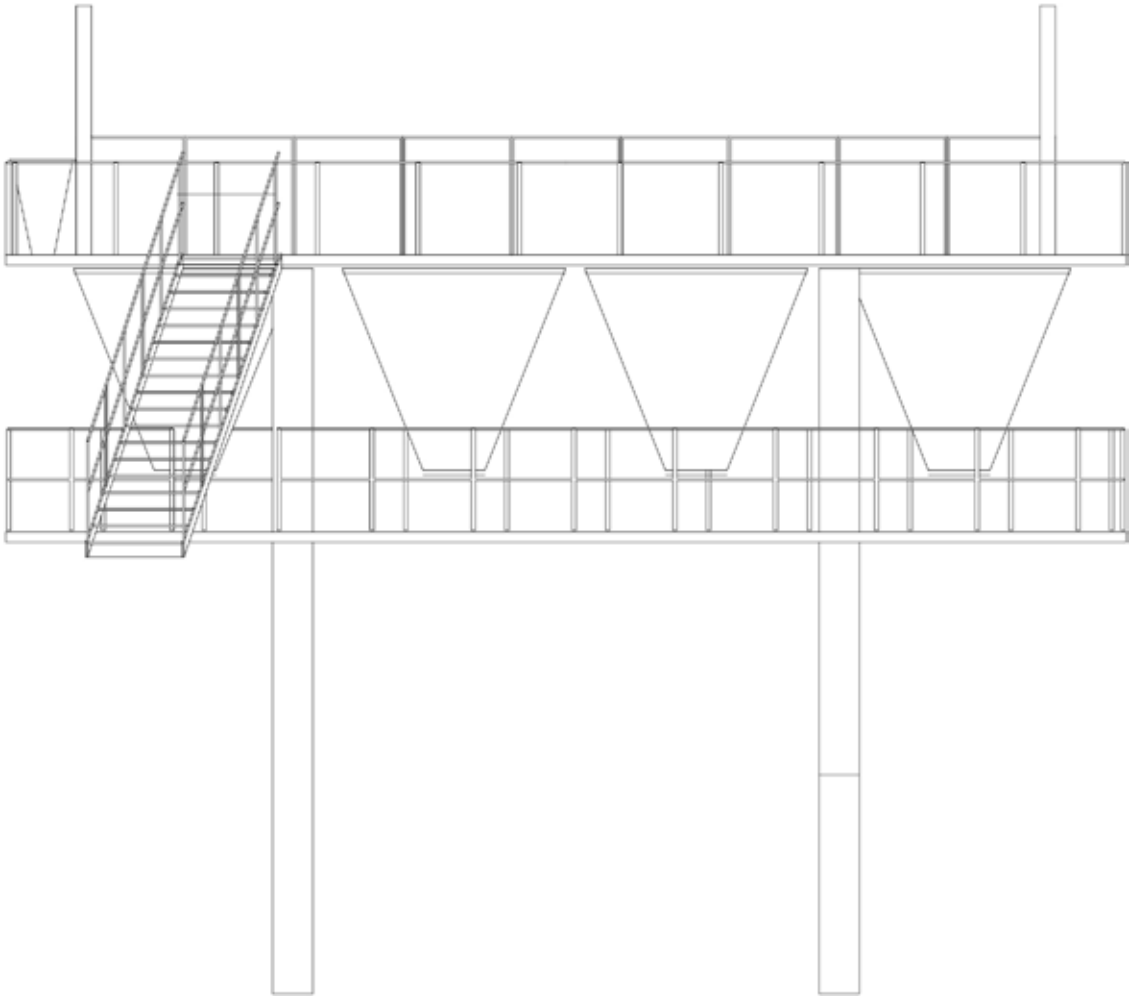
Illustration list

ill. 143 Hoppers, 1:75

APPENDIX



Appendix 0

AALBORG UNIVERSITET

THESIS TITLE PAGE

This form must be submitted for all theses written in programs under the Study Board of Architecture and Design, and it should be placed at the beginning of the appendix section of the assignment.

A printed copy of the form must be submitted along with the printed copy of the thesis.

The information given in this form must also be available in PURE.

(All fields must be filled out)

Program: Architecture Industrial Design Urban Design
This thesis was written by (full name):
Jacob Bundgaard Nielsen
Michael Korsgaard Gad
Title of the thesis: Excavated Futures: A Symbiotic Praxis for Design Beyond Extraction
Supervisor´s name: Joel Peter Weber Letkemann, Tina Vestermann Olsen
Submission date/year: 16/6/2025
Is the project confidential? Yes No
External collaboration * Yes No
External collaboration partner (name of company/organization):
Contact at external collaboration partner (title, name og email):

*What is an external collaboration? Read more here.

Appendix 1
Design Process

1.
Themes
Typologies
Methods

This chapter outlines the initial phase of the project, where a wide range of themes, sites, and typologies were explored. Through speculative research and design probes, we investigated ideas of regeneration, land-use shifts, and post-extractive futures.

2.
Site-Analysis
Scenario buildi

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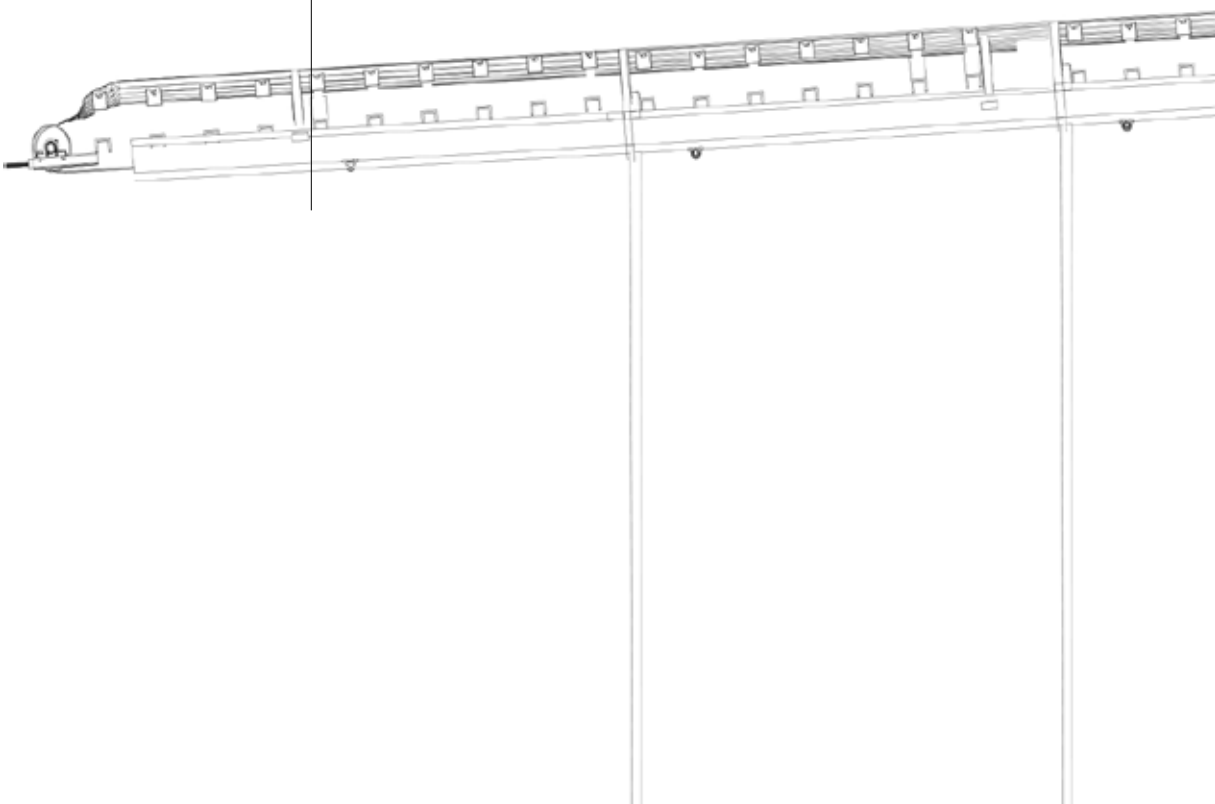
grounded the design in a
landscape, and socio-ec

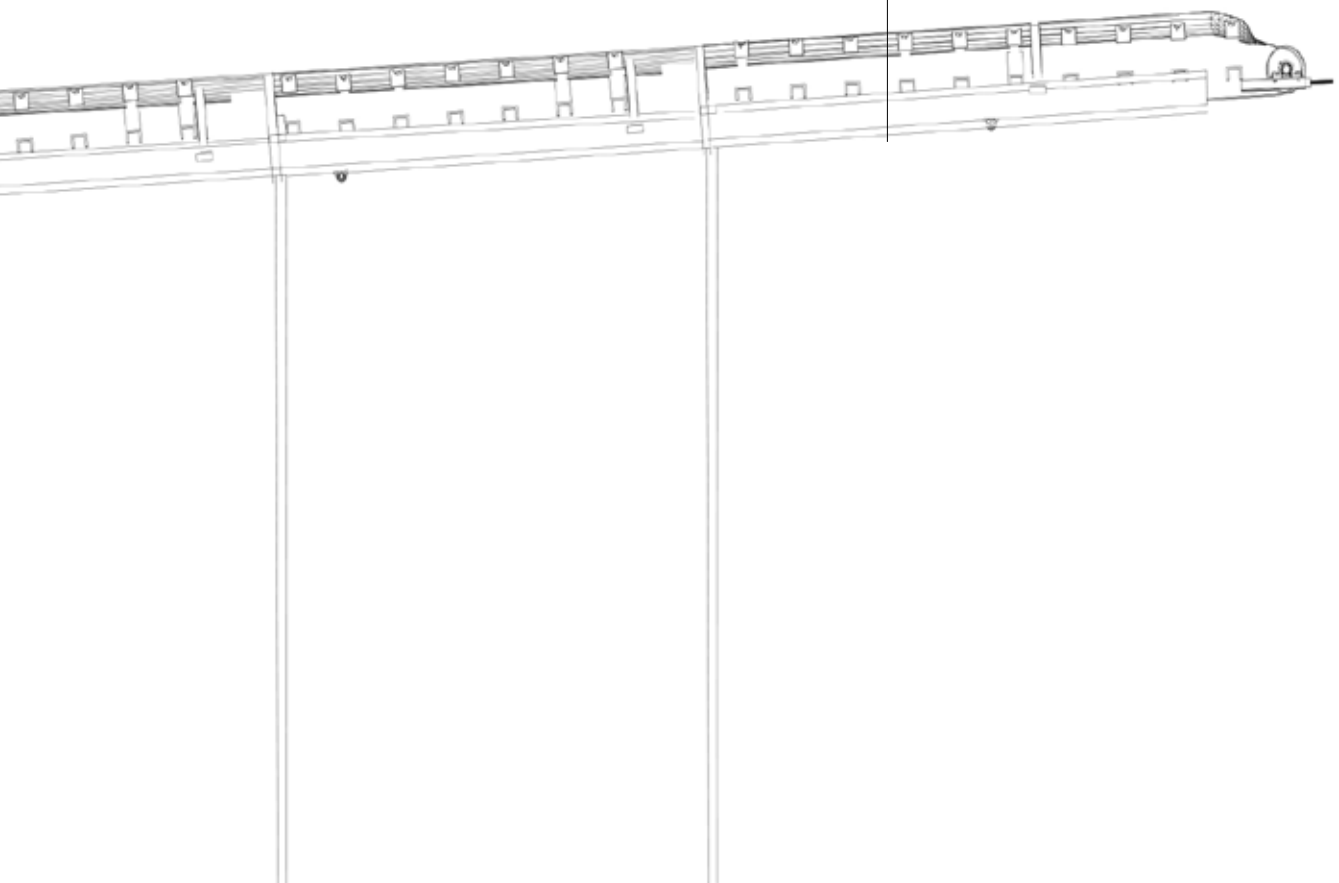


ng

pit landscape, this chap-
n from broader context
of a specific site within
e readings, narrative vi-
responses, futures scenar-
ested. These speculations
n understanding of time,
cological transformation.

3.
From Extraction Infrastructure to Institute of Soil Regeneration

This chapter presents the architectural design process centered on the reuse and reconfiguration of existing industrial structures-conveyor belts, hoppers, and platforms. Through spatial interventions, material strategies, and programmatic reimagining, the project transforms the logic of extraction into one of regeneration. The design emerges through careful negotiation between inherited forms and future potentials.



Contents & Reader's Guide

The following chapter seeks to cast light on divergent directions throughout the speculative design process. These divergences unfold across three key dimensions: (1) themes, typologies and methods (2) site analysis and scenario building and (3) the transformation of the industrial landscape.

Although some directions reached a dead-end or were eventually set aside, they served as critical foundations for shaping the project's conceptual framework and values.

At each stage of investigation, a marker highlights the chosen option. 

Although the process is presented in as linear, it reflects a highly iterative and experimental journey.

1. Themes, Typologies and Methods

To explore non-extractive architecture, we investigated typologies with potential for transformation, multi-scalar use, and estrangement.

Manor ruins: Egebaksande, Thisted
a remote Danish site with burnt-down ruins, blending decay and resilience.
Potential: its liminal state between destruction and preservation makes it ideal for exploring futures with post-collapse ruins.

Farm: Remshøjevej, Balle
traditional agriculture landscape surroundings. Rosmus and Birkesig as adjacent villages.
Potential: use of enstrangement such as a biolab or politicians in transformed silo.

Industrial and town :Aalborg, Jutland
material extraction and concrete production facility, located next to town.
Potential: exploring relation between consumer city and extraction sites.

Processing hub and transit: Lille Hjøllund, Jutland
material transit in small village.
Potential: Transformation strategies across typologies.

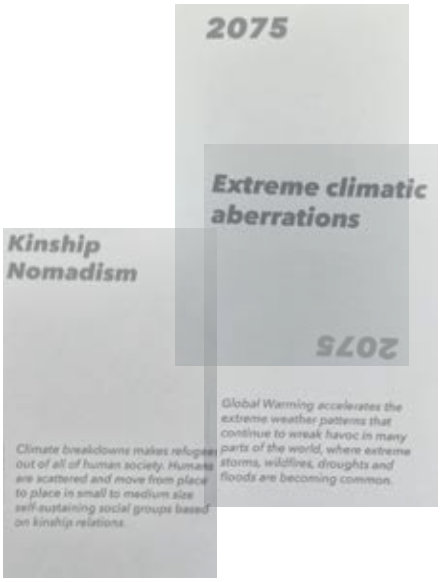
Gravel extracion: Stenrand, Svebølle
gravel extraction site with industrial processing on site and adjacent small village.
Potential: use of enstrangement by exploring post-extractive functions such as an institute in an extractive landscape.

Ill. 144 Collage of Google Earth sattelite pictures. CC by DataForsygningen

Exploring Speculative Futures

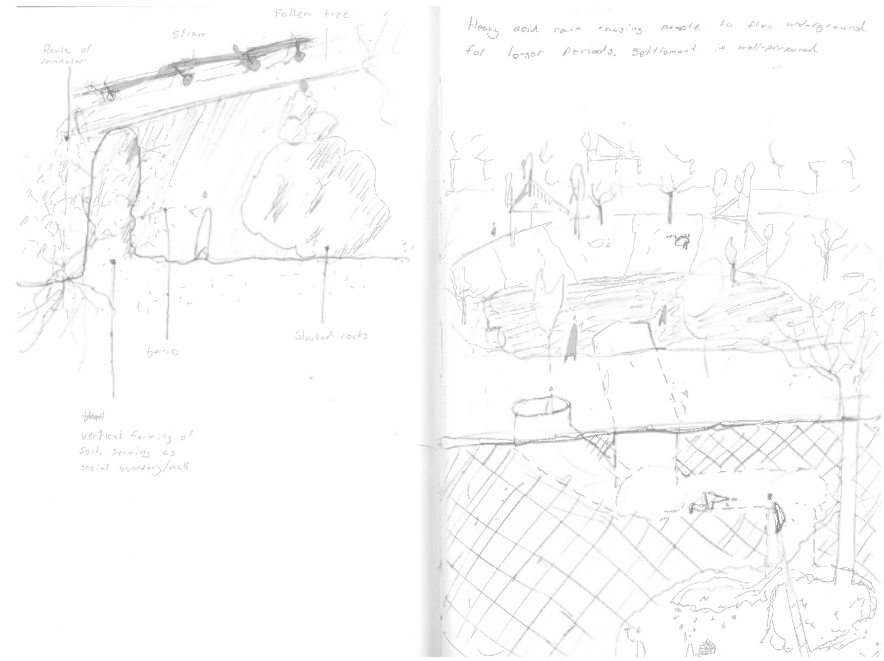
One speculative method explored was the use of 'speculative card game'. The aim of the method is to free ones mind from assumptions to explore speculative scenarios.

The rules of the game are simple. Pick a year. Pick a couple of terms. Start a timer and conduct a written or sketched story of a random or a chosen site before the time is up. Below are some of the stories conducted.

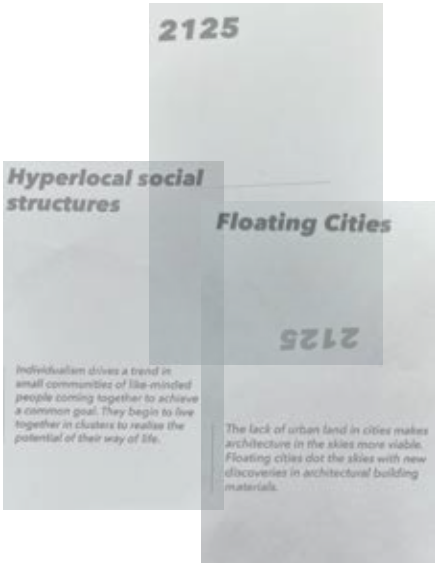


ill. 146 Pictures of 'speculative card game', underground

Future scenario: Occasionally, everything is demolished and must be rebuilt from scratch due to extreme climatic aberrations. Therefore, humanity lives in nomadic structures and seeks refugee under ground.

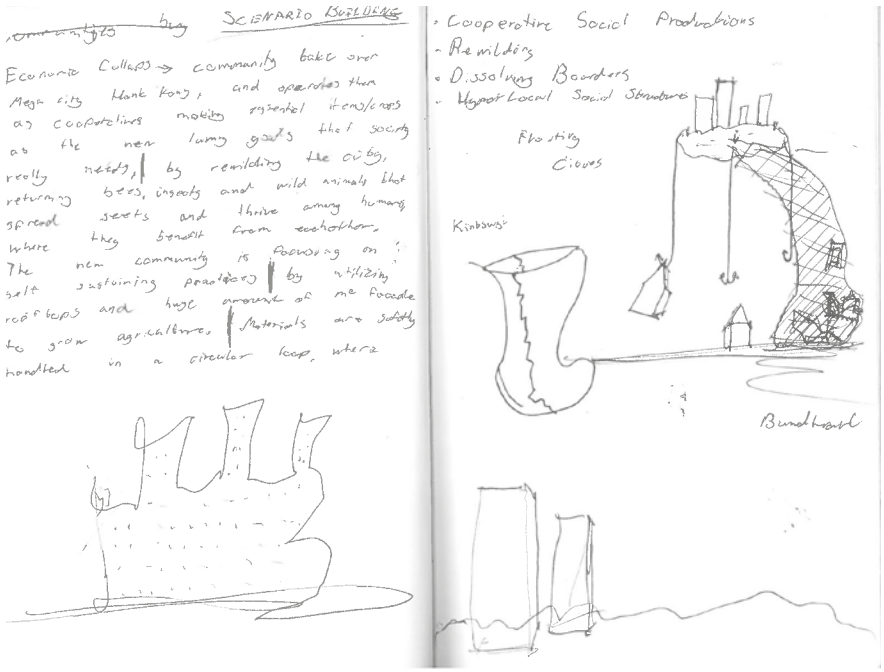


ill. 148 Drawing of speculative future, underground



ill. 145 Pictures of 'speculative card game', floating city

Future scenario: Some cities move to the sky, as they live in hyperlocal social structures. They havest materials from the surface of the Earth.

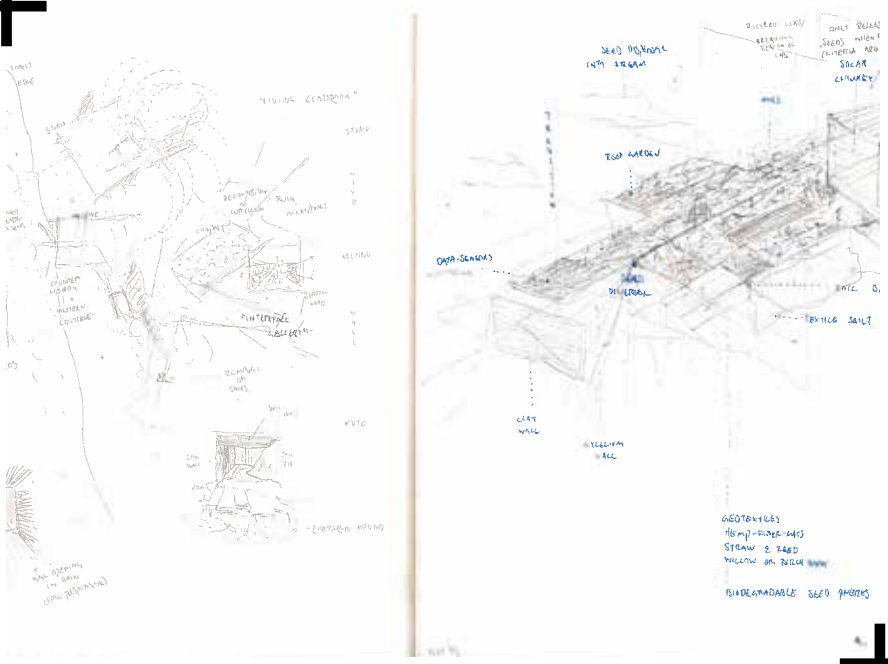


ill. 147 Drawing of speculative future, floating city

Developing Our Speculative Future

By applying the method more strategically to the chosen site - Stenrand - we were able to gradually build a coherent future scenario, including both a design proposal and narrative. This vision emerged through many iterative loops of speculation, analysis, and design. Each phase represented a shift in mindset. The method of fictioning and storytelling allowed us to break free from today's constraints, while grounding the fiction in real-world conditions through site analysis.

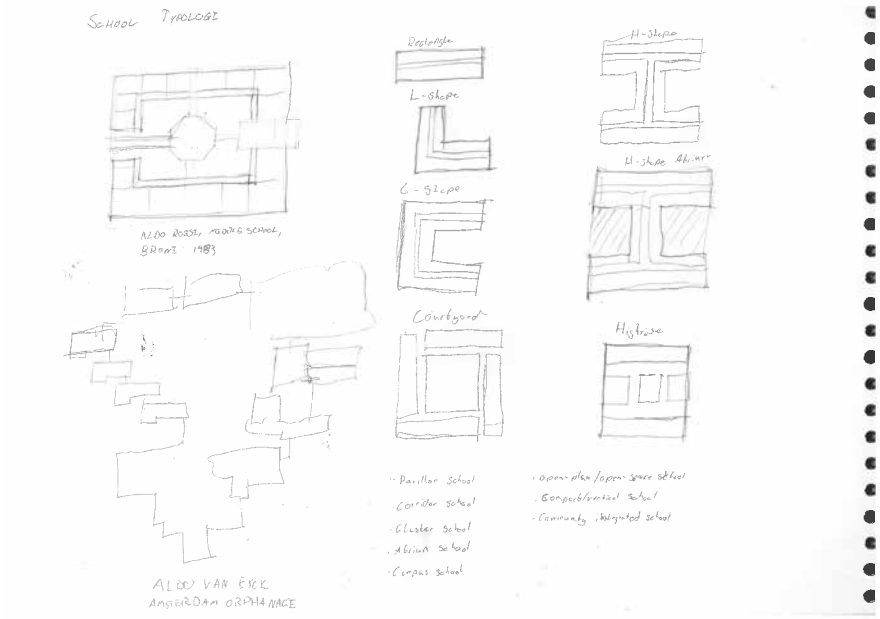
Future scenario: An institue emerges around the existing extractive infrastructure of the site, turning it into infrastructure of regeneration, as foundation for a pedagogical framework. The institute first needs to unlearn current extractive practices before they can relearn.



ill. 149 Drawing of speculative future, institute of unlearning

Theme Studies

Based on the speculative story of an institute emerging in a gravel pit to unlearn and regenerate the site, several key themes were explored.

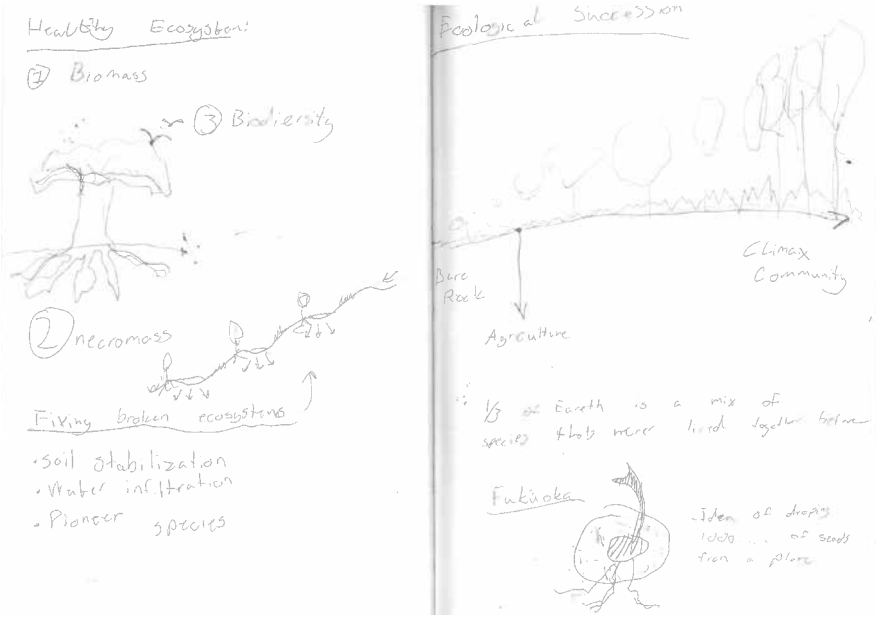


An investigation of school typologies, made it clear that designing for traditional pedagogy was not our goal. The Utzon Center, a hybrid of museum and institution, embodied some of what we were seeking: independent, sequentially connected spaces interspersed with open areas - potentially natural spaces.

ill. 150 Drawing of school typologies.

An investigation into permaculture design strategies showed that integrating natural patterns and closed-loop systems can enhance site resilience and promote sustainable resource use.

ill. 152 Drawing of Permaculture strategies



An investigation into permaculture theory showed the essential principles needed for regenerating a site.

ill. 151 Drawing of Permaculture theory

By studying Landschaftspark Duisburg Nord, we found that transforming industrial ruins into multifunctional public spaces can foster ecological regeneration while preserving cultural heritage.

ill. 153 “ ” by Frank Vincentz, licensed under CC BY-SA 3.0.

By studying Michael Reynolds, Garbage Warrior, we found that innovative, sustainable building techniques can turn waste materials into resilient, self-sufficient homes.

ill. 154 Photo: “Earthship Brighton Front” by Dominic Alves, licensed under CC BY 2.0.

2. Analysis and Scenario Building

Site Visit

The site visit revealed the big scale and rough landscape, while also providing insights into the site's social dynamics.


ill. 155 Picture of the landscape.


ill. 156 Picture of the building stock.


ill. 157 Picture of the interior.


ill. 158 Picture of the material stocks.

Site Investigation

Initial readings of the existing state of the gravel pit. These were conducted based on site visit and desktop mappings.

Extraction of materials

Raw material storage

Material processing machinery

Processed materials

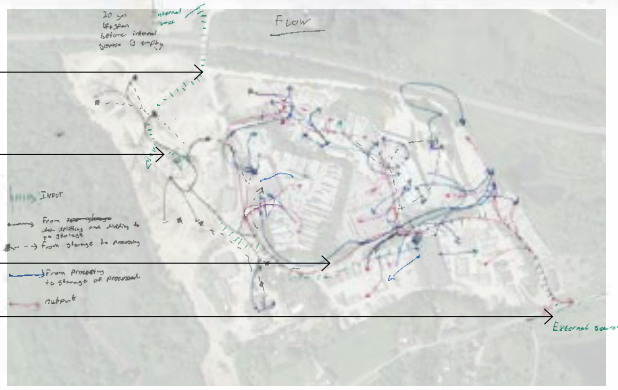
ill. 160 Drawing of material stocks.

Site input of materials

Main path for raw materials

Main path for processed materials

Site output of materials



ill. 159 Drawing of material flows.

Ecological Resilience and Supporting Features

1.1 Break of the connectivity between natural landscapes

1.2 Graded and earthwork

1.3 Sealed and compressed

2.1 redirect rainwater away from the soil

2.2 redirect rainwater away from the site

2.3 non-renewable materials

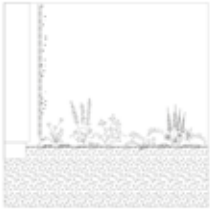
ill. 161 Drawing of existing ecological resilience features of the site.

2.1 Planning for connected natural landscape

2. 2 Designing with the terrain

2.3 Sit lightly

2.1 Ratinwater returned to soil in dry periods



2.2 Rainwater returned to the site

2.3 renewable materials

ill. 162 Drawing of soil supporting strategies

Microclimate

The sites microclimatic conditions played a role in shaping the (un) planning approach.

Slope & Design Potential

0–10°: Ideal for structures, gardens, and infiltration.

10–20°: Suited for terraces, light structures, and agroforestry.

20–30°: Better for planting and slowing water, not building.

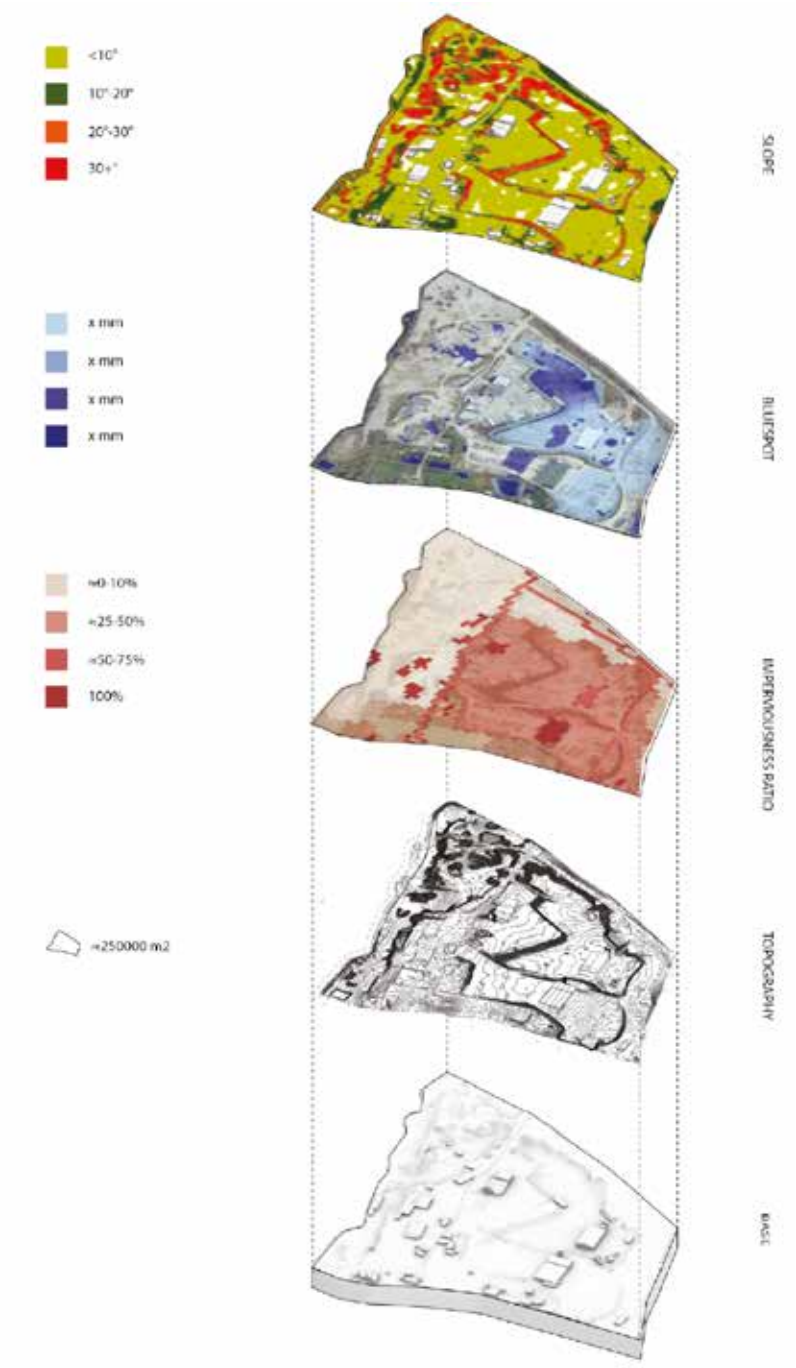
30°+: Leave untouched - suited for rewilding.

Bluespots & Impervious Surfaces

On hard surfaces: Causes runoff - opportunity to de-pave or add retention.

In low areas: Potential wetlands or biotopes for habitat and water storage.

Conclusion
Let water guide the design - showing where to build, soften, or hold back.

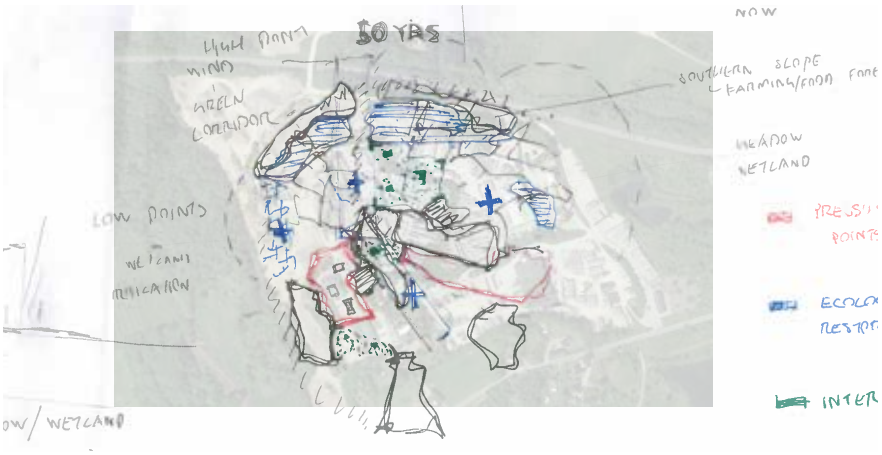


ill. 163 Isometric of micriclimatic site conditions.

From Analysis to (Un)planning

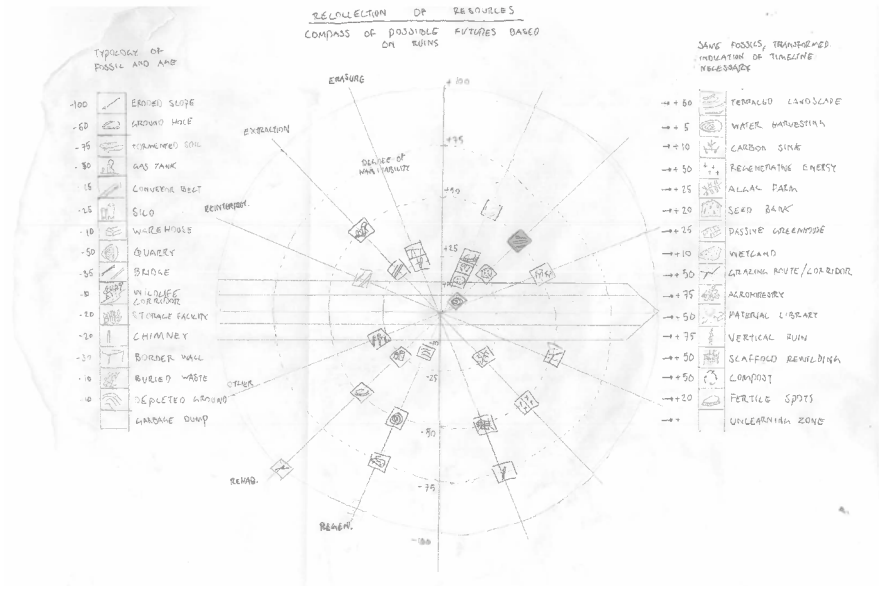
Instead of traditional planning for further development, (un)planning became the approach for degrowth - signaling a process of unlearning, as new values begin to form the new norm.

Although the final design focuses on one area, the whole site was explored. Site-wide analysis and sketching revealed recurring principles that informed the final intervention and could guide the rest of the landscape.



Red: Pressure points
Blue: Ecological restoration
Green: Design intervention

ill. 164 Drawing of (un)planning map.



Compass of possible futures based on ruins. Changing roles of landscape, buildings and artefacts.

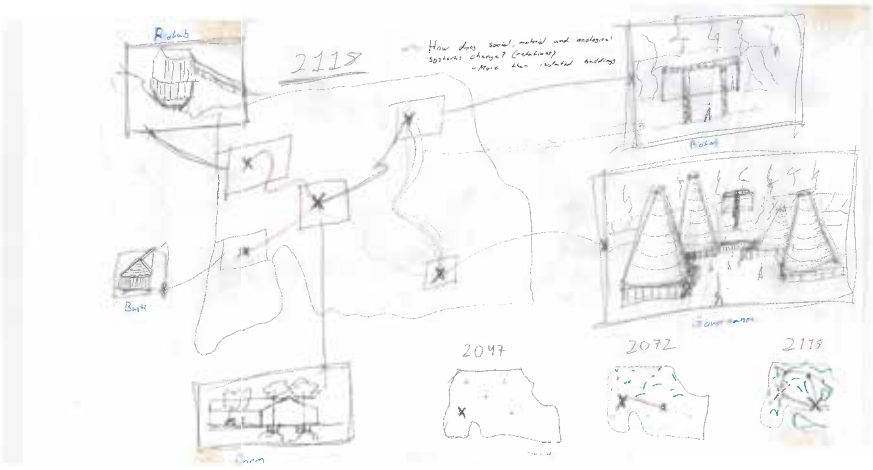
ill. 165 Drawing of (un)planning futures.

Exploring (Un)planning Strategies and Functions

Shifting agents:
1. Rewilding natural features.
2. From paving to planting.
3. Unpacking unnecessary buildings
4. From extraction to stewardship

ill. 166 Drawing of (un)planning strategies.

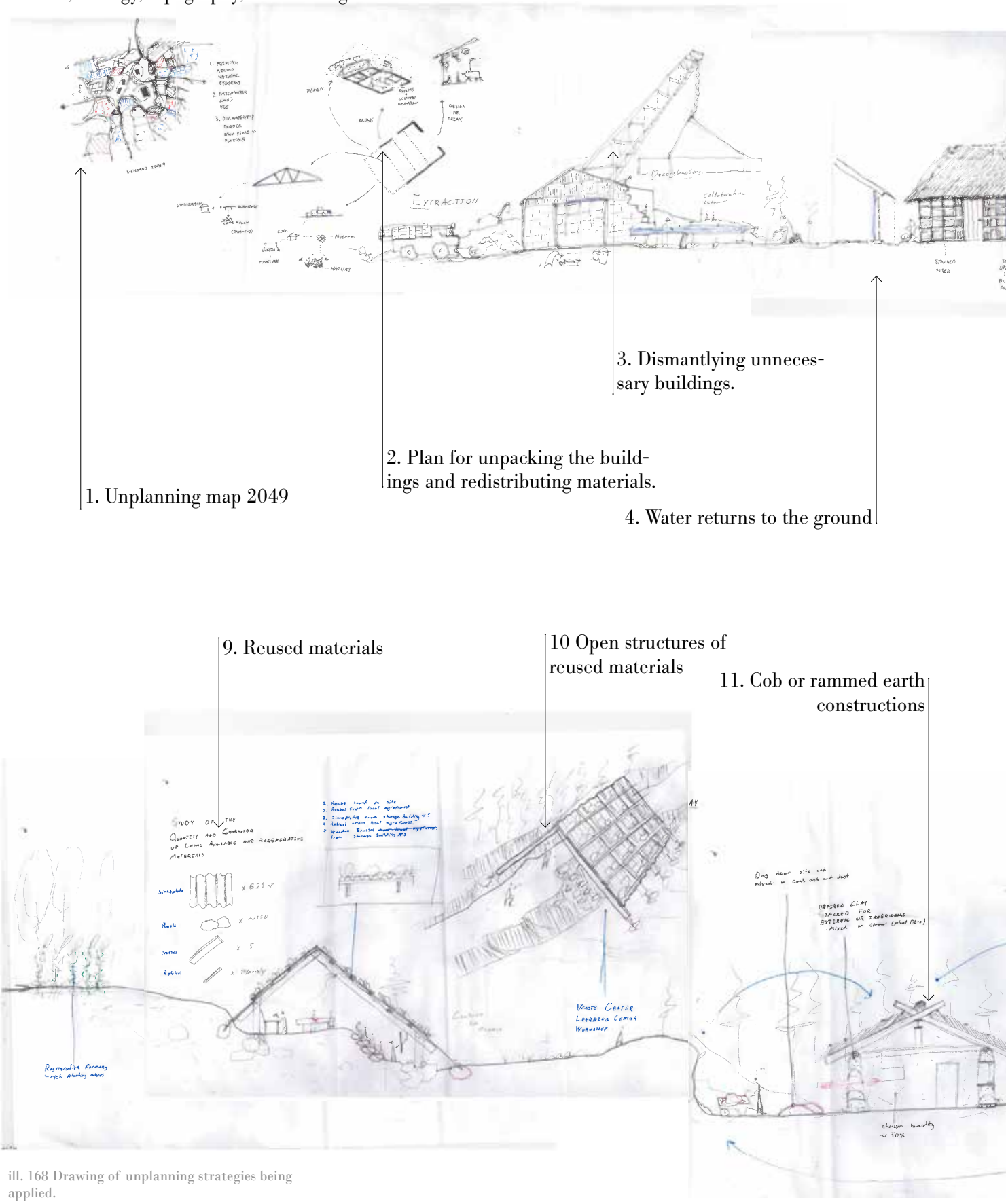
Shifting roles of the landscape:
1. Institute
2. Vertical farming tower
3. Basti (settlement).
4. Governance



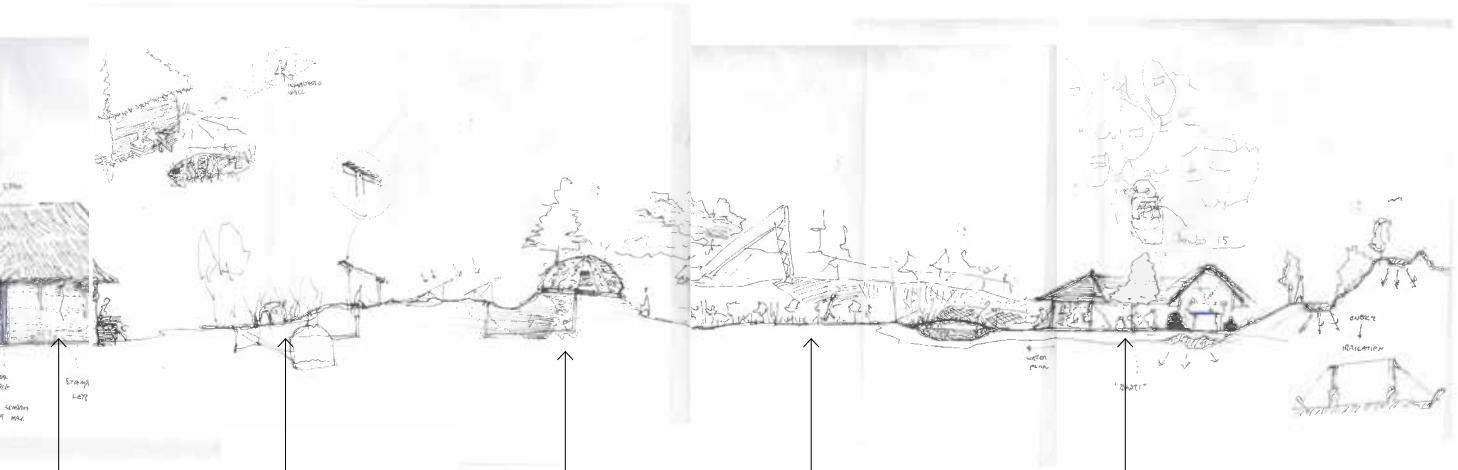
ill. 167 Drawing of a masterplan with functions reflecting (un)planning principles

Meter Long Manifold Sketches

Unplanning strategies emerged through close attention to the site's varying conditions. Each area had its own logic for transformation, shaped by climate, ecology, topography, and existing infrastructure.



ill. 168 Drawing of unplanning strategies being applied.



5. No waste.

7. Stewardship

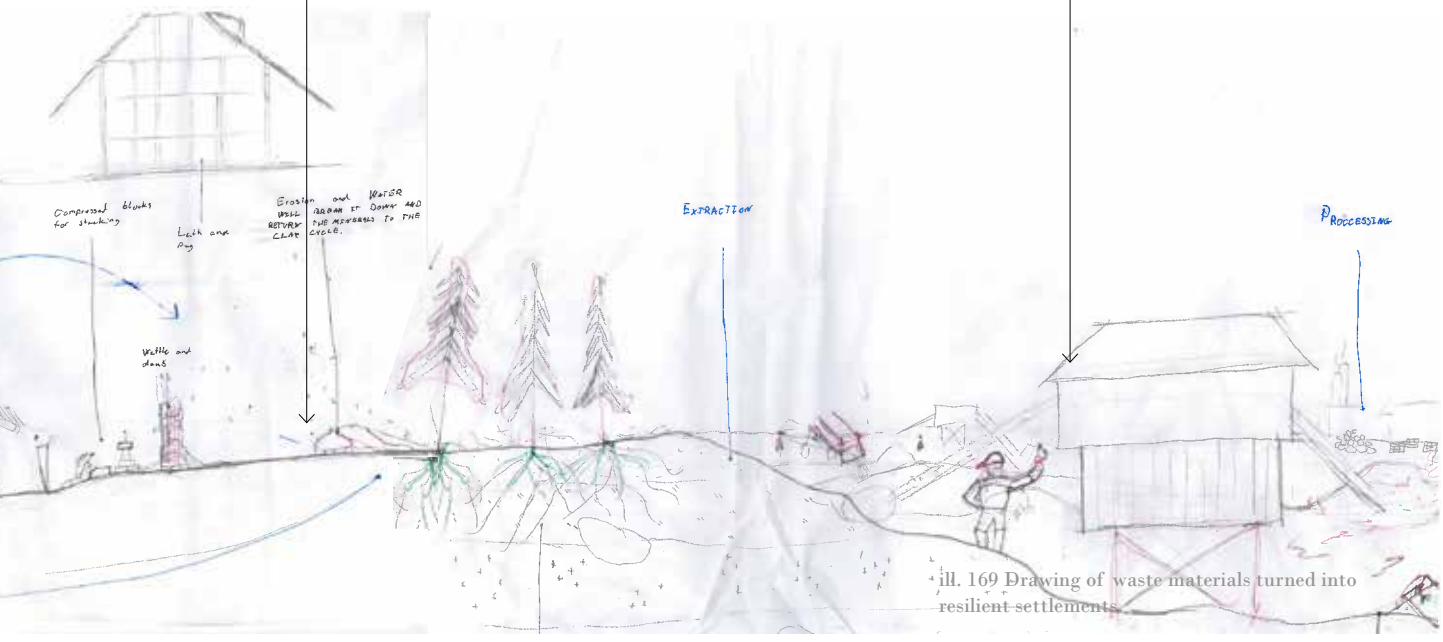
4. Patchwork of regenerative materials.

6. Small, decentralized, self-sufficient buildings

8. Hyperlocal social structures.

12. Decay as biological metabolism

13. Entering the zone of extraction infrastructure



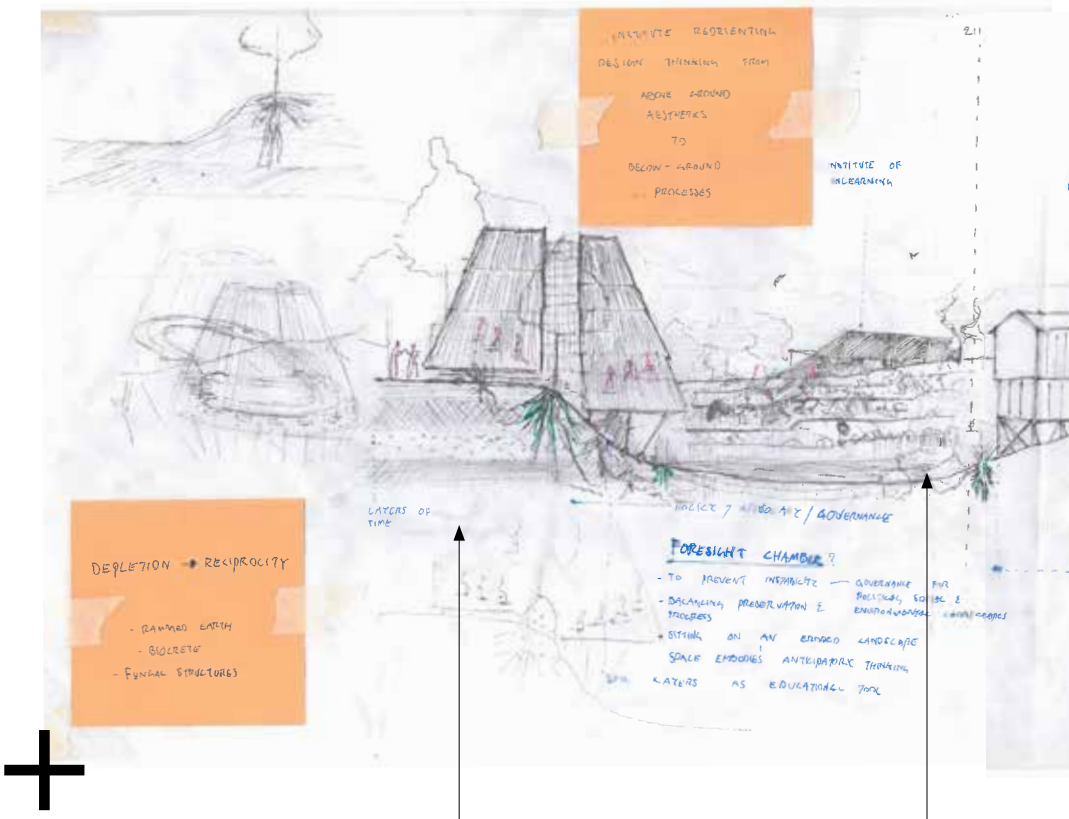
ill. 169 Drawing of waste materials turned into resilient settlements.

3. From Extraction Infrastructure to Institute of Unlearning

When diving into the zone of extraction infrastructure on the site, we realized it held the greatest potential for enstrangement.

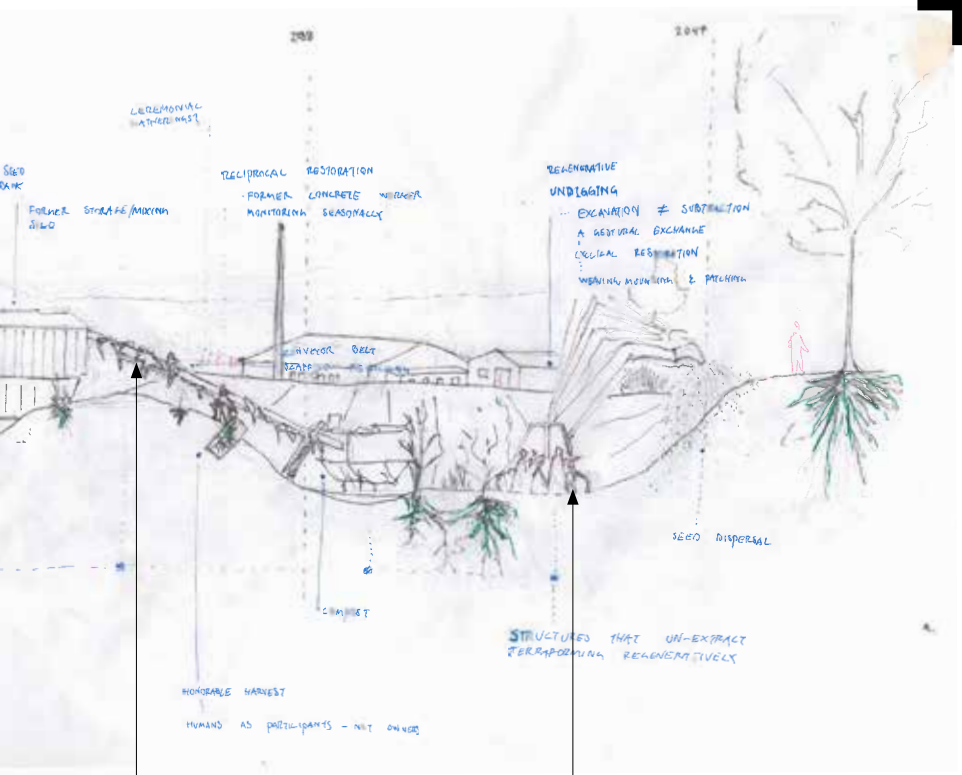
The concept of transforming extractive infrastructure into regenerative infrastructure became central to our narrative.

1. Emerging from the extraction landscape, the Institute of Unlearning signals a new paradigm of non-extractive architecture



2. The Foresight Chamber becomes a symbol of interspecies responsibility - a space where decisions are made with more-than-human futures in mind.

3. Humans become stewards and custodians of the landscape

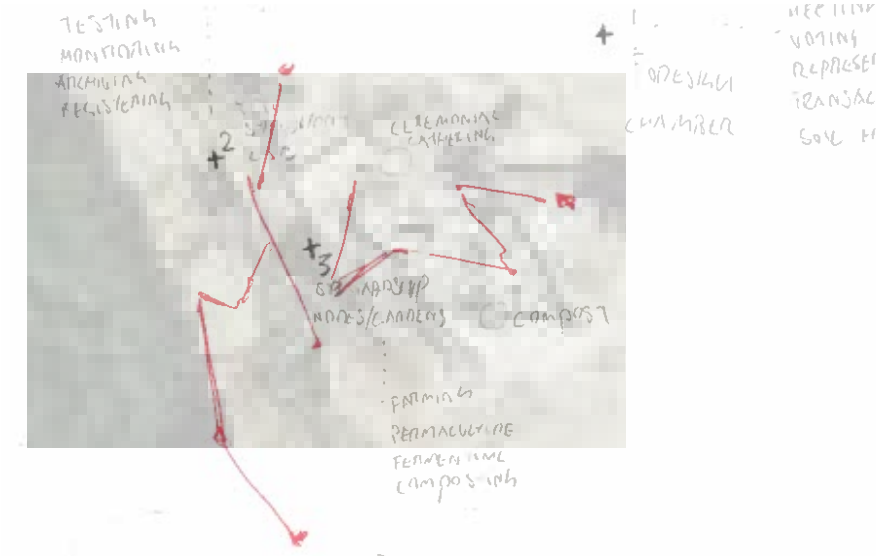


ill. 170 Early drawing of the decaying industrial landscape

4. Opposite to degredation of old mineral artefacts - full biological circularity becomes part of the concept. Embracing decay and allowing materials to return to the ecosystem as the agents change.

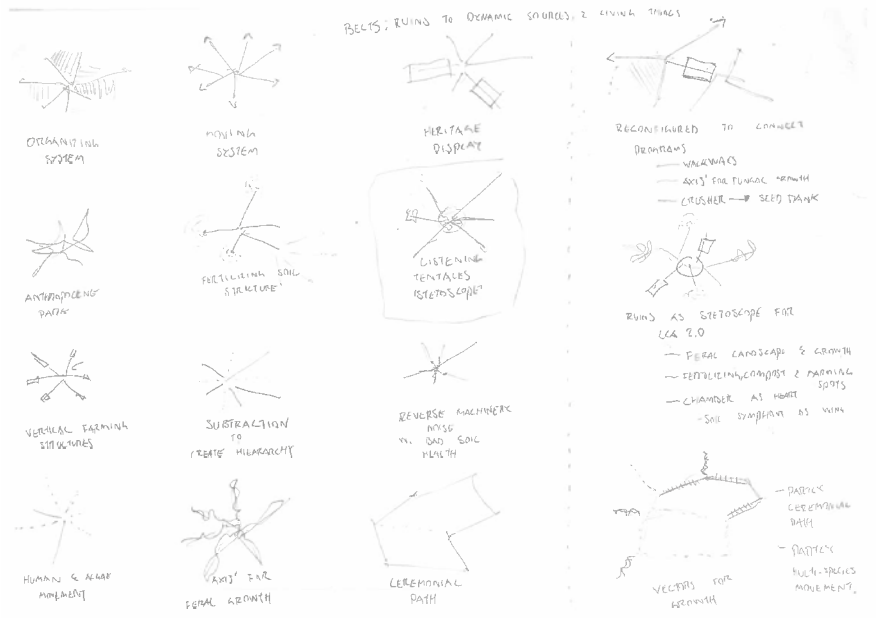
5. Extractive artefacts become vital parts of the Institute, repurposed within a regenerative framework.

Repurposing Extractive Infrastructure as the Pedagogical Framework of The Institute



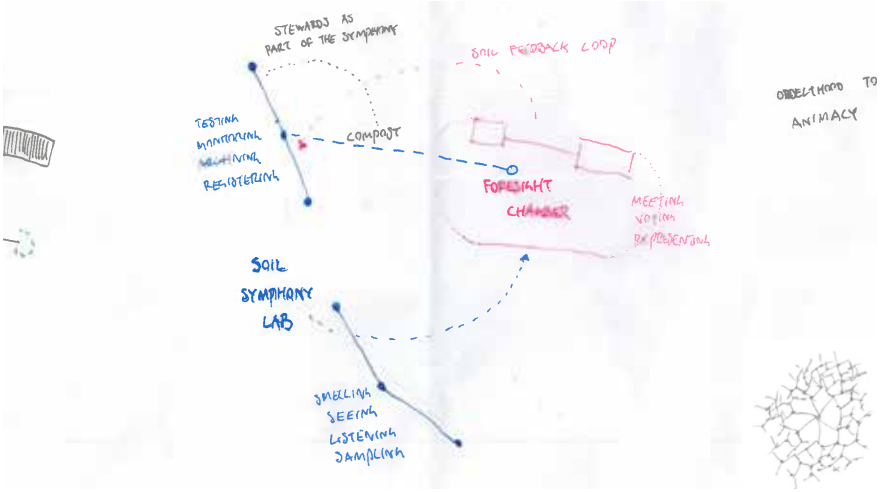
As we must unlearn extractive practices, the extractive infrastructure takes on a new role - serving regenerative purposes and providing a framework for a new pedagogy of regenerative learning

ill. 171 Drawing of the extractive infrastructure and its operational logic



Principles for how the conveyer belts can shape a living, dynamic instutute - moving soil and humans between functions.

ill. 172 Drawing of principles for the new roles of extractive infrastructure and placement of functions

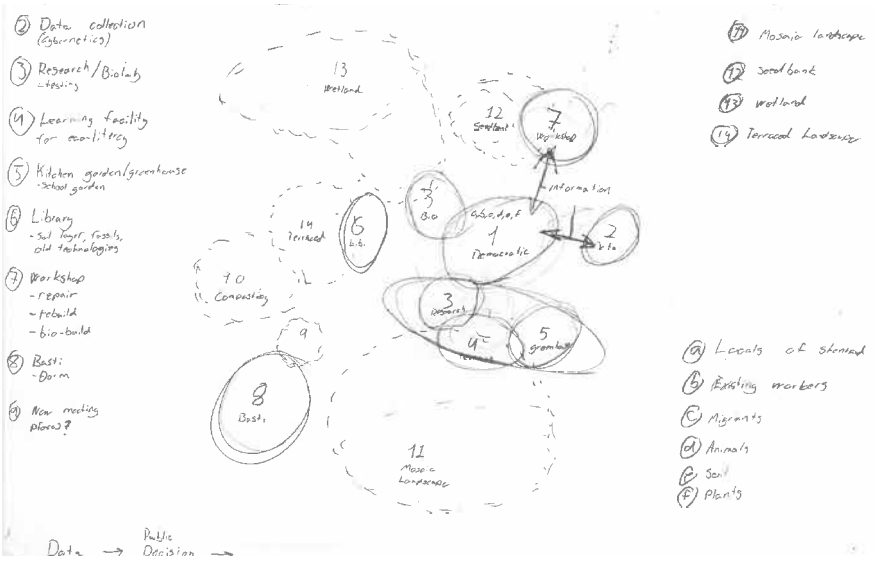


The conveyer belts connect different functions as they rotate, direct and move.

ill. 173 Drawing extractive infrastructure being the connection between functions

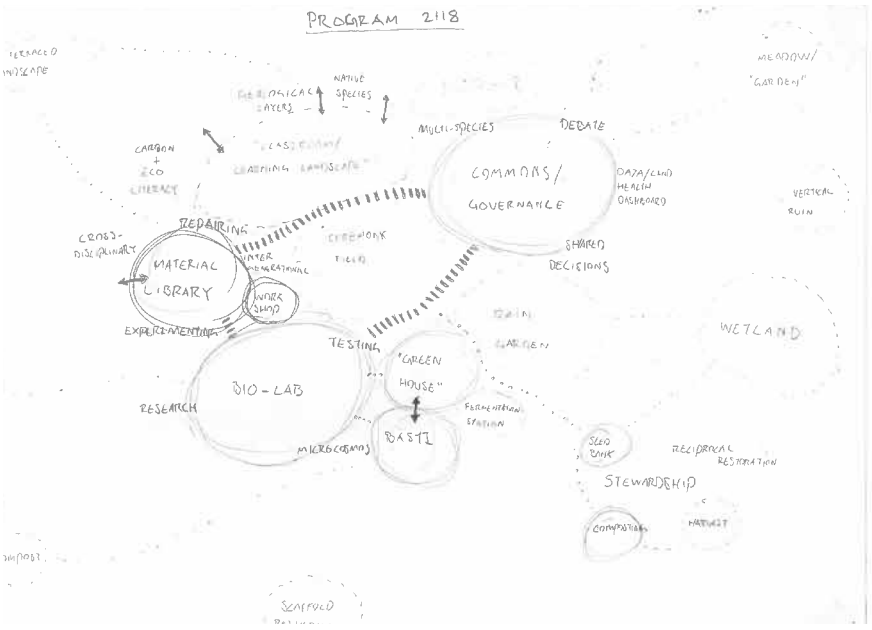
Planning the Functions around New Pedagogical Infrastructure

The institute's functions involve different actors



ill. 174 Drawing of Plan iteration 1

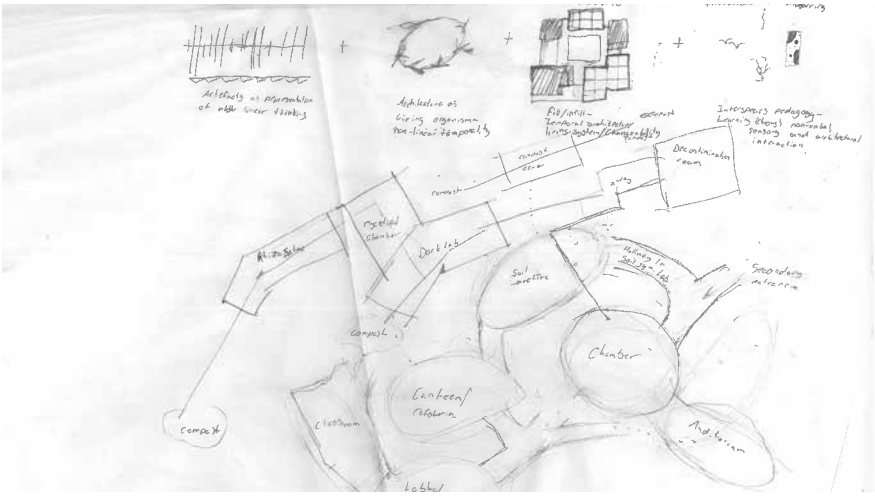
A biolab and a governance were established as the main functions, supported by a variety of functions.



ill. 175 Drawing of plan interation 4

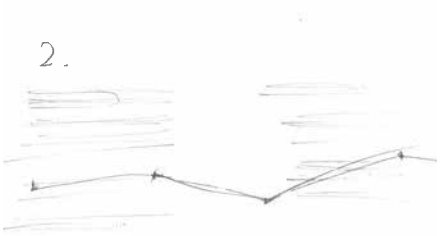
A concept that was explored was the the symphony lab embodying linear understainding of time, while the chamber representing a cyclic understanding. The duality, combined with the spatial layout inspired by the Utzon Center and the inclusivity of multi-species actors, framed the prjects approach.

The emphasis on time representation in the spatial layout was dismissed due to the number of concepts involved.

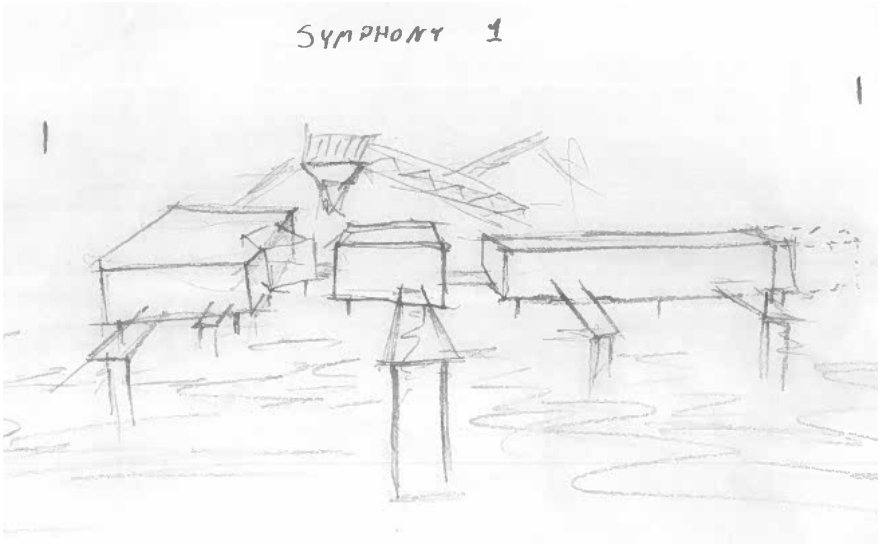


ill. 176 Drawing of plan interation 7

The Emergence of the Soil Symphony Lab

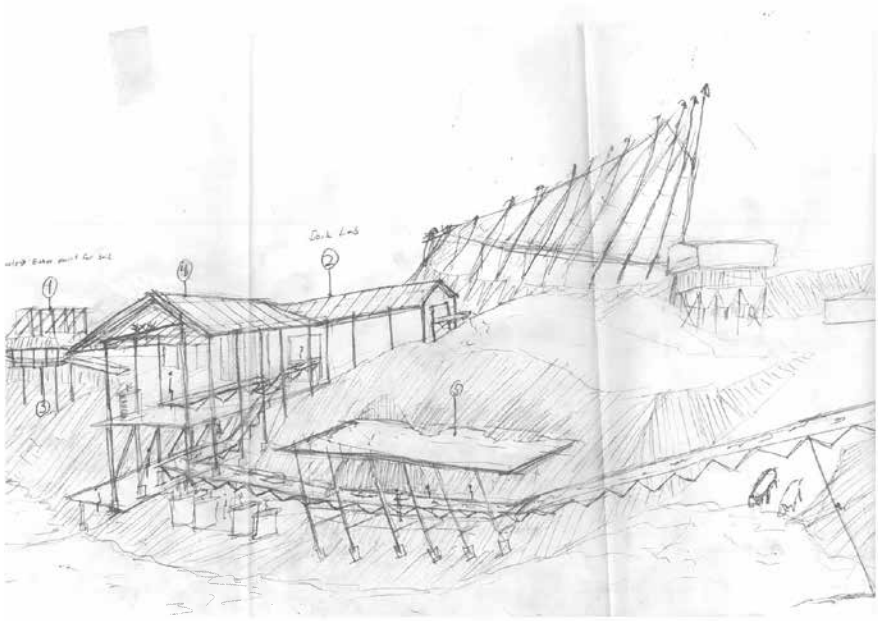


ill. 178 Drawing of design criteria for the Soil Symphony Lab.

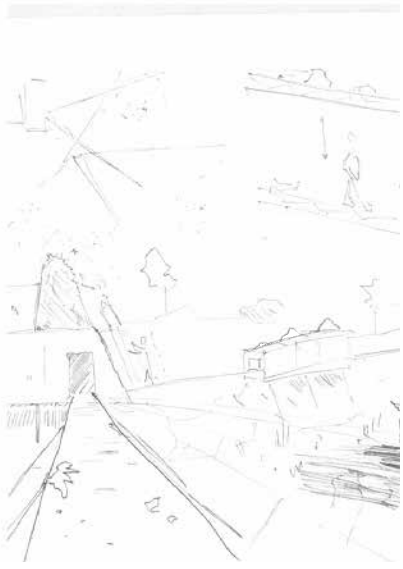


ill. 177 Drawing of early ideas for the symphony lab

Various sketches exploring the emergence of the soil symphony lab.



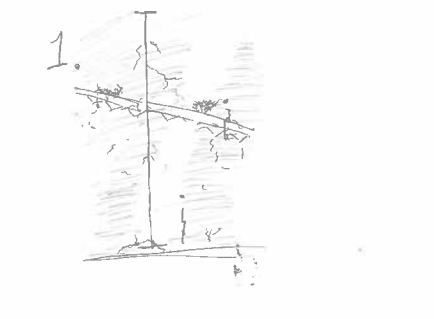
ill. 179 Drawing of early ideas for the instutue



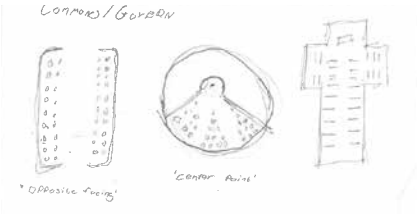
Exploring the connections between the functions.

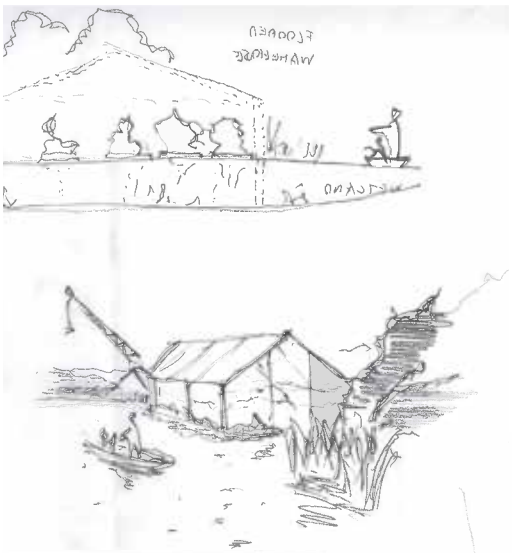
ill. 180 Drawing of conveyer belt connecting the soil symphony lab and the foresight chamber

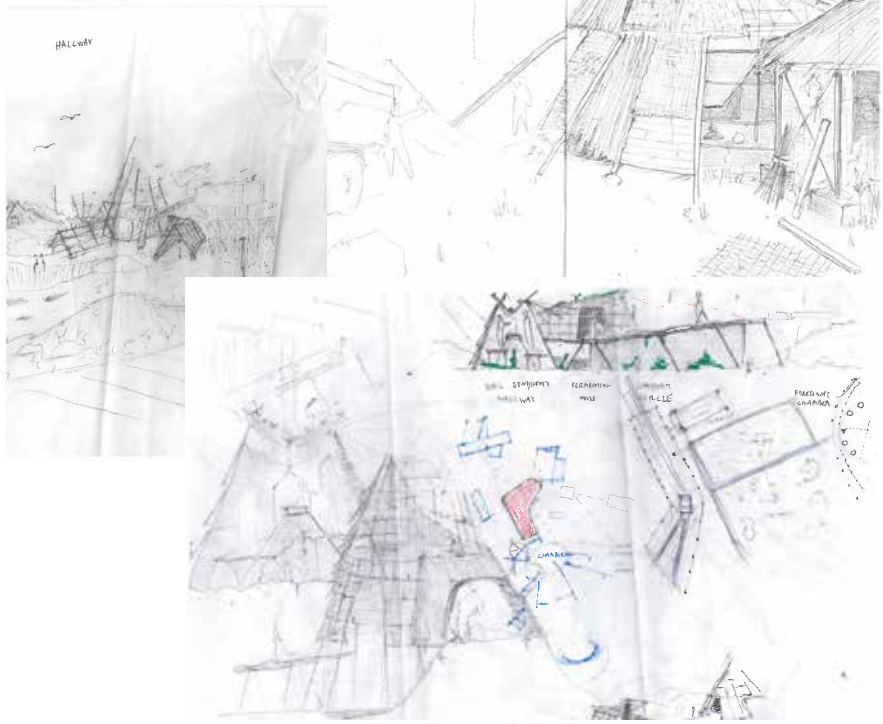
The Emergence of the Foresight Chamber



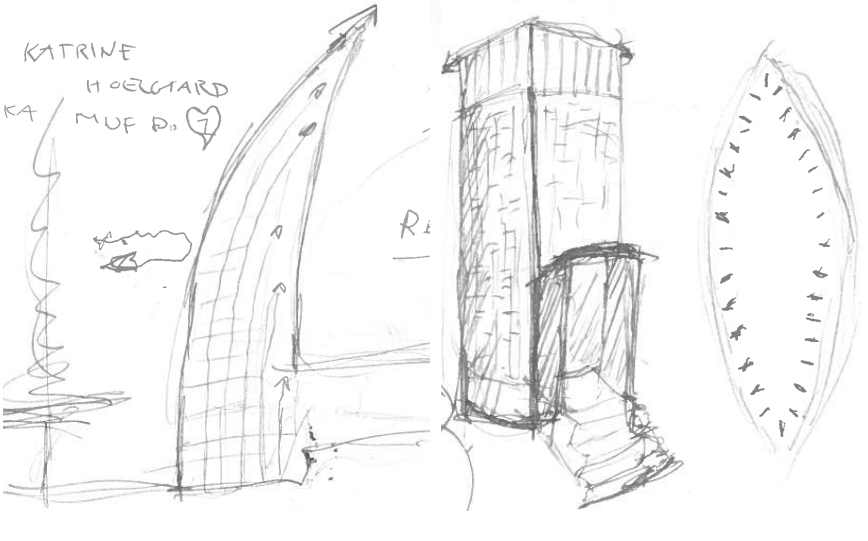
ill. 181 Drawing of design criterias for the Foresight Chamber.







Various sketches exploring the emergence of the foresight chamber.

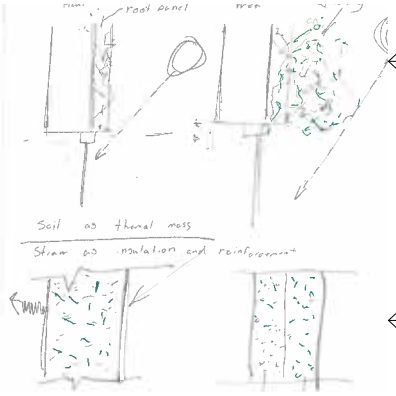


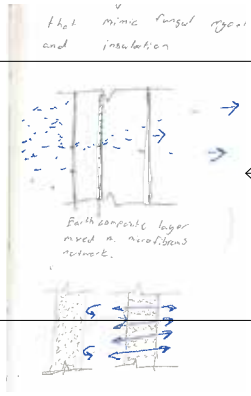
Atmospheric and tectonic inspiration.

ill. 183 Drawing of Saint Benedict Chapel by Peter Zumthor (to the right).

ill. 182 Drawing of Tjibaou Cultural Centre by Renzo Piano (to the left)

Investigating Future Material Assemblies

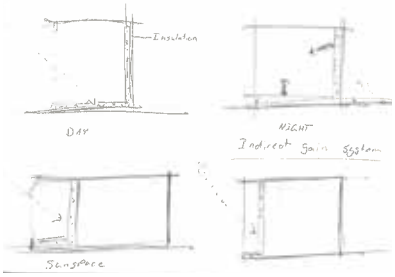


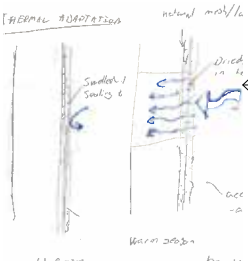


Plant root interface.

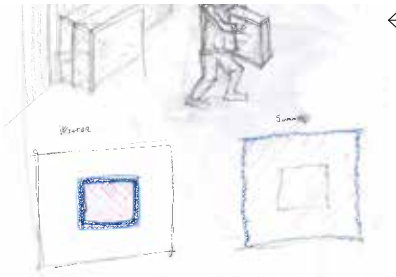
Soil infused panels for moisture regulation.

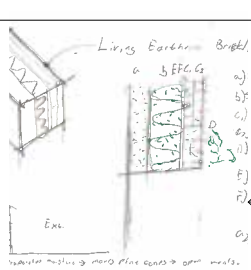
Soil as thermal mass





Pine-cone infused panels enable the building to self-regulate its thermal performance.





Exploring the idea of shrinking the building in times of energy scarcity.

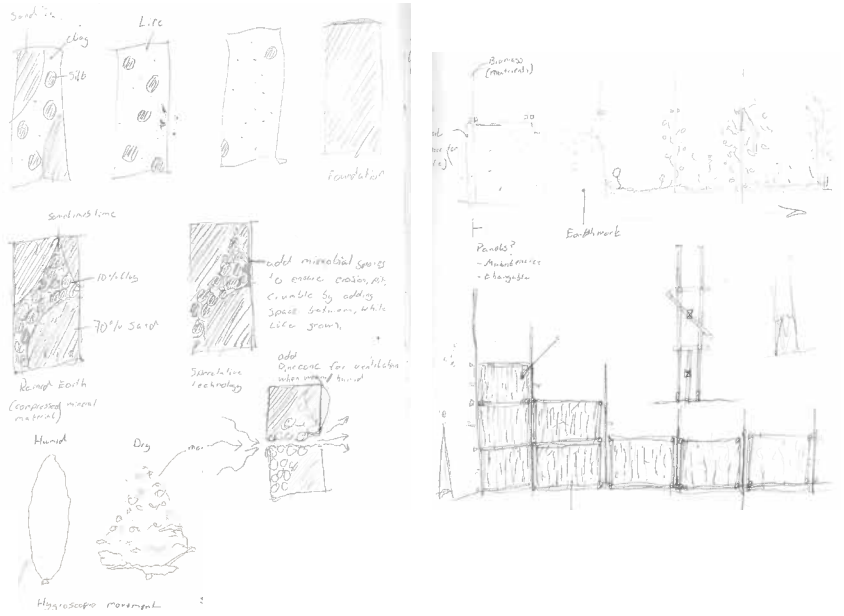
A living earthen envelope combining the speculative technologies.

ill. 184 Collage of ideas exploring speculative material technologies

Biological Circularity of the Materials

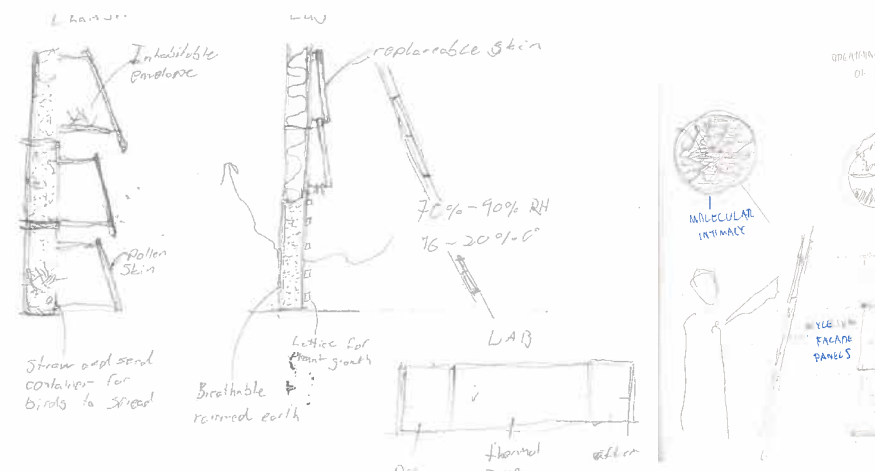
The idea of a pine-cone infused rammed earth wall, that enables the building to self-regulate its thermal performance was paired with insights of soil from the permaculture theory.

By infusing microbial spores into the rammed wall it is able to fully decompose.



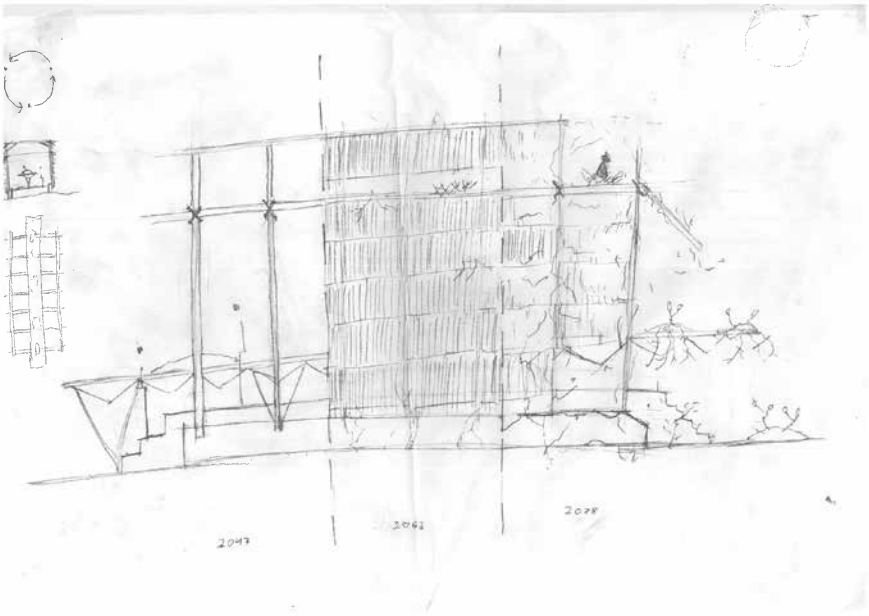
ill. 187 Drawing of the pine-cone infused rammed earth wall

Based on that, the envelopes were developed - including an inhabitable skin for the Foresight Chamber



ill. 186 Drawing of the building envelope.

The concept of biological circularity.



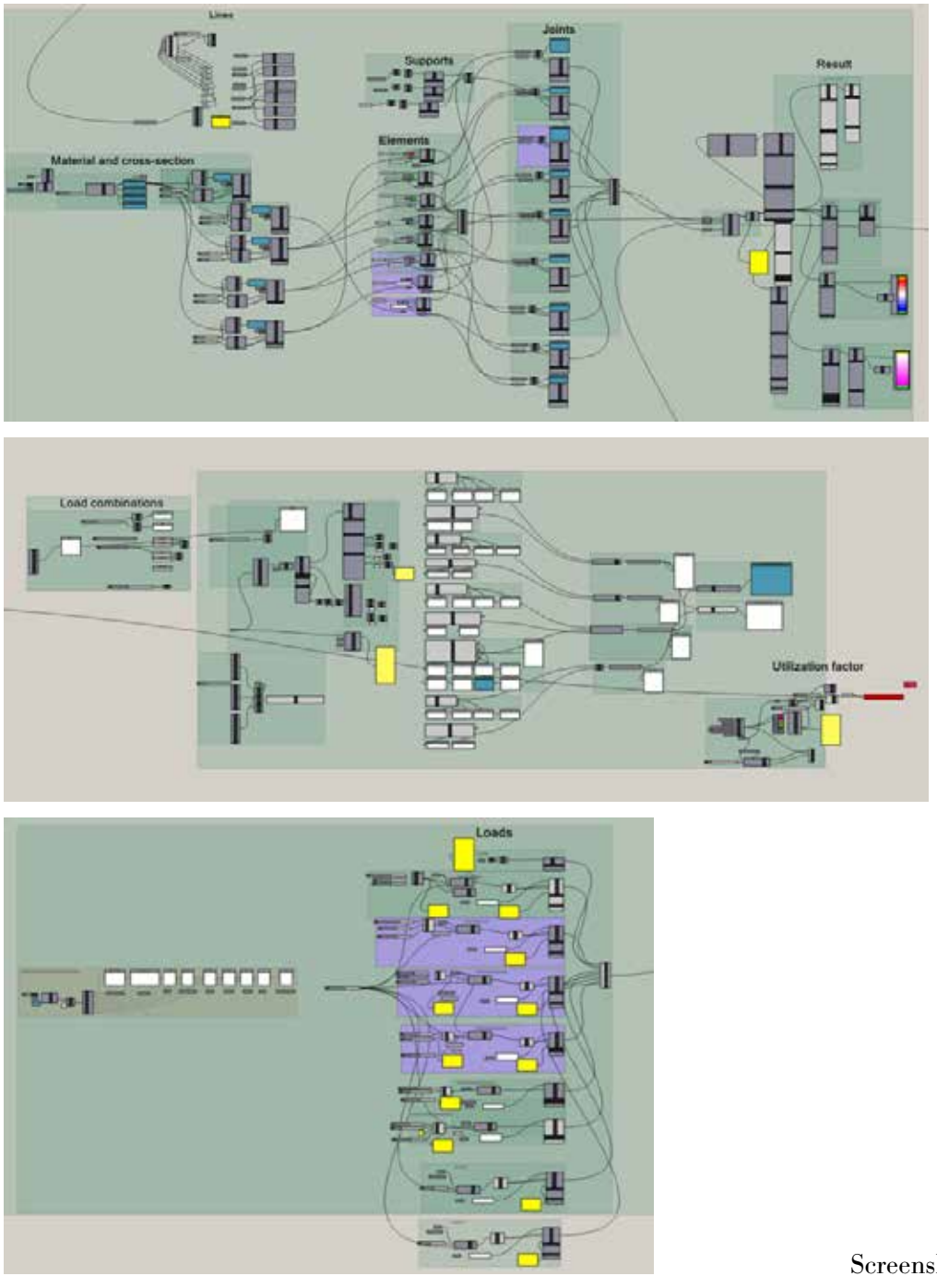
ill. 185 Drawing of biological circularity of the building.

Appendix 2
Structural Analysis

A structural analysis was performed using Karamba to verify the frame's performance under defined load cases and combinations.

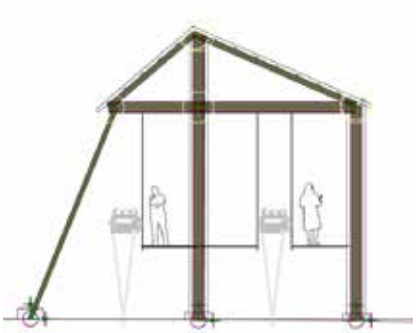
The cross-section dimensions used in the structural model are as follows:
- Columns: 280mm x 140mm
- Tilted column: 120mm x 80mm
- Roof beams: 150mm x 100mm
- Beam: 280mm x 120mm

The suspended walkway is fixed to the upper beam in 3 distinct points supported by the column, resulting in point loads. For simplicity, these loads are applied as line loads in the analysis.

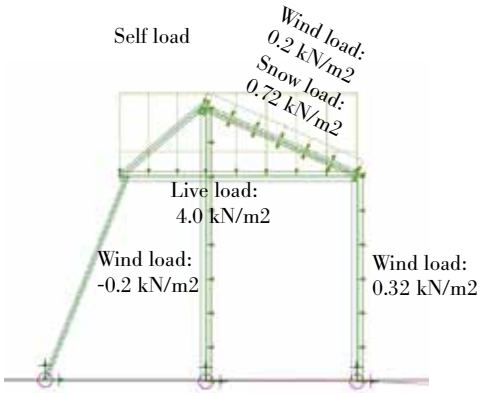


Screenshot of grasshopper script

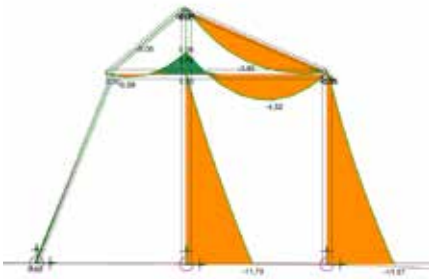
Diagrams of results from structural analysis



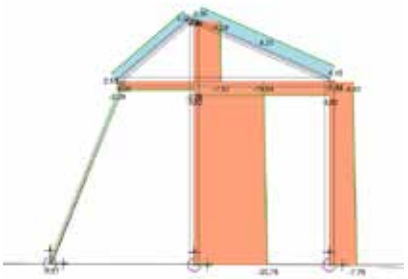
Structure cross-section, joints and support



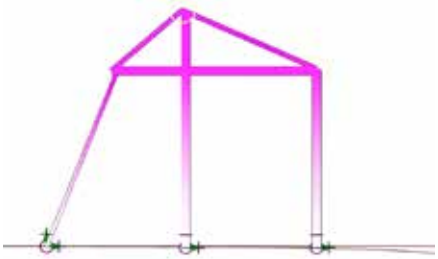
Loads



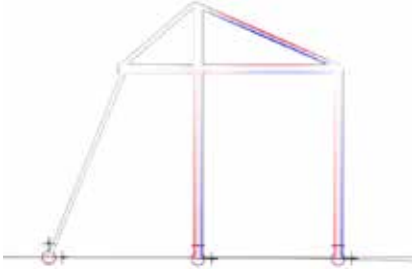
Moment



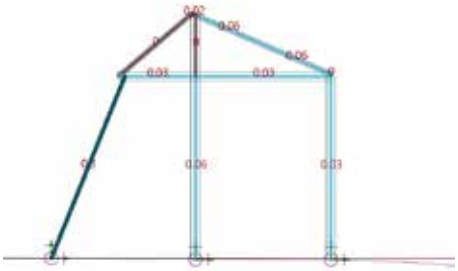
Normal force



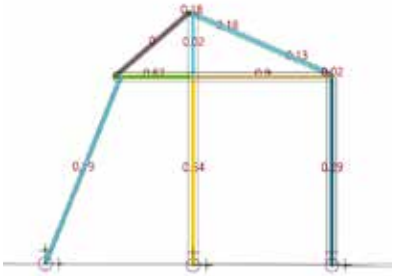
Displacement on beam cross-section



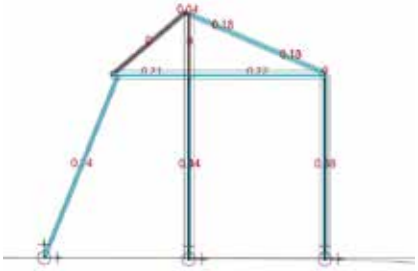
Axial-stress



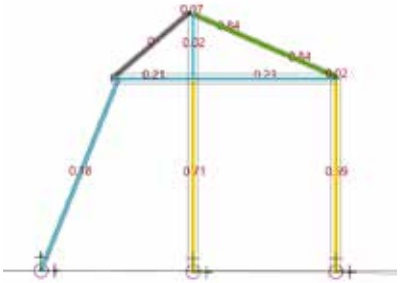
Utilization (Dominating self load, bending and compression)



Utilization (Dominating live load, bending and compression)



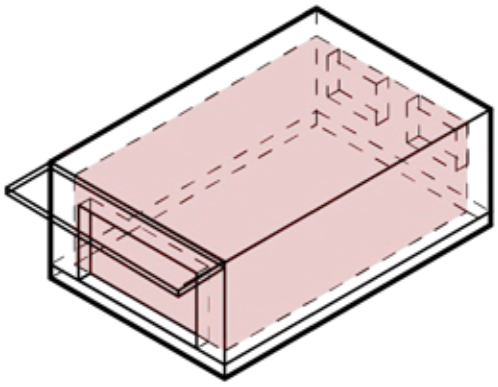
Utilization (Dominating wind load, bending and compression))



Utilization (Dominating snow, bending and compression))

Appendix 3
Energy Calculations and Thermal Comfort

This version represents an earlier stage of the building design and has been used as the basis for thermal simulations and the calculation of required photovoltaic (PV) panel area. Although it does not meet the Danish energy frame requirements (2025).



Model 1: Simulation Model

Area: 52m²
lwh: 9m x 5,9m x 3,4m
Opening area (N): 4m²
Opening area (S): 9m²

Energiforbrug

kWh/m2 år	Forbrug	RK2	RK1	LE15	BK20
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00
Rumopvarmning	51,60	51,60	51,60	41,28	30,96
Køling	0,00	0,00	0,00	0,00	0,00
Belysning	0,00	0,00	0,00	0,00	0,00
El til bygningsdrift	0,00	0,00	0,00	0,00	0,00
Varmt brugsvand	13,10	13,10	13,10	10,48	7,86

Energiproduktion

kWh/m2 år	Forbrug	RK2	RK1	LE15	BK20
Varmepumpe, Rumopv	0,00	0,00	0,00	0,00	0,00
Varmepumpe, VBV	0,00	0,00	0,00	0,00	0,00
Solvarme, Rumopv	0,00	0,00	0,00	0,00	0,00
Solvarme, VBV	0,00	0,00	0,00	0,00	0,00
Solceller	0,00	0,00	0,00	0,00	0,00
Vindmøller	0,00	0,00	0,00	0,00	0,00

Walls - U-value (W/m2K)
Roof: 0,18
Floor: 0,18
Facade: 0,18

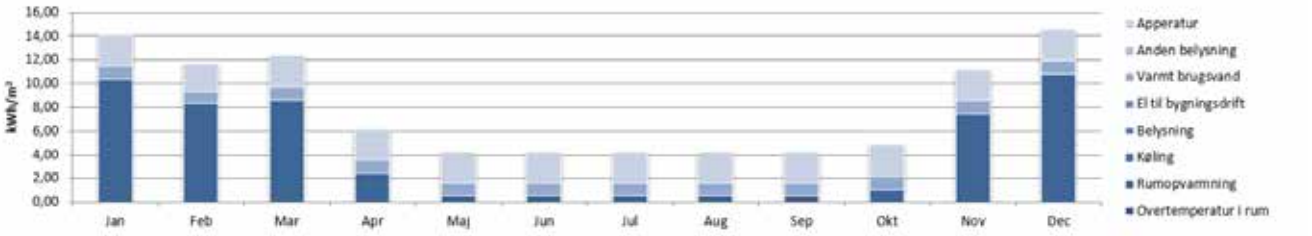
Windows
U-value: 0,80
b-value: 1,00
Ff-value: 0,70
g-value 0,63
Overhang: 2m
Fc: 1,00

Energifaktorer

	RK2	RK1	LE15	BK20
pvarmning	1	1	0,8	0,6
	2,5	2,5	2,5	1,8

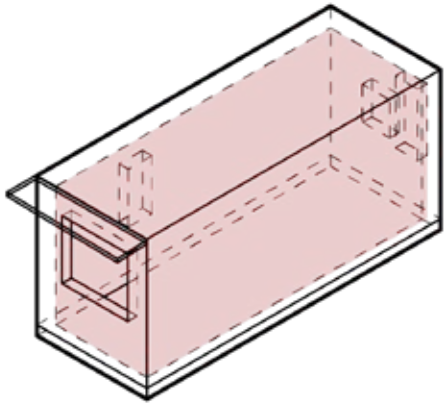
Energiramme

Wh/m2 år	Forbrug	RK2	RK1	LE15	BK20
ım	64,70	64,70	64,70	51,76	38,82



kWh/m²	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rumopvarmning	10,40	8,30	8,60	2,50	0,50	0,50	0,50	0,50	0,50	1,10	7,50	10,80	51,60
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Belysning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El til bygningsdrift	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmt brugsvand	1,10	1,00	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	1,10	13,10
Anden belysning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Apperatur	2,66	2,40	2,66	2,58	2,66	2,58	2,66	2,66	2,58	2,66	2,58	2,66	31,40

This version is the finished design model, and has been used to verify compliance with the current BE18 energy frame requirements. A BE18 energy calculation has been conducted specifically on this version to ensure that the updated geometry meets today's regulatory standards.



Model 2: Design Development Model

Area: 59m²
lwh: 12,5m x 4,7m x 4,9m
Opening area (N): 4,2m²
Opening area (S): 7m²
Opening area (W): 2,1m²

Walls - U-value (W/m2K)
Roof: 0,12
Floor: 0,10
Facade: 0,18

Windows
U-value: 0,80
b-value: 1,00
Ff-value: 0,70
g-value 0,63
Overhang: 2m
Fc: 1,00

Nøgletal, kWh/m² år

Renoveringsklasse 2		
Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
112,3	0,0	112,3
Samlet energibehov		37,3

Renoveringsklasse 1		
Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
84,2	0,0	84,2
Samlet energibehov		27,3

Energiramme BR 2018		
Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
49,2	0,0	49,2
Samlet energibehov		37,3

Energiramme lavenergi		
Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
27,0	0,0	27,0
Samlet energibehov		37,3

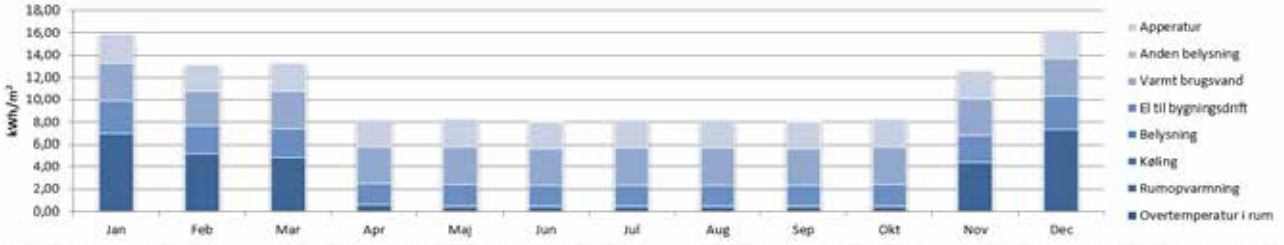
Bidrag til energibehovet	
Varme	14,9
El til bygningsdrift	12,9
Overtemp. i rum	0,0

Netto behov	
Rumopvarmning	26,4
Varmt brugsvand	40,0
Køling	0,0

Udvalgte elbehov	
Belysning	0,0
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	25,2
Ventilatorer	0,0
Pumper	0,0
Køling	0,0
Totalt elforbrug	56,7

Varmetab fra installationer	
Rumopvarmning	5,9
Varmt brugsvand	26,8

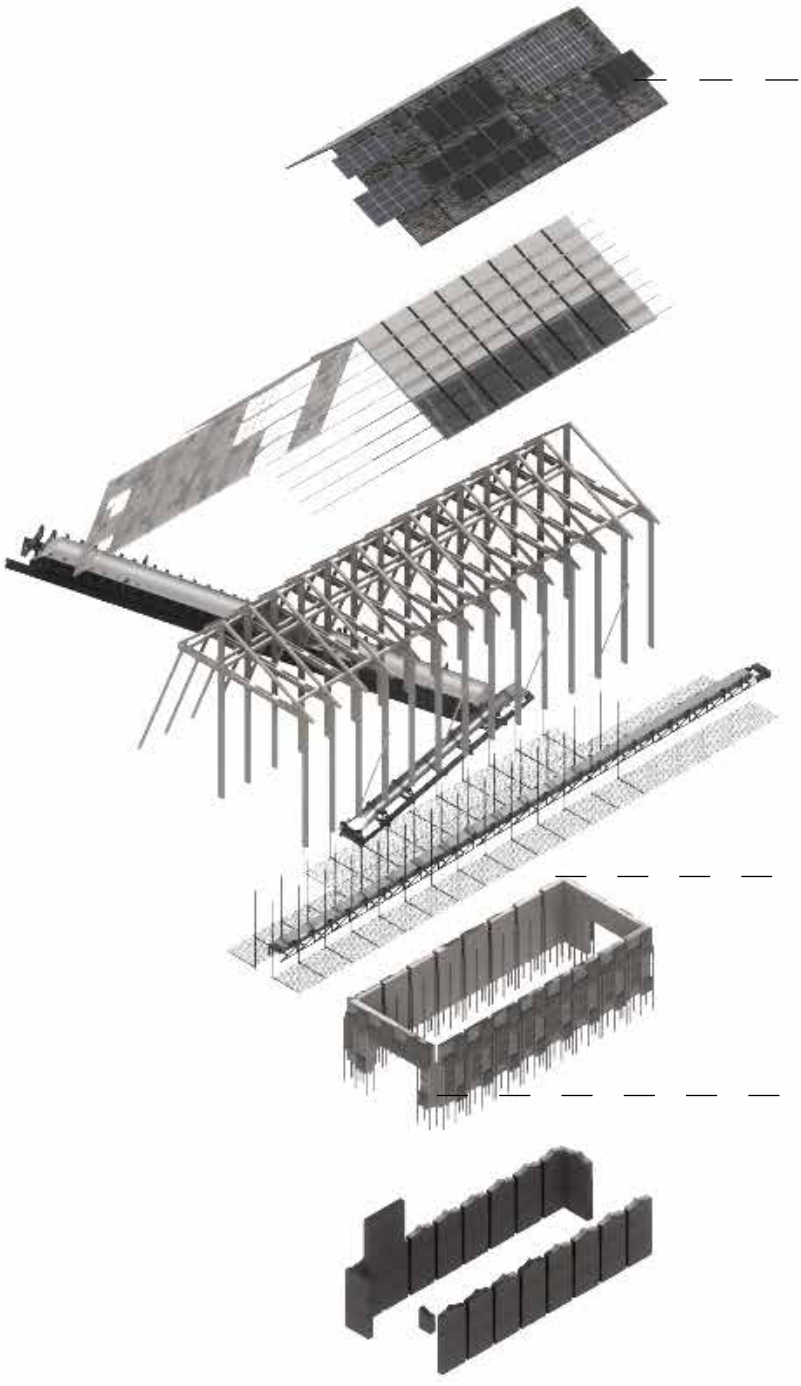
Ydelse fra særlige kilder	
Solvarme	0,0
Varmepumpe	62,4
Solceller	14,9
Vindmøller	0,0



kWh/m²	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rumopvarmning	7,00	5,20	4,80	0,60	0,50	0,50	0,50	0,50	0,50	0,50	4,40	7,30	32,30
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Belysning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El til bygningsdrift	2,90	2,50	2,60	1,90	1,90	1,80	1,80	1,80	1,80	1,90	2,40	3,00	26,10
Varmt brugsvand	3,40	3,10	3,40	3,30	3,40	3,30	3,40	3,40	3,30	3,40	3,30	3,40	40,00
Anden belysning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Apperatur	2,52	2,28	2,52	2,45	2,52	2,45	2,52	2,52	2,45	2,52	2,45	2,52	29,77

Slowing Down: A New Architectural Ethic of Energy and Existentialism

The concept is to slow down - to reduce heating input, energy use, and expectations of thermal comfort - during periods of low energy production by photovoltaic (PV), rather than compensating through increased reliance on district heating. This approach reframes the notion of comfort in western cosmology, embedding it within a new existential paradigm. It acknowledges that comfort is not a fixed entitlement, but something negotiated within ecological limits. In this light, it is not only architecture but also philosophy that must reckon with the reality that continued growth in consumption is no longer viable - and that true freedom may instead be found through voluntary limitation.



Note: Pv-panels calculated as being horizontal

Note: The geometry of v2 reflects the final design, but the previous version v1 was used for further energy and indoor climate calculation.

From Annual to Seasonal

Calculating amount of pv-panels to cover the anually energy demand based on be18 results. The calculation includes the efficiency of mono-crystalline, storage loss and incident radiation as realistic estimates of actual solar radiation received, accounting for:

- Daylength and seasonal variation (short days in winter, long in summer)
- Weather patterns (cloud cover, fog, etc.)
- Sun angle and atmospheric conditions.
- Shading from the horizon (on a macro scale)

(1Library, n.d.)

Incdident radiation (0 degree slope)	1003	kwh/m2
Mono-crystalline efficiency	0,23	%
System efficiency after storage loss	0,75	%
Institute of unlearning		
Energy demand		
Appliances - Be18 value	31	kwh/m2
Hot water - Be18 value	13,1	kwh/m2
Heat - Be18 value	51,6	kwh/m2
Heat * primary energi factor	43,9	kwh/m2
Total energy frame	88	kwh/m2
Total net area	52	m2
Needed energy pr unit	4595	kwh
Total Needed energy	4595	kwh
Energy supply		
Pv panels	25	m2
total incident radiation on 0' roof	25075	kwh
produced energy from PV	5767	kwh
useful energy due to storage loss	4325	kwh
negative = deficit, positive = surplus	-269	kwh
Units supplied with energy	0,9414	

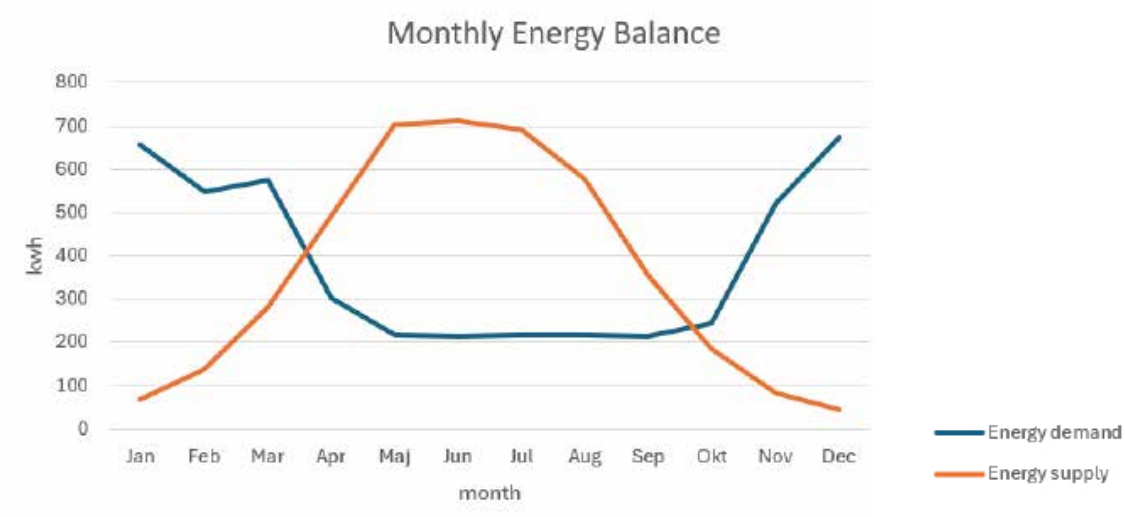
Incdident radiation (Anually)	
Horizontal rotation	KWh/m2
0	1042
10	1140
20	1213
30	1256
38	1268
40	1268
50	1237

To account for seasonal variations in energy input from PV panels, a monthly estimate of incident solar radiation is used to identify periods of energy surplus and deficit.

Incdident radiation (Monthly)	
Copenhagen	
Global horizontal irradiation (GHI) (the average monthly)	
Horizontal rotation 0 degrees	KWh/m2
Jan	16
Feb	32
Mar	65
Apr	114
Maj	163
Jun	165
Jul	160
Aug	134
Sep	82
Okt	43
Nov	19
Dec	10
Yearly	1003

Monthly Energy Balance

When matching PV panel energy production with the BE18-defined energy demand to operate the building efficiently year-round, regardless of natural seasonal cycles, this approach highlights months of energy deficit and months of surplus.

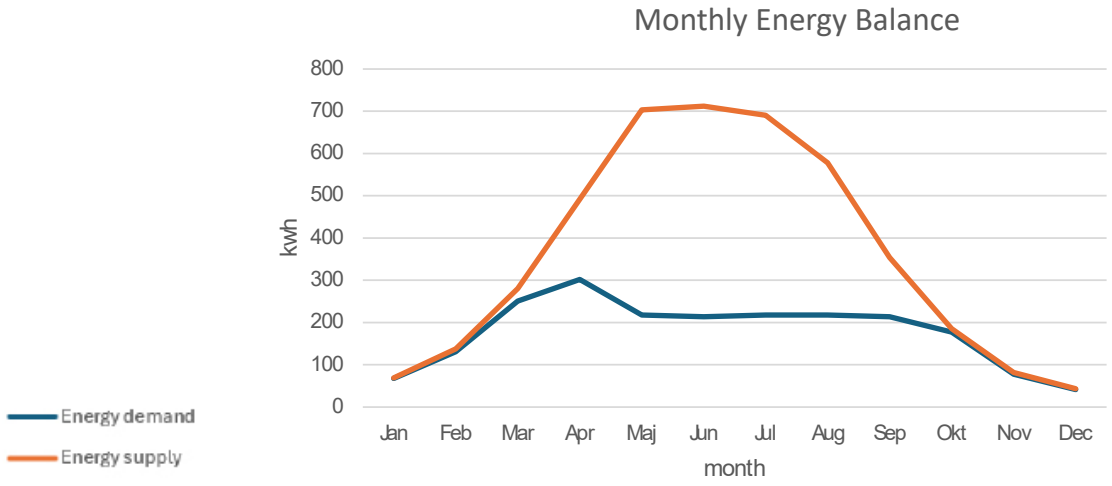


January	Febuary	Marts	April	May	June	July	August	September	October	November	December
16 kwh/m2	32 kwh/m2	65 kwh/m2	114 kwh/m2	163 kwh/m2	165 kwh/m2	160 kwh/m2	134 kwh/m2	82 kwh/m2	43 kwh/m2	19 kwh/m2	10 kwh/m2
0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %
0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %
2,66 kwh/m2	2,40 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,66 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,66 kwh/m2
1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2
10,4 kwh/m2	8,3	8,6	2,5	0,5	0,5	0,5	0,5	0,5	1,1	7,5	10,8
8,8	7,1	7,3	2,1	0,4	0,4	0,4	0,4	0,4	0,9	6,4	9,2
13 kwh/m2	11 kwh/m2	11 kwh/m2	6 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	5 kwh/m2	10 kwh/m2	13 kwh/m2
52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2
655 kwh	549 kwh	576 kwh	302 kwh	218 kwh	213 kwh	218 kwh	218 kwh	213 kwh	244 kwh	523 kwh	673 kwh
655 kwh	549 kwh	576 kwh	302 kwh	218 kwh	213 kwh	218 kwh	218 kwh	213 kwh	244 kwh	523 kwh	673 kwh
25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2
400 kwh	800 kwh	1625 kwh	2850 kwh	4075 kwh	4125 kwh	4000 kwh	3350 kwh	2050 kwh	1075 kwh	475 kwh	250 kwh
92 kwh	184 kwh	374 kwh	656 kwh	937 kwh	949 kwh	920 kwh	771 kwh	472 kwh	247 kwh	109 kwh	58 kwh
69 kwh	138 kwh	280 kwh	492 kwh	703 kwh	712 kwh	690 kwh	578 kwh	354 kwh	185 kwh	82 kwh	43 kwh
-586 kwh	-411 kwh	-295 kwh	190 kwh	485 kwh	498 kwh	472 kwh	360 kwh	140 kwh	-59 kwh	-441 kwh	-630 kwh
-37 m2	-13 m2	-5 m2	2 m2	3 m2	3 m2	3 m2	3 m2	2 m2	-1 m2	-28 m2	-63 m2
0,11	0,25	0,49	1,69	3,23	3,33	3,17	2,66	1,66	0,76	0,16	0,06

Monthly Energy Balance: Slowing Down

The concept of energy consumption as "energy demand" reflects a Western worldview that assumes unlimited access to energy as a basic human right. However, this perspective conflicts with the reality that Earth's resources are finite.

This calculation illustrates a necessary reduction in energy use for appliances, hot water, and heating in order to align consumption with the available energy supply.



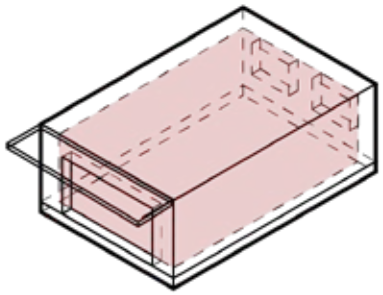
January	Febuary	Marts	April	May	June	July	August	September	October	November	December
16 kwh/m2	32 kwh/m2	65 kwh/m2	114 kwh/m2	163 kwh/m2	165 kwh/m2	160 kwh/m2	134 kwh/m2	82 kwh/m2	43 kwh/m2	19 kwh/m2	10 kwh/m2
0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %	0,23 %
0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %	0,75 %
0,80 kwh/m2	1,44 kwh/m2	1,86 kwh/m2	2,58 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,66 kwh/m2	2,66 kwh/m2	2,58 kwh/m2	2,39 kwh/m2	0,52 kwh/m2	0,40 kwh/m2
0,3 kwh/m2	0,7 kwh/m2	0,8 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	1,1 kwh/m2	0,6 kwh/m2	0,7 kwh/m2	0,2 kwh/m2
0,2 kwh/m2	0,6	2,6	2,5	0,5	0,5	0,5	0,5	0,5	0,6	0,4	0,2
0,2	0,4	2,2	2,1	0,4	0,4	0,4	0,4	0,4	0,5	0,3	0,2
1 kwh/m2	3 kwh/m2	5 kwh/m2	6 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	4 kwh/m2	3 kwh/m2	1 kwh/m2	1 kwh/m2
52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2	52 m2
68 kwh	131 kwh	251 kwh	302 kwh	218 kwh	213 kwh	218 kwh	218 kwh	213 kwh	177 kwh	78 kwh	42 kwh
68 kwh	131 kwh	251 kwh	302 kwh	218 kwh	213 kwh	218 kwh	218 kwh	213 kwh	177 kwh	78 kwh	42 kwh
25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2	25 m2
400 kwh	800 kwh	1625 kwh	2850 kwh	4075 kwh	4125 kwh	4000 kwh	3350 kwh	2050 kwh	1075 kwh	475 kwh	250 kwh
92 kwh	184 kwh	374 kwh	656 kwh	937 kwh	949 kwh	920 kwh	771 kwh	472 kwh	247 kwh	109 kwh	58 kwh
69 kwh	138 kwh	280 kwh	492 kwh	703 kwh	712 kwh	690 kwh	578 kwh	354 kwh	185 kwh	82 kwh	43 kwh
1 kwh	7 kwh	29 kwh	190 kwh	485 kwh	498 kwh	472 kwh	360 kwh	140 kwh	8 kwh	4 kwh	1 kwh
0 m2	0 m2	0 m2	2 m2	3 m2	3 m2	3 m2	3 m2	2 m2	0 m2	0 m2	0 m2
1,0170	1,0517	1,1172	1,0287	3,2301	3,3335	3,1707	2,6554	1,6566	1,0453	1,0542	1,0333

Integrating Energy Scarcity into Thermal Comfort Calculations

The calculated limited energy demand for heating is converted into a reduction factor used as input for the thermal simulation in BSim.

This indoor climate simulation for v1, which incorporates the limited heating energy and relies solely on natural ventilation, allows for the evaluation of both summer and winter performance. Due to the future design scenarios of the project, the building is evaluated in 3 different points in time: 2025, 2050 and 2090, using predicted future weather data.

Area: 52m^2
lwh: 9m x 5,9m x 3,4m
Opening area (N): 4m^2
Opening area (S): 9m^2



Walls - U-value (W/m2K)
Roof: 0,18
Floor: 0,18
Facade: 0,18

Windows
U-value: 0,80
b-value: 1,00
Ff-value: 0,70
g-value 0,63
Overhang: 2m
Fc: 1,00

Calculating reduction factor for heating in Bsim

Month	Energy for heating (kWh/m²/day)	Total Energy (kWh/day)	Avg Power (W)	Equivalent maxPw (W/m²)	Factor for Bsim Heating (ref: 65W/m²)
January	0,2	9,2	383,1	7,4	0,1
February	0,4	22,0	917,2	17,6	0,3
March	2,7	114,0	4751,5	91,4	1,4
April		0,0	0,0	0,0	0,0
May		0,0	0,0	0,0	0,0
June		0,0	0,0	0,0	0,0
July		0,0	0,0	0,0	0,0
August		0,0	0,0	0,0	0,0
September		0,0	0,0	0,0	0,0
October	0,5	24,3	1012,9	19,5	0,3
November	0,3	16,6	690,6	13,3	0,2
December	0,2	9,5	397,8	7,7	0,1

Thermal Performance
2025 - 2050 - 2090

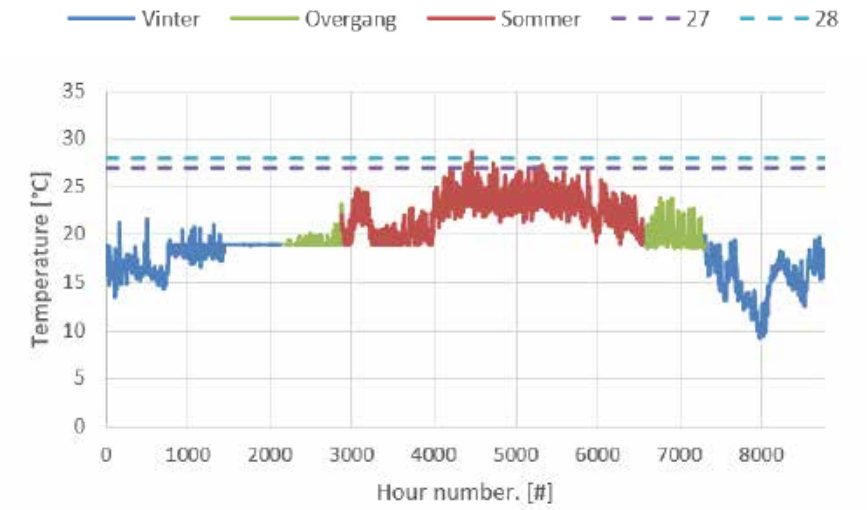
Operative indoor temperature: A combined measure of the indoor environment's thermal conditions. It accounts for:

- Air temperature
- Mean radiant temperature

The observed variation in indoor temperatures ranging from 8-23°C in 2025, 12–21°C in 2050, and 12–23°C in 2090 - reflects a deliberate response to limited heating energy availability during winter months. This temperature drift does not mean a system failure or poor design but aligns with the conceptual framework that prioritizes adaptive comfort and ecological responsibility over rigid thermal control.

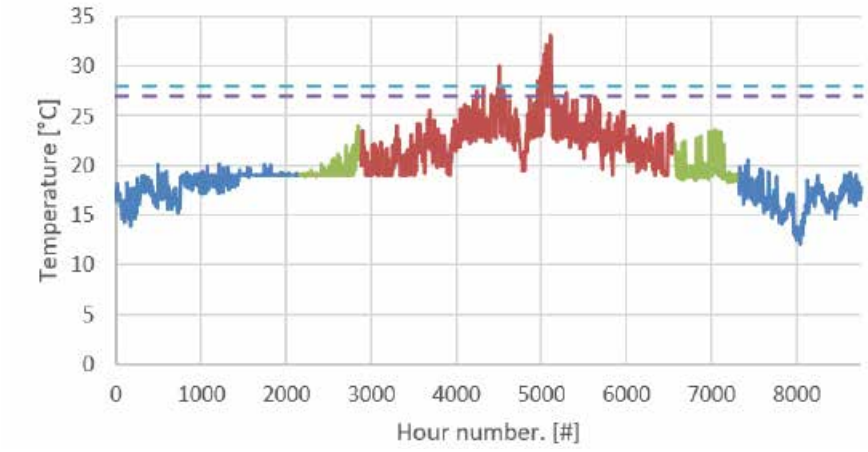
Hours above 27°C: 37
Hours above 28°C: 7

Hourly operative indoor temperature simulation 2025



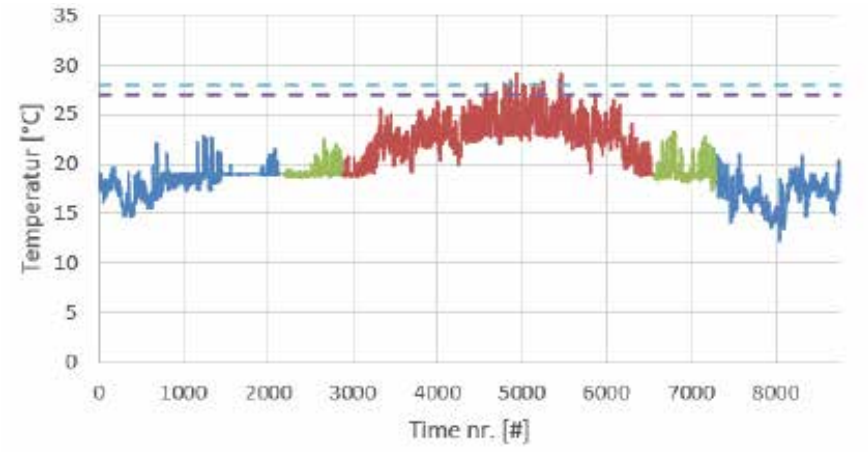
Hours above 27°C: 170
Hours above 28°C: 109

Hourly operative indoor temperature simulation 2050



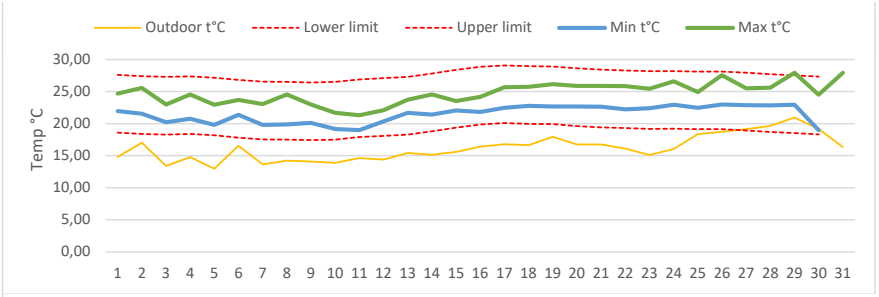
Hours above 27°C: 119
Hours above 28°C: 37

Hourly operative indoor temperature simulation 2090

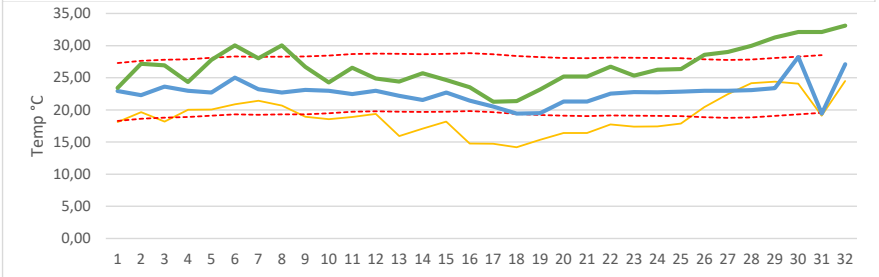


Adaptive Comfort and Seasonal Drift

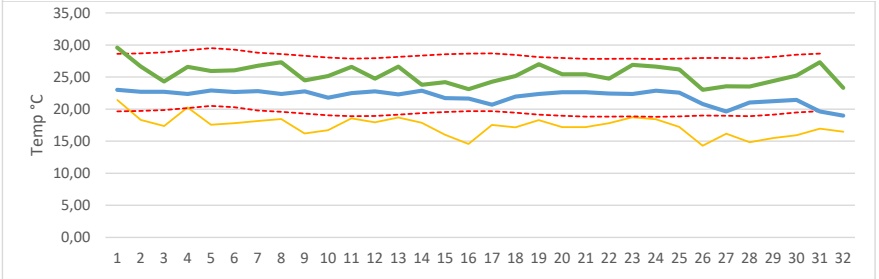
The 'Adaptive Thermal Comfort Model' supports the notion, that comfort is dependet on context and is a evolving experience rather than a fixed thermal condition. The calculation consider the occupants temperature experience over the past seven days.



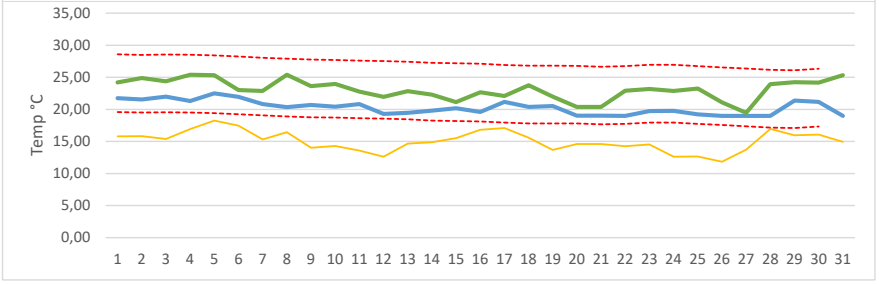
Adaptive Thermal Comfort Model
June 2090



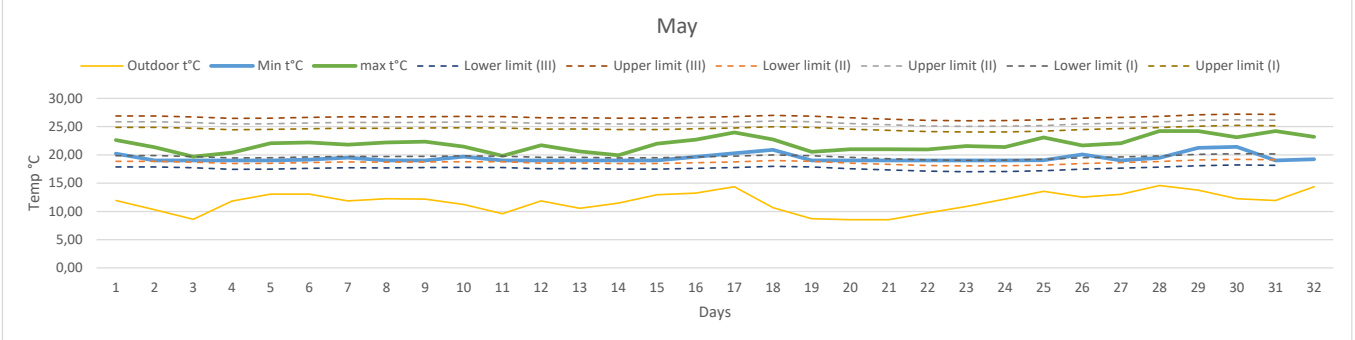
Adaptive Thermal Comfort Model
July 2090



Adaptive Thermal Comfort Model
August 2090

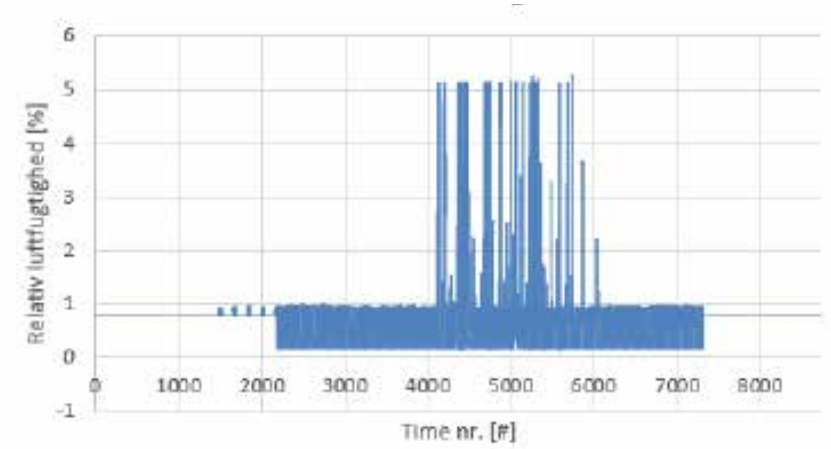


Adaptive Thermal Comfort Model
September 2090

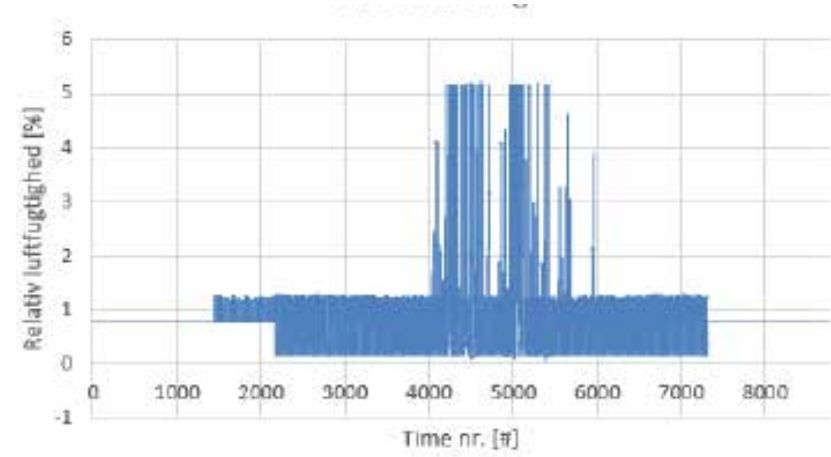


Natural Ventilation
2025 - 2050 - 2090

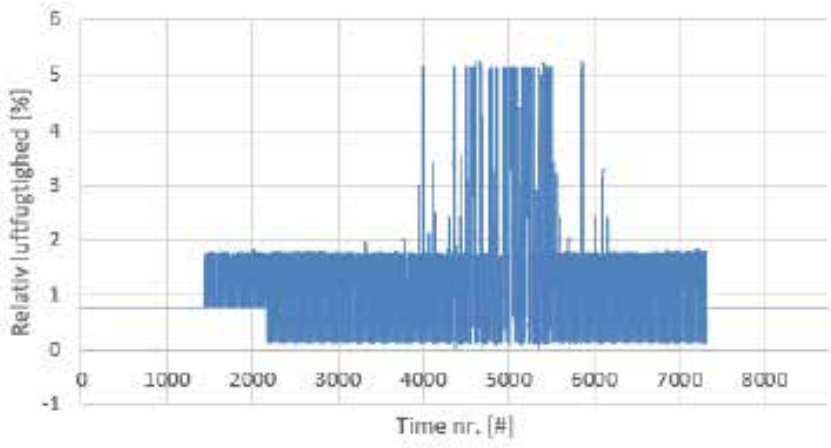
ACH (Air Change Rate):
How many times the air inside a space is replaced per hour.



Hourly Air Change Rate (ACH)
2025



Hourly Air Change Rate (ACH)
2050



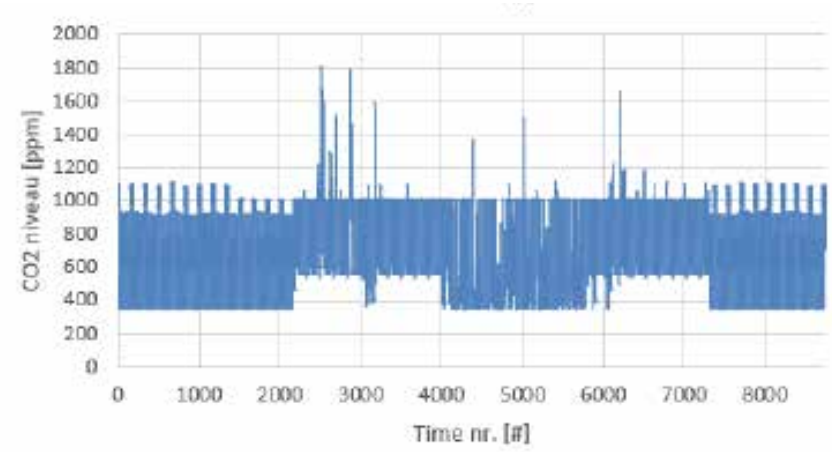
Hourly Air Change Rate (ACH)
2090

Air Quality
2025 - 2050 - 2090

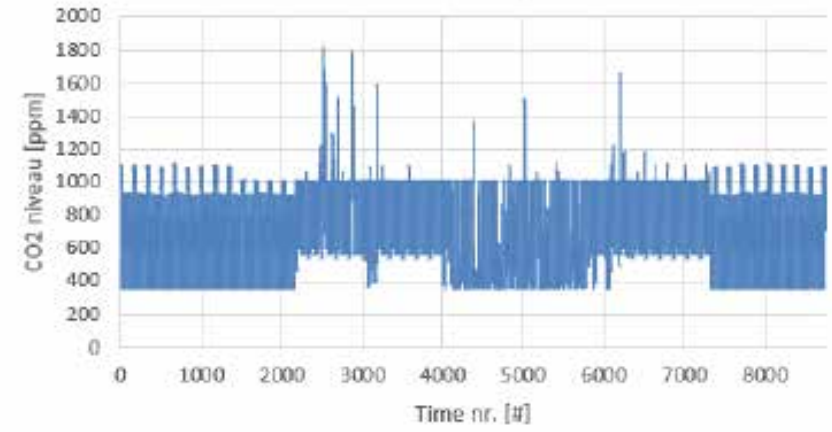
Atmospheric CO2 concentration used for simulation:

- 2025: 350ppm
- 2050: 500ppm
- 2090: 650ppm

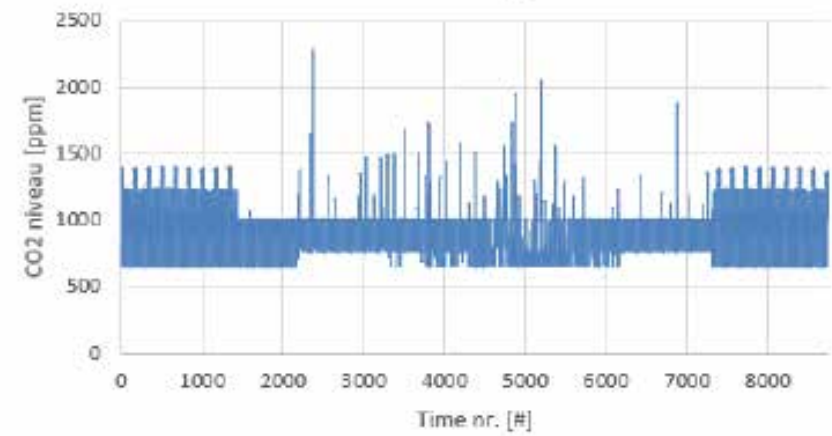
Hourly operative indoor temperature simulation 2025



Hourly operative indoor temperature simulation 2050



Hourly co2 level simulation 2090



Appendix 4
AI Prompts for Image Generating

Historical Timeline:
Pictures in illustration 8 was created with Midjourney. These prompts correspond to the respective pictures.
Picture of gravelpit: “black and white picture of extraction pit”
Picture of containerships: “black and white picture of the containerships moving goods in 1950”
Picture of steam locomotive: “black and white picture of the industrial revolution”
Picture of people harvesting by hand: “black and white picture of the agricultural revolution”

Illustration 135 and 136:

Mycelium insulation: 2d simple fine line drawing of 2-3 stacked mycelium insulation plates, icon square

Corridor pollination: 2d simple fine line drawing of landscape corridor pollinating, icon square

Timber columns: 2d simple fine line drawing of wooden beams and columns laying down, icon square

Forest cycle planting: 2d simple fine line drawing of forest cycles, icon square

Straw and reeds: 2d simple fine line drawing of straw and reeds, icon square

Wetland edge and flows: 2d simple fine line drawing of wetland edge, icon square, black and white

Bark: 2d simple fine line drawing of birch bark pieces laying down

Tree health and swamp regeneration: 2d simple fine line drawing of trees in a swamp, icon square, black and white

Wetlands restoration: 2d simple fine line drawing of wetland edge, icon square, black and white