Defossilise Väster

By August Grundtman

TESTING A FOSSIL FREE URBANITY FOR THE DEBATE

Degree Project in Sustainable Urban Design at Lund University

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Before I dive into the project, I would like to take a moment to acknowledge the contributions so many of you have made to this project.

First, my supervisor Ida Sandström has kept me steadily on the path to completion, always challenging my thoughts and helping me push the thesis further.

Secondly, my examiner Jesper Magnusson saw the project from different perspectives and pushed me to give it a more profound meaning.

I'm grateful to the Sudes team and all my colleagues in the programme for being part of this challenging and exciting journey and especially to my Thursday friends in the studio.

Almost last, but not least: Linn, I'm indefinitely grateful for having you in my life and for supporting and especially putting up with me during these chaotic years.

Göte, you're my little star. I didn't know at first, but this is for you.

Abstract

Humanity is facing one of the greatest challenges ever. Climate change and global warming is a great risk and our consumption and dependency of fossil fuel are important causes of this accelerating issue.

My thesis aims to design an entry for the professional debate about what urban areas in a fossil free future might be like. I'm investigating how an urban environment that requires as little transportation as possible, with as little added energy as possible, can be created in an existing area through a set of strategies and design principles. The project is framed in a scenario where fossil fuels don't exist and the design applied on the Väster neighbourhood in Lund, Sweden.

In my defossilised Lund, people have got their time back. Work is next door, children can walk by themselves to the neighbourhood school and food is grown and processed within reach. The neighbourhood streets are taken back from the car and turned into a versatile public space. There's no longer a need for tedious, stressful commutes and everything you need for your everyday life is within walking and biking range. Consumer goods, bikes and household items are to a great extent manufactured locally or in the region from recycled materials and can be repaired within a stone's throw from home. Everything is within human range and reachable by human power.

Prologue

Looking out the window, Hjördis tells Ernst he better get the umbrella today. With all the biking she does at work, she picks up the raincoat for herself. The couple have just graduated from the university in Lund and settled in a house in the area immediately west of the railway station.

Hjördis works as a resource engineer, assisting the different local workshops in how to handle different materials, how old products can be dismantled and reused efficiently and what materials need to be procured new. She has a certain soft spot for working with products from the early 2000's, being produced for one time usage and with poor repairability. Every time Hjördis manages to extract most of the resources from those products, she enjoys a little high from pure satisfaction.

Most days, the couple leaves home at the same time. Because she's virtually somewhat of a consultant, Hjördis takes her bike everywhere. There's plenty to do in her field, so she never has to bike further than ten minutes, but most days she's closer to home than that. Her partner just has to go around a corner, down the brick paving next to the stormwater swale before arriving at the mobility centre where he works as a repairman. Lund has always had plenty and good bike repair shops, but now they have grown into something much more holistic. Ernst repairs bikes, rents out other mobility options and he even manages a pickup and drop-off point for parcels. Being in a service profession suits him perfectly, he loves helping people in their everyday lives.

Within ten minutes by foot, the couple has got most amenities they need for their daily life. Ten minutes by bike covers almost every speciality service, goods or experience they might need. But sometimes they want to go further than that. To see family and friends or maybe just stop by a concert in Malmö. Sometimes, the couple would rent electrically assisted bikes at the mobility centre, other times they would catch the train.

"See you at Luisa's and Albin's tonight, then! And don't forget to bring the cargo bike!" Hjördis said to Ernst. "Sure! Just hope the weather clears up until then. Bye Honey!"

They were looking forward to visiting Luisa and Albin. Ernst had been working with Luisa at the mobility centre for a few years, and they had become close friends almost from the time they met. Her new sambo Albin calls himself a cook, but he is really more of a neighbourhood food craftsman, getting produce from the rich farmland surrounding Lund and growing a little something himself in the back yard. He refines, cooks and preserves the food, stores it and consumes and sells throughout the year. Tonight, he's invited them to come with him to one of the farms he's working with, getting the freshest seasonal produce possible and then cooking dinner in a nice spot outside. Hopefully the weather will have cleared up by then.

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Background

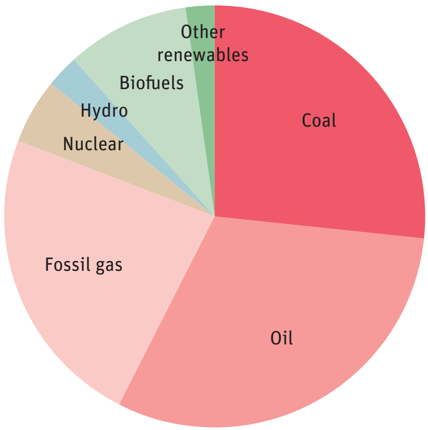
Climate change

One of many severe issues facing contemporary society is climate change. The scientific community has been aware of the basic mechanics of earth's climate for around two hundred years. To find out what caused ice ages, late 19th century the Swedish physicist Svante Arrhenius (1896) made the first calculations of how especially carbon dioxide and water vapour controls the temperature of the planet. However, the calculations were contested by several scholars during the first half of the 20th century and it's not until the computer aided modelling by Manabe & Wetherald (1967) that the precise relationship between carbon dioxide levels in the atmosphere and global temperature was proven. A meta study of peer-reviewed papers from the period 1965–1979 argues that scientific consensus of a warming climate was already established at the time (Peterson, Connolley & Fleck 2008).

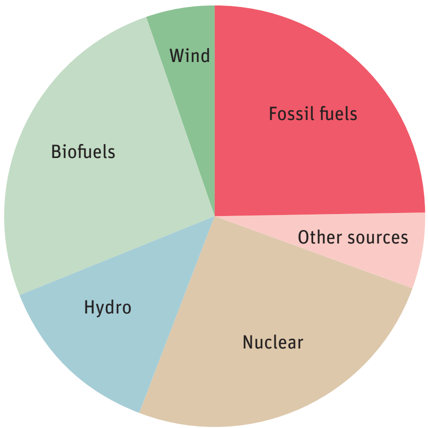
Despite being known for a long time, economic growth and political favour of status quo has weakened the political case for mitigating the misuse of fossil fuels (Adams 2020). In fact, the global contribution of carbon dioxide equivalents has risen almost every year the last century with the exceptions mainly being economic crises like the *oil crisis* and the *covid-19 pandemic* (Friedlingstein et al. 2021). But even these decreases has made little more to the general trend curve than putting a wee dent in it.

Fossil fuels and energy

In a global context, the main sources of primary energy are still fossil. 26.8% coal, 30.9% oil, 23.2% natural gas. That means that less than a fifth of primary energy is



Global primary energy sources in 2019 (IEA 2023)



Swedish primary energy sources in 2020. Exported petroleum products and bunker fuel excluded. (Statens energimyndighet 2023)

fossil free. Of the fossil free energy, around a quarter (5.0% of the total) is nuclear, meaning that the share of renewables is still just a fraction of the total. (IEA 2021)

In a Swedish context, fossil fuels accounted for 328 TWh of the added energy in 2020. Of those, 95 TWh were for domestic use, the rest was exported after being processed in the country. Of this, 84 TWh were used for transportation, but there were also substantial amounts used in the industry sector. (Statens energimyndighet 2023, p. 7)

The amount of petroleum products used in Sweden is quickly diminishing. However, the decrease is most substantial in heating. Diesel and petrol use is around the same level now as in 1983, but petrol use has been decreasing the last decade even though some of that use has been overtaken by diesel. (Statens energimyndighet 2020, p. 43, 2023, p. 50)

Domestic road traffic used 74 TWh in 2020, domestic flights around 1 TWh and international flights 4 TWh (which is significantly lower than the pre-pandemic figures of 11 TWh from 2018). Shipping uses 31 TWh, the bulk being international shipping. Rail transport around 3 TWh. The usage of fossil fuels by transportation mode range from virtually all transports (aviation) to very few transports (rail). The sector as a whole is quite dependent on fossil fuels. (Statens energimyndighet 2020, p. 69, 2023, pp. 78–86)

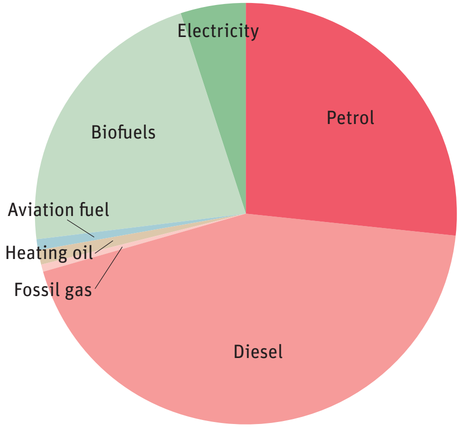
Competition for biofuels and electricity

There are numerous alternatives to fossil fuels. Renewables, such as wind, solar and hydropower are established and mature technologies. In Sweden, hydropower and wind are already in widespread use. Grid level solar plants has not yet been built on a large scale, but the installed base of rooftop solar systems is growing fast. Biomass usage is extensive, both as an energy source for heavy industry and in combined heat and power plants, which are common all over Sweden.

Several sectors are exploring possibilities to shift from fossil energy sources to electricity and renewable fuels. Electric cars are gaining momentum and heavier road vehicles, especially buses, are following closely. Biogas and various biodiesel varieties have been fairly widespread fuels, with an overrepresentation in public transport. The heavy industry is persuading their own shifts away from fossil fuels, where fossil free steel projects like Hybrit are gaining momentum. However, replacing coal with hydrogen in steel production requires enourmous amounts of electric energy. Hybrit Fossil-Free Steel (Hybrit Fossil-free steel 2021) estimates that 15–55 TWh – 9%–32% of the total Swedish electricity production (Energimyndigheten 2023) – is needed to replace all fossil fuels in steel production.

New electricity-intensive industries are also gaining ground. Data centres are major electricity consumers and battery factories are being built in multiple locations around the country. The demand for (green) electricity is vast and if all demands are to be met, an extensive expansion of the green electricity and energy production is needed.

Even "green" energy sources have their own challenges. Scaling up the energy supply from biomass risk putting an even larger strain on biodiversity (Tudge, Purvis & De Palma 2021) and also risk reverting the benefits of using biomass as a carbon sink. Wind power is facing opposition from neighbours and drastically changes the landscapes where they're built. Large scale solar is competing for the fertile farmland in southern Sweden, another precious natural resource in high demand.

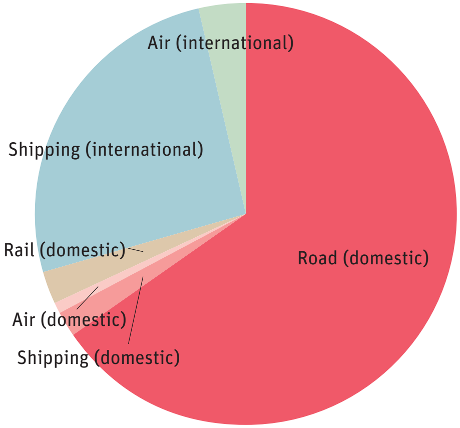


Transport energy sources in Sweden in 2020. (Statens energimyndighet 2023)

More efficient energy

Even though the volume of renewable energy and especially electricity is growing rapidly, some scholars (York & Bell 2019) question whether it's really a transition, where fossil fuels are replaced, or merely an addition. It even seems like previous transitions, from wood to coal, to oil, to natural gas, were all additions when looking at absolute numbers rather than relative (ibid.). Furthermore, on a global scale, adding renewable energy doesn't actually limit the uses of fossil fuels, but increase total consumption and foster economic growth. York & Bell (ibid.) actually calls for a change to the growth based capitalist economy to be able to solve this issue.

The pattern that more efficient energy usage combined with more accessible and cheaper energy usually leads to an increase in total energy consumption was discovered more than a century ago (Jevons 1866) and has since been referred to as *Jevons' Paradox*.



Transport energy usage in Sweden in 2020. Air traffic figueres are a fraction of previous years due to the covid 19 pandemic substantially affecting international travel (Statens energimyndighet 2023).

Possibility of replacing

Work is ongoing in most sectors to find replacement for fossil energy sources and fossil process ingredients. The approaches differ depending on each sector's conditions and challenges. Some options are electrification, where fossil fuel sources are replaced by electricity, hopefully produced in a fossil free way; biofuels, where fossil fuels are replaced by biofuels that often mimic the fossil fuel's characteristics; new processes, where for instance replacing coal in steel production with hydrogen requires a different chemical process.

The challenge of replacing fossil fuels vary greatly with the conditions of each sector. Replacing a fuel used as an energy source is usually easier than replacing an industrial process. Replacing fuel in a stationary facility is usually easier than replacing it in a moving vehicle. Vehicles or vessels where weight is less of an issue, like ships or trains, is easier to convert than vehicles or planes where a low weight is important. When writing this thesis, more or less mature solutions are available for almost all transportation modes except flights, where only small electric aircraft with short range and some biofuels for commercial airliners are available. (Barrett, Cooper, Hammond & Pidgeon 2018; Grubert & Hastings-Simon 2022; Smil 2022)

A study by Lemm et al (2020) shows considerable supply restraints in converting the entire transportation sector to renewable energy, regardless of electrifying, using biofuels or a mix of the two.

Future tech outlook

Research on solutions to replace fossil fuels in major sectors is progressing rapidly. Some proposed solutions are already being rolled out and some are still in various stages of research.

Carbon capture and storage (CCS) is a collection of technologies to capture carbon dioxide from air (the atmosphere), turn it into a material that can be stored, usually underground in mines, depleted oil wells or similar. The process usually requires added energy and water. There are small scale working installations, but the lack of deposit sites and early stage of development still limit its usage. CCS has a great possibility to reduce the amount of carbon dioxide, given it can be powered by non-fossil power sources. (Bahman, Al-Khalifa, Al Baharna, Abdulmohsen & Khan 2023)

Electric vehicles are already gaining a solid market share in Sweden. In 2022, 32% of all new cars were fully electric, but only 4% of the total car fleet (SCB 2023; Trafikanalys 2023). With the technology maturing and purchase prices going down, that percentage is going to increase. However, scaling up battery-powered vehicle production is not without challenges. Mining for lithium and rare earth metals has been subject of criticism, both from environmental and political concerns. Some have also questioned if lithium and rare earth metal deposits are large enough to supply the amount of materials required for a full worldwide electrification.

Scientific problem

Research in reducing fossil fuel usage is often focused on substitution by biofuels or electrification. The driver for this is to allow the current economic and political systems to stay intact, keeping the perpetual growth of consumption and economy that forms the foundation of contemporary market economy driven societies.

This poses a significant limit to presenting possible solutions for reducing the use of fossil fuels, since all measures and alterations to status quo requires them to be weighed against economic and political consequences. Likely, this prevents transformative solutions to the problem from being investigated and evaluated.

In theory, all energy demands on earth could be satisfied by a vast expansion of solar power. But since new energy sources, according to the research I previously mentioned, usually adds to the total energy consumption rather than replacing other sources, it could be useful to approach the issue from the other end – what if energy consumption was much lower? A significant reduction in energy use could prove at least as important for reducing fossil fuel usage as new energy sources.

In a Swedish context, a major part of fossil fuels are used for transportation, particularly for cars. And considering most development in European and North American cities since at least the second world war has been focused on enabling mobility in personal motorised vehicles and moving functions apart spatially, investigations of alternative spatial configurations may have an opportunity to give new insights. More recently, densification, transit oriented development and walkability has been important discourses in urban planning and design. In their own ways, all of them could be said to reduce the need for car journeys and foster a less carbon dependent urbanity. Densification does so by providing more destinations within close proximity. With shorter average trip lengths, those trips would likely more often be done by foot. Transit oriented development focuses on densification around high quality transit stops, providing the necessary ridership basis for good service. With good service, a larger quota of journeys are likely done with public transportation. Walkable designs increase the attractivity of walking by various measures that make walking faster, easier, safer and more stimulating. These discourses all provide methods proven to reduce car dependency and carbon emissions, but are they enough? The least environmentally damaging trip is the one that’s never made, regardless of how efficient the transportation mode is.

Thesis foundation

Objective

The main objective of this thesis is to design an entry for the debate about what urban areas in a fossil free future might be like. I'm investigating how an urban environment that requires as little transportation as possible, with as little added energy as possible, can be created in an existing area through a set of strategies and design principles. The project will be framed in a scenario where fossil fuels don't exist and the design will be applied on the Väster neighbourhood in Lund, Sweden.

Research questions

How can the urban structure and design (greatly) reduce the need for motorised mobility?

How could spatial strategies be used to minimise transportation needs in urban environments?

Delimitations

No building energy performance

Although building energy performance has a significant impact on energy usage, I'm first and foremost a planner or urban designer. There are other professions more suited to work on those issues while my profession is more naturally tied to structures and public space.

Low tech

Since climate change is already happening, waiting for experimental technology to fix climate change is a risky bet. Hence, my design should be based on existing technical solutions or be possible to achieve by existing solutions that are easy and obvious to combine. Simple and pragmatic solutions should be preferred to those founded on experimental technology, digital dreams or pure science fiction.

Adapt and reuse

Building new structures and producing new building materials requires both natural resources and energy. Building on the thesis' background and purpose, I'm proposing the new structure to be sensitive to the existing structures and materials, using and reusing the existing as far as possible.

Lasting materiality

Related to *adapt and reuse*, the built environment needs to be designed with durability and repairability in mind. Over time, this will reduce energy needs and the need for natural resources. Building and infrastructure materials and parts should be possible to disassemble and reuse in new applications if the existing structure is no longer suitable for use, for example brick or cobblestone. Materials could also come from low-carbon sources, like wood or vegetation.

Setting the tone

Degrowth

Starting with ecologists and left-leaning scholars, critique has evolved of economic growth being a social objective since depletion of natural resources usually follows. The degrowth proponents seeks to replace GDP growth as the major indicator of welfare with a different economical system that requires less natural resources and energy. However, this is not achieved by doing less of the same. It requires new approaches for everything from production and consumption to transportation. This is envisioned in new forms of communities, where resources can be shared and cared for, and where production and work are founded in the local community. In a global west context, degrowth usually implies a shrinking GDP and economic activity. In developing countries, the same principles could actually result in GDP growth because less exploitation of human and natural resources by the industrial countries will give them a better chance to develop on their own. In the end, degrowth is about replacing economic growth as the prime indicator of quality of life with something local, like the Danish hygge. (Kalli, Demaria & D'Alisa 2014)

15-minute city

The 15-minute city was proposed as a reaction to the modernist, function-separated and car centric development of urban areas that has been the norm for the better part of the last century. With reduction of car space, introduction of bike lanes and efforts to make sure amenities are available within an 15 minute radius by foot or bike, examples from around the world, particularly temporary measures during the covid-19 pandemic, shows significant increase in bike usage. The city of Paris has been an early adaptor, implementing the 15-minute city at policy level with the target of increasing quality of life while decreasing the environmental footprint of its inhabitants. Some scholars also promote the importance of a walkable and bikeable city for health reasons – a moving population is generally healthier than one that just drives everywhere. (Moreno, Allam, Chabaud, Gall & Pratlong 2021)

Local production of food

Several scholars and designer-architects have been researching and investigating how the urban environment once again could play a larger role in producing the food consumed in the city. Everything from urban farming as education or recreation to scaled-up vertical greenhouses and closed loop fish farms has been suggested.

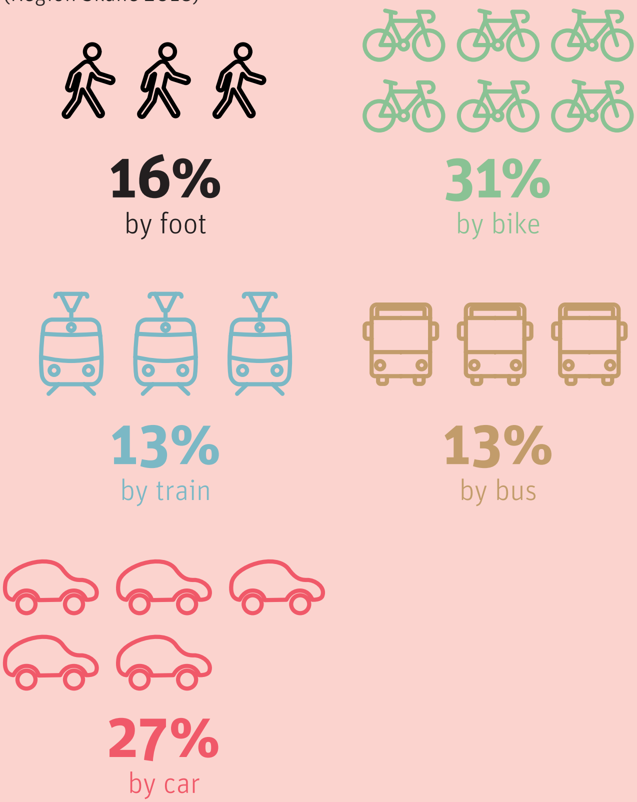
There are however two inherent problems with urban farming as a solution-for-all. For one, farming requires ample space. With today's western diet heavy on animal proteins, every person's farmland footprint is around 1.1 hectares. An optimised vegetarian diet requires around 0.13 hectares to feed one person. (Peters et al. 2016) The space requirement means that it's unrealistic for low-intensity urban farming to be a significant part of the food supply. The second problem lies within the large-scale greenhouse solutions. They usually require significant amounts of energy for heating and artificial sunlight. That makes them less suited to supply food in circumstances where energy availability is low. However, recreational and educational aspects are still be important reasons to implement some food production in urban areas.

Site – Väster

Early on, I decided to work on an existing site. In a scenario without access to fossil fuels, constructing an entire new area might not be easily achievable. I selected a site in Lund in southern Sweden. The area, Väster, is located just west of the central station. When I started working on this thesis, Europe went through the second wave of covid-19 closures and the possibity to access the site was an important factor for my choice – I do live in an apartment in the detailed design area. Lund is also a compact city, with decent walkability and bikeability. I found it interesting to pick a site with a decent starting point, assuming the project would still in parts look radically different than today.

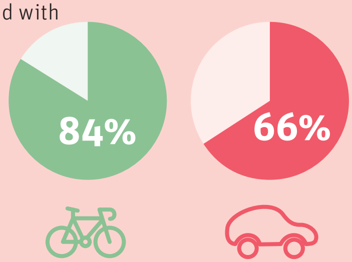
Transport mode choices

In Lund, 2018
(Region Skåne 2018)



Vehicle access

Percentage of households in Lund with bike or car (Region Skåne 2018)



Trip lengths

Percentage of trips by trip length.
Lund, 2018 (Region Skåne 2018)

Data

Fossil fuel usage

As mentioned in the background section (see *Fossil fuels and energy* starting at page 13), one of the major sectors using fossil fuels in Sweden is the transportation sector, especially cars. In Lund, 7,6% of all personal cars at the end of 2022 were battery electric vehicles, which is high compared to the national share of 4% (SCB 2023).

Travel

Lund has a decent bike route network and a lot of the amenities are within walking distance. Travel statistics confirm this with more trips being done by bike than car (Region Skåne 2018). Walking and biking make up for almost half of all trips, transit and cars have just over a quarter of all trips each (ibid.). Over half of all trips are shorter than five kilometres, a distance that is often regarded as suitable for biking, but 17% of the trips are longer than 25 kilometres (ibid.), which could be explained by Lund being located in a tightly interconnected region.

Site analysis

The site is located just west of Lund central station and the area of the detailed design covers around 12.5 hectares. The railway forms a barrier to the city centre, but both sides are fairly well connected with bridges and tunnels. Around the station, bike parking is found next to most station entrances. At Västra stationstorget, there is a major two level underground car park.

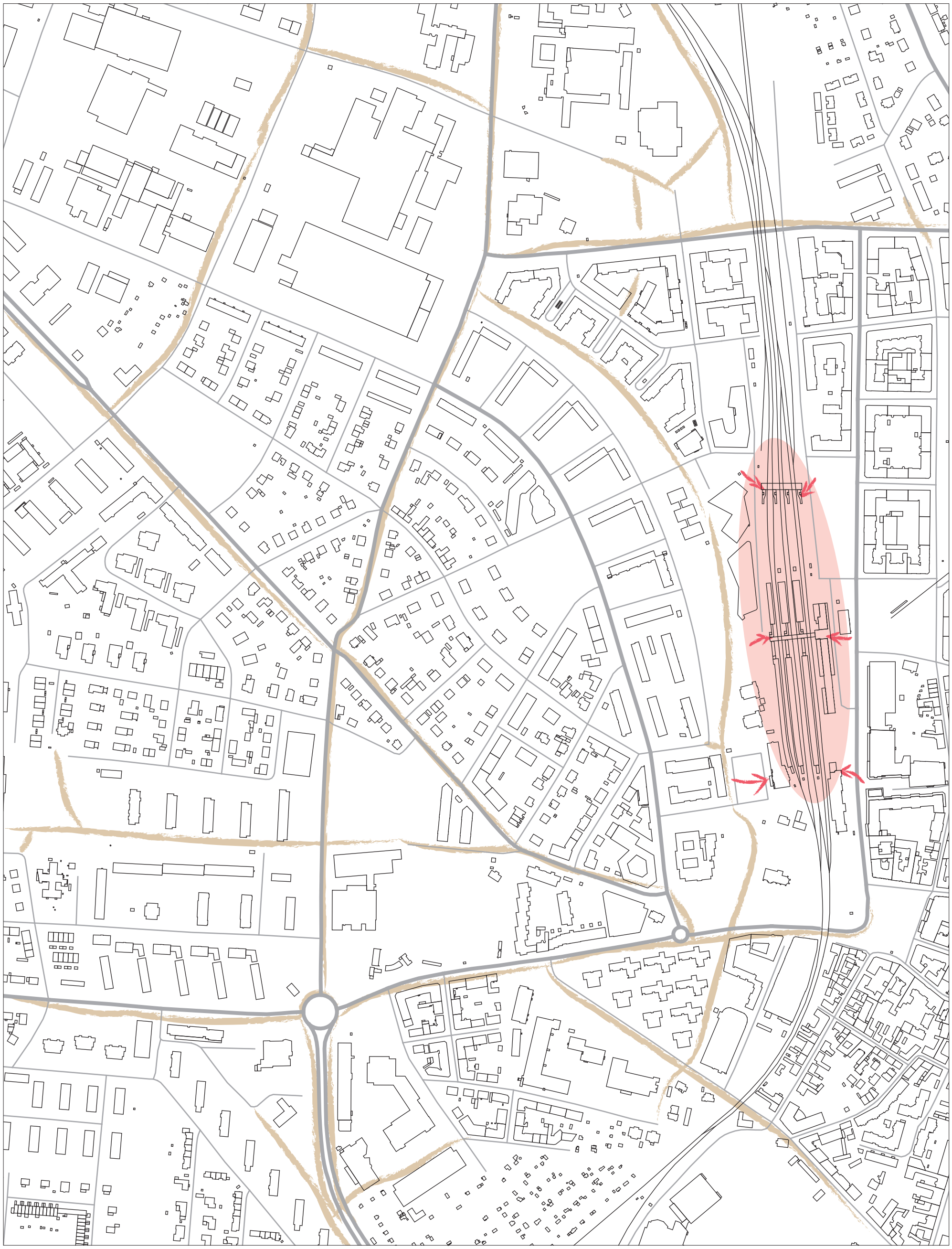
The site has a diverse urban morphology and a wide range of typologies with varying functions and building ages. There are early 1900 brick villas, rendered block of flats from the 1930's and in brick from the 1940's. Gardens and courtyards are generally generous, with ample vegetation.

There is one major park, Bjeredsparken, next to the station. It has a curved and elongated shape, following the former railway line to Bjärred. Here, a variety of programming is located, like a playground, kindergarten, outdoor gym and an amphitheatre. There's also a smaller park located next to Byggmästaregatan, with a large lawn and a couple of tall trees.

The street network has a few arterial roads, most with bike lanes, like Fjelievägen, Byggmästaregatan and Trollebergsvägen, but the bulk is made up of small scale residential links with ample on street parking. City and regional bus lines run along the arterial routes, connecting Lund's centre with the neighbourhoods further out and surrounding villages and towns.

Programming

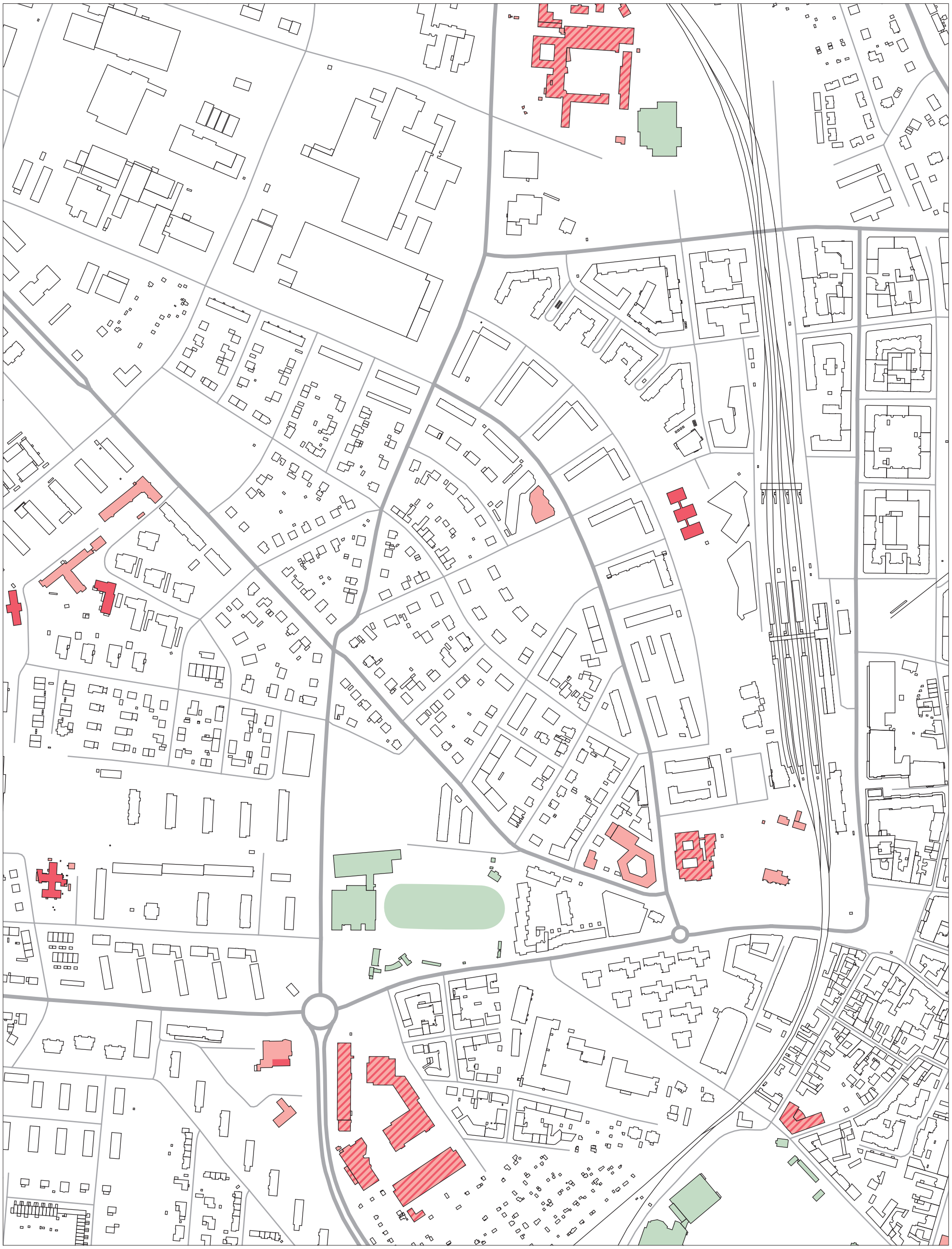
Transport



Railway station

Bike lane/path

Main street



Public amenities

Car structures

Surface car parks

Garages

Petrol stations

View of Stadsbudsgatan looking north. The mixture between various building typologies on the site is visible.

View of Hantverksgatan towards the station. In the foreground to the right is a 30’s building with garages below ground.

View of Byggmästaregatan looking north. This is an arterial street with bus service.

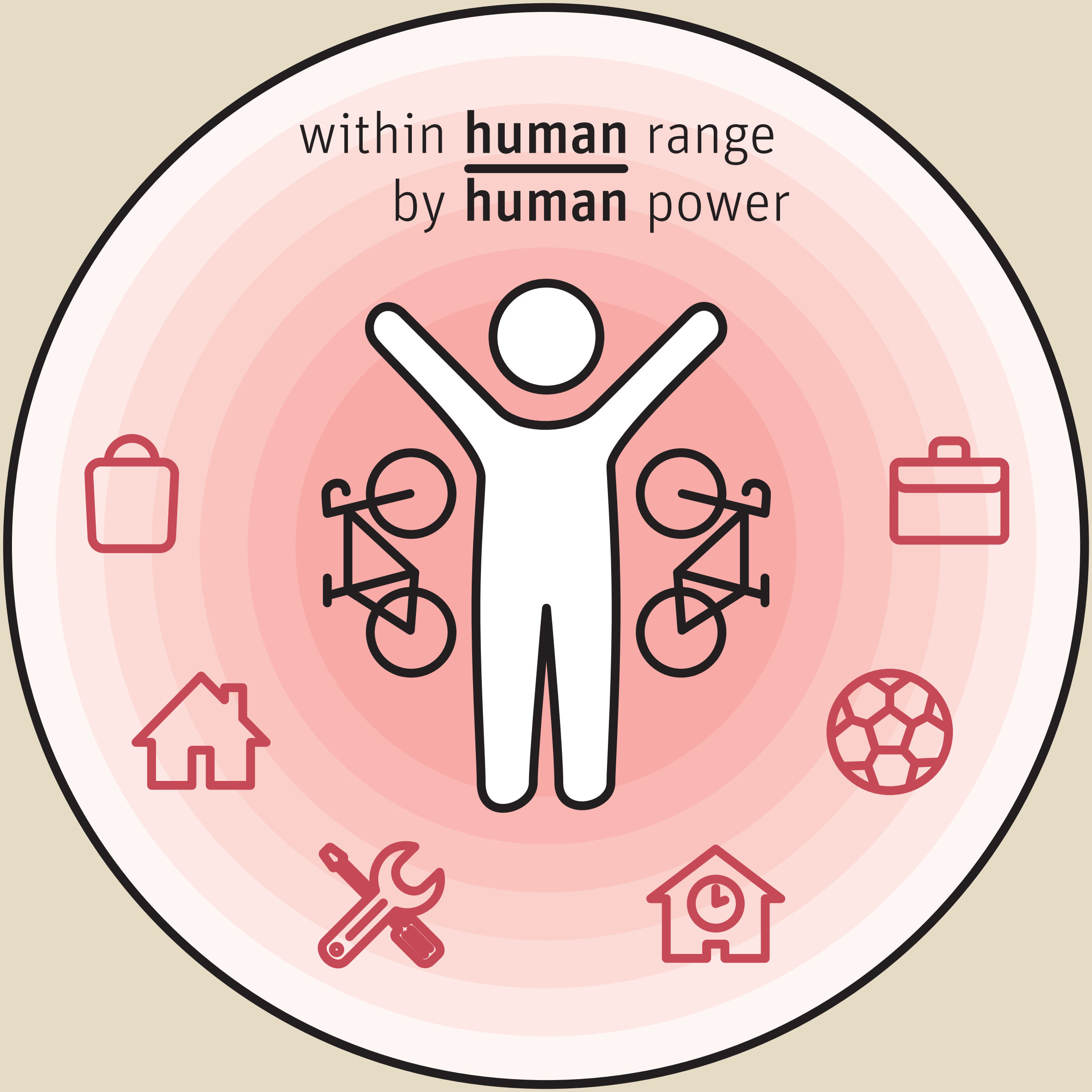
View of Stadsbudsgatan with one of the early 1900's brick buildings, this one has got a garage added later.

Project

In a not too distant future, fossil fuels will no longer be available. I'm presenting a scenario where design is used to investigate a different, yet very familiar Lund. Combined with previously presented literature on energy systems, potential for fossil fuel replacement and transport systems, these factors informs all parts of the design process and outcome.

Vision

In my defossilised Lund, people have got their time back. Work is next door, children can walk by themselves to the neighbourhood school and food is grown and processed within reach. There's no longer a need for tedious, stressful commutes and everything you need for your everyday life is withing walking and biking range. Consumer goods, bikes and household items are to a great extent manufactured locally or in the region from recycled materials and can be repaired within a stone's throw from home.


within **human** range
by **human** power

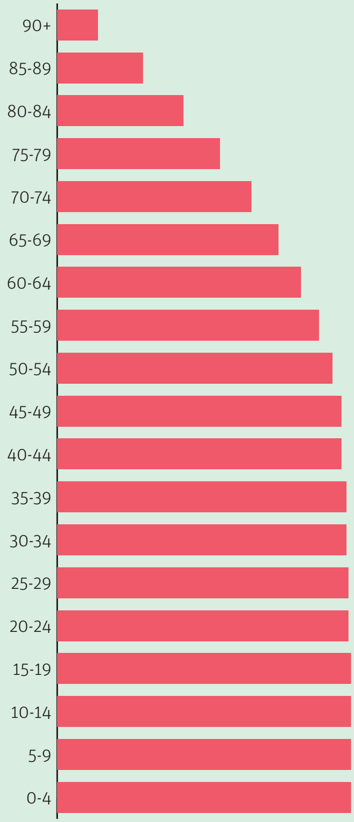
Strategy

Within human range – through human power

When energy is something precious, daily travel needs to be as short and efficient as possible. Walking and biking are some of the most energy efficient transportation modes existing. Although their energy source, food, can have a substantial climate impact, there are also existing local and sustainable production methods.

A city where walking and biking are the dominant transportation modes needs all common destinations to be in proximity to people's homes. Work, school, commerce, activities and social locations all need to be easy to reach walking or on a bike. Everything has to be *within human range* and you're getting there by *human power*.

For some purposes, like specialist professions and visiting family and friends, there will always be a need for longer journeys. Public transportation and shared vehicle pools in the mobility nodes fills that space.



Stable population pyramid

1.2
bike parkings at home

0.1
cargo bike parkings

0.5
workplaces

1/6
school places

1/15
kindergarten places

Key figures

Building a world of key figures

Stable population pyramid

With limits to resource usage, society and economy cannot be dependent on growth. That includes population growth. I've created a stationary population pyramid, where population neither grows nor shrinks.

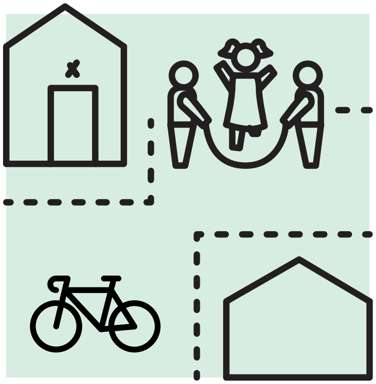
Key demands

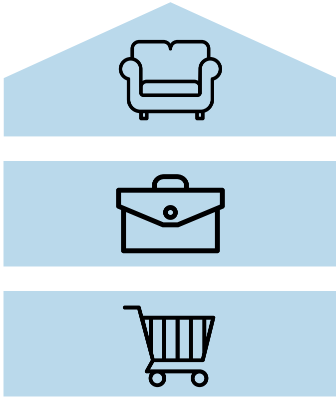
The population pyramid has formed the basis for the key figures representing the demands of the inhabitants. For every inhabitant, there is a need for a certain amount of parking, workplaces and so on. Starting with the Swedish average for flats, 34 square metres for rented and 39 square metres for owned (SCB 2020), I've settled on an average dwelling area of 35 square metres per person. When common areas are included, this figure will be around 50 square metres per person. This makes it possible to calculate required amenities per gross floor area, rather than per person.

The work, school and kindergarten figures have been derived from the quota of the population in the population pyramid belonging to age groups in question for each subject and slightly rounded for practical reasons. The inhabitants are expected to attend kindergarten between 1.5 and 6 years, school between 6 and 19 years and work from 20 to 65 years.

Bike parking has been calculated to one bike place per person plus 20 per cent for visitors and extra bikes. Cargo bike parkings have been estimated to one spot for every other family with children plus 20% for visitors and cargo bike loans.

Toolbox





Neighbourhood street

Made for walking, biking and meeting, the *Neighbourhood street* replaces the traditional linearity of the capillary streets with a sequence of spaces. The street combines flexible and programmed space with stormwater and microclimate management. It also provides some logistics functions for the adjacent properties and has a priority of spaces as shown below.

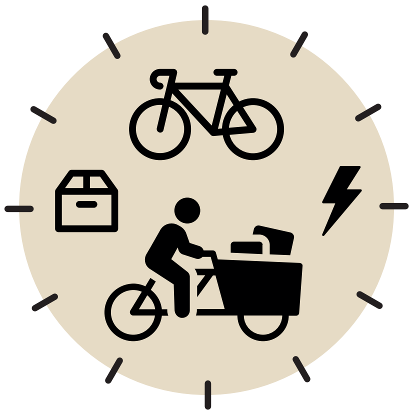
To enable transportation between neighbourhoods, the street typology is complemented by a *transport street* where light mobility is prioritised, but public transportation and other heavier vehicles also can navigate a little bit quicker. Priorities are shown below.

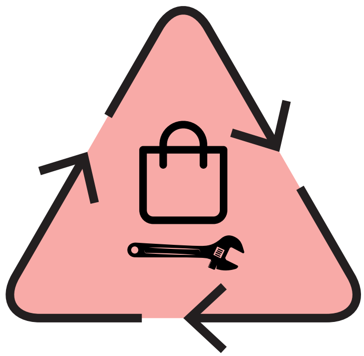
Neighbourhood street space priorities
Pedestrian prioritised mobility (≈10 km/h)
Bike parking
Activities (playing, socialising …)
Greenery
Stormwater
Logistics

Transport street space priorities
Swift movement between areas with bike priority (≈20+ km/h)
Greenery
Public transport
Heavy vehicle circulation (≈30 km/h)
Parking

Mixed use

The city should be mixed, especially in terms of functionally. In the best of worlds, city, district, neighbourhood, block and building scale should be mixed, but the importance of mixed functions is greater on neighbourhood scale than on building scale.





Mobility centre

For personal mobility, the centre gives an opportunity to make modal transfers, rent cargo or electrical bikes or even larger vehicles. Bike service and charging are also available. This is also the location for freight despatch and deliveries. The *mobility centre* reduces or removes the need to own mobility options not used every day.

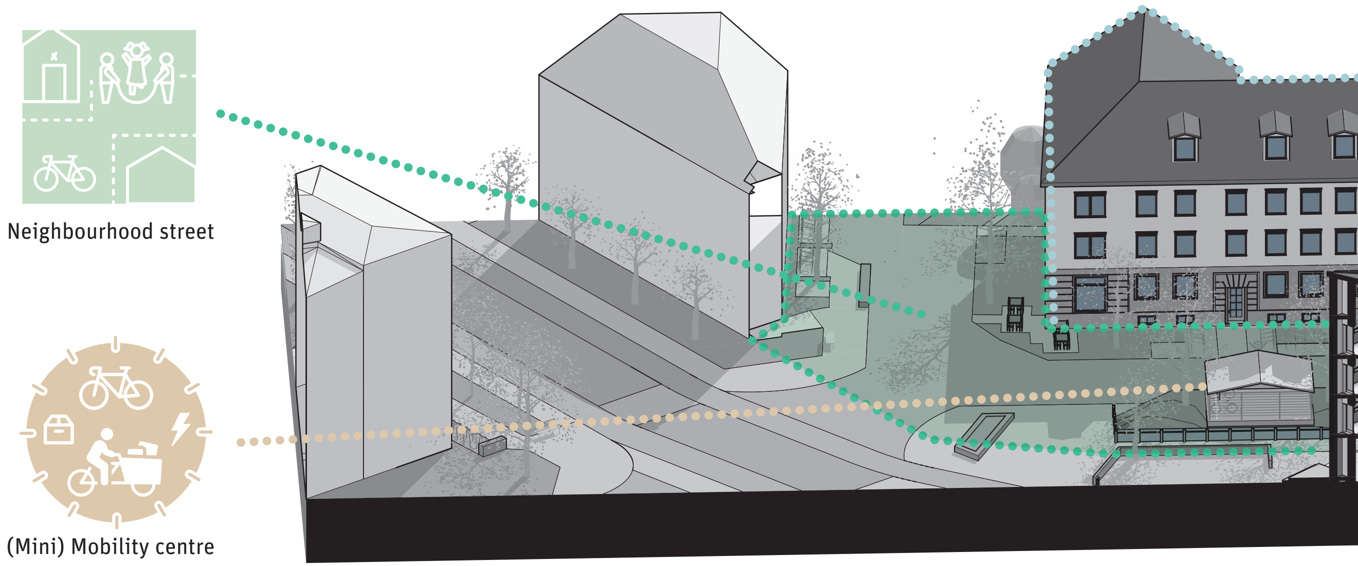
For easy access to more frequently used mobility options, like cargo bikes and electrical bikes, mini mobility centres are provided in the streets with easy to access electrical bikes and cargo bikes. These are serviced from the nearest mobility centre.

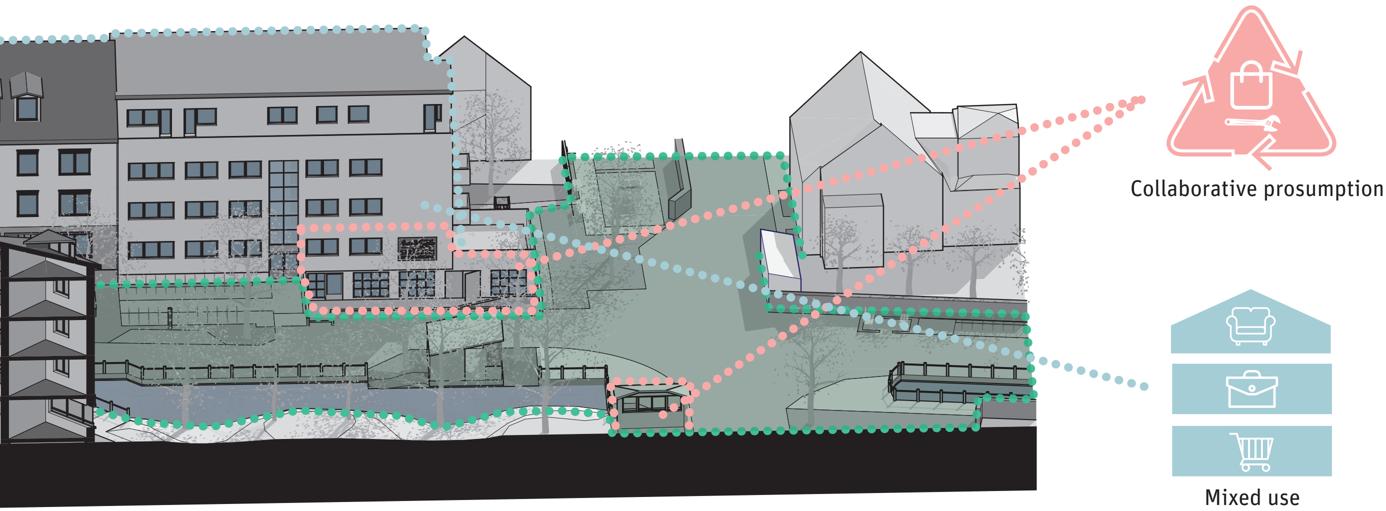
Collaborative prosumption

To reduce transports further, *collaborative prosumption* facilitates the change of a linear consumption model, where resources are used by a producer to make goods that then are consumed and disposed by an end consumer, into a circular model, where the lines between consumer and producer and product and raw material are blurred. Production and repairs move closer to consumers, goods are reused, repaired, recycled and remade instead of disposed.

Toolbox landing

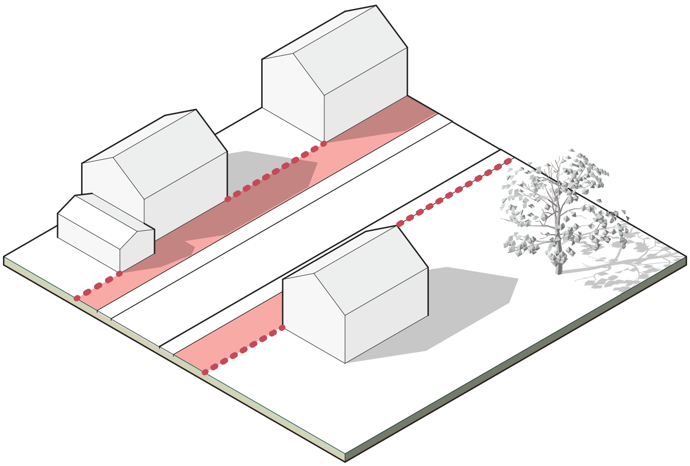
A simple axonometry showing the different tools landing on site.

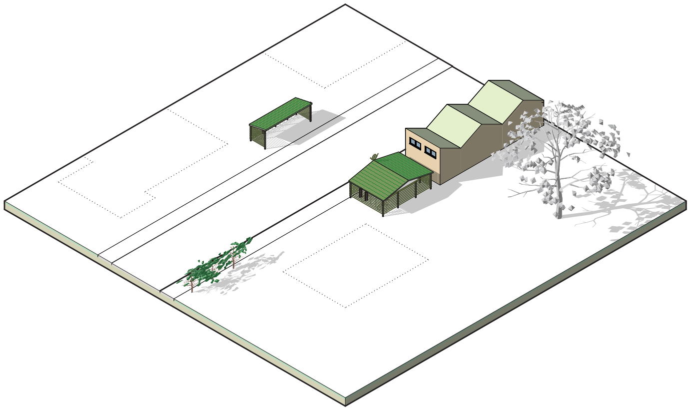



Collaborative prosumption
Mixed use

Finding edges

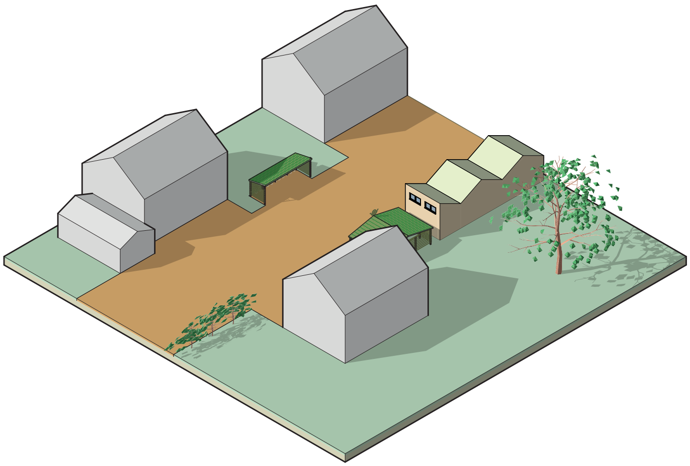
The project's basic principle for working with the boundary between public and private in this mixed typology site.





1. The first step to define a clear boundary between public and private is to find locations for edges defined by buildings, vegetation or other structures that can be built upon.

2. The second step is to define the edges with light structures like bike sheds, light infill developments like small business premises or productive vegetation like fruit trees tied up like hedges.



3. This gives a built environment where there is a clear contrast between public (the street side) and private (facing away from the street).

Proposal

The surroundings (strategic plan)

To get an understanding for the area outside of my detailed design, I've plotted the surroundings according to the strategy and toolbox. This plan shows the street hierarchy with neighbourhood streets and transport streets, the bike route network and the route of the stormwater swales. Outside of the detail design area, the precision of the design is more general to give an idea of what a place could look like, but not adapted fully to the specific place.

Neighbourhood street

Transport street

Square/public space

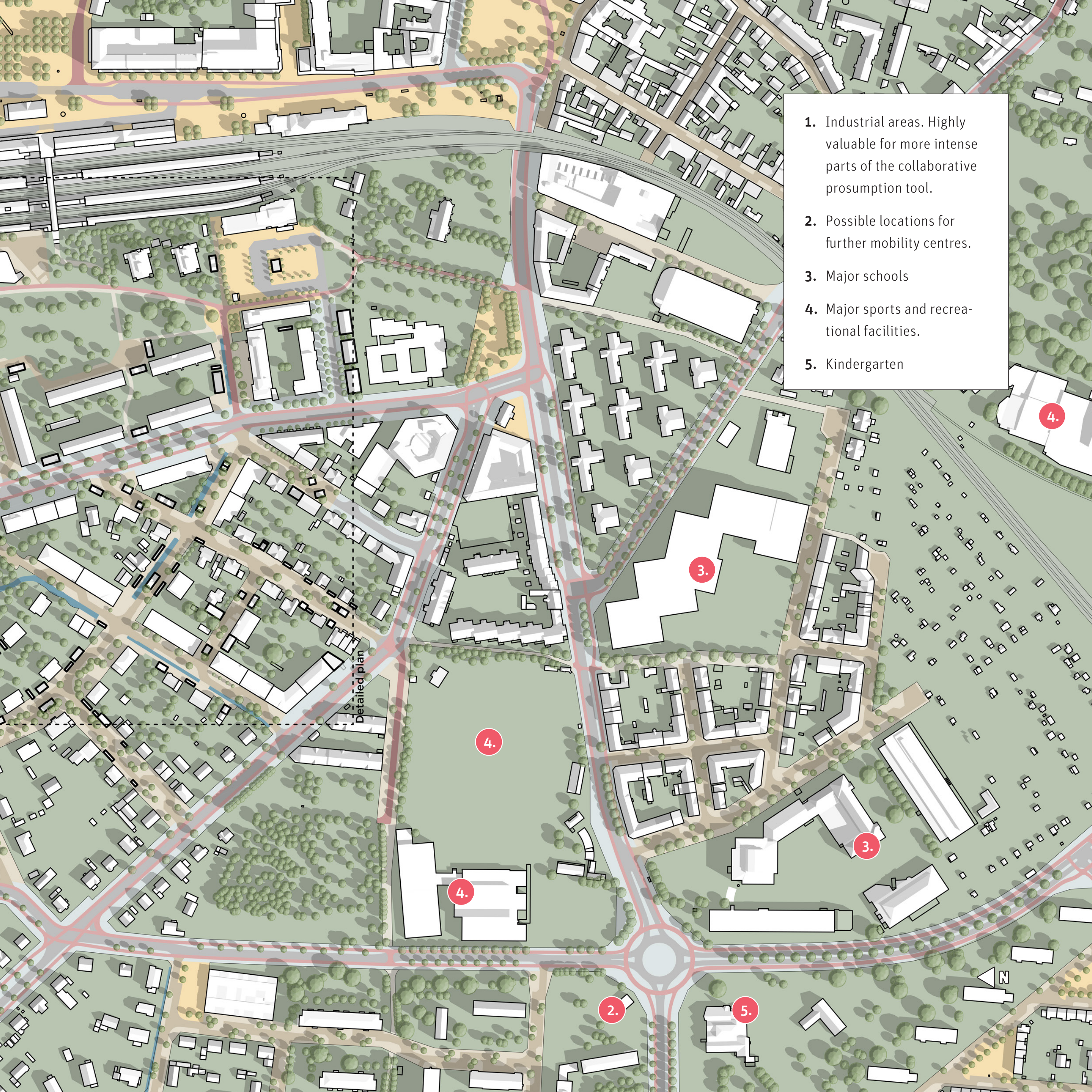
Bike lane

Lane with bike priority

Stormwater

Possible new building/densification

New structure


1. Industrial areas. Highly valuable for more intense parts of the collaborative prosumption tool.
2. Possible locations for further mobility centres.
3. Major schools
4. Major sports and recreational facilities.
5. Kindergarten
Detailed plan
4.
3.
4.
4.
3.
2.
5.
N

Looking closer (detailed plan)

In the detail plan, the implementation of the neighbourhood streets is evident, showing how the sequence of spaces lay out in the neighbourhood. With bike parking, greenery and integrated activities, the streets turn into a place to be, rather than a place to leave. This is in contrast to the transport street which has a linear character, quite like a normal street where soft mobility is prioritized.

Bike parking in front of each building is dimensioned after how many inhabitants it presumably holds.

In various locations around the site, places for activities has been added to the streetscape. A boule court, playgrounds, chess board, urban gardening planters and table tennis.

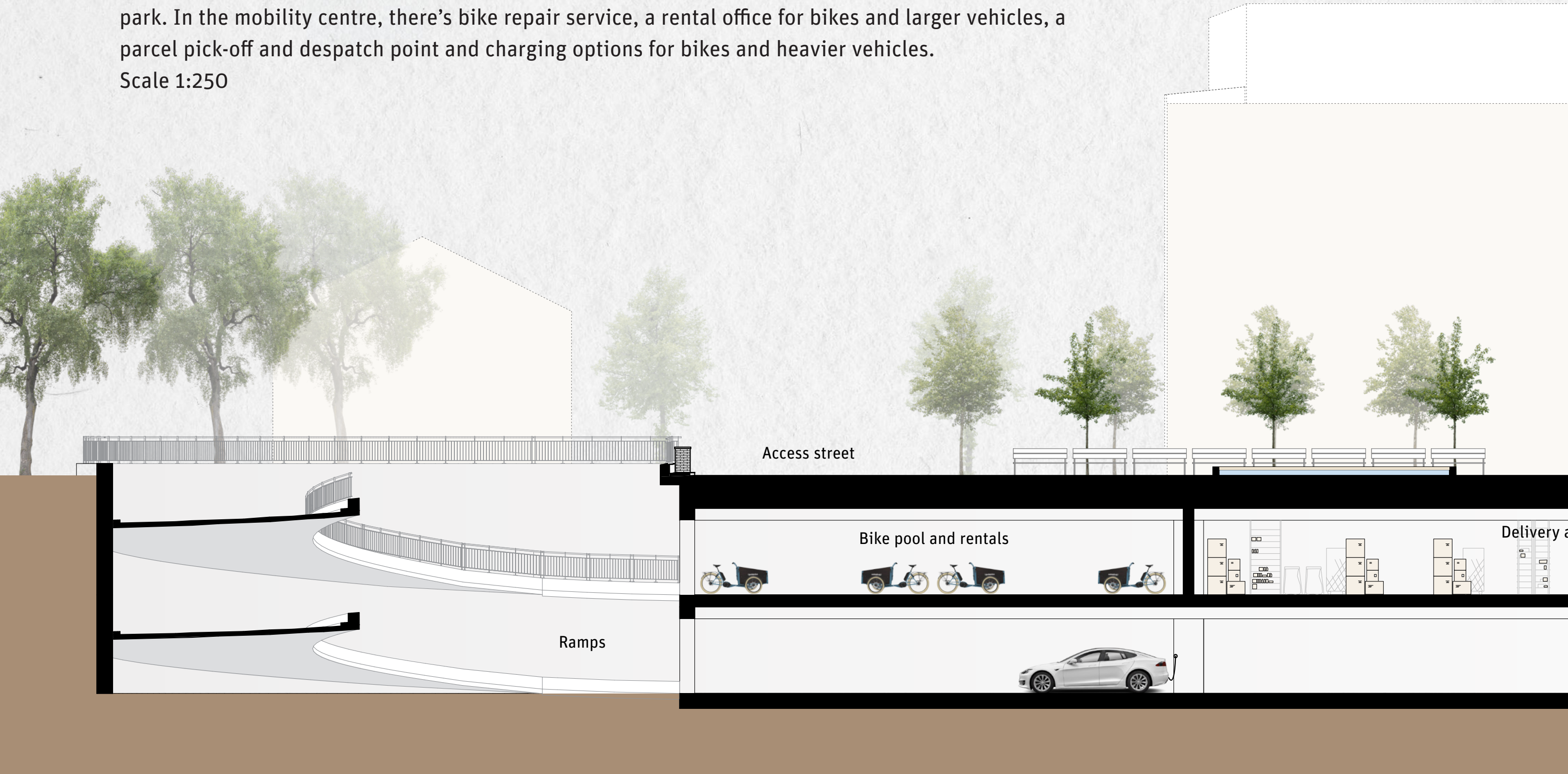
The boundary between public and private has also been strengthened with light structures, vegetation etcetera. When more free time is spent closer to home, a clearly defined private space could be very useful for, amongst other things, relaxation and rest.

Sports field (existing)
MMC
Urban gardening
Byggmästare-gatan
MMC
MR
MMC
Mobility centre
Station entrance
MR
MMC

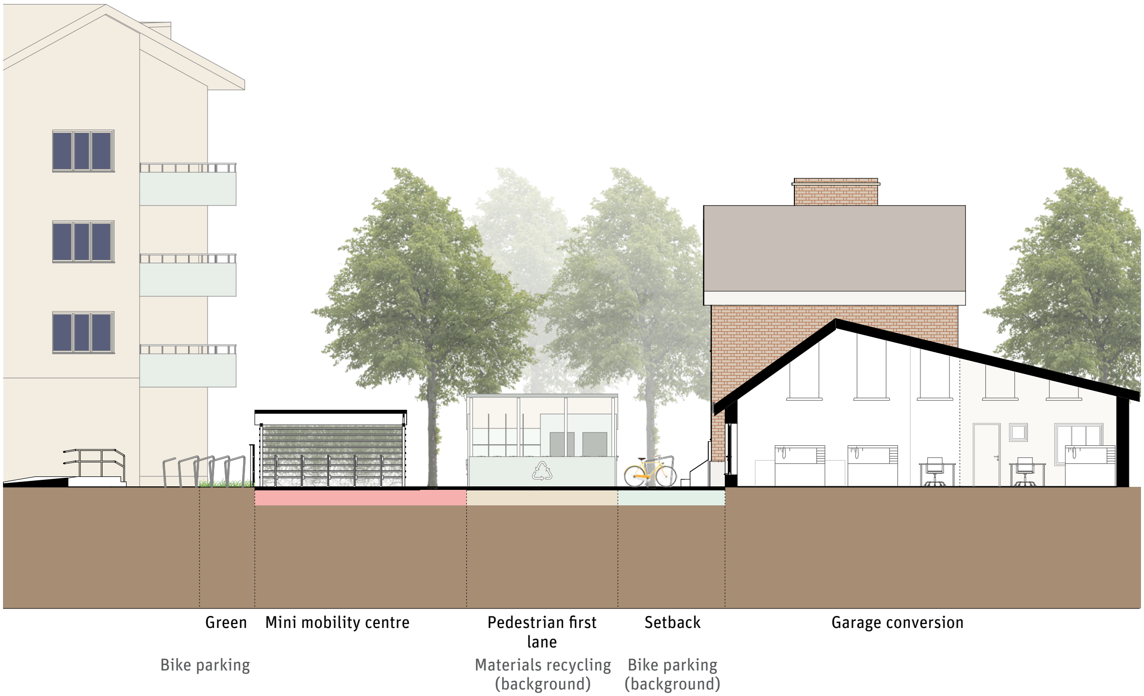
C-C Bike parking is always close to the entrances. In buildings with step free entrances, bike storage can also be cared for inside.
Scale 1:250

D-D The garage in this block of flats turns into a tailor's workshop. A circular business where clothes are manufactured, repaired, sold, upcycled and resold.
Scale 1:250

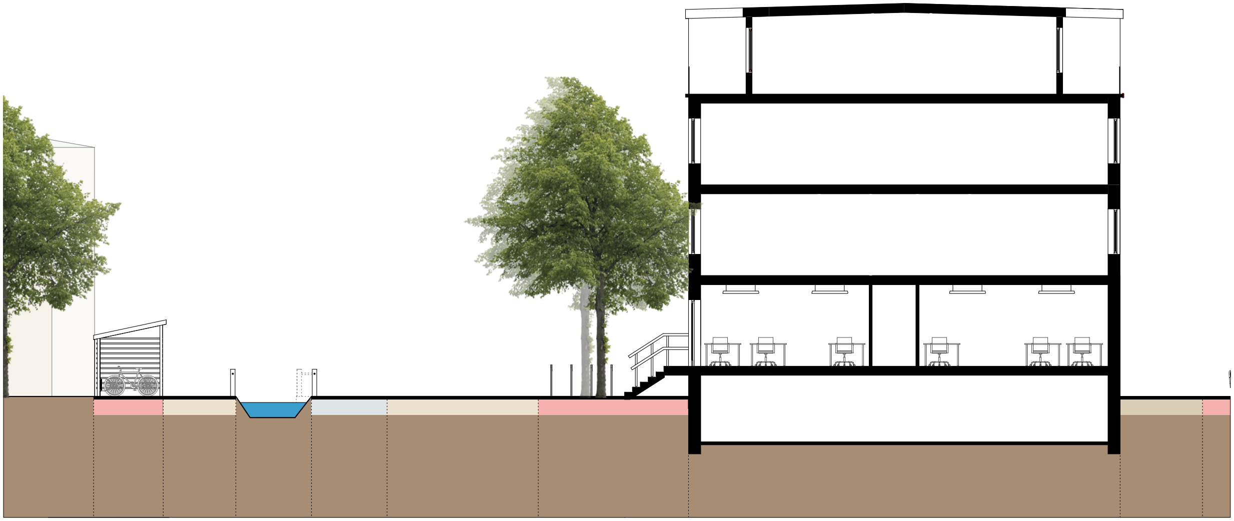
E-E The mobility centre next to the station is coverted from the existing underground multi level car park. In the mobility centre, there's bike repair service, a rental office for bikes and larger vehicles, a parcel pick-off and despatch point and charging options for bikes and heavier vehicles.
Scale 1:250



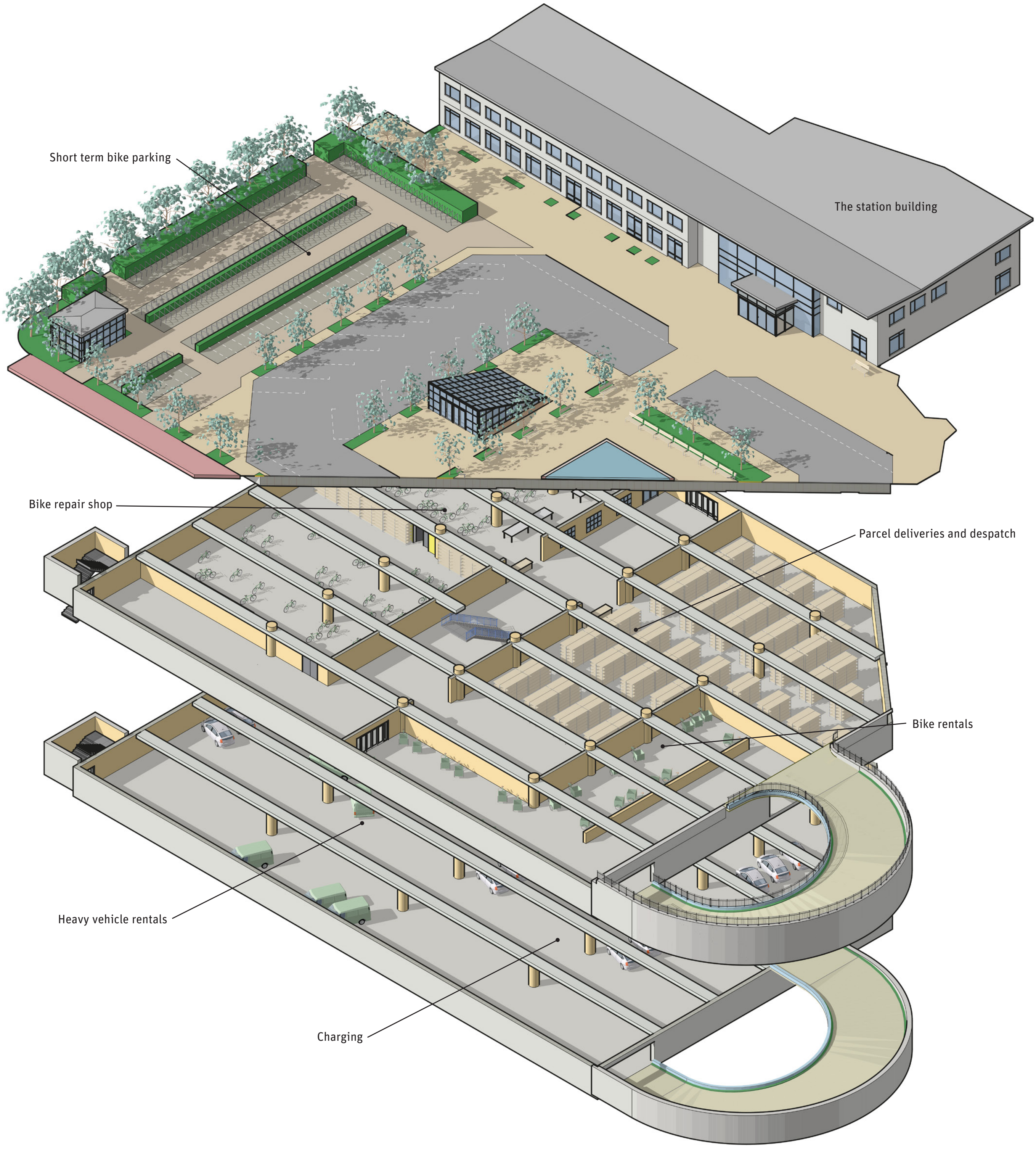
Bike parking
and despatch
Passage with
new entrance from square
VI FIXAR
DIN CYKEL
Bike repair shop
POOLBIL
POOLBIL
Heavier vehice
pool and rentals
POOLBIL



A-A The garage makes a great space for a small workshop. It's accessible for clients from the street and provides a small number of workplaces.
Scale 1:250



B-B A flat has been turned into an office with its own entrance facing the street. The office could be anything from a consultancy firm to a neighbourhood co-working facility.
Scale 1:250


Short term bike parking
The station building
Bike repair shop
Parcel deliveries and despatch
Bike rentals
Heavy vehicle rentals
Charging

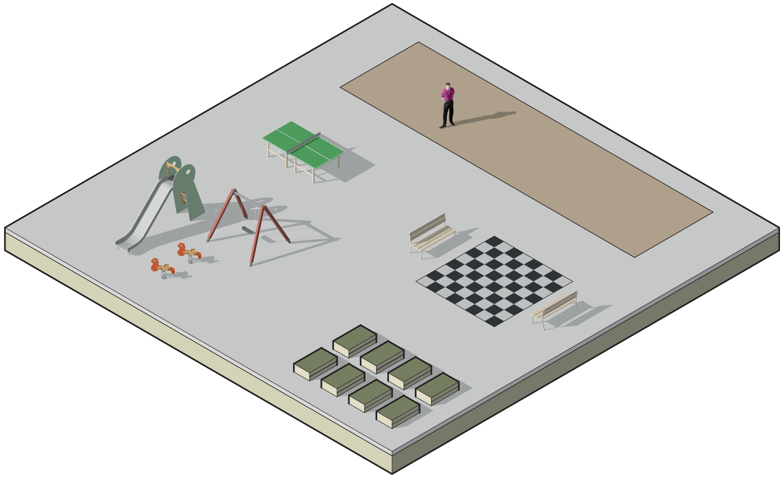
The mobility centre

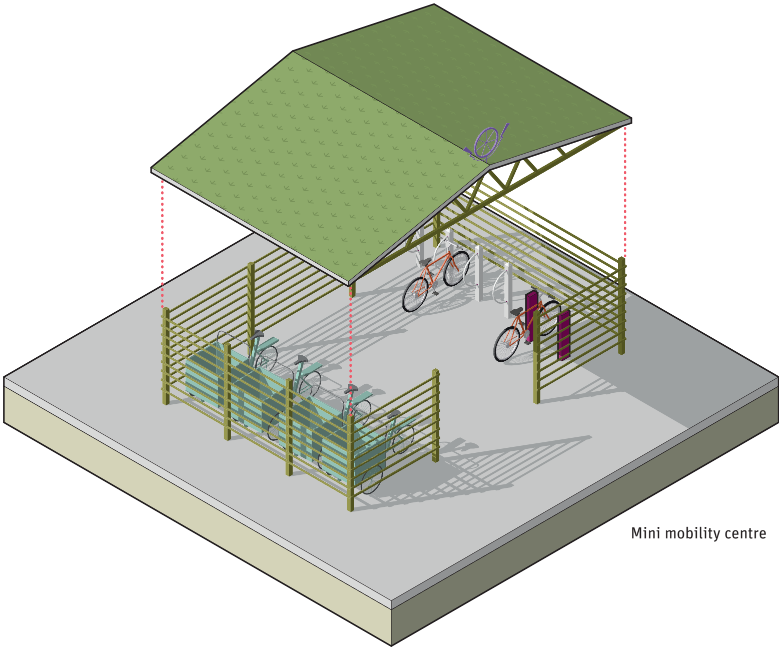
This mobility centres are converted from existing car-centric structures. The project's main mobility centre is built in the former car park next to Lund C. It provides for most transportation needs and has two underground levels where -1 connects directly to the underground walkway to the platforms of the railway station. This is also the level where we find bike repair, rentals and package services.

Rental services provide electrical bikes for longer rides, cargo bikes to move things or take the children for a tour and even larger vehicles, for instance light lorries for when moving into a new home.

Freight despatch and deliveries make parcel and package deliveries and pick-up accessible for the neighbourhood.

The most common rentals, like electric bikes and cargo bikes are also available from satellite mini mobility centres located in the neighbourhood streets.





Mini mobility centre

Activities

In the neighbourhood street, there's plenty of room for activities, like playgrounds, table tennis tables, outdoor chess sets, boule courts, urban gardening and so on.

A living neighbourhood street

Circular businesses have taken over former garages and the street's linearity has warped into a meandering shape forming a sequence of individual places, each giving residents and visitors a place to work, play or pause. The street is transformed into the living room of the neighbourhood. But it's not all about leisure. The mini mobility centres give easy access to light transport options such as electric bikes and cargo bikes.

Close to all entrances, bike parking for all inhabitants is arranged, including spaces for cargo bikes and visitors. Within range, there's also a materials return point where stuff you no longer need is returned to find its way back into refurbished or new products.

To improve the microclimate and make a pleasant space, a good part of the street is planted with various vegetation. The greenery is integrated with the open stormwater swales, which makes sure flash flood risks are kept low.

In the crossroads

To provide access for heavy vehicles, crossings have generous radii, which makes them small neighbourhood squares where the sequenced streetscape opens up and turns into a large unprogrammed space. This is a natural gathering spot, place to play and even a site for a small market to take place.

Combined with the varying public spaces brought by the neighbourhood streets, these squares form a foundation for building social ties in the area.

Conversion of small garage

Small prosumption businesses have taken over this former garage of a single-family house. In this electronics workshop, small devices are repaired and occasionally manufactured. Other types of businesses taking place in similar spaces are small offices, food plants and various workshops.

In some of the businesses, materials collected from the inhabitants are used to recycle, upcycle or create new products, in others produce from the nearby farmlands is refined or preserved for later consumption.

Freedom to roam

The transport streets forms the backbone of the city and acts as spatial opposites to the neighbourhood streets. Their linearity gives them a classic streetlike appearance, but their functions are heavily geared towards unmotorised mobility. Swift movement between areas is the highest priority. That means the cycle lanes have to be straight, continuous in crossings and wide enough to fit cargo bicycles being taken over.

Public transport isn't covered much in this thesis, but the transport streets are where the bus services operate. A slightly wider and more linear lane also makes it possible for the heavier traffic that still needs to circulate – this is where cars and lorries still can navigate the city.

There is also plenty of space left for lush greenery and even parking.

Room for activities

An intense game at the boule court, a nerve-tickling slide ride in the playground or the queen's gambit on the outdoor chess board? Imagination is the only limit for what activity spaces can be furnished into the neighbourhood street. When parked cars wasting public space becomes a thing of the past, there's room for all kinds of other programming.

Combined with all other functionality of the neighbourhood streets, this strenghthens this urban space as an active place where people meet and live.

Vegetation added in the street restructuring is mainly chosen for its microclimate properties. But where that's suitable, plants and trees with edible produce are selected.


>PAKET<
CYKLAR
service uthyrning försäljning

Mobilising the neighbourhood

This mobility centre is built in the former car park next to Lund C. It provides for most transportation needs. This is a great place to make a modal transfer, for instance between bike and public transportation. When left here, the bike is securely stored and can be charged or even serviced while the owner tends to their own affairs.

Rental services are useful and varied. There are electrical bikes for longer rides and cargo bikes to move things or take the children for a tour. When you need to transport something not suitable for a bike or cargo bike, there are also light lorries and electric cars to rent.

Freight despatch and deliveries make parcel and package deliveries and pick-up accessible for the neighbourhood.

Discussion

In this thesis, I've used literature and statistics on global warming, fossil fuels with their possible replacements and transportation to inform my vision, strategy and design. With a pragmatic, but still extensive approach, I've applied the design on an existing site.

Realisation

Placing the project in an existing site makes it logical to implement it gradually. Each street can be turned into a neighbourhood street when the end of the life span of the existing materials or water and sewage systems is reached. To a great extent, the area is equipped with a combined stormwater and greywater sewer that is becoming old, which means that the streets will have to be dug up anyway in a not too distant future.

Repeatability

Spatially, this design is tightly tied to the site. However, with adaption to the local climate and culture, the strategy and tools could be implemented in more sites around the country or world. In colder climates, more indoor public spaces and adaption of the bike infrastructure will be needed. In hot climates, focus on shade and microclimate could be welcome additions.

Liveability

Everyday life in the defossilised Väster is quite different from today, which I've given an example of in the prologue. When most people live close to work, average commute times will be substantially lower than today, giving the population greater liberties in choosing how to spend their time and hopefully reducing stress. However, this also means fewer possibilities for long distance travel and a different market in regards to what combinations of employment and accommodation could be feasible. Altogether, people will lead a more local way of life.

The immediate environment will be very different. Local streets will no longer be a storage facility for cars, but turned into a public space for meeting and activities, more possibilities for outdoor play, work and social interactions. This could alter the way the space is perceived into something like a neighbourhood living room, the transition strengthened by the transition from a linear space of movement to a sequence of spaces with more greenery and programming.

Economical feasibility

One of the more challenging aspects of implementing this design is economic feasibility. To just build the spatial parts of it will likely be fairly expensive, but to actually implement the full project includes transitioning the economic system from one driven by growth and globalisation to one focused on strengthening local ties and minimising its impact on natural resources. This is obviously an undertaking not done in the blink of an eye. However, according to scholars proposing *degrowth* (see *Setting the tone*) this transition is necessary to not extinguish the earth's natural resources (Kalli, Demaria & D'Alisa 2014).

Other benefits of a more physically active society

Giving urban areas a local focus and achieving a very large quota of transports being done by human power – walking and biking – has other benefits apart from the environmental. One important issue in modern societies is low physical activity in the general population. Parts of the population where every day physical activity, like walking or biking to work, is common are significantly more healthy than the parts of the population where every day physical activity is low. The benefits include better personal physics, lower frequency of cardiovascular diseases and lower frequency of mental illness (Westenhöfer, Nouri, Reschke, Seebach & Buchcik 2023). On a society level, scholars have of this reason estimated a significantly lower society cost for people walking or biking to work, mainly because they put less stress on the health care system.

Conclusion

My project seeks to explore one possibility of creating an urban environment for a situation without fossil fuels, showing that this could be achieved with existing technologies, not depending on any future scientific progress. The resulting design should be seen as an entry to the debate and give ideas for how existing urban areas could be developed for a future where energy isn't as abundant as today. However, the project's economic and political requirements are extensive and the changes to people's lives are profound, which means that realising this project might pose a significant threat to major economic interests.

Bibliography

Adams, K. A. (2020). Climate Change: Your Money or Your Life. *Journal of Psychohistory*, 48(1), pp. 2–22.

Arrhenius, S. (1896). XXXI. On the influence of carbonic acid in the air upon the temperature of the ground. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 41(251), pp. 237–276, doi:10.1080/14786449608620846.

Bahman, N., Al-Khalifa, M., Al Baharna, S., Abdulmohsen, Z. & Khan, E. (2023). Review of carbon capture and storage technologies in selected industries: potentials and challenges. *Reviews in Environmental Science and Bio/Technology*, pp. 1–20, doi:10.1007/s11157-023-09649-0.

Barrett, J., Cooper, T., Hammond, G. P. & Pidgeon, N. (2018). Industrial energy, materials and products: UK decarbonisation challenges and opportunities. Applied Thermal Engineering, 136, pp. 643–656.

Energimyndigheten (2023). Minskad elanvändning under 2022.

Friedlingstein, P., Jones, M. W., O'Sullivan, M., Andrew, R. M., Bakker, D. C. E., Hauck, J., Le Quéré, C., Peters, G. P., Peters, W., Pongratz, J., Sitch, S., Canadell, J. G., Ciais, P., Jackson, R. B., Alin, S. R., Anthoni, P., Bates, N. R., Becker, M., Bellouin, N., Bopp, L., Chau, T. T. T., Chevallier, F., Chini, L. P., Cronin, M., Currie, K. I., Decharme, B., Djeutchouang, L., Dou, X., Evans, W., Feely, R. A., Feng, L., Gasser, T., Gilfillan, D., Gkritzalis, T., Grassi, G., Gregor, L., Gruber, N., Gürses, Ö., Harris, I., Houghton, R. A., Hurtt, G. C., Iida, Y., Ilyina, T., Luijkx, I. T., Jain, A. K., Jones, S. D., Kato, E., Kennedy, D., Klein Goldewijk, K., Knauer, J., Korsbakken, J. I., Körtzinger, A., Landschützer, P., Lauvset, S. K., Lefèvre, N., Lienert, S., Liu, J., Marland, G., McGuire, P. C., Melton, J. R., Munro, D. R., Nabel, J. E. M. S., Nakaoka, S.-I., Niwa, Y., Ono, T., Pierrot, D., Poulter, B., Rehder, G., Resplandy, L., Robertson, E., Rödenbeck, C., Rosan, T. M., Schwinger, J., Schwingshackl, C., Séférian, R., Sutton, A. J., Sweeney, C., Tanhua, T., Tans, P. P., Tian, H., Tilbrook, B., Tubiello, F., van der Werf, G., Vuichard, N., Wada, C., Wanninkhof, R., Watson, A., Willis, D., Wiltshire, A. J., Yuan, W., Yue, C., Yue, X., Zaehle, S. & Zeng, J. (2021). Global Carbon Budget 2021. *Earth System Science Data Discussions*, 2021, pp. 1–191, doi:10.5194/essd-2021-386.

Grubert, E. & Hastings-Simon, S. (2022). Designing the mid-transition: A review of medium-term challenges for coordinated decarbonization in the United States. *Wiley Interdisciplinary Reviews-Climate Change*, doi:10.1002/wcc.768.

Hybrit Fossil-free steel (2021). HYBRIT: SSAB, LKAB och Vattenfall först i världen med vätgasreducerad järnsvamp.

IEA (2021). *World Energy Balances: Overview*. Paris.

Jevons, W. S. (1866). *The Coal Question*. 2nd ed. London: Macmillan and co.

Kalli, G., Demaria, F. & D'Alisa, G. (2014). Introduction: Degrowth. In: *Degrowth : a vocabulary for a new era*. Routledge.

Lemm, R., Haymoz, R., Björnsen Gurung, A., Burg, V., Strebel, T. & Thees, O. (2020). Replacing Fossil Fuels and Nuclear Power with Renewable Energy: Utopia or Valid Option? A Swiss Case Study of Bioenergy. *Energies*, 13(2051), pp. 2051–2051, doi:10.3390/en13082051.

Manabe, S. & Wetherald, R. T. (1967). Thermal Equilibrium of the Atmosphere with a Given Distribution of Relative Humidity. *Journal of Atmospheric Sciences*, 24(3), pp. 241–259, doi:10.1175/1520-0469(1967)024<0241:TEOTAW>2.0.CO;2.

Moreno, C., Allam, Z., Chabaud, D., Gall, C. & Pratlong, F. (2021). Introducing the "15-Minute City": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities. *Smart Cities*, 4(1), pp. 93–111, doi:10.3390/smartcities4010006.

Peters, C. J. (1), Griffin, T. S. (1), Picardy, J. (2), Darrouzet-Nardi, A. F. (3), Wilkins, J. L. (4) & Fick, G. W. (5) (2016). Carrying capacity of U.S. agricultural land: Ten diet scenarios. *Elementa*, 2016, doi:10.12952/journal.elementa.000116.

Peterson, T. C., Connolley, W. M. & Fleck, J. (2008). The Myth of the 1970s Global Cooling Scientific Consensus. *Bulletin of the American Meteorological Society*, 89, p. 1325, doi:10.1175/2008BAMS2370.1.

Region Skåne (2018). *Så reser vi i Lunds kommun – Resvaneundersökningen 2018*. Kristianstad.

SCB (2020). Minst bostadsarea per person i storstäder.

SCB (2023). *Fordon i län och kommun vid årsskiftet 2022*. Stockholm. Statistics.

Smil, V. (2022). Decarbonization Is Our Costliest Challenge: It has no clear beginning or end, and it affects every aspect of life. *IEEE Spectrum*, 59(10), pp. 22–23, doi:10.1109/MSPEC.2022.9915632.

Statens energimyndighet (2020). *Energiläget 2020*. Eskilstuna: Statens energimyndighet.

Statens energimyndighet (2023). *Energiläget 2022*. Eskilstuna: Statens energimyndighet.

Trafikanalys (2023). *Nyregistrerade fordon*. Stockholm.

Tudge, S. J., Purvis, A. & De Palma, A. (2021). The impacts of biofuel crops on local biodiversity: a global synthesis. *Biodiversity and Conservation*, 30(11), pp. 2863–2883, doi:10.1007/s10531-021-02232-5.

Westenhöfer, J., Nouri, E., Reschke, M. L., Seebach, F. & Buchcik, J. (2023). Walkability and urban built environments—a systematic review of health impact assessments (HIA). *BMC Public Health*, 23(1), pp. 1–19, doi:10.1186/s12889-023-15394-4.

York, R. & Bell, S. E. (2019). Energy transitions or additions?: Why a transition from fossil fuels requires more than the growth of renewable energy. *Energy Research & Social Science*, 51, pp. 40–43.

Graphics sources

All graphics, photos, illustrations, icons and so on where not specifically stated otherwise are original artwork made for this degree project.

The illustrative watercolour images are based on photos from Unsplash and the author's own photographs.

The perspective visualisations contain 3d library textures and objects from Twinmotion.