# From being Consumers to becoming Producers: DESIGNING CYCLES at 64°

subarktis klimatanpassning
lokal matproduktion
växthus
cirkulär design
living lab
**sub-arctic climate adaptation**
**local food production**
**greenhouse**
**circular design**
**living lab**

**Redeker, Cornelia[1]; Thor, Sara[2]; Hirt, Constanze[1]**

[1]UMA Umeå University, Sweden.
cornelia.redeker@umu.se

[2]UMA Umeå University, Sweden.
sara.thor@umu.se

[3]UMA Umeå University, Sweden.
constanze.hirt@umu.se

Citation: Hirt, C; Redeker, C; Thor, S. (2022). "From being Consumers to becoming Producers: DESIGNING CYCLES at 64°" UOU scientific journal #04, 96-109.

ISSN: 2697-1518. https://doi.org/10.14198/UOU.2022.4.10

Date of reception: 14/10/2022
Date of acceptance: 20/12/2022

I det subarktiska klimatet med extremt korta säsonger för odling och en marktäckning som domineras av skog och mycket lite jordbruksmark, erbjuder den byggda miljön en outnyttjad kapacitet gällande platser för livsmedelsproduktion. Detta relaterar både till det befintliga och, baserat på norra Sveriges dynamik gällande utveckling och befolkningstillväxt, det kommande byggnadsbeståndet.

Designing Cycles at 64° tar ett mångskalärt tillvägagångssätt som adresserar individuella byggnadstypologier och, som exempel på klimatanpassning av nordliga klimatzoner, staden Umeå, Sverige med dess mångsidiga stadsväv som helhet. Genom utvidgning av Bengt Warnes Naturhus (1974) koncept och efterföljande exempel, förutser vi nya multifunktionella arkitektoniska modeller att tillämpa i olika sammanhang och skalor (se fig. 2). Det bygger vidare på hypotesen att lågteknologiska-, lågkostnads- och landskapsbaserade lösningar är applicerbara i olika samhälleliga sammanhang och kan därför potentiellt bidra till att övervinna segregation (Redeker, Jüttner, 2020).

På latitud 64° N erbjuder interiöra landskap och deras koppling till vatten-, energi-, och mat-system intressanta möjligheter att förlänga växtsäsongen och diversifiera grödor, till att minska energiförbrukningen samtidigt som det tillhandahåller privata och offentliga rum med en hybrid mellan inne och ute. Genom att utforska växthustillbyggnader och växthusskal (GEE) som lokala passiva arkitektoniska lösningar, siktar DC64° på att bygga produktiva gränssnitt mellan den privata och offentliga sektorn, akademin som involverar disciplinerna arkitektur och stadsplanering, stadsvattenförvaltning, växtfysiologi och vertikal odling, såväl som allmänheten i ett living lab format. I den här texten vill vi reflektera över fas 0 av ett living lab, och över idén om en ny folklig tradition för lokal livsmedelsproduktion i den sub-arktiska klimatzonen och det sammanhang som definierar denna anpassningsbara process samt utarbeta konturerna av en tillämpningsbar metodik.

**In the sub-arctic climate with its extremely short growing seasons and land cover that is dominated by forest with very little agricultural land, the built-up area offers an untapped capacity when thinking about sites for food production. This accounts both for the existing and, given the dynamics of Northern Sweden in terms of development and population growth, the forthcoming building stock.**

**Designing Cycles at 64° takes a multi-scalar approach addressing individual building typologies - and exemplarily for climate adaptation of northern climate zones - in the city of Umeå, Sweden with its diverse urban fabric as a whole. Expanding on Bengt Warne's Naturhus (1974) and following examples, we anticipate new multifunctional architectural models applicable in various contexts and scales (see fig. 2). It further builds on the hypothesis that low-tech, low-cost landscape-based solutions are applicable in different societal contexts and therefore potentially contribute to overcoming segregation (Redeker, Jüttner, 2020).**

**At 64° latitude, interior landscapes and their water-energy-food nexus offer interesting possibilities to extend growing seasons and diversify crops, and to reduce energy consumption while providing hybrid living spaces between inside and outside. By exploring greenhouse extensions and building envelopes (GEEs) as local passive architectural solutions, DC64° sets out to build productive interfaces between the private and public sector, academia - involving the disciplines of architecture and urban planning - urban water management, plant physiology and vertical gardening, as well as the general public in a living lab format. In this text we want to reflect on phase 0 of a living lab set up, reflect on the idea of a new vernacular for local food production in the sub-arctic and the context that defines this adaptive process and elaborate the outline of the methodology to be applied.**

## GREENHOUSE EXTENSIONS AND ENVELOPES (GEES) TO GROW FOOD AND MORE

Climate change demands a recalibration of our built environment to become more resilient. Retrofitting the existing building stock, repurposing vacancies, and expanding our building performance to integrate food production. Accumulatively, these may have a systemic impact both in terms of reducing water and energy consumption, as well as food miles, while buffering existing infrastructure networks and enabling local food production on site.

The active involvement of all stakeholders in the planning and future use of buildings and their immediate open spaces becomes key. How to create spaces that contribute to community building and social interaction while integrating a maximum of ecosystemic services is therefore a central question that demands implementable methods, tools, processes and design solutions.

In the sub-arctic climate with its extremely short growing seasons and a land cover that is dominated by forest with very little agricultural land, the built-up area offers an untapped capacity when thinking about sites for food production.

This accounts both for the existing and the forthcoming building stock, given the dynamics of Northern Sweden in terms of development and population growth (see fig.1).

Designing Cycles at 64° takes a multi-scalar approach addressing individual building typologies and - exemplarily for climate adaptation in northern climate zones - using the city of Umeå as an example with its diverse urban fabric as a whole. Expanding on Bengt Warne's Naturhus (1974) and subsequent examples, we anticipate new multifunctional architectural models applicable in various contexts and scales (see fig. 2).

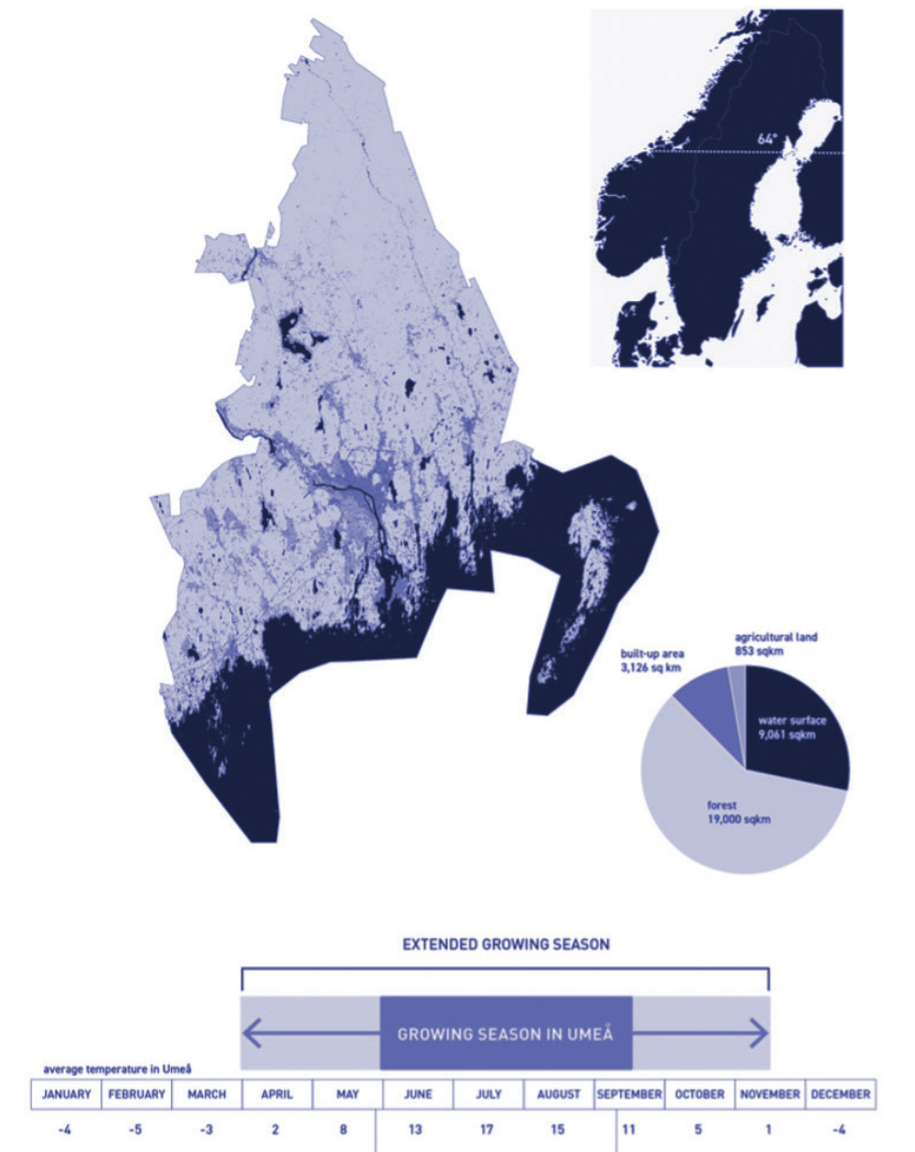


Fig. 1 - Land use and growing season Umeå municipality (graphics: Philipp Lott, Emelie El-Habta).

It further builds on the hypothesis that low-tech, low-cost landscape-based solutions are applicable in different societal contexts and therefore can potentially contribute to overcoming segregation (Redeker, Jüttner, 2020).

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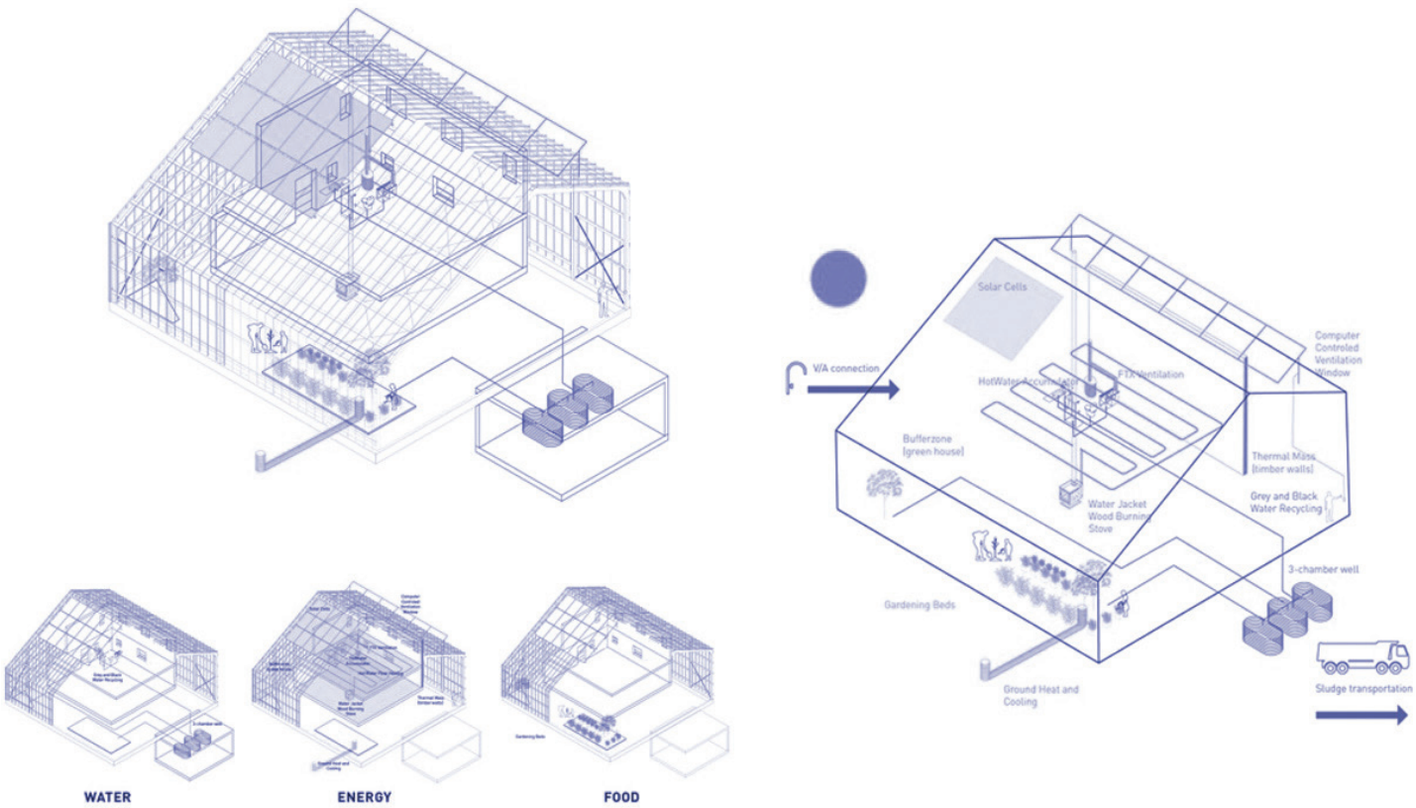
By exploring greenhouse extensions and building envelopes (GEEs) as local passive architectural solutions, DC64° sets out to build productive interfaces between the private and public sector, academia (involving the disciplines of architecture and urban planning), urban water management, plant physiology and vertical gardening, as well as the general public in a living lab format.[1, 2]

In this text we want to reflect on phase 0 of a living lab set up, reflect on the idea of a new vernacular for local food production in the sub-arctic and the context that defines this adaptive process and elaborate the outline of the methodology to be applied.



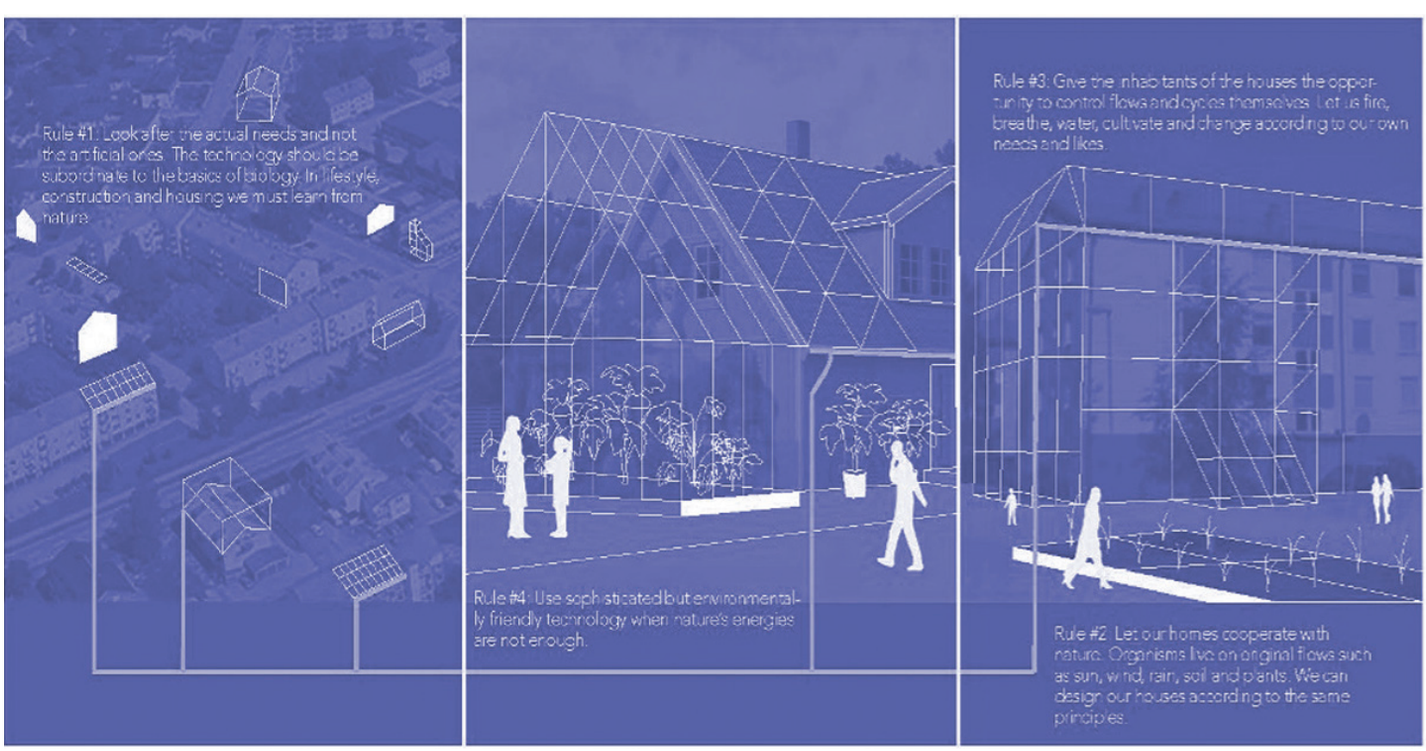




Fig. 2 Designing Cycles at 64° / above: Circularity diagram of Sundby Naturhus by Tailormade Architects, greenhouse Living, (visualization UMA design studio DC64° spring 2022, students: Cassandra Lundgren, Molly Mirsten) .
/ below: Naturhus principles according to Bengt Warne (graphics: Sara Zetterlund).

# BACKGROUND

## TOWARDS FOOD SOVEREIGNTY

The world's population is expected to grow to almost 10 billion by 2050, increasing agricultural demand – in a scenario of modest economic growth – by some 50 percent compared to 2013 (FAO, 2017). The majority of this population will be living in cities. Most texts and presentations start with a statement such as this one or similar. And yes, as we are urbanizing on rapidly diminishing resources; how we live and eat therefore plays a pivotal role. The food on our plates has become increasingly alienated from our local environment in terms of growing and refining different crops and other products. This relates to both the distance travelled (food miles) and its content. The amount of processed food on the market is steadily rising. As part of modernization and globalization, we expect to be able to find any type of food on our supermarket shelves at anytime of the year regardless of season and local growing conditions. This has become the urban norm for large parts of the world. Similar to how we have become accustomed to having the world's entire collection of popular culture at the end of a search button click, our food has become detached from the very soil and specific conditions required to produce it. Seen in a critical light, this poses some serious challenges, and we need to revert to more local production and circular processes in many of our everyday practices to be able to reach the climate goals set by governments around the world. In this context, the built environment offers an untapped resource that communities, practitioners and researchers have been exploring in recent years. The advent of climate change, global urbanization, the loss of industry and the commodification of housing has produced food dependencies, food deserts and resulting malnutrition specifically in underprivileged neighbourhoods. A growing environmental awareness and striving towards more stewardship have led to highly transformative agricultural bottom-up initiatives both in the urban and rural realm. Historically, we have seen similar developments in the 1990s in Cuba triggered by the collapse of the Soviet Union caused by the US embargo where a lack of fuel and fertilizers led to a resurrection of small-scale organic farming methods (see Atwood, 2017), influenced by the permaculture movement initiated by Bill Morrisson in the late sixties after being tired of the protest movement that he deemed incapable of bringing forward alternative models of living (see Mollison, 1988). And before that there was the self-organized allotment gardener's movement after the world wars, as for example on the outskirts of Vienna supported by intellectuals like Otto Neurath to spread awareness of these self-organized communities through the development of a pictorial language (see Redeker, Decaix, 2002). While the technical knowledge for doing so exists, adaptations to the current context and social models are often missing. By exploring models that include learning loops with the aim to be upscaled, the quest here is to overcome existing path dependencies which often only become tangible when alternative practices are introduced. By understanding food production as a spatial challenge, both in relation to its landscapes, buildings and infrastructure, it can be considered an architectural project to develop models that connect transdisciplinary knowledge in a holistic system with a direct relationship to the surrounding context.

Looking at bringing together existing research across different disciplines and scales, with the intention to generate new models from the building to the regional scale aiming to increase food sovereignty,[3] will enable consumers to becoming producers. Through research that engages in a transdisciplinary practice and using technology to nurture natural circular systems around us, we are currently trying on many different fronts to turn our negative environmental impact into a positive one. Connecting different systems to return to a more circular approach is one way to respond to the urgent need for action in our society. Using case studies and living labs as a way to gather existing knowledge and to test prototypes to become part of an open-source knowledge base, can enable reactivation of previously existing infrastructures for food production and distribution. This is also an important factor to create food sovereignty, a system in which the people who produce, distribute and consume the food are in control of its mechanisms and policies. Food sovereignty also puts an emphasis on local food economies and sustainable food availability as well as on indigenous people, who have been disproportionally impacted by climate change and disrupted foodways. Below we will outline an approach for how architecture, design and pedagogy can be used to strengthen local food systems in the North of Sweden at different scales – from the building to the regional scale, all grounded in the understanding of the local context, heritage and the specific challenges faced by different communities with different needs and possibilities.

In the context of Northern Sweden and the sub-arctic climate, questions around food systems and food availability are increasingly relevant in relation to our built environment and the future resilience of our communities. On a national scale, Sweden produces approximately

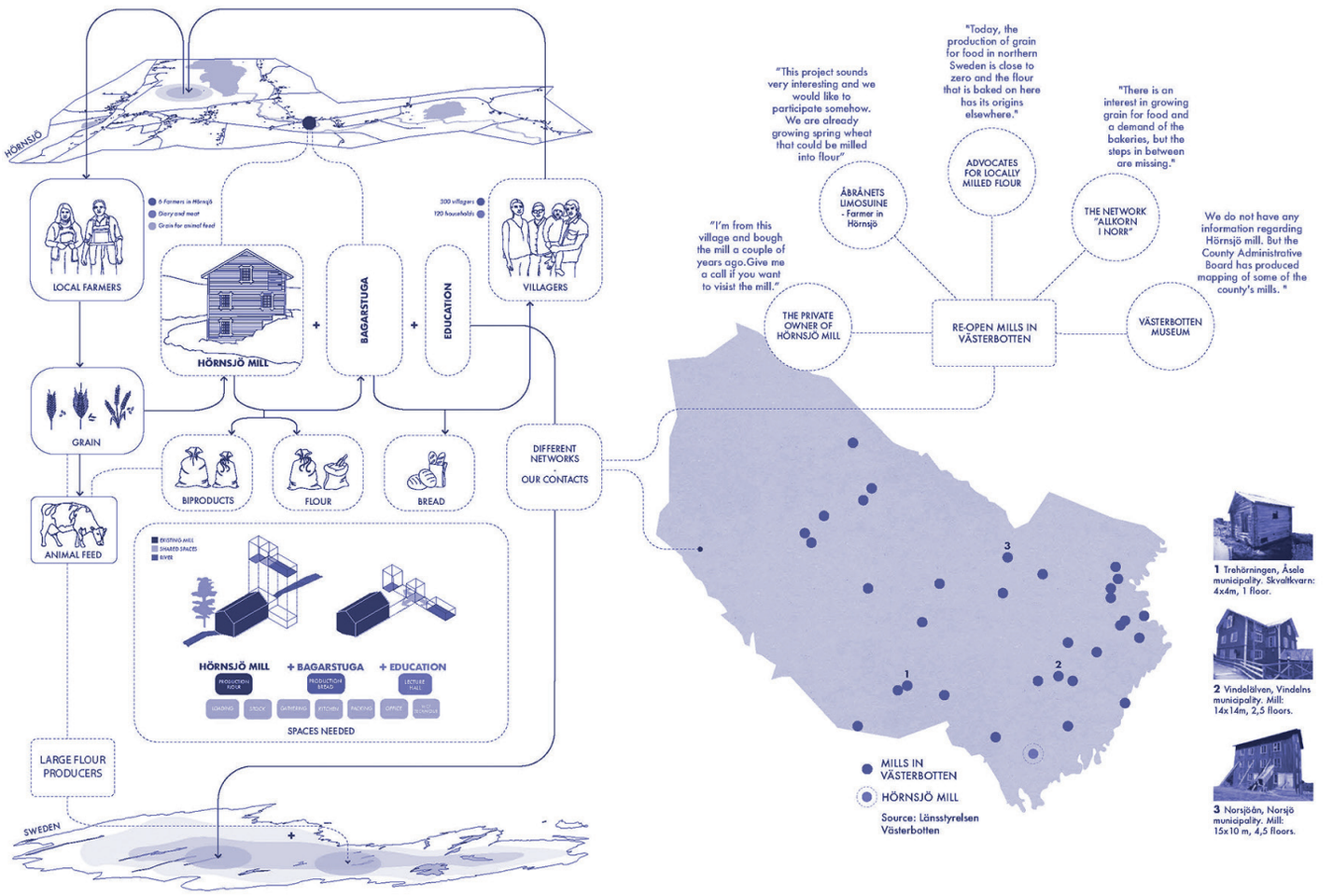



Fig. 3 From Wheat to Bread: Reopening the local mills in Västerbotten Region, students: Karin Wilstrand, Erica Grundström, UMA design studio Nordmaling Calling, spring 2021.

50% of its own required food[4] and has therefore put local food production on its national agenda for several years.[5] The pandemic crisis with closing borders put the spotlight on, amongst other things, the problem with reliance on globally imported food. The ongoing climate crisis and requirement to transition our societies into less fossil fuel reliance and lowering emissions, also reflect the need for a new approach to food production and consumption. Similar to many other industries where production has been outsourced globally, the food industry in Sweden has gone from local to the global scale over the past.

The larger questions this raises is: how can we increase the local production in the sub-arctic climate zone and still provide high quality food that encourages people to have a healthy diet? Can the introduction of productive programs in urban (and rural) environments also impact on communities' models for housing and local economies? Who is involved in the production and maintenance, and what models for this can be developed depending on existing conditions? How can we develop systems that can be applied to both the existing building stock - through re-adaptation and the activation of vacancies - as well as for new built developments? To understand the possibilities, and architecture as a holistic approach, we have to start by addressing the specific context: in terms of landscape, climate, the built environment and the communities within it. We find ourselves at phase 0, meaning that we are building up a knowledge base spanning across different disciplines in relation to the Naturhus typology and creating networks of people and communities. Finding the community to work with and establishing contacts, defining a collaborative working process and framework as part of the research project has proven to be the most time consuming but also most integral part of the work.

*The Naturhus Principles and the Northern Swedish Vernacular*

*"It has been said that a haunting is the memory of something you already know, but that you have not yet lived. If we are to wisely welcome that ghostly memory as the unfolding of Global Warming, then I argue that 'greenhouse' is—beyond metaphor—a ghost of colonial trauma. Because, as a ghost, in its glowing glassy void, it hides the memory of the enslaved haunting the past, present, and future of agriculture, of the natural sciences, and their histories. The current industrial form of greenhouse stems directly from that dubious, ghostly technological history. It is the empty*

Fig. 4 - From top clockwise: Freja Dahrl Kofoed, Martha Skytte and Randi Kjær doing their Ritual for Water at the Negathropic Anarchive, Denmark, DK, 2019 / The Wardian Table at Agropoetics: Soil is an inscribed body, Savvy Contemporary Berlin, 2019 / Earth Score Specularium at Experiment Färgfabriken Stockholm, 2015 / Works by Luis Berríos Negrón.

*body of the illusion of control over nature, becoming the core conflict of interest that underlies how we extract andconsume nature, the opaque ghost of behaviour that drives Global Warming. So delusional is this drive, that greenhouse is conjured to be the promised saviour, the messianic Noah's ark that ought save mankind from itself … not just on this glimmering earthly world, but also as the extraterrestrial ark being sold to the billionaire class on the Moon and Mars by a group of supermen having the mother of all mid-life crises out in the public open. That self-fulfilling prophecy of virility and demise is what turns greenhouse into a ghost of double-bind, a doppelgänger of colonial memory. It is a paranormal projection of man's contradictory mastery and deposing 'greenhouse' in all of its privilege over nature, arguably deeply marking the geological timeline of the Anthropocene. It is then that I am compelled to ask: how is the ghost seen, sensed, and talked-to? Perhaps bymetaphors, at once as object and display of environmental relations. This is done, not to control or merely observe, but to shatter the glass of human observation itself, to (re)mediate the relations between the more-than-human worlds; to remember to forget the haunting ghost, to unlearn what makes life possible, and worth living, again. And again."*

*Luis Berríos-Negrón, 2020*

Beyond the long list of greenhouse devices from the Wardian case and its historical displacement of plants, which can be consideredas the advent of our degenerated relations to biome, to the failed dystopian scenarios of biosphere autarky and the suburban winter gardens warmed by gas heaters to create thermal comfort at any price: How was the greenhouse envelope of the Naturhus conceived by Swedish architect Bengt Warne fifty years ago?

*Naturhus Rule #1: Look after the actual needs and not the artificial ones. The technology should be subordinate to the basics of biology. In lifestyle, construction and housing we must learn from nature.*

*Naturhus Rule #2: Let our homes cooperate with nature. Organisms live on original flows such as sun, wind, rain, soil and plants. We can design our houses according to the same principles.*

*Naturhus Rule #3: Give the inhabitants of the houses the opportunity to control flows and cycles themselves. Let us fire, breathe, water, cultivate and change according to our own needs and likes Naturhus Rule #4: Use sophisticated but environmentally friendly technology when nature's energies are not enough (Bengt Warne, 1974).*

For centuries, vernacular architecture has produced intelligent and natural building methods that we are currently trying to relearn and adapt to a trans-industrial context: by treating buildings holistically and incorporating food production and preservation as one component of many. This circular approach to the water-energy-food nexus[6] is particularly evident in the highly efficient and sustainable building principles that have been incorporated over centuries. Food was not considered a singular need. The coexistence of people, animals and surrounding nature functioned as a recurring revision of food procurement, food preservation and the recycling

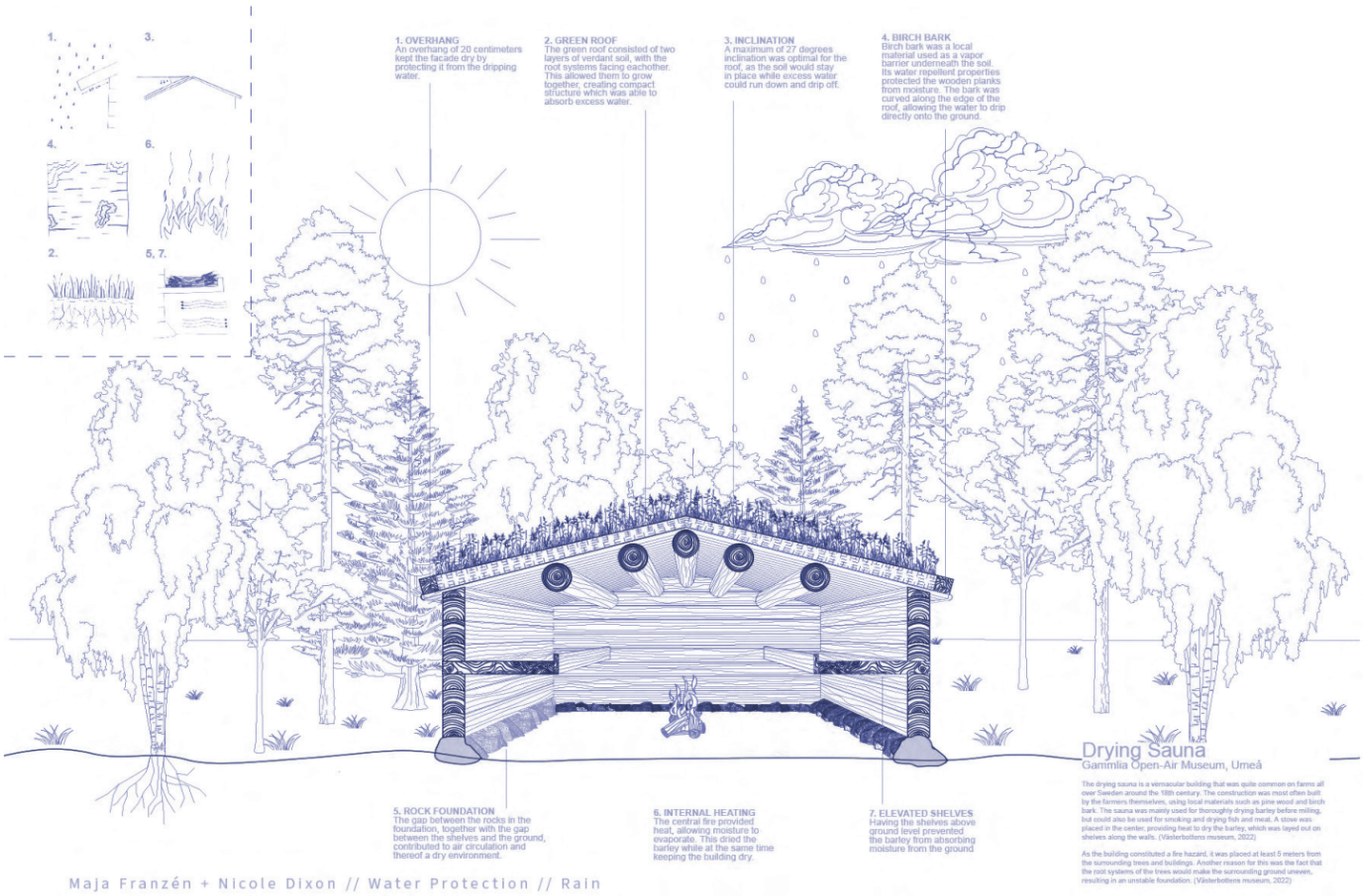



Fig. 5 - Barley-drying Sauna by Maja Franzén + Nicole Dixon, UMA design studio Closing Loops, fall 2022

of leftovers embedded in cycles. Thus, vernacular architecture was not viewed as a primitive building technique, but rather as a very flexible and adaptable way of using available raw materials from the region, responding to a given prevailing climate in a highly sustainable and simple way. Building houses meant passively and actively using natural influences such as wind, water and plants to generate energy.

It is therefore not surprising that in sub-arctic Northern Sweden, for example, food was stored in turf houses dug deep into the earth to harness geothermal energy. Simple topographical conditions and climatic factors such as sun, wind and water were naturally integrated into residential communities. There were pantries on stilts, deliberately built with round logs to protect food from invading animals such as rats. Drying huts for grain, which was also a sauna for the people, combining multifunctional tasks in one. Using biproducts such as reindeer skins as building materials for temporary Sami huts was just as important as using plants for food and their waste products in building houses. Nature was used, and every part was given a purpose without becoming exploitative. In this sense, vernacular means low-tech building, which is energy-and resource-efficient as well as cost-effective for the requirements of food production. Using natural resources such as geothermal heat, construction methods in vernacular architecture are historically optimized to keep stable ventilation, temperature, micro-climate and humidity control (Eldtrimner, 2022).

With few exceptions, the Naturhus model as a greenhouse envelope or extension (GEE) is today mainly applied to single detached housing. Diversifying this model to multiple apartment buildings and other programs demand adapted models which includes adaptation of the systems involved in relation to water, energy and food production and, most challenging, new user models. Through the updated models, we anticipate not only extending the growing season and thus potentially increasing local food production. This can be achieved by expanding the typologies from the Naturhus as a single-family detached house with a GEE to upscaled typologies such as multiple-apartment units or industrial/retail units, and by applying more productive growing reused materials engaging local In addition to user models, the project aims at developing an open-source model for building processes, with local and/or systems, we anticipate to design economically viable models by creating synergetic benefits regarding energy-efficiency, water harvesting and reuse. In addition, defining and testing more collective user models that also have an impact from a social sustainability perspective and

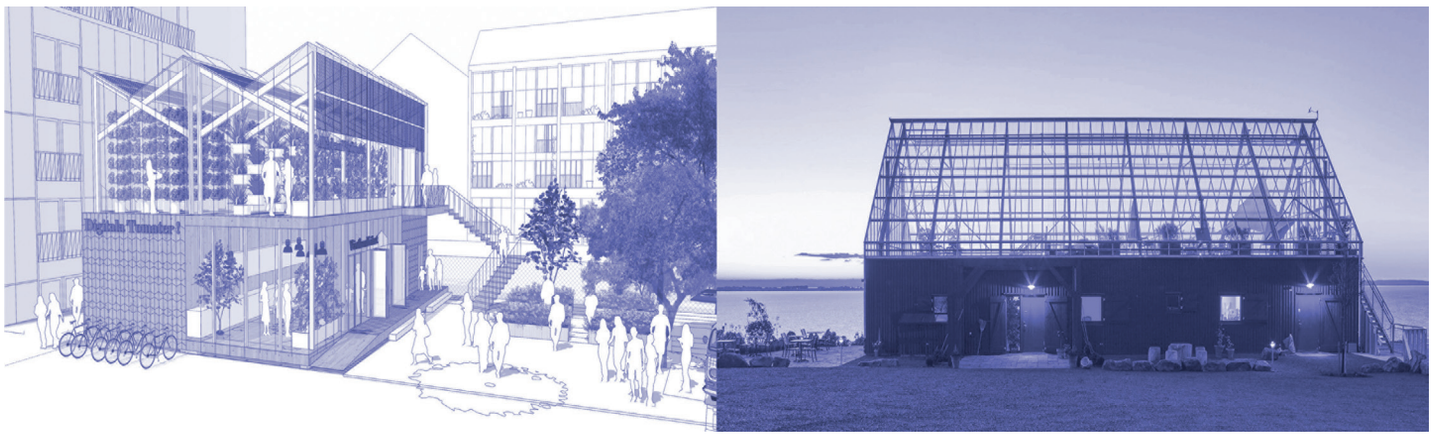


Fig. 6 - Digital Tomatoes, Greenhouse Living and Upgrenna Naturhus, Tailormade Arkitekter.

naturally raise intriguing design questions when it comes to the shared spaces this produces. In addition to user models, the project aims at developing an open-source model for building processes, with local and/or reused materials engaging local expertise, with the possibility of being adapted to other sites and communities. Some of the examples in this context are:

On a building scale, projects like the restaurant Moment in the self-built, mortgage-free permaculture community of Friland in Denmark are trailblazing DIY. Wastewater from the restaurant is reused to irrigate crops in the green house that are then used in the kitchen - under the monitoring of experts to ensure that the plants are free of pollutants. Uppgrenna Naturhus by Tailormade Architects which uses the EcoCycle system to purify wastewater makes use of its nutrients from up to 150 visitors which enables a disconnection from the municipal sewage water system. Digital Tomatoes by Tailormade Architects and Greenhouse Living, in cooperation with Gothenburg's energy company, use the heat produced by a neighbouring server plant to warm the greenhouse (see fig. 6). We-Houses in Germany, a co-housing model with multiple city locations, include rooftop plant beds and greenhouses, green walls, water treatment greenhouse farm and serves as through reed beds and its reuse. A new Supermarket in Wiesbaden, Germany, is hosting a rooftop an example of growing where you are selling the produce. The Million program is a large-scale Swedish housing program from 1965-1974 that is now in need of energetic refurbishment. Due to its scale and with its predominantly flat roofs it also offers potential sites for greenhouse rooftop extensions that could, due to its sheer scale, potentially offer a capacity of systemic relevance. An example of how these pre-fab building typologies can benefit from greenhouse extensions can be seen in the example of the Shine project in Gothenburg[7]. On the village scale RegGen villages provide a community model that aims towards self-sufficiency through the integration of high yield organic food, clean water, renewable energy and circular waste to resource management at the neighbourhood scale supporting the community (who also owns this data through AI and machine learning).

It is never one use that enables buildings to become productive and to be thought of holistically, ideally to create economically and socially viable models. As hosts for food production through GEEs, foremost energy savings and production have to be factored in, but also water recycling as ways to buffer centralized systems that are currently not laid out for climate change weather conditions. Specifically in the sub-arctic, snow requires an adaptation of existing systems: water harvesting turns into snow harvesting for which we yet find no formal examples in the domestic realm, but also snow loads raise structural questions when the greenhouse is not heated. When a greenhouse is not heated, a third climate zone in the form of a nursery (orangery) may be needed to enable germination temperatures to be reached. In conclusion, many exciting models are currently appearing, but data regarding user models and cohesive monitored productivity or temperatures are missing, specifically for this climate zone.

## THE COMMUNITY

When talking about turning inhabitants from consumers into producers, it demands new forms of participation and raises questions of expert/non-expert collaboration. When looking at communities in Umeå in both the urban and rural context, we find both push and pull factors that drive a potential Naturhus model to increase local food production (see fig. 7).

In the urban context, Kollektivhus Umeå is an association that aims to build and live together as a community to counter the phenomenon of increasing loneliness. The model implies that private apartments are 10-15% smaller to allow for enlarged shared spaces for the inhabitants. In the spatial program for the common spaces, future


Fig. 7 - Push and pull factors: Holmön Island, exemplary for rural communities struggling with fluctuation in population numbers (left: data HUF, 2020) and urban communities like Kollektivhus Umeå looking for communal living (graphic: Erica Grundström, DC64° UMA bachelor design studio, spring 2021).

inhabitants wished for gardening and cultivation in relation to a shared kitchen and dining room (Grundström, 2022). The idea of growing food and sharing meals together as a community defines the Kollektivhusmodel for its 80 members.

In the rural context, the community of Holmön, is a former fishermen's island in the Baltic Sea of Västerbotten, just 10 km off the coast North of Umeå's river delta. Fishing, farming, and hunting were the main livelihood of the islanders for many centuries. Today, with a steady population of only 79 persons, and with a sevenfold increase in the summer months through visiting tourists and summerhouse owners, the island faces a number of challenges. Lacking appropriate public services produces water scarcity in the summer months due to a high influx of visitors, which impacts upon living conditions. And a ferry that is unable to work through the ice during the winter months often leads to prolonged periods of isolation. This disconnect to supply lines showed the islands biggest vulnerability; a reliance on "food imports" from the main land. Fishing today is highly restricted, but hunting, potato and vegetable growing, foraging the forest for berries and mushrooms, honey production and private gardens provide food for certain parts of the year and the local "Lanthandel" supermarket provides goods from the mainland all year round as long as the ferry is able to sail. In the local-economic analysis conducted by the community association Holmön Utvecklingsforum in 2020, 78% of the inhabitants wished for an increase of local food production, 83% naming potatoes and vegetables as their priority (HUF, 2020).

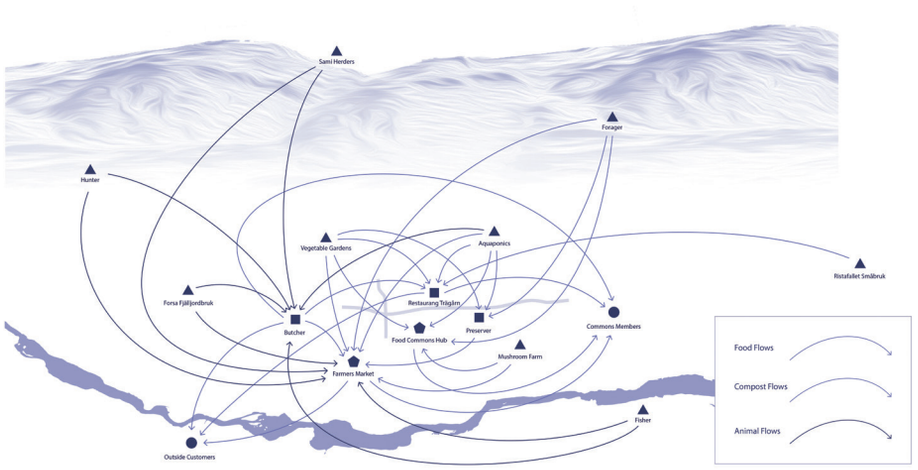



Fig. 8 - Village and the Plot: Food supply network by Karina Gataullina, Kasimir Suter Winter, Oscar Magnusson UMA Duved summer school 2021.

## STATE-OF-ART / LIVING LABS

*"Food and the rural versus the city and buildings: It did not require a lot of thinking until the idea popped up in my mind: food systems. That had to be the key for an innovative strategy for societal innovation, turning the rural into the innovation engine, even for urban development. It was in January 2018 and I had just started reflecting on Duved, asked to find a strategy for the development of the future of this small village in the Northof Sweden, situated in an area known for skiing and hiking, but also for artisan food. In the small scale of the village I saw something that had been in the back of my mind for a few years. I had been talking to chefs like Dan Barber, Magnus Nilsson and Douglas McMaster, and realised that their way of transforming the production system of food from the point of view of a restaurant, was in fact a starting-point for change in a much larger context than the restaurant itself. What they did, in redefining their roles as chefs, required change from everyone they were working with.*

*A couple of years earlier, in 2015, I was commissioned to lead the innovation program for the USA pavilion at the World's Fair in Milan. The theme of the Expo 2015 was how to feed the planet in 2050. One part of the program I curated was to 'exhibit' and accelerate nine new companies, all with different ideas of food-system innovation.*

*. We selected them carefully and they were all based on smart and relevant ideas. But I gradually realised that there was something lacking in the very idea of the start-up company: context.*

*The companies had solutions, but for a very specific, singular purpose. What they lacked – and what would have made their ideas better – was a context. A context where the singular solution of one company would be matched by another company's solution in a different field of food. Through collaboration and digital efficiency, the different solutions could, gradually, be turned into a new and innovative local food system. So, with these two things in my mind – the innovative chefs and what they demanded of their suppliers, and the new companies need for a context to match their solution with, I saw a glimpse of something big. The future of food and food systems needed the small scale of the village to show its potential. That was the starting point of Duved as a tool for societal change, based on collaboration between very many local partners, a journey that will take a few years to handle and that will include a greenhouse by Shigeru Ban.*

*Giving a lecture, in 2021, on Duved at the School of Architecture in Umeå, we continued to talk and came to the conclusion to set up a summer studio in Duved, where students would develop solutions for a common local future food system. The result?*

*Through the studio visionary material was produced by the students that will be used as inspiration for many years to come in the actual development of Duved, on food systems as well as, as a give non the side, on where the possibilities of the future role of the architect might be embedded.*

*It is all about switching positions, to find a better outlook on today's possibilities: instead of cities and buildings we need to look at the rural and on the future (local) food systems to move ahead toward what is needed for societal innovation, for the rural as well as the urban."*

*Jan Åman, Duved model, on context (unpublished)*

The Duved model for local communities 2.0 is an example of a living lab in the Northern Swedish context, the village scale serving as a canvas to develop and test ways towards a more sustainable and resilient community following the approach of "governance through local collaboration". Among other goals, this includes the development of a food system that focusses on local production and circularity. The Duved model involves inhabitants, farmers, the municipality, restaurant owners and other local businesses, with the aim to influence the development of a village that is also becoming increasingly attractive for young families and others who want to escape the big cities to live in communities where they can engage themselves not least in growing food. As a living lab, the Duved model aims to inform policy making on a national scale based on the experiences and learning processes on the ground (Appelqvist, Almqvist, 2022).

Depending on context and authorship, there are multiple definitions of living labs (see Verhoef, Bossert, 2019). As a tool for transformative science to enable urban innovation and challenges, they have a large amount of user co-creation and should be in real life settings (see Maas, et al, 2017). As a complex and explorative approach, choosing a living lab format is motivated by complicated challenges and multi-stakeholder problems or solutions. They demand a location, budget and goal. Living Labs can speed up development and the adoption of new technologies (McCormick et al, 2017). For architects, the living lab format offers a practice-based, integrated, research-by-design approach that enables the transformation of our disciplinary practice - from developing a project to designing, realizing, monitoring and evaluating a research infrastructure that, as a learning model, needs to be able to incorporate change and inform the larger scale (system innovation).

## MATERIALS AND METHODS

*Phase 0: Beyond setting the agenda*

As an emergent research environment at Umeå University School of Architecture, the UMA lab Designing Cycles at 64° sets out to explore directly and indirectly a new vernacular in response to current urgencies related to local food production and climate adaptation of the built environment.

It starts by creating a network around the topic of interest. When meeting new people, we don't know where that meeting will take us and how - through the combining of different perspectives, individual interests and expertise it might lead to entirely new paths or communal projects. Even though this can be a slower or less intuitive process when at first getting to know someone across a screen, it can still be said that the possibilities that opened up during the pandemic - i.e., digital meetings and creating networks - that were less bound by geographical constraints, has had an impact on how we approach new networks. Designing Cycles at 64° started with numerous meetings of potential partners and stakeholder groups with the aim to frame the task and to create a research team in response to current concerns, but also to engage in a joint discourse on the topic.

As a think tank informed by, and linking, research and education, we not only aim to explore

Fig. 9 - Umeå's flat roofs as potential sites for greenhouse extensions (DC64°graphic: Philipp Lott).

building design and performance, but also to anticipate implementation and user models. Applied to Designing Cycles at 64°, the living lab format is based on a transformative science approach: a mode of science that not only analyses processes of transformation, but also actively supports and accelerates them (Schneidewind et al, 2016).
The ambition is to accelerate change through transdisciplinary collaboration and co-creation towards more self-sufficient buildings and inhabitants with a specific focus on food production. This approach relies on a network of practitioners and researchers in multiple fields supported by educational formats. In terms of education in our specific field, it involves the outline of architectural design studios that enable students to conduct case study and field research and to engage in design explorations in a safe environment. These may inform the project in different ways while exposing the students to a transdisciplinary In discourse beyond their current curriculum. Working with model clients and contributing to knowledge production creates a learning environment for all involved. The living lab approach is framed by the current funding period of two plus, through a follow-up call, potentially two more years if deemed successful the first phase the project involves five work packages:

A comparative atlas of case studies of selected existing Naturhus models in Sweden and internationally were researched together with students.
Beyond their respective spatial organization and architectural expression, the atlas documents the project in relation to its water-energy-food nexus components and user models. We have introduced some of these examples previously in this text.

A site and foodshed analysis of Umeå as an exemplary model of a Northern city, illustrates spatial capacity and maps the existing foodshed. On the urban scale, we are performing a GIS-based site analysis to assess spatial capacities by documenting flat roofs, south-western elevations, urban voids, vacancies and plots exposed to noise pollution as potential sites for GEEs (see fig. 9); embedded in a regional foodshed analysis to understand current local food production and the importation of food to the region from global sources. On a building scale we are currently setting up a temperature log for an existing green house and cold roof to understand the temperature differences between inside and outside over the course of a year.
A participatory design: working with Lanthandel on Holmön, we are engaging in a research-by-design process with model clients and users as well as plant and water experts to develop a circular model with different climate

zones to maximise the growing season through a greenhouse extension and nursery in the cold roof, to produce a viable yield of leafy greens (green walls) and vegetables (plant beds), to conserve food in a root cellar and to harvest snow and rain to irrigate the plants and flush the existing water toilet. With the green house extension to the South (naturally ventilated) with solar panels and the root cellar expansion to the North the overall energy consumption of the building will be reduced (see fig. 10). An implementation and user model: by anticipating who will build and how (with local / reused /pre-fabricated building materials) and how and by whom the plant beds will be managed we are defining our living lab set up to be built, monitored and evaluated in the coming phase if deemed viable. And last, but not least, different formats of dissemination: by sharing this work with our students, in workshops with our project partners and stakeholders through an international symposium on the topic to bring together practitioners and academics from different fields of expertise, and through documentation and scientific publication.

## (PRELIMINARY) RESULTS

DC64° has created a research environment that links architectural education, interdisciplinary academic practice (architecture, urban planning, plant physiology and decentralized, nature-based water treatment and reuse) with the work of NGOs and the public and private sector to define a preliminary design to explore the potential of a prototype to be built, monitored and evaluated in the next phase. Through research-by-design for an exemplary site, we are able to inform our research questions that engage in the construction, materiality and planting yield. It enables us to anticipate implementation and user models with our partners. In that way, it is not only a project design, but a communication tool with all stakeholders and partners. This project can also be viewed in the light of an on going discussion around the role of the architect, now and in the future, going from designers of buildings and spaces to also include the role of the facilitator and moderator of a building process operating from initiation, urban planning and policy perspective, circular building processes, implementation and user models.

## DISCUSSION AND CONCLUSIONS

Transformative Science and Living lab formats to increase the impact of research demands for established partners on the ground, trust and management of expectations. Here it helps to start small and slow in a safe environment. To ensure the sustainability of any outcome, any intervention needs to be thought beyond the research project phase.

The biggest challenge of developing a test building in a real-life environment demands for a prototype that is “safe-to-fail”, in the sense that it offers additional benefits for the community beyond the model to be tested and evaluated. In our case this means, if the anticipated water-energy-food application and a viable user model - as the outlined goal of ‘turning buildings and their inhabitants from being consumers to becoming producers’ - is only partially successful, a plan b has to be in place. This can involve multiple solutions: from deconstruction to adaptation of the set-up, i.e. a different planting system or a change in the user model, or even a change in program. This has to be anticipated and communicated and demands a clear management of expectations and responsibilities. Further potential outcomes from looking at interior landscapes in the sub-arctic climate zone relate to the provision of an in-between climate zone that could have other uses and impacts than solely to produce food. This is especially evident in connection with multi-dweller housing, where a collective space could have multi-functional uses for the inhabitants and adding to the quality of life in the

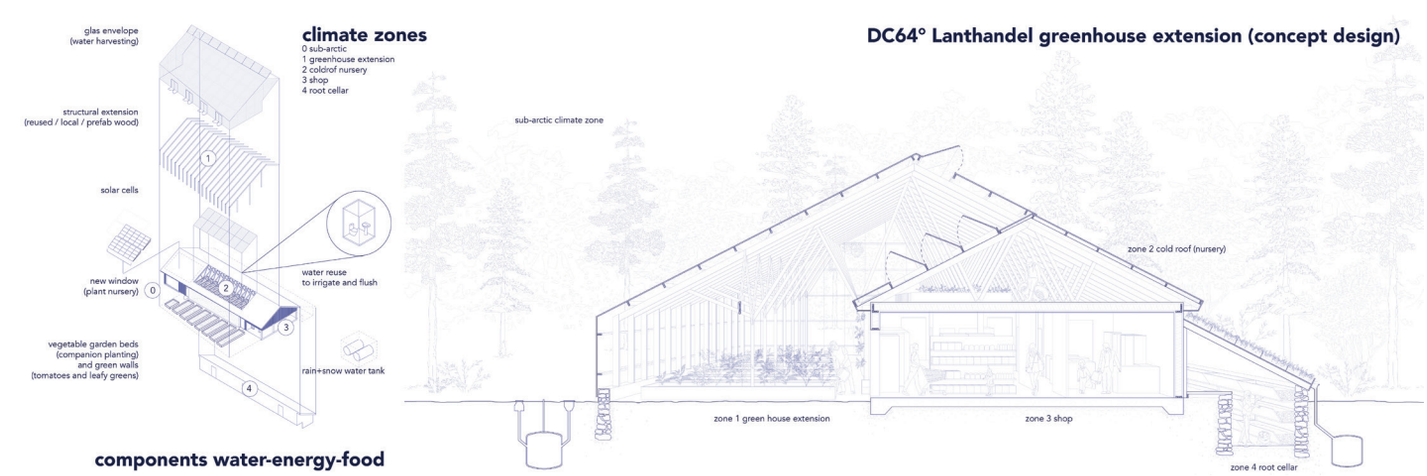



Fig. 10 - DC64° Climate zones and water-energy-food components (graphic: Cornelia Redeker, Constanze Hirt, Erica Grundström)

foreseen extensive renovations required in coming years to the existing national housing stock of Sweden.

In terms of how transformative science and academia may impact upon reality and driving change, the current system of publishing and the acquisition of third-party funding may need to be extended. In this context, the transdisciplinary collaboration of living labs may offer hopeful, if complex and challenging possibilities, to drive and accelerate change. For architects, landscape architects and urban planners in academia who are struggling with their core competence - which is spatial and increasingly holistic design - then Living labs, by including a physical intervention that is monitored and evaluated offer, a model for change.

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## NOTES

1. Designing Cycles at 64° - Interior Urban Landscapes and the Water-Energy-Food Nexus is a two-year research project at the Umeå University School of Architecture together with SLU, Aarhus University, Umeå municipality and Vidden Bostad AB. The project is funded by the Climate adaptation fund of Vinnova, the Swedish Agency for Innovation

2. JPI Urban Europe defines urban living labs (ULL) as an approach to research and innovation to describe methods, approaches, and projects that involve a high level of stakeholder participation, co-creation, co-production, learning-loops and experimental approaches to improve urban life. (...)
In general, the ULL concept is applied to urban areas to institutionally densify the urban innovation ecosystems that deal with multidimensional challenges in urban areas (see ERA-NET Co-fund Urban Transformation Capacities, Project No. 101003758, Annex D: Urban Living Labs, p.65)

3. According to the IPC – International Planning Committee for Food Sovereignty, "Food sovereignty is the right of individuals, peoples, communities, and countries to define their own agricultural, labour, fishing, food and land policies which are ecologically, socially, economically and culturally appropriate to their unique circumstances. It includes the true right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food-producing resources and the ability to sustain themselves and their societies."

4. See https://www.svd.se/tufft-for-sverige-att-klara-maten-i-en-kris

5. See https://www.ja.se/artikel/53006/vi-har-mat-for-tio-dagar.html and https://www.riksdagen.se/sv/dokument- lagar/dokument/motion/sjalvforsorjning-av-mat-i-sverige_H8022602

6 According to the UN Economic Commission for Europe: The "nexus" term in the context of water, food and energy refers to these sectors being inextricably linked so that actions in one policy area commonly have impacts on the others, as well as on the ecosystems that natural resources and human activities ultimately depend upon.

7. 'SHINE' GÅRDSTEN SOLAR HOUSING RENOVATION in Gothenburg, Sweden, by Nordström Kelly Arkitekter AB is an older example from the late 1990s where a housing slab of the Swedish Miljoen Program was transformed by adding a greenhouse extension to preheat the air and use solar energy for water-heating and energy production. It also enhanced qualities of the shared hallway. (see https://world-habitat.org/world-habitat-awards/winners-and-finalists/solar-housing-renovation-gardsten-sweden/).