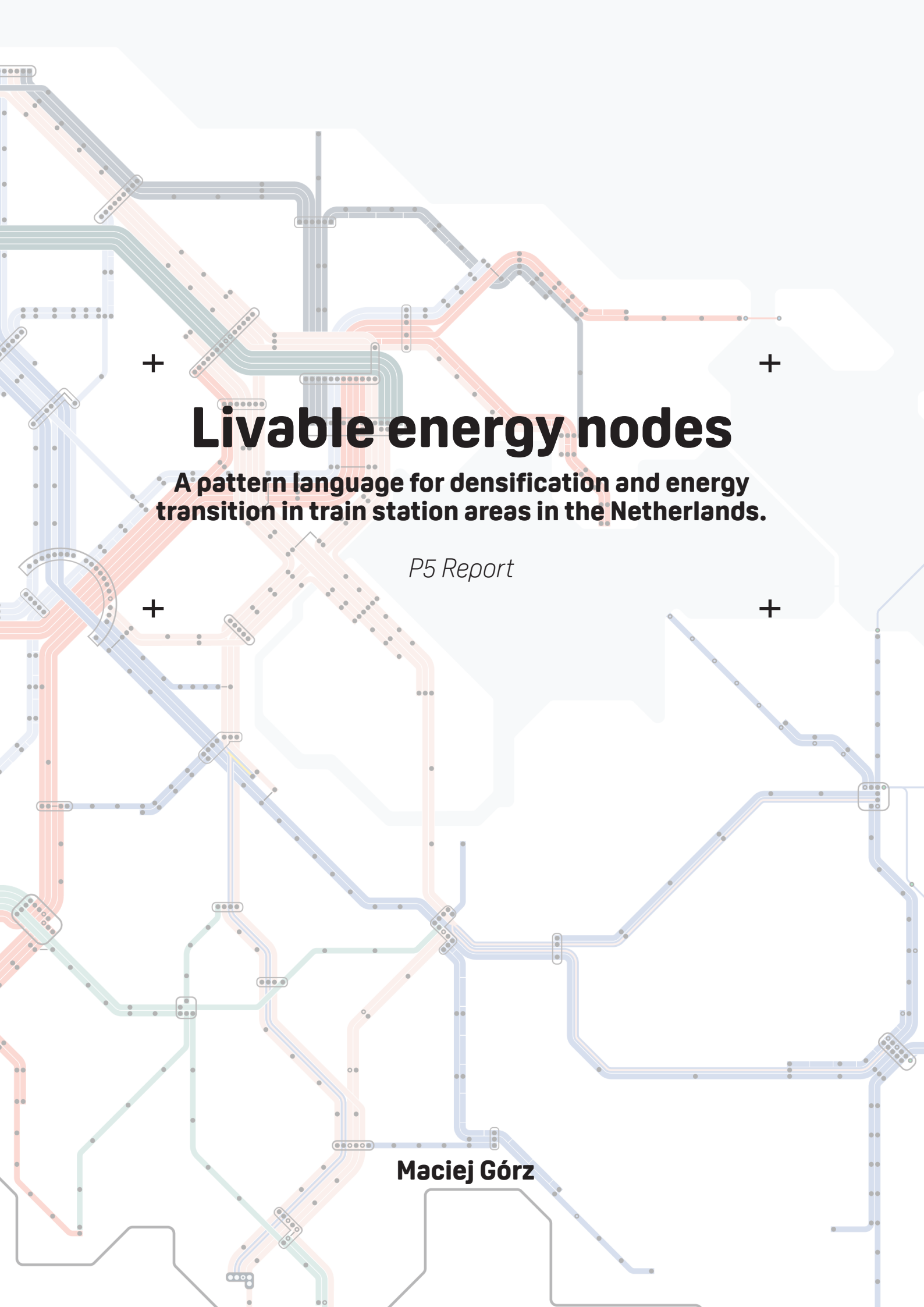


Livable energy nodes

A pattern language for densification and energy transition in train station areas in the Netherlands.

P5 Report

Maciej Górz



Colophon

Livable energy nodes.
A pattern language for densification and energy transition in train station areas in the Netherlands.

Graduation thesis
P5 report
June 23rd, 2021

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Abstract

The importance of train stations in the Netherlands is growing next to the numbers of passengers. The pandemic hampered the growth that could not be accommodated by the infrastructure. In Europe the future of rail looks bright, as it is essential to achieve the goals of the Paris Climate Agreement, while in the Netherlands, train station areas were recognized as one of the main sites for densification until 2030, which aims to tackle the housing crisis.

National ambitions are high, but at the same time there is no coherent national agenda for train stations. Municipalities are competing with each other, and stations acts as hubs of capital allocation rather than catalysts of sustainability transition. This results in growing disparities between small and large stations, and between Randstad and other regions. The disruption of the pandemic gives an opportunity to rethink this unsustainable, neoliberal development model.

The key proposal of this project is to turn around the dominant paradigm of train station areas. Nodes consuming fossil energy and hectic places oriented on business could evolve into hubs of green energy and livable, equitable neighborhoods. The place-node model established by Luca Bertolini (1996) should be reframed by adding the dimension of livability and energy, to address housing and climate crises.

A pattern language was chosen a method to integrate the observations from case studies, experience from practice, insights from literature, create a catalog of patterns - good practices, and apply it to site-specific design. Interrelated patterns forming a language offer more possibilities than a toolbox or a set of principles, and may help with decision-making and defining the program of a station area with multiple stakeholders.

Applying patterns is in fact programming a station area during workshops with relevant stakeholders. Four design scenarios are demonstrating this process and speculating on future-proof train stations. Short-term (2026) and long-term (2040) scenarios were explored in Amsterdam Sloterdijk and Bergen op Zoom. Designs in two different contexts of large and small station were then assessed by the framework developed from Bertolini's model, in terms of node, livability, place and energy, demonstrating how could development according to a new paradigm look like.

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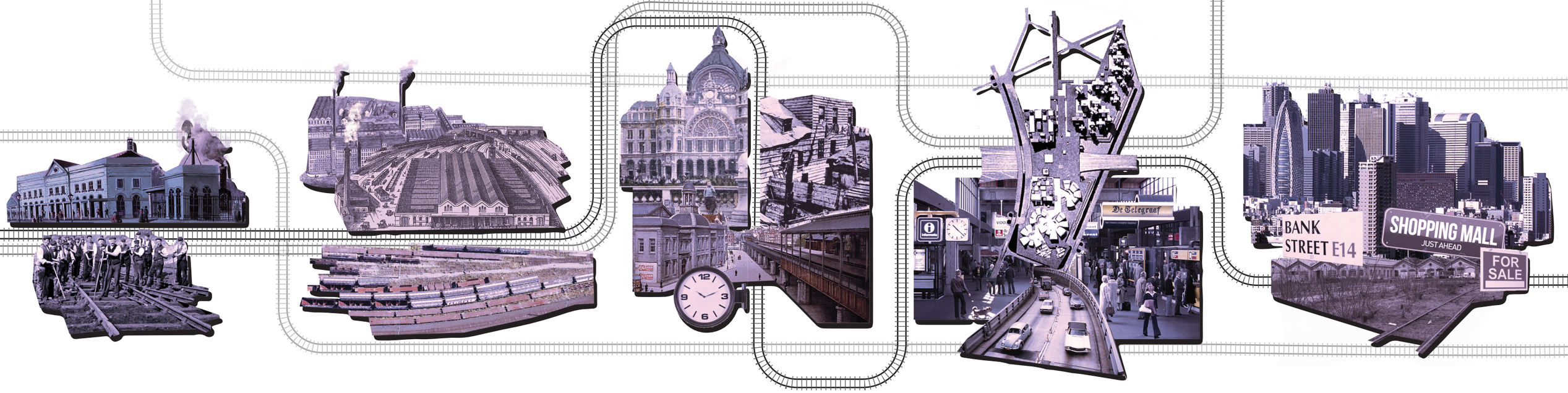
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Motivation



Qualities of density, a theme of Urban Fabrics studio, is for me the entry point to question the future of train station areas in the Netherlands. The national railway network with 397 stations is the busiest in Europe. Due to its high-frequency and vital role in daily commute it reminds more of a metro system. The current agenda of densification and construction of 1 million homes until 2030 is a major challenge for these overcrowded mobility hubs. Is it a chance or rather a threat for

Station areas are often seen as a book cover of the city, on the base of which you judge it. The first impression is often very clear: newcomers entering the city through the station feel urban decline, prosperity or stagnation. Since late 1980s. and due to high-speed rail projects, train station areas in Europe are seen as a business card. Successful cities redevelop their underused railway yards and turn them into commercial venues. Inserting large office volume in historic urban cores is seen as the last chance to keep up the pace with the network of global cities.

However, this dimension of neoliberalization is a two-sided coin. When growing up in Krakow I experiences both decline and then commercialization of railway areas in the city. What struck me was two-fold role of railway in the city: its presence shaped both the most prestigious (central station, shopping mall) and the most shady places in the city (goods station, railway yards). The development of the recent decade seems only to deepen this disparity instead trying to bridge it, even in the Netherlands, where the state did not withdrawn as far as for instance in the UK. Stations in smaller cities or with less favorable position in the network could not count on governmental or private funds and experienced decline or stagnation. Although, it does not mean urban decline - the growth in smaller cities fueled car-oriented business parks or low-density urban sprawl.

My special interest for railway in the urban context i supported by professional experience. Before pursuing my master's degree I worked for a year on the feasibility study of metro line in Kraków and the construction project of the second metro line in Warsaw. I realised that inserting railway in urban fabrics can be both cure to and cause of spatial problems. I observed also a major gap between transport and urban planning.

A critical input to this thesis will be provided by by my work at PosadMaxwan. There I will co-create the strategy for Amsterdam-Sloterdijk station area, a large and fast-growing mobility hub that could serve as a testing lab for adaptable high-density living environment over the railway tracks. To balance this metropolitan proposal, the second design case of the thesis project will focus on stagnating station area in Bergen op Zoom that could serve as a model for smaller cities avoided by neoliberal urban development.

I am convinced that, in order to meet future challenges, the design of the train station areas should be a quest for integration of disciplines. In this project I would like to mobility designer that would interweave the fields of urban design, transport planning, real estate development and architecture.

01 Context

- Introduction
- Rail network
- Urban fabric
- Housing crisis
- Energy transition
- Problem statement



◀ Euralille, a hallmark of neoliberal TSAD. Initial concept, OMA, 1990. Source: https://bit.ly/2TG3YjP

Train stations will play a decisive role in sustainability transitions. Will it be a burden or a catalyst of densification?

INTRODUCTION

According to Luca Bertolini's theory (1996), station areas are understood simultaneously as node and place. Stations were initially built as nodes in a specific transportation network, but in addition they are also place, occupying particular space, interacting with the urban context and accommodating certain program. There are also two overlapping jurisdictions: node (transportation companies) and place (municipalities). However, an important drawback of this theory is that it frames station areas as an office volume positioned in mobility network, omitting the question of urban design qualities and relationship with urban fabric.

Train stations since their beginning had very strong influence on urban fabrics. In Europe they had crucial impact on urban formation in the second half of 19th century. Until now they define the urban center and areas of the highest density.

In the recent railway development vision for 2040 (NS, 2020) stations where described as hubs of sustainable mobility and liveability: attractive urban places to work, live and spend free time. This poses a challenge central for this project: adding high-density living environment to station areas, often associated with high property prices, overcrowding, noise pollution and scarce of space. However, above mentioned conditions refer mostly to a dozen of large stations, while station areas in smaller cities are often lag behind. This disparity between stations boosted by neoliberal growth and small stations marginalized by car-oriented business parks is central for the problem field.

The renaissance of railways in Europe since 1990s. resulted in many spectacular stations which got back its 19th-century role of gateways to the city and "cathedrals of modernity". This metropolitan station area typology developed since 1990s. includes foremost business district. However, this model is becoming increasingly obsolete, especially in the context of Covid-19 pandemic. The demand for office spaces will not return to the level from 2019 quickly, which creates a chance to rethink the logics of this development.

Here a good illustration is the case of Amsterdam-Sloterdijk, a hallmark of profit-oriented station development in the Netherlands. In the late 1980s. and 1990s. a large office park was developed around the new train station. Branded as "Teleport" it focused solely on telecommunication services. After the year 2000, newly developed area turned out to be obsolete due to rapid development of cell phones. Another crisis struck after the year 2008, turning the neighborhood into a "ghost town" of vacant offices.

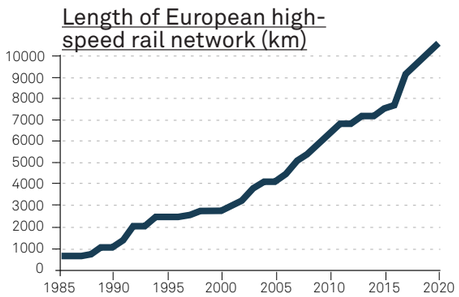
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The advent of high-speed rail since the 1980s. initiated a rail renaissance in Europe. Train became a sustainable alternative to flights.



Length of the European high-speed rail network. Source: EU

Rotterdam Centraal. Source: https://www.scheuten.com/_asset/_private/portfolio/70/CS-Rotterdam_luchtfoto.jpg



Rail network

The high-speed network developed in Europe since the invention of a high-speed train at the end of 1970s. resulted in redis-covery of rail as sustainable alternative to flights.

Post-pandemic reconstruction plans are The 2021 was proclaimed as the European Year of Rail, the initiative of the European Comission aims to promote the rail, and strive for seamless mobility across borders. Development of rail is listed as crucial mean to achieve the 90% reduction of greenhouse gas emission in the transportation, as part of the European Gren Deal - an extremely ambitious goal for Europe to become the first energy neutral continent in 2050.

Train stations as nodes in the micro scale are “connectors” (Spek, 2001), configura-tions of underground passages, stairs, paths and bridges, allowing transfers between different modes of transport. Smaller nodes of regional and local importance are more standardized, while main international nodes have very unique layouts.

The Dutch network, although not the most dense, is located in the European core and connected by lines of three large high-speed train operators: Eurostar from Amsterdam to London, Thalys from Amsterdam to Paris, and ICE from Amsterdam to Frankfurt.

The Netherlands joined the high-speed network relatively late. In 2008 HSL Zuid finally connected Amsterdam and Paris with speed of 300 km/h. The country has different traction voltage (1,5 kV) than its neighbors, which for years was preventing integration with Belgian (3kV), and German (15kV) rail networks.

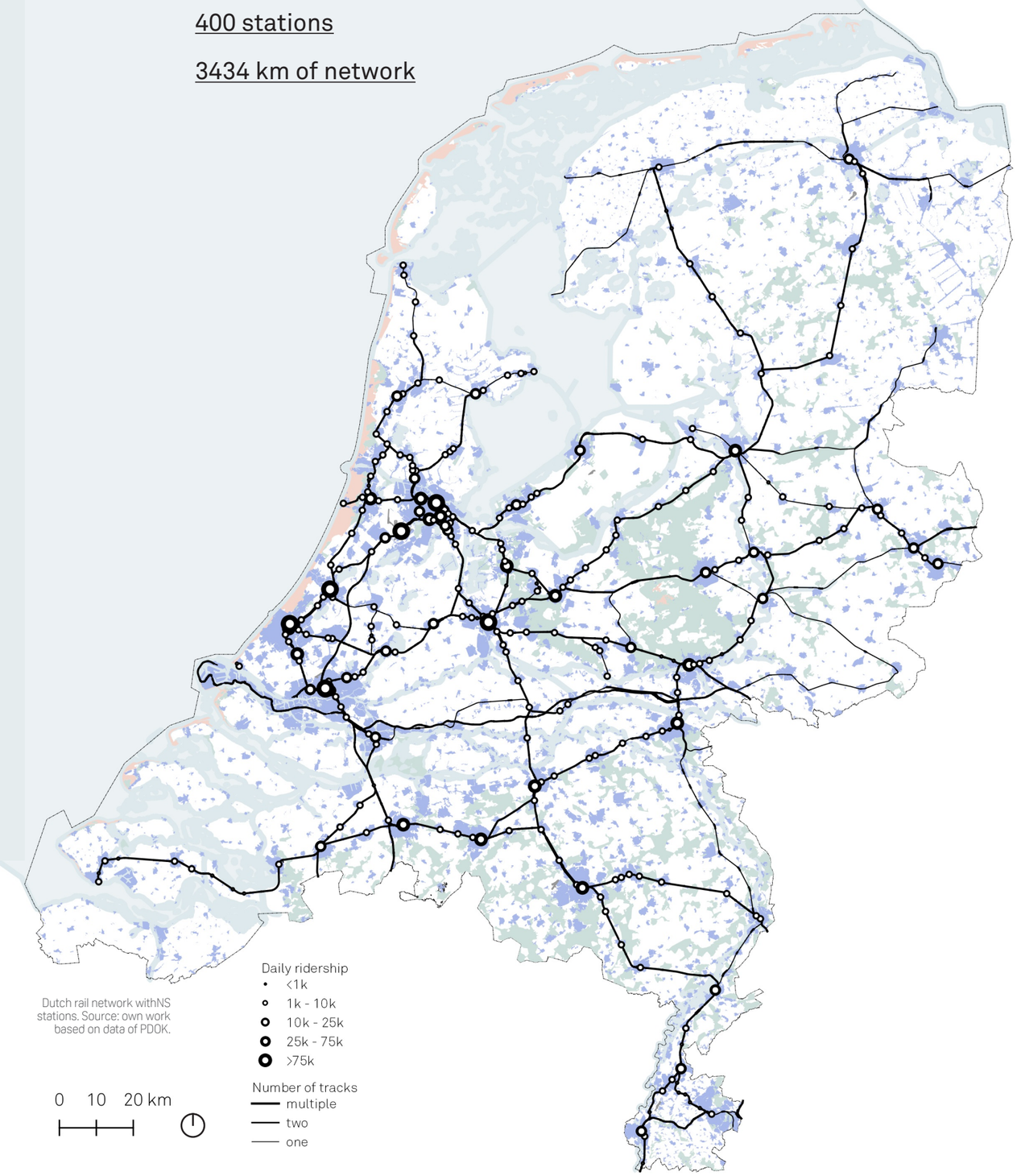


High-speed rail in Europe in 2019. Source: adapted from https://en.wikipedia.org/wiki/High-speed_rail_in_Europe

Rail network of the Netherlands

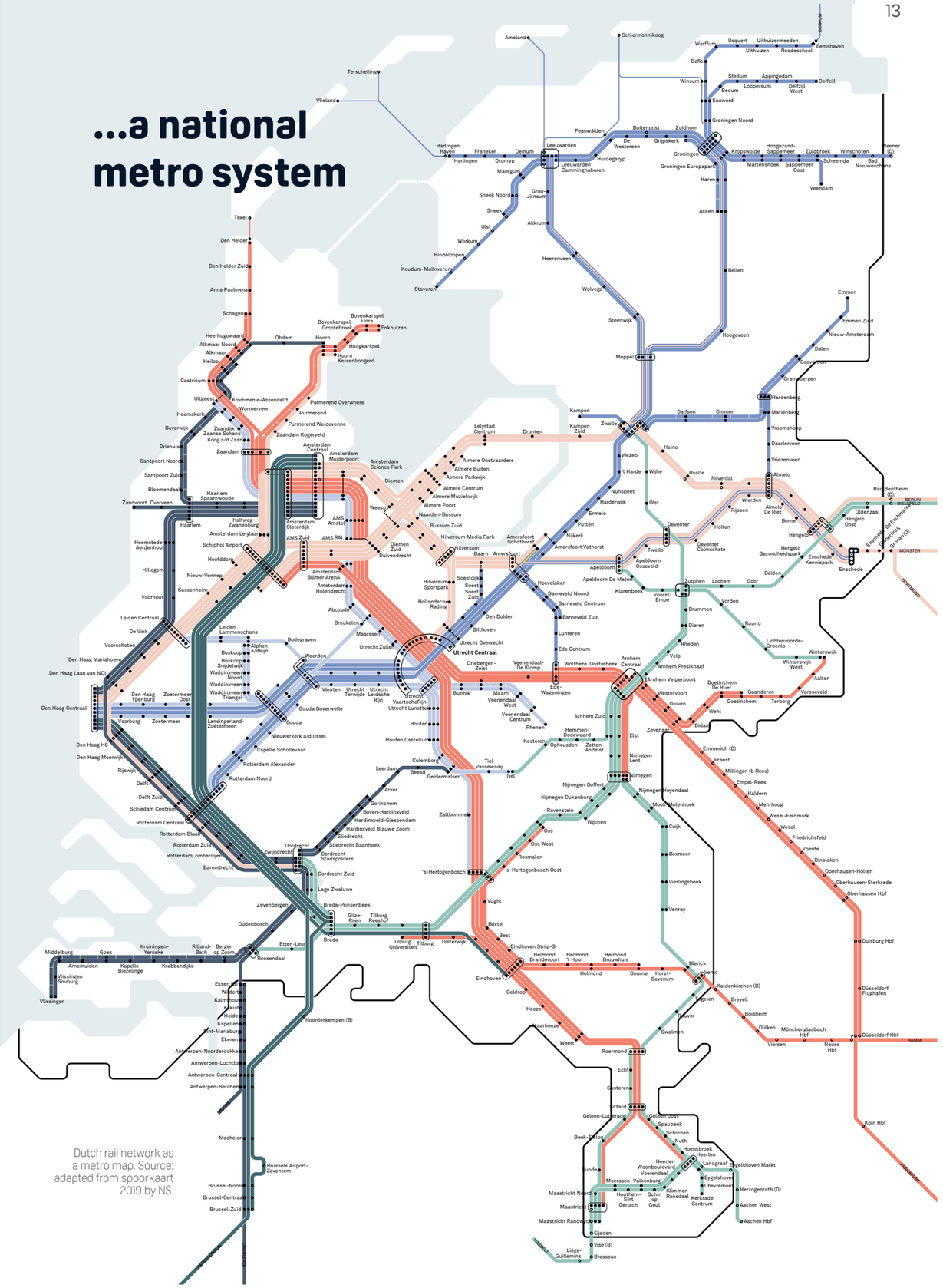
400 stations

3434 km of network



Dutch rail network withNS stations. Source: own work based on data of PDOK.

...a national metro system

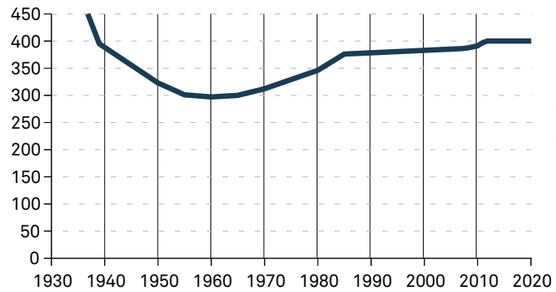

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Ameland
Terschelling
Vlieland
Texel
Den Helder
Den Helder Zuid
Anna Paulowna
Schagen
Heerhugowaard
Alkmaar Noord
Alkmaar
Heiloo
Castricum
Uitgeest
Heemskerk
Beverwijk
Driehuis
Santpoort Noord
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Haarlem Spaarnwoude
Zaandijk Zaanse Schans
Koog a/d Zaan
Zaandam
Krommenie-Assendelft
Wormerveer
Purmerend
Purmerend Overwhere
Purmerend Weidevenne
Zaandam Kogerveld
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Bovenkarspel Grootebroek
Bovenkarspel Flora
Enkhuizen
Hoogkarspel
Hoorn Kersenboogerd
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Amsterdam Science Park
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Duivendrecht
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AMS Zuid
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De Vink
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Geldermalsen
Leerdam
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Hardinveld-Giessendam
Hardinveld Blauwe Zoom
Sliedrecht
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Dordrecht
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Dordrecht Stadspolders
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Lage Zwaluwe
Breda-Prinsenbeek
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Oberhausen-Holten
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Franeker
Deinum
Leeuwarden
Leeuwarden Camminghaburen
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De Westereen
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Hoogezand-Sappemeer
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Houten Castellum
Culemborg
Tiel
Tiel Passewaaij
Beesd
Geldermalsen
Leerdam
Arkel
Gorinchem
Zaltbommel
Boven-Hardinveld
Hardinveld-Giessendam
Hardinveld Blauwe Zoom
Sliedrecht
Sliedrecht Baanhoek
Dordrecht
Zwijndrecht
Dordrecht Stadspolders
Dordrecht Zuid
Lage Zwaluwe
Breda-Prinsenbeek
Zevenbergen
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Middelburg
Goes
Arnemuiden
Vlissingen Souburg
Vlissingen
Kruiningen-Yerseke
Kapelle-Biezelinge
Rilland-Bath
Bergen op Zoom
Krabbendijke
Essen (B)
Wuustwezel
Kalmthout
Putte (B)
Heide-Kalmthout
Kapellen (B)
Wommelgem
Mortsel-Mariaburg
Ekeren
Antwerpen-Noorderdokken
Antwerpen-Luchtbal
Antwerpen-Centraal
Antwerpen-Berchem
Noorderkempen (B)
Mechelen
Brussels Airport-Zaventem
Brussel-Noord
Brussel-Centraal
Brussel-Zuid
Lelystad Centrum
Almere Oostvaarders
Almere Buiten
Almere Parkwijk
Almere Centrum
Almere Muziekwijk
Almere Poort
Naarden-Bussum
Bussum Zuid
Hilversum Media Park
Hilversum
Hilversum Sportpark
Soestdijk
Soest
Soest Zuid
Baarn
Amersfoort
Amersfoort Schothorst
Amersfoort Vathorst
Den Dolder
Bilthoven
Utrecht Overvecht
Utrecht Centraal
Driebergen-Zeist
Veenendaal-De Klomp
Bunnik
Maarn
Veenendaal West
Veenendaal Centrum
Rhenen
Wolfheze
Oosterbeek
Ede-Wageningen
Ede Centrum
Barneveld Zuid
Barneveld Centrum
Barneveld Noord
Hoevelaken
Apeldoorn De Maten
Apeldoorn
Apeldoorn Osseveld
Twello
Arnhem Centraal
Arnhem Velperpoort
Arnhem Presikhaaf
Arnhem Zuid
Hemmen-Dodewaard
Opheusden
Zetten-Andelst
Kesteren
Elst
Westervoort
Duiven
Zevenaar
Didam
Velp
Doetinchem De Huet
Doetinchem
Gaanderen
Terborg
Varsseveld
Nijmegen
Nijmegen Lent
Nijmegen Goffert
Nijmegen Dukenburg
Nijmegen Heyendaal
Ravenstein
Oss
Oss West
Rosmalen
's-Hertogenbosch
's-Hertogenbosch Oost



Source: Adapted from https://nl.wikipedia.org/wiki/Spoorlijnen_in_Nederland

Network operators

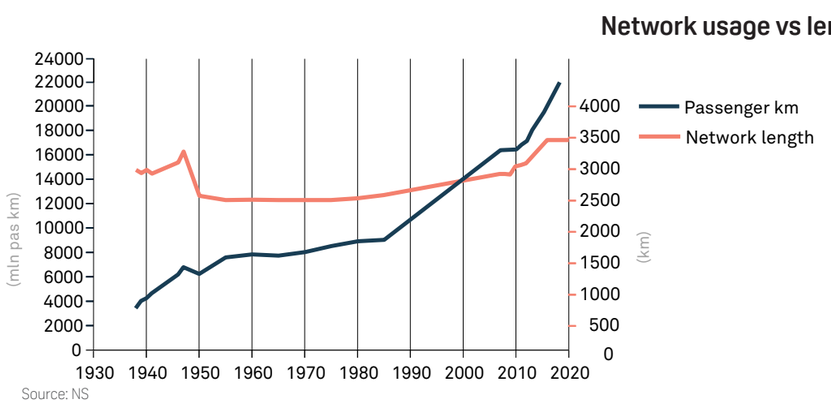
State-owned operator Nederlandse Spoorwegen (NS) has exclusive concession to serve the country's main electrified network. Hence, InterCity trains are only run by NS. Other operators serve regional connections, especially in provinces of Friesland, Groningen, Overijssel, Gelderland and Limburg.



Source: NS

Train stations

The Netherlands managed to keep most of its train stations, since 1960 only increase was noted, which is unique in European context. The reduction was caused by war damage and the end of local steam trams.



Source: NS



Overloaded rail network. Source: https://cdn.nos.nl/ im age/2019/08/16/570508/1920x1080a.jpg

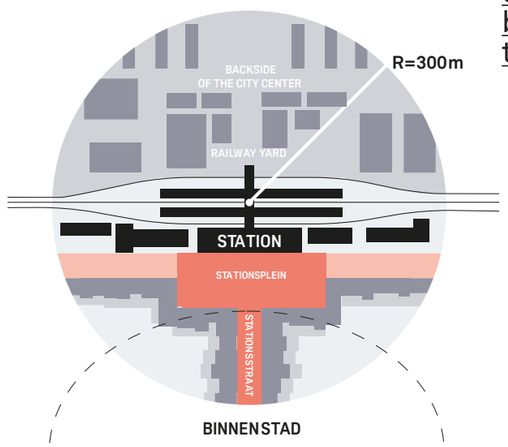
In the Netherlands the railway network has expanded relatively late, due to the strong competition of waterways and unsuitable soil conditions. The Dutch rail networks remains less dense then neighboring Belgium or Ruhrgebied, nevertheless it is the Europe's busiest (ACM, 2018).

This pressure on infrastructure was increasing faster than projected, as, until the pandemic of 2020, the number of passengers grew sharply. Hence, corona-crisis hampered the growth that could not have been accommodated. According to ProRail, as early as 2025 the network could be overloaded, if the pace of the growth continues.

It must be emphasized that the case of Dutch rail network is quite unique in Europe. It did not shrink, even in the years 1960 and 70s., when car-oriented development overshadowed the rail. Only Switzerland could be compared.

During rush hours, trains are departing every two-three minutes from major stations, a frequency similarly to a metro station. Across the years the network was not expanded considerably, why its usage is experiencing steady, recently sharper growth. This results in competition between freight and passenger trains, usually at the expense of freight, being redirected or delayed.

Thanks to compact size of the country, Intercity connections play an important role in daily commute in the national scale. Passenger modal share for rail in the Netherlands in 2016 with over 11% was the 5th highest in the world. (Eurostat, 2016).



A spatial configuration of a typical Dutch station area, before TSAD project. Source: own work.

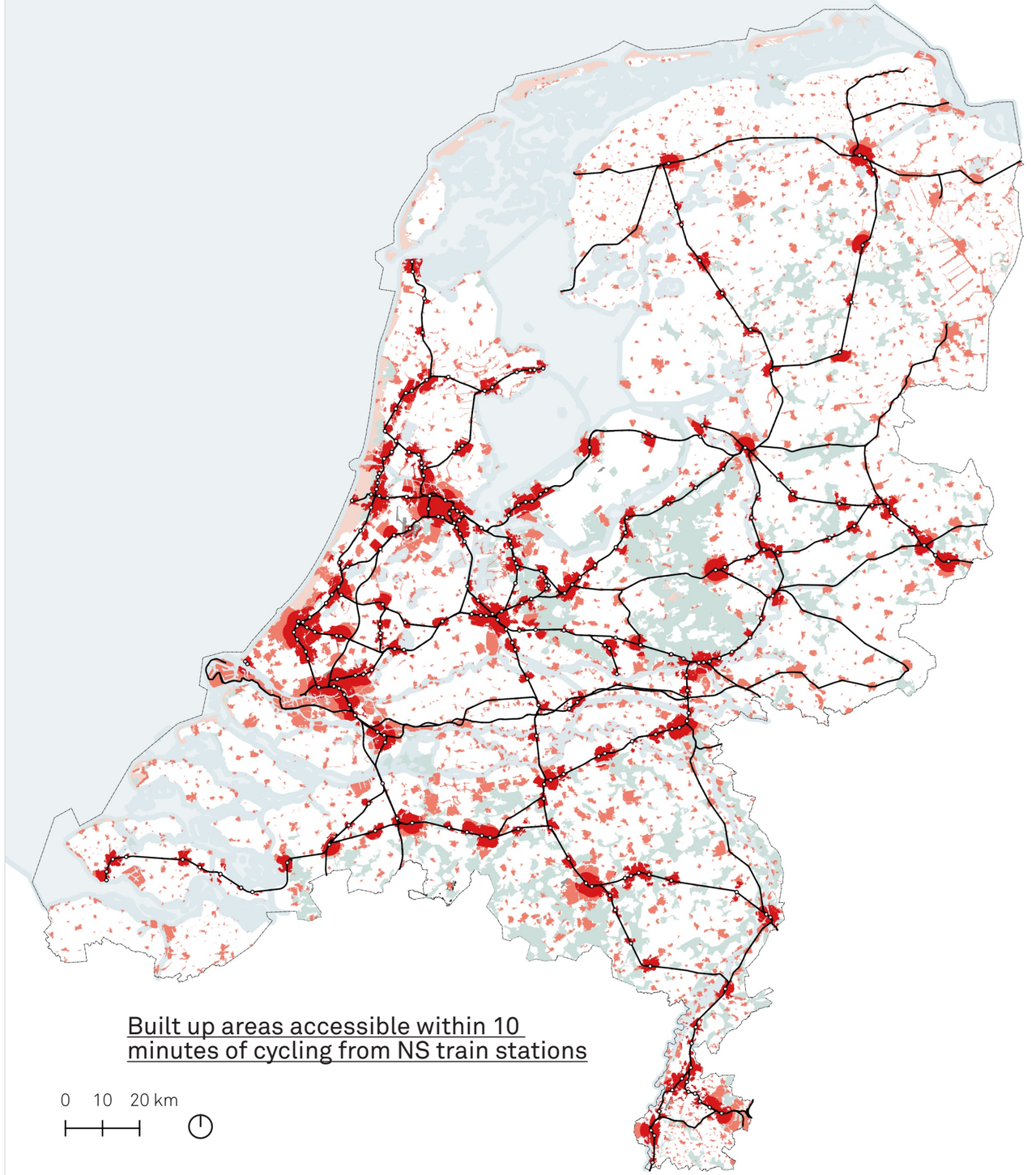
The advent of railway in the 19th century resulted in both unprecedented pace of urban formation, and creation of disparities in urban fabric. Most of European cities have “the bad” and “the good” side of the tracks.

Urban fabric

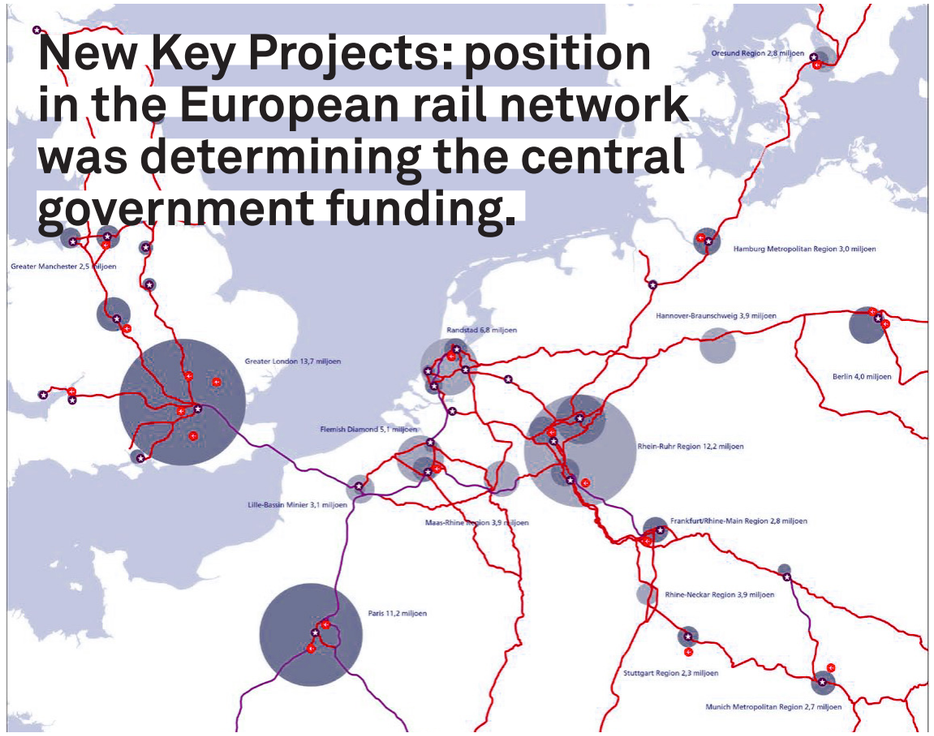
In the center of interest of this thesis is train station area: a spatial configuration that includes the train station, and directly related urban fabric, public spaces, situated within the radius of 300 meters from the middle of the train station. In the European context such areas are often considered as the gateways to the city, often located on the edge of historical core.

Train station areas are the among the most dynamic parts of European cities. Complex master plans are tested against property market, changing lifestyle, trends or mobility networks. As a result, after a long development process they turn out to be obsolete soon after completion.

The rail reneissance has brought back the importance of train stations in formation of urban fabric. The relationship between rail and the city entered the new stage, which continues until this day. Train stations became a catalysts of neoliberal restructuring (Bixel, 2014). Former industrial land uses and rail yards were on a large scale turned into commercial properties. The case study by Bertolini & Spit (1998), highlighted, that this first generation of redevelopment projects was clearly profit-oriented. As Bixel (2014) argues, since the 1990s. not much has changed, and contemporary development of large stations is overwhelmingly driven by the logics of neoliberalization. Sustainability rhetorics is used only to create place-based competitive advantages so as to attract business and capital by enhancing network connectivity and revalorizing urban space. (Bixel, 2014)



Built up areas accessible within 10 minutes of cycling from NS train stations

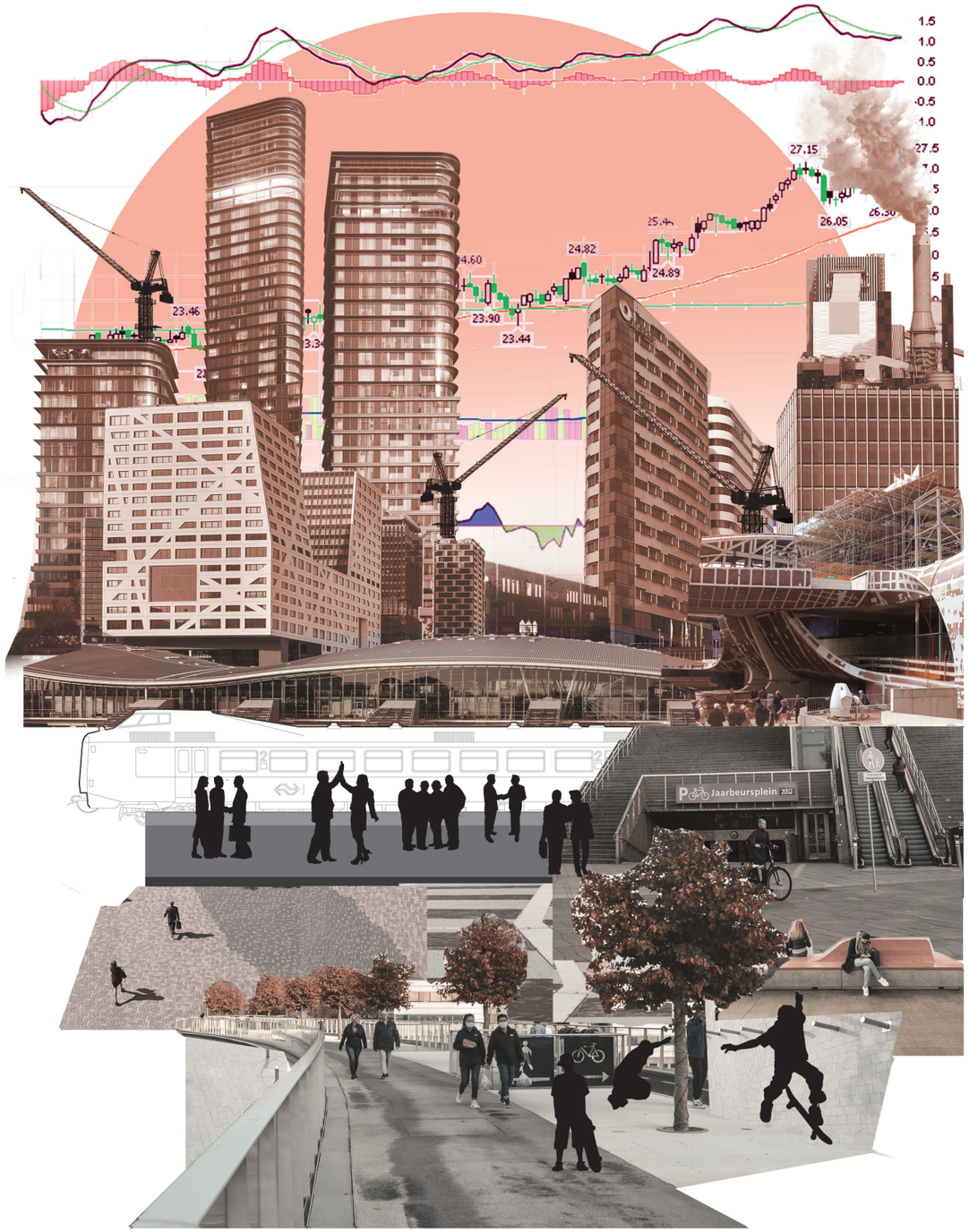


Netherlands in the European railway network. Source: Must Stedebouw, 2015

Large train stations are evolving into a high-density urban configurations, in which the border between train station and the city becomes blurred. The growing number of passengers and importance of nodes often results in increasing the realationship with urban fabric. Hence, it is not relevant anymore to approach train stations as stand-alone objects.

The national strategy to redevelop crucial railway nodes into strong urban places was framed as New Key Projects (Nieuwe Sleutelprojecten). It was initiated in 1997 as a response to long-awaited introduction of high-speed rail to the Netherlands. The six benchmark projects (Arnhem CS, Breda, Rotterdam CS, Den Haag CS, Amsterdam Zuid, Utrecht CS) partially accomplished in 2016 has set the bar for development in other large Dutch cities. The following features of the neoliberal model can be often observed on their example:

- Capitalizing on the new international connection is the priority, development attracting external capital and new users.
- Development of premium offices and apartments for sale to balance the costs of infrastructure.
- Railway company acting as an active player on the real estate market.
- Sustainability used as a PR tactics to boost sales. Public spaces focusing on premium appeal rather than climate adaptation and inclusivity.
- Municipalities competing in developing their station areas and attracting foreign investors.
- Maximizing commercial volume at the expense of public spaces.
- Energy transition framed as improving energy efficiency and reducing maintenance costs.



Large stations: fossil-powered hubs of capital allocation?

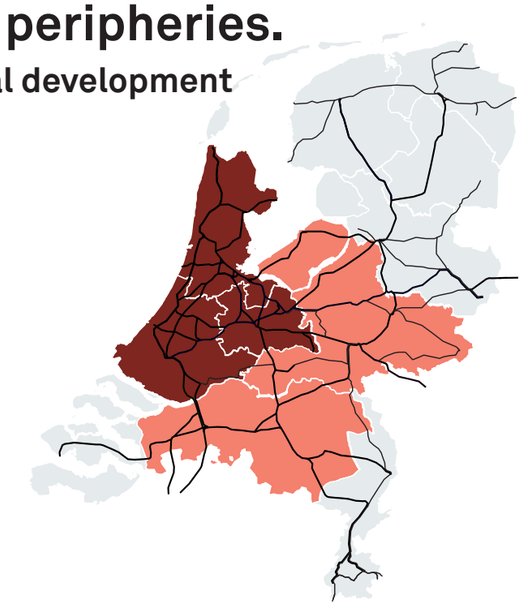


Small stations: missing sustainability transition through stagnation?

The question of peripheries.

Perspective on regional development from the Hague:

1/Randstad
2/ Intermediary zone
3/Peripheral zone



The most important side-effect of high-speed rail and profit-oriented station development is stagnation or marginalization of smaller stations. Only stations with the best location in the network and the strongest urban economic base could benefit from the neoliberalization. As observed by Milikowski (2020), since three decades the regional disparities within the compact country are alarmingly growing , and developmnent of rail focused on Randstad and international connections is not contributing to this.

In the Netherlands, due to strong position of state, it was possible to avoid the complete decay of small stations. They were usually properly maintained, but many has not seen any major renovations since the 1980s. While the advisory board of Dutch railways, Bureau Spoorbouwmeester was busy promoting the metropolitan model of growth, and New Key Projects, it had nothing to offer to smaller municipalities, which were left on their own.

As a result, smaller cities were often pushed to a default car-oriented trajectory of development, focused on business and logistic parks and suburban housing, while station areas mostly kept their historical layout, some of them remained surrounded by rail yards and industry. The most common changes in station areas involved expanding the bicycle storage.

However, in the context of prognosed population growth, also in the regions outside of Randstad, the Netherlands cannot afford on wasting the potential of sustainable urban development around smaller stations.

There is no coherent strategy that would address and balance the needs of small and large stations, their development usualy depends on vision of municipality. Even if there is a vision, there is no governmental funding, because of the focus on New Key Projects and high-speed rail. As a result, travel time from Rotterdam to Paris by Thalys high-speed train (450 km in 2h 30 min) is the same as travel time by NS Intercity to Enschede (195 km).



Source: https://www.erasmusmagazine.nl/specials/woningnood/

Deregulation of the housing market in the 1990s. and withdrawal of the central government instead of solving the problem, resulted in severe housing shortage.

Housing ~~market~~ crisis

Source: https://www.trouw.nl/economie/zo-kwam-nederland-aan-een-tekort-van-331-000-woningen~b04d8d53/

Thanks to the policy of densification iinstead suburban expansion, train station areas are about to become one of the main areas of construction of new housing stock. The new generation of station area redevelopment projects in the Netherlands will mostly focus on densification.

The population growth in the Netherlands of the last two decades has exceeded the flawed forecasts based on great uncertainties, like migration flows. Now it is expected that the country will reach the population of 19 million inhabitants in 2039 (CBS, 2019).

The housing shortage was a steadily growing problem, neglected for years by the national governments preferring market-oriented policy. This negligence has reached its climax in 2010, when the Ministry of Housing, Spatial Planning and the Environment (VROM) was dissolved. All disciplines where spread around other ministries, beside housing, which gradually was left to the market.

A major step in the process of dimanstling the successful social housing system was law of 1995, making housing corporations to act as competitive companies. In effect, they no more built “countercyclical” to balance the times of crisis on the commercial housing market, but also started to strive for profit, as they could no longer count on sufficient public support.

Corona crisis increases uncertainty among consumers and slow down the issue of building permits, which have negative effect on the housing market.

Station areas often have similar structure of

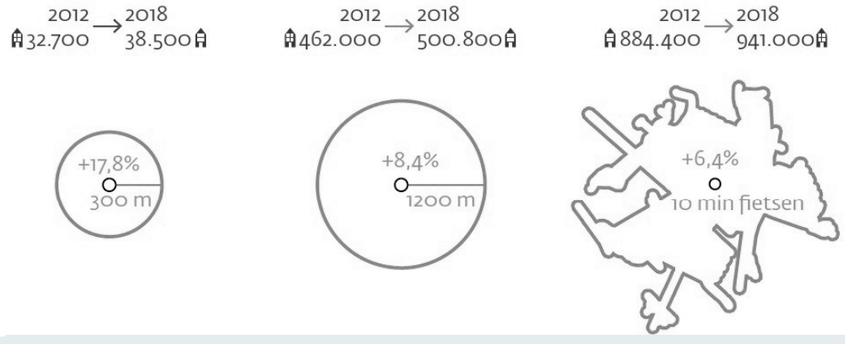
Out of balance

Since 1995 housing prices are growing much faster than the average income.



The change of house prices and average income in the years 1975-2020. Source: Raboresearch

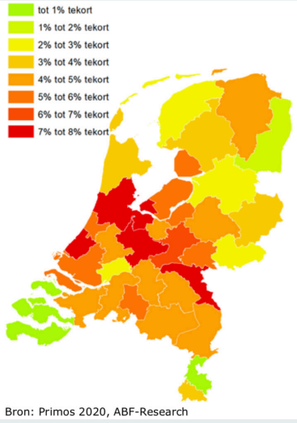
Densification around train stations in Noord-Holland 2012-2018.



Densification around train stations in the province of Noord-Holland 2012-2018. Source: Noord Holland, 2018

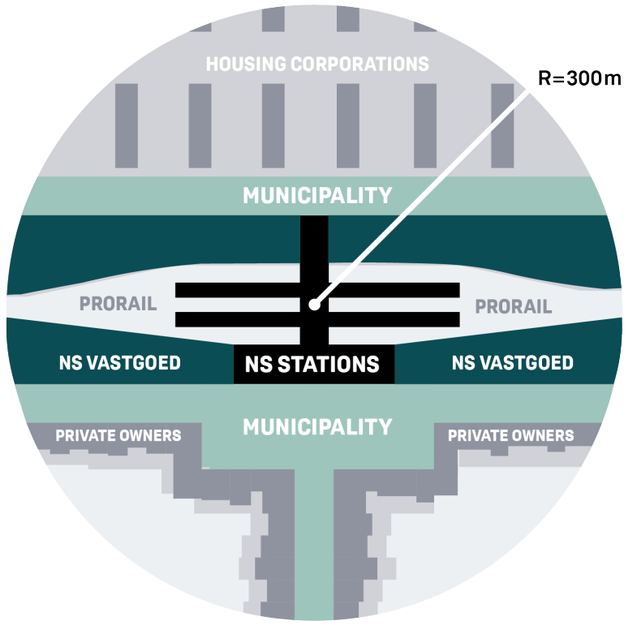
The crisis is wide-spread

Housing shortage is not the problem of Randstad only: in the forecast for 2025 there are only two peripheral subregions, with the suprlus of homes.



Bron: Primos 2020, ABF-Research

Housing shortage in the Netherlands prognosed for 2025. Source: Promos 2020, ABF-Research



Typical ownership structure in Dutch train station areas before redevelopment project. Source: own work based on kadaster.nl.

ownership. All train stations in the country are owned and managed by NS Stations, a subsidiary of state-owned NS. Tracks, energy supply and all rail-related infrastructure in the country is owned and managed by ProRail, also owned by the state. The strip of land next to tracks area, former rail yards or buildings not serving passengers are owned by NS Vastgoed, NS subsidiary created in 1993, following other European countries, in order to capitalize on the rail property (Bertolini & Spit, 1998).

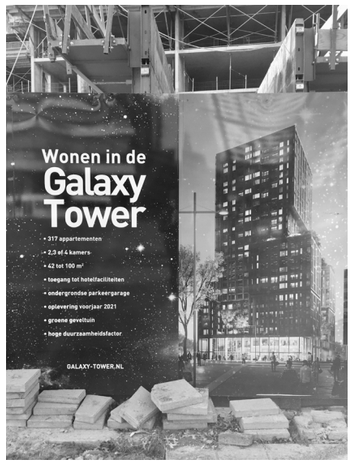
At the end comes the municipality, which usually owns neighboring squares, streets and bus stations. On the one side of tracks, they are often postwar social housing estates owned by housing corporations. Although it is not the case in the large cities with central station, such generalization works in the case of smaller cities with traditional station layout. The cooperation between these public actors is usually smooth, as they share similar ambitions and goals.

Thanks to active land policy, municipalities are actively acquring land to redevelop strategic locations. Plots prepared for the strategic area development are sold to developers, following the masterplan and vision.

Municipalities claim that instruments that they have are insufficient, and the national coordination of the housing policy is necessary to effectively tacle the crisis. (NOS, 2021). To prevent the expensive housing in well-connected train station areas, where land is scarce, Amsterdam has adopted a strict rent policy in 2018. From then, new rental apartments should include at least 40% social rent, 40% of medium rent and maximum 20% of free sector. The maximum height of social rent as of 2021 is € 752. Medium-priced rental homes should fall within the range of € 752-1042. More expensive rent is classified as free sector.

Source: https://nos.nl/artikel/2363993-grote-steden-missen-landelijke-hulp-bij-aanpakken-excessen-woningmarkt.html





Ad of a premium housing project next to Utrecht Centraal. Source: own picture.



330 000 **estimated housing shortage in 2020**

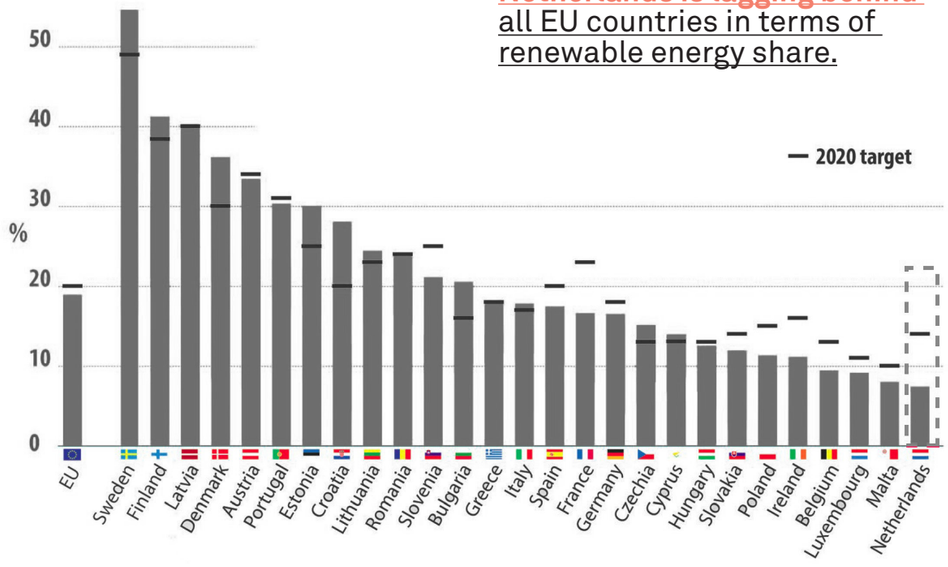
Source: PRIMOS 2020

Impression of a new housing project in Amsterdam Sloterdijk. Source: https://bit.ly/3i793Nv



Temporary student housing in Eindhoven. Source: https://bit.ly/3i793Nv

Students living next to the station Arnhem Centraal . Source: https://www.ad.nl/arnhem/wonen-naast-het-spoor-als-er-goederen-treinen-voorbijkomen-trilt-het-hele-huis~a13e09d7/



Renewable energy shares and goals for 2020 in the EU. Source: Eurostat 2018

Due to dependency on its own natural gas since the 60s., the **Netherlands is lagging behind** all EU countries in terms of renewable energy share.

Energy transition

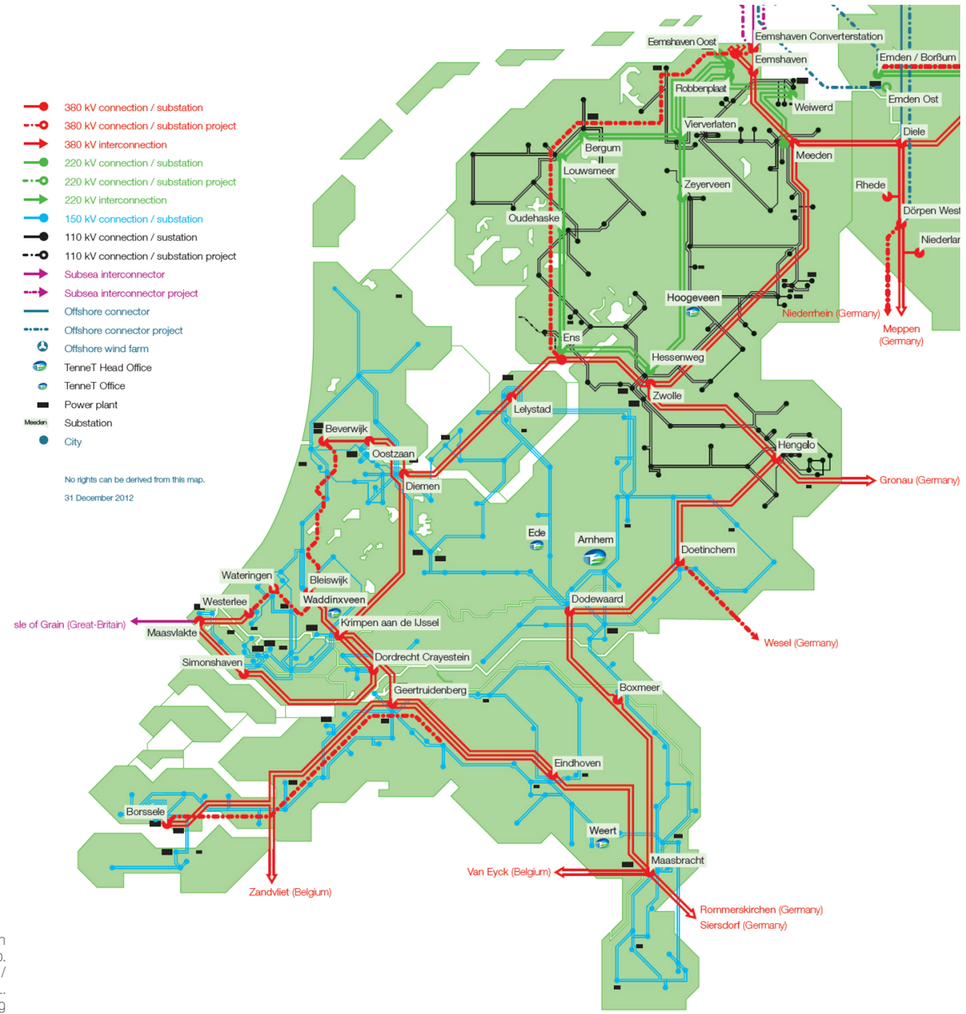
The humanity is facing a climate crisis, accelerating much faster than most scientists estimated. The climate change is caused by human activity, and to mitigate it, a radical makeover of the global energy system is necessary.

Within this global ambition, the Netherlands has its fair share. Since 2016, the country is commited to Paris Climate Agreement - the first legally binding international treaty on climate change. In addition to the UN goals, The Netherlands is also committed within the European Union, it was actively lobbying for more ambitious goal of 55% reduction of greenhouse gas emissions compared to 1990 levels, instead of 40%. The National Climate Agreement (Nationaal Klimaatakkoord) was concluded only in 2019 and included consultation of climate goals within the main sectors of the economy.

Nationaal Klimaatakkoord. Source:https://www.klimaatakkoord.nl/klimaatakkoord/documenten/publicaties/2019/06/28/klimaatakkoord

The urgency of the transition is especially high, because during the last decade the problem was fiercely neglected. The last four years after the Paris Agreement has brought the topic of energy transition into the discipline of urbanism. A number of reports was published, mapping the energy potentials and speculating about the spatial dimension of transition, however the government did not manage to realize the ambitions, and most of the studies remained theoretical. As a result, the Netherlands is lagging behind all EU members in terms of renewable energy share and failed to meet the goal for 2020.

When following the official reports, it is easy to get the impression, that Dutch railways



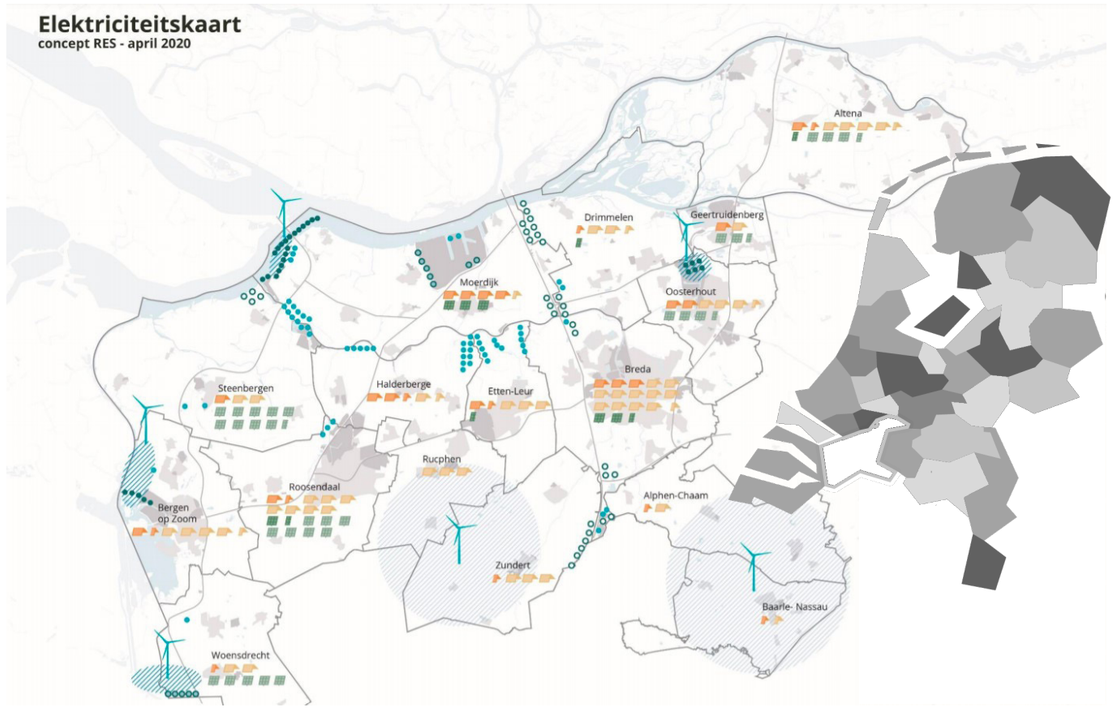
Main electricity network in NL. Source: http://eduweb.eeni.tbm.tudelft.nl/TB141E/imgs/TenneT-kaart-NL.png



Network



Nodes



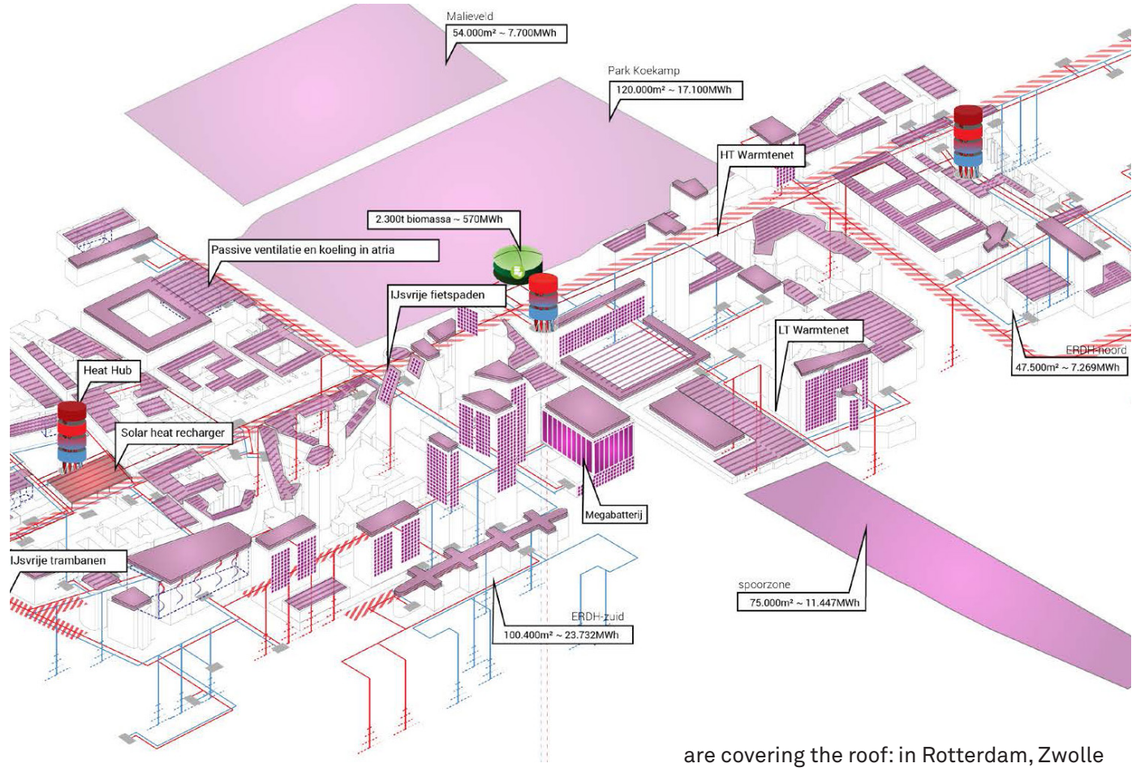
RES West Brabant. Source: https://resinbeeld.nl/

are the most sustainable mean of transport in the country and transition was already completed. NS boasts that 100% of its electric trains is run on wind energy, on the other hand, Prorail, state-owned company that owns the network, maintains the rail infrastructure and constructs new stations, aims to become CO2 neutral by 2030. Although, I argue that railways should not be considered as a green island in the fossil economy, but as a catalyst, responsible for the transition in the urban context. This role calls for new spatial solutions for the future train stations.

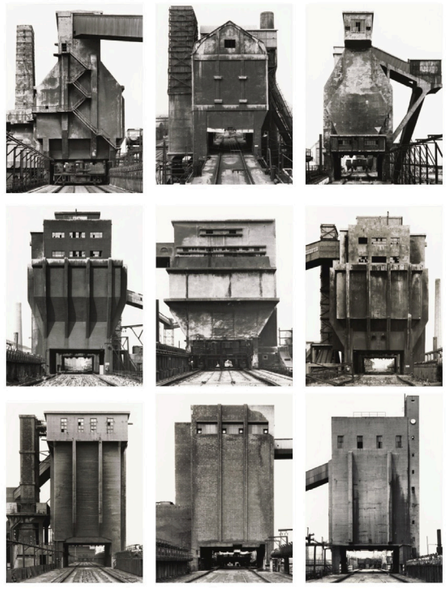
The most important result of Klimaatakkoord was introduction of regional energy strategies (RES). New policies groups of municipalities smaller than provinces that will support and control each other in the transition. The national goals where split between RES regions, and within the regions, after negotiations, into municipalities. publish it in April 2020. They can count on the support from the national program of RES.

In April 2020 regions presented their draft concepts for transition. It must be noted, however, that concept strategies are not coherent in terms of structure and content, and some regions lack sufficient mapping. For instance the strategy for RES West Brabant is an extensive, ambitious document with detailed mapping of possible infrastructure, while such for neighboring RES Hart van Brabant is sketchy and conceptual. Eventually, putting all puzzles of energy regions together does not result in a coherent national strategy. RES are still on the abstract level of regional distribution of renewable energy, thinking in terms of existing land uses and integration with development plans will be the next step.

Most of the redevelopment projects of Dutch train stations considered only improving energy efficiency. Renewable energy generation is only on few stations, where PV panels



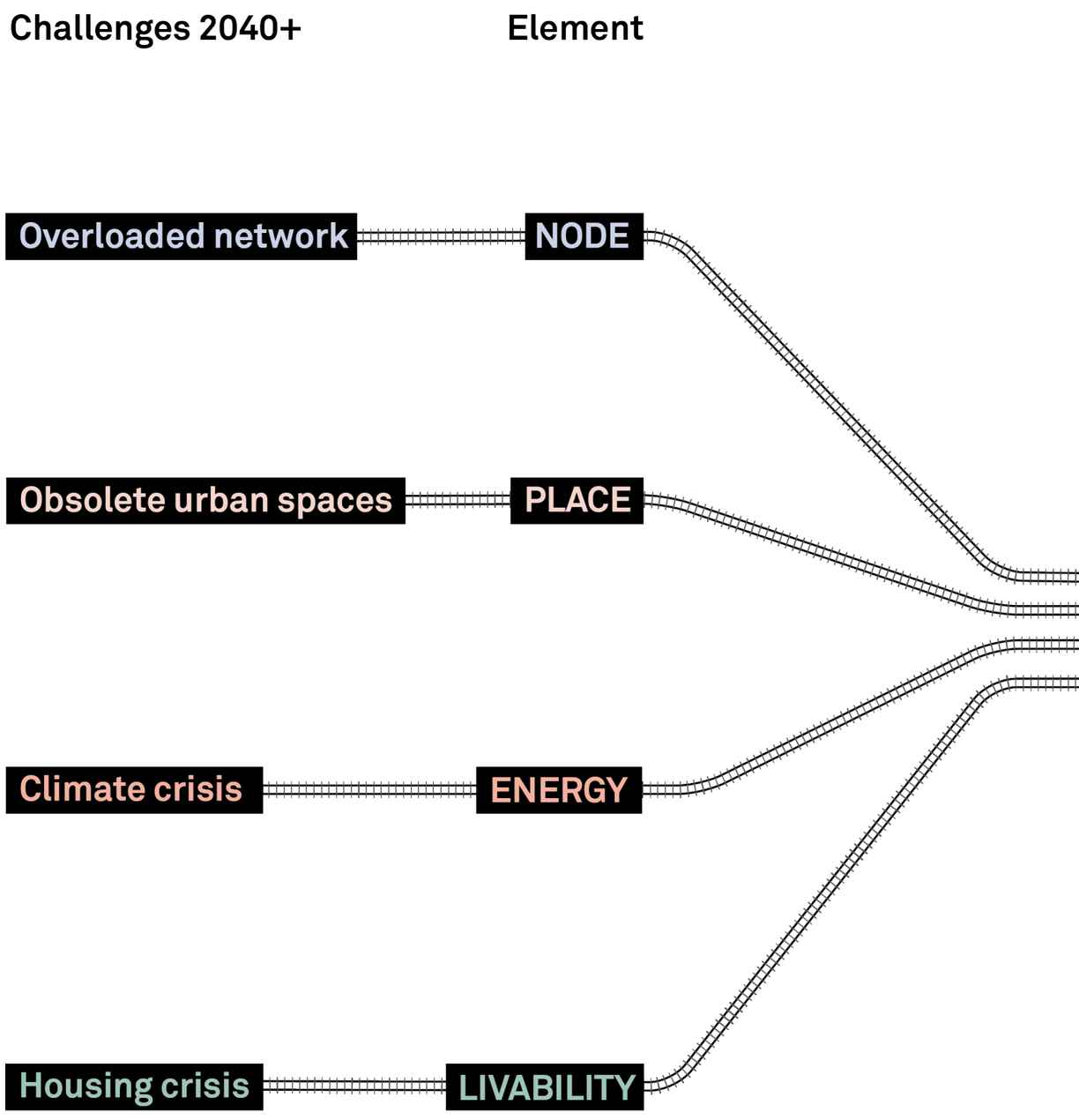
Center of the Hague seen through the lens of decentralized energy system. Source: Deltagrid 2050



Bernd and Hilla Becher, Typologies (coaling towers). Source: https://www.tate.org.uk/art/images/work/T/T01/T01923_9.jpg

are covering the roof: in Rotterdam, Zwolle and Eindhoven. Delft Campus will be an example of the first energy-neutral station and may be followed to other small stations. In 2020 in total, stations generated over 2000 GWh of electricity. It is not a lot, in comparison, the annual energy usage of station in Eindhoven is 775 GWh (comparable to 220 households). Deltagrid 2050 (Studio Marco Vermeulen, 2019) was the first document to explore the spatial scenarios for decentralized energy system. On the example of Den Haag Centraal we can see that stations may become nodes also for energy network with new elements such as multi-commodity hub, waste transformer or energy storage.

In history, energy-related typologies shaped the identity of railways. Coaling towers or water towers were essential infrastructure for steam locomotives. The energy transition may also revolutionize the spatial dimension of train stations we know.



Problem statement

1. The challenges of the future call for integrated approach, in which train station, transfer hub, public space and directly related urban fabric is considered as one urban configuration - a train station area.

2. The dominant model of station area development in the Netherlands is based on neoliberal principles of the 1990s., fails to address social urgencies, and is not resilient enough to provide future-proof densification.

3. In the neoliberal model small stations were stagnating, unable to respond to sustainability transition. Large stations in turn, are challenged by the transformation of unsustainable spaces.

4. TSAD projects in the Netherlands should go beyond the place-node dimension, and address the urgency of energy transition and housing crisis as equal elements shaping train stations of the future.

02 Methodology

- Research questions
- Research aims
- Conceptual framework
- Methods & rationale



Construction of station in Utrecht. Source: https://retours.eu/en/35-dutch-railway-poster-1930s/

A selection of research methods for three phases: inductive (literature review), deductive (case studies), and design iterations (testing scenarios and generation of strategic framework).

INTRODUCTION

This chapter explains the process and approach to the research. The key part is introduction of conceptual framework, which conceptualizes the whole research project, followed by description of applied methods, and rationale behind the their selection.

The previous chapter of literature review highlighted the existing body of knowledge in the emerging study field of train station area development (TSAD). Discussed authors used methods which are also relevant in this research project. However, these methods need to be adapted to fit the study oriented on densification and energy transition in train station areas.

The literature can be divided into two groups according to dominant research methods. In the first, the authors rely on case studies, often arguing that TSAD is very contextual and cannot be easily compared (Bertolini & Spit, 1998; Peters & Novy, 2012; Van Acker & Trigianese, 2020; Bruinsma et al., 2008) . This results in prevalence of qualitative studies. However this is mainly caused by the fact mentioned authors are dealing with international cases. The only common element is connection with European high-speed rail network.

The second group deals with cases set in one national context (Conceição, 2015; Spek, 2001; Reusser et al., 2008). Here more quantitative and comparative methods are prevalent. Authors developed mapping methods allowing to compare different stations as transfer hubs or subjects of urban design, but als used place-node theory by Bertolini (1996) to create an assesment framework that could be applied to all stations in the network from regional perspective.

This research project focuses on the national perspective of Dutch rail network and development model of station areas within a one, country-specific typology. Hence, the research project will elaborate on the methods used by the second group of literature. Nevertheless, qualitative methods will also be present, I would like to highlight its importance when approaching the topic of living environment, spatial form, and relationship between the train station and urban fabric.

PROBLEM STATEMENT

Train station areas in the Netherlands are facing an enormous challenge in the next decade. In Dutch urban landscape they are the only location close to the historical center, still capable of a major transformation. On the one hand, planned densification aims for construction of 1 million homes within the city limits until 2030, station areas being the priority location. On the other hand, the energy transition in dense urban areas is crucial to achieve the goals of Paris Climate

RESEARCH QUESTION

RQ

How can train station areas development in the Netherlands allow adaptable and equitable densification, and catalyze energy transition?

SUBQUESTIONS

SQ1 How do we define TSAD and what does it tell us about the contemporary relationship between the train station and the city?

SQ2 What is neoliberalization and how does it influence TSAD in the Netherlands?

SQ3 What are the spatial implications of energy transition for train stations?

SQ4 How to achieve dense and equitable living environment in station areas?

SQ5 How to plan and design adaptable train stations of the future?

SQ6 How TSAD can contribute to energy transition?

RESEARCH AIMS

To understand the shortfalls of the current model and propose the pattern language for train station areas addressing densification and energy transition.

Research by design

To implement the pattern language in the context of a large and small station, and achieve adaptable train station, integrated with dense living environment and renewable energy system.

train stations x urban fabric

sustainability catalyst

housing crisis + climate crisis

Agreement.

However, the development of station areas is usually profit-oriented, and usually results in premium offices, scarce of greenery, and corporate greenwashing instead of solutions for energy transition. Moreover, neoliberal TSAD model worked only for major stations, neglecting the potential of smaller towns, and fostering territorial disparity.

I argue that the dominant model of train station area development in the Netherlands is based on **neoliberal principles** of the 1990s., it **fails to address sustainable transitions** and **cannot provide equitable, future-proof densification**. In this context, corona crisis questioning the oversized office market creates an opportunity for a paradigm shift.

This problem statement is followed by relevant research questions. The main question is supported by six subquestions, each dealing with one variable derived from the main question. First three subquestions will be investigated in the first, more deductive part of the research. The last three will be covered in more inductive stage, which will bring design results. However all two stages will include research by design as an important method.

Strategic aim is to harness the potential of **train stations as sustainability catalysts**, contributing to the most urgent cases faced by Dutch cities: **housing crisis** and **energy transition.** This will be addressed through integrative approach to station areas, including mobility hubs, public spaces, energy system, and directly related urban fabric.

CONCEPTUAL FRAMEWORK

RQ Research question

How can train station areas development in the Netherlands allow adaptable and equitable densification, and catalyze energy transition?

Subquestions

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SQ2 What is neoliberalization and how does it influence TSAD in the Netherlands?

SQ3 What are spatial implications of energy transition for station areas?

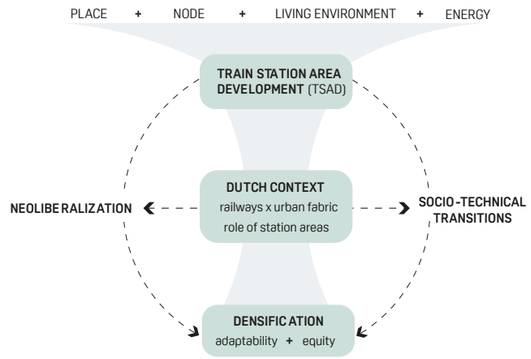
SQ4 How to achieve dense and equitable living environment in station areas?

SQ5 How to plan and design adaptable train stations of the future?

SQ6 How TSAD can contribute to energy transition?

Process

1 Problem analysis



2 Deconstructing cases

Analyzing Intercity stations

Selecting 6 cases out of 61 Intercity stations

Deconstructing sites: place, node, living environment, energy

Evaluation: profit- or sustainability-oriented?

3 Constructing toolbox

Extracting patterns from analyzed cases

Addressing future agendas

Addressing urban context and station class

Design iterations

4 Applying design

Selection of two previopusly analyzed cases: small and large station

Local policy analysis

Applying pattern language to each site

Evaluation

Design iterations

Outcome

Definition of the neoliberal TSAD model

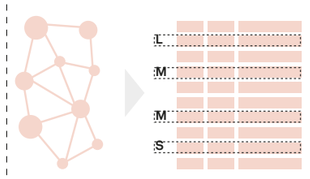
Typology of Dutch station areas

A set of design principles and guidelines:
- quality of public spaces
- energy transition
- adaptable planning and design

A set of selection criteria

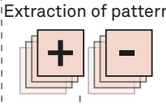
Analysis of the national network

Selection of four cases



Spatial analyses
"Winners" "Loosers"

Evaluation
Extraction of patterns



Pattern language for densification and energy transition in train station areas

Site-specific scenarios

Methods

Literature review
Historical study
Policy analysis
Case study

Data collection
Statistical analysis
Spatial analyses
Fieldwork
Multiscalar mapping
Research by design
Multiple criteria assessment

Research by design
Construction of pattern language
Testing design scenarios

Multiscalar mapping
Research by design
Testing design scenarios
Multiple criteria assessment

Conceptual framework guides through the research process, outcomes of each phase, and methods used to achieve them. It also relates research questions to these three elements.

METHODS & RATIONALE

My research approach constitutes of the four main parts. At the beginning, the literature study will be conducted for the main components of theoretical framework: train station area development (TSAD), neoliberalization of development, socio-technical transitions and densification. Existing models of train station area development will be addressed by a critical survey. In addition, a historical study will highlight the evolution of train stations in the Netherlands and its relation with urban fabric. The selection of literature aims to bring balance between the analysis of universal models and peculiar Dutch context.

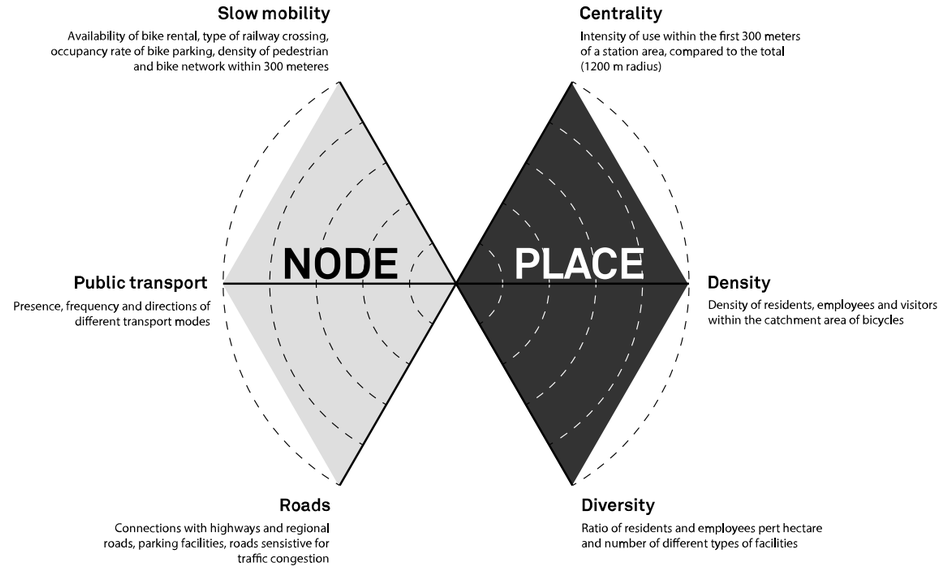
The second part will focus on deconstructing selected cases, and means transition to more inductive part of the research. TSAD projects will be analyzed in the scale of Dutch rail network, which will lead to selection of four stations for case study, divided into two groups. The selecion criteria will be derived from literature review.

The first two cases will represent the “winners” - station areas that attracted capital and succeeded in implementation of TSAD project since the 1985. These are usually stations in cities above 100k inhabitants, supported by central government as part of the key national projects. The other two stations are “loosers” to use neoliberal terms - areas that did not manage to attract external capital and had not a realized TSAD strrategy since the 1985. These areas are usually smaller stations, having less favorable position in the network and often stagnating or shrinking.

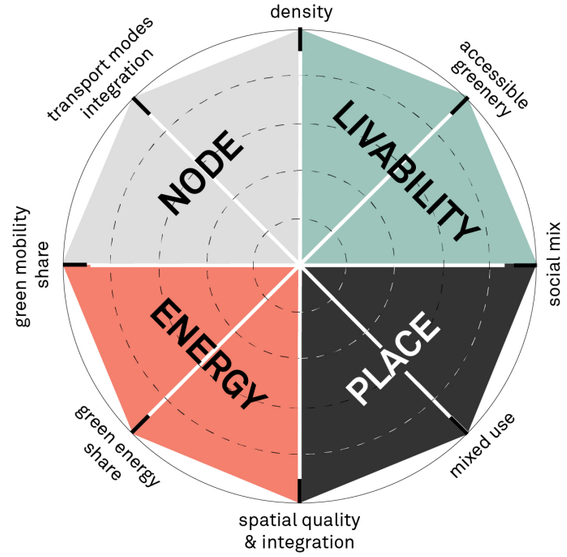
Due to the limitations of the pandemic, fieldwork will be restricted to site visit and photo documentation. Qualitative interviews with users and residents about their perception of station area as living environment are optional. Other qualitative interviews will include experts from design offices Posad-Maxwan and Generation.Energy dealing with station areas and energy transition, planners from selected municipalities developing station areas and advisors from Bureau Spoorbouwmeester.

Some studies in the Dutch context used quantified assessment method taken from literature is the butterfly model (het Vlindermodel) developed by Vereniging Deltametropool (2013) on the basis of Bertolini’s place-node theory (1996). It is a relevant method for assessment of existing stations in a regional scale. It allows to compare stations of different size in terms of place-node balance. More

While transition to sustainable mobility or circularity is often addressed, affordable housing and energy transition is missing in the current TSAD model. To emphasize that, for multi-criteria assessment in my case study, pattern language and design scenarios I will use a reframed “rose model” (see right.)



The butterfly model. Source: based on Vereniging Deltametropool (2013).



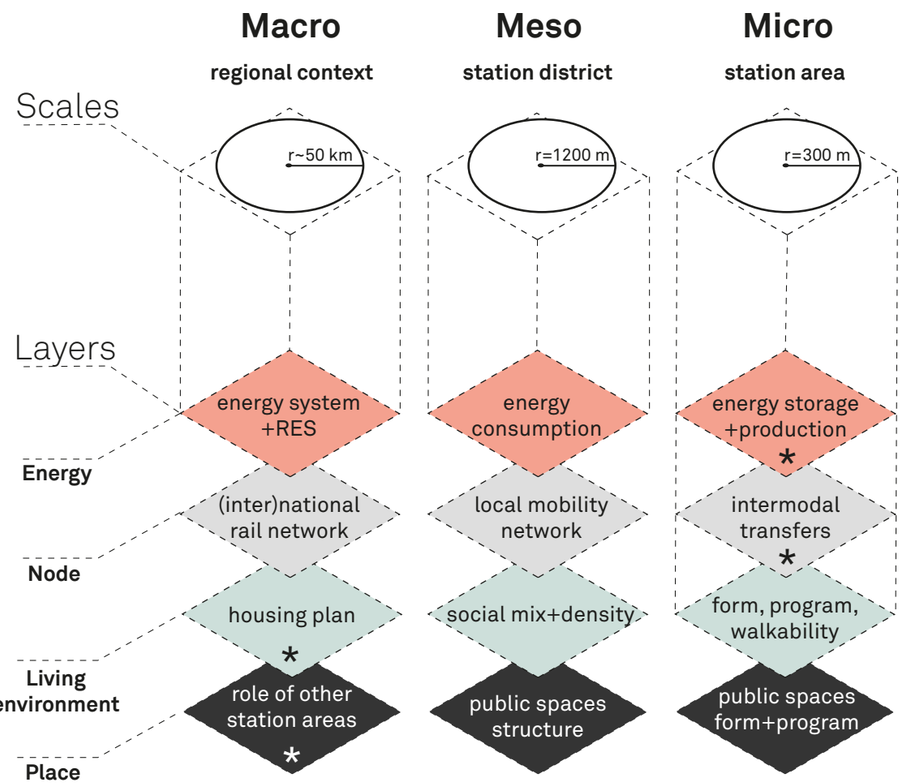
The rose model integrating living and energy aspects in TSAD. Source: own work.

All four dimensions (node, place, livability environment, energy) are interrelated and share assessment criteria. The graph drawn according to criteria will serve as a synthesis and diagnosis of the station area and will be an entry point when applying design to site.

This model, similarly to the butterfly model, gives an idea how balanced, or specialized, a given station area is.

I introduced eight criteria, partly based on the existing model, derived from literature and goals of this project:

- Accessible density: how does assessed pattern/scenario influences density of a



Scales and layers of the research outcomes. Source: own work.

station area that can be reached in 300 m of walking distance?

- Accessible greeenery - how does assessed pattern/scenario influences the amount and qualities of green spaces that can be reached in 300 m of walking distance? Criterium is based on WHO indicator of a green space of at least 1 ha per 300 m radius of urban fabric (28.5 ha).
- Social mix: how does assessed pattern/scenario influences social mix? Is station balancing the contrast between neighbordhoods, or rather is a high-income island?
- Mixed use - how does assessed pattern/scenario change the balance of functions in a station area?
- Spatial quality & integration: what spatial quality assessed pattern/scenarios achieves and how it integrates solutions for energy transition and climate in a design?
- Green energy share - how does assessed pattern/scenario influence the energy mix of a station area?
- Green mobility share - how does assessed pattern/scenario influence the share of zero-emission mobility and logistics?

The question of adaptability and equity of new development is present in multiple criteria, instead of one dedicated criterium. It is necessary to consider it, if development is to be awarded the highest score. The assessment framework is described in detail later in this chapter.

I would like to emphasize the relevance of comparative mapping methods introduced by Spek (2001) and similar work by Conceição (2015). However, for the purpose of this work, I will develop a more suitable mapping method, that will serve more integral approach to station areas. My research spans across three three scales relevant for station areas, derived from the definition by Peek & van Hagen (2001).

Pattern language demonstrated on the example of CoM project. Source: https://citiesofmaking.com/resources/

Macro scale allows to capture the role of the station in region and (inter)national rail network. At the same time it is the best scale to represent the regional distribution of planned densification and existing or planned energy system.

Scale of station district allows to study the relationship between station area and urban context. Here density and network analyses may be conducted. This scale is also relevant to explain the role of the station in the structure of public spaces. Mapping socio-economic profile of station district and its surrounding will allow to tackle the question of equity.

The scale of station area covers the direct surrounding of a train station. It is scale where research by design on urban form and public space will take place, and where technical aspects of energy transition may be mapped. The micro scale includes also the scale of intermodal hub (r=100 m), often covered in literature (Conceição, 2015; Peek & van Hagen, 2001; Spek, 2001), but not being the main focus of my research. Its influence on energy system and living environment is the most relevant.

Data collection is obviously a necessary stage before mapping. Required data covers specified layers and relies mostly on open-access data shared by municipalities and national portals, but also local newspapers, energy network operators and real estate portals.

Multiscalar mapping will be an iterative process of research by design. It will lead to complementary outcomes in each of three scales, as they have different sets of layers corresponding with four elements of the rose model: node, place, energy and living environment. Layers indicated by * will be considered for the two chosen sites, but not on the stage of case studies.

The third part will begin with generating a a pattern language. Described layers distributed among scales will allow to extract patterns from analyzed cases. Pattern language as a method is gaining increasing popularity in urbanism, but according to my literature review, it was not yet applied in the context of train stations. The strength of a pattern language, is that it is a flexible, not definitive framework that allows applying spatial and non-tangible solutions in various contexts, with active participation of stakeholders.

At the fourth, final stage, the developed pattern language will be applied to two selected sites of different characteristics. On the one hand, a large station transitioning from unsustainable profit-oriented model, on the other, a small station, where no TSAD project was yet realized. Here very helpful methods will be mapping and testing design scenarios.

Scenarios developed in design iterations will explore how the station district of the future could look like, if it would be shaped by the ambitions of high-density, affordable housing and renewable, decentralized energy system. Pattern language will be applied in various configurations. At this stage fieldwork will also help to contextualize patterns. Final design for each site will be evaluated by the multiple criteria assessment and the rose model used also in the case study.

The conceptual framework was intended to be the main guide in design process, but in

Design process

Through research by design and observations from practice at PosadMaxwan I reached a conclusion, how the process should look like.

Scheme of a design process Source: own work.

in the course I realized that the complexity of a pattern language and scenarios calls for a conceptualization on its own. I hope this five-step process is transferable to every train station area planning and design assingment. I hope to make use of it in my professional life.

Defining the process is my reaction to lack of systematic approach to train station area redevelopment I experienced in literature and in practice.

Bridging the node is in fact a decision on the connector of the station; its core that allows changes between modes of transport and connects two sides of tracks. Is the existing bridge or tunnel sufficient, should it modified or a new one localized? Here such questions will be explored.

Defining the connector is the main design decision that influences the potential of the station. It requires objective reasoning, that is clear to multiple stakeholders. I would like to specify three tools that may support the decision on bridging the node:

- use of big data (such as Strava Heatmap indicating cycling or running activities),
- Space Syntax analysis, to verify the improvement of connectivity in the network,
- prioritizing connectors of the node according to their calculated value (Spek, 2001).

Applying patterns is in fact a stage of forming the site-specific program, where all stakeholders are involves. This stage is also related to macro scale, with focus on energy and housing goals in the region and municipality.

After that comes contextualizing design, and spatial optimalization, more of an urban design and architectural assingment. The assessment at this stage allows feedback loops. It is an iterative process, patterns and contextual design are adjusted until the assessment shows desirable results.

My research approach aims to fill the niche in the emerging study field of TSAD by the combination of quantitative and qualitative methods. Proposed methods have limitations, as they are partly based on speculation on the future transitions, nevertheless they goal is to generate a coherent set of guidelines for future development of station areas.

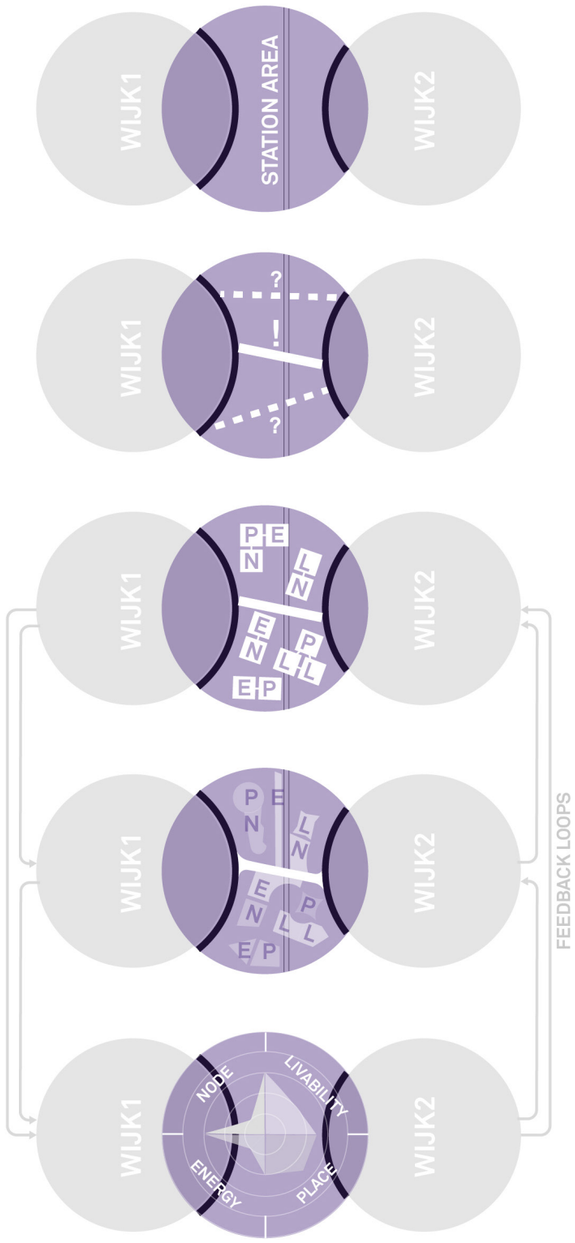
I. Context analysis

II. Bridging the node

III. Applying patterns

IV. Contextual form-finding

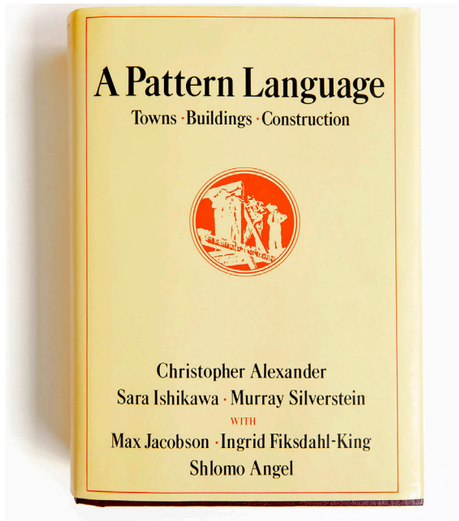
V. Assessment



A pattern language as a design method



Workshop in Zwolle, pattern language of Cities of Making. Source: Birgit Hausleitner



Cover of A Pattern Language. Source: Harvard GSD, https://bit.ly/3v9oNoG

Creation of a pattern language for future-proof station areas is the core of my research by design process. The main reason is to allow transferability within the Dutch rail network, to make the results of this project applicable for small and large stations of all types. This will support my statement that coherent national agenda for development of station areas is necessary, if we want to tackle housing and climate crises.

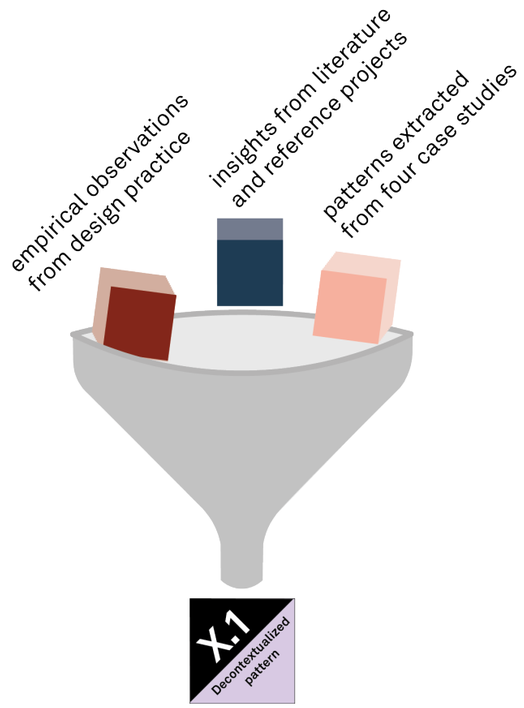
A pattern language is not a catalog imposing standardized designs, but it may be a guide on the level of urban design; how to achieve future-proof configurations of train stations and high-density urban fabric. Contextual architectural design is still necessary to achieve quality and properly address local needs.

The logic of pattern language in urban design originates from the extensive publication by Alexander et al. (1977). The authors derived a catalog of patterns from their research on vernacular, intuitive building methods. Their patterns have different scales (Towns, Buildings, Construction) and are interrelated; some are hindering each other, and some bring better effect when combined. Of course, many of these patterns cannot be treated literally and applied in contemporary high-density urban environments.

A good example of a contemporary pattern language in practice is international research project Cities of Making. A pattern language was used as a main tool translating the research on urban manufacturing into practical guidelines for municipalities and investors dealing with transformation of urban fabric.

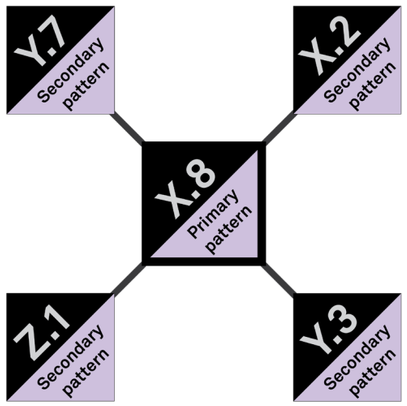
Patterns can also foster communication between stakeholders, and make the negotiations less abstract. As project Cities of Making has shown, such meetings when the program of the site is defined by multiple stakeholders, can be turned into an involving board game and be more productive. In a catalog of 36 patterns, each is tested on-site, followed by assessment. You will find the catalog after the Atlas in this report.

Making patterns



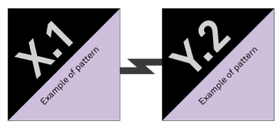
Hierarchy

Selection starts from **primary** patterns, which can be further defined by **secondary** patterns. Primary patterns are more general and overarching, while secondary patterns focus on specific quality or solution.

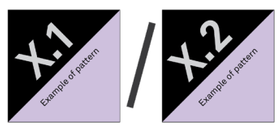


Relationships

- **Tension** creates a design challenge and may require compromises to be solved.



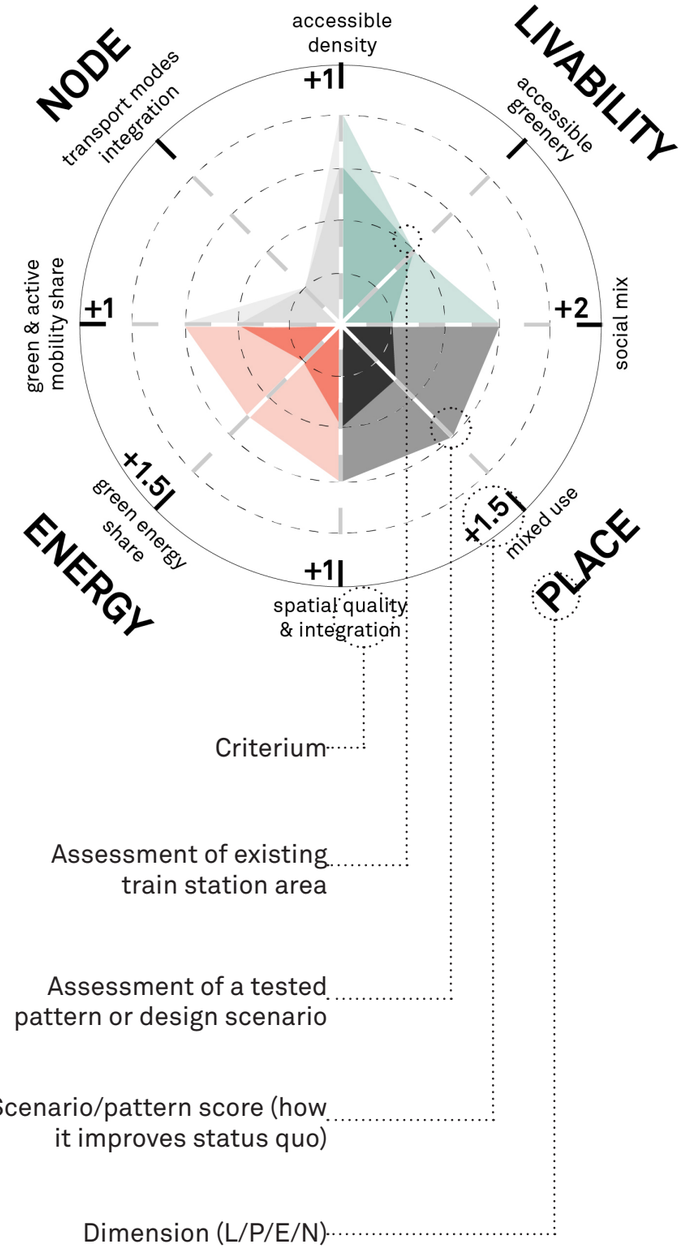
- **Mutually exclusive** patterns hinder each other and should not be applied together. It guides to reject the patterns.



- **Synergy** guides selection and means that a specific combination of patterns can bring better effects than implementing them separately.



Assessment framework



Assessment framework for train station areas. Source: own work.

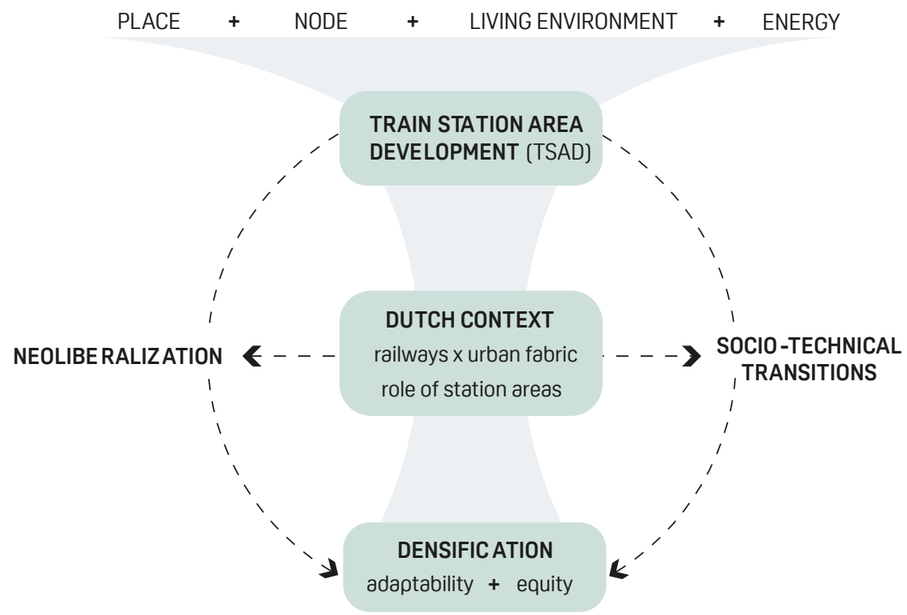
Criterium	Score				
[N/L] Accessible density	[1] Average FSI of new blocks (post 1995) reachable in 300 m of walking distance from the station =50-80% of blocks within the radius of 1000 m.	[2] Average FSI of new blocks (post 1995) reachable in 300 m of walking distance from the station =80-100% of blocks within the radius of 1000 m.	[3] Average FSI of new blocks (post 1995) reachable in 300 m of walking distance from the station =110-150% of blocks within the radius of 1000 m.	[4] Average FSI of new blocks (post 1995) reachable in 300 m of walking distance from the station =150-200% of blocks within the radius of 1000 m.	[5] Average FSI of new blocks (post 1995) reachable in 300 m of walking distance from the station > 200% of blocks within the radius of 1000 m.
[L] Accessible greenery	[1] No publicly accessible greenery in 300 meters of walking distance from a station, beside lawn as an infrastructure buffer.	[2] In 300 meters of walking distance from a station less than 1 ha of publicly accessible green spaces for leisure. (Surface of rooftop greenery is counted as 1/2).	[3] In 300 meters of walking distance from a station at least 1 ha of green public spaces of different qualities (ie. sport, relax, reception zone).	[4] In 300 meters of walking distance from a station more than 2 ha of high-quality green public spaces designed with biodiversity and neurodiversity in mind.	[5] In 300 meters of walking distance from a station more than 3 ha of green public spaces unique on a city scale, designed with biodiversity and neurodiversity in mind.
[L/P] Social mix	[1] Since 1995 no new housing in station area. Or: 80% of new development is commercial and for sale. New spaces and facilities are exclusively available for new residents or employees.	[2] Share of free-market homes in new development more than 60%. New social spaces and facilities are designed as semi-public and addressed to new residents and employees.	[3] New development in a station area is preserving the existing social mix and providing the neighborhood with facilities, connecting old and new residents. Share of affordable housing above 50%.	[4] New development is balancing social mix of two sides of tracks, and includes housing and facilities for people with special needs (ie. disabled, elderly). Share of affordable housing above 60%.	[5] A station area is intergenerational, inclusive neighborhood with social facilities important on a city scale. Share of affordable housing above 80%.
[P] Mixed use	[1] A station area is a monofunctional neighborhood. Streets are not active and their functions are not guiding towards the station.	[2] One function dominates in a station area, but others are present. Mixed use is present in streets guiding to the station area.	[3] New development is introducing horizontal mixed use: balancing the neighborhood by mixing functions within one urban block.	[4] New development is introducing vertical mixed use: mixing functions within one building.	[5] Balanced and adaptable mixed use neighborhood. New development can adapt to shifting demands. Streets guiding to station are active and have adaptable program.
[P/E] Spatial quality & integration	[1] Low quality, unsustainable spaces with negative influence on the image of the station area. Energy and climate are not addressed at all.	[2] Public space are generic and are keeping the same quality level as the surroundings. Energy and climate are not addressed at all.	[3] Quality public spaces that blends the station area into urban fabric. Single solutions for energy and climate appear, but are not sufficiently visible in the design.	[4] High quality spaces, considered as one of the best in the city, make the station a meeting place. Designed with multiple solutions for energy and climate.	[5] Landmark spaces with unique qualities, attracting users from the whole city and beyond. Solutions for energy and climate are one of the main elements of the design.
[E] Green energy share	[1] Train station and development in the radius of 300 m is not generating green energy.	[2] Train station generated green energy to cover less than 50% of its energy needs. Less than 50% of post-2010 development is energy-neutral.	[3] Train station generated green energy to cover at least 50% of its energy needs. More than 50% of post-2010 development is energy-neutral	[4] Train station is energy neutral and it has visible integrates for the neighborhood. Post-2010 development is fully energy-neutral.	[5] Train station is supplying the neighborhood with green energy, and is recognized as a landmark of energy transition. Post-2010 development is fully energy-neutral.
[E/N] Green & active mobility share	[1] A station area is accessible to private cars, has poor walkability and bike connections. Lack of charging points and share of zero-emission busses below 50%.	[2] Street dedicated to active mobility from one direction. Charging points are accessible at least in one parking garage and bike storage.	[3] Station has good active mobility connection from all sides. Charging points are accessible in every bike storage and parking garage.	[4] Public spaces next to the connector are dedicated to active mobility. Mobility in a station area is fully served by zero-emission vehicles, charged by electricity generated in the station area.	[5] Active mobility is primary in all public spaces of a station area. Mobility and logistics in a station area are fully served by zero-emission vehicles, charged by electricity generated in the station area.
[N] Transport modes integration	[1] More than 150 m of walking distance between modes of transport, unclear layout of the node without hierarchy. Lack of sunlight access and visual connections.	[2] Lack of clear hierarchy in the connector, poor visual connections between modes of transport, and walking distance of 100-150 m.	[3] Node with clear hierarchy and spatial quality of the connector. Less than 100 m of walking distance between modes of transport.	[4] All modes of transport integrated under one roof. Sunlight access, short distances and clear navigation, beyond signage.	[5] All modes of transport are seamlessly integrated, yet change in components of the node (renovation, expansion) does not disrupt functioning of the whole.

03 Theory

- Theoretical framework
- Theory paper on TSAD
- Energy transition
- Densification
- Adaptability



Railway poster, Willy vd Poll, 1932. Source: https://retours.eu/en/35-dutch-railway-poster-1930s/



Theoretical framework.
Source: own work.

THEORETICAL FRAMEWORK

Train station area development

This phrase has been coined in a special issue of Built Environment, which originated from an international symposium, “Rail Station Area Redevelopment Mega-Projects in Europe & Beyond” (Peters and Novy 2012b). The acronym TSAD is distinct from TOD. The debate on train station areas is centered on reneissance of railway in the context of European city, while Transit Oriented Development originates from the U.S., deals mostly with South American and Asian cases and focuses on sustainable settlement patterns next to new rapid transit systems.

Socio-technical transitions

“Socio-technical” refers to the interrelation of social and technological aspects, while ‘transitions’ refers to the dynamics of fundamental change in these relationships. Transitions to sustainability imply behavioural change following technological change. The focus will be on energy transition, as it may have the largest influence on the form and performance of train stations.

Dutch context

Setting of the project in the Netherlands results in peculiar characteristics of planning process and typo-morphology of stations and surround urban fabrics. This context needs to be related to neoliberalization and socio-technical transitions.

Neoliberalization

Neoliberalization is a syndrome of processes and activities, not a single, unified phenomena (Brenner 2010). After explaining the general logics of neoliberalization, it will be expined in the context of Dutch spatial planning system and railway development.

Densification

This aspect covers current policies of increasing density around mobility hubs in the Dutch context, but also more general take on the problem of equity and adaptability.

Train stations: catalysts of sustainability transitions or hubs of capital allocation?

Towards a new model of densification in train station areas in the Netherlands.

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ARU023 Theory of Urbanism
November 25th 2020

Abstract - The importance of train stations in the Netherlands is growing next to the numbers of passengers. Station area development is essential while addressing socio-technical transitions faced by Dutch cities, especially transitions to sustainable energy and mobility. However, by far the biggest challenge faced by station areas is densification. Train station areas are recognised as one of the main sites for the construction of new homes until 2030. Does the current development model allows to reconcile living environment with multimodal hubs? This paper aims to verify the hypothesis, that the dominant model of train station area development in the Netherlands is based on neoliberal principles of the 1990s., fails to address social urgencies, and is not adaptable enough to provide future-proof and equitable densification. The literature review of on train station area development (TSAD) is connected with literature study on neoliberalization. Subsequently, the coevolution of urban fabric and rail in the Dutch context is discussed, followed by case studies of TSAD. Lastly, the future challenge of densification is analyzed, including questions of adaptability and equity. Conclusions allow to verify the hypothesis, proving that the current development model is oriented on commercial development around few favorably located stations, and cannot provide sustainable living environment integrated with stations across the whole rail network. The place-node model established by Luca Bertolini (1996) should be reframed, in order to be used for future TSAD oriented more on living environment.

Keywords - Train stations, train station area development (TSAD), densification, equity, socio-technical transition, neoliberalization

1.Introduction

In contemporary European urban landscape, the Netherlands being no exception, train station area is usually the only location close to the historical center, still capable of a major transformation.

In the Dutch context the past decade has seen the completion of New Key Projects, an ambitious set of train station area development projects supported by the national government. In 2020 the largest stations in the Netherland boast of its airport-like terminals surrounded by central business districts. Meanwhile it is enough to take the train to a mid-size town out of Randstad to get the impression of underused rail yards and train stations unchanged since the 1980s.

Furthermore, there is evident discrepancy between what we imagine as harmonious living environment and the efficient mobility environment of train stations. Planned densification may bring a paradigm shift to development of the train station areas.

I argue that the dominant model of train station area development in the Netherlands is based on neoliberal principles, it fails to address sustainable transitions and cannot provide equitable, future-proof densification. This paper aims to investigate the validity of this statement by analyzing a TSAD model in the Dutch context, the influence of neoliberalization on it and the future challenge of adaptable, equitable densification. Applied methods include literature review, case study, historical study and policy analysis.

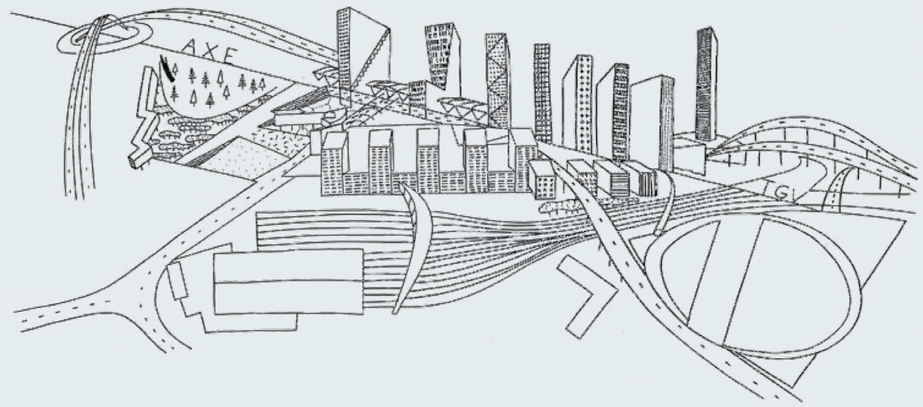


Fig. 1. Euralille conceptual sketch. Source: https://oma.eu/projects/euralille.

The literature review on train station area development theory (TSAD) is followed by a literature study on neoliberalization. Subsequently, the coevolution of urban fabric and rail in the Dutch context is discussed, and supported by case studies of TSAD. Lastly, the future challenge of densification is analyzed, including questions of adaptability and equity.

2. Train station area development – literature review

How can we delimit the area influenced by a train station? I would like to follow the definition by Peek & van Hagen (2001):

- 100 m – transfer area – connections between modes of transport, station building.
- 300 m – station area – differs in terms of morphology from the surrounding urban fabric.
- 500 m – the area of direct influence on the property value.
- 1000 m – station district – urban fabric directly influenced by transformations of the station area.

A major trigger for European rail renaissance was EU policy for trans-European high-speed rail network (Peters & Novy 2012). It resulted in development of new high-speed nodes, like Euralille in Lille, often described as a benchmark project (fig. 1). A master plan by Rem Koolhaas had been commissioned in 1988, even before TSAD became a study field. The project shaped collective imagination of the European train station, but I argue that after almost 30 years, Euralille should not be framed as a good practice for the future TSAD. This profit-oriented case does not adhere to the current socio-economic and environmental agenda in Europe.

Train station area development (TSAD) as a study field emerged after the first wave of rail renaissance, to analyze and reflect upon its outcomes. The acronym “TSAD” was coined only in 2012, in a publication following the international symposium “Rail Station Area Redevelopment Mega-Projects in Europe & Beyond” (Peters & Novy 2012). The authors state that TSAD is distinct from well-established study field of Transit-Oriented Development (TOD), as it deals with European context and central stations related with urban fabric, while TOD focuses on more linear development patterns integrated with new rail projects in modern cities of Americas and Asia.

One of the key authors, who established the theory of train station area development is Bertolini. He is best known as the author of place-node model, an analytical framework consisting of two dimensions: “node” within transport network and “place” within urban fabric (Bertolini, 1996). The model has been applied by numerous authors in different contexts, in academia and in practice. In the Dutch context, I would like to highlight the butterfly model elaborated by Vereniging Deltametropool (2013) (fig. 2), which can be used as quantitative assessment framework.

“Cities on Rails” (Bertolini & Spit, 1998) was one of the first comprehensive publications forming the new field of study. Theoretical part is enhanced by the study of rail development in Europe, and in-depth case studies of six European stations. However, the question of urban design quality is not addressed, the “place” dimension of station areas is mostly framed as a potential for property development.

The study by van der Spek (2002) helps to understand the stations in the scale of transfer area. It introduces six instruments for analyzing connectors (transfer areas). This work fills the niche of missing comparative mapping techniques and quantitative evaluation methods of station areas.

In “From city’s station to station city” Conceição (2015) places centrally the question of a spatial performance, and contributes to architectural and urban design studies of station areas. Similarly to van der Spek, Conceição develops a comparative mapping technique, focusing more on spatial form and performance. However, the case studies are not in-depth and do not contribute much to the field. Author focuses on high-speed rail stations and does not address critically the development process.

A comprehensive historical study by Cavallo (2008), gives broad perspective on coevolution of stations and urban fabric in the Netherlands. It also helps to understand path-dependencies of the current development model.

“Railway development: Impacts on urban dynamics” (Bruinsma et al., 2008) is an important contribution to urban studies of European station districts, however, due to the year of publication, it lacks the post crisis perspective on the topic and it does not consider the need for alternative development model.

The study of mega projects by Peters & Novy (2012) set an ambitious goal of stocktaking of mega TSAD projects in Europe and creating its typology. The available data allowed only for qualitative summary of the findings, contrary to the intention. Out of 500 European train stations studied, in the years 1990-2010 136 of them had TSAD projects worth at least €100 million, including 9 Dutch examples (Peters & Novy, 2012). The authors argue that the success of TSAD relies not solely on local economy and connectivity, but rather synergic adjacencies - so also urban morphology, spatial quality and accessibility (Peters & Novy, 2012).

The most recent contribution to the topic is study of small and medium stations around Dutch-Flemish border by Van Acker & Trigianese (2020). Authors point out that the second wave of rail renaissance is at hand, and it may influence small stations that were excluded from the first wave dealing with high-speed rail.

There are two main tendencies in the analyzed literature. On the one hand, some authors perceive station areas as mere property development locations in the international network of globalizing cities, omitting its societal and urban design qualities. On the other, as also observed by Gert-Joost & Louw (2008), many studies on this subject are content-based and give little attention to the development process.

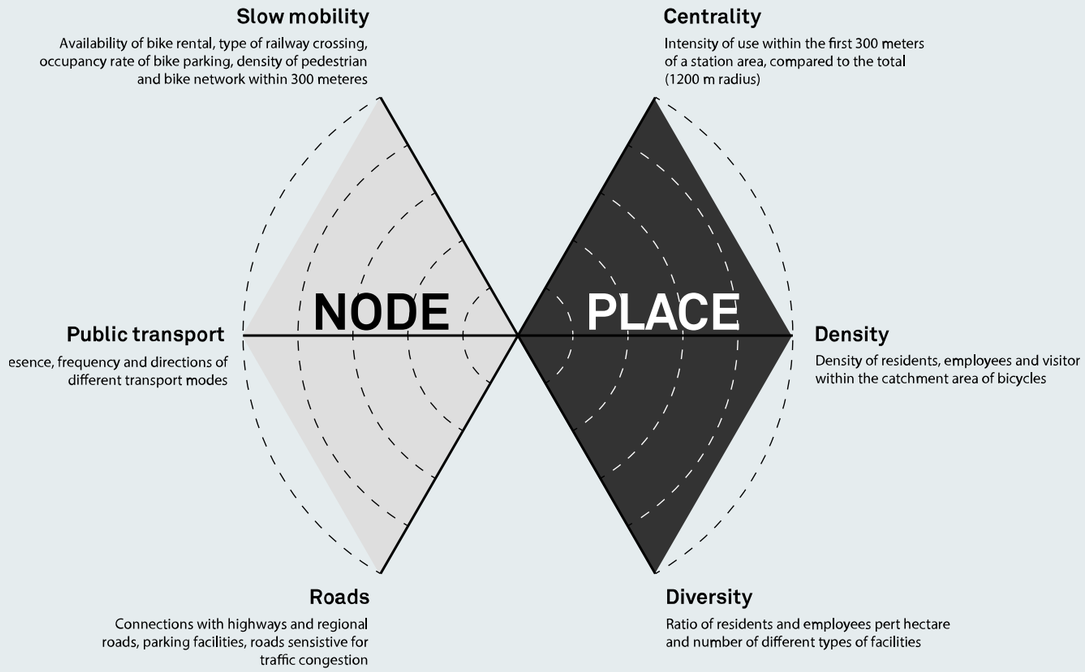


Fig. 2. The butterfly model – place-node model. Source: own work based on Vereniging Deltametropool (2013).

The reviewed literature mostly relies on case studies. Beside place-node there is lack of theoretical model conceptualizing the city-station relationship, as in the case of port-city relationship. This paper aims to contribute to the emerging field of study, by relating the typology and spatial evolution of Dutch station areas to neoliberalization and prospects of densification.

3. Neoliberalization

The shortfalls of neoliberal urban development have been widely addressed in the literature after the economic crisis of 2008-2009. But can we really define the neoliberal urbanization and its spatial implications? Brenner (2010) argues that neoliberal urban development is not a single, unified phenomena; we should rather speak of neoliberalization as a syndrome of processes and activities. I would like to follow this line of reasoning, as it may be easily referred to the long, evolving process of area development.

According to Brenner et al., neoliberalization is deeply heterogenous: its patterns are mostly place-specific (2010), but some of them are present in majority of rail renaissance projects. Starting from the use of market-oriented solutions to regulatory problems such as housing or mobility, through privatization of state-owned rail companies, to financing infrastructure by public-private partnerships or speculation on rail property.

Undoubtedly, neoliberalization resulted in creation of the most popular spaces of the contemporary, post-fordist cities: revitalized industrial sites, commercial waterfronts or central business districts in station areas. On the other hand, there are no doubts about

its negative consequences. As Harvey (2006) is alarming, in big picture it leads to highly uneven, unsustainable development, with soaring social inequalities.

Neoliberalization in the context of TSAD is not widely discussed. Peters & Novy (2012) among the few acknowledged that trains station areas are crucial part of neoliberal restructuring of former industrial land uses. Also paper by Bixel (2014) deserves attention. The author argues that contemporary TSAD is overwhelmingly driven by the logics of neoliberalization. Bixel (2014) also observed that sustainability discourse was often used by political actors only to enforce place-based competitive advantages in order to attract global capital. However, the weak side of this paper is that the author confirmed her hypothesis only by the case study of Stuttgart 21, which is a radical, often discussed example of a failed TSAD project.

4. Dutch context

In the Netherlands the railway network has expanded relatively late, due to the strong competition of waterways and unsuitable soil conditions (Cavallo, 2008). Even though the Dutch rail networks remains less dense then neighboring Belgium or Ruhr region, it is Europe's busiest (ACM, 2019). Thanks to densely populated, compact territory, and frequent connections, rail have important role in daily commute, acting like a national metro system.

In 2020 in the Netherlands were 397 functioning train stations, all of them managed and owned by NS Stations. Study of 2012 has shown that 54% of the Dutch population lives in the vicinity of the station, more in the densely populated provinces of Randstad (64%), the least in Zeeland (37%) (Rietveld, 2013). It would be interesting to repeat this study, to assess the results of densification. Currently, stations are divided into five classes:

- Halte (115) <1 000 pax/day
- Basic (233) 1-10k pax/day
- Plus (27) 10-25k pax/day
- Mega (20) 25-75k pax/day
- Kathedraal (6) >75k pax/day

This classification is formed simply on the basis of daily ridership, which may not give a clear image when analyzing TSAD. Of course, not all stations are suitable for area development projects.

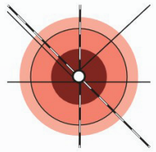
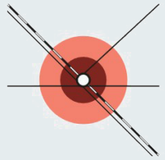
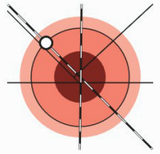
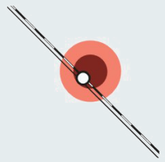
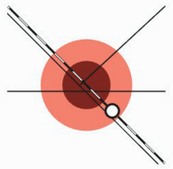
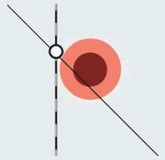
More accurate would be using the typology that includes the role of the node and urban context. In 2002 this kind of experimental typology was developed by NS, but apparently not widely applied (van Hagen & de Bruyn, 2002). Six types are characterized by the location in relation to the city (suburban, central, in the outskirts), population of the catchment area (small town, mid-size city, large city) and role of the multimodal node (other modes of transport). Typology based on the report by van Hagen & de Bruyn (2002) is presented in the table 1. It must be noted that daily ridership statistics has changed since 2001, when the data was collected.

In principle, the first three types are the most suitable for area development, as they rely on influx of users from local and national mobility network and dense catchment area. Certain number of stations from the fourth type may also be promising, but it requires further investigation.

In order to better understand the characteristics of the Dutch stations and their role in urban development, it is useful to take historical perspective. The overview of coevolution of rail and urban fabric in the Dutch context is presented in table 2.

Based on the literature, I specified seven main stages of development that had different consequences for place and node dimension. These seven stages can be grouped into three main phases of coevolution of urban fabric and rail (A, B, C).

Table 1. Typology of train stations in the Netherlands. Own work based on van Hagen & de Bruyn (2002).

TYPE	SCHEME	NAME	CHARACTERISTICS
1		Intermodal station in a large city center	>50k pax/day Transfer to metro/tram/bus/train Central business district Part of metropolitan public spaces network
2		Intermodal station in a medium city center	15-70k pax/day Transfer to local/regional bus lines + trains Commercial redevelopment project Part of main public spaces network
3		Intermodal station in the suburb	10-50k pax/day Transfer to metro/tram/bus/train, P+R Commercial program and offices Scarcity of public spaces
4		Station in the center of small town/village without node function	2k-18k pax/day Transfer to local bus lines Small retail and local public functions Connected with main public spaces
5		Suburban station without node function	1-10k pax/day Good accessibility by car, P+R, bus lines Only necessary amenities on station Connected with residential neighborhood
6		Station in the outskirts of small town/village without node function	<5k pax/day Good accessibility by car, P+R No commercial activities Often located on old railway lines

In the first phase (A), stations provided the main impulse for growth and formation of urban fabric. At the same time, they usually constituted a border of the city, outside of which industry and other "dirty" land uses were located.

In the second phase (B), car replaced the train as a main driver of urban development. Historical city centers were adjusted to motorized traffic, occasionally modern office buildings appeared in the station areas, however rail yard and industrial zone kept its

Table 2. Phases of coevolution of railways and urban fabric in the Netherlands. Own work, based on (Bertolini & Spit, 1998; Cavallo, 2008; Conceição, 2015; Douma, 1998; Van Acker & Triggianese, 2020)

Phase	Stage	Years	Name	Spatial implications	
				node	place
A	0	1839-1860	Private experiments	Competition with waterways, disconnected railway lines built by private companies	Station as new gateway outside the fortified city; connector and a spatial barrier of urban growth.
	I	1860-1880	National standardization	Formation of national rail network between main cities, taking over goods and passengers of waterways.	Standardization of station design, formation of rail yard's industrial typology, introduction of bridges and overpasses to urban fabric.
	II	1880-1920	Cathedrals of progress	Increasing coherence of (inter)national rail network, emergence of commuter train, introduction of trams.	Station as a gateway to the city; formation of living environment in station areas: station square and station street (shops, restaurants, hotels),
B	III	1920-1965	Functionalism	First intermodal stations: transfers to trams and busses, competition with private car.	Station as a functionalist public building, experimentation with new types, rise of modern office buildings in station areas.
	IV	1965-1985	Uniformization	Losing competition with car, shape of transfer hub influenced by car-oriented design: overpasses, parking lots.	Station as a canopy, standardization, focus on minimizing cost and functional dimension, public sector-led development, social housing on the backside of stations
C	V	1985-2000	Rail renaissance	Emerging multimodal nodes, integration with metro lines, trams and buses, rise of cycling infrastructure.	Stations as a showcase of diverse architectural forms, attracting international capital, development of commercial offices.
	VI	2000-2020	Profit center and transfer machine	Introduction of high-speed rail, further multimodal integration, often accommodated by one overarching design.	Station as a commercial center and monumental public building in a dense urban fabric. Focus on accessibility, new connections over rail and public spaces.
	VII	2020+	Station-city: integration of living environment	Introduction of new sustainable modes of transport. Intermodal, adaptable nodes consisting of connected modules.	Station as a dense living environment, integrating hybridized urban functions specific to the local context. Adaptable form adjusting to socio-technical transitions.

shape of a strip dividing the city. Thanks to mass production of social housing, the backside of the station was usually urbanized in that phase.

In the third phase (C), large stations took over the role of catalysts of urban development, but only in their catchment area. Modern construction and typologies from the second phase this time are used to maximize profit. Rail yard is turned into a dense office district, new connections and quality public spaces are binding the divided city.

It is very apparent, that the last two stages of development taking place since 1985 are offering only one, commercial recipe for "rail renaissance". As a result, stations of types 4, 5 and 6 could not follow the same development trajectory as leading types 1-3, which was recognized by some authors (Bixel, 2014; Peters & Novy, 2012; Van Acker & Triggianese, 2020). In principle, in the Dutch context redeveloped station area is typical only for cities with population above 100 000.

Neoliberalization in the Dutch context

The previously described disparity of development pace between the largest, the best connected station areas and the rest is a typical sign of neoliberalization. Train station areas were arguably the first parts of urban fabric affected by neoliberalization in the Netherlands. In 1986 the government published the report "Densification around stations" (Verdichting rond stations), expressing ambitions to turn the promising station areas into business centers (Bertolini & Spit, 1998).

What is striking, the first motivation was clearly about sustainability. Ambitious investment plan in public transport and rail network aimed to hamper the development of car-oriented suburbs. But to achieve this, a typical set of tools for neoliberalization was used. In addition to that, the perspective of connection to European high-speed rail aimed to attract investors to the most promising areas referred to as "key projects" (Sleutelprojecten), supported by the central government subsidies and advisory board Bureau Spoorbouwmeester. The state-owned rail company NS was split into specialized subdivisions., but not fully privatized. The one responsible for capitalizing on rail property (NS-Vastgoed) was created in 1994 (Bertolini & Spit, 1998).

Let us take a look at the station Amsterdam-Sloterdijk, arguably the earliest example of implementing a neoliberal TSAD model in the Netherlands. The masterplan of 1986 branded the greenfield development around the new station as "Teleport": it envisioned the largest office hub for telecommunication services in Benelux. After the crisis of the year 2000, newly developed area turned out to be obsolete due to the rapid development of cell phones. A new masterplan in response aimed to diversify the businesses, and add even more office volume to the station area. However, it was not implemented on time. Another crisis struck in 2009, turning the neighborhood again into a "ghost town" of vacant offices.

After this crisis, Sloterdijk became a site of temporary pilot projects, such as modular student housing or cultural pavilion BRET. Some of the buildings in Sloterdijk were adapted to hotels or apartments, but it was not easy and widespread, as the buildings were not designed with adaptability in mind.

Recently accomplished New Key Projects also bear signs of neoliberalization. The publication of Dutch railways spatial advisor (Bureau Spoorbouwmeester) "Station Centraal" from 2010 leaves no doubt that the desirable model was oriented on Castell's "network society", introducing international business locations surrounded by quality public spaces (Hendriks et al., 2010).

The example of stations Breda and Roosendaal can illustrate the double-edged consequences of the current TSAD model.

When reading the description of project in Breda of 2015, one may mistake it with Euralille of 1993. The project capitalizes on new high-speed rail connection, aiming to attract new companies and (wealthy enough)

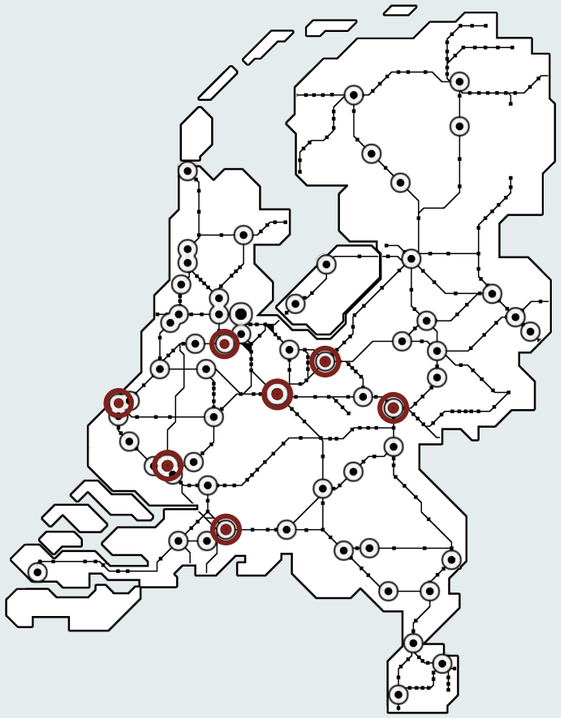


Fig. 3. Dutch rail network with intercity stations (black) and Key Projects (blue). Source: own work, based on https://nl.wikipedia.org/wiki/ Lijst_van_Nederlandse_intercitystations.

residents. In contrary to Euralille, the station is not a “UFO structure” that could have landed anywhere, but a contextualized megastructure with a massive parking lot on the rooftop. This spatial form constraints adaptability: parking lot, bus station, office or housing components cannot be easily modified without distorting the rest.

The negative externality of the rise of Breda was decline of the station of Roosendaal (70k inhabitants). The station has lost its function of international hub and has not seen any major investments. The municipality came up with an ambitious business-oriented master plan, however it was not realized due to a lack of external support and economic crisis (Van Acker & Triggianese, 2020). As a result, urban growth of Roosendal of the last decade was accommodated by suburban housing development and car-dependent business parks.

The reforms of the 1990s has also restructured the corner stone of the Dutch welfare state: the social housing system. Housing corporations were forced to conform to market norms. The implications are clearly visible today: substantial increase of prices, increased power of few major development companies, high vulnerability of the housing market to global economic crises. Moreover, according to Boie (2020) these decisions have laid ground for housing shortage, in recent years turning into a regular crisis.

The Dutch planning system is widely considered as both strict and successful in guiding urban development (Holtslag-Broekhof et al., 2018) but it increasingly uses processes of neoliberalization to achieve spatial quality. Since 2010 we observed further decentralization of the planning system (Boie, 2020). More and more responsibilities were delegated to municipalities, only boosting competition between them. Instead of striving for territorial cohesion, such competition only deepens disparities. Smaller cities cannot rely on influx of foreign capital, while metropolitan areas like the Randstad, are becoming even stronger, draining social capital from the peripheries.

To conclude, the current development model in which short-term profit is determining every project, and sustainability remains a marketing buzzword, is unable to create future-proof solutions. The spatial implications of neoliberalization in the Dutch context include profit-oriented development of the best connected nodes, which does not address social urgencies, and marginalization of less favorably located stations. In this context, densification and corona crisis may be an opportunity to rethink the current TSAD model, which wastes the potential of Dutch cities.

5. Densification and future challenge for TSAD

Noise, vibrations, crowd, shortage of greenery, to mention but a few, are reasons why we do not perceive station districts as desirable places to live. In the Netherlands they are often the most busy spots, where different streams of users are crossing: commuters changing transport modes, local residents doing groceries, tourists arriving to the city, teenagers hanging out. This constant pressure on public spaces makes a task of introducing high-density living environment to station areas very challenging.

The current policy of densification (stedelijke verdichting) is envisioned as a direct response to suburban city extensions caused by Vinex program, and the housing crisis resulting from neoliberalization. The vision was formulated in the report by Planbureau voor de Leefomgeving (2012) and repeated in Nationale Omgevingsvisie (NOVI) in 2020. In the first report (2012), station areas were specified as one of the five focus areas for densification.

Densification is realized often by a powerful instrument of compulsory acquisition. The land policy in the Netherlands is described as one of the most extreme forms of active land policy (Holtslag-Broekhof et al., 2018). Municipalities initiate and lead development, instead of just restricting it and waiting for the private market. They strategically acquire land, take risk, profits, and closely cooperate with private developers. As a result, legally binding land-use plan is usually seen as a contract between private and public actors, only formalizing solutions they previously agreed upon (Holtslag-Broekhof et al., 2018).

Adaptability

Cyclical crises are endemic to the current form of free-market capitalism, and we should embrace it when planning the future densification. Dutch municipalities are vulnerable to speculation bubbles as other active market players. In addition, the implications of energy or mobility transitions, and corona crisis are not fully known yet. The most accurate response to this uncertainty would be implementing planning and design for adaptability at every scale of TSAD. Modular and circular solutions should be considered for platforms, footbridges, public spaces, retail and housing typologies.

In terms of planning, this thinking could be embodied by a transition from airport-like megaproject integrating all modalities (i.e. central stations in Utrecht, Den Haag, Breda) and built at once, towards more adaptable, yet integrated set of modules allowing incremental development. Ideally a multi-modal hub would consist of modules which can be replaced or modified without interrupting each other’s functioning.

Equity

When we consider densification around the best connected mobility hubs, next to adaptability, the question of equity should be raised. Equity is often discussed in the context of TOD (Chava et al., 2018; Thomas & Bertolini, 2020), because gentrification is often a side-effect of improved connectivity.

In the context of TSAD, scarce of space and proximity to the city center, results in high land value. Thus, under the Dutch active land policy, municipalities aim to get the return of investment in infrastructure by selling land for commercial development, as seen on the example of Delft (Janssen, 2019). Private developers aim to maximize the number of free-sector rental apartments. Of course, Dutch municipalities can set the rules for

minimum share of affordable homes, but still the new housing in station areas is often more expensive than existing properties, as examples of rising towers with premium apartments show (i.e. Eindhoven, Utrecht, Rotterdam, den Haag).

Research conducted on the cases of Breda, Tilburg and Arnhem concluded, that there was no clear influence of the stations on the price of existing housing (van Ruijven, 2019). However, housing development following New Key Projects is not yet completed, and it creates risk that station areas will become islands of premium apartments, inhabited by similar social groups. Hence, future development should pay special attention to equitable densification that creates socio-economically diverse communities.

Recent examples of densification in train station areas

The development of train station area in Delft is still in the midst of construction, so it is too early for assessment, but it seems that spatial conflicts of mobility hub and quiet living environment were reconciled. Nieuw Delft aims to become a cozy residential neighborhood with a central park and self-built homes. Thanks to active role of residents in the process, over 30% of land area development was dedicated to housing by private or collective private commissioning (Janssen, 2019). It must be noted, however, that energy transition and climate adaptation were not in the agenda of the original plan, and could not be fully integrated on later stages, as it was not adaptable enough (Janssen, 2019).

Of course the case of Delft is quite unique because of its location on the main railway line of the southern wing of Randstad, which justified the construction of the tunnel across the city center. Focus on living environment in masterplan was caused by housing crisis, that manifested itself in Delft earlier than in other cities. Thus, the case of Delft is not transferable to other Dutch cities of 100k inhabitants.

Let us take a closer look at the role of densification in train station areas in cities below 100k residents. There are already hopeful signs that small stations are coming back to the development agenda. In 2019 NS Stations announced the investment package for small stations for the years 2021-2023, which includes 200 small stations, and focuses on introduction of toilets and comfortable waiting rooms (NS, 2019). Within the Dutch Design Week 2019, a design competition for a circular small station was organized. When analyzing press articles, it may seem that the topic of future small stations is becoming increasingly popular.

For instance, municipalities of Woerden (52k) and Culemborg (28k) in 2020 were planning housing projects in their station areas. Both projects may be addressed to young people who want to work or study in Utrecht, but live in a smaller city (Franck, 2020). In Culemborg previous commercial plan was cancelled (the developer withdrawn after the crisis), while Woerden had no comprehensive plan (Franck, 2020; Gemeente Woerden, 2020). It may be a sign that small cities have spotted the window of opportunity: shifting political climate and evolving model of TSAD.

However, beside the future ambitions, small and mid-size station areas more often have unrealized plans or no plans at all (Van Acker and Triggianese, 2020). Municipalities initiating a TSAD project are on their own, they cannot refer to an overarching national vision for sustainable TSAD development or EU projects and need a lot of time and energy for lobbying in the Hague.

6. Conclusion

The analyzed material allows to conclude that the effect of neoliberalization on Dutch train stations is quite apparent. It resulted in different spatial implications for large stations of types 1-3, that may be described as “winners”, and for the smaller stations of (types 4-6), that may be framed as “loosers”.

Large station area development projects in the Netherlands acted as catalysts of neoliberalization, while sustainability was only a supportive argument. This model of development oriented on exploiting capital from rail property in short-term is very vulnerable to the market crises and is not sufficiently contributing to the socio-environmental agenda like Paris Climate Agreement or goal of 1 million new homes until 2030.

Small and mid-size Dutch train stations, were not neglected as those in some large European countries (UK, Germany, Spain, Poland), but their potential remains underexploited. They need to be rediscovered as catalysts of sustainability. Currently, due to a lack of national vision or subsidies, small municipalities often fail when trying to transform their station areas on their own.

In the course of neoliberalization, Dutch municipalities and public rail company did not withdraw, but instead became active players in the market game. Their strong position makes the Netherlands privileged when facing adaptation to sustainable transitions or corona crisis.

Development of housing in station areas has to overcome many barriers: nuisance caused by rail, lack of greenery, creation of semi-private spaces next to the most public spaces in the city, and the issue of equity. New housing projects in station areas are often less affordable than their surroundings, and are addressed to very specific group of users (students, young professional, expats) of high mobility.

To conclude, I would like to emphasize the urgency of shifting the current TSAD model into the one oriented on creation of sustainable living environment, territorial and social cohesion. The potential of train stations as catalysts of sustainable transitions cannot be wasted.

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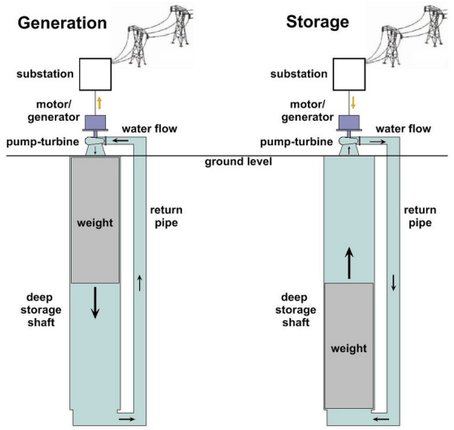
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Scheme of gravity energy storage in water. Source: https://www.researchgate.net/figure/Gravity-Power-Module-GPM-developed-by-the-company-Gravity-Power_fig5_286130812

Energy transition

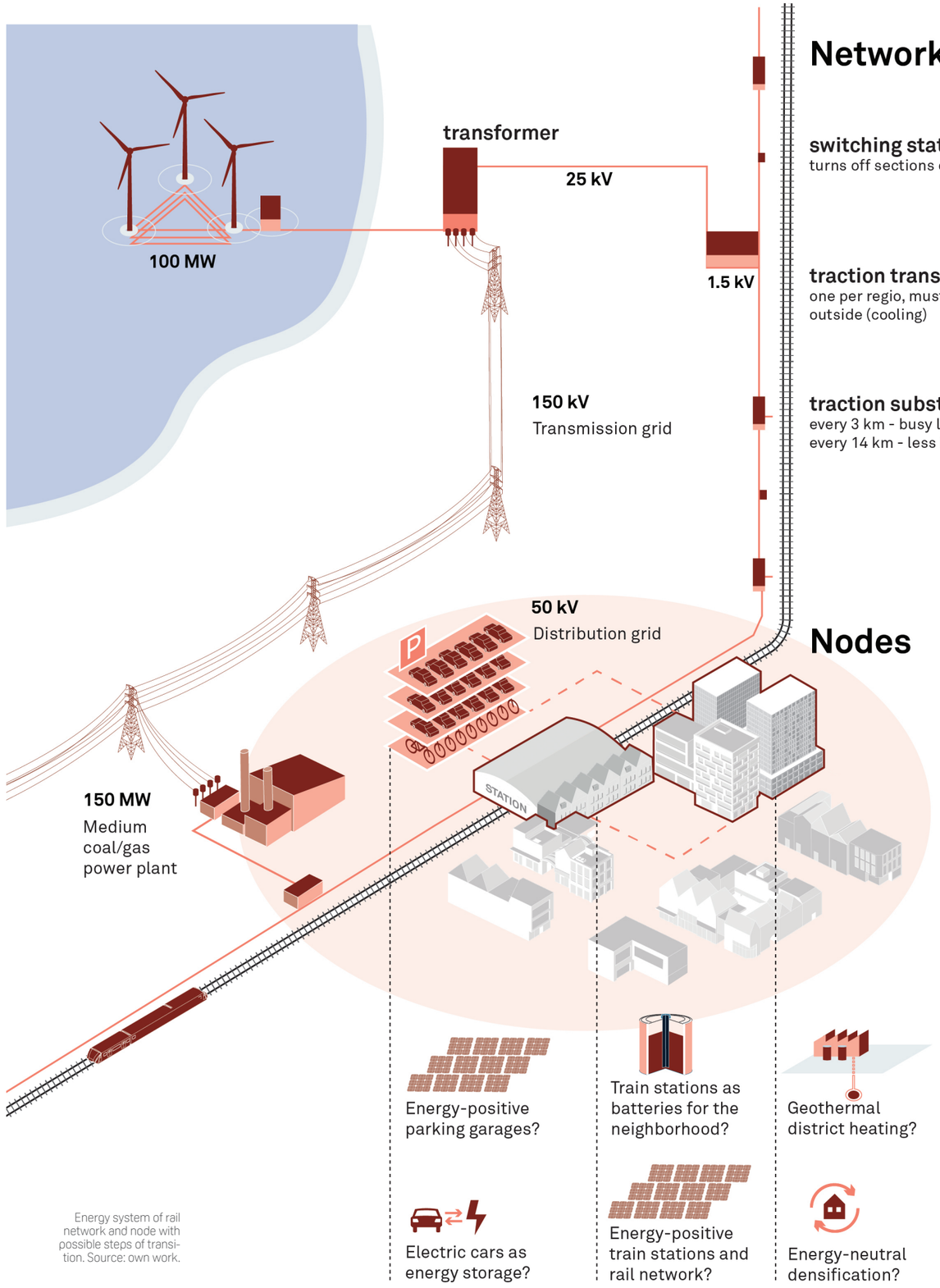
Energy transition refers to a fundamental structural change to the composition of an energy system. In the past, energy transitions have been fueled by discovery of new energy sources, such as the transition from biomass to coal and eventually to oil (Smil, 2010). However, the current energy transition differs from the past as it is driven by a need to reduce global carbon emissions. Since the existing energy sources are predominantly fossil fuels and the largest single source of carbon emissions, the energy transition focuses on the shift to renewable energy sources with low to zero carbon emissions.

In theory, the energy system based on renewable energy would rely on large number of energy sources smaller than conventional power plants. This would result in decentralization of the system. In terms of electricity, more importance will be given to local power grid, while international transmission and ultra-high voltage will be reduced. Decentralized electricity generation could reduce transmission losses, and thus the overall demand in the grid. Total annual grid losses in the Netherlands in 2014 were almost 5% (World Bank, 2014), compared to 5.5% share of renewable energy in the same year.

In addition to decentralization, the efficient energy storage is necessary to integrate renewable energy on the large scale into the power grid. Currently storage lithium-ion batteries is the most advanced technology, but it has multiple constraints. For safety reasons large-scale storage is planned outside of living areas, and the technology is fully dependent on harmful lithium extraction.

Gravity energy storage is particularly promising. Electricity can be generated and stored through dropping and lifting large weights, by cables or water pressure. In theory, such solutions could last for 50 years without the loss of performance. In 2021 the construction of first prototypes is planned.

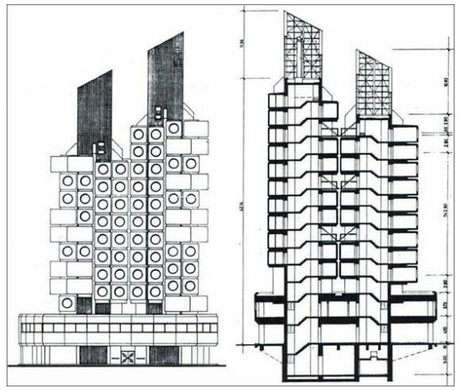
Energy transition is a socio-technical transition, so it involves also behavioral change. The new energy infrastructure could become more transparent and integrated with urban fabric. Train station areas could play an important role in a decentralized grid. The topic of energy transition in station areas will be further explored through research by design.



Energy system of rail network and node with possible steps of transition. Source: own work.

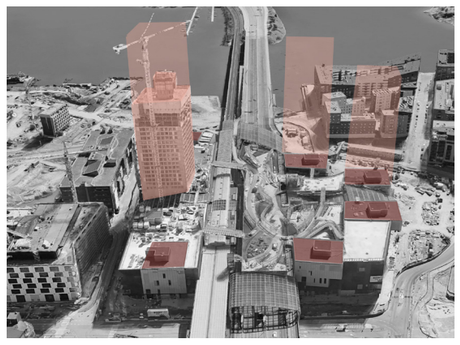
Adaptability

Train stations areas are undoubtedly the most dynamic areas close to Europeans city centers, anu development within them should address the risk of becoming obsolete.



Nakagin capsule tower- Source: bit.ly/jx217xm

Adaptable architecture was a strong theme in the 1960s. especially promoted by a metabolist movement in Japan. One of the few realizations of this concepts is Nagakin capsule tower in Tokio, which consists of small, residential modules attached to a high-rise core. The concept of open-ended forms came back in high-tech buildings, however did not became a leading theme of architectural mainstream. Adaptable solutions nowadays are in fact spread over different layers of planning and design, they are not related with any architectural style or movement.



Adaptable development around a metro station in Helsinki. Source: google maps.

The complexity of train station areas brings together disciplines of architecture, urban design, and transport planning. Here relevant may be the focus on the layers of site, surrounding and structure listed by Schmidt & Austin (2016) in their comprehensive book on adaptability. The spatial layouts of stations should consist of smaller components that can be modified without interrupting others, for example to make sure that the renovation of the busstation will not damage the greenery or obstruct train traffic. Different modalities despite striving for integration should also be to some degree independent, when it comes to possibility of expansion and renovation.

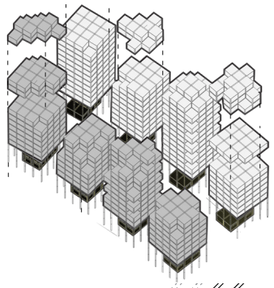


Adaptable housing in a former Olympic site in Loindon, by Hawkins/ Brown. Source: https:// www.hawkinsbrown.com/

Large stations need to strive for adaptable solutions in order to adjust to the dynamic needs of crises and densification. The commercial example of such thinking is development around Kalasatama metro station. Mixed-use complex integrated with station will include up to seven towers, depending on the market demand. The whole site can function even if the towers are not built, or only part of them.

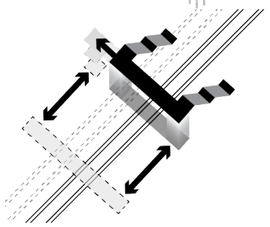
From the key layers urban design are surroundings, site and structure. In addition it is relevant to consider social layer, that determines the success of place. Considering space plan of ground floors directly related with station would also be appriopriate. Out of 290 solutions for adaptability mentioned by Schmidt and Austin (2016), a majority referred to architectural layers, foremost a space plan, but beside them there were still 63 solutions (22%) for layers mostly related with urban design (social, site, surroundings). These solutions will be considered when contructing the pattern language and to a less extend, when deconstructing the cases in this report.

Considered types of adaptability in train station areas



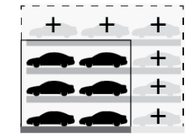
1/ Adaptable high-rise

Modularity allows to scale the building according to the demand. During phasing, future sites are temporary public spaces.



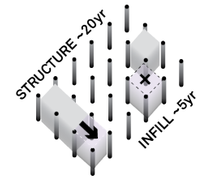
2/Flexible infrastructure

Elements of rail or energy infrastructure that can be relocated, such as footbridges or energy storage.



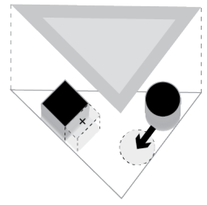
3/Scalable parking

Overground parking facilities having modular structure that allows to scale according to the demand; extend or add another floor.



4/ Adaptable plinth

Long-term frame, flexible infill Overground parking facilities having modular structure that allows to scale according to the demand; extend or add another floor.



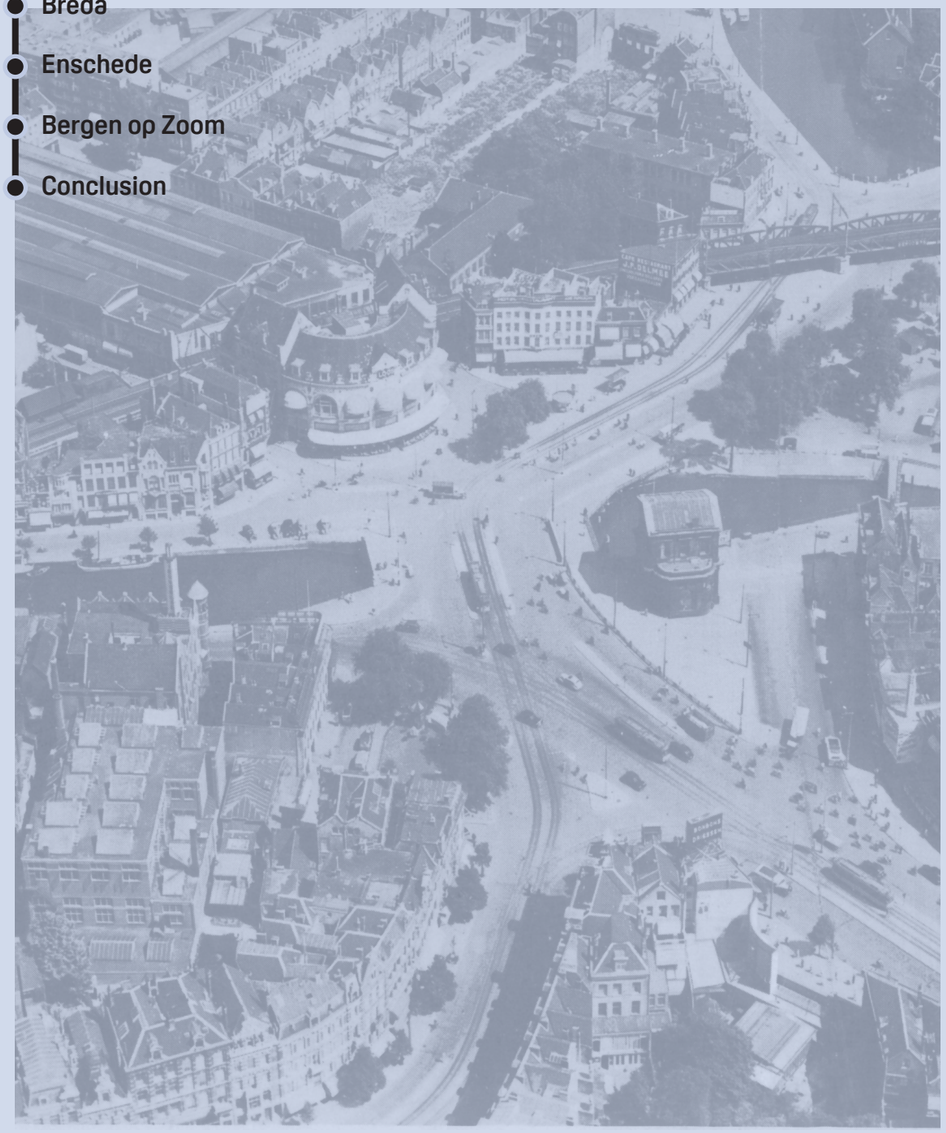
5/ Adaptable station hall

Flexible infill under overarching canopy.

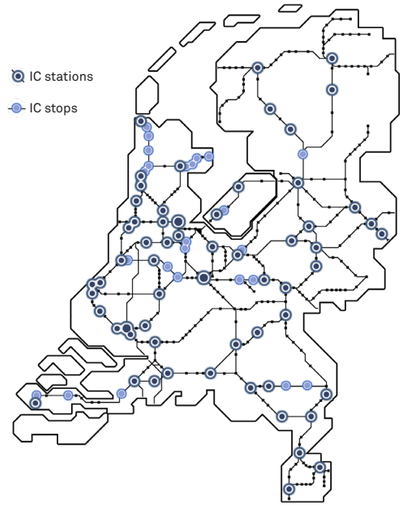
The model of adaptability in the built environment. Source: Schmidt & Austin, 2016.

04 Atlas

- Selection of cases
- Loosers and winners
- Amsterdam Sloterdijk
- Breda
- Enschede
- Bergen op Zoom
- Conclusion

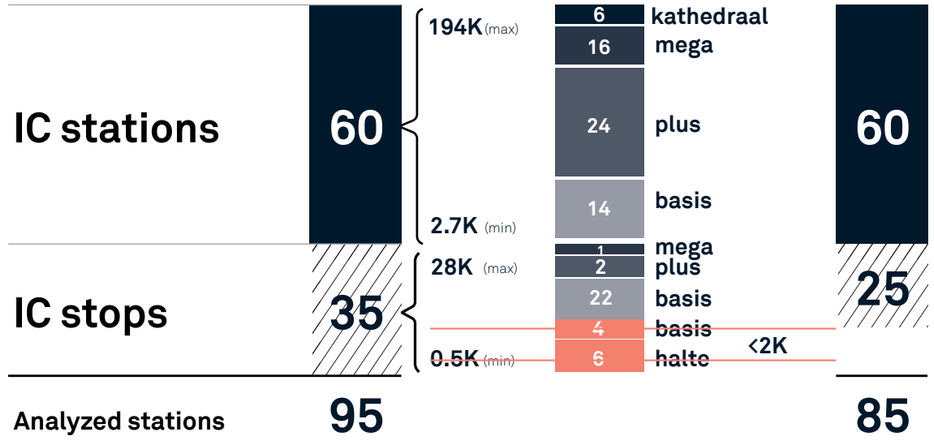


Station Rotterdam Hofplein in 1930. Source: https://i.pinimg.com/originals/f8/ac/f8/f8acf84c4120251ce-867ccc7ecf63c76.jpg



Map of IC stations and stops. Source: own work on the basis of https://nl.wikipedia.org/wiki/Lijst_van_Nederlandse_intercitystations

SELECTION OF CASES



Intercity stations in principle are the main stations in the Dutch rail network, where every Intercity train stops, next to sprinters/stoptrains. Intercity stops are also served by Intercity trains, but without a strong mobility node, they are mostly located in small towns. This group should not be completely skipped from the analysis, as it contains one large station as Amsterdam Biljmer ArenA or stations important for commuter traffic such as Woerden.

In the next step, IC stops below 2k daily passengers were rejected. There is a gap of around a thousand passengers between Vlissingen and first stations below 2k, moreover, they mostly serve villages in shrinking regions. Final group of stations for further analysis consists of 60 IC stations and 25 IC stops.

In the subsequent analysis, stations are ordered in a table, according to ridership. TSAD is understood as realization of post-1985 strategy for station area, as opposed to the “organic” development, that occured without coherent vision and strategy initiated by the municipality or railway company.

			Class	Realized TSAD	Densification plan	City population	Name	2018	2017	2016	2014	2013	Change [%]
New Key Project	1	IC station	Kathedraal			358 500	Utrecht Centraal	194.385	186.313	181.644	176.292	170.207	14.2
	2	IC station	Kathedraal			872 700	Amsterdam Centraal	192.178	184.614	174.179	162.103	168.800	13.8
New Key Project	3	IC station	Kathedraal			651 400	Rotterdam Centraal	96.690	92.928	91.750	81.811	80.015	20.8
New Key Project	4	IC station	Kathedraal			544 800	Den Haag Centraal	91.437	87.107	82.057	76.216	71.997	27.0
	5	IC station	Kathedraal			-	Schiphol Airport	92.214	85.859	78.896	68.689	69.437	32.8
	6	IC station	Kathedraal			124 900	Leiden Central	79.376	77.703	75.699	71.680	70.905	11.9
	7	IC station	Mega			231 600	Eindhoven	65,468	62,919	61,844	59,466	59,782	9.5
	8	IC station	Mega			872 700	Amsterdam Sloterdijk	58,800	54,330	50,611	47,804	45,194	30.1
New Key Project	9	IC station	Mega			872 700	Amsterdam Zuid	60.819	54.706	45.771	42.265	41.389	46.9
	10	IC station	Mega			154 200	's-Hertogenbosch	47.347	45.937	45.397	41.953	41.962	12.8
	11	IC station	Mega			176 700	Nijmegen	45.403	44.705	44.044	43.149	44.051	3.1
	12	IC station	Mega			127 500	Zwolle	41.100	45.507	43.542	40.591	38.594	6.5
	13	IC station	Mega			157 500	Amersfoort	43.710	42.604	40.861	39.651	38.279	14.2
New Key Project	14	IC station	Mega			159 200	Arnhem Centraal	43.677	42.987	40.588	38.442	38.316	14.0
	15	IC station	Mega			163 000	Haarlem	42.040	41.166	39.822	38.367	37.040	13.5
	16	IC station	Mega			544 800	Den Haag HS	33.612	32.956	37.124	35.603	38.210	-12.0
	17	IC station	Mega			103 000	Delft	38.423	35.454	34.490	31.249	32.049	19.9
	18	IC station	Mega			217 000	Tilburg	34,503	34,531	34,045	32,093	33,232	3.8
New Key Project	19	IC station	Mega			183 900	Breda	35,863	34,414	32,916	30,296	31,029	15.6
	20	IC station	Mega			872 700	Amsterdam Amstel	33.717	31.688	30.570	29.549	28.703	17.5
	21	IC station	Mega			90 200	Hilversum	26.697	25.922	25.778	23.490	23.321	14.5
	22	IC station	Plus			118 600	Dordrecht	24.483	24.351	24.434	23.020	22.765	7.5
	23	IC station	Plus			651 400	Rotterdam Blaak	24.006	22.548	24.226	21.273	19.856	20.9
	24	IC station	Mega			207 900	Almere Centrum	27.124	25.888	24.127	24.071	23.334	16.2
	25	IC stop	Mega			872 700	Amsterdam Bijlmer ArenA	28,111	26,427	23,922	21,545	18,961	48.3
	26	IC station	Plus			73 000	Gouda	23.696	23.139	22.763	21.139	20.621	14.9
	27	IC station	Plus			156 900	Zaandam	22.765	21.643	21.177	21.515	21.778	4.5
	28	IC station	Plus			82 900	Deventer	20.903	20.785	20.862	19.647	19.476	7.3
	29	IC station	Plus			79 000	Schiedam Centrum	23,164	21,654	19,636	18,721	18,581	24.7
	30	IC station	Plus			109 400	Alkmaar	21.026	20.951	19.620	19.512	19.693	6.8
	31	IC station	Plus			232 700	Groningen	17,768	17,937	19,133	19,091	19,916	-10.8
	32	IC station	Plus			158 900	Enschede	9,792	17,558	18,525	17,227	17,142	2.4
	33	IC station	Plus			115 700	Ede-Wageningen	18.369	17.893	17.758	17.458	17.366	5.8
	34	IC station	Plus			651 400	Rotterdam Alexander	18.310	17.938	17.207	17.598	17.318	5.7
	35	IC station	Plus			544 800	Den Haag Laan van NOI	16.660	15.751	15.317	13.872	11.299	47.4
	36	IC station	Plus			121 500	Maastricht	11.854	11.649	15.254	15.906	17.068	-30.5
	37	IC station	Plus			162 400	Apeldoorn	14.840	15.034	14.857	14.354	14.015	5.9
	38	IC stop	Plus			(AMS) 872 700	Duivendrecht	13.126	13.063	14.447	14.231	13.068	0.4
	39	IC station	Plus			77 900	Lelystad Centrum	14,531	14.153	13.858	13.035	12.693	14.5
	40	IC station	Plus			80 600	Hengelo	8,951	12.921	13.535	13.345	14.008	-7.8
	41	IC station	Plus			73 200	Hoorn	14.306	13.718	13.469	13.425	13.709	4.4
	42	IC station	Plus			58 200	Roermond	11.378	11.482	13.136	12.938	13.611	-16.4
	43	IC stop	Plus			52 200	Woerden	13.358	12.872	12.414	12.222	11.648	14.7
	44	IC station	Plus			37 500	Sittard	10.286	10.698	12.125	12.259	12.634	-18.6
	45	IC station	Plus			47 500	Zutphen	11,988	11.936	11.895	11.670	12.104	-1.0
	46	IC station	Plus			72 800	Almelo	8,092	10.860	10.803	10.560	10.908	-0.4
	47	IC station	Plus			77 000	Roosendaal	10.317	10.400	10.679	11.003	11.123	-7.2
	48	IC station	Plus			73 000	Alphen aan den Rijn	10.759	10.286	9.930	9.977	10.130	6.2
	49	IC station	Plus			93 000	Leeuwarden	10.393	9.822	9.661	9.492	9.151	13.6
	50	IC stop	Basis			49 500	Driebergen-Zeist	8.787	9.321	9.330	9.393	9.267	-5.2
	51	IC station	Basis			57 900	Oss	8.270	8.247	8.351	8.211	8.606	-3.9
	52	IC station	Basis			50 100	Weert	7.690	8.084	7.856	7.571	7.390	4.1
	53	IC stop	Basis			58 000	Heerhugowaard	7.434	7.401	7.357	7.580	7.818	-4.9
	54	IC station	Basis			36 000	Castricum	7.493	7.364	7.287	7.050	7.011	6.9
	55	IC stop	Basis			28 000	Goes	7,148	7,187	7.197	7,302	7,660	-6.7
	56	IC station	Basis			86 800	Heerlen	4,864	4,546	7.130	7.088	7.255	-33.0
	57	IC station	Basis			92 400	Helmond	7,419	7,345	7,054	6,705	6,847	8.4
	58	IC stop	Basis			53 100	Bergen op Zoom	6,979	6,967	6,963	7,015	7,220	-3.3
	59	IC station	Basis			27 400	Heemstede-Aerdenhout	7.118	6.862	6.755	6.439	6.222	14.4
	60	IC stop	Basis			207 900	Almere Buiten	7.532	7.314	6.488	6.788	7.304	3.1
	61	IC station	Basis			29 500	Heerenveen	6.236	6.185	5.946	5.802	5.782	7.9
	62	IC stop	Basis			127 500	Amersfoort Schothorst	7.003	6.412	5.895	5.963	5.642	24.1
	63	IC station	Basis			41 500	Beverwijk	5,239	5,295	5,782	5,823	6,237	-16.0
	64	IC stop	Basis			28 500	Meppel	6.342	5.989	5.765	5.522	5.346	18.6
	65	IC stop	Basis			29 500	Schagen	5.325	5.410	5.311	5.484	5.580	-4.6
	66	IC stop	Basis			73 200	Hoorn Kersenboogerd	5.117	5.158	5.111	5.361	5.388	-5.0
	67	IC stop	Basis			109 400	Alkmaar Noord	4.792	4.688	4.723	5.066	4.950	-3.2
	68	IC stop	Basis			39 700	Middelburg	4.666	4.559	4.657	4.547	4.800	-2.8
	69	IC stop	Basis			24 100	Heiloo	4.762	4.662	4.591	4.788	4.614	3.2
	70	IC stop	Basis			32 100	Deurne	4,486	4,365	4,379	4,498	4,703	-4.6
	71	IC station	Basis			64 400	Venlo	4.966	4.272	4.356	4.133	4.571	8.6
	72	IC stop	Basis			66 900	Veenendaal-De Klomp	4,446	4,370	4,229	3.807	3.745	18.7
	73	IC stop	Basis			124 900	Leiden Lammenschans	4.591	4.219	4.039	3.786	3.643	26.0
	74	IC station	Basis			41 100	den Helder	4,143	4,044	3.985	4,040	4,180	-0.9
	75	IC station	Basis			13 700	Dieren	3.607	3.704	3.623	3.777	3.848	-6.3
	76	IC station	Basis			17 100	Steenwijk	3.825	3.646	3.363	3.102	3.021	26.6
	77	IC station	Basis			43 900	Etten-Leur	3.459	3.333	3.293	3.260	3.449	0.3
	78	IC stop	Basis			19 100	Bodegraven	3.232	3.159	3.033	2.970	3.005	7.6
	79	IC station	Basis			33 100	Vlissingen	2.728	2.769	2.939	2.858	2.999	-9.0
	80	IC stop	Basis			13 500	Horst-Sevenum	2.654	2.541	2.720	2.643	2.635	0.7
	81	IC stop	Basis			18 700	Enkhuizen	2.326	2.312	2.414	2.485	2.604	-10.7
	82	IC stop	Basis			8 300	Hoogkarspel	2.197	2.272	2.322	2.318	2.300	-4.5
	83	IC stop	Basis			10 700	Bovenkarspel-Grootebroek	2.216	2.213	2.285	2.318	2.399	-7.6
	84	IC stop	Basis			7 900	Anna Paulowna	2.066	2.121	2.108	2.175	2.333	-11.4
	85	IC stop	Basis			41 100	Den Helder Zuid	2.146	2.184	2.105	1.997	1.918	11.9

S1

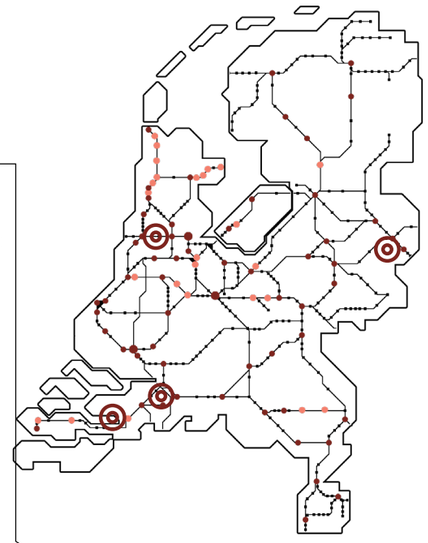
▲ "Winners"

▼ "Loosers"

S2

S3

Table X. Comparison of IC stations and stops in terms of ridership. Source: own work based on data by NS Stations and CBS.



Selection of 4 cases:

2 - "winners" of the neoliberal game, where TSAD project was realized.

2- "loosers" that did not attracted capital.

Is the success in neoliberal game also determining spatial quality?

Are the "loosers" having worse starting position for the future densification?

1. Amsterdam Sloterdijk

One of the fastest growing stations surrounded by the office park, with ambition to become a livable district through densification over the rail.

2. Breda

The station is awarded, but controversive building from 2015 and part of ongoing TSAD project, based on the introduction of HSL-Zuid.

3. Enschede

Enschede (156k) although similar size of Breda and situated next to the border, did not develop as an important railway hub, but mostly terminal station. Organically developed station area was important step for postindustrial city. The station building represents experimental approach to prefabrication from 1950s.

4. Bergen op Zoom

This station is representative for smaller cities that unsuccessfully tried to follow the neoliberal model. Modest station from 1971 is on the edge of old town and the surrounding area lacks coherent strategy.

- TSAD project - strategy realized after 1985 (not built up in a "organic" way)
- Suburban TSAD connected with Vinex housing development.
- Densification plan scheduled after 2020. (or started construction)
- Large value shifts - unreliable data

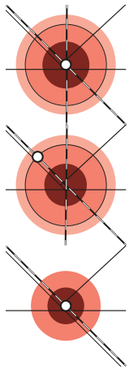
[1] Data of ridership is only collected by NS and does not include passengers of other operators. Hence, stations for which NS does not have an exclusive concession have lower values than in reality, especially Maastricht, Groningen, Heerlen, Leeuwarden, Venlo.

[2] A large drop in passenger number is possibly caused by a closure of rail connection due to works. The table is ordered by the values of 2016 in which there were no major shifts.

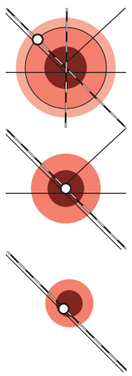
After the three decades of neoliberal urban development, the erosion of the celebrated egalitarian polder landscape is evident.

LOOSERS AND WINNERS

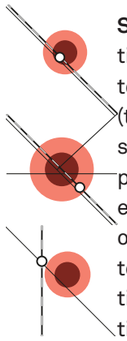
Analyzed station can be divided in to three groups, which were differently related to TSAD projects since 1985.



S1 - "Winners"- 31 stations - frontrunners of projects for station areas, experiencing the largest growth. This group consists mostly of types 1, 2 and 3. Since 1985 all stations, where land was available, got a TSAD project, usually through transformation of existing railway yard or industrial land uses. In the group of frontrunners 84% of stations have been redeveloped since 1985 and 65% are planning future densification, mainly oriented on housing. Station S1 are distributed mainly in the Randstad and cities above 100k inhabitants with a strong nodal position in the network. The case study on the example of Amsterdam Sloterdijk and Breda will investigate, whether this group also achieved better spatial quality.



S2 -"Loosers" - 25 stations - balancing in between. Stations of types 2, 3 and 4. The could have been possible to realize TSAD project. Many of them are planning densification after 2020. This group of stations is under threat of marginalization, but simultaneously it has a large potential. In this group medium cities of 50-80K inhabitants dominate. Most importantly, majority of cities are planning densification after 2020. I argue that future policies should target especially this group of stations. Station Enschede will



S3 "Loosers" - 27 stations - stations located usually in the small towns or edges of mid-size cities (types 4, 5 and 6), which are not sufficient to realize "urban" TSAD projects. However, this station areas are important for the quality of life, and could still contribute to the needs of local communities. In 2019 NS drafted a national plan of upgrading smaller stations (Landelijke Aaanpak Stations). It is oriented merely on improving facilities in the buildings, introducing toilets, cozy waiting rooms, libraries or cafes. This plan should be followed by national policies for smaller station areas. The case of Bergen op Zoom will demonstrate the spatial challenges typical for small stations.

The results of the analysis are confirming the hypothesis, that TSAD projects are concentrated in a number of large cities, favorably located in the network. The following case study will explore four selected stations through multiscalar mapping. This short atlas of cases will allow to understand spatial qualities of stations representing different groups and its relation with urban fabric. Is "winning" or "loosing" in neoliberal urban development competition predeter-

Distribution of groups

S1 (31)

S2 (25)

S3 (27)

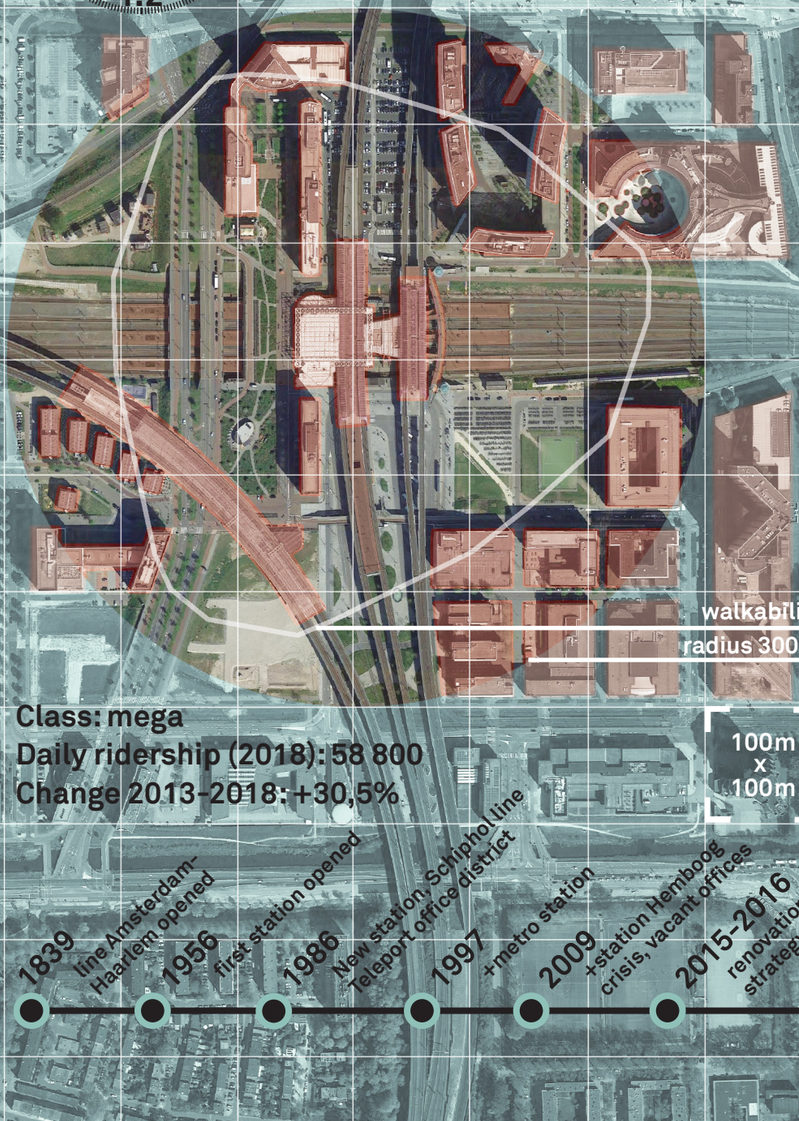


Distribution of three groups of analyzed stations. Source: own work, based on data by PDOK. and NS.

Amsterdam Sloterdijk







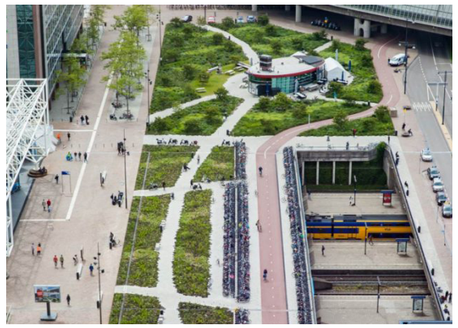
Class: mega
Daily ridership (2018): 58 800
Change 2013-2018: +30,5%

1839 line Amsterdam-Haarlem opened
1956 first station opened
1986 New station, Schiphol line Teleport office district
1997 +metro station
2009 +station Hemboog crisis, vacant offices
2015-2016 renovation of Orlyplein strategy Haven-Stad
2021 strategy for over track densification





Sloterdijk in 1985 and 2015, aerial perspective. Source: https://bit.ly/2XplBGo





Orlyplein. Source: https://bit.ly/3s6jQvD

WASA temporary student village. Source: https://bit.ly/2XplBGo

Can temporary urbanism and densification change the negative image of a vacant office district?

Sloterdijk was one of the first station areas in the Netherlands to be developed according to new paradigm. Since 1986, around the new station, a large office park was built. Monofuntional area struggled with vacant offices after crises of 2000 and 2008, and got the reputation of soulless, desolate neighborhood isolated from the city. As a response, some office buildings were converted into hotels or apartments.

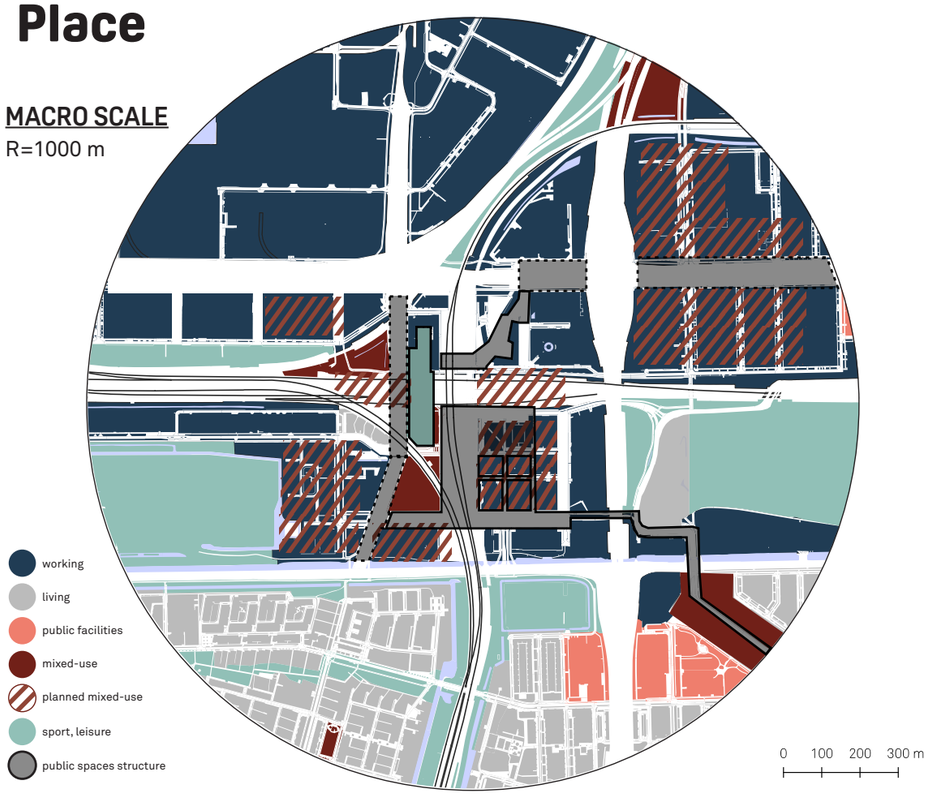
It is one of the most complex transfer hubs in the country, connecting metro, rail in four directions, buses and trams. The complexity of the three-level “connector” (Spek, 2001) makes it overwhelming for new passengers. Reviews on the Internet are expressing common frustration of users, criticizing the signage, how the station is cluttered, unclear to navigate, difficult for people with disabilities, and charge extra money during the transfer.Sophisticated spatial form of the station can be considered as a value of its time, but it also creates problems: there is lack of clear hierarchy of routes and visual connections between modalities.

Since 2016 Sloterdijk-Centrum is also part of extremely ambitious Haven-Stad project: redevelopment of harbor, industry and office parks in Amsterdam-West into a dense city of the future with 70k new homes and 58k jobs. In the south part of station area around 2 000 new homes will be built until 2024, of total 7 500 planned until 2040. In addition to that, municipality together with NS is considering densification over the tracks and redevelopment of train station. On behalf of PosadMaxwan, I am involved in the project.

Place

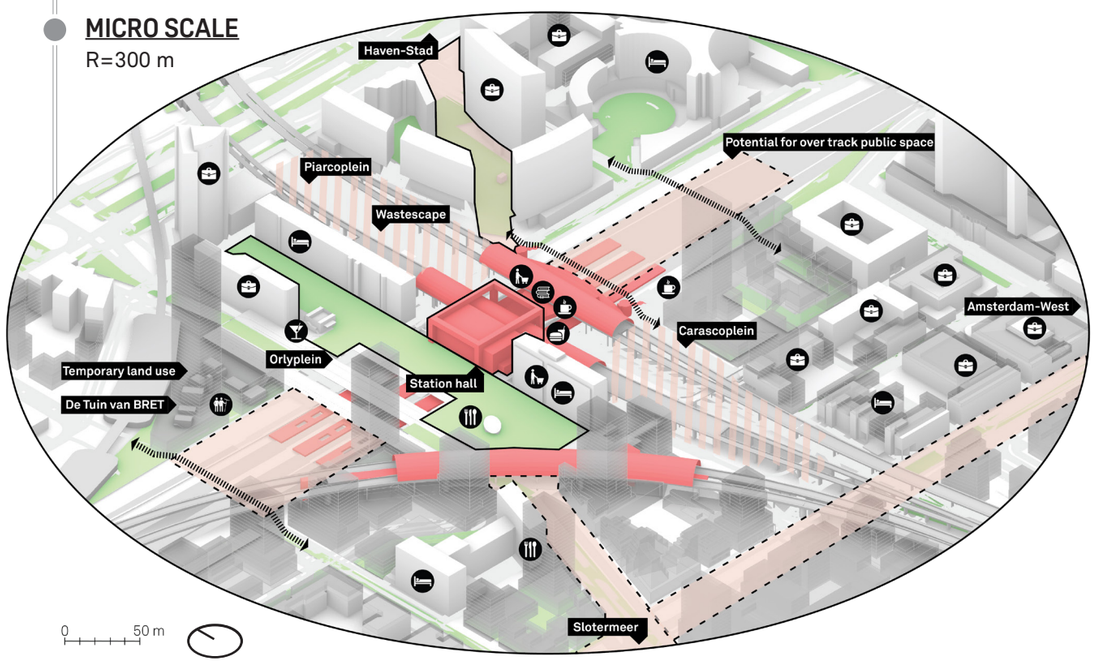
MACRO SCALE

R=1000 m



MICRO SCALE

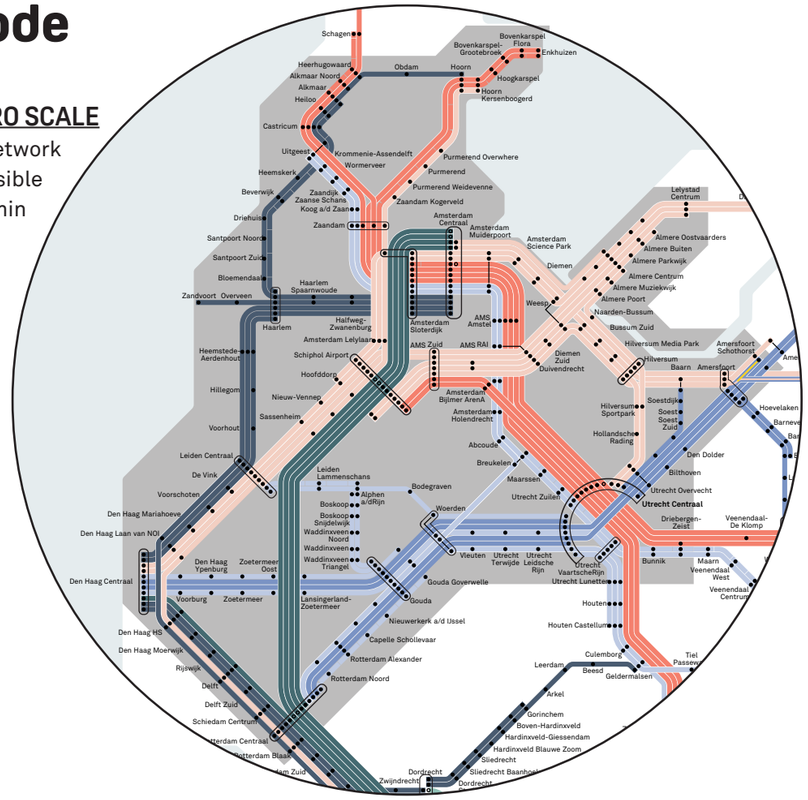
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Node

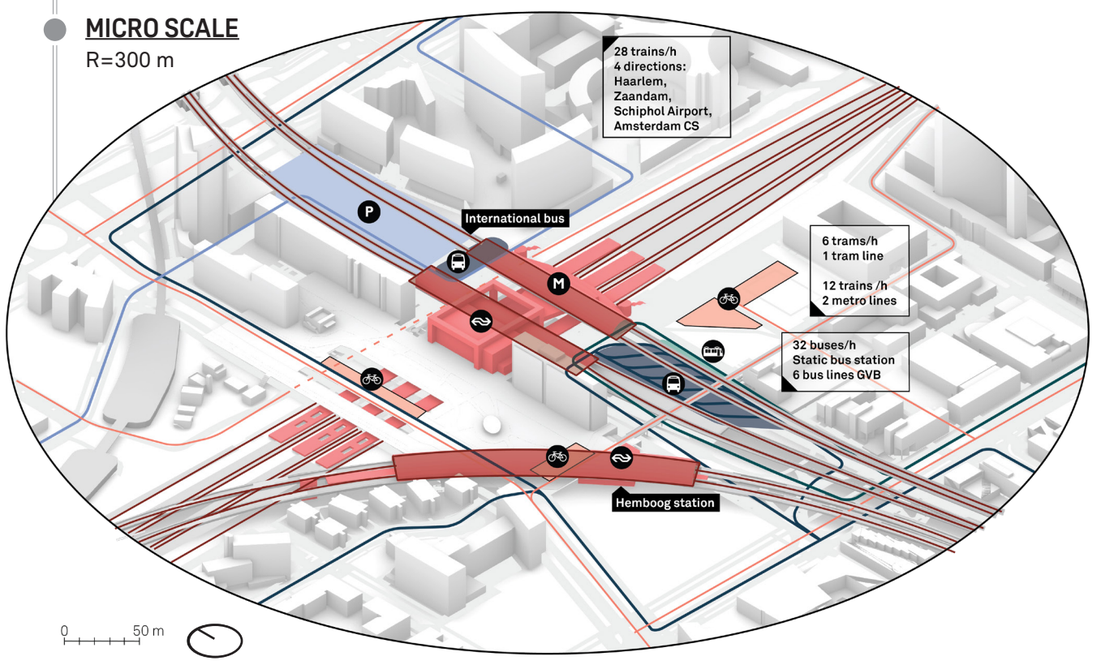
MACRO SCALE

Rail network
accessible
in 60 min



MICRO SCALE

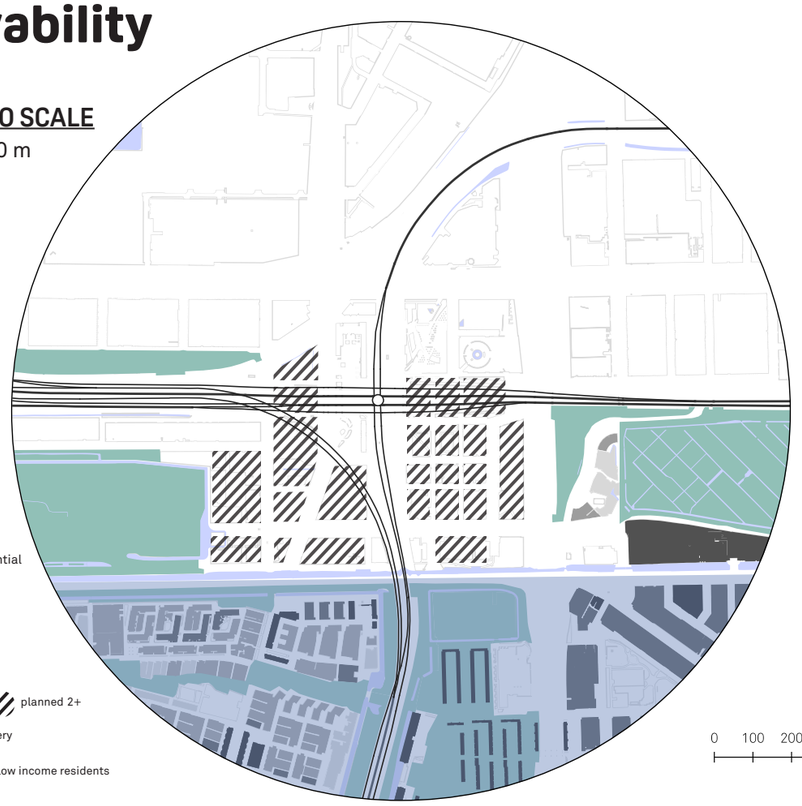
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Livability

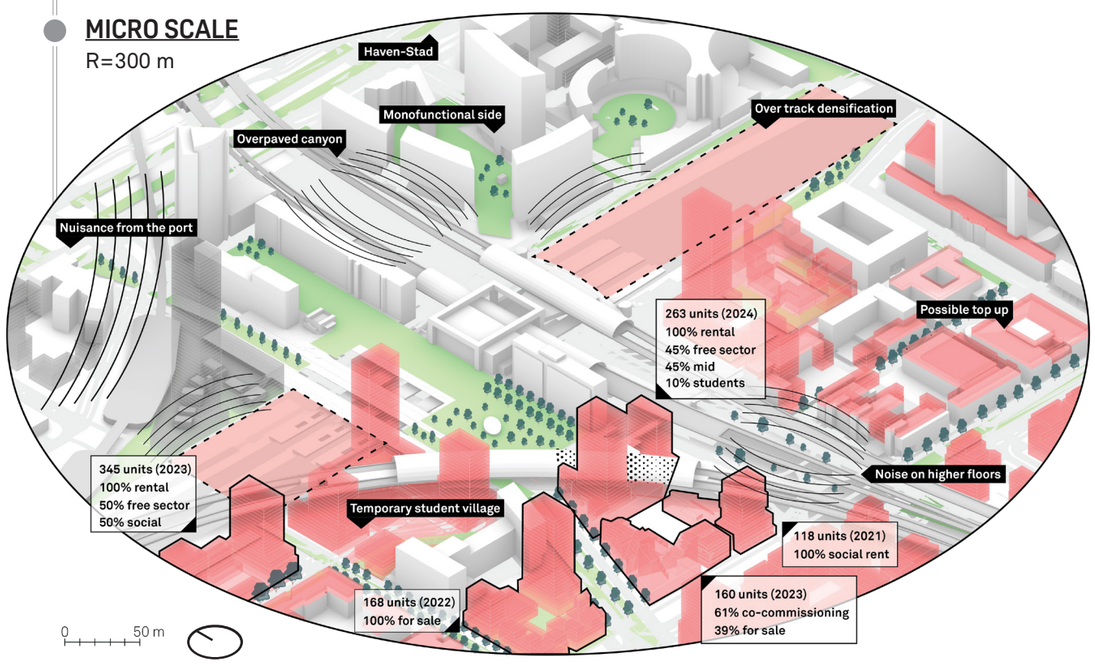
MACRO SCALE

R=1000 m



MICRO SCALE

R=300 m

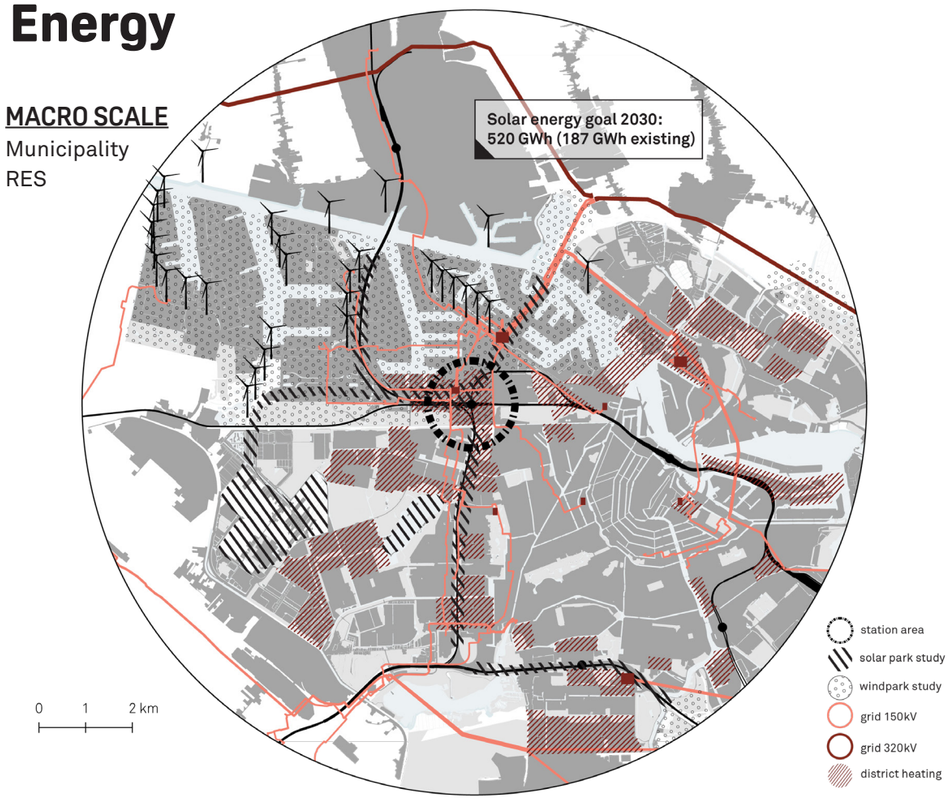


Energy

MACRO SCALE

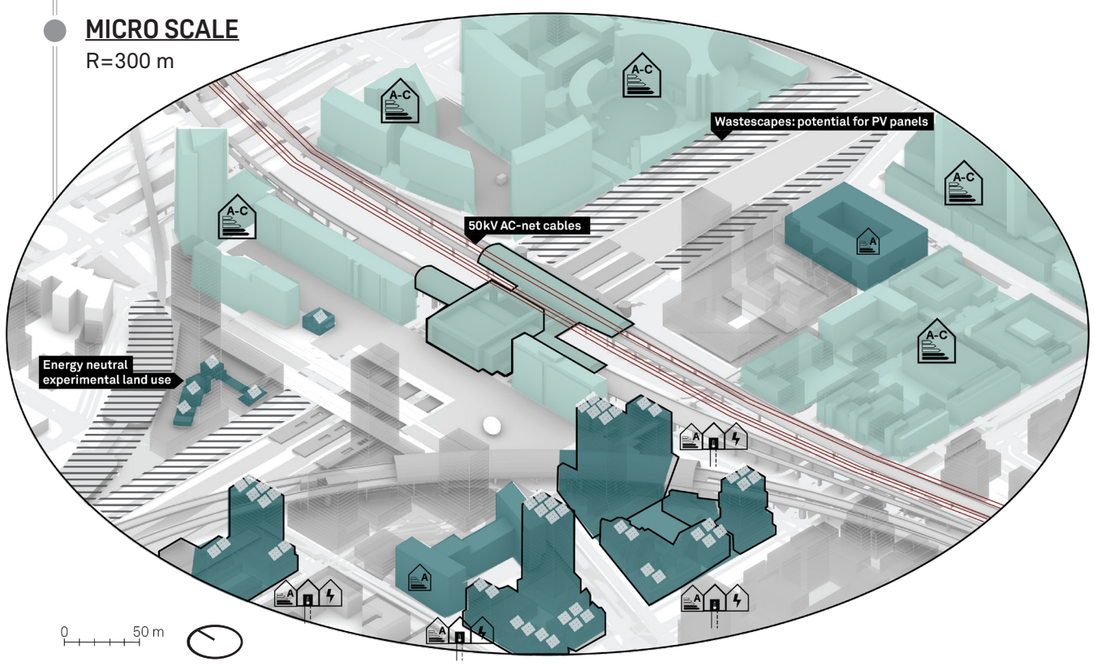
Municipality

RES

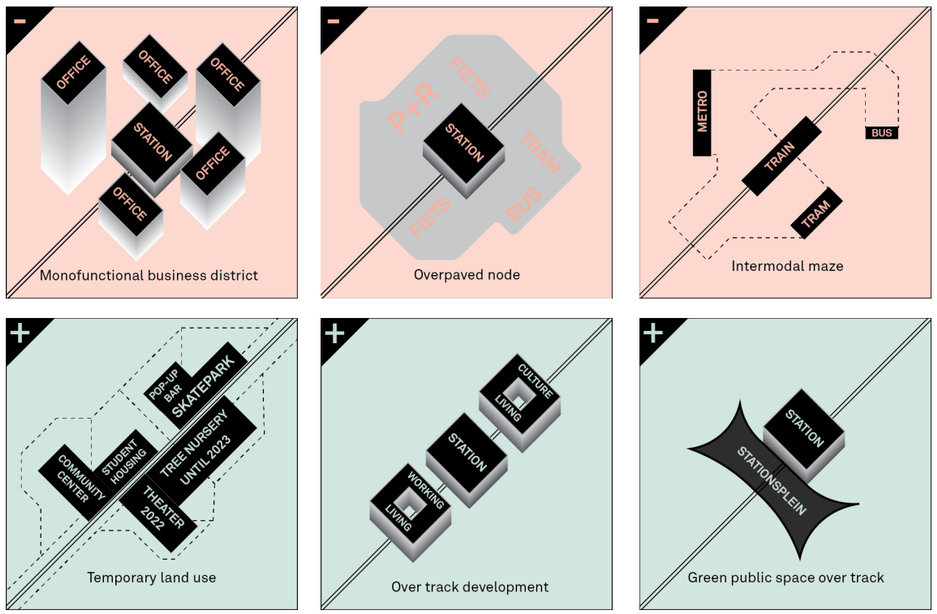


MICRO SCALE

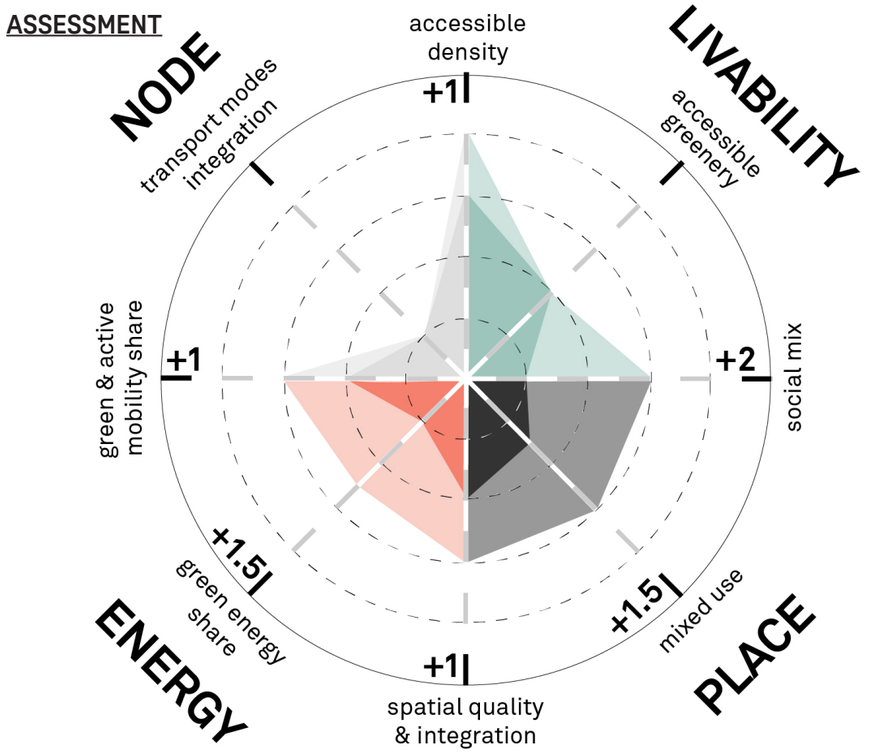
R=300 m



PATTERNS



ASSESSMENT



The initial identity of Sloterdijk, as a monofunctional business district, still act as a burden. Spatial form and program of the office park of the 1990s. are not diverse, not sustainable, nor attractive.

Sloterdijk has a very strong node function, which appeared even before place, as it was a greenfield development. This makes Sloterdijk quite unique in the Dutch context, but also creates a potential for testing lab for innovative solutions that could be implement elsewhere.

Example of such are temporary land uses on the plots, where high-density development is scheduled. Student housing WASA was located next to the overpass of Hemboog; it consist of sustainable modules that can be relocated, when the proper construction will start. On the other side of the track, bottom-up initiative De Tuin van Bret runs a circular business park and garden connected with the well-known restaurant pavilion next to the station entrance. This cultural hotspot, built from reused waste and shipping containers is contrasting with formal business actvities dominating the area.

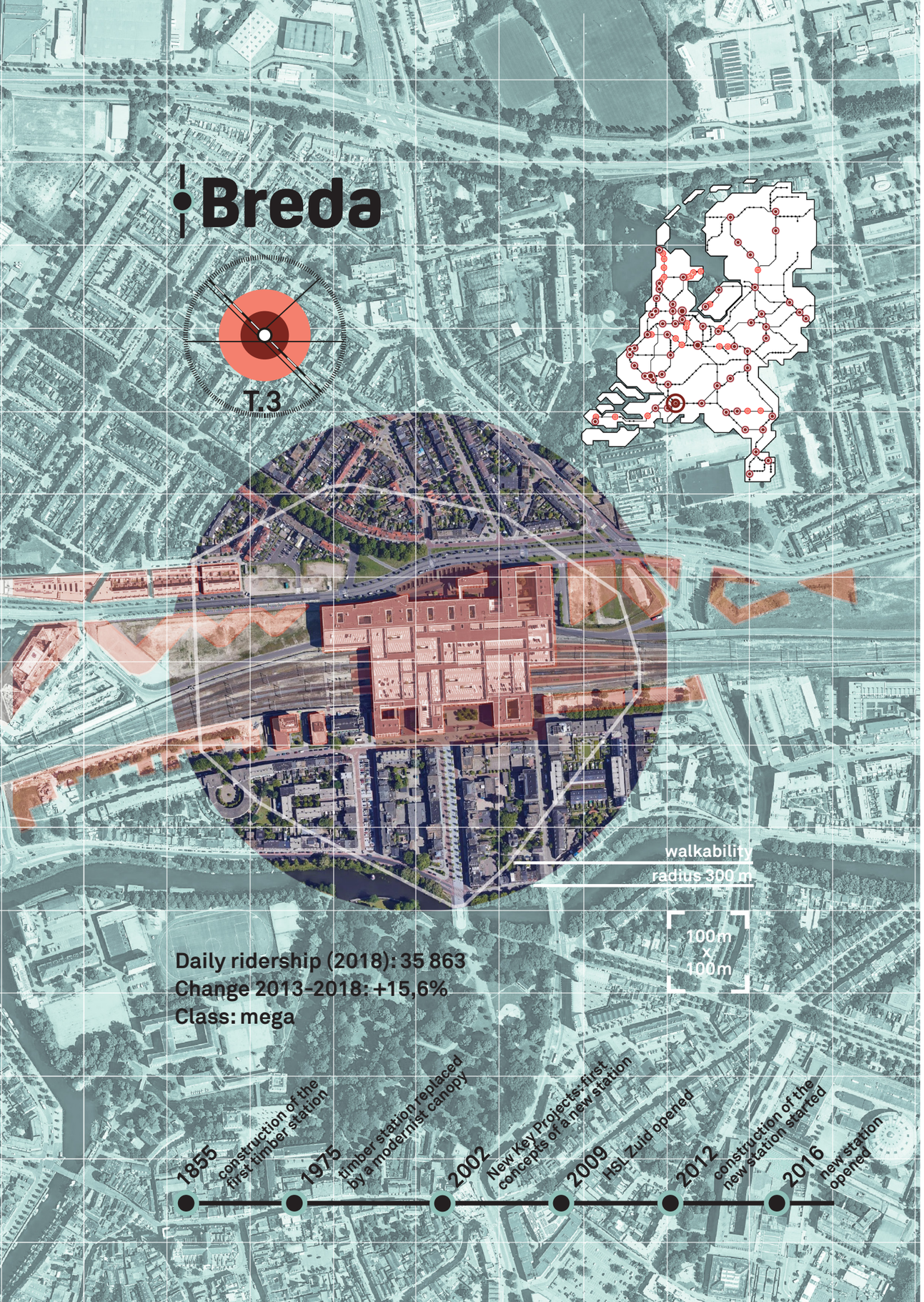
The place dimension of Sloterdijk is especially weak. The area is separated from the urban fabric of Amsterdam West by the main road and canal, and the pedestrian connection is weak. Strategy for Haven-Stad intends to change this insular characteristic of Sloterdijk. The area will be connected in the north-west corner to the future lively avenue Transformatorweg.

The transformation of Orlyplein into a green square has brought first quality public space to the overpaved station surrounding. However, the space is designed with transfer hub and rush hours in mind, and does not offer sufficient diversity for living environment (for example for children or seniors). In this context, introduction of residential high-rise aims to bring islands of attractive semi-public or semi-private spaces, separated from the busy hub and allowing family life.

When looking at the map, Sloterdijk station area holds a strategic position in Amsterdam's energy system. Highway ring and railway have a large potential for solar energy generation. From north to south, underground cables 50kV supplying the electricity to Slotermeer are crossing the station area.

Planned development on the southern side will consist of A+++ energy labelled buildings, almost energy neutral thanks to PV panels and heat pumps. However, there no plans with regards to the mobility node, wastescapes or public spaces. Bus station includes charging points for electric busses, and P+R for electric cars. Parking lot together with bus and tram stop could be optimized; they are overpaved and space-consuming.

In 2040 Sloterdijk will be perhaps the most dense living environment integrated with train station in the Netherlands, although it does not mean that successful. High density will result in new spatial conflicts and pressure on infrastructure and public spaces.
In this context, the prospect of over track development creates a chance to integrate two sides of tracks, and introduce demanded public facilities, renewable energy, intuitive transfer hub and sense of place.









Station Breda. Source: https://www.koenvan-velsen.com/nl/projects/70/ov-terminal

Can megastructure be the future-proof answer to the challenge of densification?

Survey described in the article. Source: https://www.deingenieur.nl/artikel/breda-opent-multifunctioneel-station

The first station of Breda was a modest timber building, as it was located outside of the fortified city and needed to be quickly removed. In 1975, a second generation of station came, which was based on the modernist concept; simple, overarching canopy, integrating station facilities. Thanks to development of high-speed line HSL Zuid, Breda, became the last station in the Netherlands on the way to Brussels and Paris, at the expense of Roosendaal.

The station was co-funded by the national government as one of the New Key Projects, increasing the international connectivity.

The complex was inaugurated in 2016, and in 2017 it was awarded as the “building of the year”. Beside the station, the TSAD project in Breda transforms the strip of land next to the tracks. New housing introduced on the eastern side will add well-needed park.

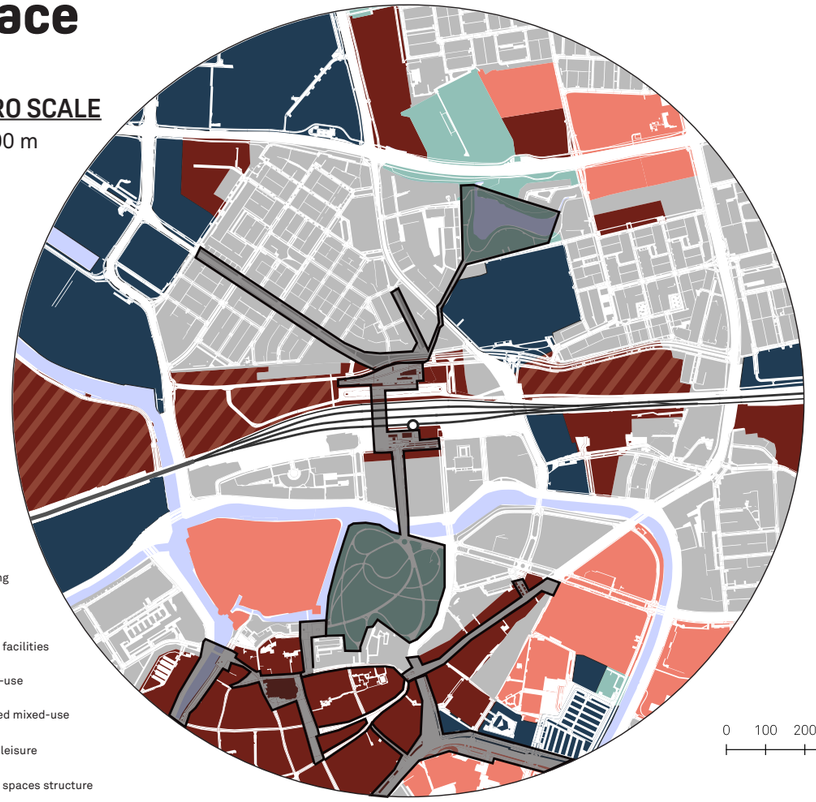
The station integrates housing, offices, small shopping passage, parking for cars and bike. Bus station was also integrated in the building, as it was another platform of the station.

Criticism towards station was visible in the surveys conducted by the local media. Users mentioned dark, unpleasant and unsafe interior, which contrasts with warm exterior. It is hard to navigate in the tunnel, and even to find the main entrance, or access the station from the parking lot.

Place

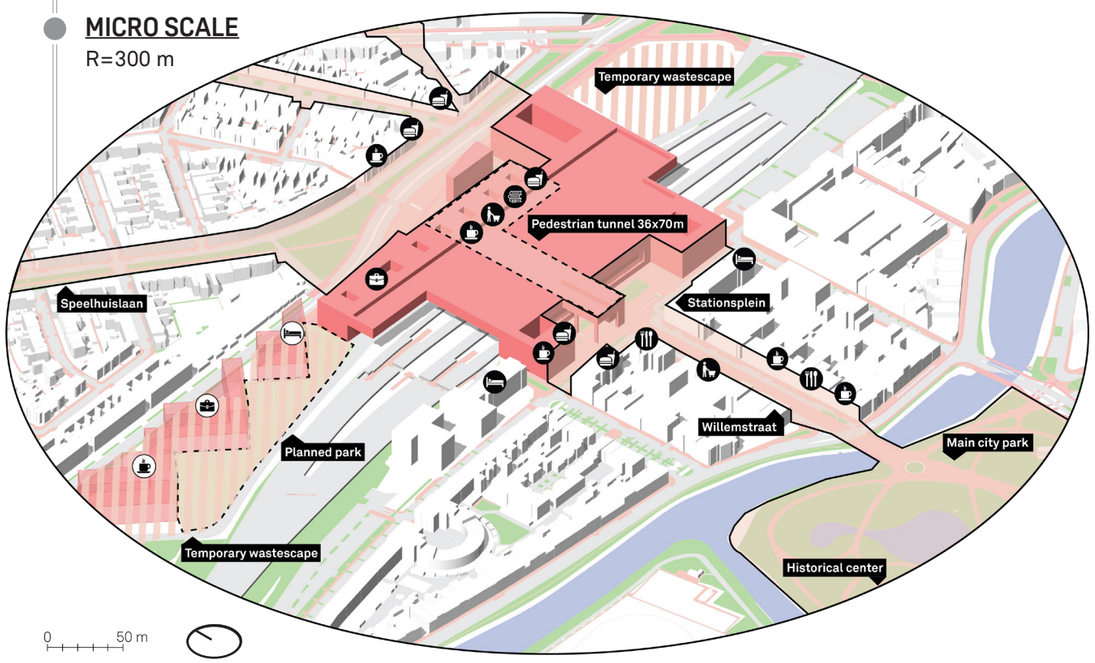
MACRO SCALE

R=1000 m



MICRO SCALE

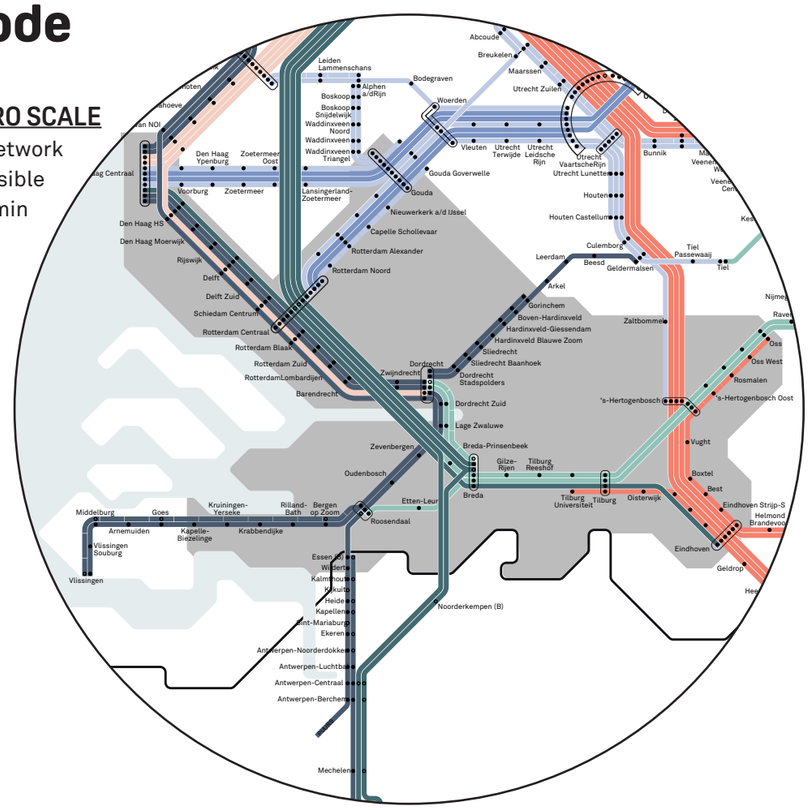
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Node

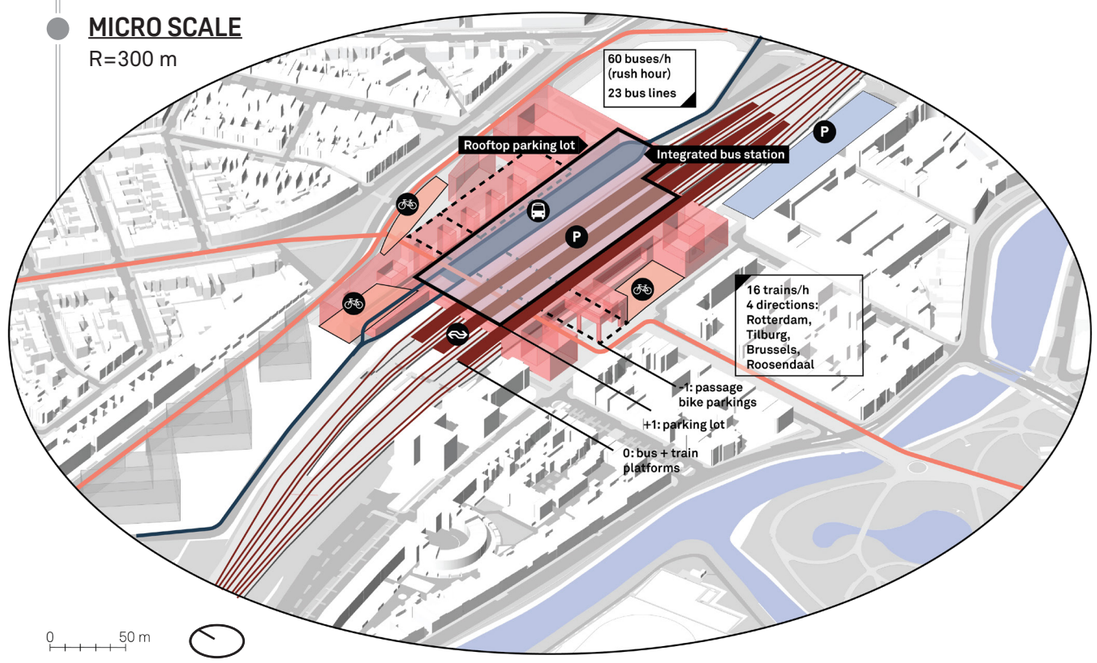
MACRO SCALE

Rail network accessible in 60 min



MICRO SCALE

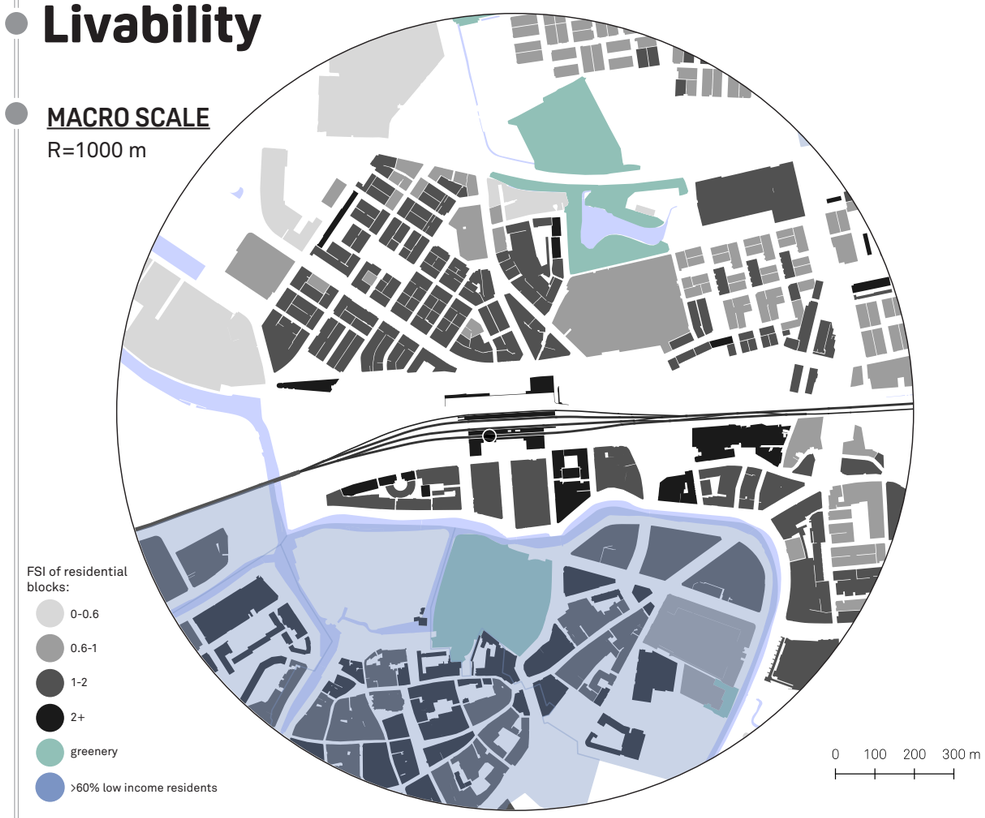
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Livability

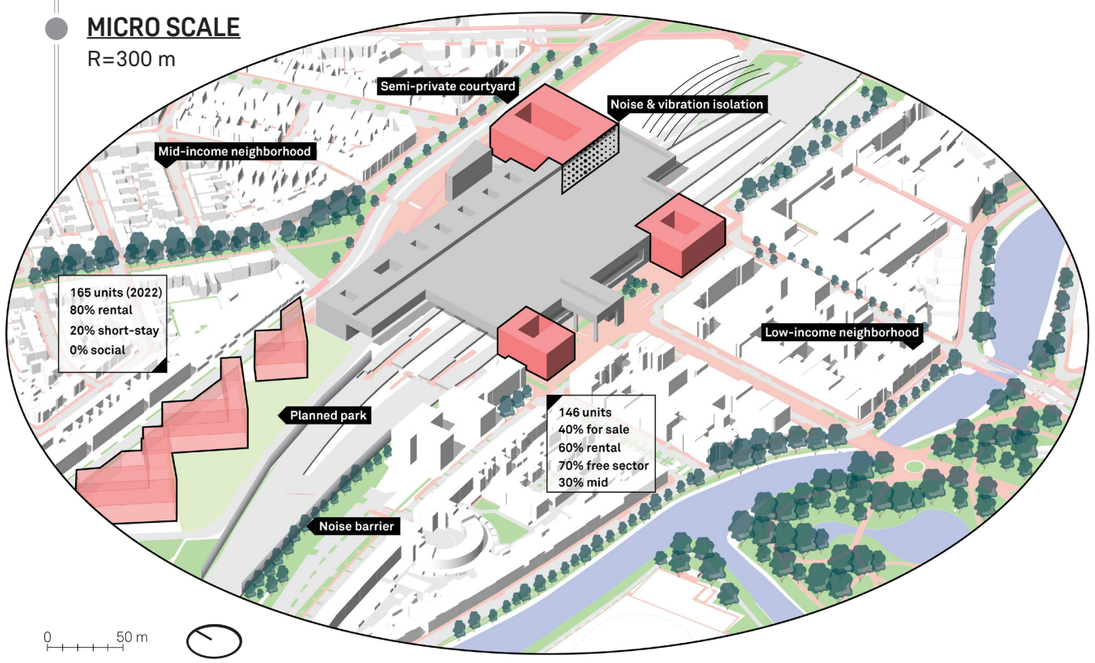
MACRO SCALE

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MICRO SCALE

R=300 m

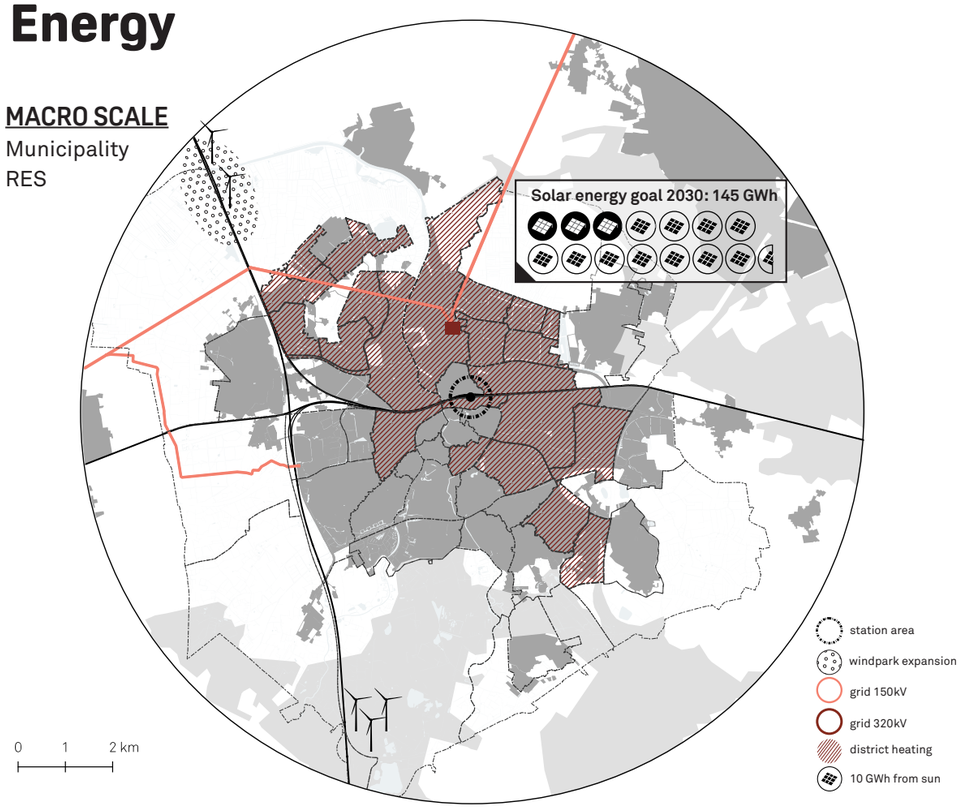


Energy

MACRO SCALE

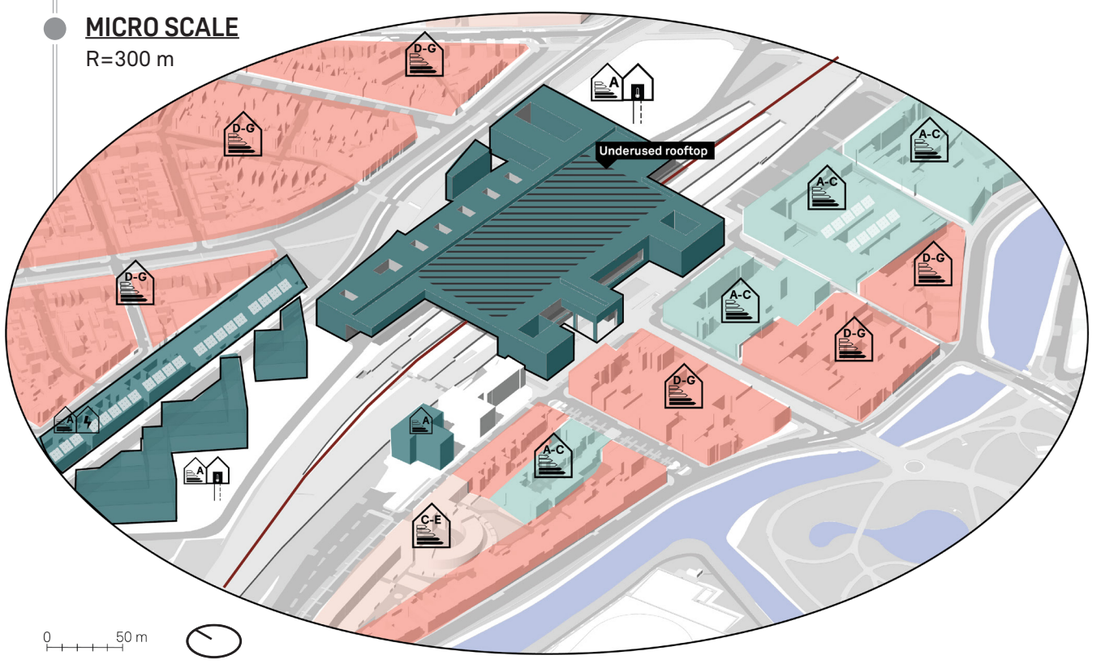
Municipality

RES

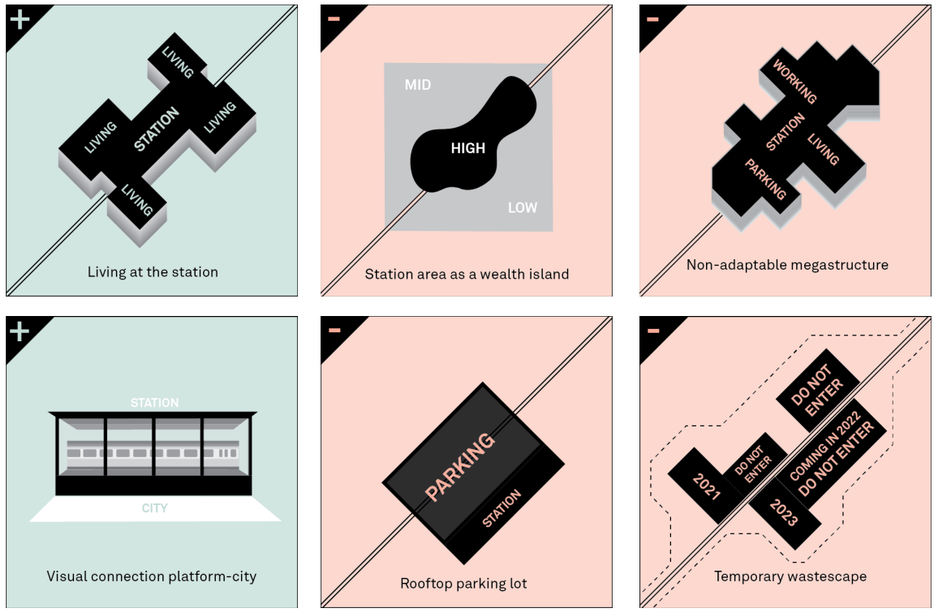


MICRO SCALE

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PATTERNS



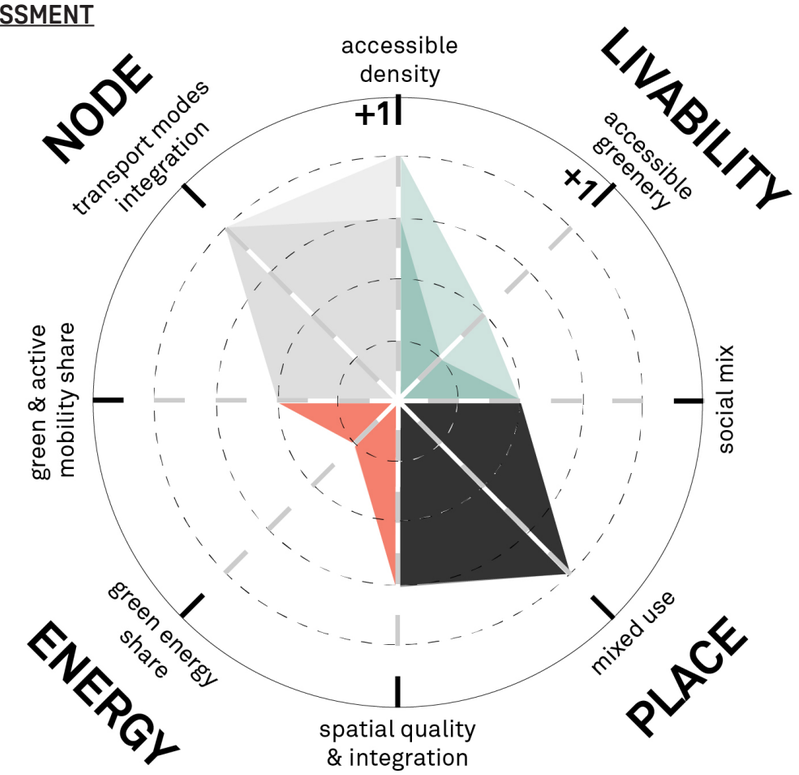
Station Breda represents a contemporary European take on stations as megastructures, which can be related to the Metabolist movement in Japan in the 1960s. However, Metabolists postulated design with change in mind, where built environment was an open system. Conversely, Breda station is carved as an stand-alone sculpture, so that every modification would spoil carefully designed composition.

This approach is obviously opposing the principles of adaptable design, in large whole can consists of components that can be modified. Stations areas are the most dynamic parts of the city, nevertheless station in Breda was designed as a monument, with detrimental confidence that it will last for century, without much adaptation needed.

The fact that station Breda is a breakthrough in integration of living environment with mobility hubs in the Netherlands should not be disregarded. Introduced residential blocks have their own semi-private courtyards and proper sunlight exposure. Residents can enjoy the peace and quiet, as the entrances are not facing busy passages, and walls facing the platforms are well isolated against noise and vibration. This make the housing suitable not only young professionals. However, in terms of equity Breda is scoring fairly poor. It is because there is barely any housing with social rent developed in the station area.

The planned station area is a business card of Breda, following the Euralille rhetorics, European urban district that aims to attract new, rich enough residents and external capital. This may lead to development of an island of premium offices, apartments, hotels

ASSESSMENT



of weak relationship with the surrounding city.

All of this sites scheduled for development in the coming years are now fenced-off and covered with mud. They can be described as temporary wastescapes. The number of users could justify developing temporary land uses, following the example of Sloterdijk.

The assessment of Breda brings worse results than Sloterdijk, especially due to difference in social mix and energy balance. Currently there is little accessible greenery, but with construction of the new park it will presumably reach the level of Sloterdijk.

Main disadvantage of the analyzed station is oversized rooftop parking lot for 720 cars. It creates a large heat island effect and the natural light is not sufficient to lighten the platforms. Even in the sunny day interior lighting is used. the parking deck does not even give direct access to the station, but only to one of the squares. At the same time, such a large surface in not used for energy generation and not even covered by passive green rooftop that could slow down the retention and decrease the heat island effect. According to local media, solar panels were not included due to fire safety and unsuitable construction of the roof, the complex was only optimized in terms of energy usage. and equipped in heat pumps.

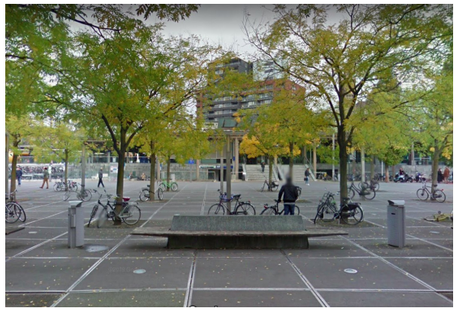
To conclude, the case of Breda provides valuable insights about integration of living environment in the vincinity of train stations, but it perhaps may better serve as an anti-example, presenting the shortfalls of the contemporary development model in a nutshell.





Captions image description as you can see. Source: osm.org





Captions image description as you can see. Source: osm.org

Can organic development and prefabrication result in quality urban spaces?

Enschede grew quickly in the end of 19th century as a booming city of textile industry. The station of Enschede is a terminus both for Dutch and German railways. The German network is not electrified and offers connections to Munster and Dortmund via RegioBahn. When looking and the Dutch rail network, Enschede may appear as periphery. Over two hours by train to Amsterdam and Schiphol Airport is the same time as from Groningen.

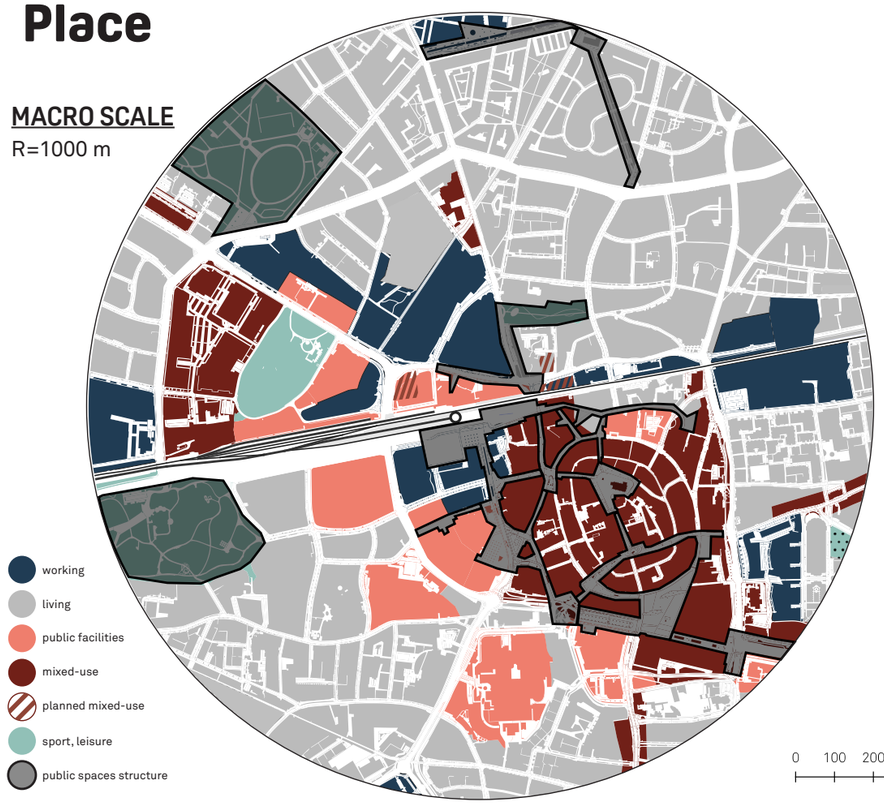
The station area reflected city's fate: after the "textielcrash" of 1970s., when the local textile industry collapsed, it was a desolate area in the middle of shrinking city. In the course of 1990s. Enschede managed to flourish, thanks to the cooperation with Hengelo and Almelo within the urban region of Twente. The city could not count on develoment of central business park, so it focused on new public functions, culture, and housing. The station area experienced gradual urban renewal and now it is located in the midst of a lively city center.

Although, it did not happen through a coherent masterplan, rather a series of smaller developments on the vacant plots. Here worth mentioning is Nationaal Muziekkwartier, a complex connecting theater, music hall, art school, restaurants, hotel, offices and housing. It was developed incrementally over the years 1992-2015, but creates a coherent whole that extends the station square to the east. Enschede branded itself as the city of music and is attracting spectators from other cities or Twente or from Munster.

Place

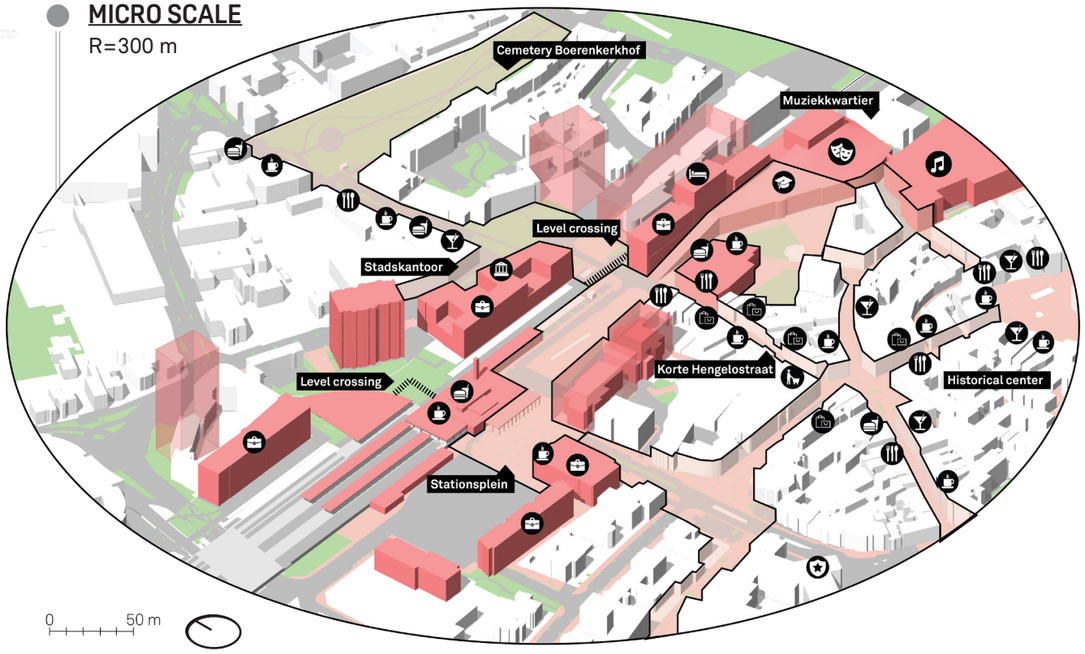
MACRO SCALE

R=1000 m



MICRO SCALE

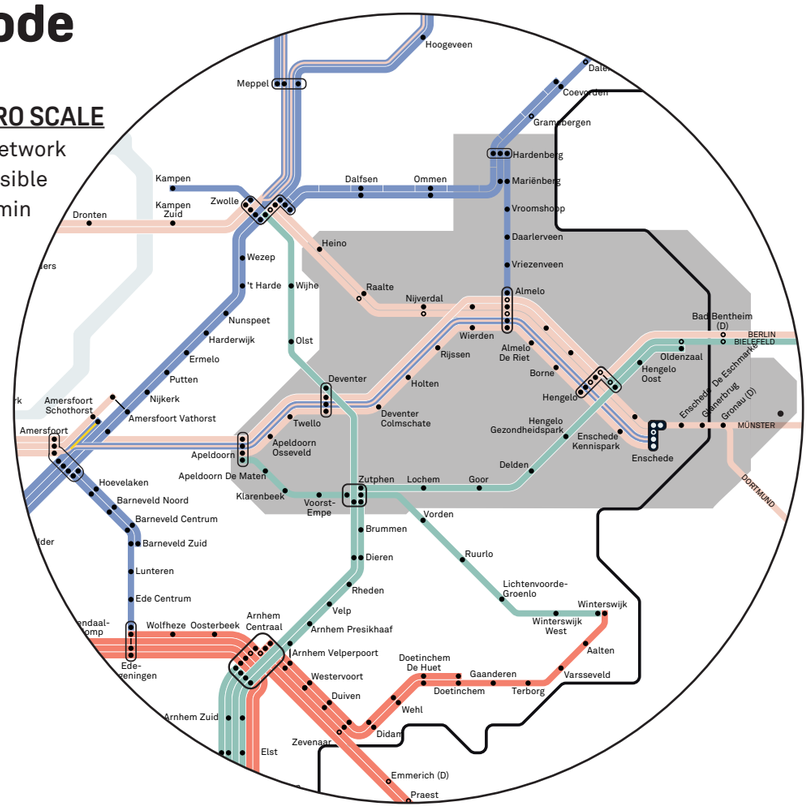
R=300 m



Node

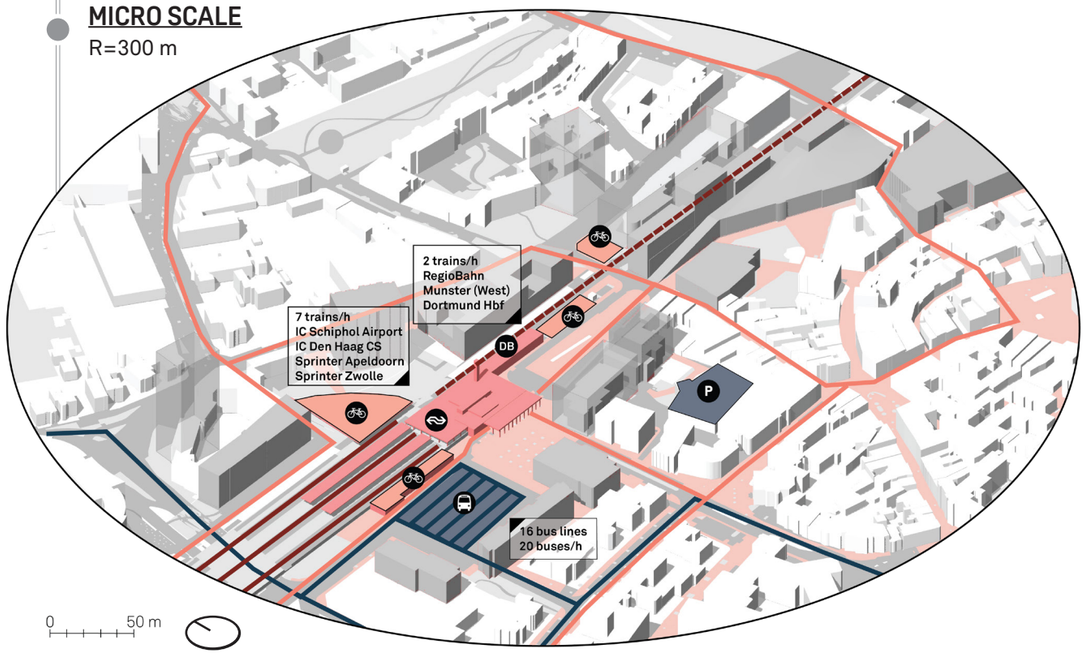
MACRO SCALE

Rail network accessible in 60 min



MICRO SCALE

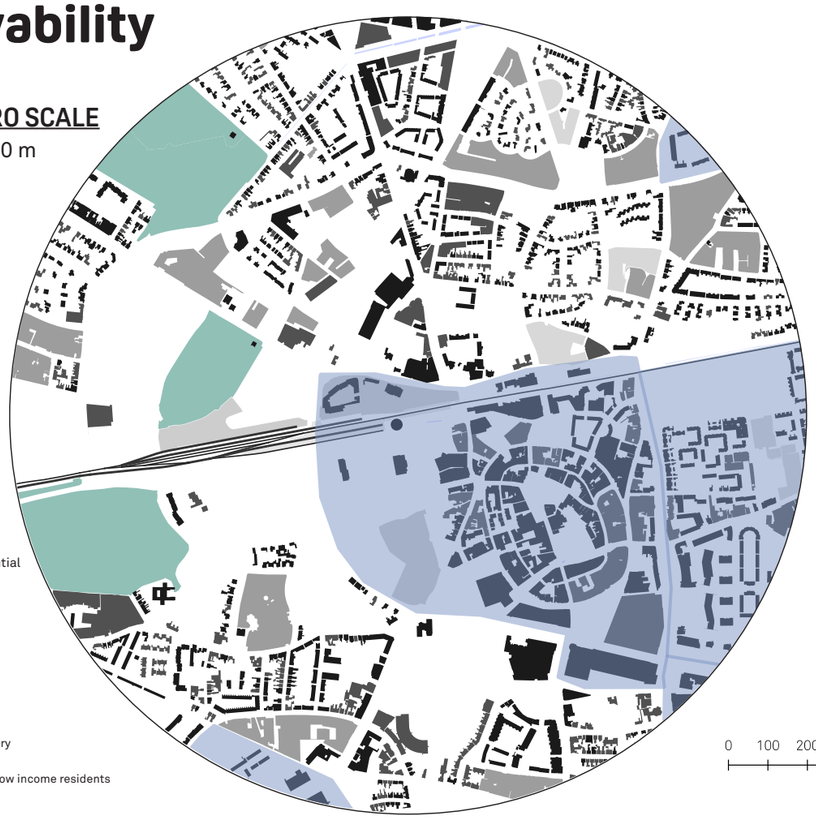
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Livability

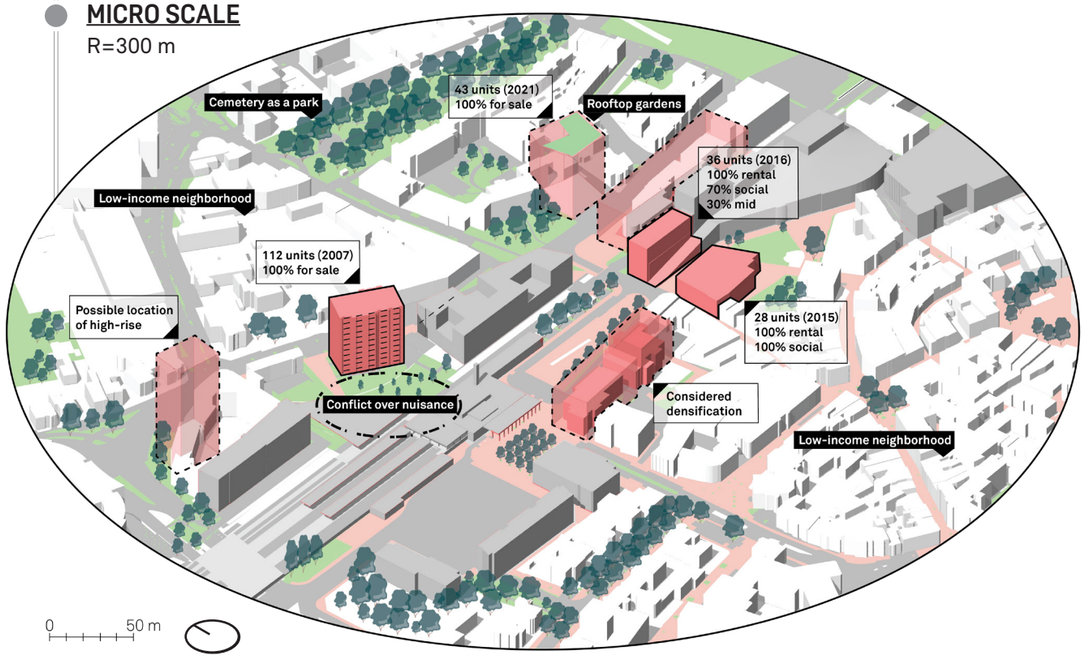
MACRO SCALE

R=1000 m



MICRO SCALE

R=300 m

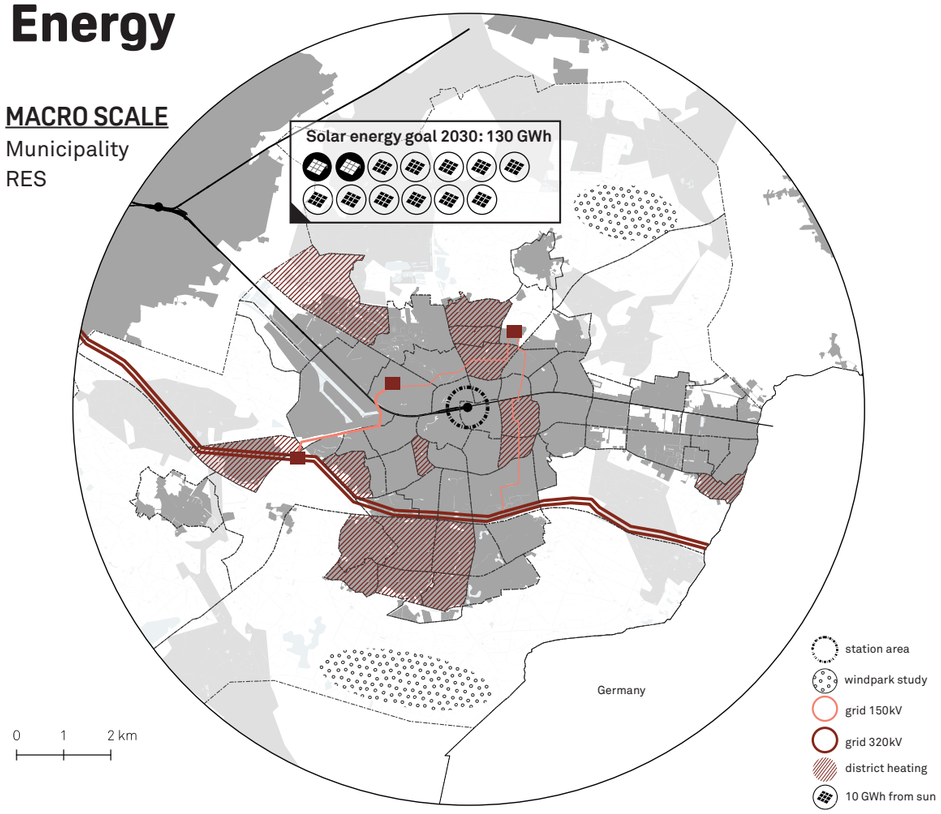


Energy

MACRO SCALE

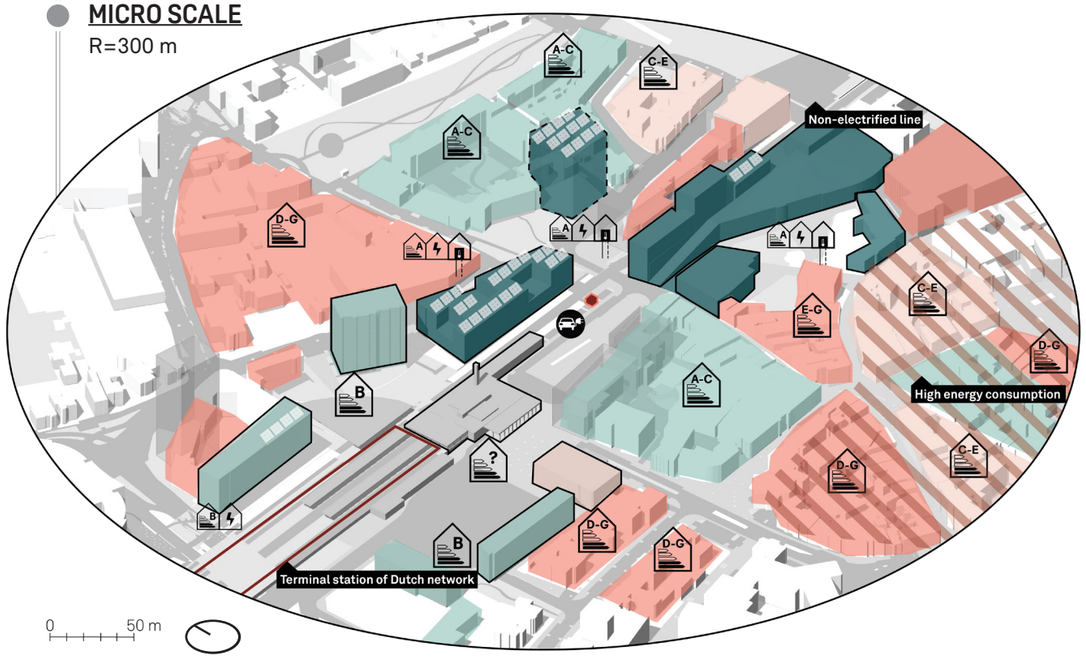
Municipality

RES

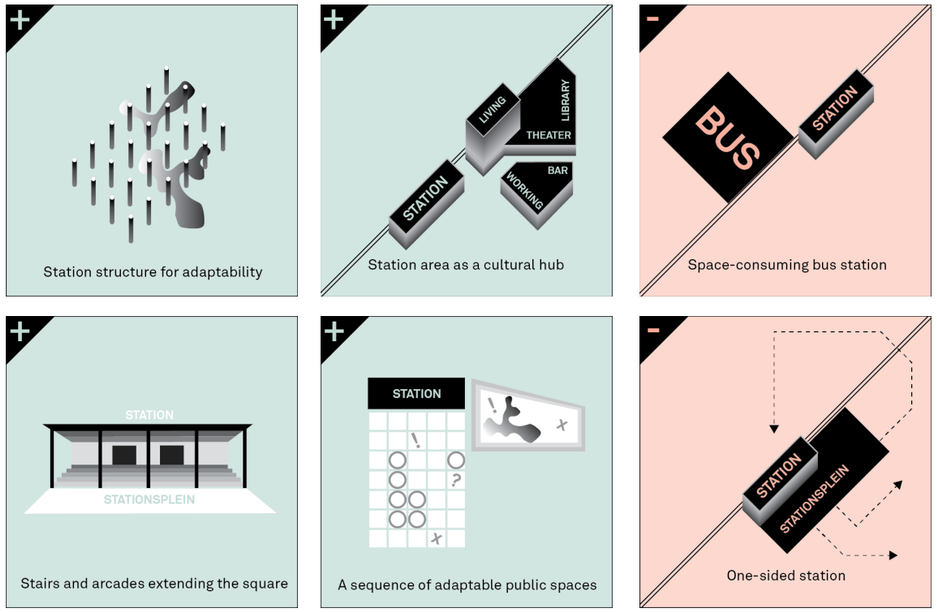


MICRO SCALE

R=300 m



PATTERNS



The station building in Enschede opened in 1950 is a listed monument, and its spatial layout deserves attention. The whole building was constructed from high-quality prefabricated components, based on the modular grid of 5.25 x 5.25 m. This allowed easy modification of the station; in 2000 a new entrance was built facing the southern square. This postwar experimentation was inspired by architecture of Auguste Perret (especially the church Notre Dame du Raincy). A similar project was applied in Zutphen, Hengelo, Arnhem and Leiden.

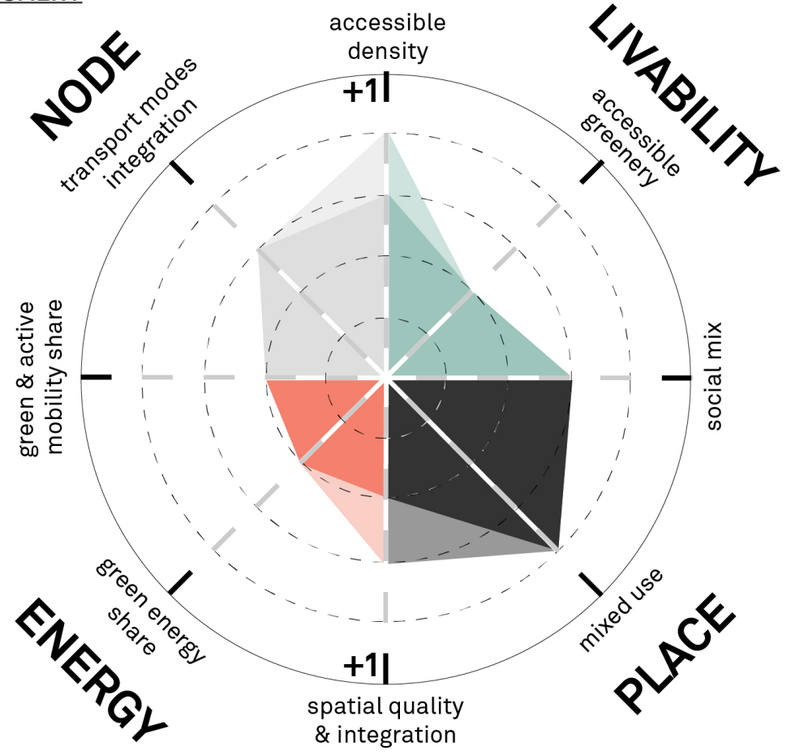
Rergarding the relation with public space, wide stairs and arcades are effectively extending the square and making the station building lively, travellers can stop by, or follow the flow.

The station square in Enschede can be considered as adaptable public space. The southern square is covered by Stelconplaten, concrete tiles in a steel frame known from quays, that can be easily relocated.

The spatial quality of the design is not remarkable, it is still a low-cost space, but the strength lies in its “whiteboard logic”; it may have different layout or colors, depending on temporary use: exhibitions, festivals and events. A dynamic square welcoming newcomers who arrived by train, may bring better results than intricately, top-down designed spaces, like in Breda, which may quickly become obsolete.

Enschede is planning to greenify the eastern square, as there is no underground car park. Instead, the station is served by a parking garage integrated inside the urban block.

ASSESSMENT



The bus station is of static type, similar to the one in Eindhoven. It has eleven platforms and asphalt covers almost one hectare. Only the edge of this runway-like square is used by passengers. For 20 buses per hour a dynamic bus station could be more efficient and compact solution.

The main drawback of the station is its one-sided orientation, which fails to extend the network of public spaces to the northern side of the track. Only since 2015 the station can be reached from this side, where the new bike parking was built. As it is a terminal station both for German and Dutch network, tracks are separated by a barier. The reason why the northern side does not have a continuation of public spaces and had no entrance for years is a conflict with the residents of the highrise apartment buildings. After the construction of bike storage, residents were complaining about nuisance, lack of privacy and safety. This case highlights the importance of quieter, semi-public spaces also in dense station areas.

Enschede has recently drafted a plan for densification of the station area, where special attention is paid to the northern side of the tracks. High-density mixed use could replace the existing housing from the 1970s. and introduction of the northern square could increase the accessible greenery. However, the topic of energy remains unadressed and depends on the developers.

To sum up, the station area in Enschede was not following the widespread TSAD model, but has reached interesting results, even though it developed organically, through experimentation, trial and error method.





Captions image description as you can see. Source: www.spoorbeeld.nl/stations/station-roosendaal





Captions image description as you can see. Source: osm.org

How can small station area contribute to the local community?

The train station in Bergen op Zoom similarly to Breda was initially built from timber, outside of the fortified city. It is a typical line station, less favorably located than Breda, after dismantling the fortress did not grow as much. Station Bergen op Zoom is located on the only line serving the province of Zeeland, connecting Vlissingen to Roosendaal.

The urban fabric around the station is typical for the stations of type 3 and 4 (in the center of small / mid-size city). On the western side there is a historical city center, on the eastern, postwar social housing neighborhood built on the former industrial terrain.

In 1971 the modernist station replaced old timber building. Stations of the 70s. were often described as uniformized and bland, although a piece of art on the facade and sculpture on the square intended to unique.

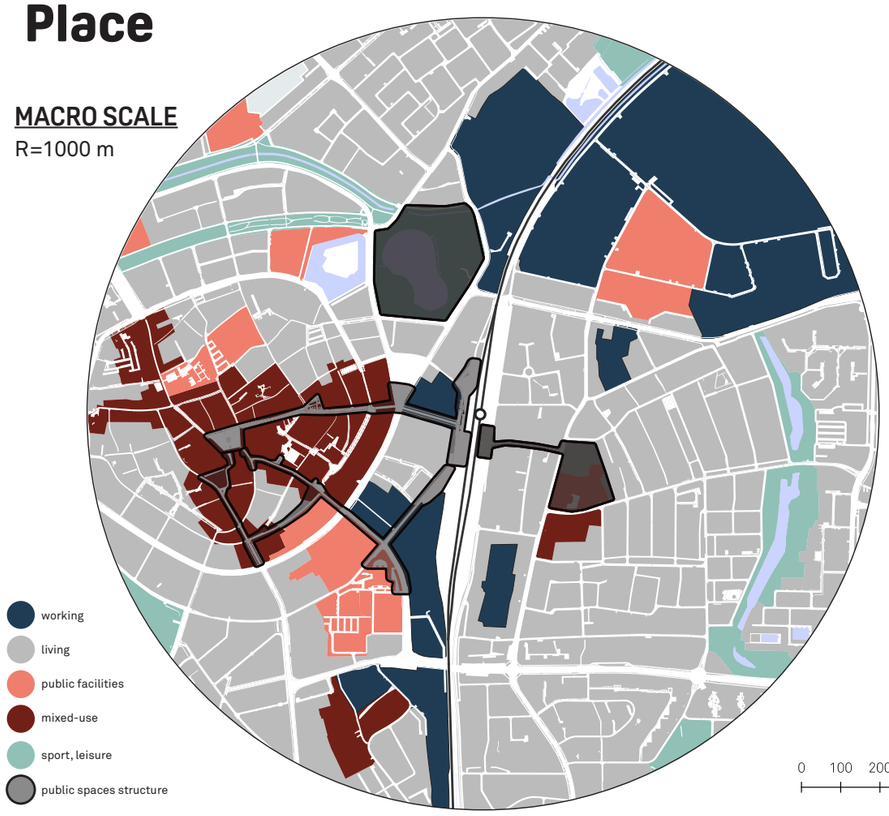
In the 1990s. and 2000s. the municipality tried to follow the model of station as an office hub, as a result five office buildings were built in the south from the station. Although, it was not a coherent redevelopment strategy, municipality only allowed offices in the zonning plan.

After the crisis of 2008 the problem of vacant offices appeared and construction of new stopped. The trajectory of development began to shift in 2015. The bus station, public space, and pedestrian tunnel were renovated, but foremost the three new housing projects started.

Place

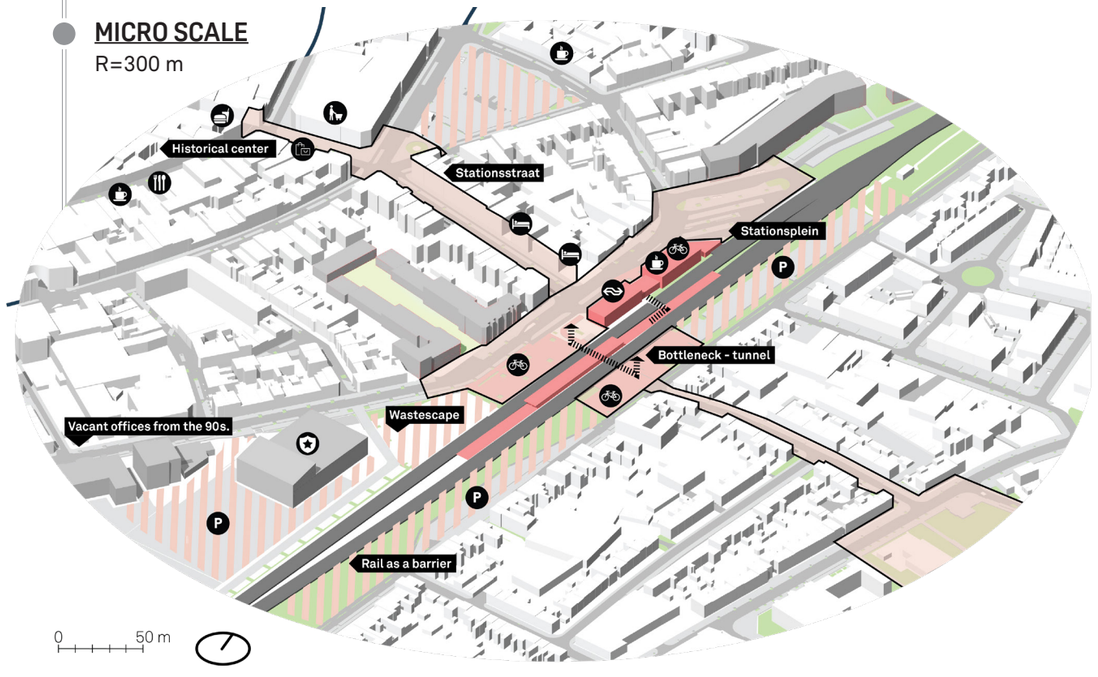
MACRO SCALE

R=1000 m



MICRO SCALE

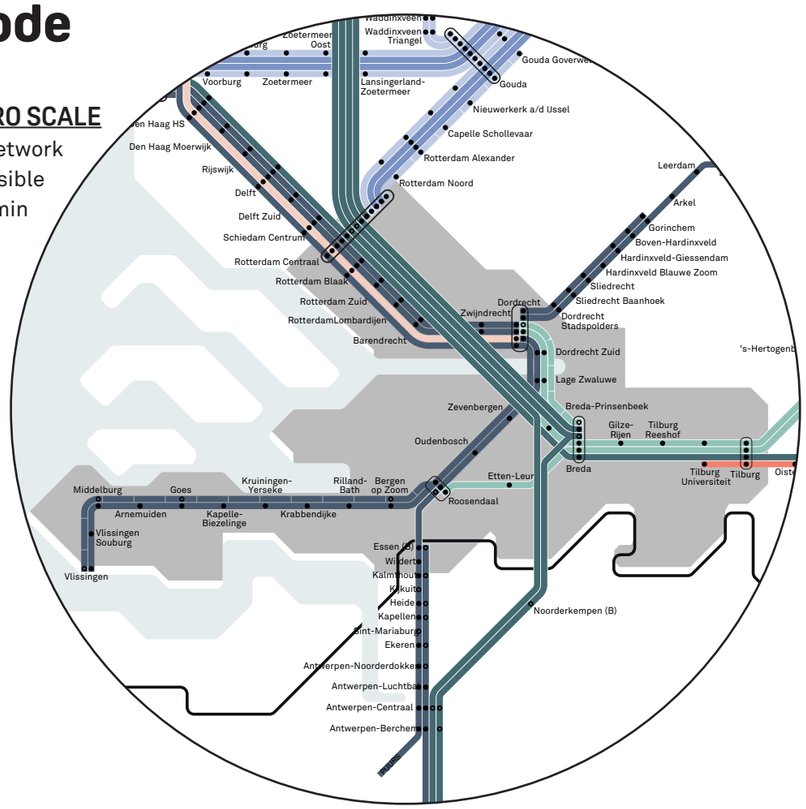
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Node

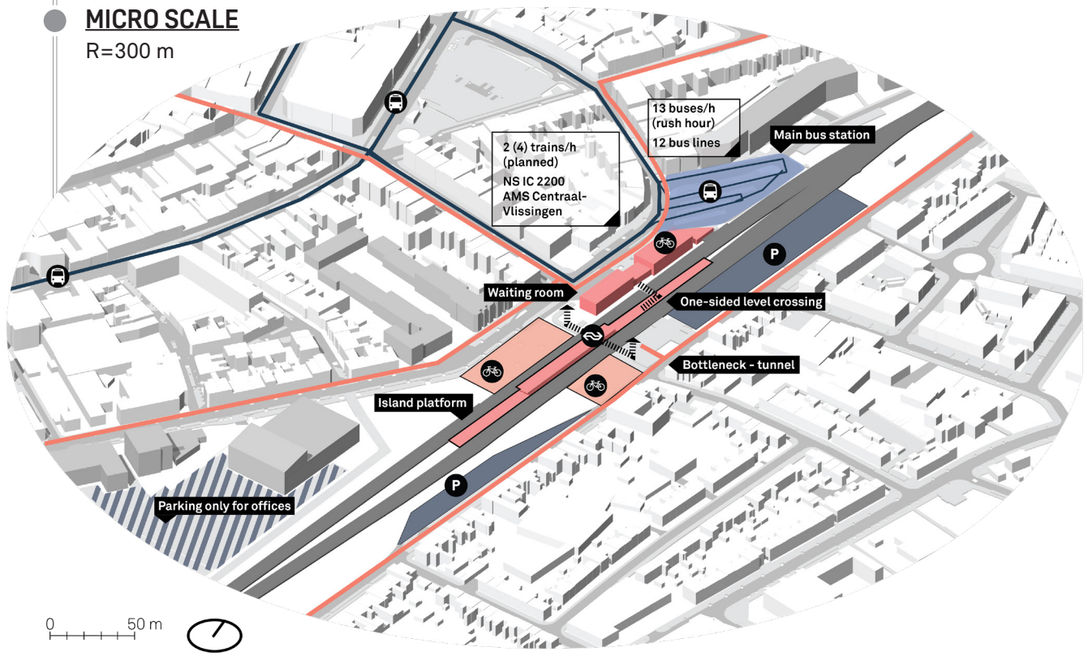
MACRO SCALE

Rail network accessible in 60 min



MICRO SCALE

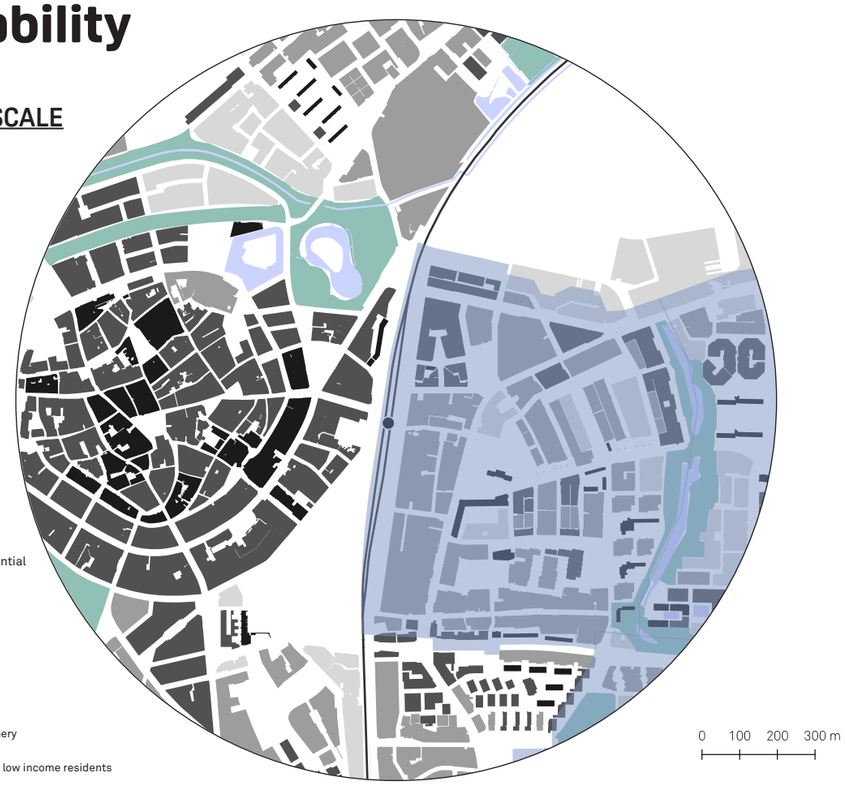
R=300 m



Livability

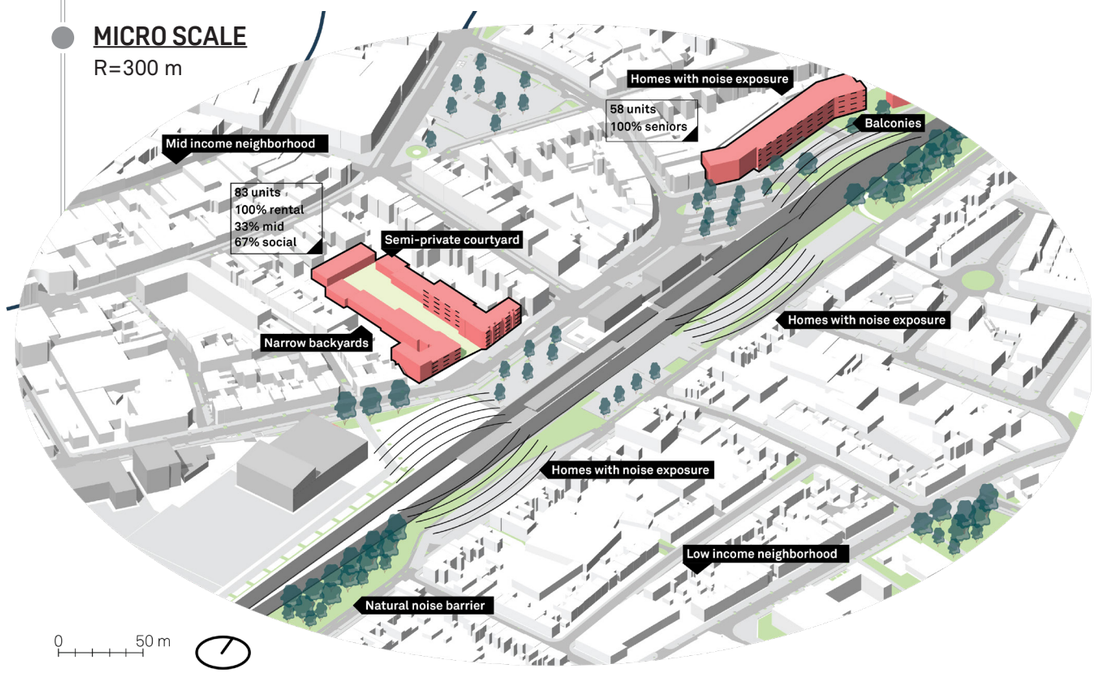
MACRO SCALE

R=1000m



MICRO SCALE

R=300 m

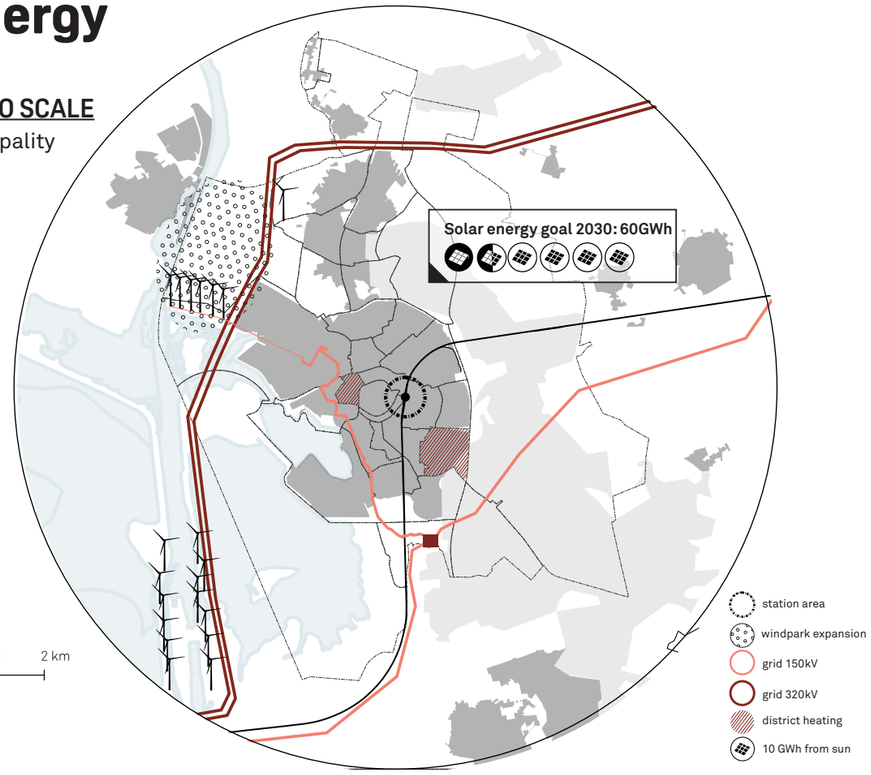


Energy

MACRO SCALE

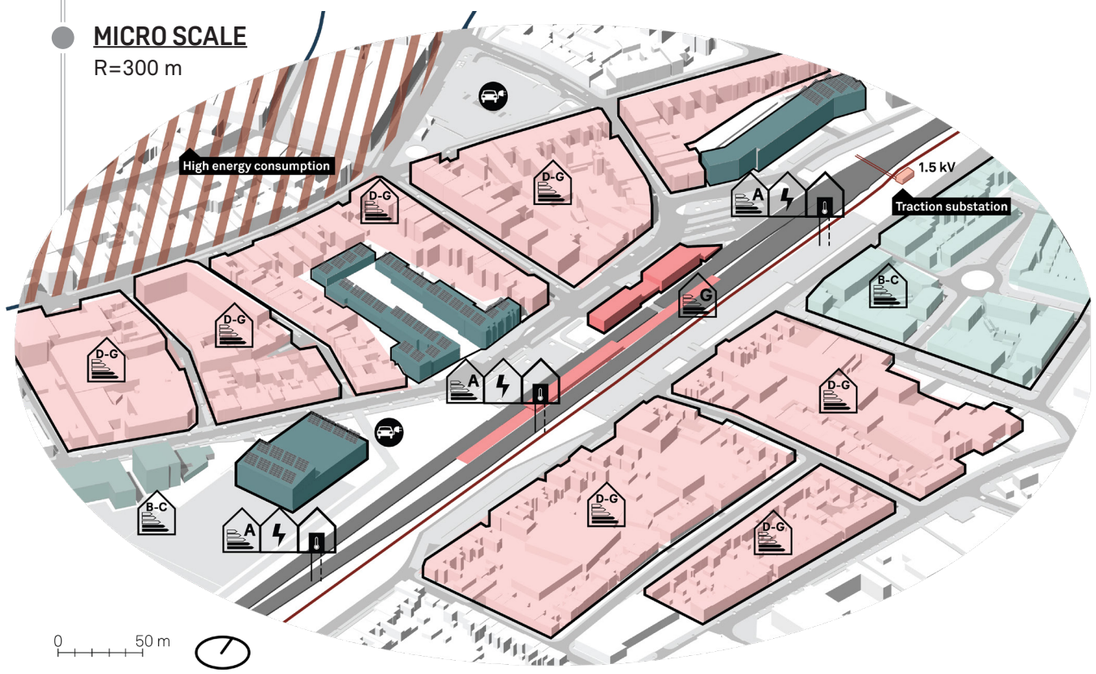
Municipality

RES

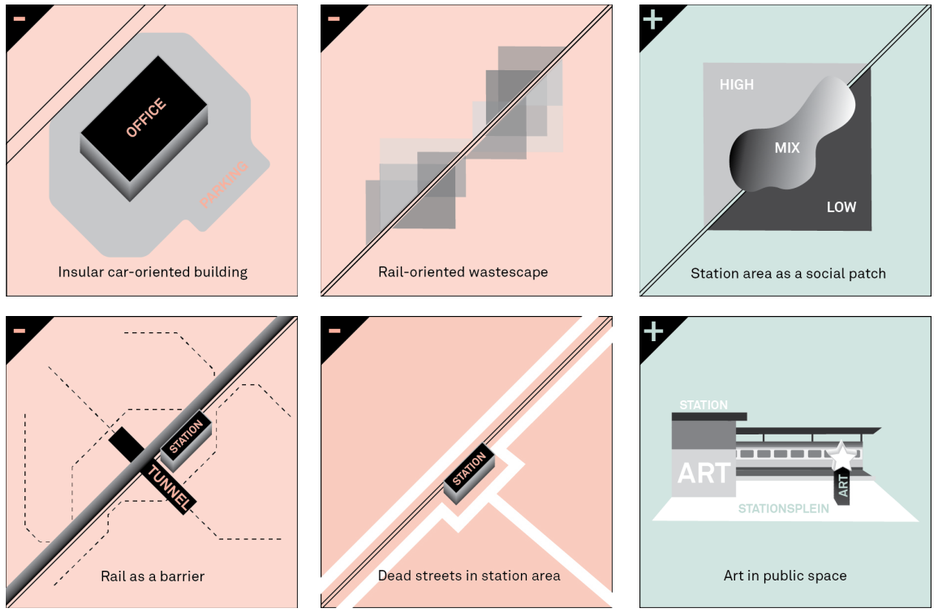


MICRO SCALE

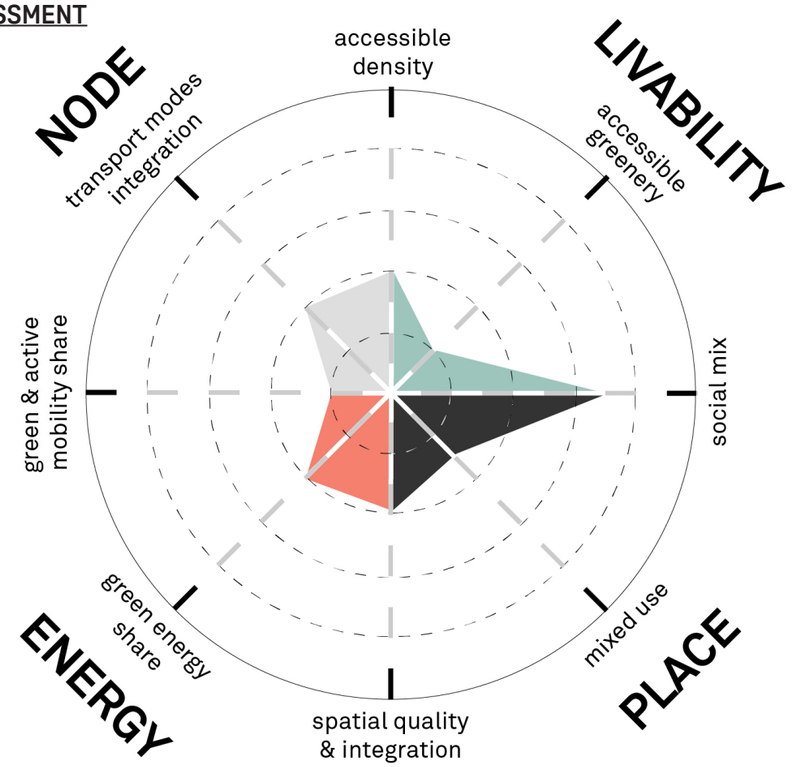
R=300 m



PATTERNS



ASSESSMENT



Bergen op Zoom presents a typical configuration in which station is dividing the city socially and spatially. The low-income neighborhood is connected with the mid-income city center by a narrow pedestrian tunnel.

Even though the station is located in the city center, it's surrounding is missing public functions. The last part of station street has no active plinths and it is not intuitive for the newcomer, where the actual city center is located. Beside the small station square, spatial quality is lower than in the city center. Many plots facing tracks can be considered as rail-oriented wasescapes; they are not contributing to the station functioning, nor the city.

The existing zonning plan has preservative character and no vision for the station area was formulated as of 2020. In the effect, the new police station was built on the empty plots owned by municipality. The building surrounded by a vast car park represents a typology more relevant for a suburban business park than city center.

In 2022 NS is planning to renovate the station building, mainly by improving waiting room and adding toilets. According to plans, the number of trains per hour will also increase to four. RegioSprinter will stop on every station of line Roosendaal- Vlissingen, while full quality IC will stop on stations Vlissingen, Middelburg, Goes, Bergen op Zoom and Roosendaal, offering travel time 15 min shorter. This will result in more frequent connections (now every 30 min), competitiveness to car and increased node importance of the station.

Local bus station is a dynamic type, which makes it relatively compact. Simple, open-air bike racks are available on both sides of the tracks. Bike storage is also available in the station building, however it is small and only the first 24h is free.

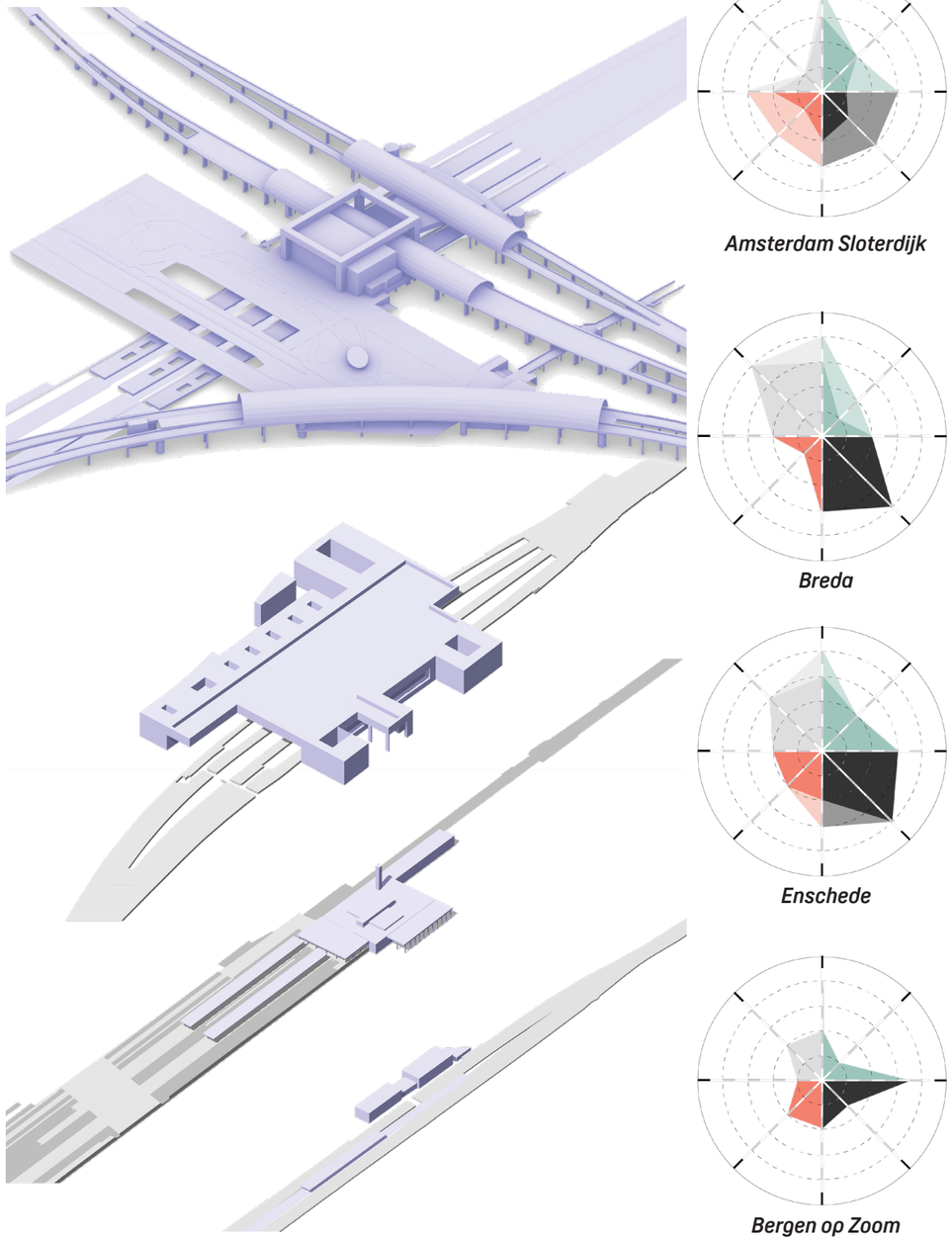
Each of the new residential buildings and the police station is producing its own electricity and heat and is labelled A. The station building itself has the category G, and large empty plots create a potential for energy generation. Urban blocks in the station area are labelled quite poorly (D-G), as the share of historical buildings is high. On the edge of 300 m radius starts the historical center, where the gas and electricity consumption per hectare is the highest in the city, beside industry (Datavoorziening Energietransitie Gebouwde Omgeving, 2020).

The main advantage of the station is social mix introduced by the recent development. Three new housing projects provide apartments for seniors, care home for autistic children, and rental apartments with a balance of social and mid rents. It may be the first step for the station area acting as a social patch.

The weak part of living environment around the station is lack of accessible greenery. A major park is located in the north, outside of the station area, while all greenery within the 300 m radius does not have leisure qualities, but rather serve as a buffer from infrastructure or a noise barrier.

To conclude, station is poorly rated as most of the potential of the location remains underused. Bergen op Zoom needs to define a vision of its station area, to truly serve the needs of local community.

Conclusion



Amsterdam Sloterdijk

Breda

Enschede

Bergen op Zoom

This report covers two initial phases of the graduation project: problem analysis and deconstruction of cases. Analyzed stations allowed to confirm the hypothesis that the dominant model of station area development in the Netherlands is still based on neoliberal principles of the 1990s. of the influence of neoliberalization on train station areas in the Netherlands.

The case of Breda shows that following the neoliberal model paid back in large urban transformation with financial support of the national government, but the spatial outcome is controversial and not widely appreciated by the users. It may also be a burden when facing future transitions, as the station and its surroundings is not designed with adaptability in mind, but rather as a top-down architectural object.

Enschede, although a city of similar size, also located next to the border, is a case contrasting with Breda. Cities of less connected, more peripheral regions, could not be very successful in realizing large commercial projects. Perhaps this lack of dynamic growth has saved the unique postwar station, now listed monument (similar station in Leiden was demolished in the 1990s.). Interestingly, Enschede relied on its regional potential of Twente and trans-border cooperation with Munster, and through trial and error it has developed its own recipe for train station area. Urban fabric around the station is diverse and relatively dense, and the complex of Nationaal Muziekkwartier makes the whole area a regional cultural destination.

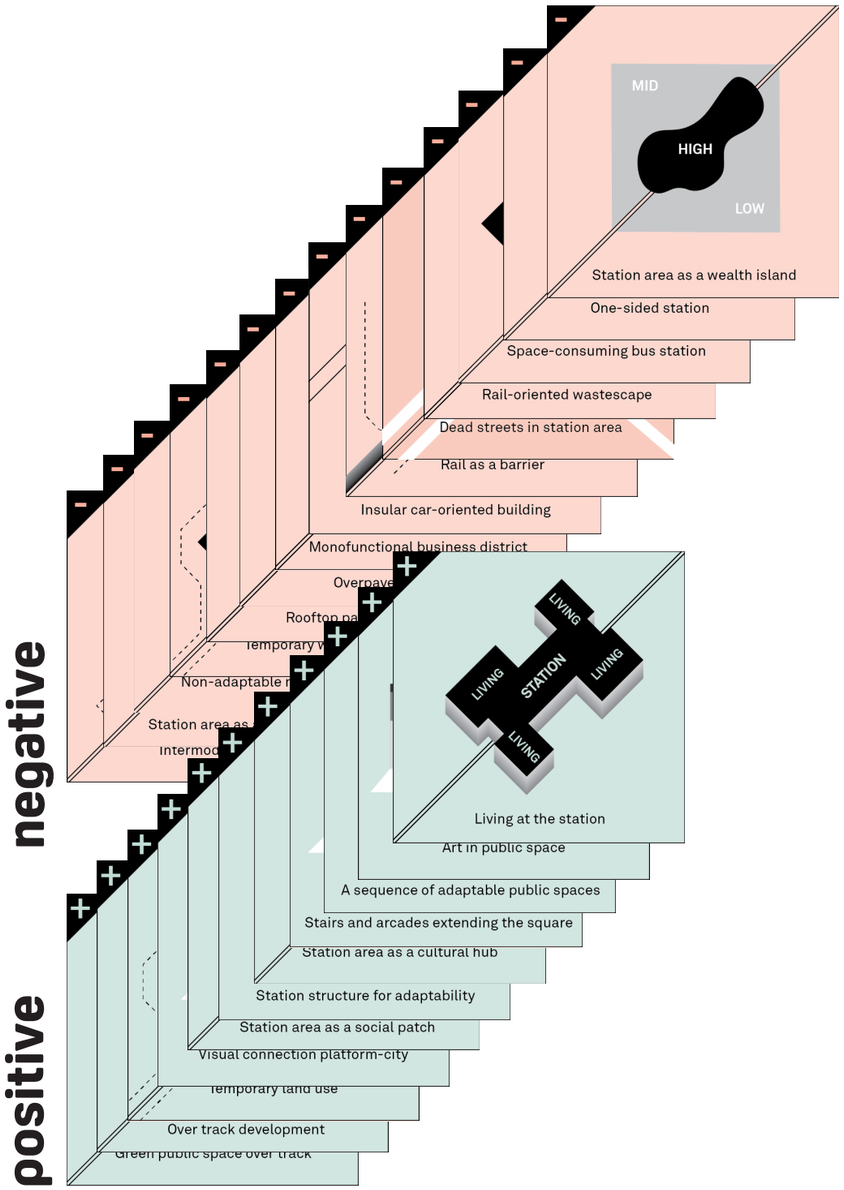
The most promising site is clearly Sloterdijk, as the municipality of Amsterdam has extremely high ambitions and all political and financial means to realize them. The major challenge is to overcome the limitations of a business park squeezed between industrial harbor and isolated from the city by spatial barriers of railway and highway. In this context Sloterdijk can become a benchmark project for sustainable densification in train station areas... or another problematic legacy for future generations.

As a complete opposite of Sloterdijk, station area in Bergen op Zoom has no clear future prospects. The preservative character of the current zonning plan does not allow new development, and municipality has not formulated any ambitions regarding the role of the station in the city. Bergen op Zoom will be a second case to apply design in this project, as it can small stations.

In the phase of applied design, are selected for further elaboration. The cases of Breda and Enschede has brought a valuable input, for the pattern language, but applying design can be on two contrasting locations of metropolitan hub in Sloterdijk and local station in Bergen op Zoom.

Selection of two contrasting design locations will allow to generate patterns that can be adequate regardless station size. I would like to clearly state, that, even in the context of densification, usually related with large cities.

From patterns to pattern language



Constructing a pattern language

The end of this report, opens the third phase of the project. It will be crucial for the formation of its design toolbox - a pattern language. The patterns extracted from the analyzed cases will serve as initial input, but they will not make up the whole language. They also require a proper description of theoretical back up and practical implication, it will be added in the upcoming phase.

New positive patterns will be developed as a reponse to negative patterns, because the language should be oriented on desireable future. Also new patterns will be created on the basis of literature, fieldwork and professional work. The pattern language will be developed through the iterative process until the next presentation P3, when a draft version will be presented.

Developing and testing design scenarios

After the presentation of draft pattern language, the iterative adjustments will continue. Simultaneously, the fourth phase of the project will start, which will consider landing of patterns in the local contexts of Bergen op Zoom and Amsterdam Sloterdijk. Developing design scenarios from different configurations of patterns will provide feedback loops, improving the pattern language. During this phase, fieldwork and input from practice at PosadMaxwan will gain importance.

For the purpose of scenario testing, the assessment framework will be adjusted, so that part of the criteria can be actually calculated. Calculating exact values of crititeria was not desireable in the case studies phase, as it led to extracting patterns, but it will be relevant as a quantified decision-making tool. Scenario with the highest score, or properly balanced values of each dimension (place, node, living, energy) will be selected.

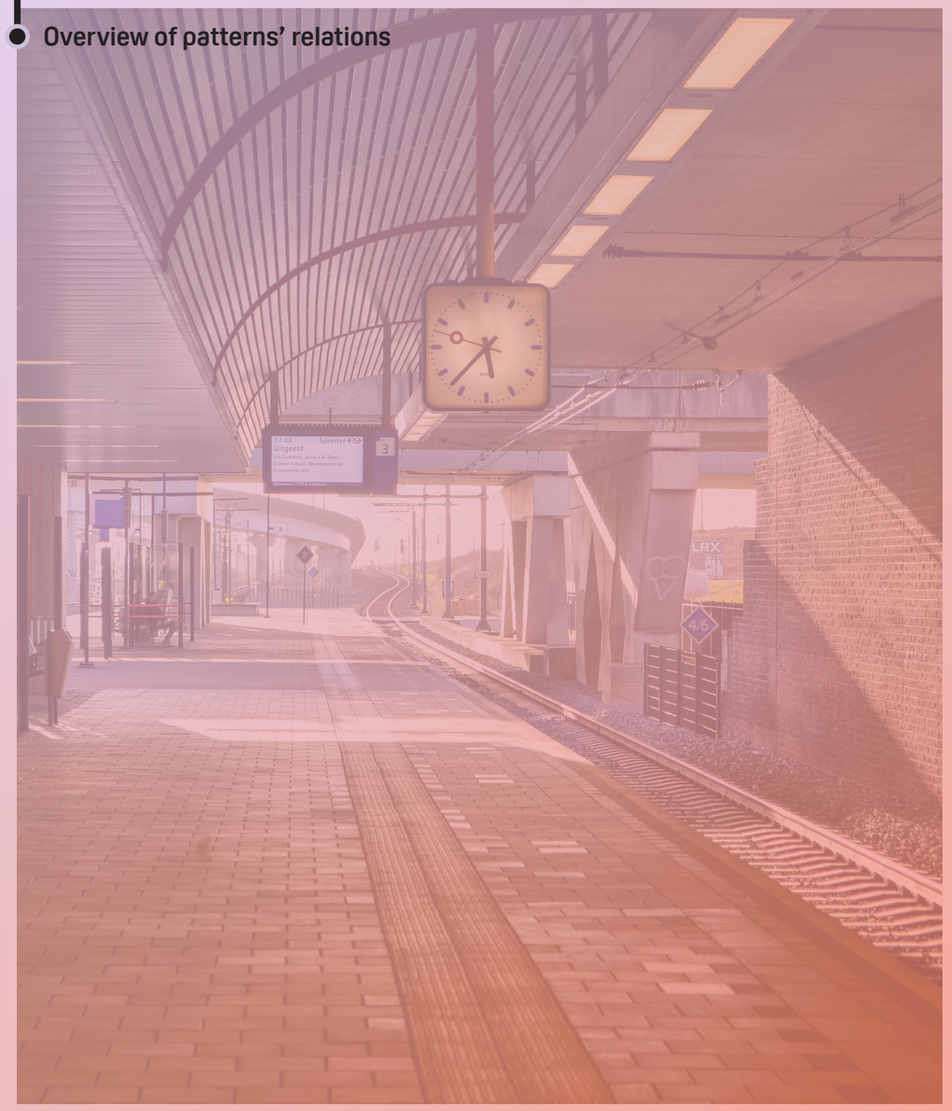
A window of opportunity

Despite the described negative tendencies of unsustainable development in the last decade, there are positive prospects for 2030, and Dutch municipalities tend to learn from the past mistakes. More emphazis is put on equity of new development, planned urban fabric around the rail nodes is less dependent on supply from the grid. However, this local efforts and ambitions need a coherent line of national policy. This project aims to provide the recommendations, on how to address the development of station areas.

In te Netherlands there is a prospect of the national government regaining its agency in the field of housing and spatial development. Across the world of economics and politics, the Netherlands being no exception, the pandemic evokes a desire not to be back to business as usual, but to radically transform our economies to sustainable and socially just.

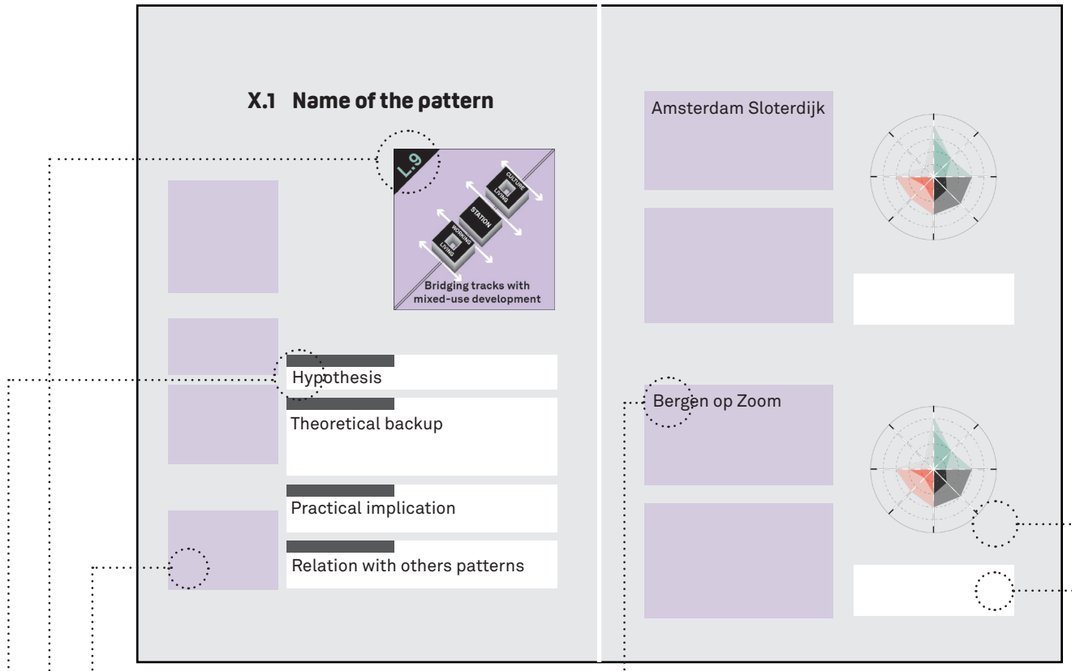
05 A pattern language

- Node
- Place
- Livability
- Energy
- Overview of patterns' relations



Interrelated patterns offer more possiblities than a toolbox and may help with decision-making and defining the program of station area with multiple stakeholders.

You will find the overview of pattern's relations at the end of the catalog. It is also documenting reseach by design process and design variants explored for Bergen op Zoom and Amsterdam Sloterdijk.



References that helped to create a pattern, illustrating the theoretical backup.

Diagram depicting pattern

Brief description for pattern cards: how pattern works if properly applied.

Plan or section of on-site testing. Synergical patterns are drawn in dashed lines

Assessment of tested pattern - how it improves status quo of the location

Conclusion from the test.

Testing locations

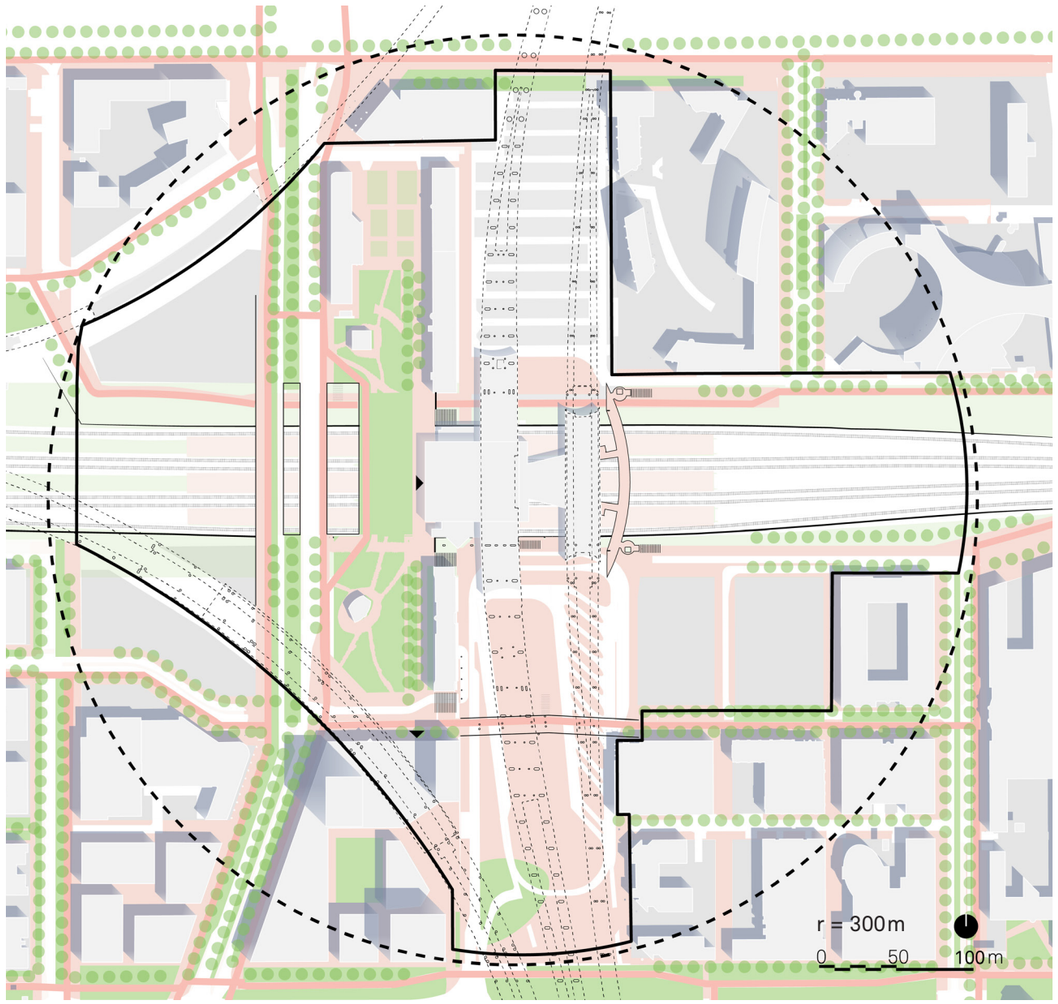
Legend:

- public greenery
- walkable public spaces
- cycling infrastructure
- urban blocks

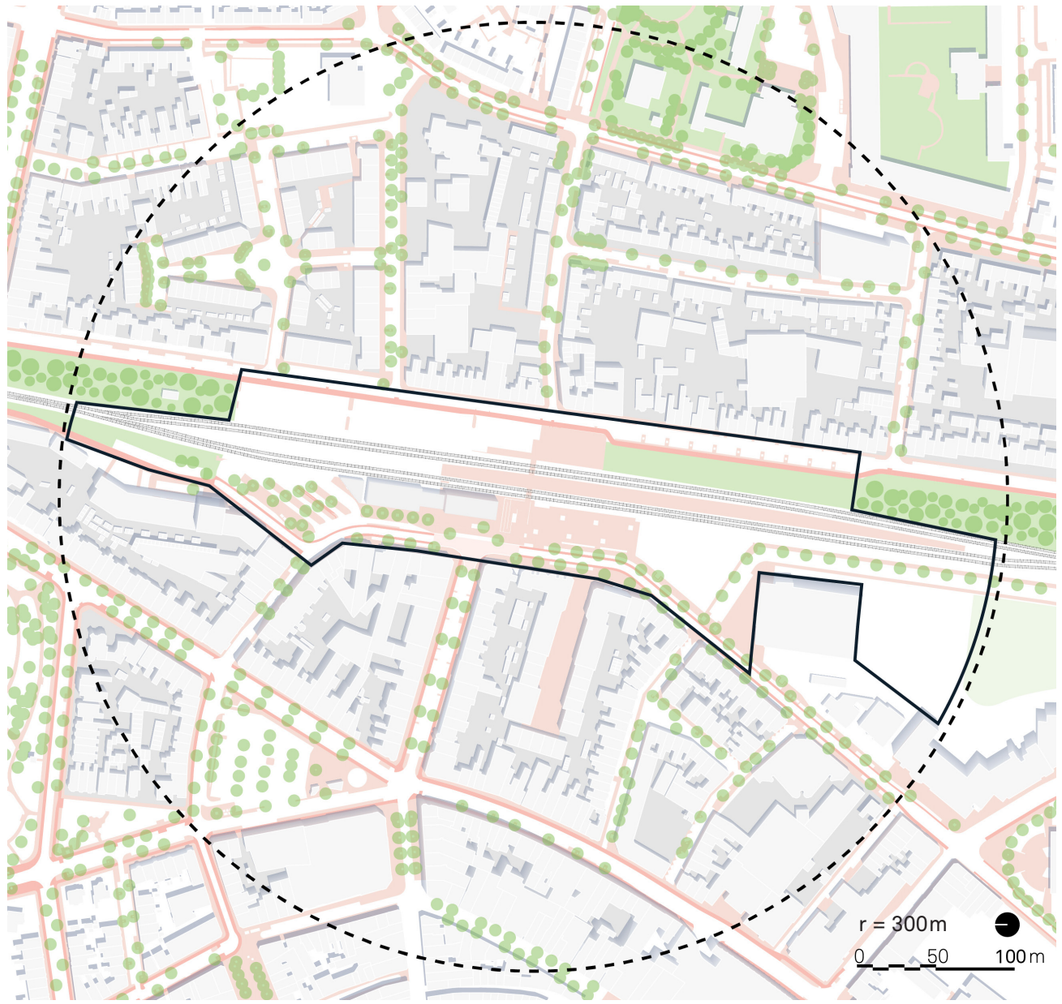
Testing patterns means drawing their spatial layouts in two selected station areas and assessing how they have changed the existing state.

Maps below indicate the area with the largest development potential, within the radius of 300 m from the middle of each train station. There patterns will be applied.

Amsterdam Sloterdijk

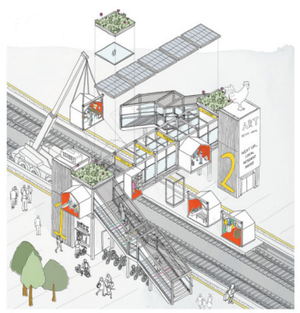


Bergen op Zoom

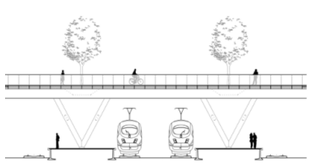


N.1 Modular footbridge

References:



Modular bridge concept for n/National Rail (UK). Source: Hawkings/Brown

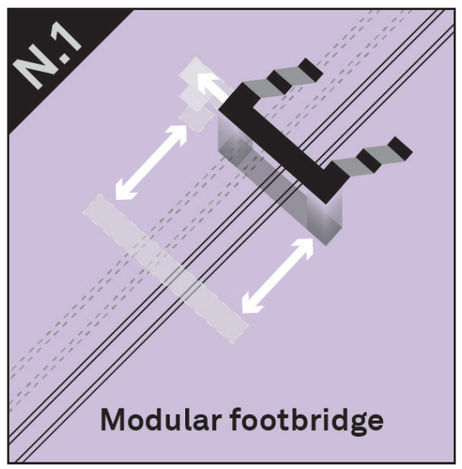




Prefabricated Morelsebrug, Utrecht Centraal. Source: cepezed.nl



Footbridge in Zwolle. Source: Karres en Brands



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Modular bridges for cyclists and pedestrians could improve connectivity of the station areas, where rail act as a barrier or where a tunnel has insufficient capacity or limited access as NS-ticket zone.

THEORETICAL BACK UP Practice shows that footbridges are much more flexible and cost-effective than tunnels, however the height difference is larger and are not the best solution for cyclists in urban areas. The minimum footbridge level is 6 meters above the tracks. Most of the large stations in the Netherlands already allow access to the platforms via tunnel. Due to NS-ticket zone there is often a demand for alternative connections across the station area.

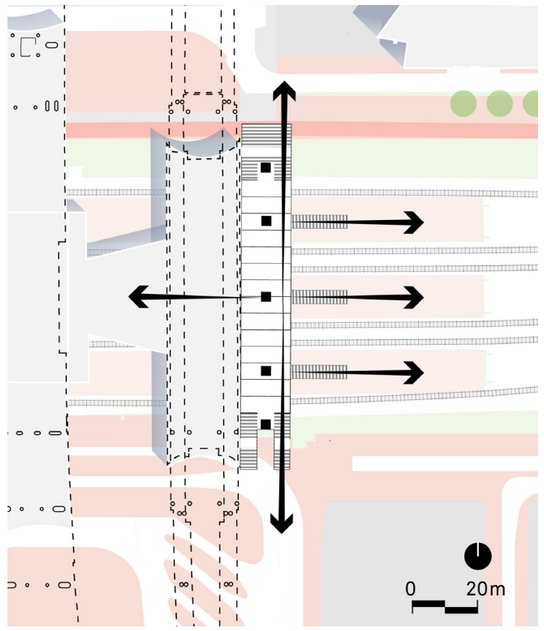
PRACTICAL IMPLICATION

- Designed to dismantle from sustainable materials.
- Easily movable in case of new construction in station area.
- Stairs and elevator shafts

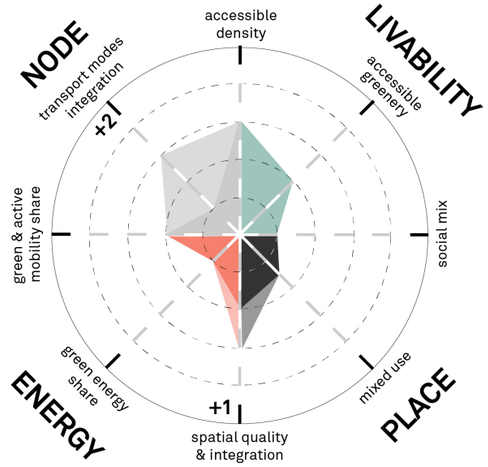
RELATION WITH OTHER PATTERNS

- Synergy with [N.2] [P.3] [E.1] [N.7]
- Tension with [L.5]
- Mutually exclusive with

Amsterdam Sloterdijk

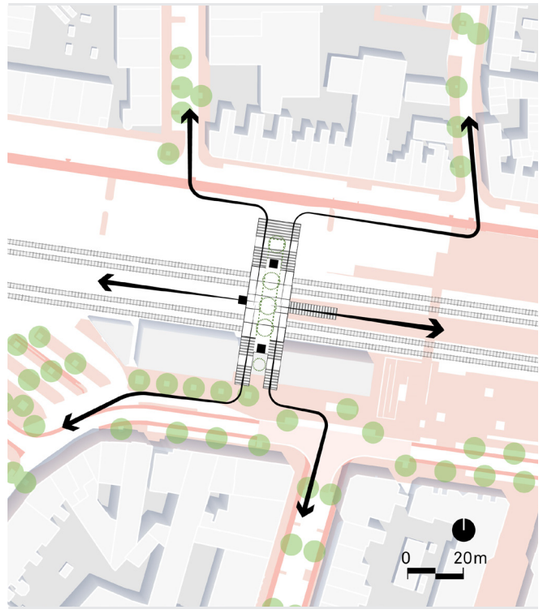


ASSESSMENT

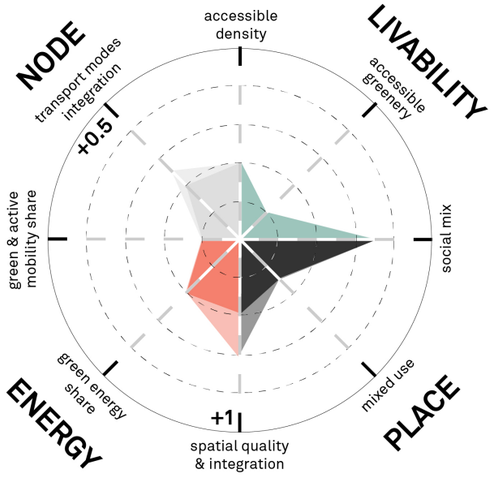


Observation: Only replacing the confusing pasarelle, by a wide, modular footbridge can bring clarity to the node and optimize the connection north-south.

Bergen op Zoom



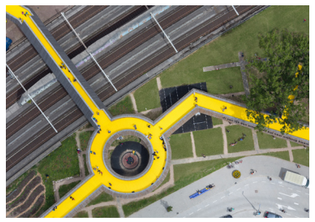
ASSESSMENT



Observation: Footbridge localized in the middle of the minimizes the need to adapt existing station buildings, but it is not improving the node significantly due to this location.

N.2 Public space design defined by wayfinding

References:



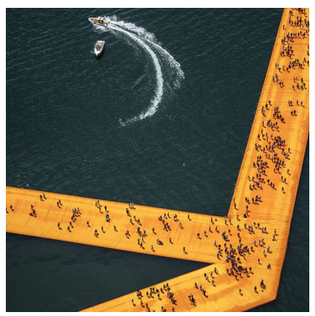
Luchtsingel, Rotterdam. Source: ZUS



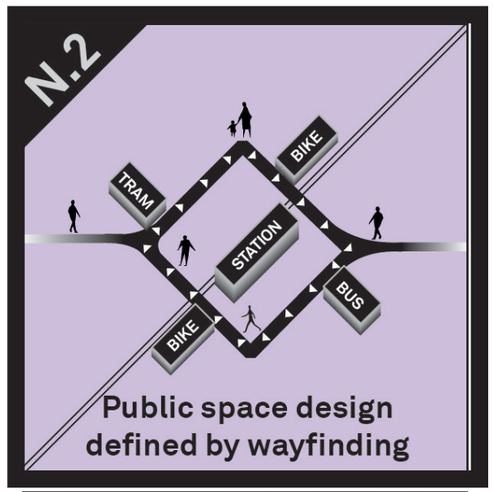
Scenography for a fashion show in Provance. Source: Jacquemus

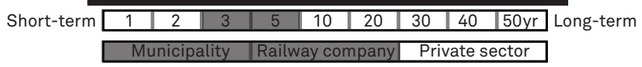


Genoa. Source: Stefano Boeri



The Floating Piers, land art by Christo. Source: Dezeen: https://bit.ly/3eFNl2H





HYPOTHESIS Wayfinding at multimodal hubs should go beyond utilitarian signage and use spatial form, color or lighting to guide passengers. It can be more effective and contribute to placemaking.

THEORETICAL BACK UP Complex nodes without a clear hierarchy of walkways, like Sloterdijk, often end up being overloaded by signage and maps. A single intervention like Luchtsingel in Rotterdam or footbridge in Genoa can reorder the space around the main connector allowing to reach all modes of transport.

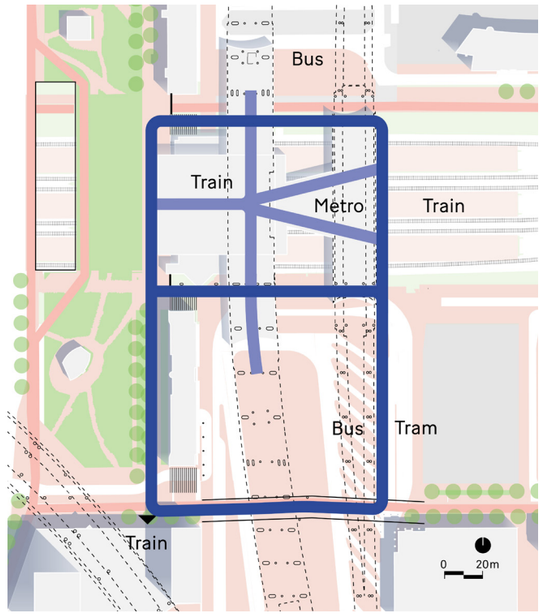
PRACTICAL IMPLICATION

- Guiding by unique spatial form/color or lighting.
- Focus on placemaking, possible land art elements.
- Sequencing station facilities around the main walkway.
- Expressing the hierarchy of pedestrian connections in the node by urban design.

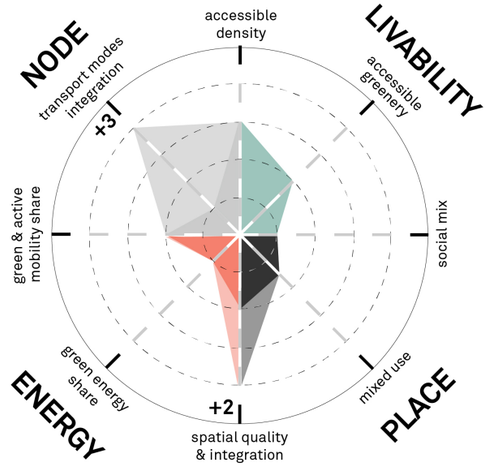
RELATION WITH OTHER PATTERNS

- Synergy with [N.1] [P.1] [L.5]
- Tension with -
- Mutually exclusive with -

Amsterdam Sloterdijk

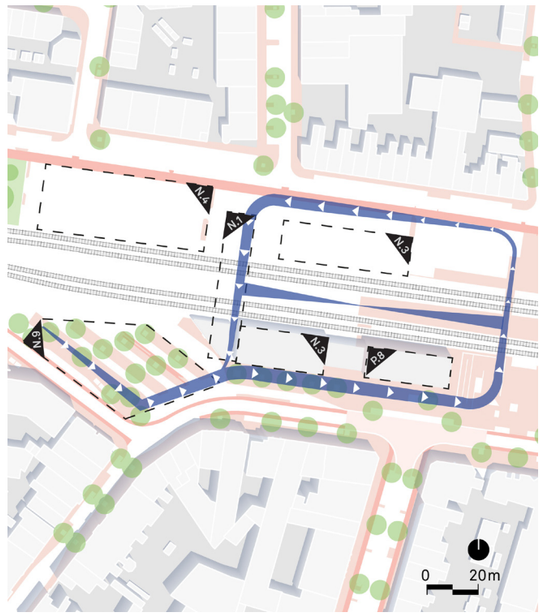


ASSESSMENT

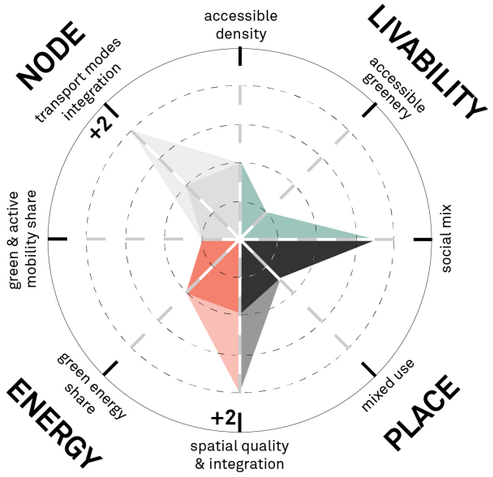


Observation: Loop on the same level as Orlyplein (+6.2 m) creates “balconies” under viaducts which provide clear connections between modes of transport on the one level.

Bergen op Zoom



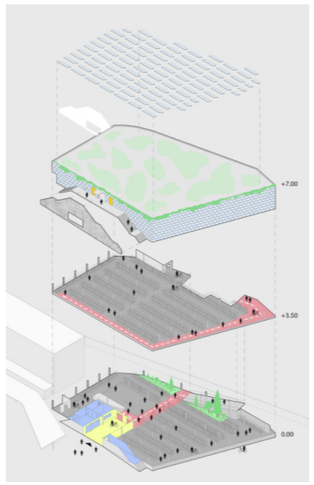
ASSESSMENT

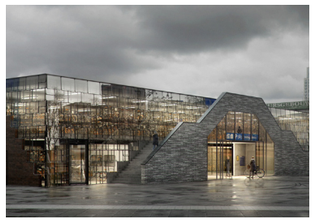


Observation: A loop using a new footbridge (more in the north) and existing tunnel can bring clarity and shorten the walking distance between modes of transport

N.3 Scalable bike storage on all sides of the station

References:

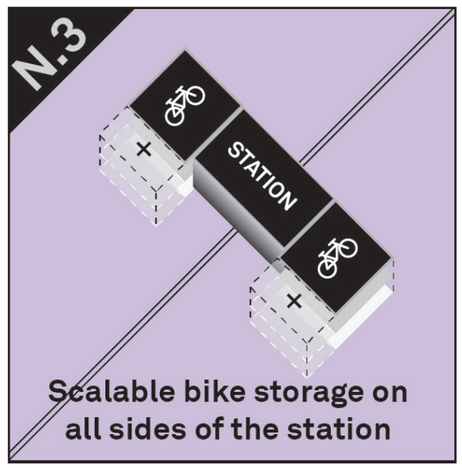


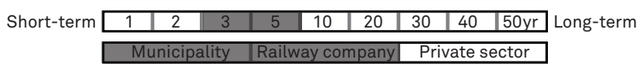


Circular and temporary bike storage in Eindhoven Centraal. Source: Architekten Cie.



Bike parking next to Tilburg train station. Source: Cepezed.





HYPOTHESIS Underground bike parkings do not provide desired flexibility and create obstructions for land uses above them. Light overground construction can better respond to changing demands and allow phasing and integration with high-density urban environment.

THEORETICAL BACK UP As the cases of Eindhoven and Tilburg show, overground parking have larger potential for circular construction and can be integrated in high density development.

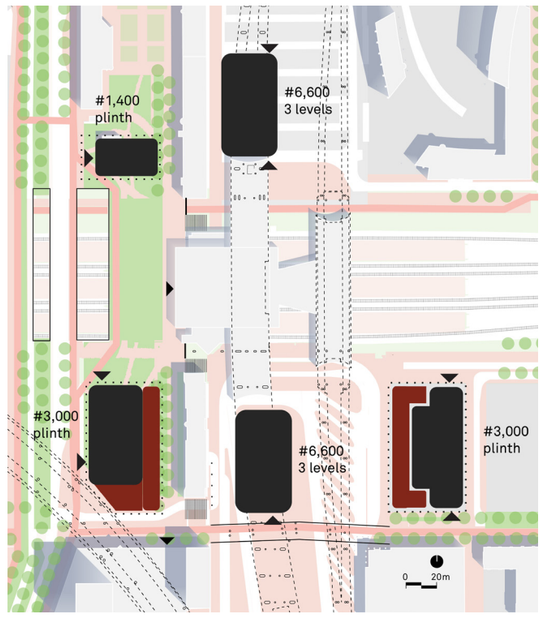
PRACTICAL IMPLICATION

- Designed for dissasembly (if free-standing) or integrated in plinth.
- Plinth facing main public spaces should be designed as active.
- Should be distributed on all sides of the station, proportionally to passenger flows.
- For multi-level bike storage a ratio of 0.9 sq m per bike can be used for estimation of the spatial claim.

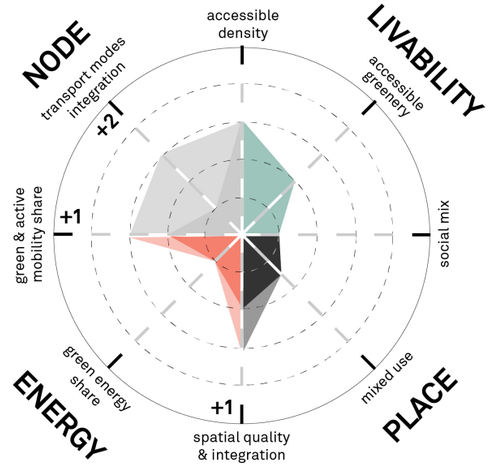
RELATION WITH OTHER PATTERNS

- Synergy with [N.7] [N.8] [E.4] [E.2] [L.1]
- Tension with -
- Mutually exclusive with -

Amsterdam Sloterdijk

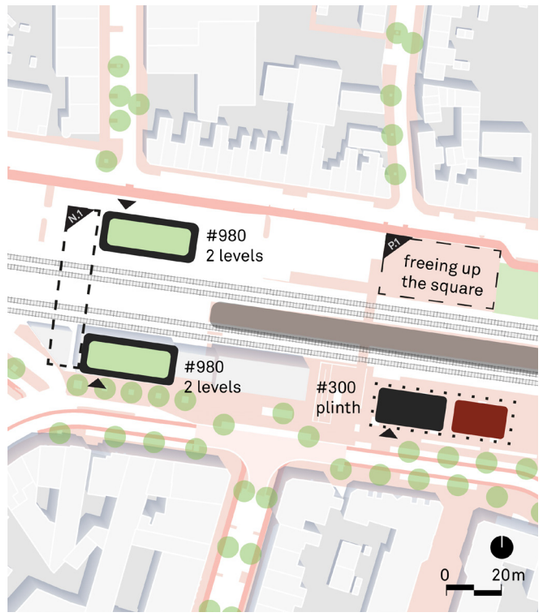


ASSESSMENT

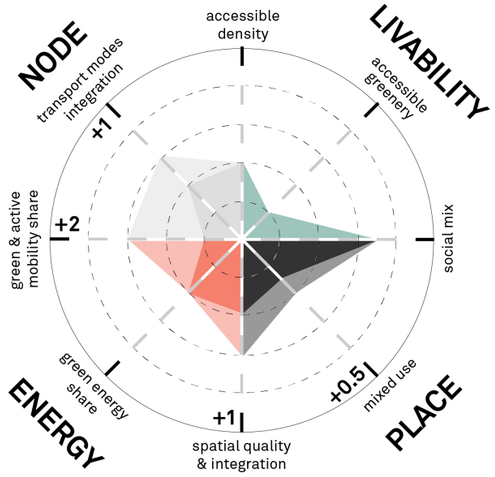


Observation: Three-level storage for train station is integrated under viaducts, north and south. New bike storage on the sides in plinths will serve a densification program.

Bergen op Zoom



ASSESSMENT



Observation: Scalable multi-level storage connected by a modular footbridge can free up the ground for densification and shorten walking distances within the node.

N.4 Clustering parking in a modular garage

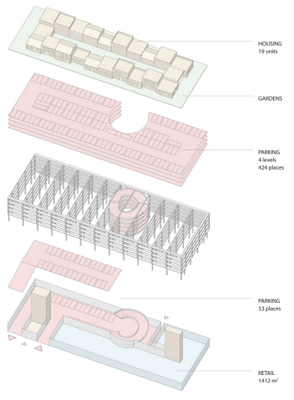
References:



Parking garage in Copenhagen
Source: JAJA Architects

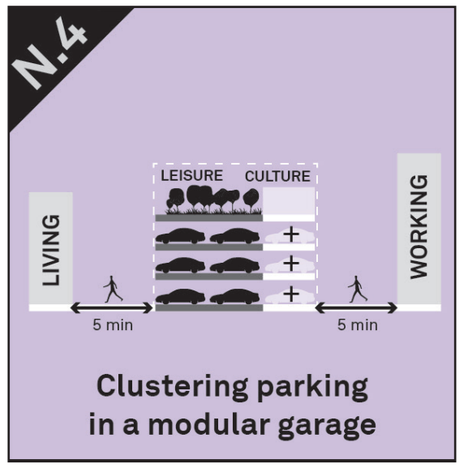


Captions image description as you can see. Source: osm.org





Parking garage with shops and rooftop housing, Bordeuax ZAC Euratlantique by Brisac Gonzales. Source: Dezeen, https://bit.ly/3bnj9ri



HYPOTHESIS A modular garage can be scaled down in the course of mobility transition or repurposed for bike storage. One collective parking facility is serving new development or acting as a P+R. It allows to save space for greenery and leisure.

THEORETICAL BACK UP Temporary parking garages can be built and dismantled in 3 months. Collective facility is cheaper and more sustainable alternative for underground parking, it may also contribute to mixed use and urban life, as shown by the example of ZAC in Bordeaux. Ratio of 24 sq m/car can be used for the spatial claim estimation.

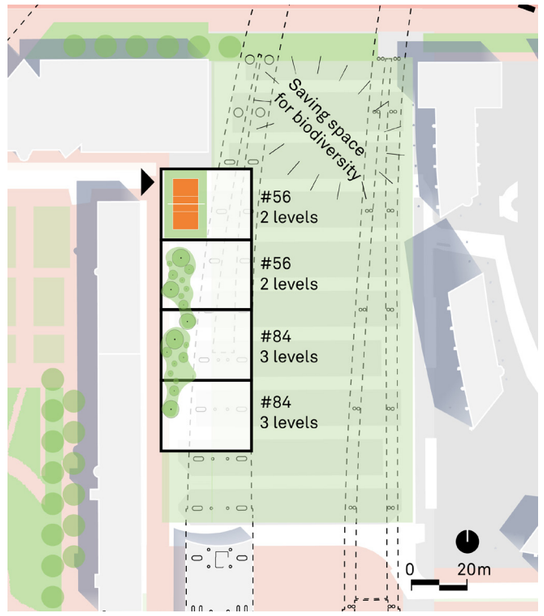
PRACTICAL IMPLICATION

- Priority in access to station facilities should be given to bike parking.
- Designed to dismantle and scale down.
- Green facades or rooftops.
- Depending on the desired degree of flexibility, adding urban functions in plinth or on the rooftop.

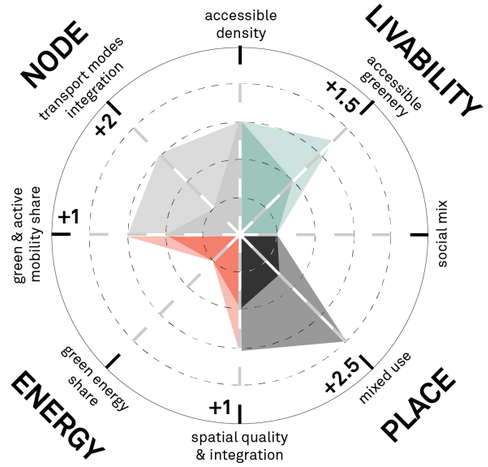
RELATION WITH OTHER PATTERNS

- Synergy with [L.4] [L.8] [L.9] [E.3] [E.4] [N.7]
- Tension with
- Mutually exclusive with [N.6]

Amsterdam Sloterdijk

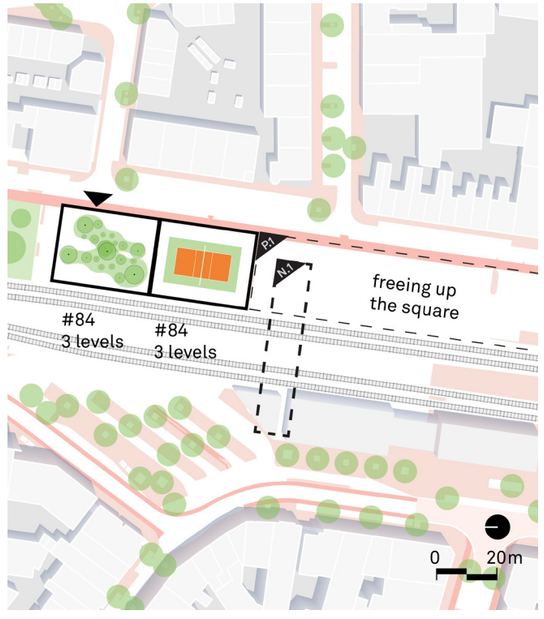


ASSESSMENT

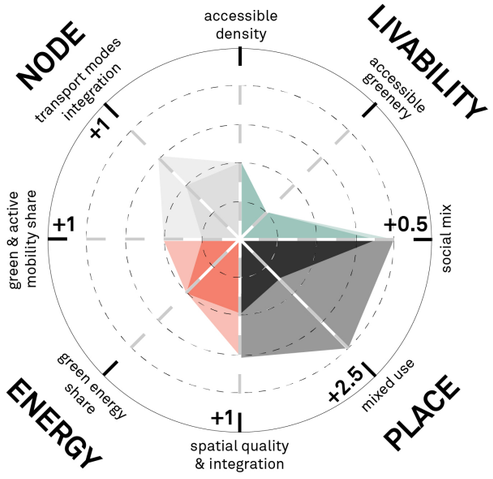


Observation: Modular garage using the space under viaduct can fit as many spots as the whole existing parking lot. In the course of mobility transition it can be scaled down.

Bergen op Zoom



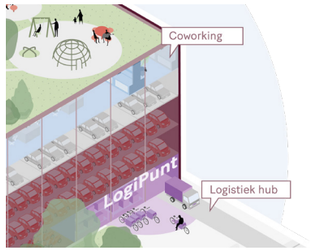
ASSESSMENT



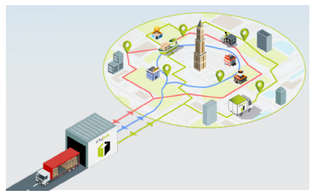
Observation: Existing P+R can be clustered in a modular garage taking 3x less space and connected with a bus station with new footbridge. Possible leisure program on top.

N.5 Clustering logistics and deliveries

References:



Concept of mobility and logistics hubs for Den Haag.. Source: PosadMaxwan.

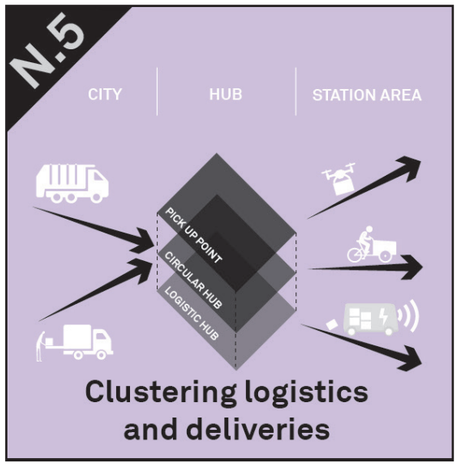


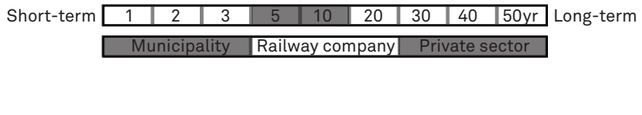


Green logistics hub in Utrecht. Source: https://bit.ly/3eTUixd



Bike delivery in Arnhem Source: https://bit.ly/3eW3l0T





HYPOTHESIS Compact hub integrating logistics and delvieries for station area can make them more sustainable and relieve the nuisance caused by heavy vehicles, allowing greener public space design.

THEORETICAL BACK UP The concept of local logistic hubs appeared in vision of mobility hubs by PosadMaxwan for Gemeente Den Haag. Multiple private companies already serve city centers with zeroe-emission light vehicles, however they rely on their own, scattered logistic centers. Historically, train stations were also important logistic hubs in the city centers, with dedicated post stations.

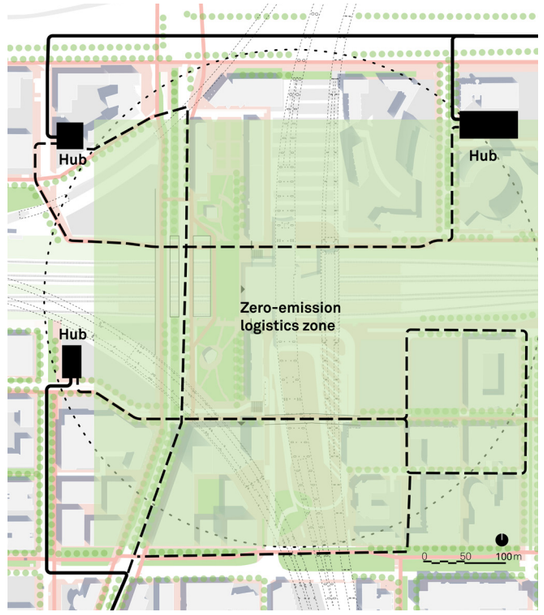
PRACTICAL IMPLICATION

- Location on the edge of walkable zone, which do not collide with other modes of transport, but not facing main public spaces.
- Pick up point for station area with package lockers.
- Circular hub for waste.
- Transfering deliveries from trucks to cargo bikes and small electric trucks.

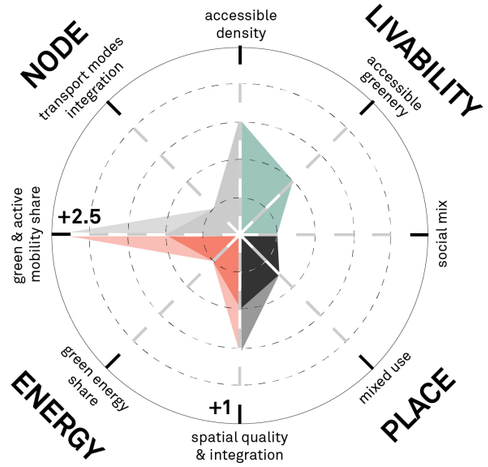
RELATION WITH OTHER PATTERNS

- Synergy with [L.9] [E.3] [E.4] [P.9]
- Tension with
- Mutually exclusive with [L.8]

Amsterdam Sloterdijk

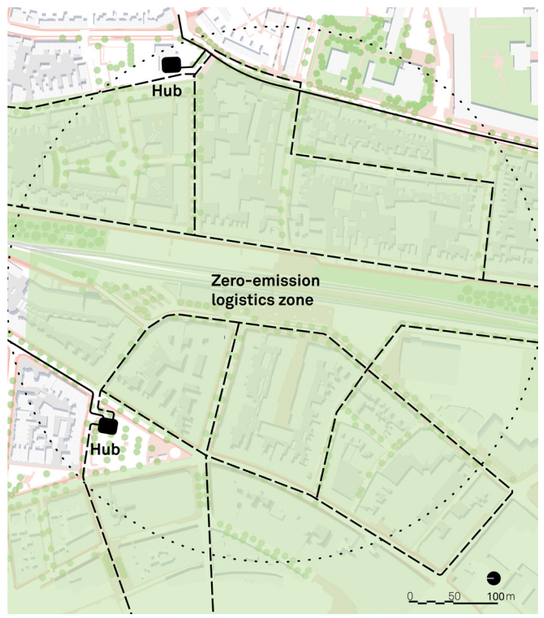


ASSESSMENT

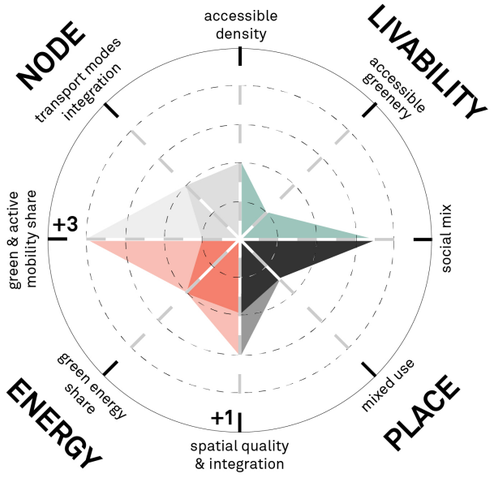


Observation: Multiple hubs are necessary in Sloterdijk due to large densification potential and poor connection between two sides of the track.

Bergen op Zoom



ASSESSMENT



Observation: The hub in Bergen op Zoom has also a potential to serve the old town. In case of densification hub in the west would be necessary to cover both sides of tracks.

N.6 Integrating shared mobility and leisure in one hub

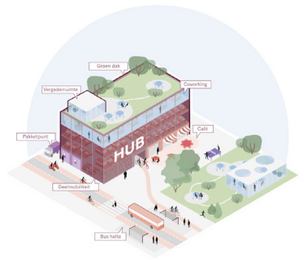
References:



Mobility hub designed in Buiksloterhan, Amsterdam. Source: https://delva.la/

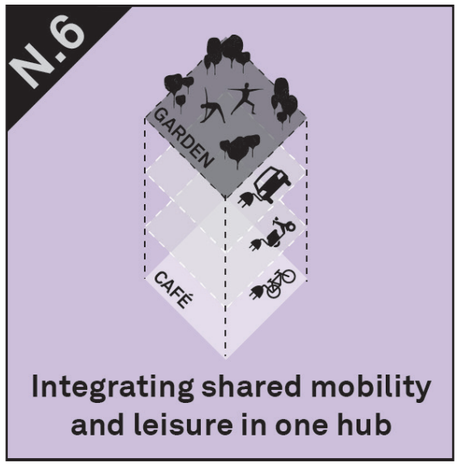


Concept of mobility hub in Stranden Eiland, Amsterdam Source: PosadMaxwan





Programmatic toolkit of local mobility hubs for Den Haag. Source: PosadMaxwan



HYPOTHESIS One hub can be a quality addition to high density urban fabric.

THEORETICAL BACK UP Shared mobility hubs are increasingly considered as a common solution for the mobility transition and included in plans by municipalities, for example Stranden Eiland in Amsterdam or hubs in Den Haag.

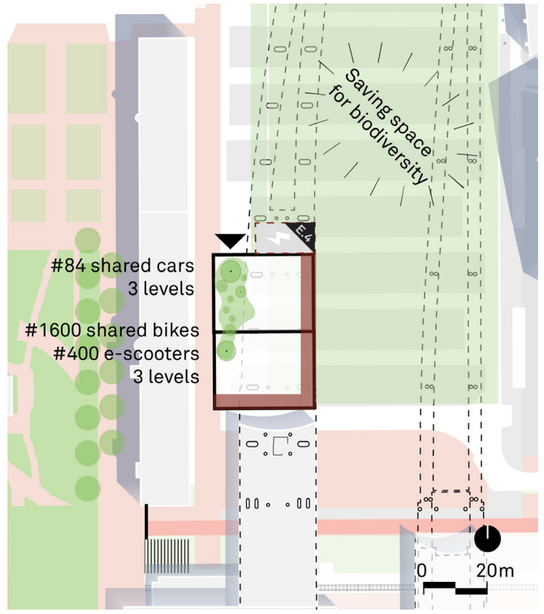
PRACTICAL IMPLICATION

- High-quality facades and seemless integration of mobility and social functions allows to locate the hub on the frontside of the main public space facing the train station.
- Optimal utilization of in proximity to public transport node
- Makes sharing of facilities (shared mobility, parking, ...) interesting.

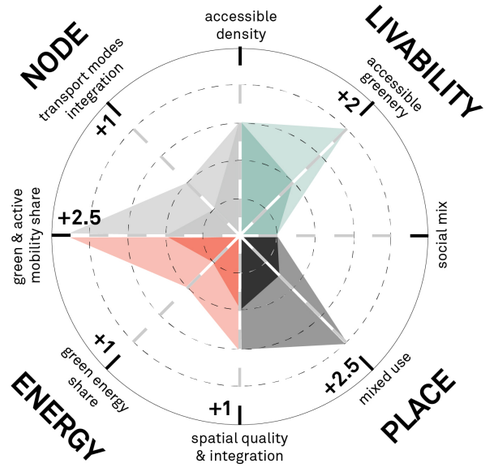
RELATION WITH OTHER PATTERNS

- Synergy with [N.7] [N.8] [L.1] [L.3] [E.8]
- Tension with
- Mutually exclusive with [N.4]

Amsterdam Sloterdijk

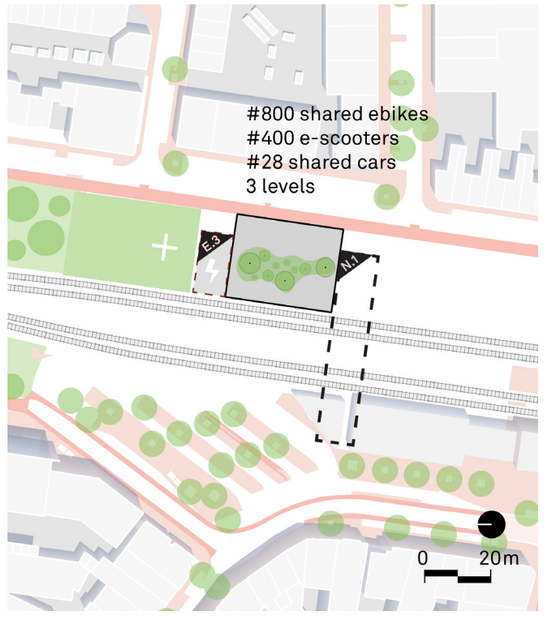


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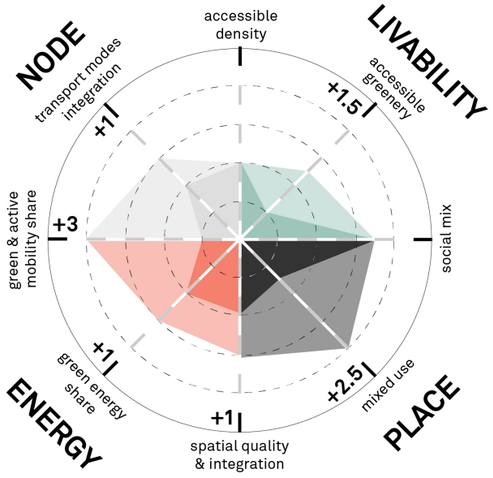


Observation: Shared mobility hub could completely replace the existing P+R (only 1% of modal share) and allow to greenify the space, while providing urban functions and a district battery.

Bergen op Zoom



ASSESSMENT



Observation: Shared mobility hub could replace the existing P+R, add pocket park, and a direct connection to the bus station via a new footbridge.

N.7 All modes under one modular canopy

References:



Sire plan of station Casa Port in Casablanca, Morocco. Source: AREP



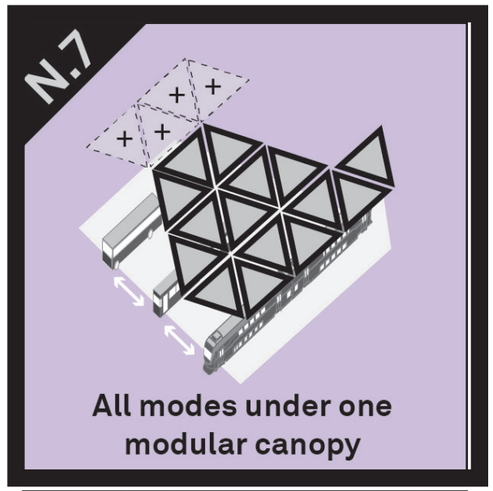
Central station in Katowice, Poland, 1962: station hall shaped by modular, concrete "goblets". Source: fotopolska.pl



Bus station in Leidsche Rijn, Utrecht. Source: https://www.jcau.nl/portfolio/bus-terminal-leidsche-rijn-centrum/



Timber canopy in design of Ede-Wageningen station. Source: Movares/Mecanoo



HYPOTHESIS A large canopy designed from repetitive elements can shape a coherent node, where passengers are protected from rain and snow, and which can adapt to changes in modes of transport.

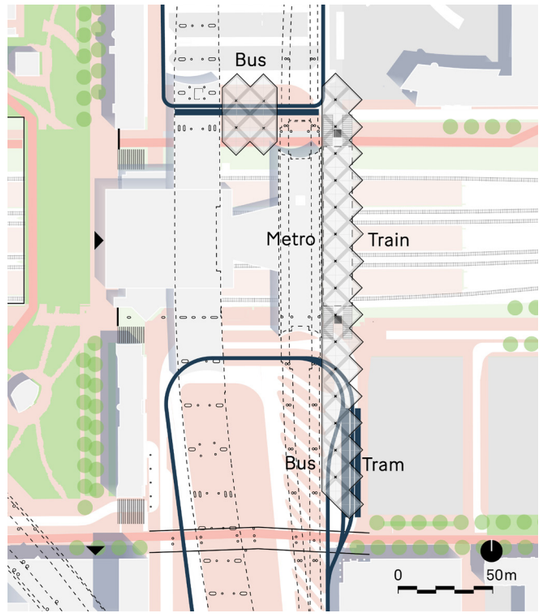
THEORETICAL BACK UP Were introduced by modernist train stations and airports, but rather designed as a finished structure than scalable canopy. The recent design of station in Ede-Wageningen shows the potential for use of such scalable canopy from sustainable materials.

PRACTICAL IMPLICATION

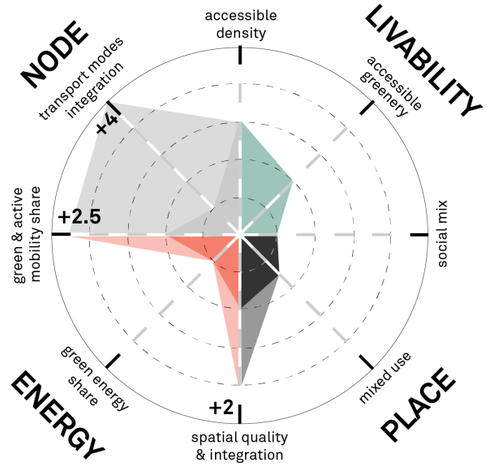
- Should have a spatial form unique for the site, yet easy to replicate.
- Use of sustainable materials, designed to dismantle.
- Works best for stations with access to platforms through a tunnel.

- **RELATION WITH OTHER PATTERNS**
- Synergy with [E.4] [N.3] [N.4] [N.6] [N.8] [P.3] [P.4]
- Tension with [L.5] [E.1]
- Mutually exclusive with [N.9]

Amsterdam Sloterdijk

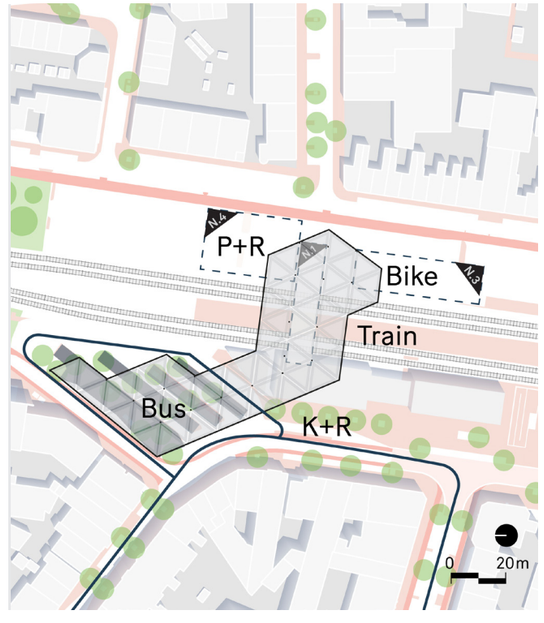


ASSESSMENT

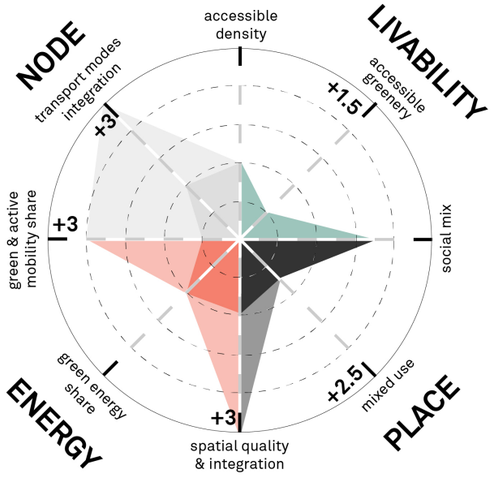


Observation: Canopy needs to be combined with a new footbridge [N.1]. Viaducts are partly providing shelter, but coherent canopy can further improve the waiting spaces.

Bergen op Zoom



ASSESSMENT



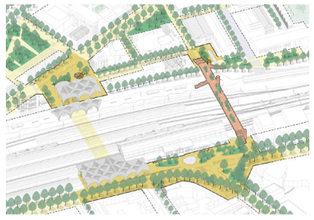
Observation: The optimal location for one canopy is northern side, as it allows to shorten the distance between bus, train, bike storage and P+R.

N.8 Balancing two sides of the station

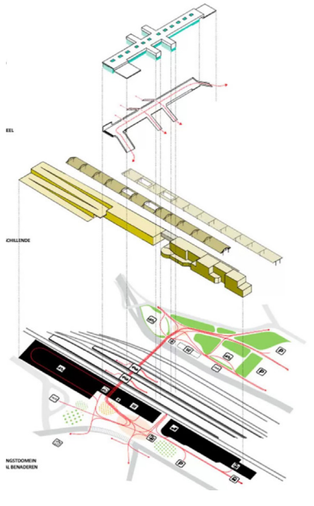
References:



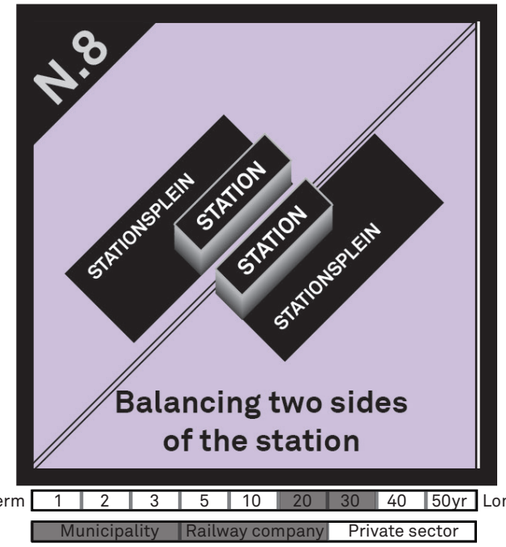
Station in Geldermarsen.
Source: https://bit.ly/3uYWGbF



Station Zwolle redevelopment-
Source: Karren en Brands



New station Alkmaar exploded
scheme. Source: Venhoeven CS



HYPOTHESIS Station facilities and spatial form on both sides of tracks should be of the same quality in order to achieve better functioning node.

THEORETICAL BACK UP Historically most of train stations have the main entrance oriented towards station square and main street, while the backside is neglected. Recently, among others, stations in Alkmaar, Zwolle, Groningen, Geldermarsen, Den Haag HS were redesigned to increase the balance between two sides.

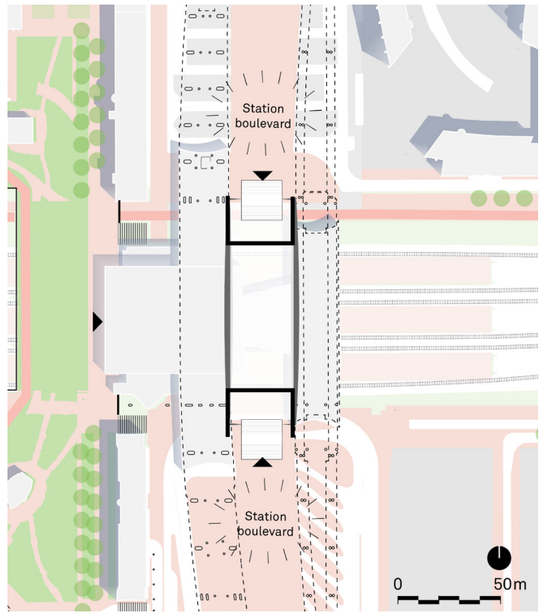
PRACTICAL IMPLICATION

- Two station squares are designed to be complementary public spaces in one sequence.
- Each side of the station is treated with equal care, regarding functions availability, design quality and accessibility of mobility modes.
- Different needs of each side's neighborhood are addressed in program.

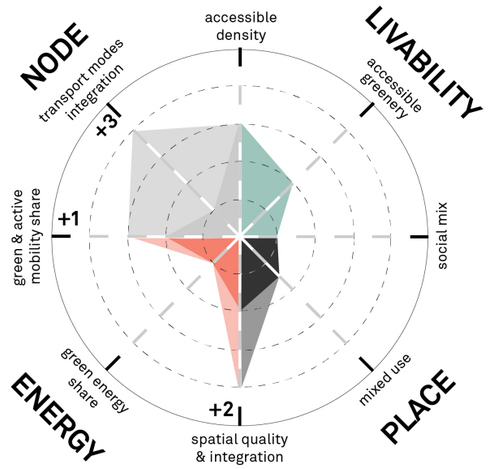
RELATION WITH OTHER PATTERNS

- Synergy with [N.3] [N.6] [N.7]
- Tension with
- Mutually exclusive with -

Amsterdam Sloterdijk

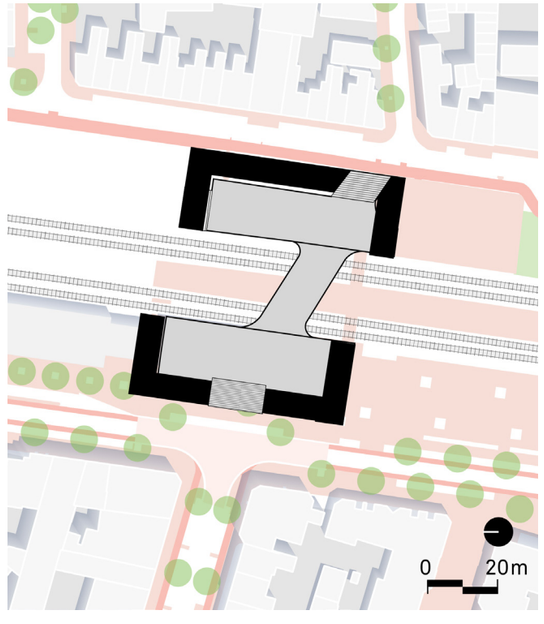


ASSESSMENT

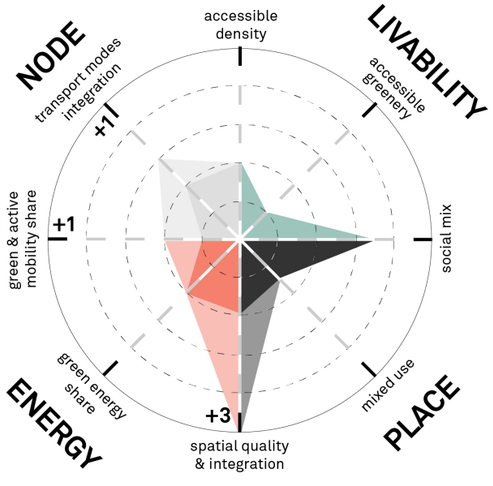


Observation: Orienting station north-south allows to create two high-quality facades and sequences of public space guiding to central station hall improving wayfinding.

Bergen op Zoom



ASSESSMENT



Observation: Two-sided station can be developed around a new wide tunnel. Each side becomes attractive public square shaped as an atrium.

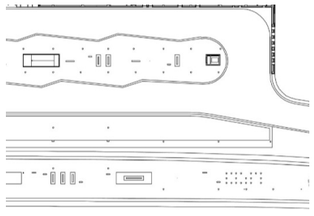
N.9 Space-saving bus station

References:

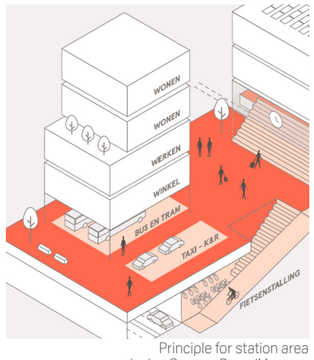


Development over bus and tram stop in Utecht Centraal. Source: https://bit.ly/7ulWgPF

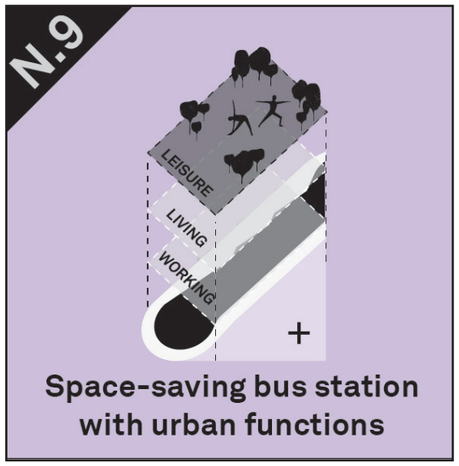




Dynamic bus station in Breda. Source: https://bit.ly/4lYvGbD



Principle for station area design.Source: PosadMaxwan (2021).



HYPOTHESIS Train station areas cannot afford overpaved bus stations with stops dedicated to each line. Space-saving, dynamic bus station can be in addition enriched with urban functions stacked upon each other.

THEORETICAL BACK UP Pattern is derived from the principles for new stations by Bureau Spoorbouwmeester (2021)

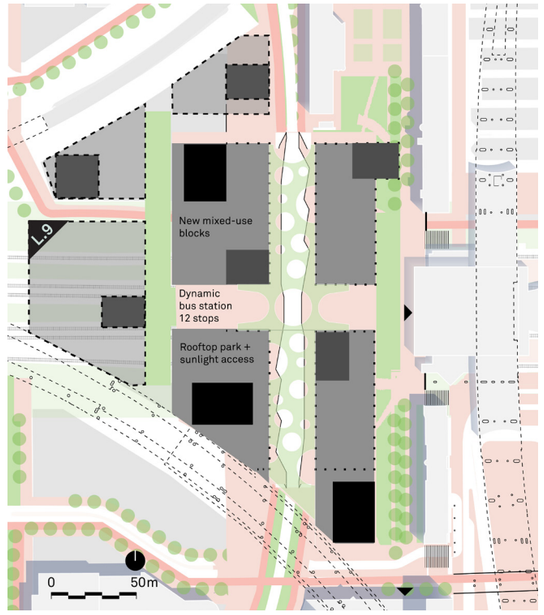
PRACTICAL IMPLICATION

- Dynamic bus station with one large platform.
- Accessible from the train station without crossing driving lanes.
- Do more with the same space: intensive and multiple use of space around and above the bus station.
- Focus on social safety and spatial quality; clear space of the station without dark corners.

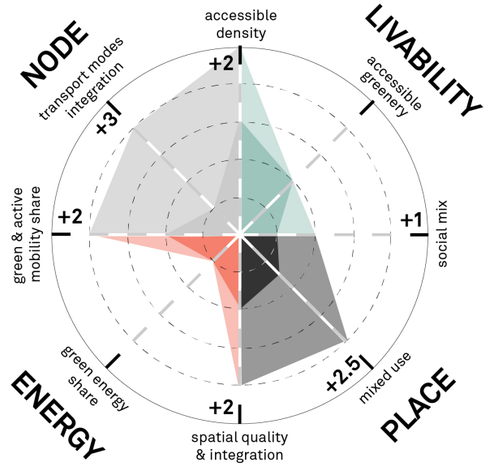
RELATION WITH OTHER PATTERNS

- Synergy with [L.9] [L.3]
- Tension with [P.4]
- Mutually exclusive with [N.7]

Amsterdam Sloterdijk

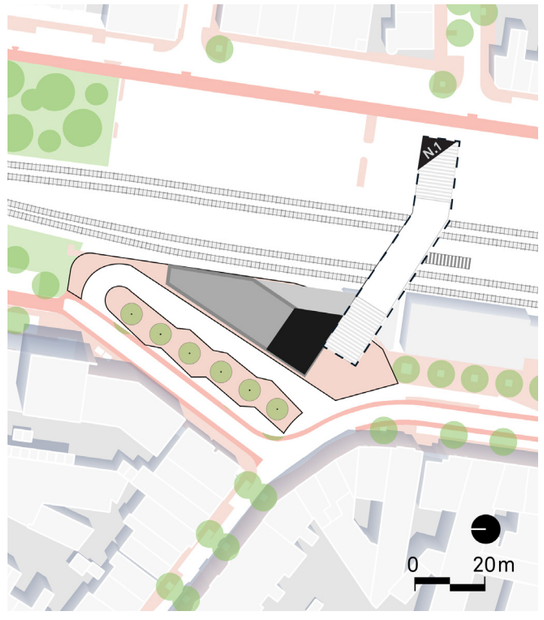


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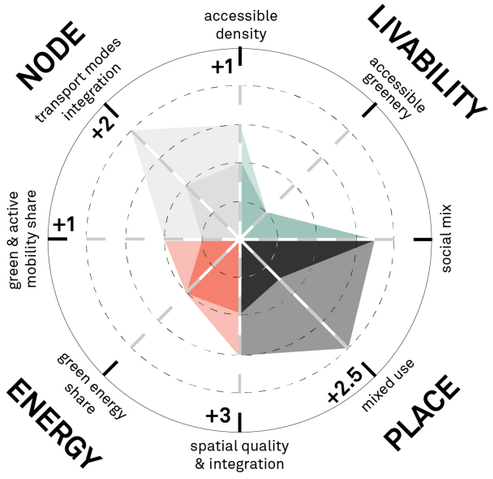


Observation: Moving two bus stations to Radarweg and combining them creates potential for new high-density neighborhood combined with over track development.

Bergen op Zoom



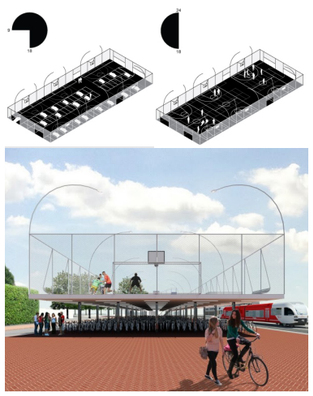
ASSESSMENT



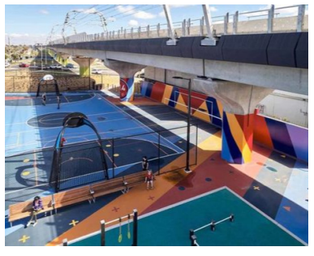
Observation: Thanks to dynamic bus station, a new high-density block can be build, for better effect combined with a modular footbidge.

L.1 ¦ Sport facilities facing tracks

References:



Study on sport facilities for small NS stations. Source: https://www.shift-au.com/projects/sport-station/





Sport areas instead of wastescape in Melbourne. Source: https://bit.ly/3uYWGbF



HYPOTHESIS Sport facilities may activate rail-oriented wastescapes, keep the station area vivid beyond rush hours and attract local residents.

THEORETICAL BACK UP Among others, a successful project in Melbourne, and study by Shift AU for ProRail proofs the potential of sport and recreation in station areas. Sport facilities can be introduced in metropolitan areas, with viaducts and large infrastructure, as well as in small towns, where rail yards are separating residential neighborhoods.

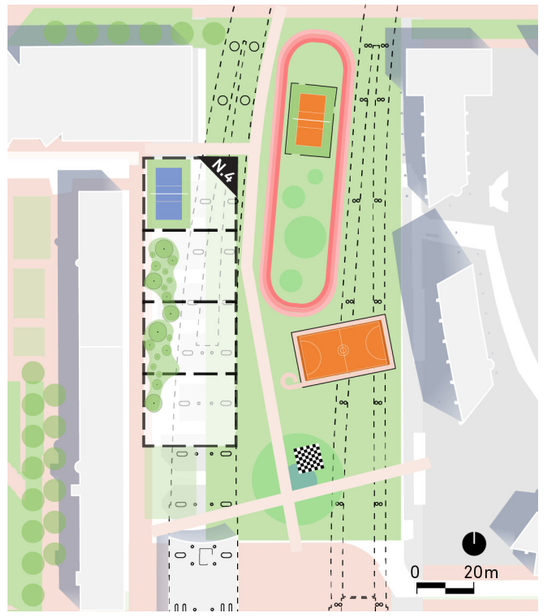
PRACTICAL IMPLICATION

- Can be used as a tactical placemaking tool to attract specific groups of residents.
- Temporary sport facilities could be introduced on P+R parkings.
- Design for social safety, non-conflicting with main walkways of the node.
- Basketball, tennis or volleyball courts should have proper fencing.

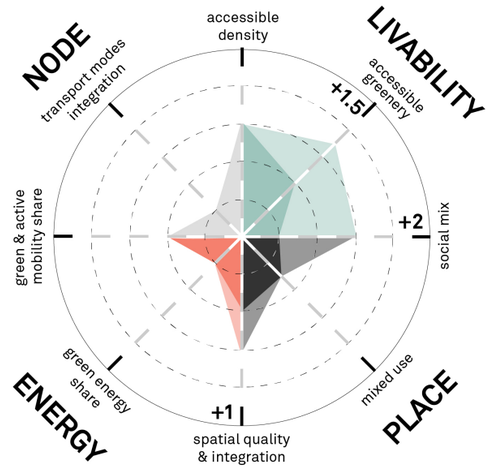
RELATION WITH OTHER PATTERNS

- Synergy with [P.1] [N.3] [N.6] [L.2] [L.3] [L.6]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk

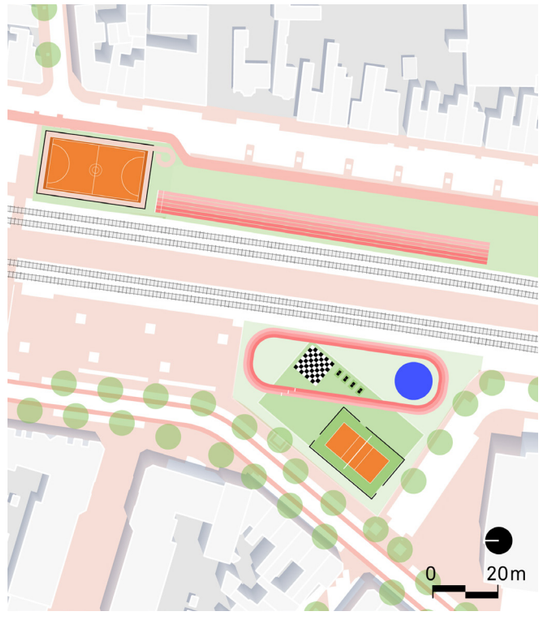


ASSESSMENT

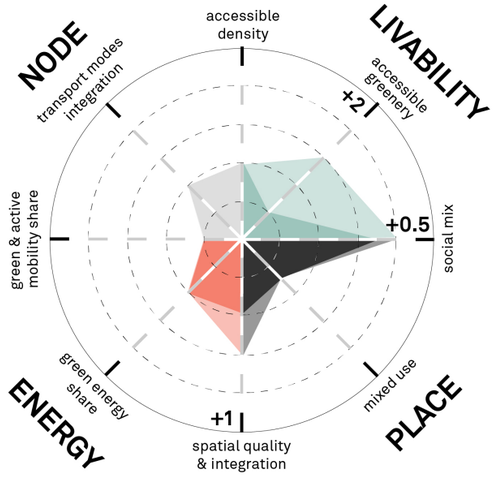


Observation: Clustering P+R in a modular garage may free up the space under viaducts for adaptable sport infrastructure.

Bergen op Zoom



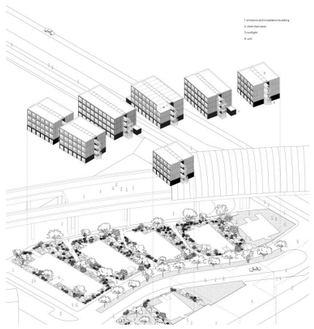
ASSESSMENT



Observation: Basketball court can cover the existing bike racks, wastescape on the western part of tracks has potential to become a temporary sport park for local community.

L.2 Activating wastescapes by temporary housing

References:



Amsterdam Sloterdijk, student village VASA. Source: https://www.studioselva.nl/student-village/

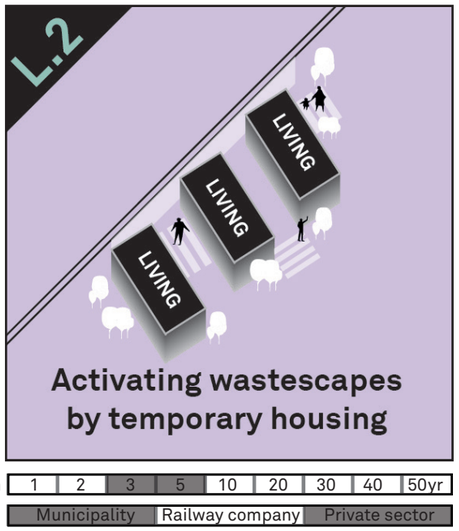
Temporary housing in Cornwall, UK, Source: https://bit.ly/3hv0egg



Container temporary student housing, Le Havre, France. Source: https://shutr.bz/33U0a0Z



Temporary housing for asylum seekers, Zurich. Source: Martin Zeller, NRS in situ



HYPOTHESIS Inclusive, temporary housing can activate the wastescapes of the station area and prepare them for long-term projects.

THEORETICAL BACK UP Temporary housing may a good solution. Asylum seekers, students and other vulnerable groups on the housing market. Especially valid in cities, where housing crisis is the most fierce.

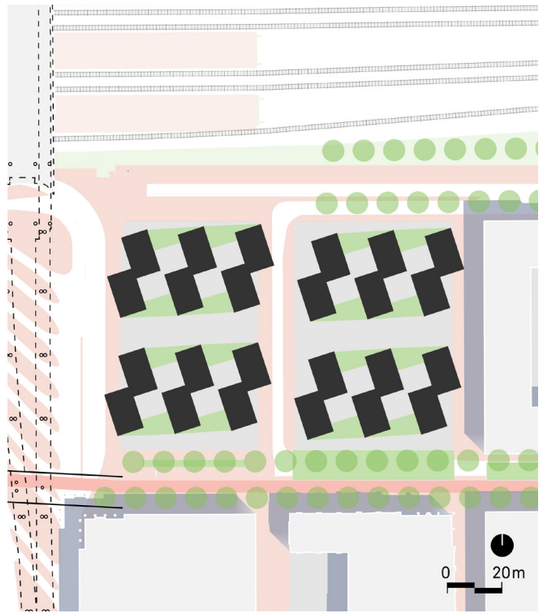
PRACTICAL IMPLICATION

- Focus on modular and reusable construction, reuse of shipping containers, prefabricated timber etc.
- Housing should not face the station square, but rather form calm backyards.

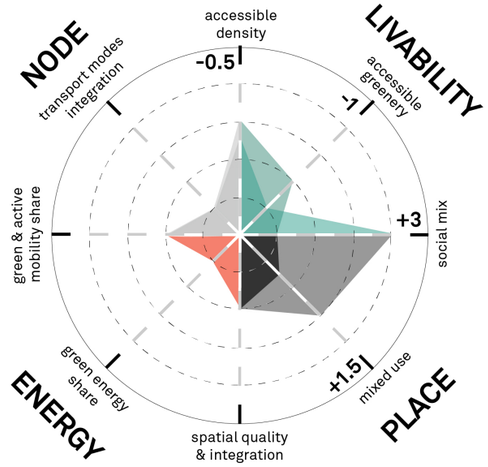
RELATION WITH OTHER PATTERNS

- Synergy with [L.1] [L.6]
- Tension with
- Mutually exclusive with [P.2]

Amsterdam Sloterdijk

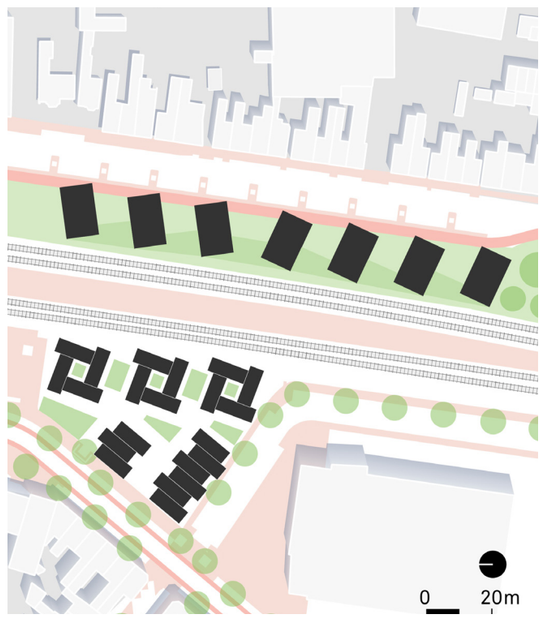


ASSESSMENT

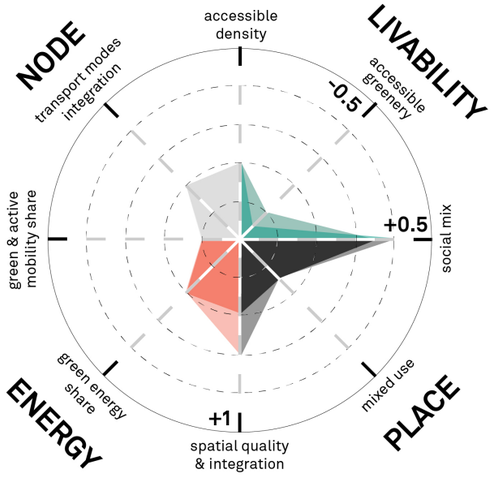


Observation: Two empty blocks are not optimal location for temporary housing due to noise exposure, large degree of publicness and their potential for other program.

Bergen op Zoom



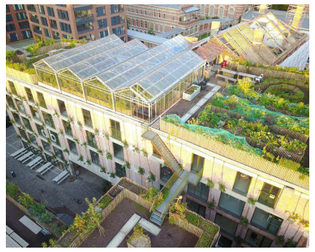
ASSESSMENT



Observation: Small city has little demand for temporary housing, but spatial conditions are more suitable. Even the narrow plot in the east allows temporary densification.

L.3 Enabling farming in high density

References:



't Dak van PAKT in Antwerp.
Source: https://bit.ly/3fmcazY



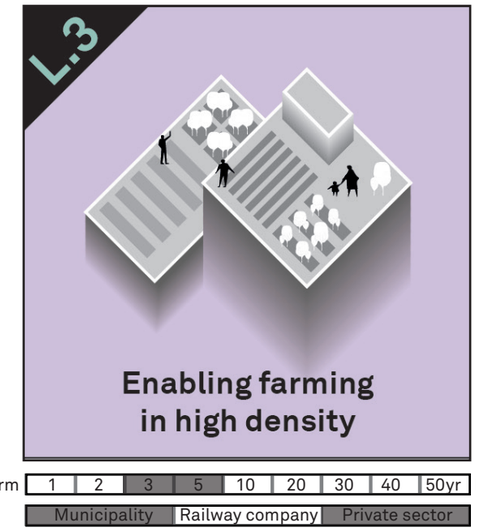
Rooftop farming in Paris Rive Gauche. Source: Martin Duplantier Architectes https://bit.ly/3EmcqzU



Copenhagen rooftop greenhouse for residents. Source: https://bit.ly/3fmcu0Y



Rotterdam, rooftop garden and cafe. Source: https://ophetdak.com/



HYPOTHESIS Introduction of farming in high density neighorhood can help to achieve better microclimate, produce food locally and build an intergenerational community.

THEORETICAL BACK UP Rooftop farming in many cities started as bottom-up initiatives dealing with brownscapes, but recent years have shown the first cases of rooftop gardens or greenhouses integrated in high-density residential development. Rooftop gardens could relieve the pressure on public spaces and heat stress in high-density overpaved station areas.

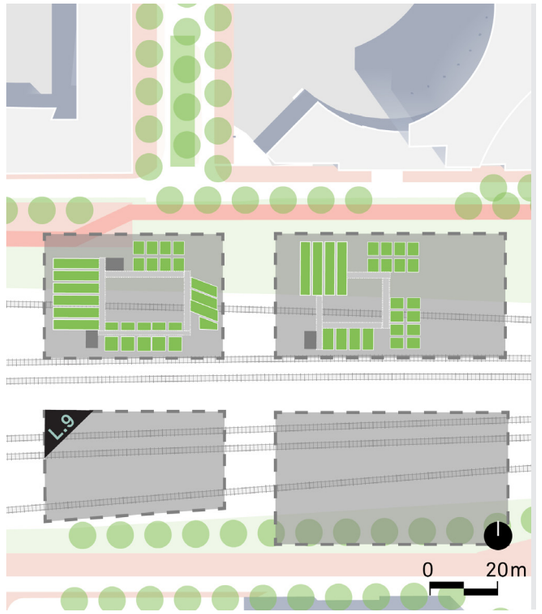
PRACTICAL IMPLICATION

- Building construction suitable for rooftop garden beds, or greenhouses for year-round cultivation.
- Local food production (catering industry in station area).
- Dedicated to residents and employees: creating communities around farming as a leisure activity.

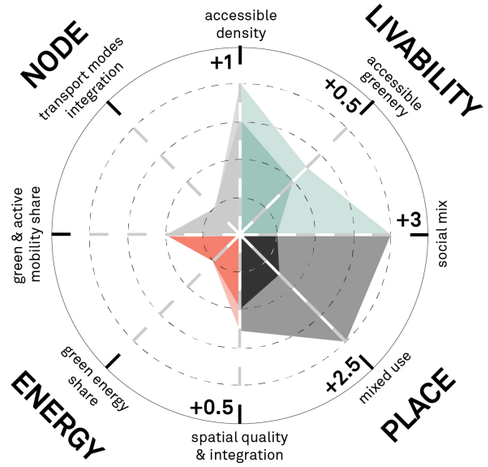
RELATION WITH OTHER PATTERNS

- Synergy with [L.1] [L.4] [L.5] [L.6] [L.7] [L.8] [L.9] [P.1] [N.6] [N.9]
- Tension with
- Mutually exclusive with [E.2] [E.3] [E.4]

Amsterdam Sloterdijk

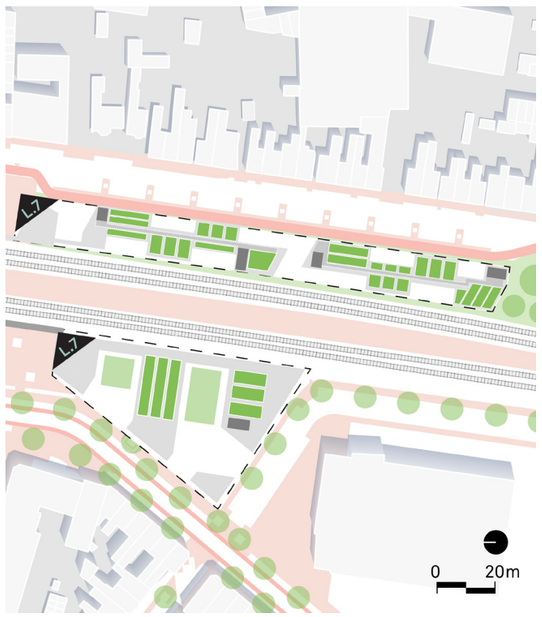


ASSESSMENT

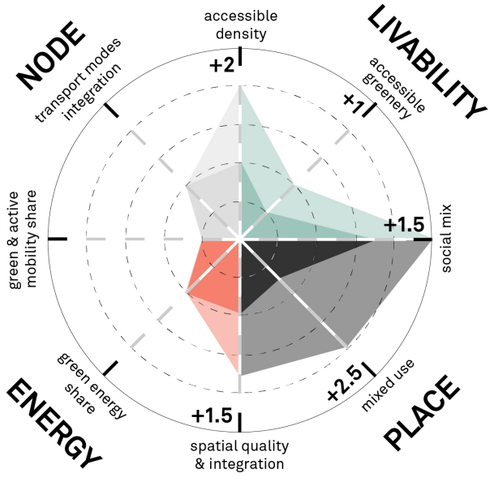


Observation: The negative effects of high density over tracks can be partly relieved by rooftop gardens that could mitigate urban heat island and help community-building.

Bergen op Zoom



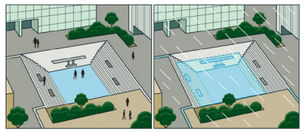
ASSESSMENT



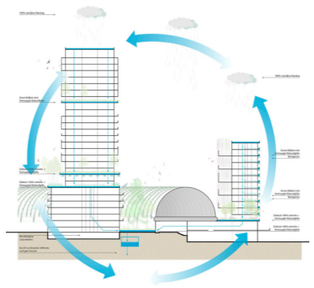
Observation: In combination with noise-proof blocks [L.7] there is enough space for farming on connected rooftops. Small greenhouses are possible on the western plot.

L.4 Rainwater collection as a shared utility

References:



Water square concept. Source: De Urbanisten



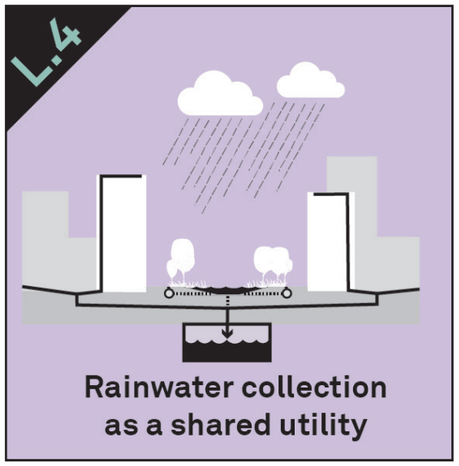
Rainwater harvesting in high density; new urban block, Amsterdam Sloterdijk. Source: bit.ly/3tAy7k9



Floating Fields, Shenzen. Source: archdaily.com https://bit.ly/3tQy4k8



Canopy harvesting rainwater, Source: https://bit.ly/3tQy4k8



HYPOTHESIS Rainwater collection in station areas have larger potential to improve urban microclimate and contribute to public spaces when it is organized as a collective utility, not only within each urban block.

THEORETICAL BACK UP Train station areas are often overpaved and have large rooftop surfaces. Extreme rainfall or heat stress are challenging the quality of life in high density. This calls for more collective approach to rainwater management, using the logic of clustering parking facilities. It may allow to optimize space and enhance cooperation between different developers and future users.

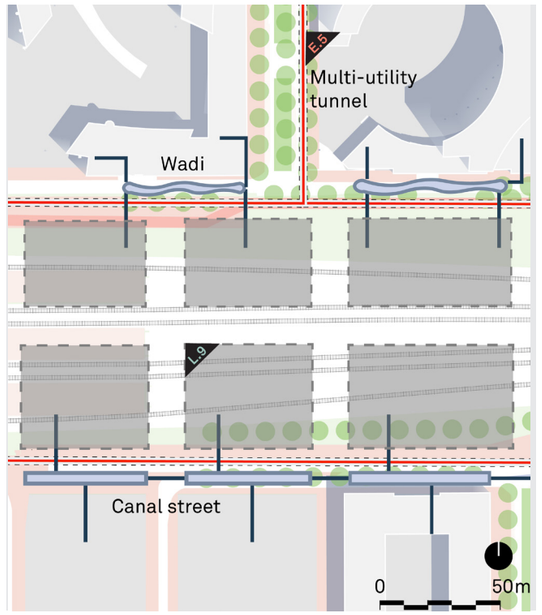
PRACTICAL IMPLICATION

- Rainwater management tackled holistically in the whole station area.
- Design of public spaces using potential of rainwater.
- Water features for slow water retention: wadis, water squares.
- Rainwater harvesting integrated in station canopies.

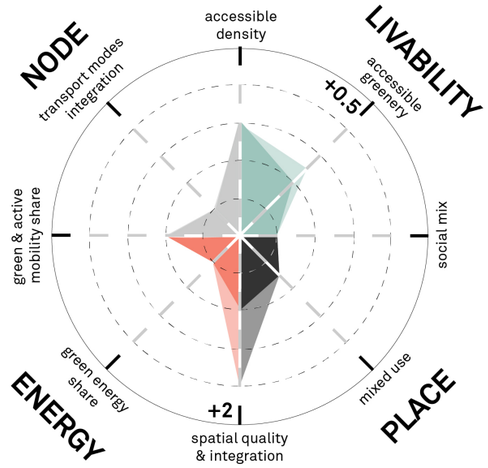
RELATION WITH OTHER PATTERNS

- Synergy with [L.8] [P.1] [P.7] [L.3] [L.5] [L.9] [N.4]
- Tension with -
- Mutually exclusive with [N.6]

Amsterdam Sloterdijk

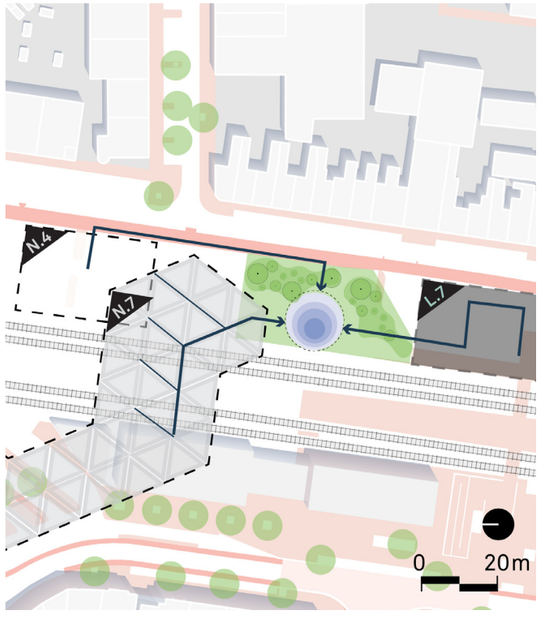


ASSESSMENT

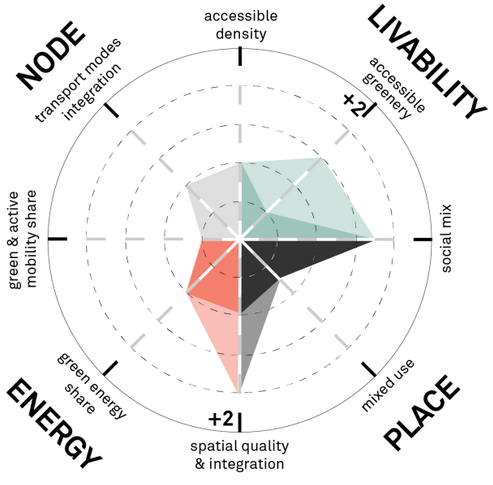


Observation: Rainwater collection can be a synergic combination with over track densification and multi-utility tunnels. It improves spatial quality, and accessible greenery.

Bergen op Zoom



ASSESSMENT



Observation: A water square or a rain garden could harvest rainwater from the station canopy and facilites, allow its reuse and create a good urban microclimate.

L.5 Bridging tracks with public greenery

References:



Redevelopment of station in Dordrecht. Source: Mecanoo.



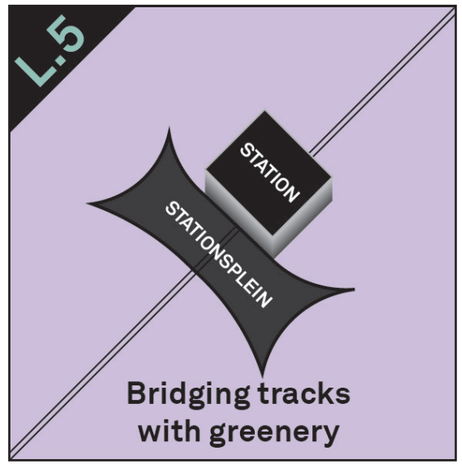
Barcelona, La Rambla park covering tracks. Source: osm.org



Section through footbridge Zwolle. Source: Karres en Brands.



Orlyplein, Amsterdam Sloterdijk. Source: osm.org



HYPOTHESIS Rail yard is usually acting as a large heat island close to residential areas. While crossing a wide rail yard on a footbridge, pedestrians are prone to sunstrokes, noise and dust. These negative effects can be diminished by integration of planters in the design.

THEORETICAL BACK UP As proofed by projects in Zwolle, Dordrecht, Amsterdam Sloterdijk or Den Bosch, quality green spaces can be introduced over tracks; whether on footbridges or regular squares. Due to gusts from passing trains and lack of greenery to navigate, more than four tracks are difficult obstacle for bees and other insects.

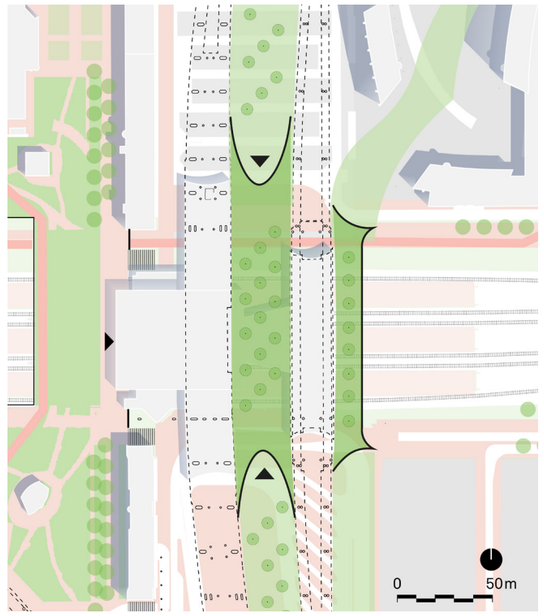
PRACTICAL IMPLICATION

- If there are more than four tracks, introduction of greenery over it may establish in addition an ecological connection.
- In smaller stations greenery can be introduced on footbridge.
- In larger, it can take shape of a regular square on the deck covering the tracks.
- Trees in planters or 1 m of soil that will allow for shrubs and trees high up to 8 m.

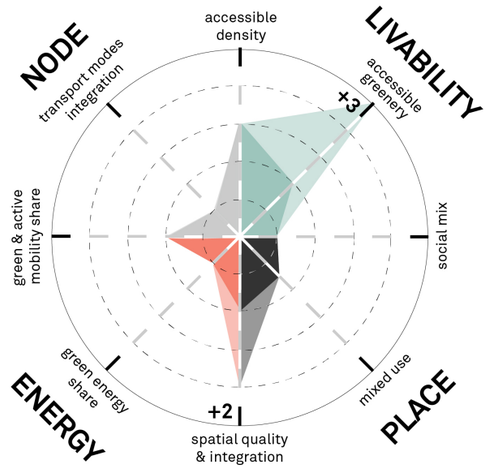
RELATION WITH OTHER PATTERNS

- Synergy with [N.2] [L.3] [L.4] [L.9]
- Tension with [P.4] [E.1] [N.7]
- Mutually exclusive with [N.1]

Amsterdam Sloterdijk

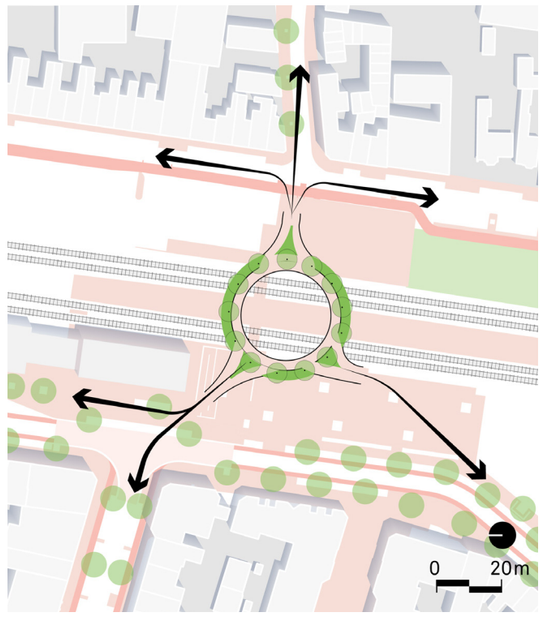


ASSESSMENT

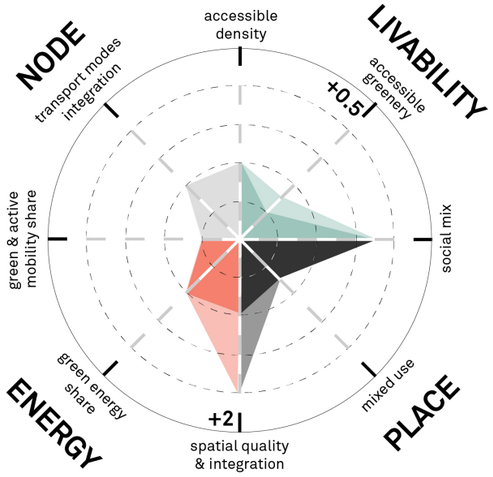


Observation: Greenification of northern P+R and southern bus/tram stops creates a potential to bridge the whole station with sloping greenery. Low adaptability is a downside.

Bergen op Zoom



ASSESSMENT



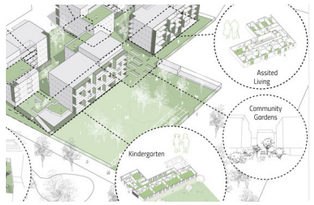
Observation: Trees and shrubs could be planted on an elevated roundabout connecting main directions in the node. However, it falls short of adaptability.

L.6 Station area as a social patch

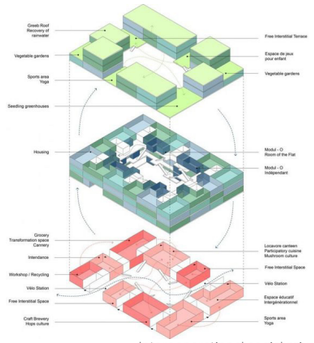
References:



Nursery by the station, concept for Ile-de-France. Source: AREP, https://bit.ly/3u56klu



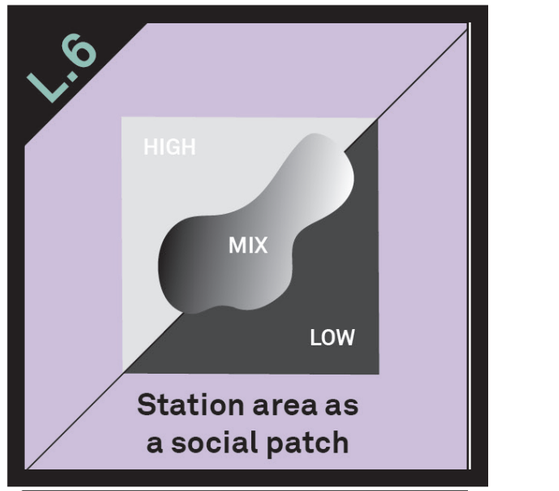
Intergenerational urban block, assisted living to kindergarden. Source: https://bit.ly/3u56klu



Intergenerational social mix neighbordhood. Source: https://bit.ly/3w76qlu



Social housing stacked over school and sport center, Paris. Source: Brisac Gonzalez & Antoine Régnault.



HYPOTHESIS Train station area should have equitable housing offer, to level inequalities of two sides of tracks. Social infrastructure like schools, kindergardens or medical centers should be integrated in high-density development, so that the new residents do not increase pressure on existing public facilities.

THEORETICAL BACK UP In the Netherlands the housing shortage is especially fierce in the affordable sector, so densification in station areas should be oriented on affordable housing and new social facilities for high-density. Gemeente Amsterdam has already introduced a rule of 40% social rent, 40% mid- and 20% free-market for the future development.

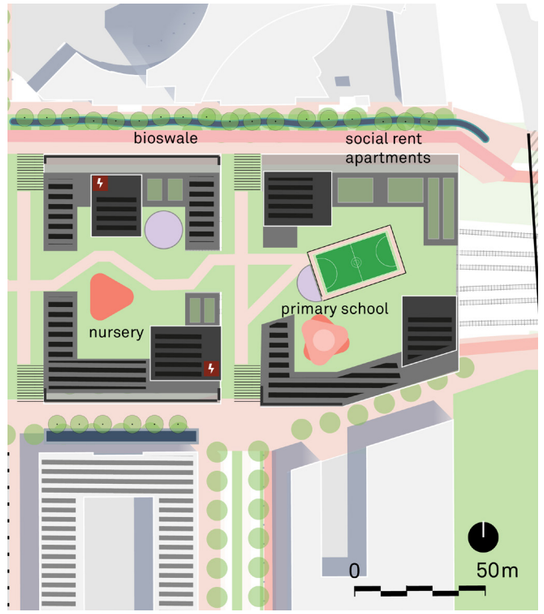
PRACTICAL IMPLICATION

- Housing and social facilities in station area programmed to achieve a desired social mix.
- The housing program of a station area should be addressed to the most vulnerable on the housing market: students, starters, elderly.
- Possible funding from governmental subsidies and commercial program on the site.

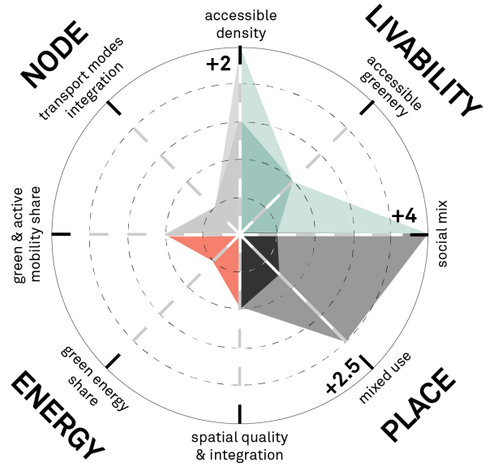
RELATION WITH OTHER PATTERNS

- Synergy with [P.1] [P.2] [P.5] [P.7] [P.8] [E.6] [L.1] [L.2] [L.3] [L.7] [L.8]
- Tension with [L.9]
- Mutually exclusive with -

Amsterdam Sloterdijk

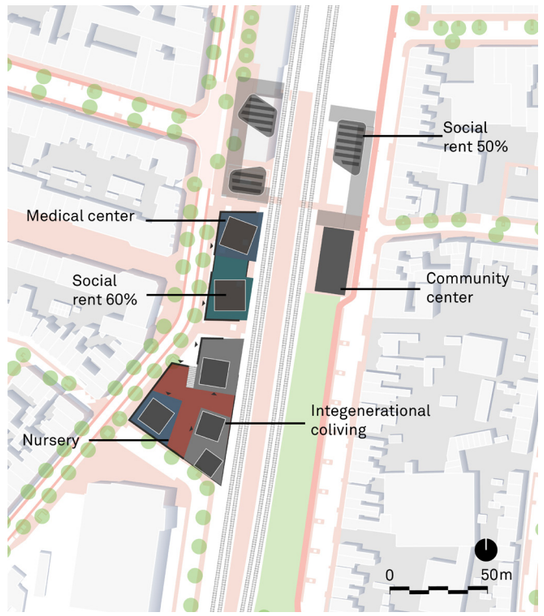


ASSESSMENT

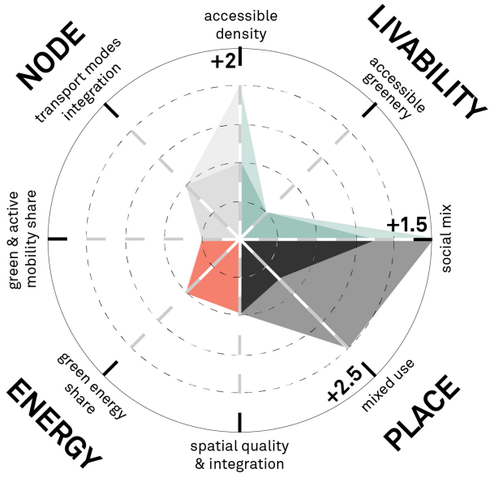


Observation: Share of affordable housing 40% is secured in each over track block. Inside, in the semi-public backyard social amenities are located.

Bergen op Zoom



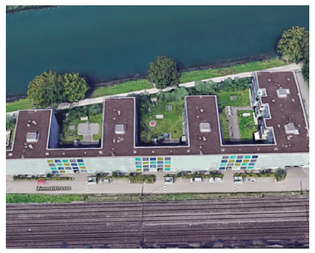
ASSESSMENT

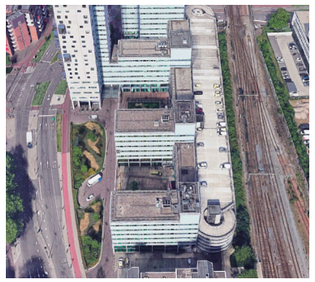


Observation: New development introduces at least 50% of social rent apartments and social amenities which are missing in the neighborhood.

L.7 Noise-proof block design

References:

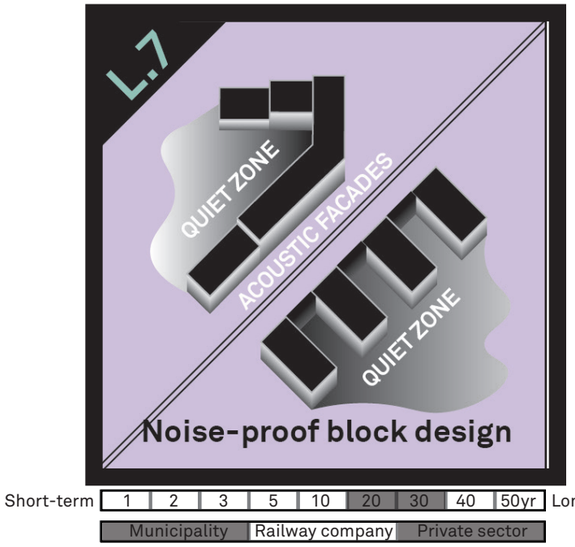








Residential blocks designed to minimize the railway noise, Zurich, Tilburg. Source: google maps.



HYPOTHESIS Urban blocks in train station area should be designed to minimize nuisance from the railway and form quiet backyards. Noise barrier should not be treated as a separate infrastructure, but instead be fully integrated in urban blocks and greenery.

THEORETICAL BACK UP Urban blocks facing railway are often c-shaped, with a gallery acting asa anoise barrier and connecting two paralell slabs. Another solution is to cluster non-residential buildings around the tracks to form a noise barrier for residential units. There are many more solutions and design decisions should be site-specific.

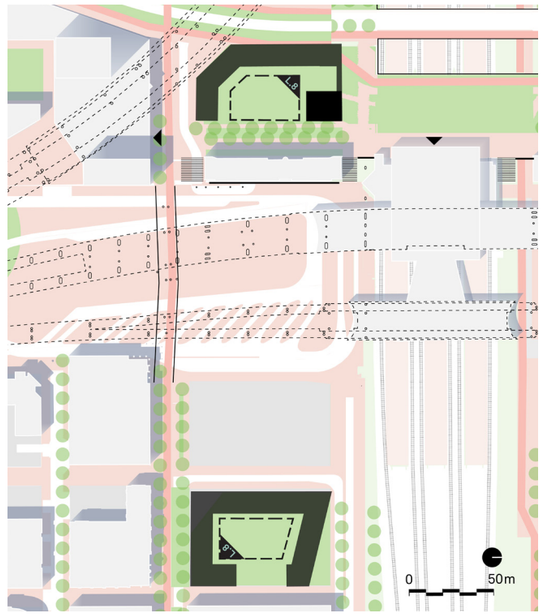
PRACTICAL IMPLICATION

- Use of sound-proof facades facing the railway
- Double-skin facades or greenery facing the railway.
- Orienting the social program to the inner courtyard.

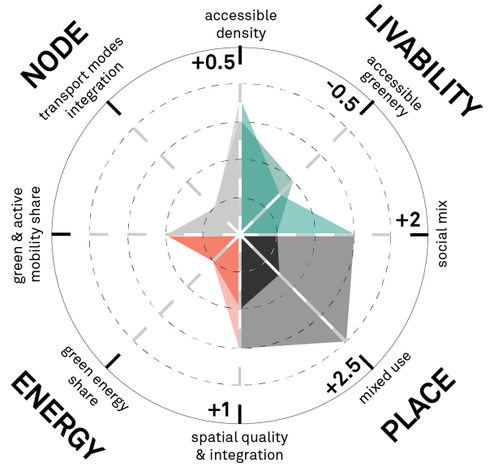
RELATION WITH OTHER PATTERNS

- Synergy with [L.3] [L.6] [L.8] [P.9] [E.9]
- Tension with [P.7]
- Mutually exclusive with [L.9]

Amsterdam Sloterdijk

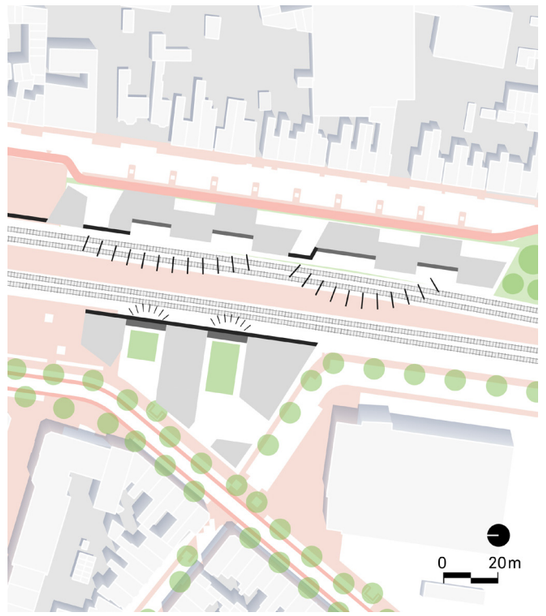


ASSESSMENT

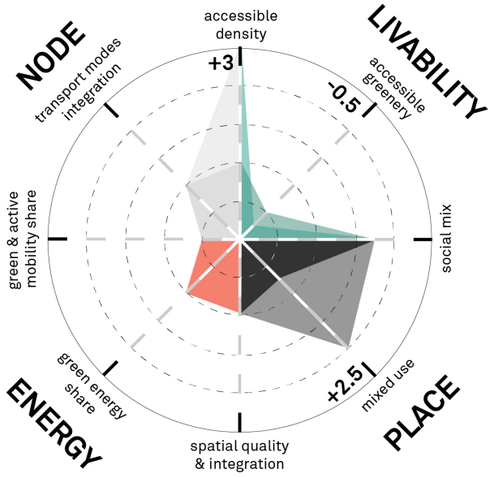


Observation: Noise-prooft design is especially challenging in Sloterdijk. The main source of noise are viaducts, selected blocks are the most promising location to apply this pattern.

Bergen op Zoom



ASSESSMENT



Observation: Noise-proof blocks can create a noise barrier for residential neighborhood and in turn minimize negative effect of more train connections, while increasing density.

L.8 Quiet semi-public greenery in high density

References:



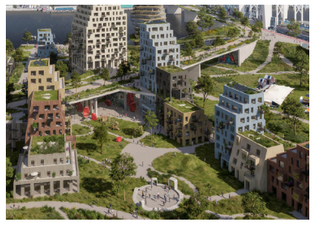
Semi-public park planned next to Utrecht central station. Source: Studio Ninedots



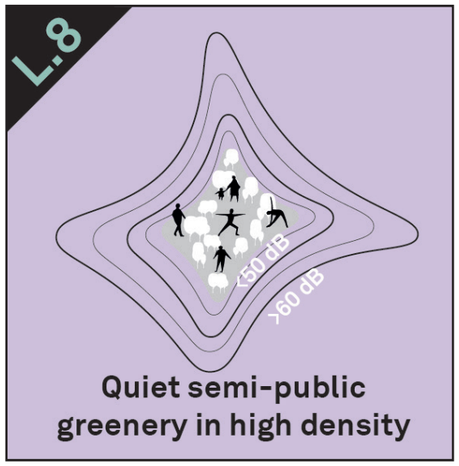
Motown, Amsterdam Sloterdijk. Source: https://dezwartehond.nl/en/projects/motown-track-8-kavel-o-sloterdijk/



Captions image description as you can see. Source: OMA



Redevelopment of station in Dordrecht. Source: Mecanoo



HYPOTHESIS In a densified station area, slow-paced family life should coexist with busy space of the connector. A living courtyard, where public and private life blends can make station area attractive for diverse social groups.

THEORETICAL BACK UP Pre-war urban blocks facing the station areas always had their quiet, private backyards, while postwar development was surrounded by open public spaces. Future development should balance this two qualities and do not neglect “woonerf” qualities in high density.

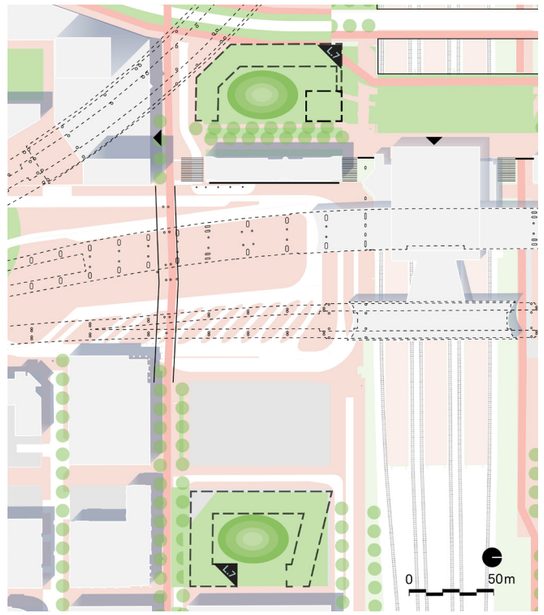
PRACTICAL IMPLICATION

- Average noise levels below 50 dB - as in a typical woonerf.
- Can be situated inside the urban block facing the station.
- Maximizing biodiversity, no structures in subsurface limiting planting.
- Enhanced by community meeting spaces on the edges.
- Oriented mainly on residents of the station area, but also accessible to other users.

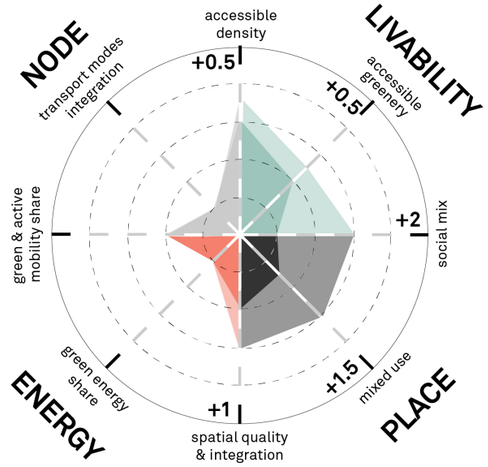
RELATION WITH OTHER PATTERNS

- Synergy with [L.3] [L.4] [L.6] [L.7] [N.4]
- Tension with
- Mutually exclusive with [N.5]

Amsterdam Sloterdijk



ASSESSMENT

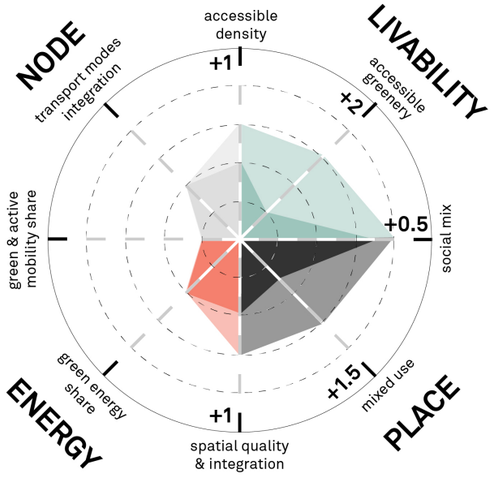


Observation: Two selected blocks are centrally located, they may become a relaxation zone for passengers. The problem of noise under viaducts cannot be solve by this pattern.

Bergen op Zoom



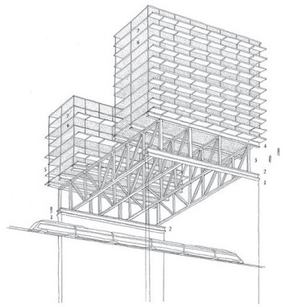
ASSESSMENT



Observation: There is a potential for one block with this pattern. Also wastescape in the south has potential to become a quiet park, if parking lot frees up space [N.4].

L.9 ¦ Bridging tracks with mixed-use development

References:



Sketch for over track development in Paris ZAC Rive Gauche. Source: http://cms.tvk.fr/



Planned over track development, Paris Rive Gauche. Source: osm.org

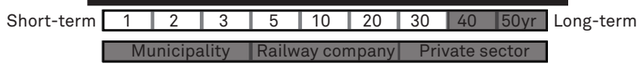


Existing over track development in Paris Clichy-Batignolles. Source: Google Earth



Study for over track development in Utecht Central Station. Source:Next Architects





HYPOTHESIS Building over tracks, creates an opportunity for densification. It can reduce nuisance, create new public spaces and connections across the tracks, while not obstructing the train traffic.

THEORETICAL BACK UP Over track development was already realized in the vicinity of stations Utrecht Centraal, Herleen, Zaandam, Amsterdam Centraal, Rijswijk. Amsterdam Sloterdijk and Utrecht Centraal. Recent development in Paris or plans in London show that it may also create inclusive high-density living environment.

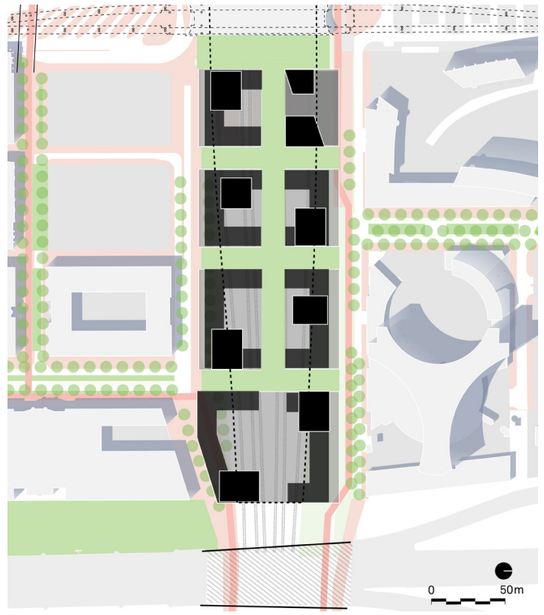
PRACTICAL IMPLICATION

- Over track public spaces will be located 8 meters above the tracks.
- Bridge-like construction spans can be integrated in buildings and public spaces design, limitation can become an
- In case of multiple tracks, development can cover only external ones, creating an acoustic barrier for the station area and livable streets parallel to tracks.

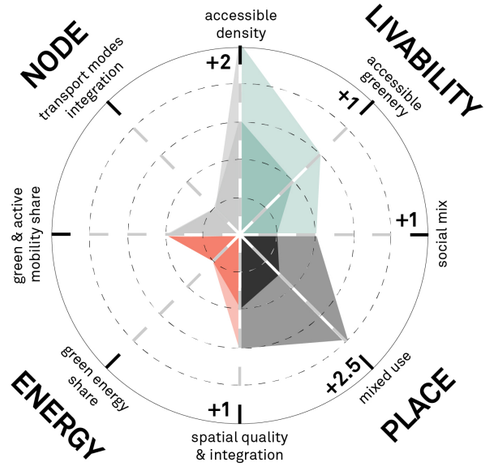
RELATION WITH OTHER PATTERNS

- Synergy with [N.4] [N.5] [N.9] [E.4] [L.3] [L.4] [L.5]
- Tension with [L.6] [P.4] [P.5] [E.9]
- Mutually exclusive with [P.7] [L.7]

Amsterdam Sloterdijk



ASSESSMENT

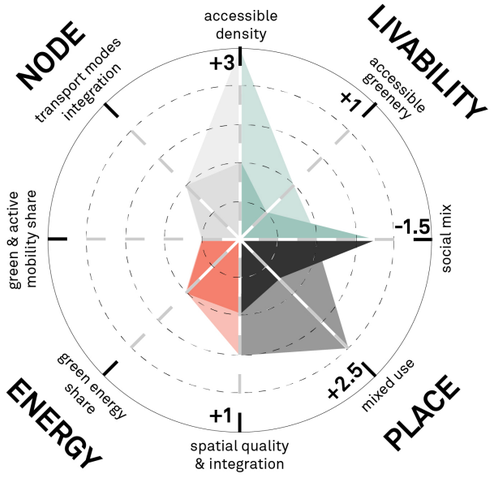


Observation: Over track development has a large potential in Sloterdijk, but it also creates pressure on existing facilities and spaces, forcing to apply many other patterns.

Bergen op Zoom



ASSESSMENT



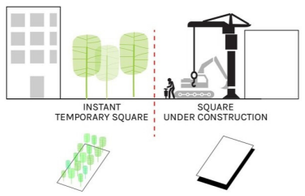
Observation: Over track development is technically possible, but a large density is required to make it financially feasible, it threatens the existing social mix.

P.1 Sequencing adaptable public spaces

References:



Temporary public space in Zhabei Qu, China. Source: https://bit.ly/3bZx0t6



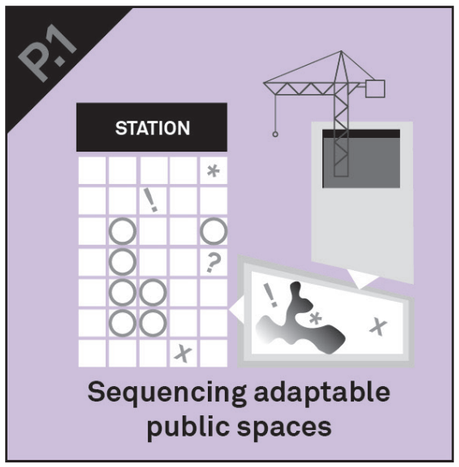
Temporary public space as a tool of phasing. Source: https://bit.ly/3wBRVV0



Temporary (2 years) station park in Hilversum. Source: https://www.hilversumci-tyguide.com/post/de-kwekerij



Salvage Swings City of Dreams, NYC. Source: https://bit.ly/3wBRVV0



HYPOTHESIS The temporary square builds the identity, while the city is built alongside. When one space becomes construction zone, the other remains socially active and provides the station with pleasant surrounding

THEORETICAL BACK UP At the beginning of station area development, important phase is to use low-cost, modular solutions, where social interactions and events are central. This helps local residents to appropriate space not only after the construction is finished, but next to it. In Utrecht Leidsche Rijn temporary public spaces are filling the niche of construction zone, the spatial quality is not the most important, but the fact that they are attracting people of all ages.

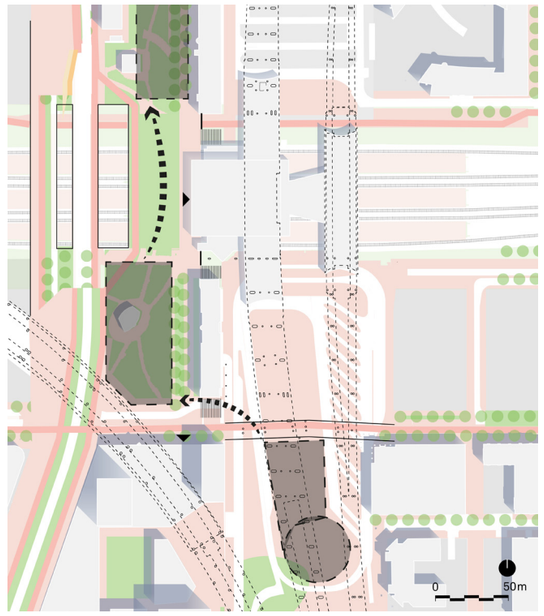
PRACTICAL IMPLICATION

- Sequencing of public spaces can allow smooth phasing.
- Focus on placemaking, possible land art elements.
- Targeting the least attractive areas around the station.

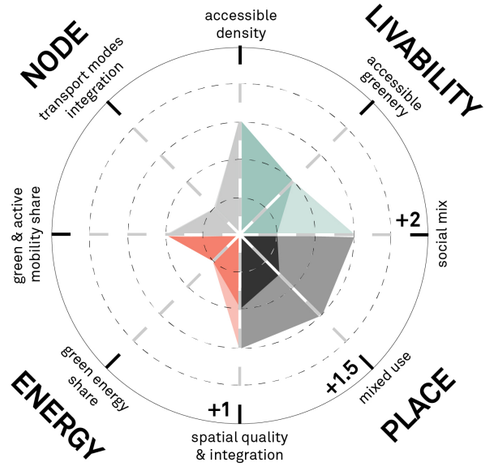
RELATION WITH OTHER PATTERNS

- Synergy with [L.1] [L.3] [L.6] [N.2]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk

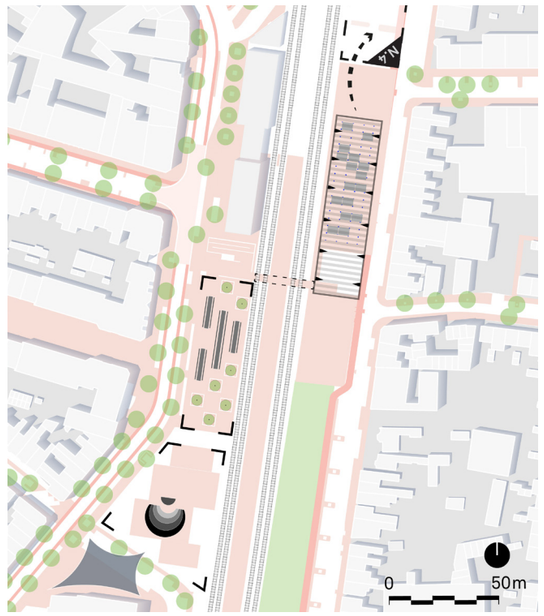


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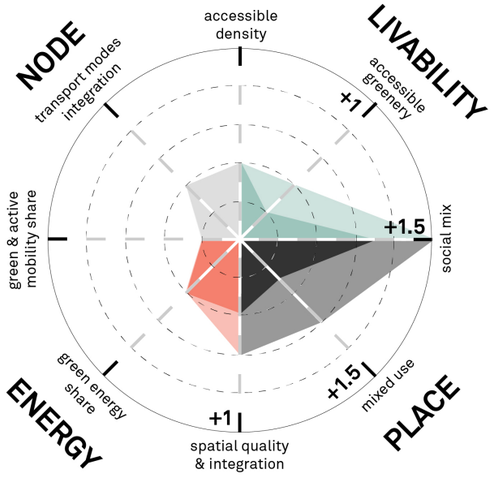


Observation: More intense, seasonal program of Orly- and Carascoplein, introducing three spaces of different atmospheres.

Bergen op Zoom



ASSESSMENT



Observation: It may achieve success as a social infrastructure, but it may be difficult to achieve high spatial quality for climate with temporary means.

P.2 ¦ Activating wastescapes by social pavilions

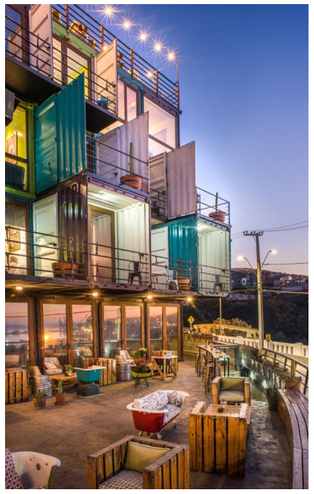
References:



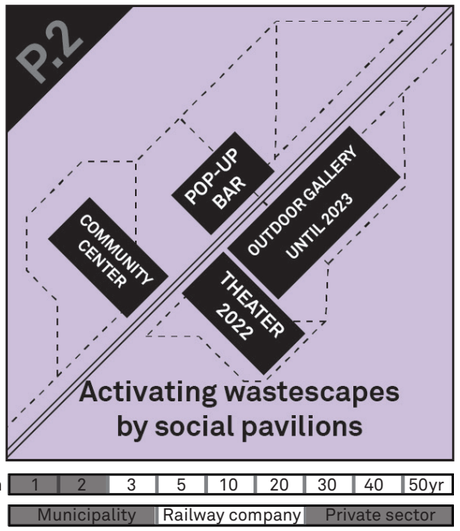
Tuin van BRET, reuse of shipping containers to create a farm and meeting place in Amsterdam Sloterdijk. Source: author



Temporary Zukunftpavil-ion with social program in Frankfurt. Source: https://bit.ly/3fw07QE



Container reuse development in Zurich. Source: https://bit.ly/5fw08iQ



HYPOTHESIS Social pavilions are more intense land use than adaptable public spaces, they activate the vacant plots and attract diverse users by a cultural offer or public facilities.

THEORETICAL BACK UP The use of pavilions in activating railway areas can be observed in some cities, ie. Delft, Hilversum, Amsterdam. They can have seasonal all year-round program. The recent pandemic has shown thay temporary pavilions in best-connected areas may have vital functions - a large covid-testing pavilion was localized in a vacant plot next to Sloterdijk station.

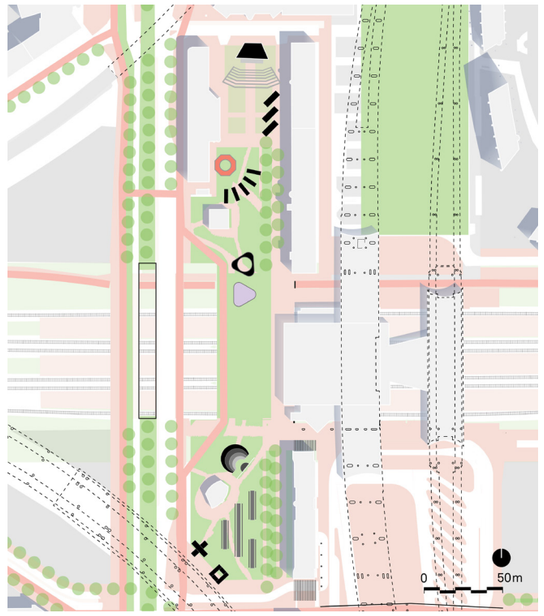
PRACTICAL IMPLICATION

- Pavilions that can be easily relocated, reuse, circular design.
- May help with development phasing or urban renewal.
- Program responding to the needs of residents and users of the area.

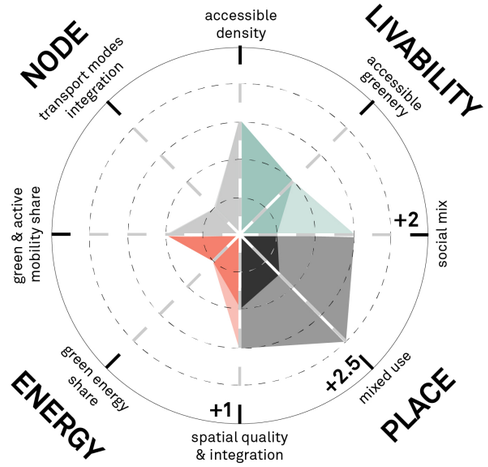
RELATION WITH OTHER PATTERNS

- Synergy with [L.1] [E.2] [L.6]
- Tension with
- Mutually exclusive with [L.2]

Amsterdam Sloterdijk

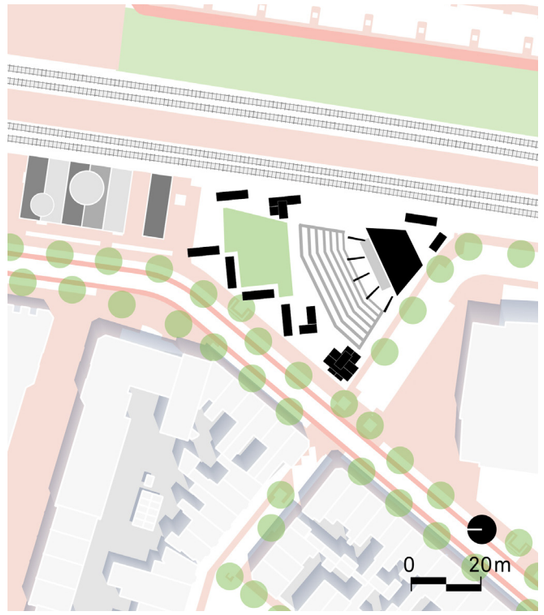


ASSESSMENT

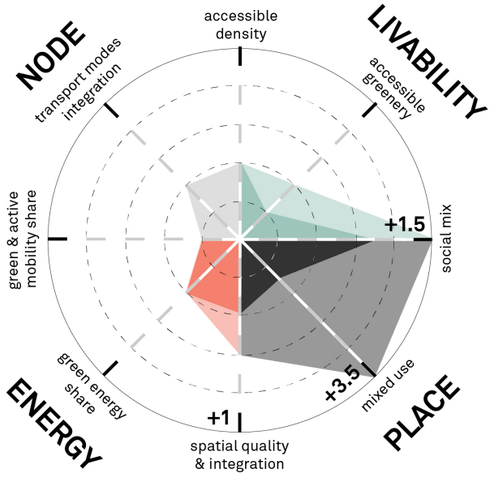


Observation: In the contxt of densification the use of Orlyplein can be intensified with a stage, small amphitheater, long tables and pavilions, to create a local nightlife zone.

Bergen op Zoom



ASSESSMENT



Observation: Empty plot could be a location of local summer festivals, attracting residents of both sides of tracks. Containers can create a temporary active plinth.

P.3 Making station structure adaptable

References:



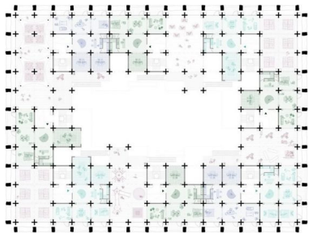
Container station in Barneveld. Source: https://bit.ly/3frOM5w



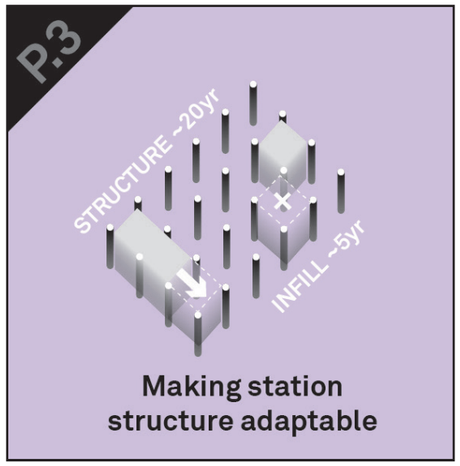
Container station concept for National Rail, UK. Source: https://bit.ly/7qr0M1w



Custom station concept by Superworld studio. Source: https://bit.ly/3bX6pl7



Adaptable flooe plan based on a regular grid. Source: https://bit.ly/4frQM8w



HYPOTHESIS Adaptable station is focused foremost of adaptability and circularity rather than unique landmark design.

THEORETICAL BACK UP Design of standardized stations in the Netherlands took place for the first time in years 1860-1880, by state-owned company SS. Station of three different categories had simple, repetitive spatial layout. In the 1970s. utilitarian standarization resulted in series of bland designs detached from their contexts. Adaptable train station can be very sustainable and circular, but it should balance between local customization and frugal modularity, as some contemporary concepts show.

PRACTICAL IMPLICATION

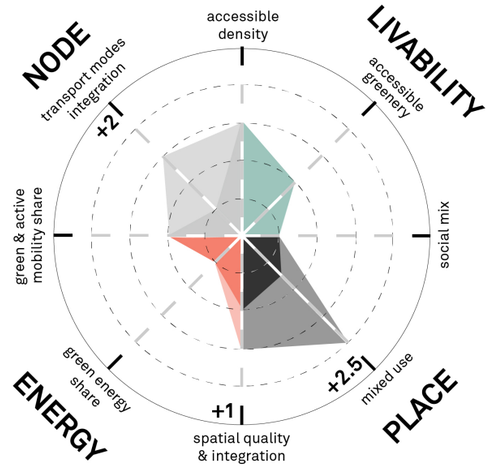
- Station consists of modular facilities gathered under one rooftop [N.7] or independent construction based on modules.
- Easy conversion due to flexible floor plan.
- Locally customized station facilities.

RELATION WITH OTHER PATTERNS

- Synergy with [N.1] [N.7] [P.4]
- Tension with
- Mutually exclusive with -

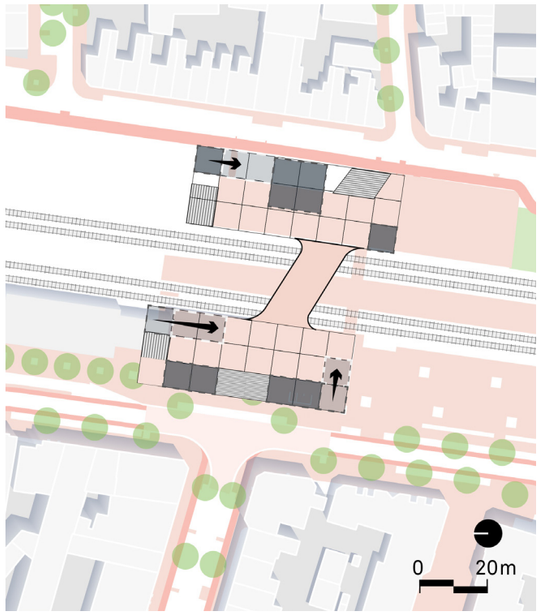
Amsterdam Sloterdijk

ASSESSMENT

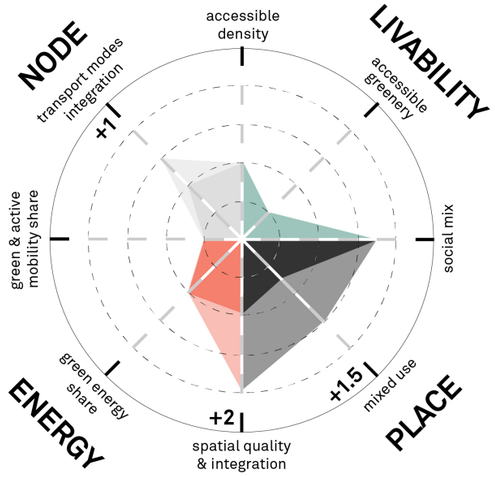


Observation: Nam pravo, Ti. Ultin teatqui praristaris consteatquam tri tiae prios, us clut audam atus, non sedo, quam medioos, us clut audam atus, non sedo, quam

Bergen op Zoom



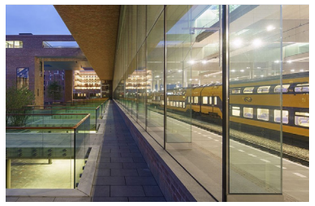
ASSESSMENT



Observation: A new tunnel could be surrounded by interior public spaces, which structure is long-term, but infill (pavilions, retail, bike storage, horeca) is adaptable.

P.4 ¦ Sunlight access and visual connection with the city

References:



Station Breda connecting visually with the street. Source: Koen van Velsen



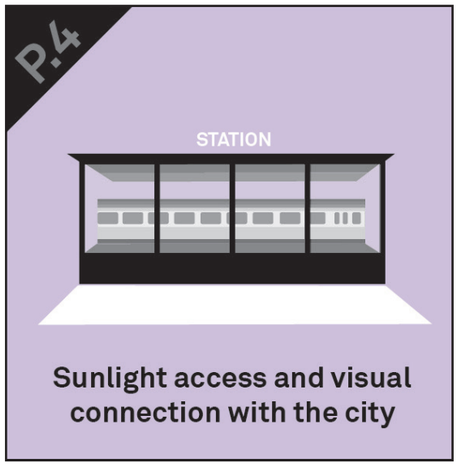
Design of metro station in Melbeourne. Source: https://bit.ly/3fw07QE



Staircase connecting visually station Saint-Charles with the main street of Marseille. Source: https://bit.ly/7Qw05ey



Visualisation of natural light in tunnel of NS station Gelder-marsen. Source: https://bit.ly/6fv08QE



HYPOTHESIS Visual connection from the train and platforms to the city provides the best wayfinding for passengers. They do not look at signage, but intuitively choose the right direction. Sunlight access contributes to social safety and energy savings.

THEORETICAL BACK UP The pattern works best when local landmarks, station square or a station street are visible from the platforms or entrance to the tunnel. Station building should not separate trains from the city, but use the activity of the station as an element animating public square and improving wayfinding. Sunlight access in tunnels, on platforms and in station hall should be maximized, as often seen in station halls from the end of 19th century.

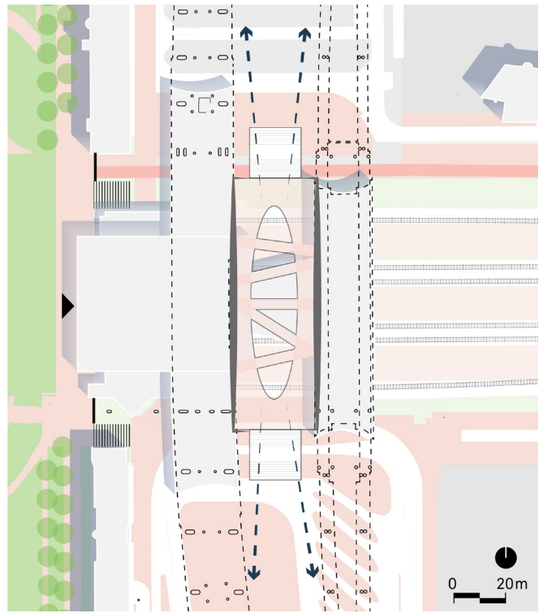
PRACTICAL IMPLICATION

- Local landmarks or streetscape should be visible from platforms, bridges or the entrance to tunnel.
- Direct sunlight access to platforms, tunnels and station hall.
- Trains visible from the station square are enhancing its liveliness, and guiding passengers.

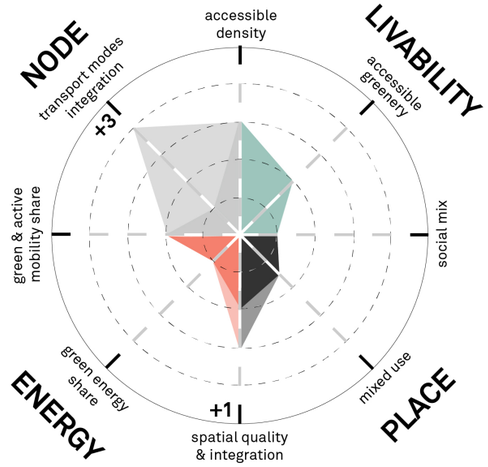
RELATION WITH OTHER PATTERNS

- Synergy with [P.3] [P.6] [P.8] [N.7]
- Tension with [L.5] [L.9] [E.4] [N.9]
- Mutually exclusive with -

Amsterdam Sloterdijk

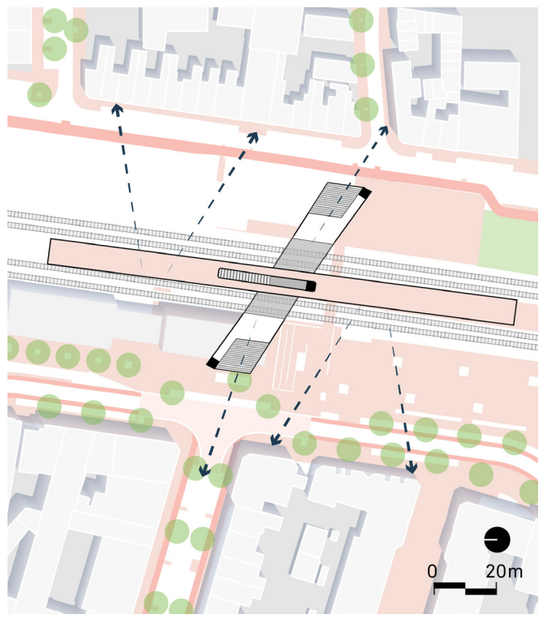


ASSESSMENT

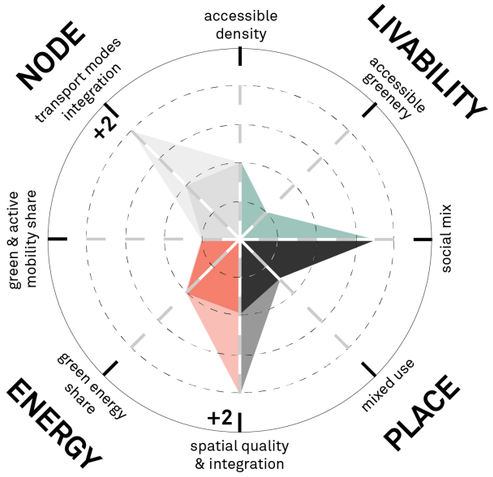


Observation: Redesigned core of the station with large stairs can improve visual connection with strong vistas along viaducts, and should not worsen the sunlight access in lower platforms.

Bergen op Zoom



ASSESSMENT



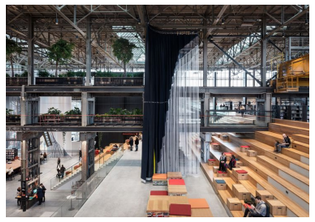
Observation: A wide tunnel with sunlight access in the middle would improve both node and place. Without densification, platforms keep the visual connection with the city.

P.5 Interior public spaces for culture

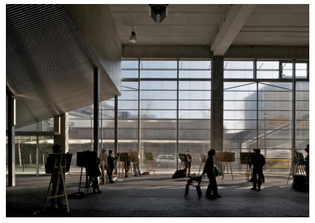
References:



Alstom Halles in Nantes by Franklin Azzi. Source: https://bit.ly/3tM3vfo



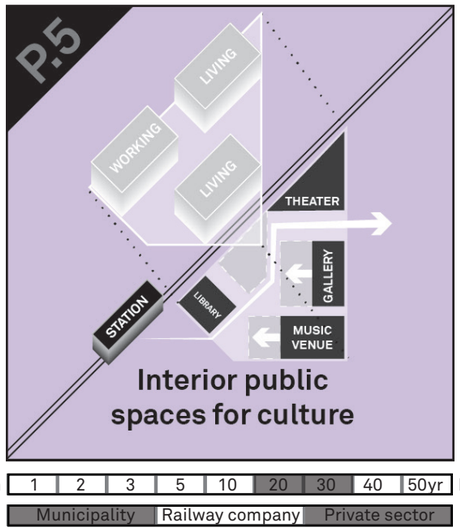
LocHal, a public library and cultural center next to Tilburg station. Source: https://bit.ly/3elTZ8n



Nantes School of Architecture by Lacaton & Vassal. Source: https://bit.ly/3bsWVUS



Captions image description as you can see. Source: White Arkitekter.



HYPOTHESIS Train station area, while equipped with flexible interior spaces can become a well-connected cultural hub, attracting users from city and region.

THEORETICAL BACK UP Examples of multifunctional LocHal in Tilburg, TivoliVredenburg in Utrecht or cultural complex near station in Enschede show how train station area can successfully become a cultural hub, attracting beyond city scale. Interior public spaces for culture included in the station area development may help create a successful place next to an efficient node.

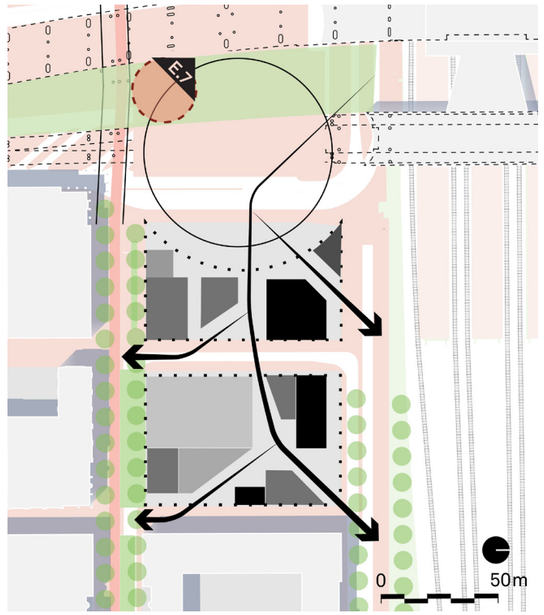
PRACTICAL IMPLICATION

- Adaptable layout of interior spaces allowing changing needs.
- Direct access from the station square or train station itself
- Space dedicated to functions like city library, concert venue, art galleries, theater, cinema, education etc.

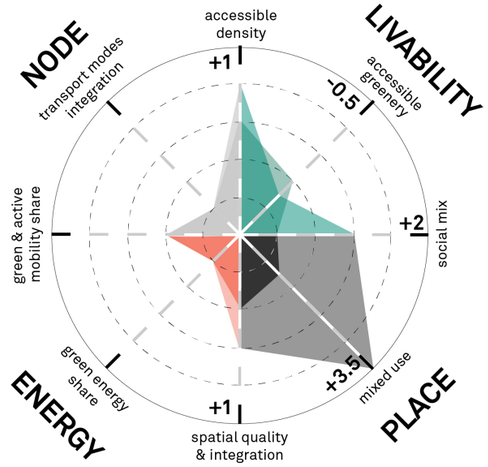
RELATION WITH OTHER PATTERNS

- Synergy with [P.6] [L.6] [P.9]
- Tension with [L.9]
- Mutually exclusive with

Amsterdam Sloterdijk

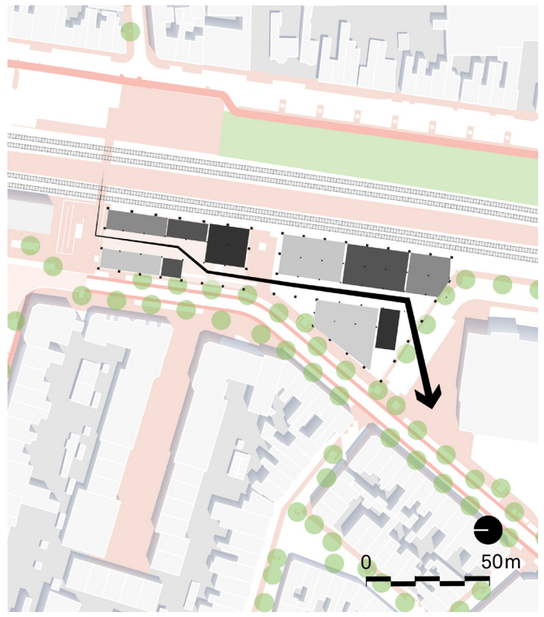


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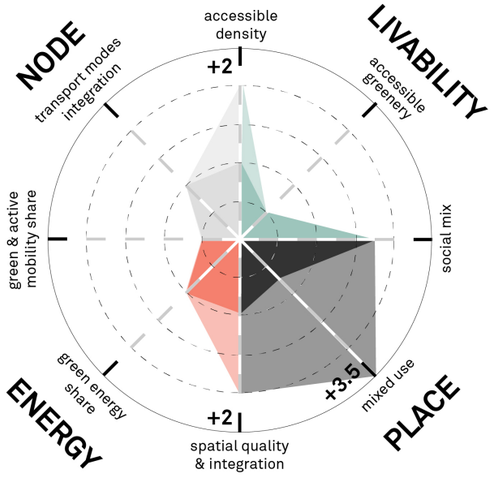


Observation: A sequence of indoor spaces for culture starts from the new station square. Music venues, theaters and cinemas topped with housing will activate a desolate office district.

Bergen op Zoom



ASSESSMENT



Observation: Local culture center with library and music venue, topped with new apartments will change the image of the station area.

P.6 Public space penetrating buildings

References:



Train station with residential function, Herrliberg-Feldmeilen, Switzerland. Source: Hosoya & Schaeffer.



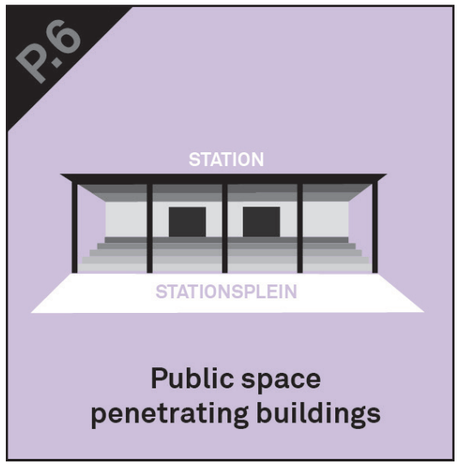
Captions image description as you can see. Source: JAJA Architects



Captions image description as you can see. Source: Studio Ninedots



Stadium in Bordeaux by Herzog & de Meuron. Source: https://bit.ly/3fitUwc



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Blurring the boundary of facades and open spaces can contribute to the liveliness of the station square, provide protection from rain and wind, and increase walkability of the station surroundings.

THEORETICAL BACK UP Alexander et al. (1977) highlighted the importance of edges in shaping a good public space. If properly designed, edges turn into activity pockets, where people tend to linger, observing the square. Public space in a train station area should balance the need for staying and moving, and edges where buildings and open space blend together may serve both.

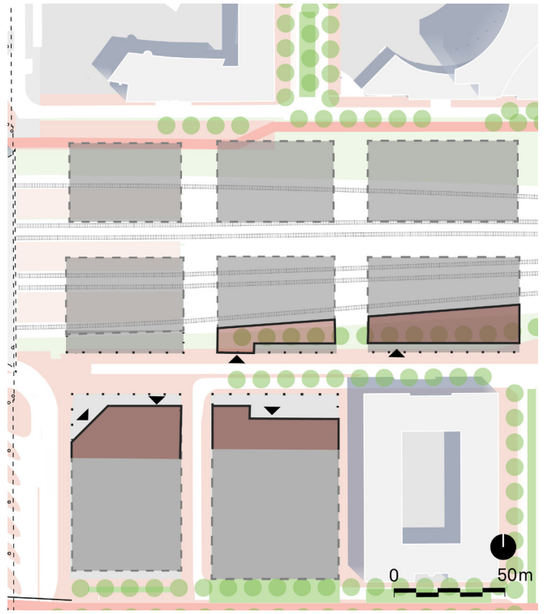
PRACTICAL IMPLICATION

- Alternative to active plinth in the frontside of station square or street.
- Maximizing walkability on the ground level.
- Introducing arcades or pergolas.
- Shortcuts through buildings optimizing the mobility node and creating attractive places of diverse degree of publicness.

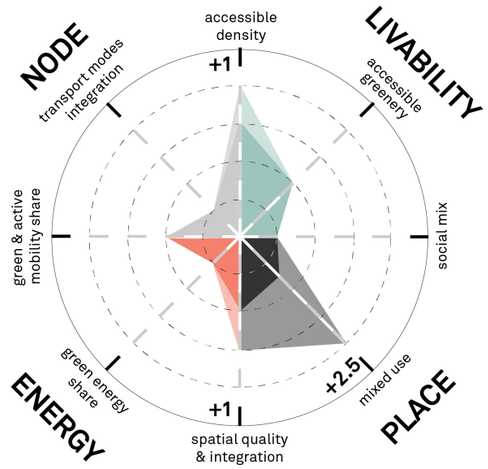
RELATION WITH OTHER PATTERNS

- Synergy with [P.5] [P.7] [P.8]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk

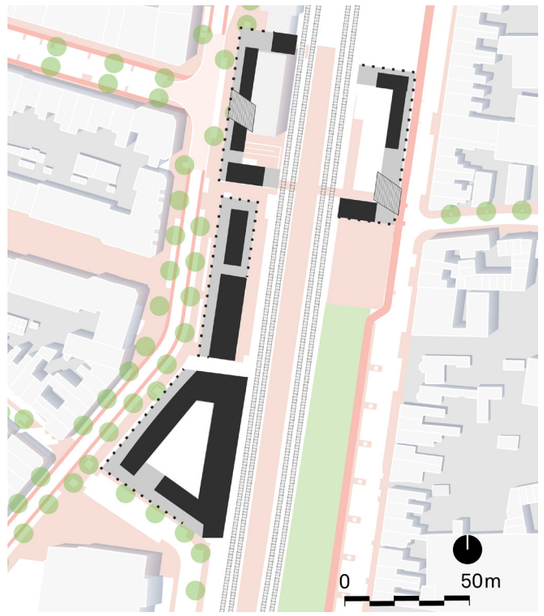


ASSESSMENT

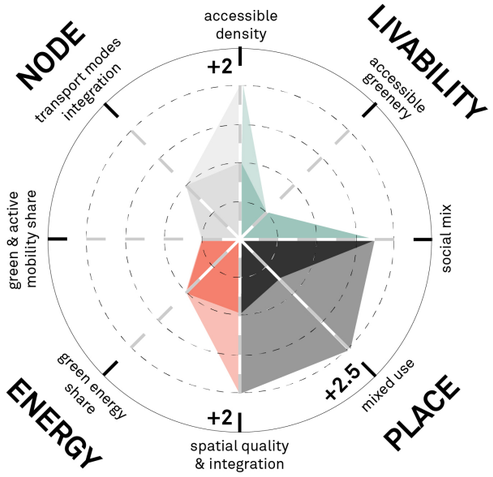


Observation: Arcades allow to widen relatively narrow street of 18 m, add diversity, and adapt plinths to changing program.

Bergen op Zoom



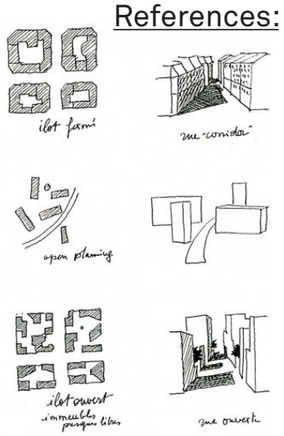
ASSESSMENT



Observation: Arcades and free ground floors will enhance the quality of a new station street and the station hall itself, blending it with open spaces.

P.7 Fine grain urban fabric made of open blocks

References:



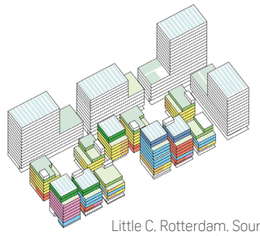
Original concept of the open block - sketch. Source: Christian de Portzamparc



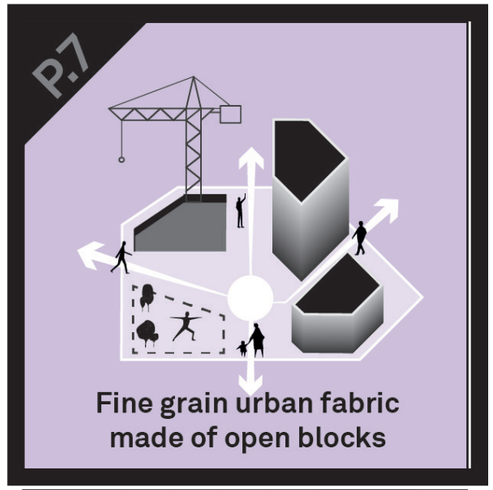
Model of planned open block in ZoHo, Rotterdam. Source: ECHO urban design



Development in Dordrecht station area. Source: Mecanoo



Little C. Rotterdam. Source: jvantspijker & partners



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Fine grain urban fabric made of open blocks increases walkability, while allowing high-density, active public plinth, green semi-public courtyard and optimal sun exposure.

THEORETICAL BACK UP The concept of open block was introduced by Chrisitian de Portzamparc in 1995 and since then became widely implemented in France and beyond. Fine grain urban fabric was for instance one of the key principles of master plan for Leiden train station area by Posad-Maxwan. A component of adaptability would mean that a block allows phasing; buildings within the block are developed subsequently. At the same time, the quality and coherence of space is preserved, there should be no fenced-off areas waiting until construction starts.

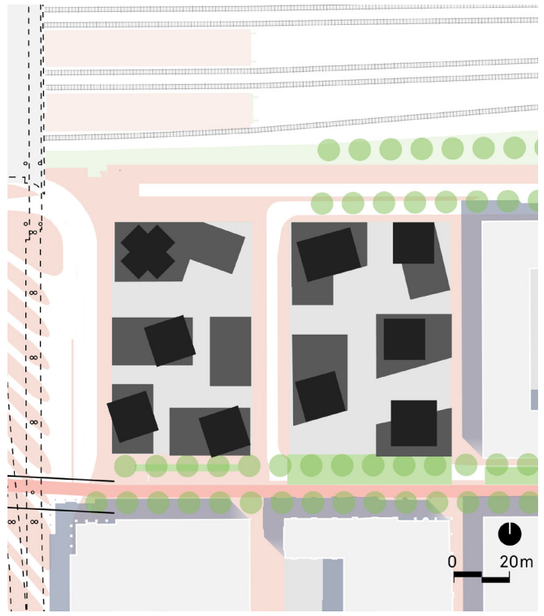
PRACTICAL IMPLICATION

- Phasing and potential alterations of program and massing within the block should be possible.
- FSI higher than 2.0 for the whole block.
- Design balancing noise protection and sunlight access with walkability

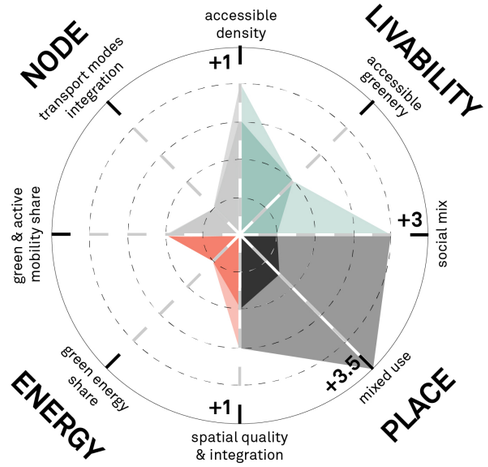
RELATION WITH OTHER PATTERNS

- Synergy with [L.6] [L.7] [P.6] [P.9] [E.9]
- Tension with [L.7]
- Mutually exclusive with [L.9]

Amsterdam Sloterdijk

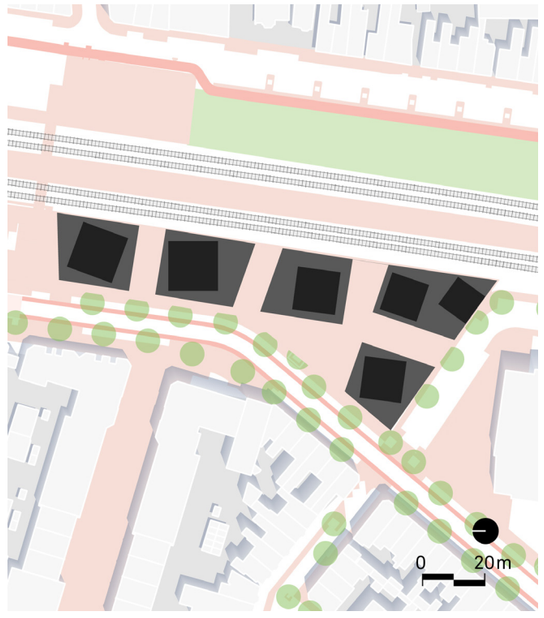


ASSESSMENT

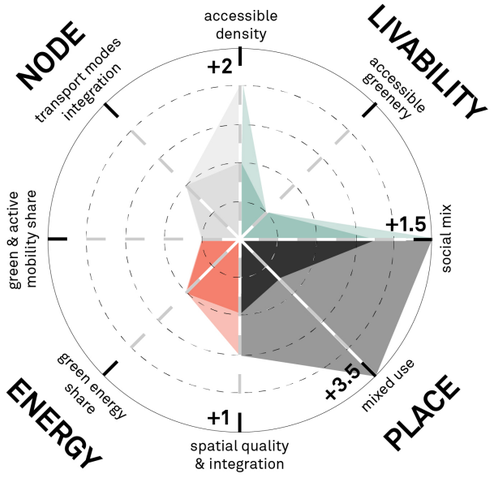


Observation: Two unbuilt blocks owned by municipality are optimal location for open blocks, public functions in podiums and housing on top fit the densification demand.

Bergen op Zoom



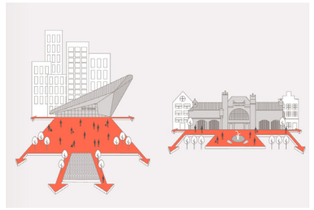
ASSESSMENT



Observation: The optimal location for fine grain urban blocks is current Prorail area and bike parking. Different functions in podium contribute to public life, housing on the top.

P.8 Station hall as a landmark and inclusive meeting place

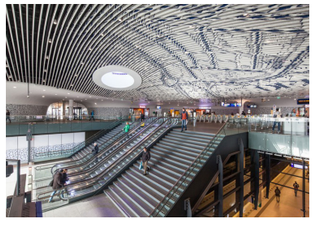
References:



Principles for landmark station design by Bureau Spoorbouwmeester. Source: Posad-Maxwan



Captions image description as you can see. Source: White Arkitekter.



Train station in Delft integrated with city hall. Source: Mecanoo



Madrid, green hall of train station Atocha. Source: osm.org



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Train station designed as a successful landmark will become an important place on a city map. Station hall should act as an interior public space equipped with social functions, not only an efficient connector, but also an inclusive meeting place.

THEORETICAL BACK UP This pattern is derived from the principles of Het Nieuwe Stationskwartier (Bureau Spoorbouwmeester, 2021). Station buildings should be treated as a gate to the city, shaping the first impression. Site-specific design will always result in higher quality than uniformized layout on the national scale.

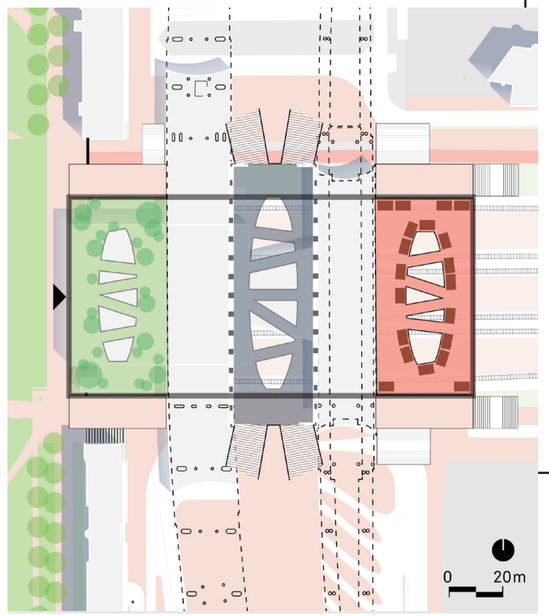
PRACTICAL IMPLICATION

- Including art and greenery in public space.
- Station hall should be designed as a core of the multimodal node, have access to direct sunlight and high-quality facade facing the main public space (the station square).
- Social functions should not obstruct the efficient intermodal node, but rather be complementary.

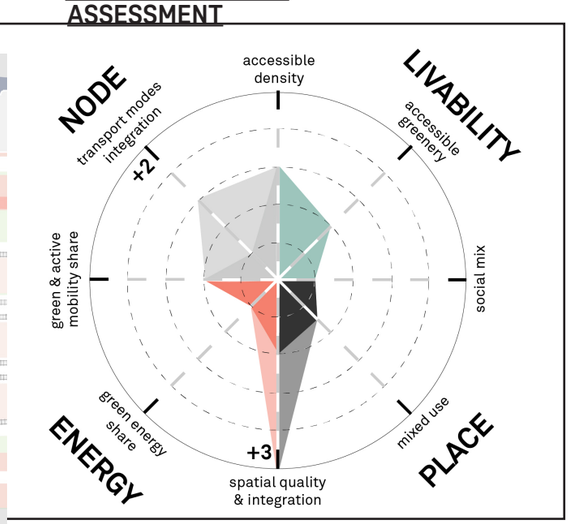
RELATION WITH OTHER PATTERNS

- Synergy with [P.4] [P.6] [P.9] [E.4] E.7]
- Tension with
- Mutually exclusive with [E.8]

Amsterdam Sloterdijk

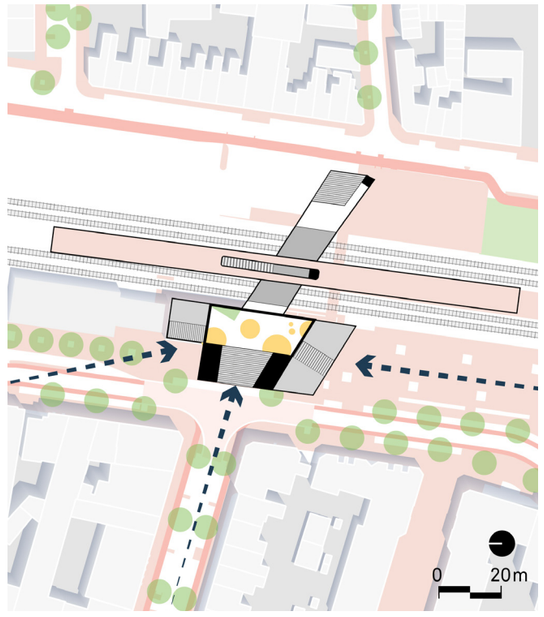


ASSESSMENT

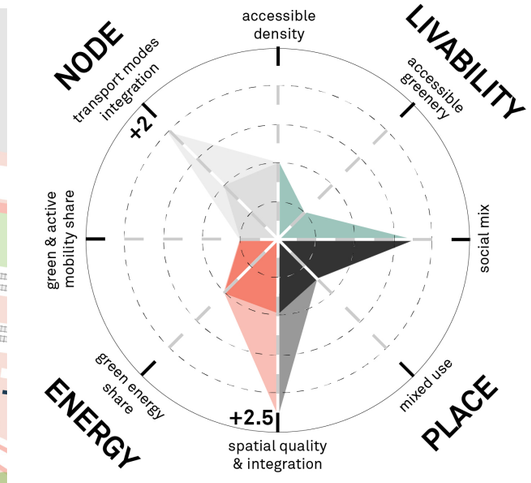


Observation: Landmark station Sloterdijk could have three halls: foodhall, central station hall and green hall for relaxation, all at the level of Orlyplein, surrounded by a “balcony.”

Bergen op Zoom



ASSESSMENT



Observation: New station hall of high architectural quality could serve as an entrance to the tunnel, closing the vista of stationstraat.

P.9 ¦ Walkable streets with flexible program guiding to station

References:



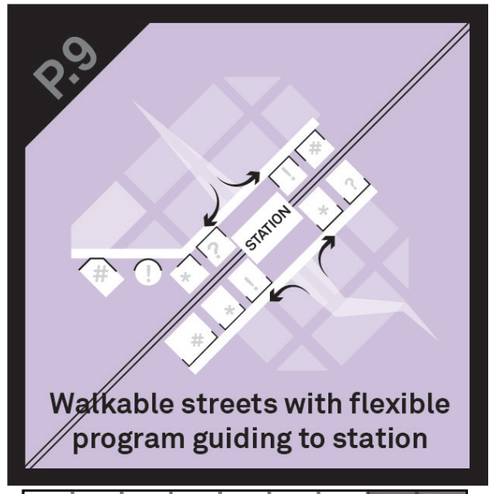
Captions image description as you can see. Source: Powerhouse company



Sloterdijk, active plinth of new development MoTown. Source: Studio Ninedots



Captions image description as you can see. Source: osm.org



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Activating streets parallel to tracks can relieve the existing station streets which are overcrowded or have little potential. Street profile should be dedicated to active mobility, while functions in plinth should be as adaptable as possible and complementary to the existing station street.

THEORETICAL BACK UP Most of the station streets in the Netherlands are perpendicular to tracks and oriented on the station buildings. They often have limitations; they may become overloaded by densification or have little potential in terms of new functions. Creation of new active streets, parallel to tracks, can be a solution.

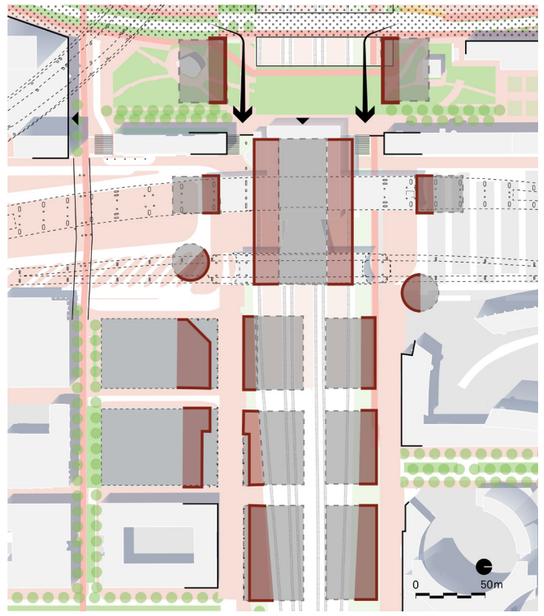
PRACTICAL IMPLICATION

- Adaptable street profile, most of it dedicated to active mobility.
- No street parking or heavy truck deliveries.
- Complementary program to the existing station street.
- Adaptable plinth; temporary program, if the buildings are not finished.

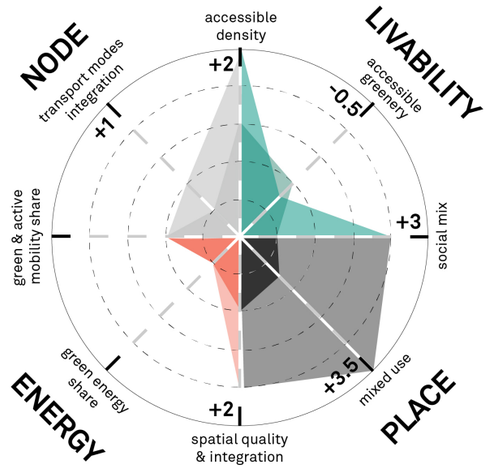
RELATION WITH OTHER PATTERNS

- Synergy with [P.5] [P.6] [P.7] [P.8] [N.5] [L.9] [E.7]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk

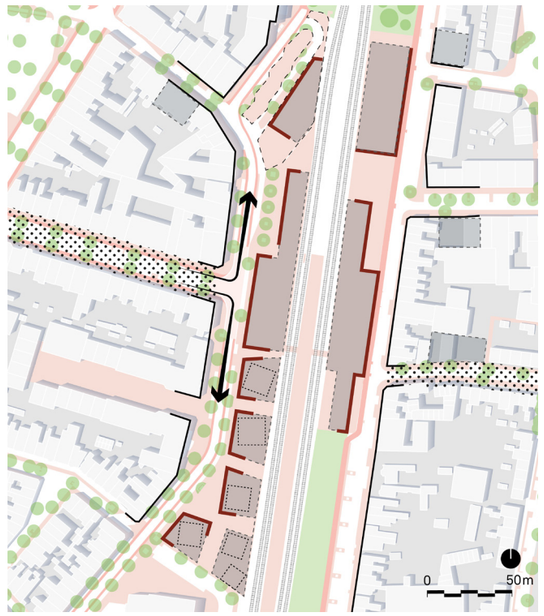


ASSESSMENT

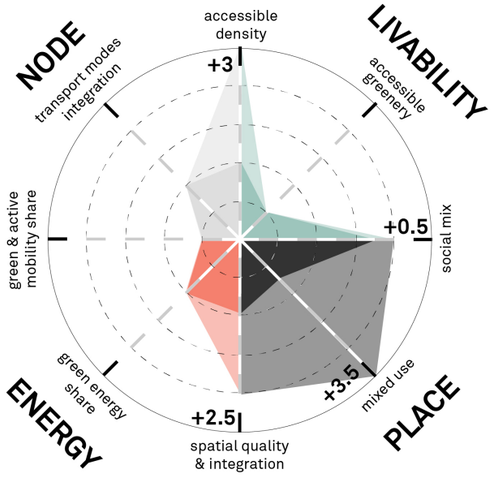


Observation: Two streets paralell to tracks where main urban functions of Sloterdijk-Centrum will be located are taking over the role of Radarweg.

Bergen op Zoom



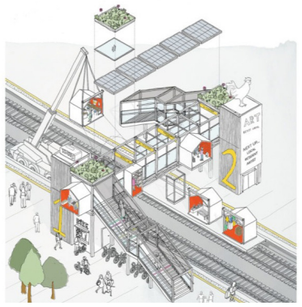
ASSESSMENT



Observation: Historical Stationsstraat has little potential, so developing street paralell to tracks can result in vibrant, livable neighborhood.

E.1 Harvesting energy by railway infrastructure

References:



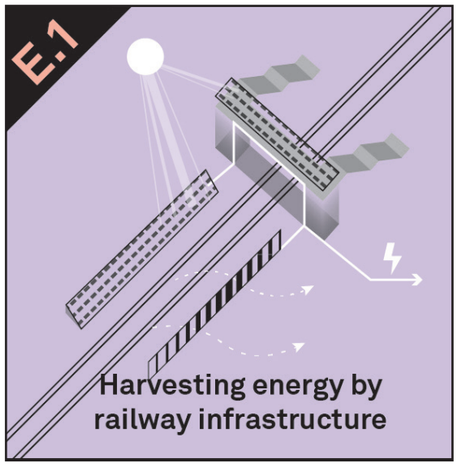
Energy-producing footbridge for National Rail (UK). Source: Hawkins/Browns



Solar panels as a fence of railway area, tested in the Netherlands. Source: https://bit.ly/3tU3ixe



Wind panel; safe for birds fence generating electricity. Source: https://bit.ly/3tN8ixa



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Edges of tracks in station areas are always fenced, technical buffer which could be used also for renewable energy generation.

THEORETICAL BACK UP Railway infrastructure was used for solar energy generation in the UK, where PV panels directly powered trains on a railway in Sussex. Footbridges, as opposed to tunnels, create an opportunity for energy generation. Equipped with wind panels or covered by photovoltaic pergola, they may balance the energy use of the stations.

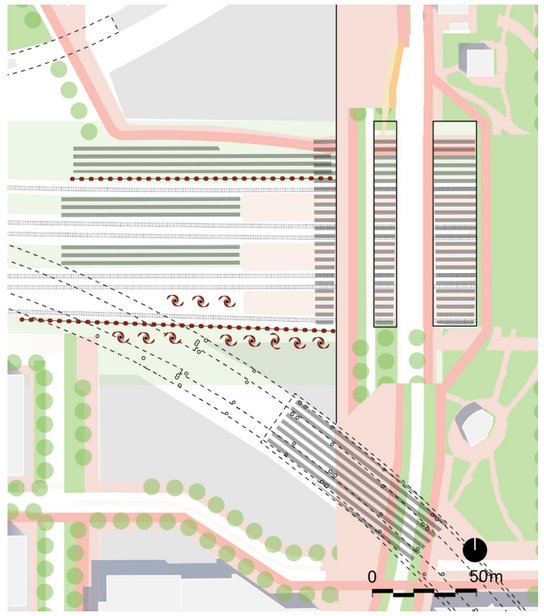
PRACTICAL IMPLICATION

- Barriers should be designed to dismantle, so they can easily be moved when the development of the station area is unfolding.
- Besides PV-panels, alternative solutions should be considered, like wind panels, generating electricity from both gusts of passing trains and natural wind.
- Infrastructure should be safe for humans and animals and free from negative impact on microclimate of a station area.

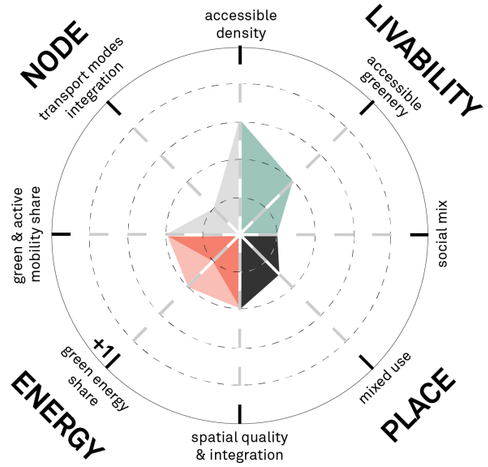
RELATION WITH OTHER PATTERNS

- Synergy with [N.1]
- Tension with [L.5] [N.7]
- Mutually exclusive with

Amsterdam Sloterdijk

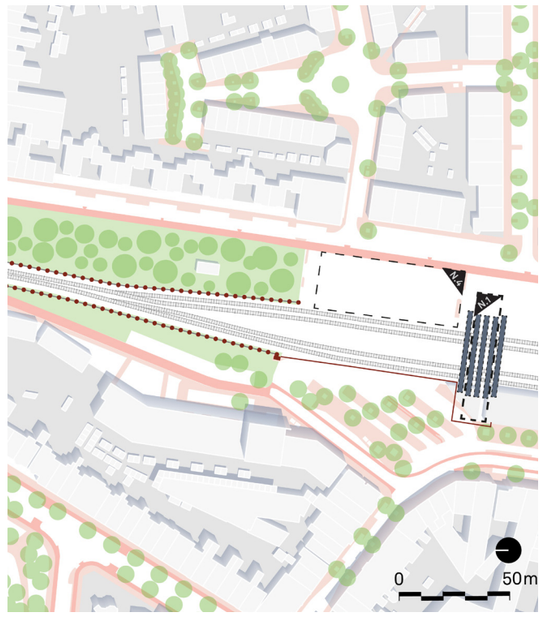


ASSESSMENT

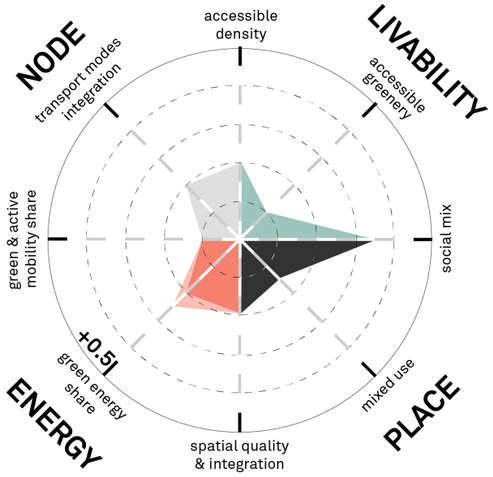


Observation: Due to lack of planned construction until 2030, eastern side has good potential to harvest wind (wind panels and small wind turbines) and solar energy.

Bergen op Zoom



ASSESSMENT



Observation: Poor solution in this location. On railway grounds little potential for solar energy (only with footbridge or a large canopy), higher potential of wind energy (panels).

E.2 Temporary energy production and storage

References:



Mobile energy storatge.Source: https://www.est-floattech.com/blue-elephant-energy-storage-2/

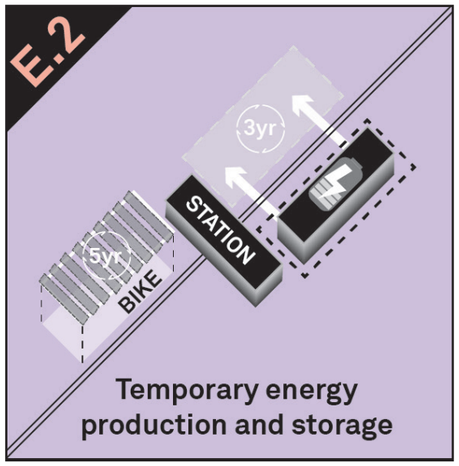


Mobile, sun-tracking solar power plant. Source: https://www.moveit.tech/en/products/solar-container/





Tulip-shape wind turbines; safe and more efficient per sq m than PV panels. Source: https://flowerturbines.com/



HYPOTHESIS Adaptable zoning for future energy system requires land reserves for future innovations. Rail-oriented wastescapes can serve temporary generation and storage and become testing grounds for innovations.

THEORETICAL BACK UP This pattern is following the logic of temporary land uses. Innovative solutions for energy storage and production in urban areas can be invented in the coming years, as the pace of transition and innovation increases. Solutions like systems generating hydrogen from excess of electricity are not yet ready to implement, but they can be a valuable addition to the future train station acting as a local energy hub.

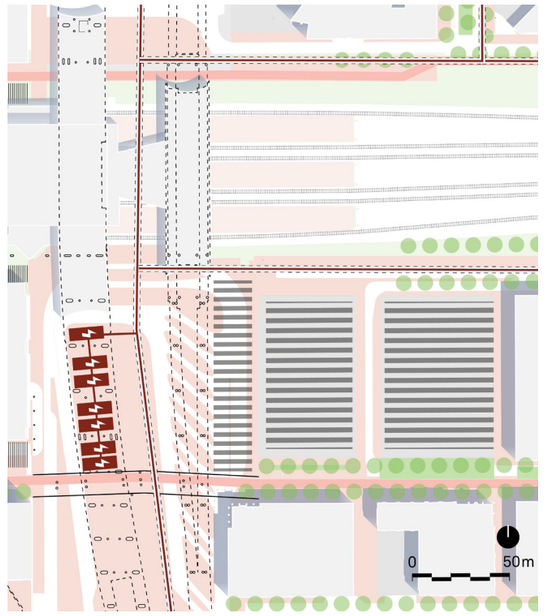
PRACTICAL IMPLICATION

- Temporary energy generation on wastescapes; solar fields, small wind turbines or wind panels, mobile district batteries.
- For synergy can be combined with other temporary land uses.
- Apply on the least attractive plot in the station area that does not obstruct daily functioning of the node.

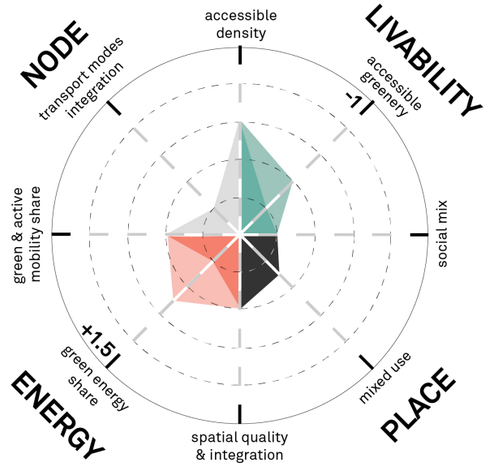
RELATION WITH OTHER PATTERNS

- Synergy with [P.2] [L.1] [L.2] [N.3]
- Tension with
- Mutually exclusive with [L.3]

Amsterdam Sloterdijk

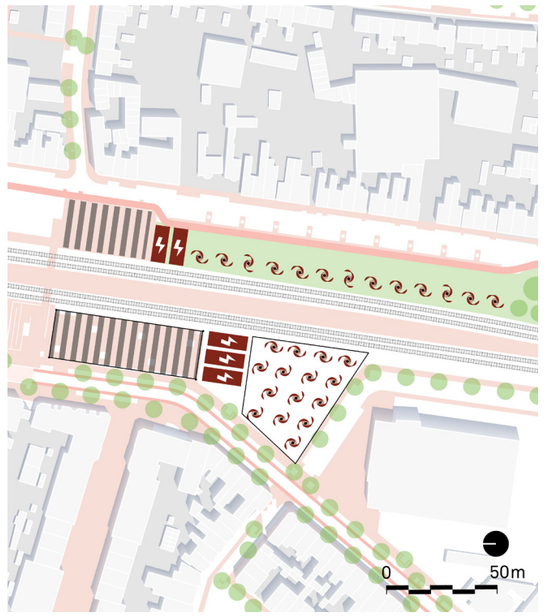


ASSESSMENT

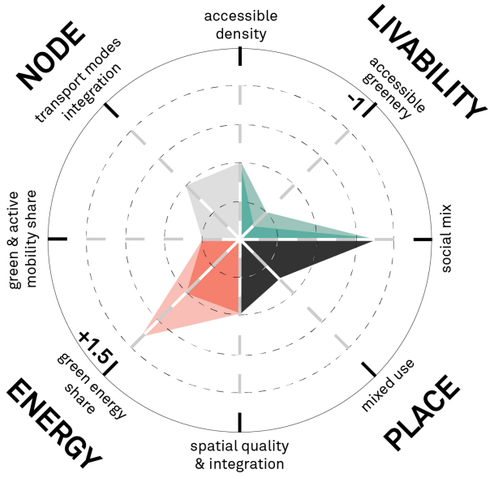


Observation: Central plots and tram stop are large-scale temporary solar canopy, if combined with other functions. Potential to integrate energy storage under the viaducts.

Bergen op Zoom



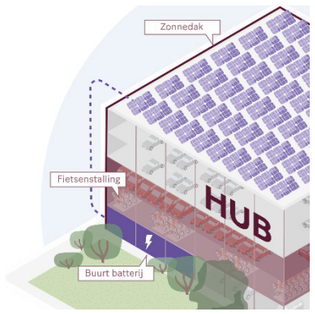
ASSESSMENT



Observation: Large potential for temporary energy generation next to railway area. Short-term zoning can include future reserves, for example for district heating hub.

E.3 Parking garage as a district battery

References:



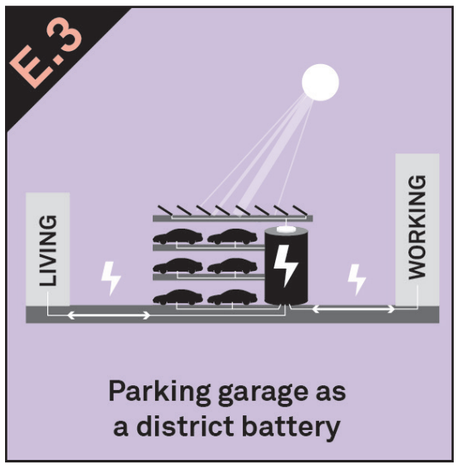
District battery as a part of mobility hub. Source: Posad-Maxwan

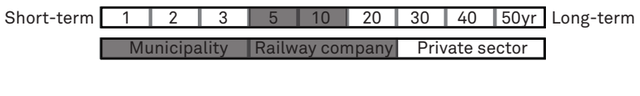


Off-grid charging station for electric cars. Source: COBE



District battery in Schwerin, Germany. Source: http://solar-media.blogspot.com/2014/04/





HYPOTHESIS Increasing share of electric cars creates an opportunity to turn parking garages into district batteries which allow efficient energy management in the station area. A step towards energy-neutral neighborhood.

THEORETICAL BACK UP The concept of implementing energy storage in appeared in mobility hubs in the Hague. Local electricity storage is slowly becoming present in urban areas.

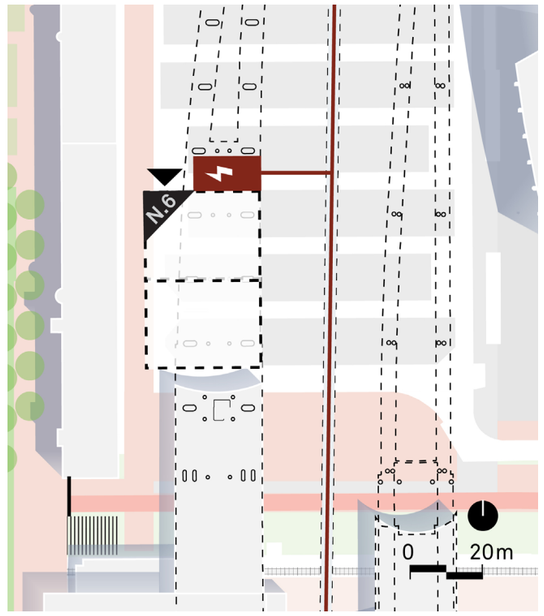
PRACTICAL IMPLICATION

- Electric cars may be used to expand the capacity of energy storage for the needs of the neighborhood.
- Usage of chemical storage (li-ion batteries) may obstruct leisure functions, like recreation on the rooftop, as it requires cooling, fire safety measures and direct access of emergency.

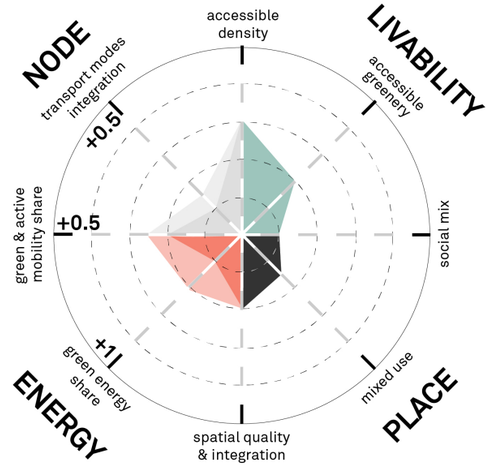
RELATION WITH OTHER PATTERNS

- Synergy with [N.4] [N.5] [E.4] [E.5] [E.8]
- Tension with
- Mutually exclusive with [L.3]

Amsterdam Sloterdijk

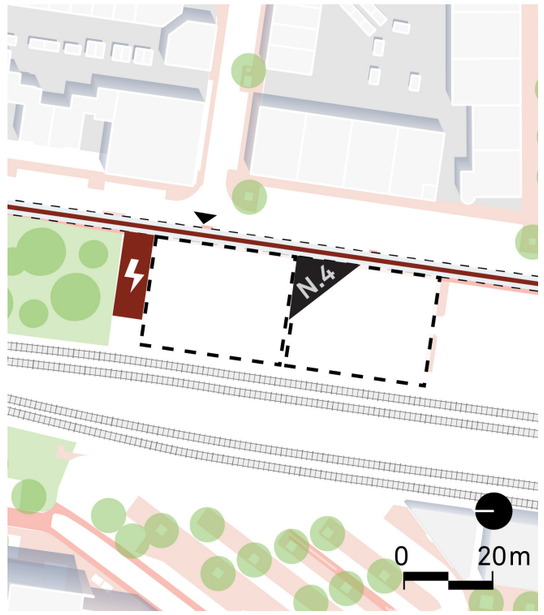


ASSESSMENT

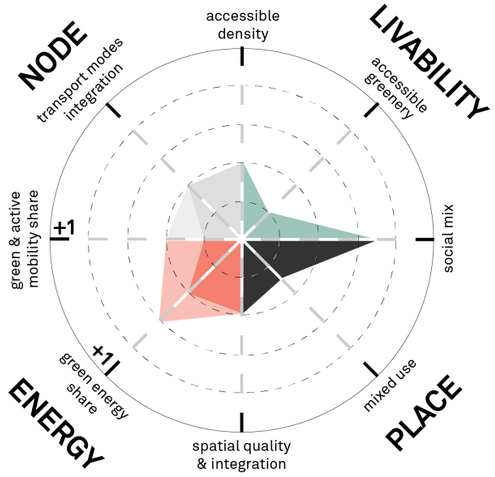


Observation: Shared mobility hub [N.6] located under the viaduct is located next to district electricity cable; battery will not obstruct the node, and has emergency access.

Bergen op Zoom



ASSESSMENT



Observation: District battery can be located on the side of a modular parking garage [N.4], directly accessible from the street, next to driveway to the garage.

E.4 Making facade and rooftop solar-ready

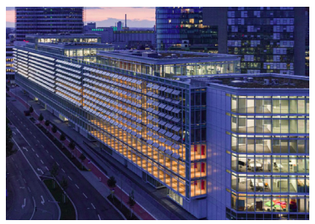
References:



Solar canopy covering Stanford University Central Energy Facility. Source: https://bit.ly/3uRcc9q



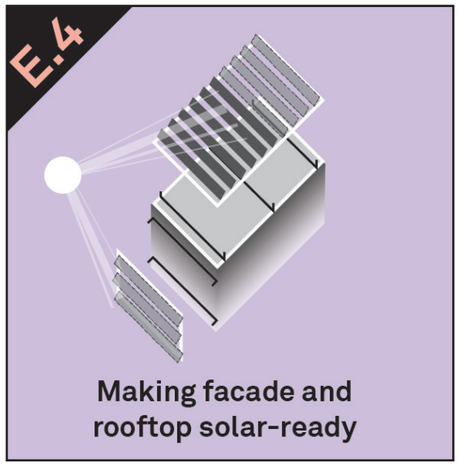
Solar rooftops in Paris ZAC Clichy-Batignolles. Source: google maps



Solar facade of the office building in Frankfurt. Source: Renzo Piano, https://bit.ly/3MPuxgi



Solar facade of International School in Copenhagen. Source: https://bit.ly/3uPExgi



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Buildings designed in station area and station itself should allow adaptable solar energy harvest

THEORETICAL BACK UP Solar rooftop and facades need to meet certain conditions in terms of fire safety, orientation and construction. Station Rotterdam Centraal is a landmark of pv-panels integration in architecture, but it lacks flexibility. On the other hand in station Breda rooftop design made it impossible to install solar panels.

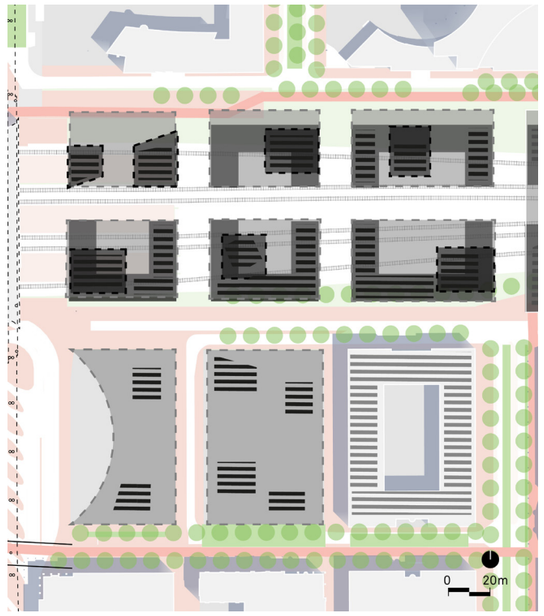
PRACTICAL IMPLICATION

- Facade and rooftops should allow to install PV panels, and scale capacity up and down, depending on the development.
- In high density widespread use of solar panels can contribute to heat island effect; this pattern should be balanced by rooftop gardens [L.3] and rainwater storage [L.4].

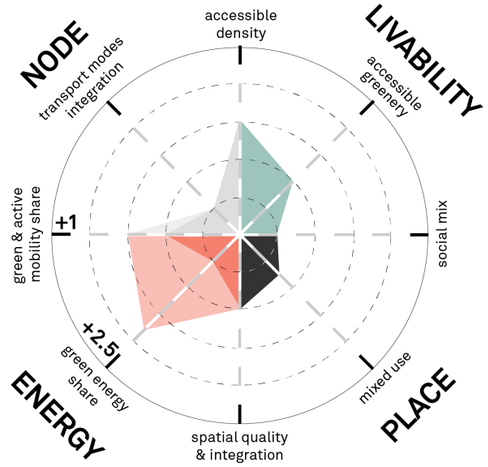
RELATION WITH OTHER PATTERNS

- Synergy with [P.8] [N.3] [N.4] [N.5] [N.7] [N.9] [L.9] [E.3] [E.9]
- Tension with [P.4] [L.1]
- Mutually exclusive with [L.3]

Amsterdam Sloterdijk

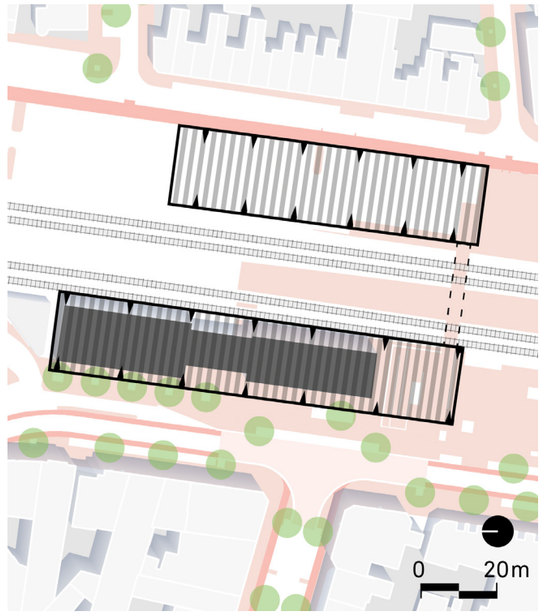


ASSESSMENT

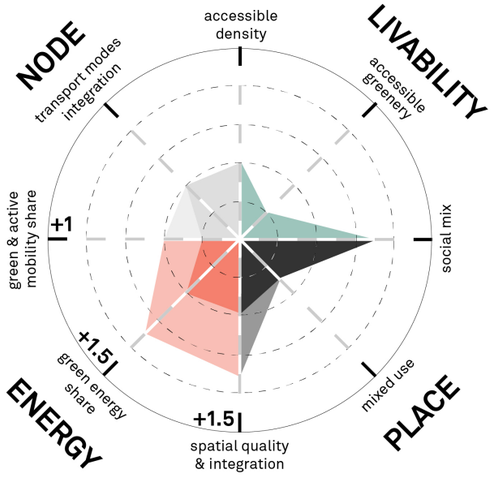


Observation: Pattern is addressing the main drawback of the office hub; lack of solar roofs and facades, despite the large potential. However may not solve heating demand.

Bergen op Zoom



ASSESSMENT



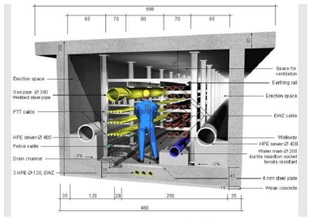
Observation: Solar canopy could completely cover the existing station building, tunnel entrance, and form a roofed square in the opposite side of the tracks.

E.5 Multi-utility corridor integrated in public space design

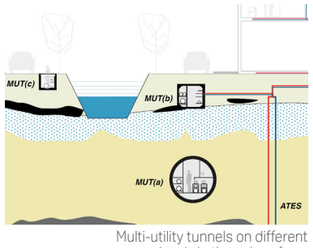
References:



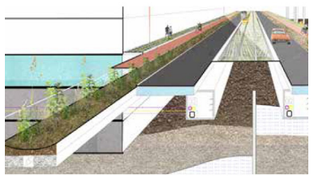
Concept design of a park covering a highway in Den Haag, Central Innovation District. Source: PosadMaxwan



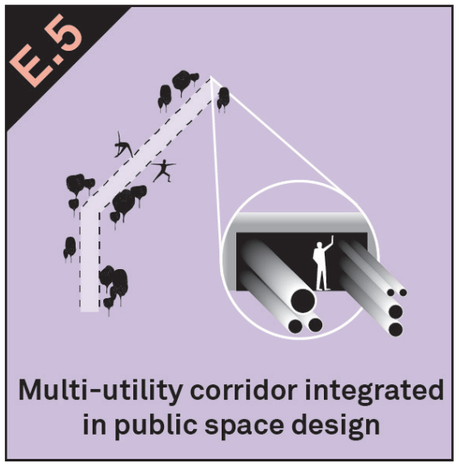
Multi-utility tunnel under Löwenstrasse, Zurich. Source: https://bit.ly/2RpTKqe



Multi-utility tunnels on different levels in the subsurface. Source: Hoijmejer (2018).



Sustainable, greeenified street profile afte introducing MUT. Source: Hoijmejer (2018).



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Integration of energy infrastructure in easily accessible corridor can allow intense greenification and prevent nuisance caused by conservation of utilities. Energy infrastructure can be also creatively used as a present element in public spaces, increasing social awareness.

THEORETICAL BACK UP As Hoijmejer (2018) noted, the integration of cables and pipes in a unique space of the MUT (Multi Utility Tunnel) allows flexible public space design where ecological re-intensification and vegetation is the main objective. Energy infrastructure in public space design, is present in a recent project by PosadMaxwan, where piping of district heating was used to create multifunctional spaces in a park.

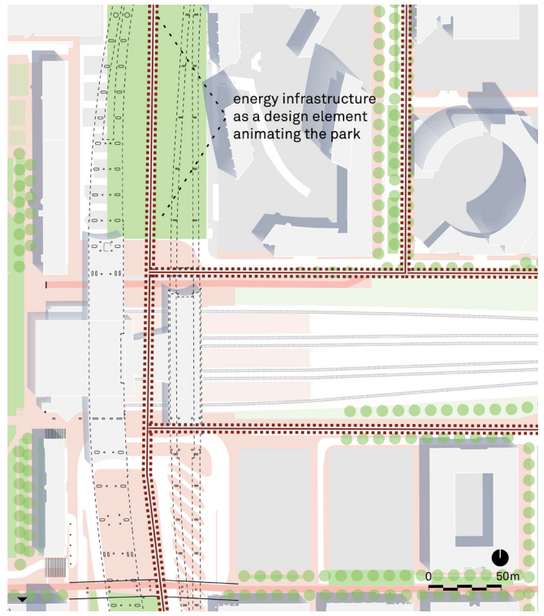
PRACTICAL IMPLICATION

- District heating, electricity, and hydrogen networks gathered in a dedicated corridor, accessible without digging.
- Conservation should not obstruct daily functioning of the node.
- Energy infrastructure used in placemaking.

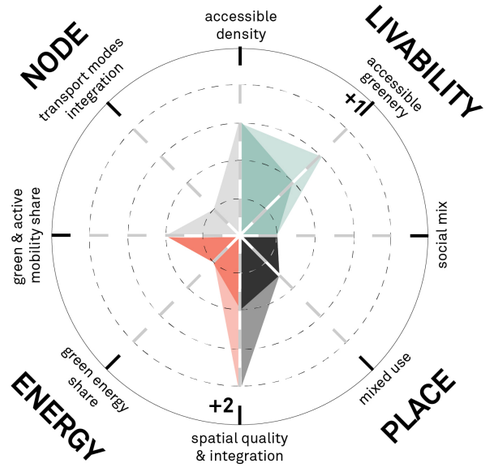
RELATION WITH OTHER PATTERNS

- Synergy with [E.6] [E.7] [E.8] [E.9] [L.4] [P.9]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk



ASSESSMENT

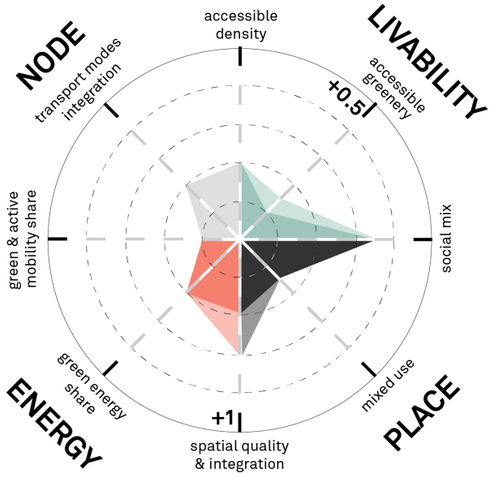


Observation: MUT corridor may allow to greenify the streets paralell to tracks. Energy infrastructure can and be a design element in the north/south park under the viaducts.

Bergen op Zoom



ASSESSMENT



Observation: MUT introduced in main streets can allow flexible rearrangement of the profile, it can be also introduced in the green patch, as overground design element.

E.6 District heating hub as a community center

References:

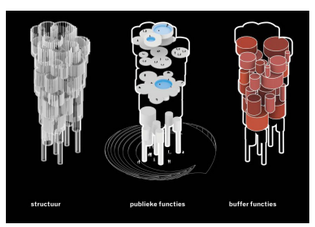


Stadshaard in Enschede, district heating plant as a landmark. Source: Architecten Cie.

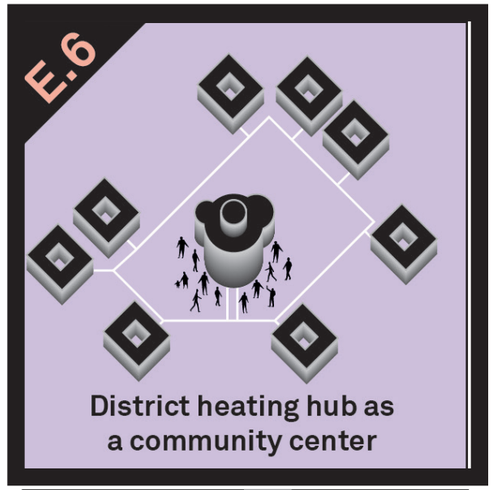


Stadshaard in Enschede, district heating plant as a landmark. Source: google maps.





Concept of a community center and heating hub in Groningen. Source: Fabrications



Short-term 1 2 3 5 10 20 30 40 50yr Long-term

Municipality | Railway company | Private sector

HYPOTHESIS. Sustainable district heating plants will play an important role in energy transition, combining them with community center may result in a public building and space enriching station facilities.

THEORETICAL BACK UP Residential neighborhoods without district heating are often located in the vicinity of train stations. The case of Enschede and concept for Groningen show that district heating can bring spatial value to the neighborhood and increase the awareness of the energy system.

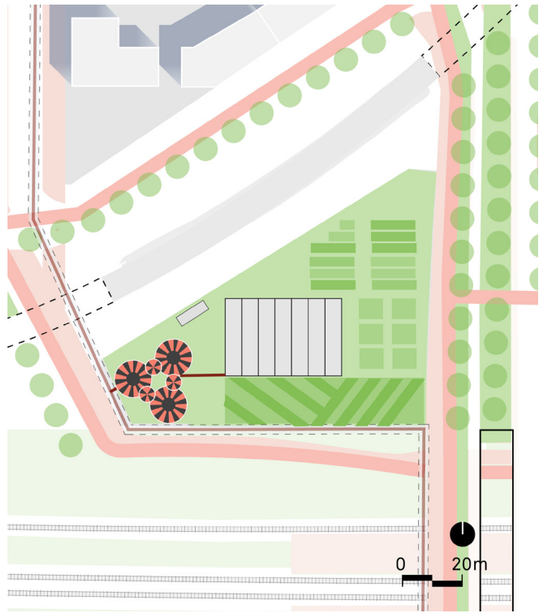
PRACTICAL IMPLICATION

- Establishing a sustainable heating system such as geothermal, hydrogen.
- Focus on inclusive facilities for community integrated with heating plant.

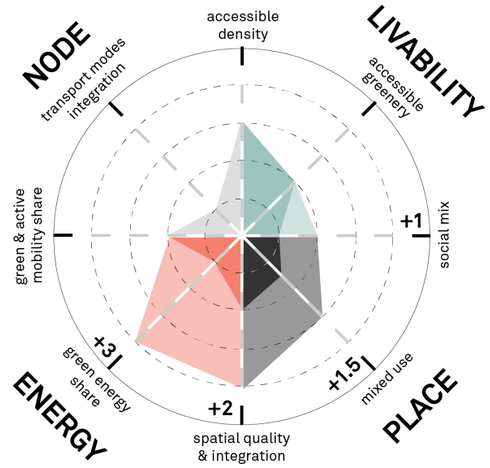
RELATION WITH OTHER PATTERNS

- Synergy with [E.5] [E.8] [L.6]
- Tension with -
- Mutually exclusive with -

Amsterdam Sloterdijk

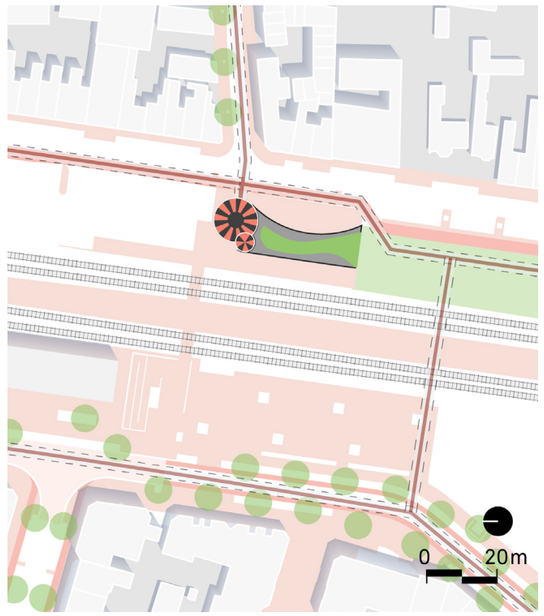


ASSESSMENT

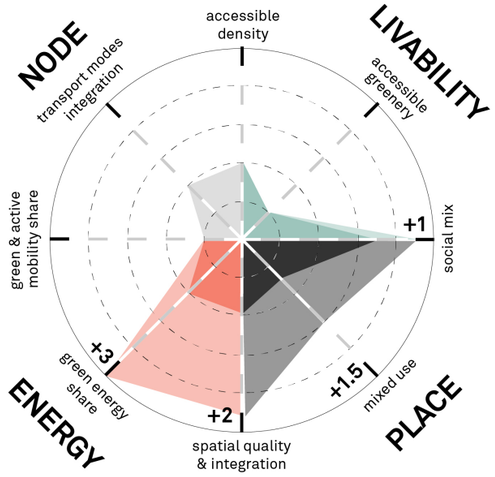


Observation: District heating hub can be combined with a greenhouse and expansion of the existing community farm for local food production.

Bergen op Zoom



ASSESSMENT



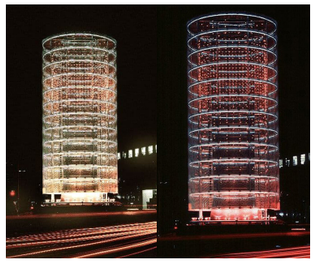
Observation:Sloping community center with a green roof can also supply the postwar neighborhood with sustainable heating, or with green hydrogen, using gas piping.

E.7 Landmark of energy production/storage

References:

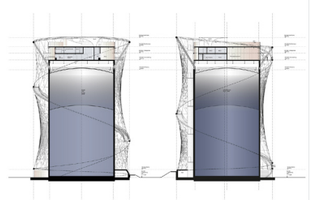


Tower of wind turbines by new train station in Genoa bridge disaster site. Source: Stefano Boeri https://bit.ly/2RGzJvx

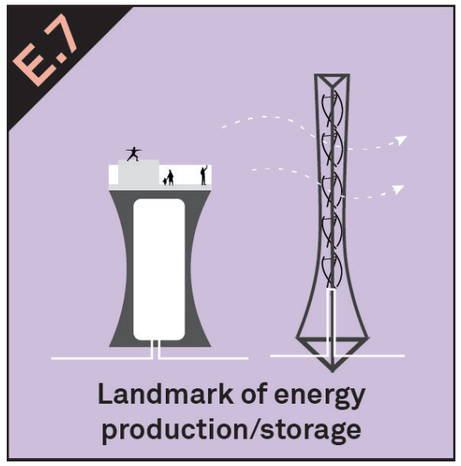


Toyo Ito, Tower of Winds, Yokohama, Japan, 1986. Source: https://bit.ly/2REJOZO





Heat storage tower with social program in Heidelberg, Germany. Source: https://www.avontuura.com/energy-storage-tower-by-lava/



HYPOTHESIS Energy transition needs its landmarks that would increase social awareness of the topic. Train stations could act as a sustainable "cover" of the city, where renewable energy production or storage, spatial quality, and social integration come together.

THEORETICAL BACK UP Historically clock towers or water towers were landmarks associated with train stations. Stefano Boeri in Genoa and heidelberg shows can bring interesting results.

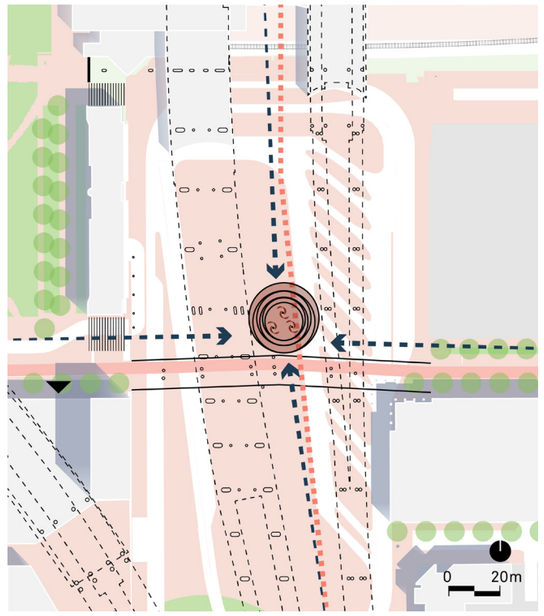
PRACTICAL IMPLICATION

- Combined with social functions, viewing platform.
- Unique design, optimizing energy harvest or storage capacity alongside with spatial quality.
- Located on important vistas in the station area; landmark used as a guiding and attracting element in the urban composition.

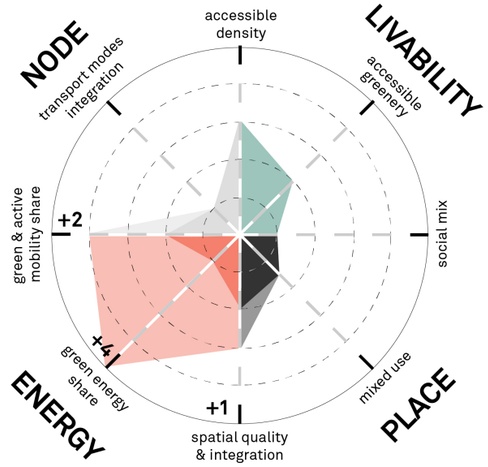
RELATION WITH OTHER PATTERNS

- Synergy with [E.5] [E.8] [P.8] [P.9]
- Tension with
- Mutually exclusive with

Amsterdam Sloterdijk

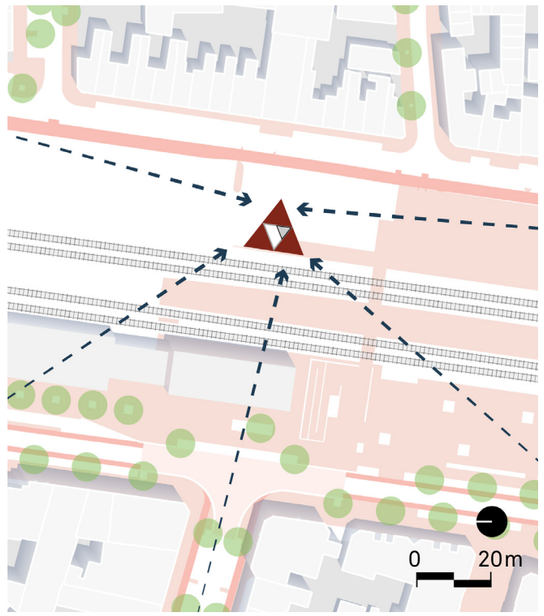


ASSESSMENT

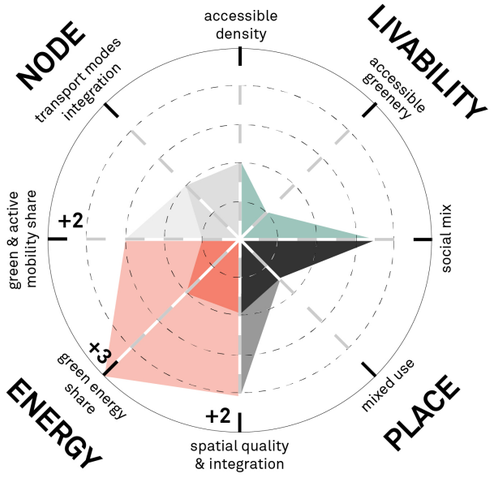


Observation: Viewing tower generating wind energy could be located at the intersection of important vistas, in the wind corridor (N/S), with direct access to 50kV AC-net cable.

Bergen op Zoom



ASSESSMENT



Observation: Station situated in a wind corridor south-north has potential for wind energy. The landmark should not cause nuisance and do not obstruct the node itself.

E.8 Energy-positive train station

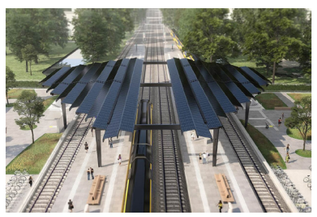
References:



Solar-powered bus station in Tilburg. Source: Cepezed



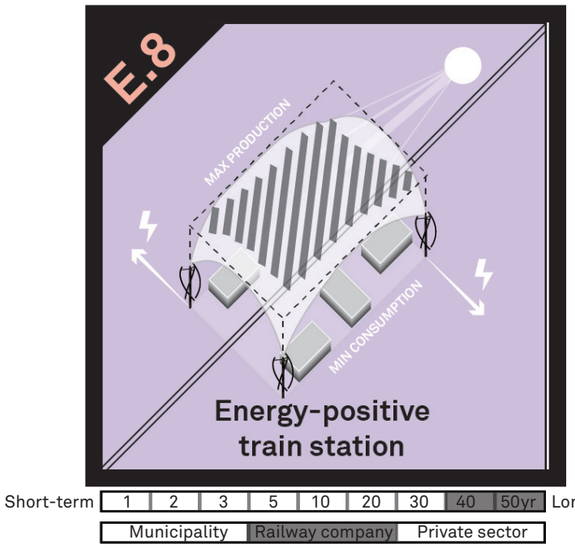
Carbon-neutral train station in Horrem, Germany. Source: https://ec.europa.eu/environment/europeangreencapital/carbon-neutral-station/



Energy-neutral station Delft Campus. Source: https://www.prorail.nl/projecten/aanpassingen-station-delft-campus



Small wind turbine suitable for rooftops, more efficient than PV panels. Source: https://grijsnaargroen.nl/wind-flower-turbines



HYPOTHESIS Train station is designed to maximize the energy harvest and minimize consumption. Energy-positive train station acts as a local power plant, supplying the neighborhood, while saving operational energy costs.

THEORETICAL BACK UP There are mostly cases of smaller stations with energy neutral design, in larger energy geenration is too often treated as an addition to the design, not a goal. This pattern challenges to find the best design for energy transition, where station can ultimately supply the local grid with electricity or heat.

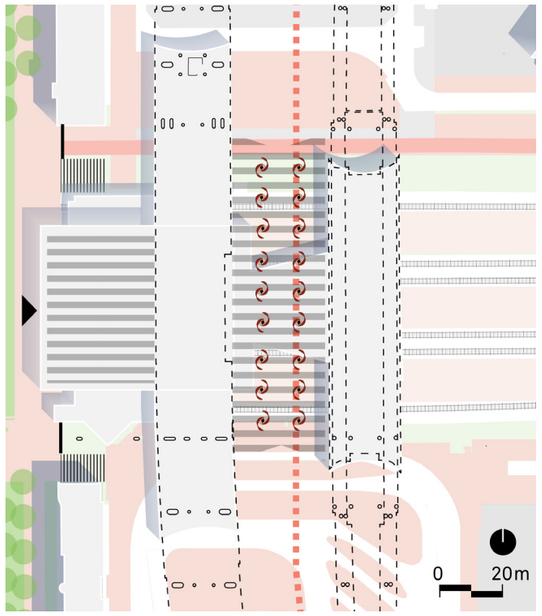
PRACTICAL IMPLICATION

- Possible solutions depend on the potential of the site solar canopies combined with small wind turbines and innovations for wind energy harvest.
- Architecture of the station is defined by energy generation.
- In neighborhoods having smaller potential of energy production and large consumption.

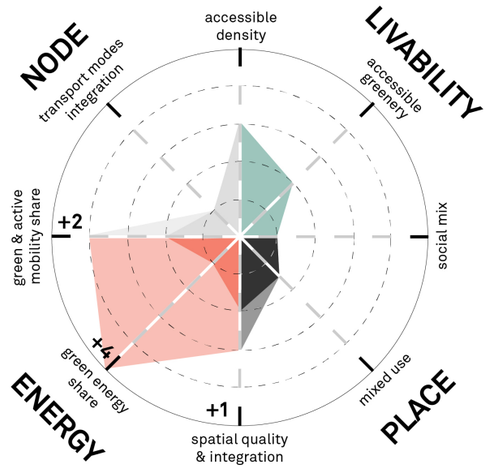
RELATION WITH OTHER PATTERNS

- Synergy with [N.6] [E.3] [E.5] [E.6] [E.7]
- Tension with
- Mutually exclusive with [P.8]

Amsterdam Sloterdijk

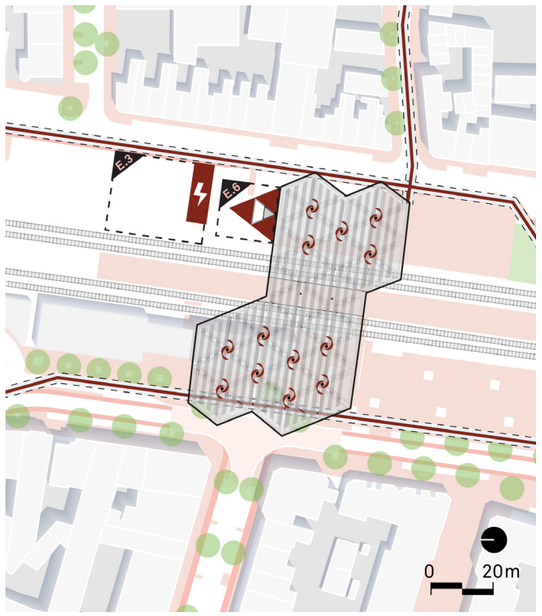


ASSESSMENT

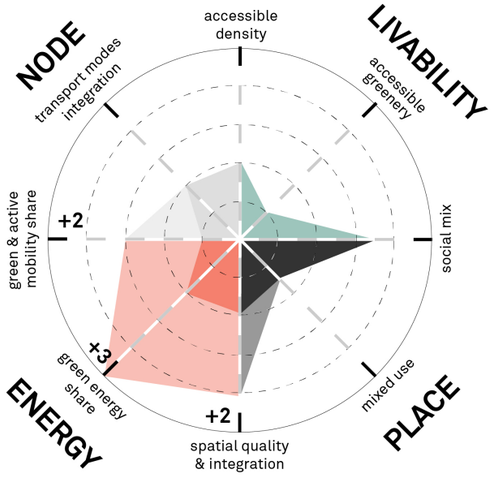


Observation: New station core north-south has a large energy potential due to location in wind corridor and optimal sun exposure. Viaducts are rather an obstacle than potential.

Bergen op Zoom



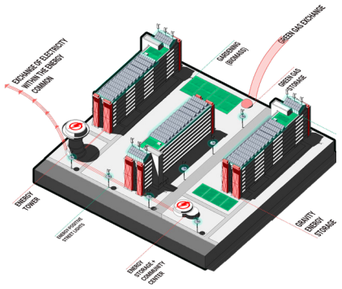
ASSESSMENT



Observation: large canopy west-east is needed for satisfactory solar energy generation; supported by small wind turbines. Station is also located in a wind corridor.

E.9 Integrating gravity storage in buildings

References:

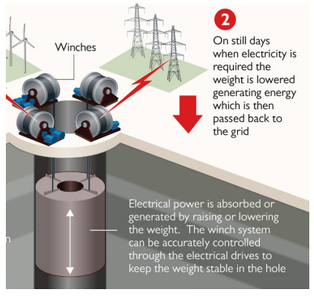


Concept of integrating gravity energy storage in postwar neighborhood. Source: own work.

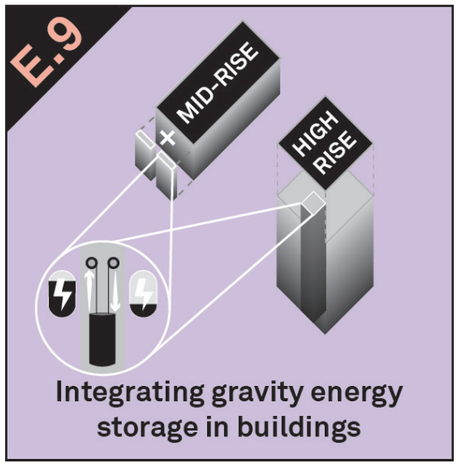




Gravity storage demonstrator in Edinburgh. Source: Gravitricity, https://www.bbc.com/news/uk-scotland-56819798.



Gravity energy storage concept for large-scale infrastructure. Source: osm.org



Short-term | 1 | 2 | 3 | 5 | 10 | 20 | 30 | 40 | 50yr | Long-term

Municipality | Railway company | Private sector

HYPOTHESIS Any new mid- or high-rise building in a train station area can be seen as a chance to introduce gravity energy storage, which can balance the fluctuations of solar and wind energy generation. Efficient energy management in station area can allow it to become energy-neutral or energy-positive.

THEORETICAL BACK UP In 2021 gravity storage technology is in its advent and its potential in urban areas remains unexplored. It much safer and sustainable than li-ion batteries, thus can be better integrated in living environment. In march 2021, Scottish startup Gravitricity, has launched the first prototype. The intended system will be suitable for mine shafts but also high-rise buildings. It is estimated to serve 25 years without major maintenance.

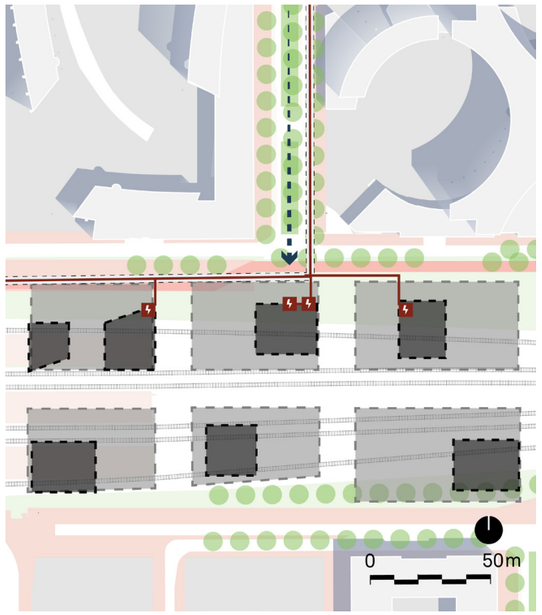
PRACTICAL IMPLICATION

- Cores of high- and mid-rise buildings can be used for energy storage.
- Transparent design instead of hiding to increase social awareness.
- Gravity energy storage could enhance the quality of high-density cityscape as a new dynamic element.

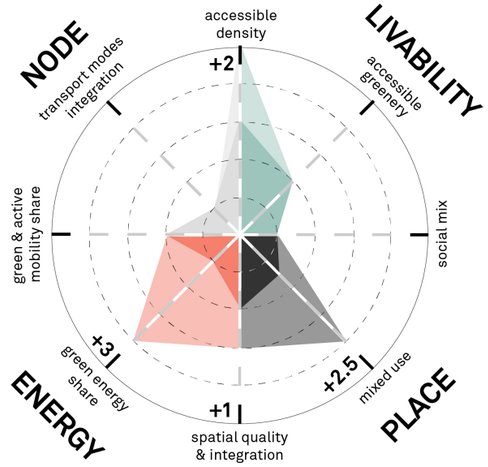
RELATION WITH OTHER PATTERNS

- Synergy with [P.7] [L.7] [E.4] [E.5]
- Tension with [L.9]
- Mutually exclusive with

Amsterdam Sloterdijk

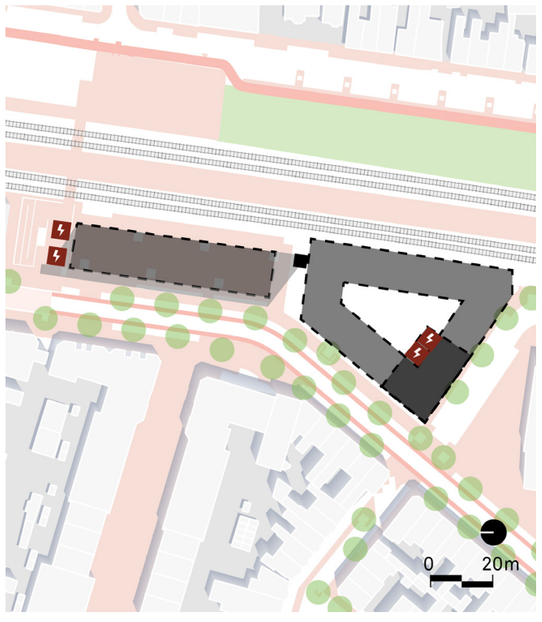


ASSESSMENT

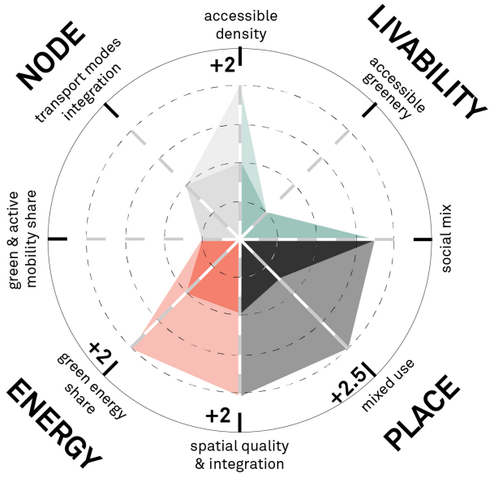


Observation: Gravity energy storage could be used for external element in highrise buildings, as elevator shafts. Large weights can be located only on the edge of the over track deck.

Bergen op Zoom



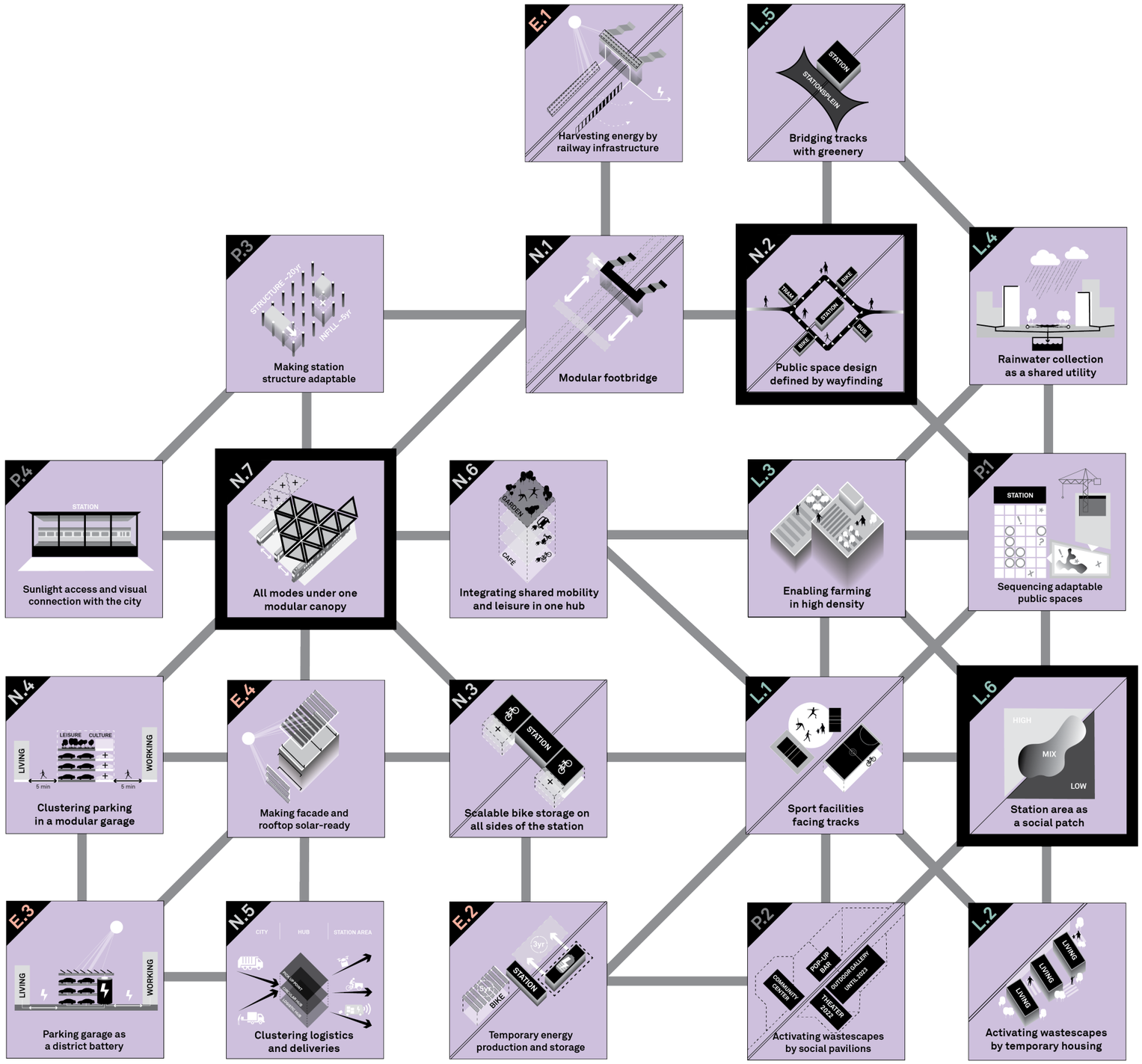
ASSESSMENT



Observation: New mid-rise blocks next to the station give opportunity to integrate gravity energy storage; energy management allows buildings to become energy positive.

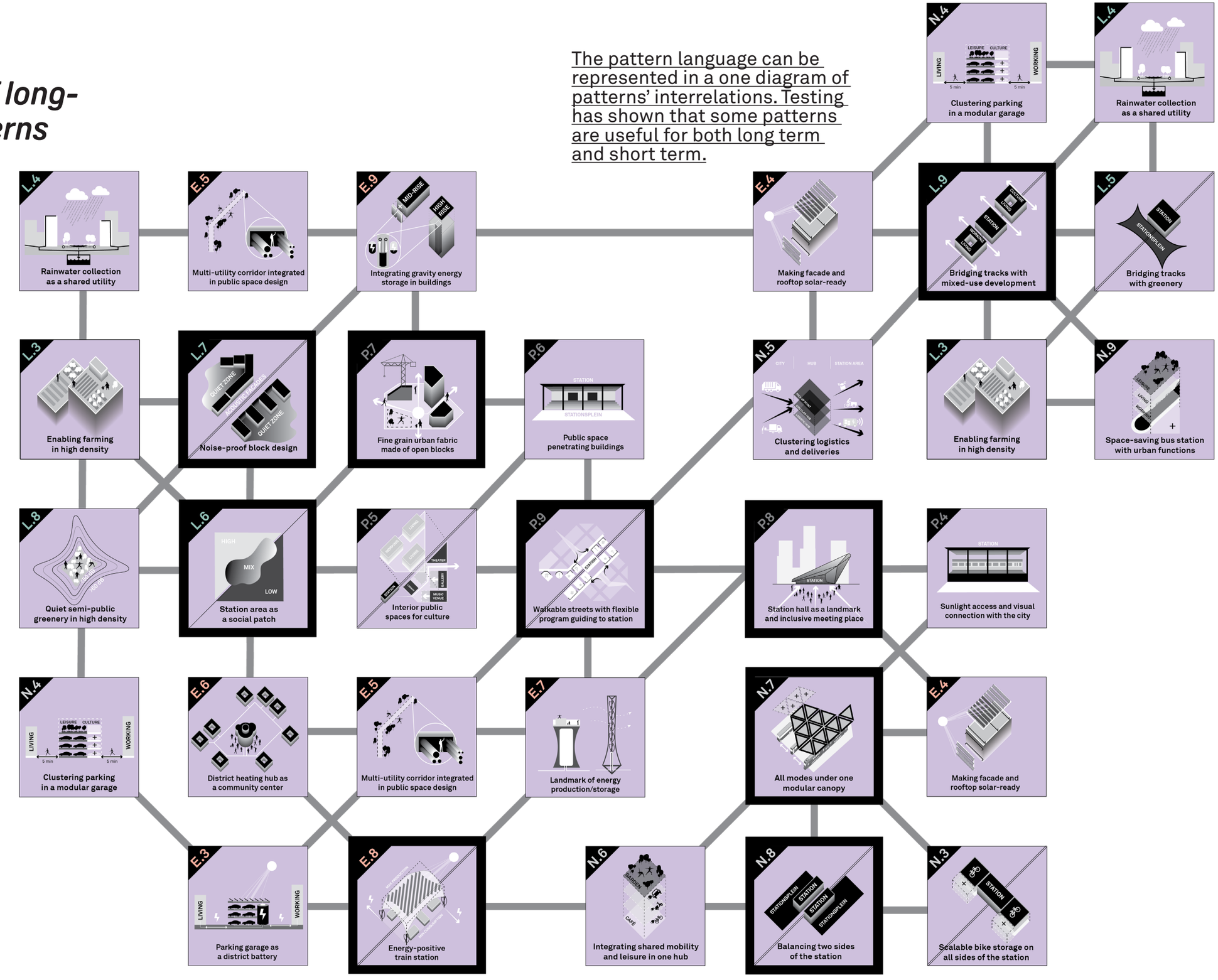
Overview synergy of short-term patterns

The pattern language can be represented in a one diagram of patterns' interrelations.



Overview synergy of long-term patterns

The pattern language can be represented in a one diagram of patterns' interrelations. Testing has shown that some patterns are useful for both long term and short term.



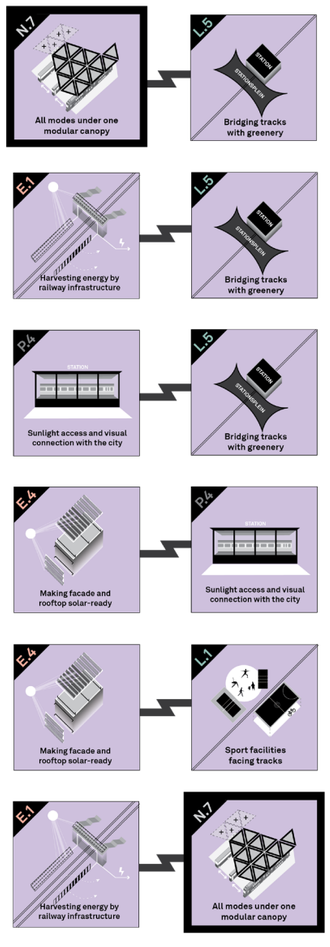
Overview
Tensions between patterns

Tensions are posing a design challenge and may lead to a compromise.

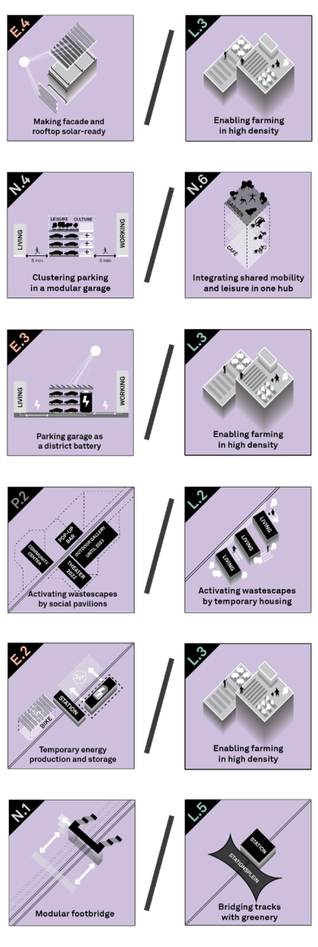
Mutually exclusive patterns should not be connected in a station area, as they are hindering each other or are alternative solution of similar problem.

Short-term

Tensions:

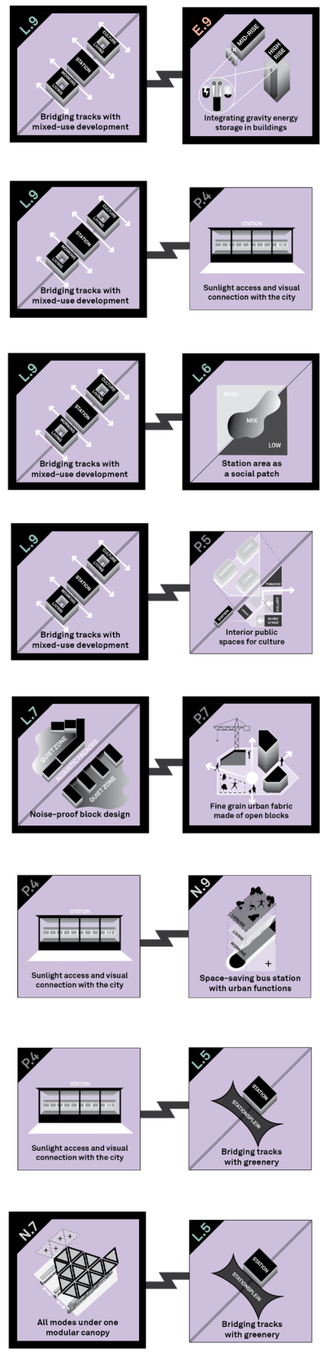


Mutually exclusive:

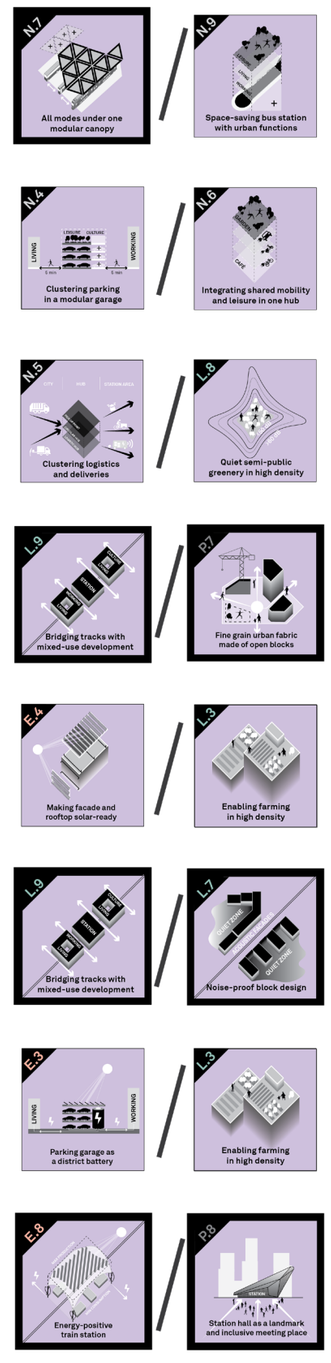


Long-term

Tensions:



Mutually exclusive:



06 Design scenarios

Bergen op Zoom

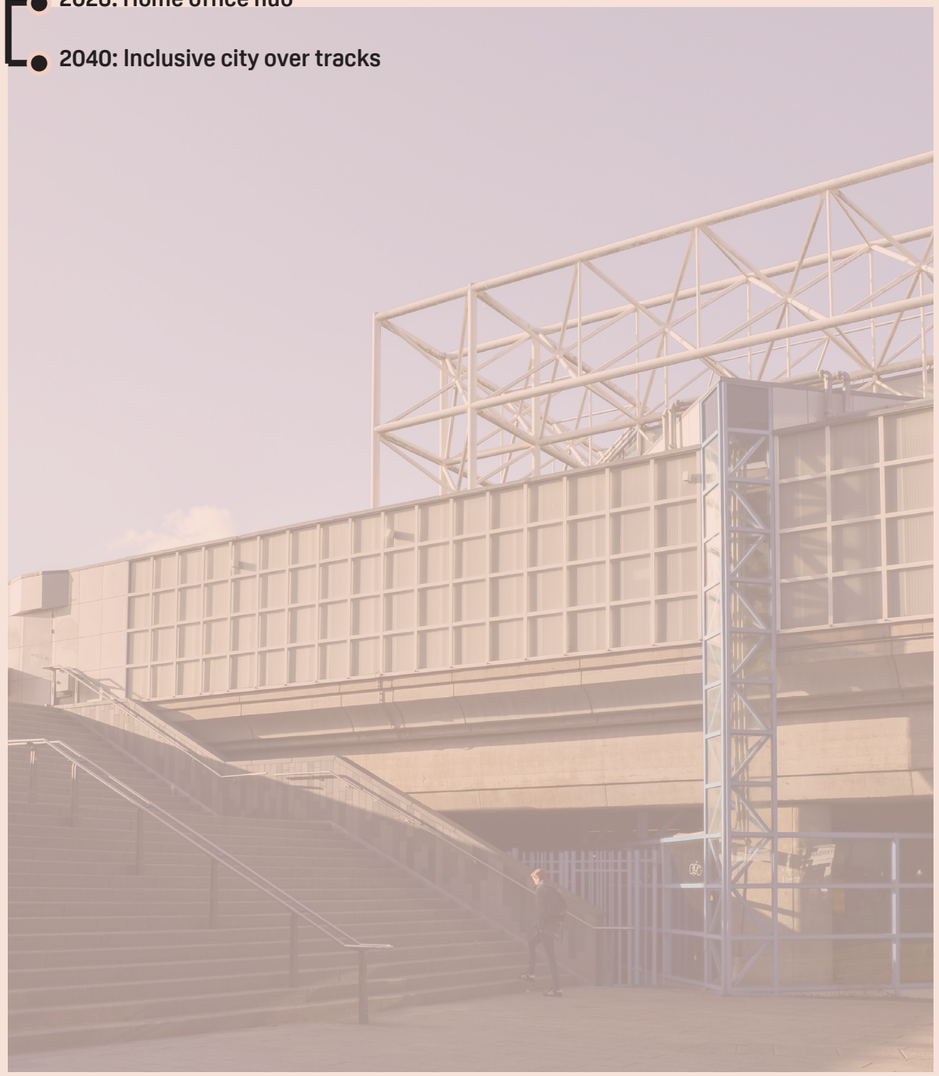
6.1 2026: New energy

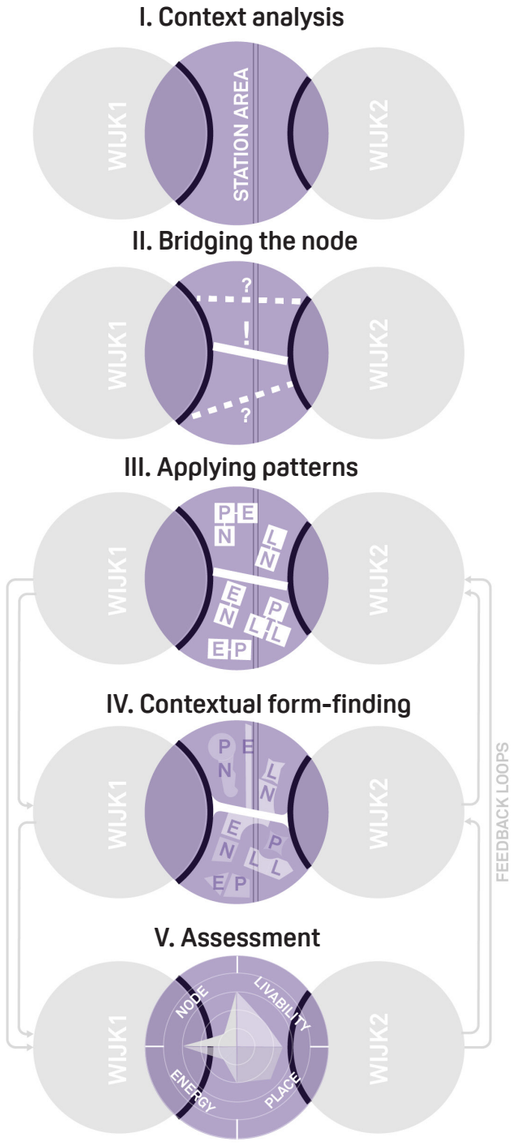
6.2 2040: Glocal transition

Amsterdam Sloterdijk

6.3 2026: Home office hub

6.4 2040: Inclusive city over tracks

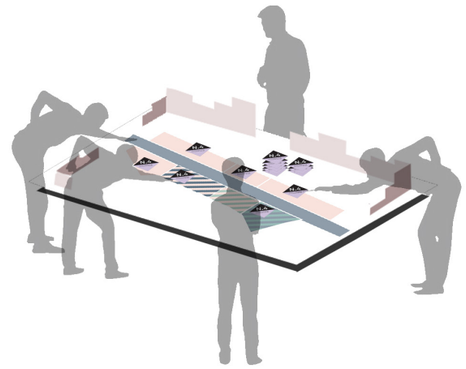




Interrelated patterns offer more possibilities than a toolbox and may help with decision-making and defining the program of station area with multiple stakeholders.

In this chapter four design scenarios will be explored, two for each site. Short-term and long-term scenarios will demonstrate the use of short-term patterns in the context of a small (Bergen op Zoom) and large (Amsterdam Sloterdijk) station.

Basic knowledge of the site is necessary to select and apply patterns. Im reality, they would be applied by stakeholders involved in planning and programming of train station areas.



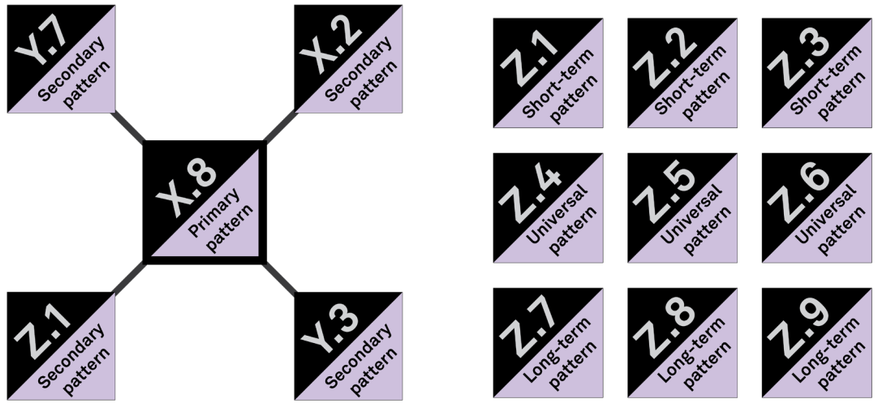
Pattern language rules

Hierarchy

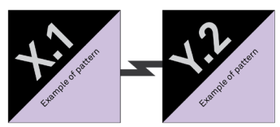
Selection starts from **primary** patterns, which can be further defined by **secondary** patterns. Primary patterns are more general and overarching, while secondary patterns focus on specific quality or solution.

Time frame

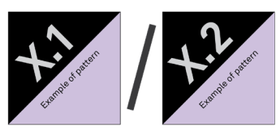
Patterns are ordered by the time frame. The number is suggesting whether it is short-term or long-term solution. Short term may bring effect quickly, but are not permanent, while long term are fundamental changes in the station area. Some middle patterns are universal, useful in both short-term and long-term scenarios.



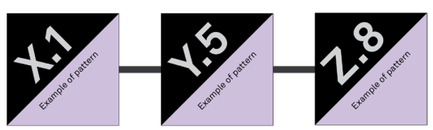
Relationships



Tension creates a design challenge and may require compromises to be solved.



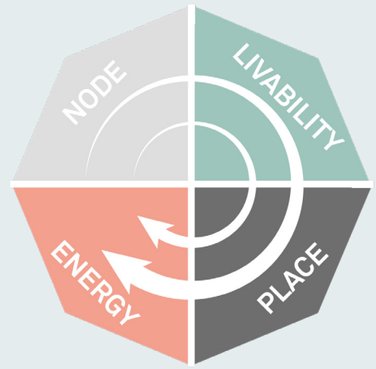
Mutually exclusive patterns hinder each other and should not be applied together. It guides to reject the patterns.



Synergy guides selection and means that a specific combination of patterns can bring better effects than implementing them separately.

Order

Patterns are selected and applied clockwise, following the rose model, starting from node. At first, the space for mobility should be optimized, then the priority is to analyze how gained space can be used for livability, where we can densify, and finally, energy that responds to planned program. There are two rounds:
1/ Preselection
2/ Verification and adjustment.



Selection

Is based on:
- problems and potentials of the site
- scenario goals
- pattern synergies

Rejection

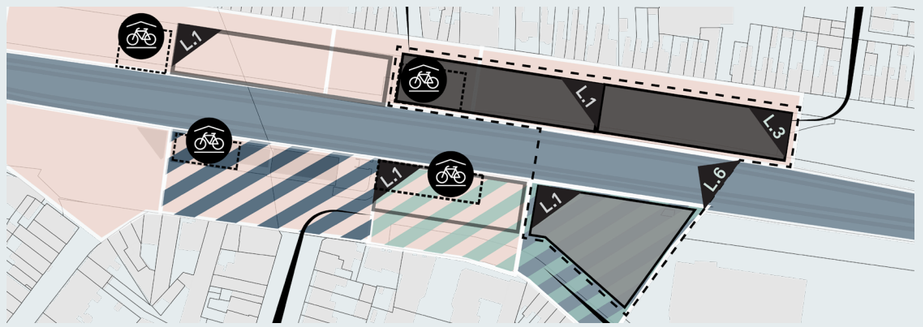
Is based on:
- problems and potentials of the site
- scenario goals
- pattern tensions
- mutually exclusive patterns

Applying

Applying patterns is in fact programming the station area during workshops with relevant stakeholders. Here, different land ownership is considered.

Each pattern has indication which actors may be involved in its implementation.

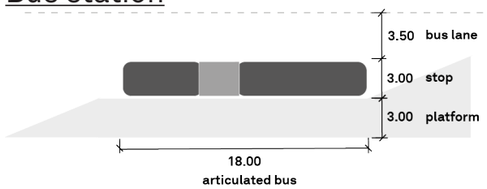
Municipality	Railway company	Private sector



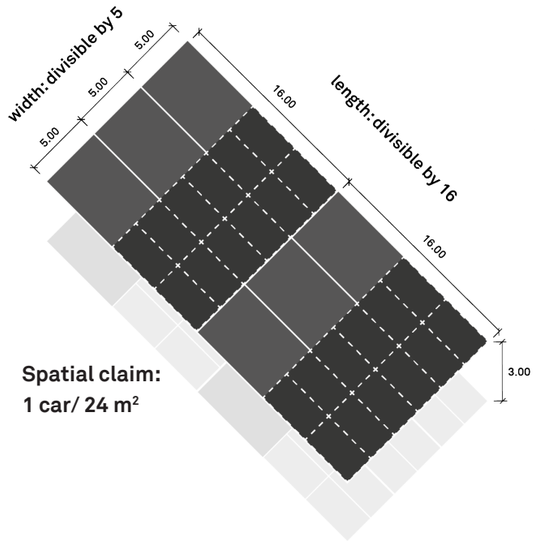
Technical requirements

Design scenarios were prepared using the spatial claim estimates for station facilities and technical requirements present in the Netherlands.

Bus station

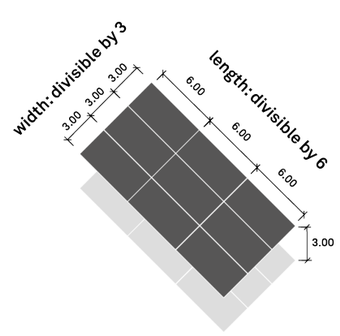


Parking garage



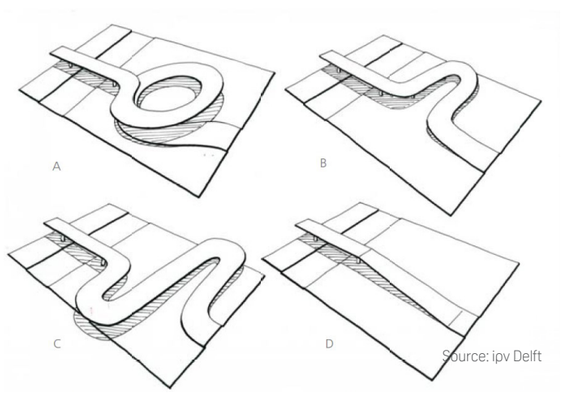
Spatial claim:
1 car/ 24 m²

Bike storage

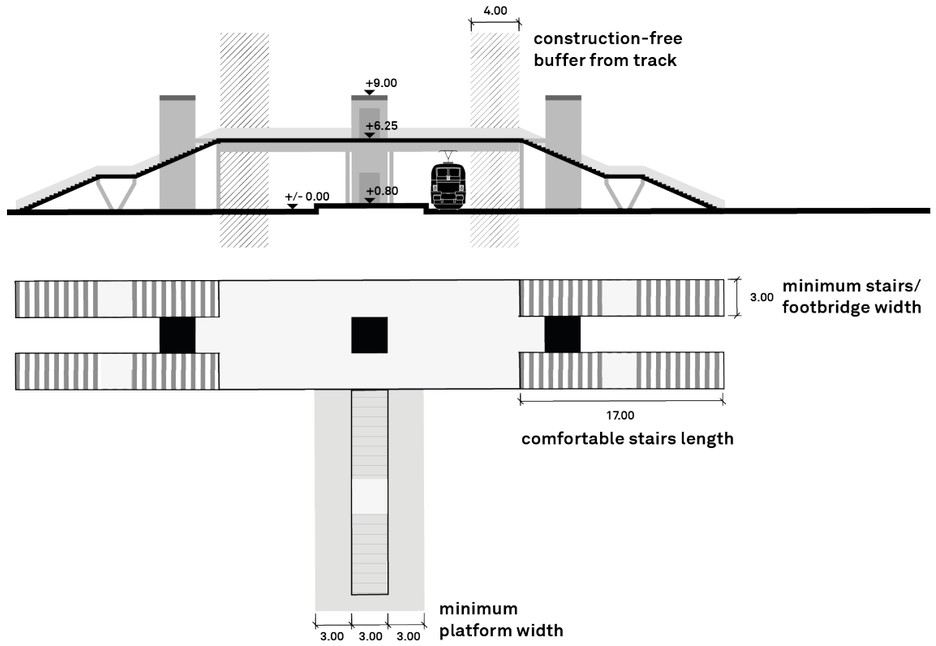


Spatial claim:
1 bike/ 0.9 m²

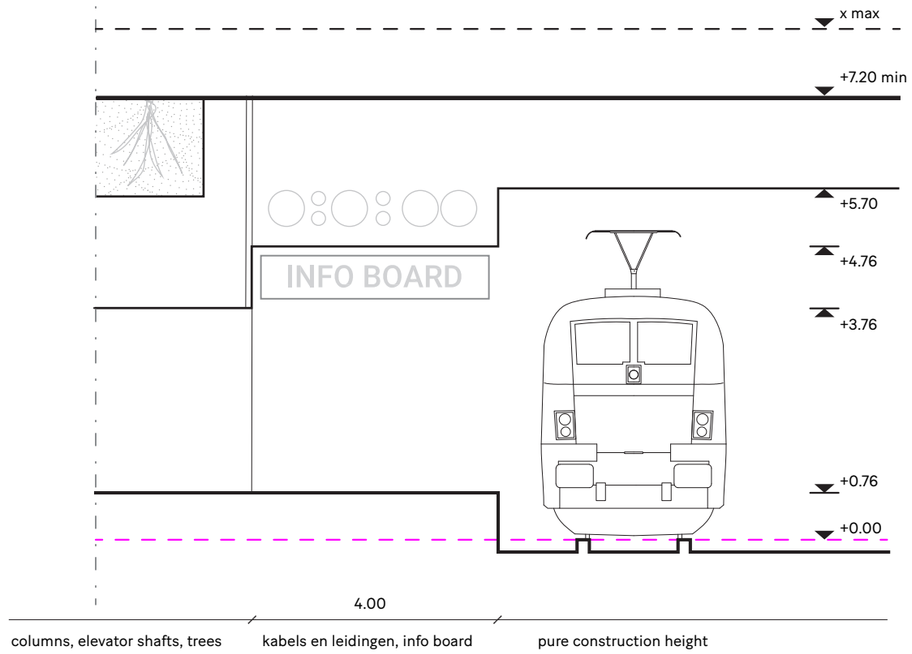
Bike ramps grading



Footbridges + platforms



Oversite development



Bergen op Zoom

Fieldwork



1



2

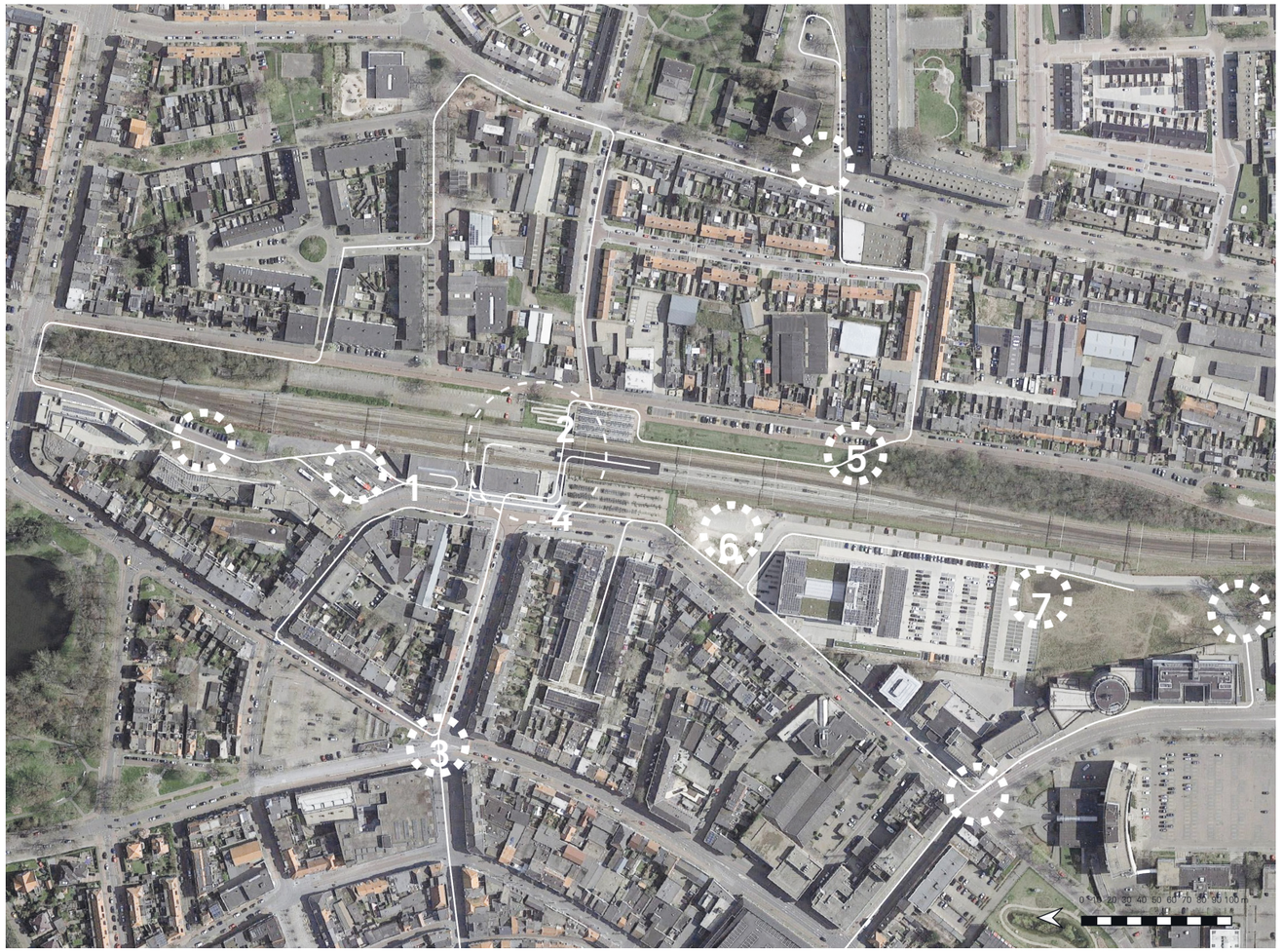


3



4





Fieldwork route and points of interest. Source: own work, Google Earth

5



6



6



7



Passengers:

Simple station, but it gets quite windy on the platform. Bike parkings are often full in rush hours, you can't switch the side easily because of the narrow tunnel.

It is a bit more cozy, when they opened the Stationhuiskamer, but in general I find it old and ugly.

There is nothing to do around the station, no shops or horeca, city life is in the historical center.

There will be more frequent train connections, that is nice, too bad there is such unpleasant place to wait for them; I think our station is backwarded and has nothing interesting to offer.

Residents:

Noise is not experienced as a problem; it is rather calm living district.

I think there are shady/ socially unsafe places in the south, by the office buildings.

I'd avoid the tunnel in the evening, also it's dark and unsafe in the south from the station.

Too narrow tunnel, local teenagers cycle fastly anyway, dangerous for old people when they want to get to Centrum.

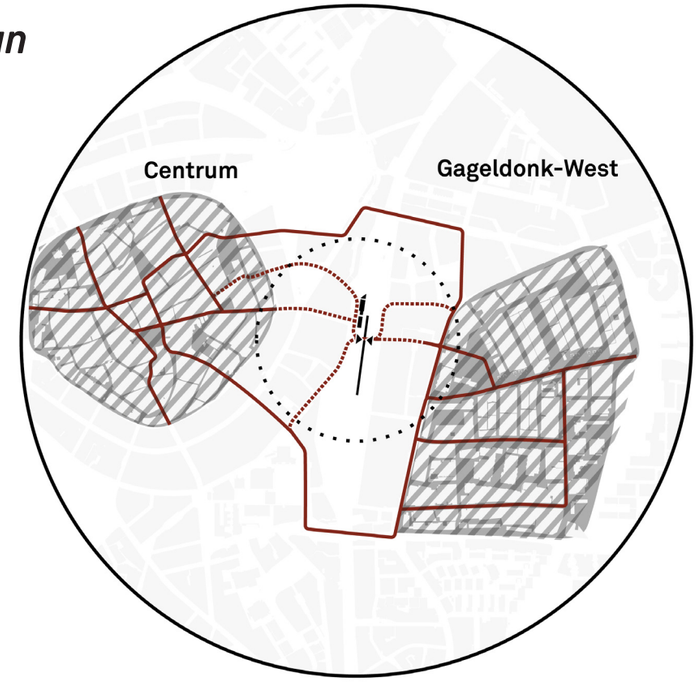
I prefer to walk around the station area, in the noorth even though it takes much longer, but it's calm, green and feels more safe.

It was such a fuss about the renovation of public spaces, few years ago, they laid down the new paving, but the problems are still the same. Tunnel is a really bad connection and there not enough bike racks.

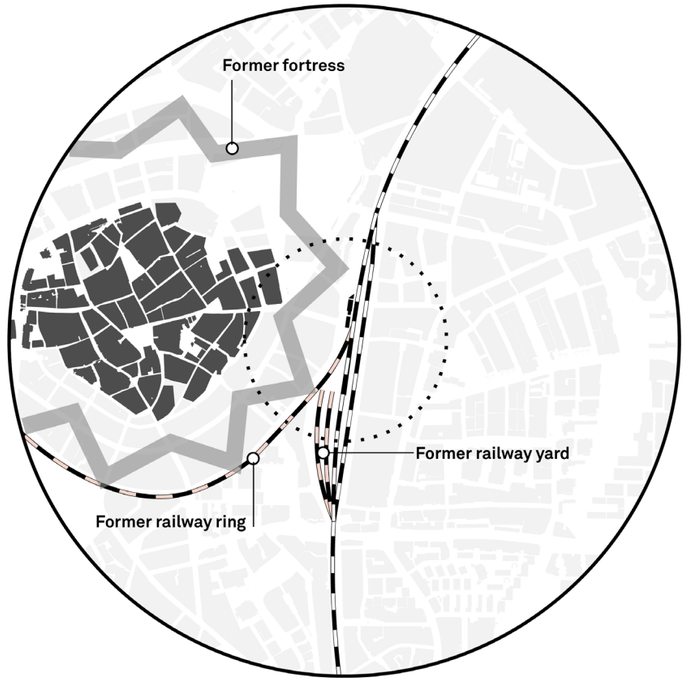
Bergen op Zoom

Context scan

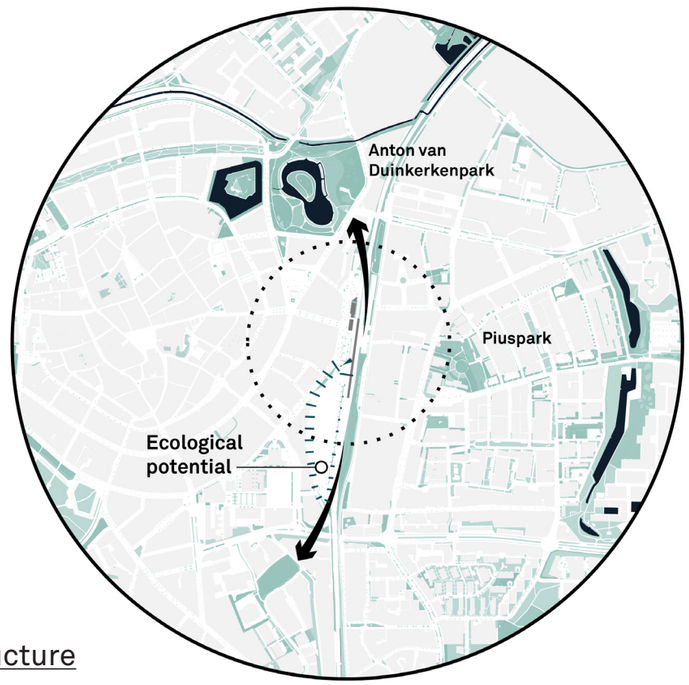
MACRO SCALE
R=1000 m



Train station as a bridge



History



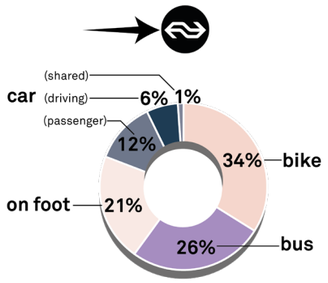
Blue-green structure

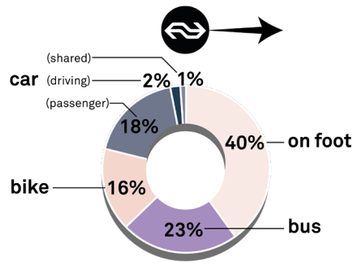


Active mobility and plinths

Bergen op Zoom

Bridging the node

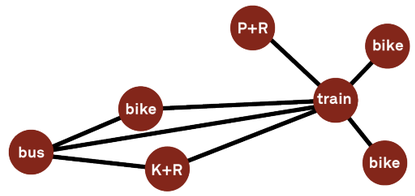




Modal split for arrivals and departures from the station, 2019. Source: https://dashboards.nsjaarverslag.nl/reizigersgedrag/

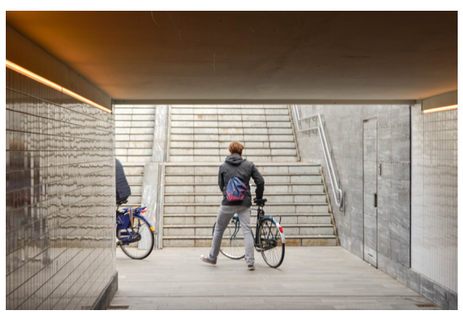
In this part potential changes in the connector will be decided. Selected layout will be a canvas for applying patterns in the next step. Patterns will shape the desired quality and program.

Modal split has relatively large share of passengers arriving by car. Improving accessibility for bikes should be priority, alongside with rearrangement of other modalities to form a more compact node.









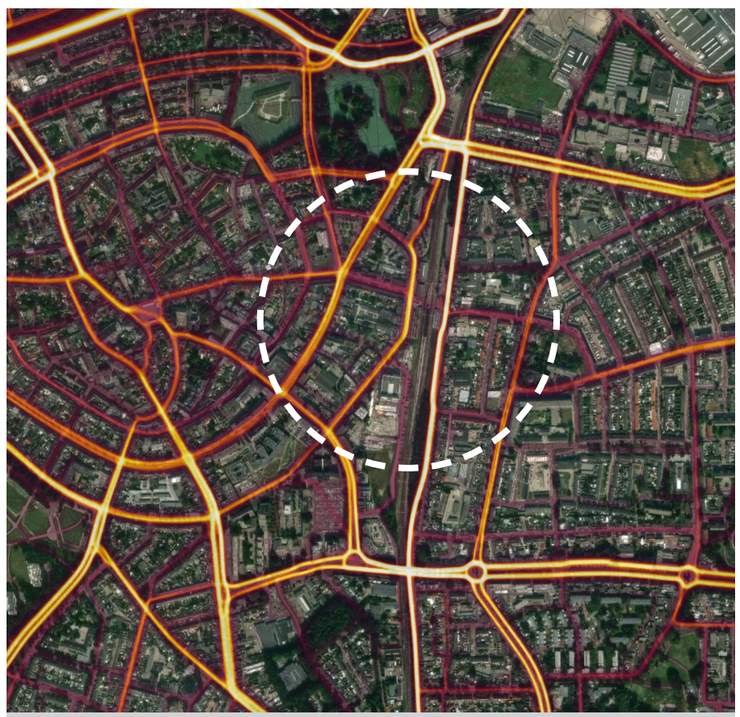


Pictures from the site visit
Source: author.

Activities heatmap



Running
alternative to tunnel needed, potential in linking to the northern park

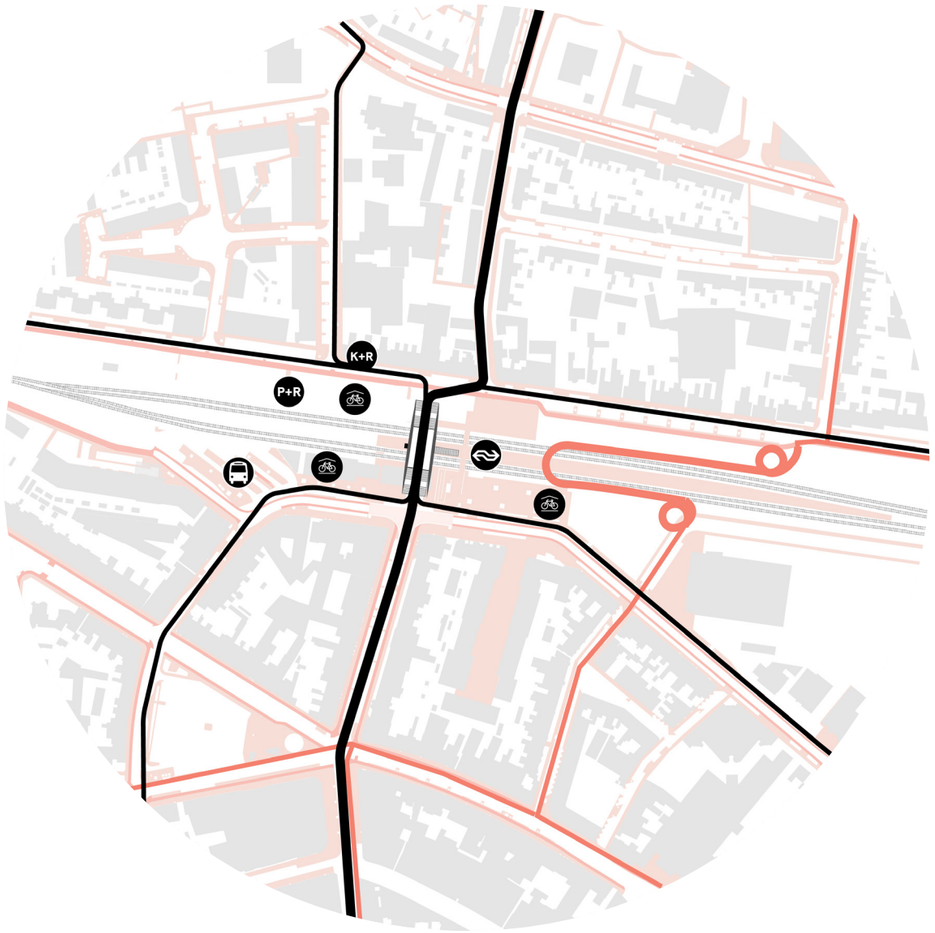


Cycling
tunnel acts as a barrier, no clear connection east-west

Strava activities heatmap.
Source: strava.com

Bergen op Zoom

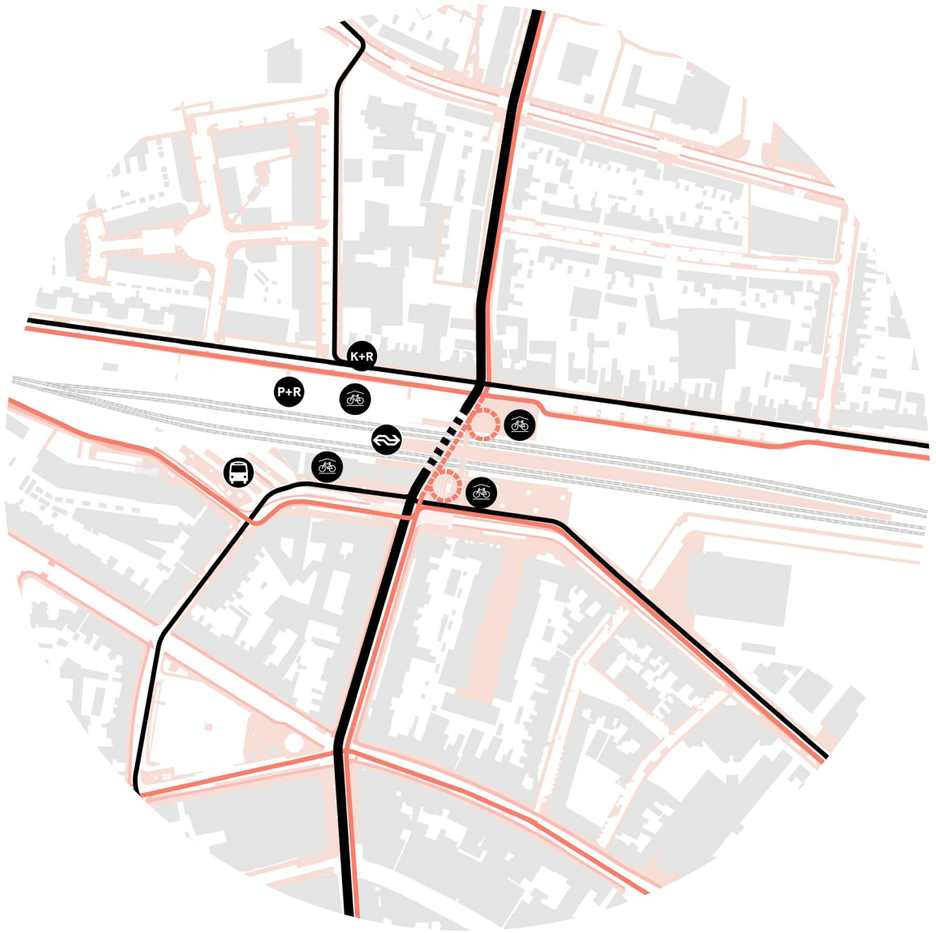
Bridging the node



Step I

Central footbridge + cycling bridge

Connector layout similar to Alkmaar, where bridge-shaped station is balancing two sides of the tracks. It can provide good visual connection with station street. However, such cycling route works like a highway ring, preventing cyclists to use the station area and doubling their distance due to long (180m) ramps.



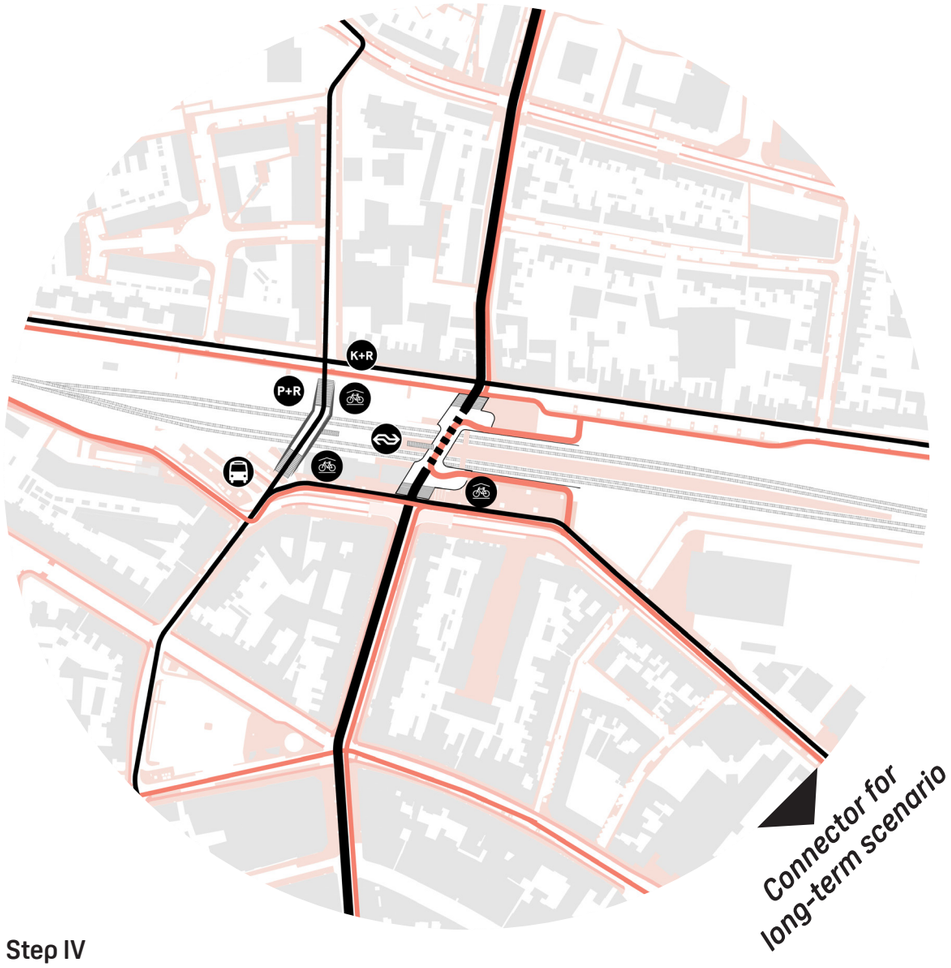
Step II

Tunnel with compact bike ramps

Combined tunnel for bikes and pedestrians can provide the most direct connection east-west. However, it is a long-term solution and it requires partial demolition of the existing station. The cycling lane located on the side of a pedestrian tunnel is restricting the access to platforms. Bike ramps are compact, but not safe solution, as they are limiting visibility.

Bergen op Zoom

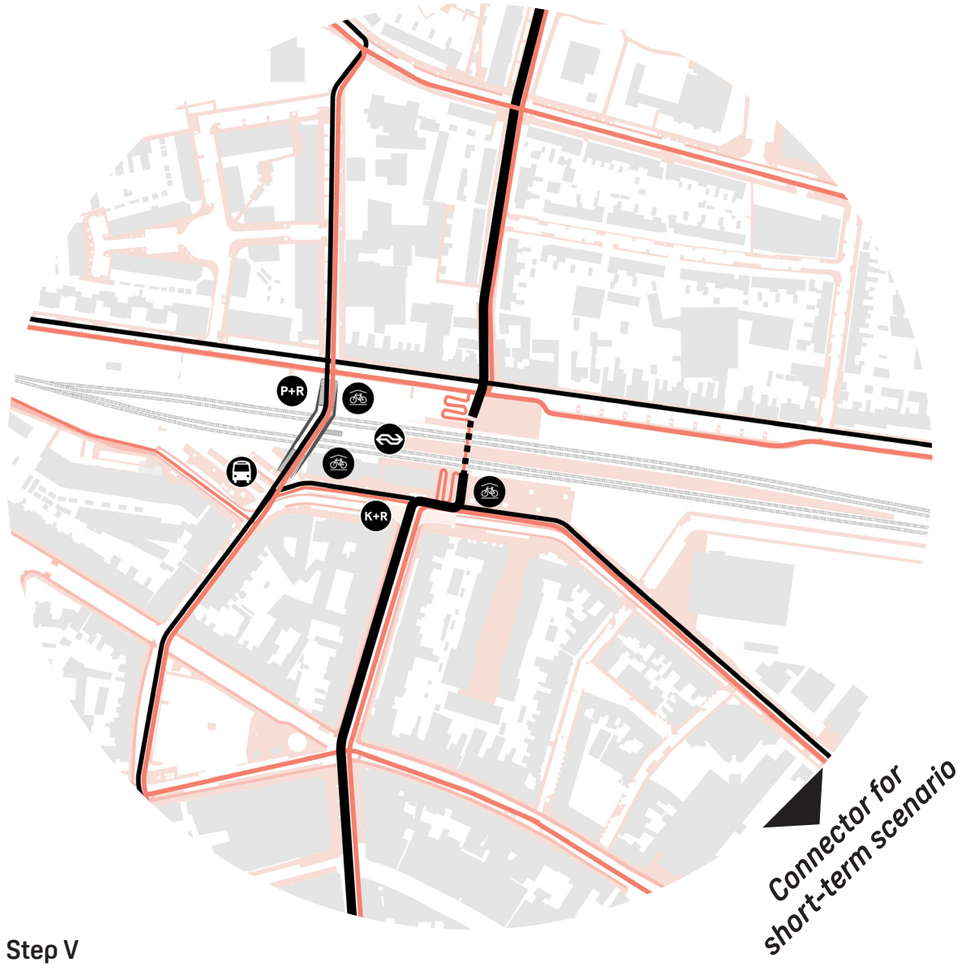
Bridging the node



Step IV

Footbridge + tunnel with ramps integrated in urban blocks

The most optimal solutions is long-term one and requires construction of new wide tunnel, (15 m) connecting pedestrian and cyclists. Additional footbridge supports the tunnel by connecting the bus station, platform and parking facilities. However, part of it



Step V

Existing tunnel + new footbridge

On the way to optimal variant IV, it is important to consider short-term variant V. New footbridge connecting bus station, platforms, bike storage and P+R can optimize the existing node and relieve the existing tunnel. Bike gutters and comfortable stairs (~Morelsebrug, Utrecht Centraal) will make the footbridge accessible also for cyclists.

6.1 ¦ Bergen op Zoom 2026: New energy

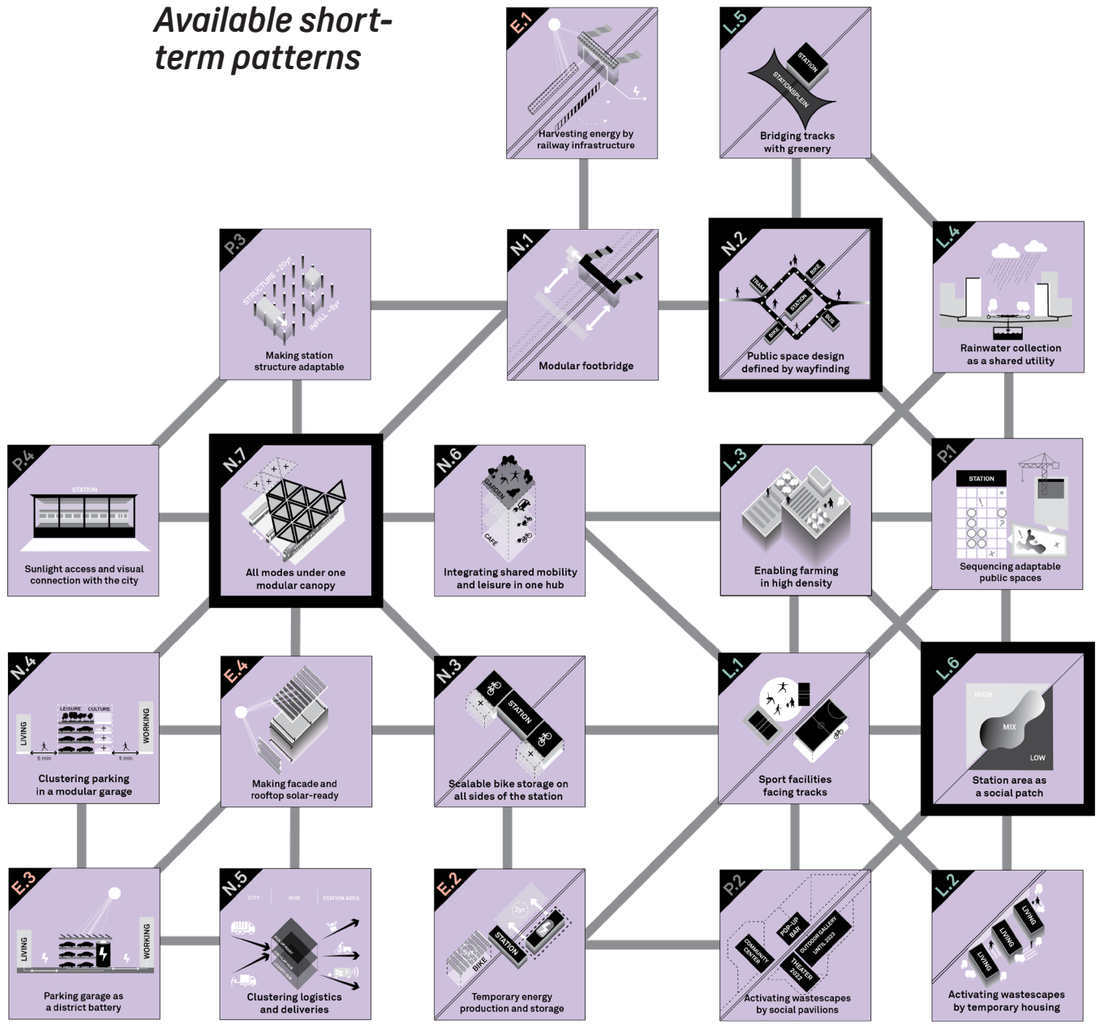
SHORT-TERM SCENARIO



What if...

A new, post-pandemic economic crisis caused by crash of the housing market has hit smaller cities. Things are not going well in Bergen op Zoom. The city is in debt, rate of vacant offices and shops is soaring, next to the crime rate in Gageldonk. While more frequent, faster train connections with Randstad aimed to help, now one can get an impression that young people are leaving the city en masse.

In the middle of this chaos a new ambitious mayor takes over. There is some hope for station area: EU funds supporting small cities, who want to become a testing lab for energy transition innovations. Municipality aims to connect it with renovation of the old station and seasonal pilot projects for urban renewal. What if the train station area can breathe a new life into the whole city?



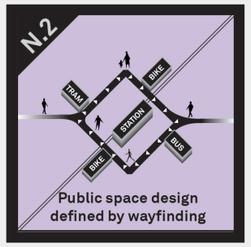
Bergen op Zoom 2026: New energy
Pattern selection

Node

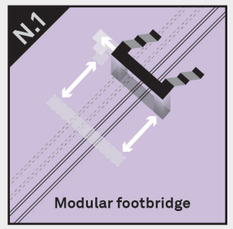
Problem
Tunnel as a barrier, long distance between bus station and platforms, generic public spaces.

Potential
Improved quality of the connector guiding passengers, optimizing P+R and bike storage.

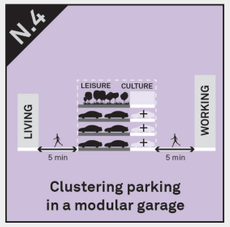
Goal
Minor intervention in the existing station without demolition, shortening distances between modes of transport, making station facilities compact and adaptable.



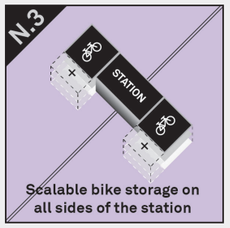
Pattern can go well with P.1, N.1 and be an unifying element of design of public spaces.



Pattern allows new connection shortening the distance between modes of transport, without demolition of the station building.



It may help to make a more compact, modular node and free up space for patterns P.1, P.2, L.1 or L.4.



Multi-level storage may solve shortage problems while saving space. Relocation may shorten distances within the node.

Livability

Problem
Lack of green spaces for leisure and social interaction, lack of social amenities.

Potential
Good social mix of the neighborhood, station area as a transition zone between two districts of different socio-economic profiles.

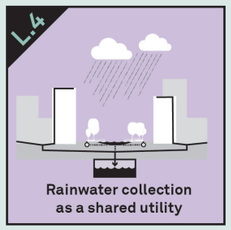
Goal
Station area as an adaptable pocket park co-created by residents of Centrum and Gageldonk-West.



All free plots in station area needs to be activated for social purposes.



Pattern allows to intensify the use of infrastructure, can be introduced on the existing square for bike storage.



Pattern may help to improve the station as a meeting place with pleasant microclimate.



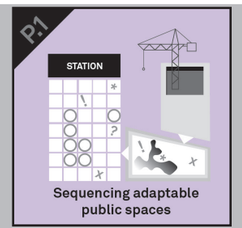
Pattern could activate railway buffers for intergenerational activity.

Place

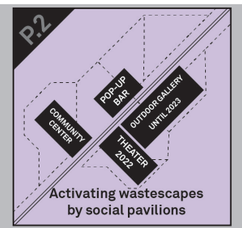
Problem
Poor continuitiy of functions and public spaces from Centrum to Gageldonk-West, lack of active streets and urban functions.

Potential
Activating streets parallel to tracks and empty plots.

Goal
Pilot project of urban renewal: inclusive spaces for social interaction, culture and entrepreneurship.



Pattern can help to activate the eastern side of the station (Gageldonk-West) until long-term transformation.



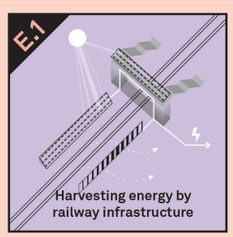
Pattern allows to add temporary structures with commercial and seasonal cultural program i.e. to empty plot owned by ProRail.

Energy

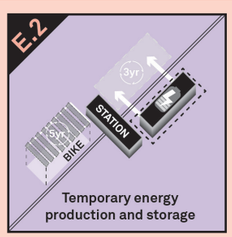
Problem
No district heating and green energy generation, low energy labels of most of the buildings and the station.

Potential
Potential for new district heating and wind energy (wind tunnel south-north).

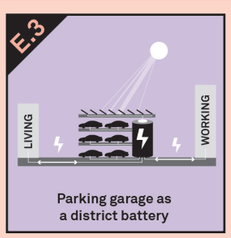
Goal
Energy-neutral temporary program, station area as a testing lab for small-scale wind turbines and storage.



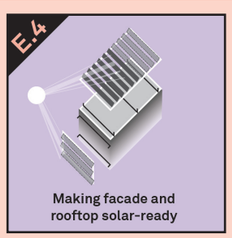
Pattern may allow to use potential of the fenced railway area (ProRail) for wind energy generation.



Solar canopies and mobile batteries can synergize with P.1, P.2. and achieve energy-neutrality of the temporary program.

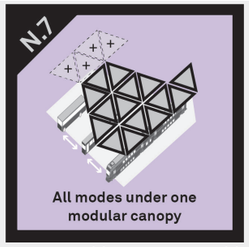


New compact parking garage can be the first district battery in Bergen op Zoom.

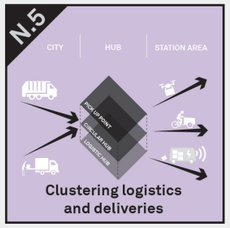


Pattern allows minor intervention in the station building, so it can cover its heating and electricity demand from solar energy.

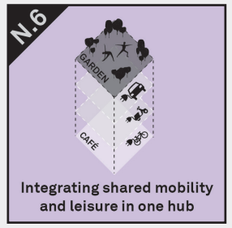
Rejected short-term patterns:



An overarching canopy would require a major intervention in the existing station building and may hinder E.1.



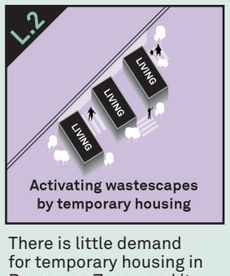
Planned densification solves parking within each plot. P+R is used only by 1% of passengers, shared mobility is more relevant.



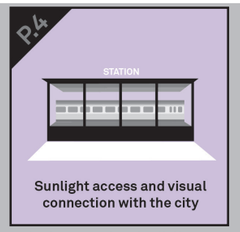
Short term is insufficient for full transition to shared mobility. P+R may be more useful as a district battery.



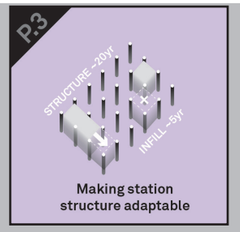
No ecological value in bridging east-west, tension with E.1, mutually exclusive with a new footbridge N.1.



There is little demand for temporary housing in Bergen op Zoom, and it creates tension with active social spaces P.2.

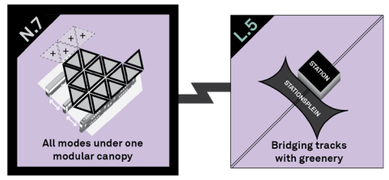


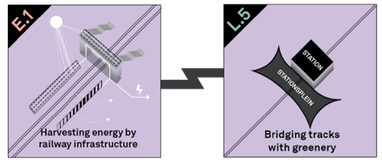
Existing station building is blocking the view; minor intervention in station structure gives no opportunity to apply this pattern.

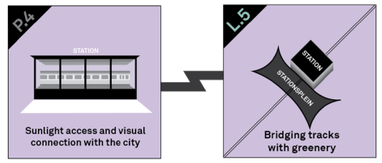


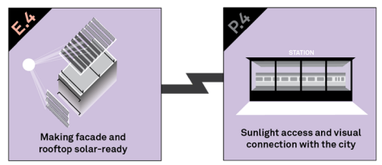
Major intervention in station structure would mean partial demolition, which scenario aims to avoid.

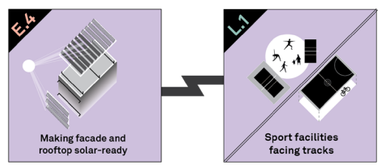
Tensions:

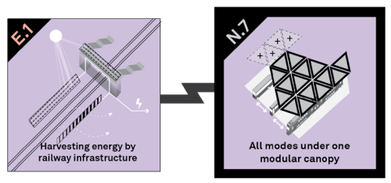




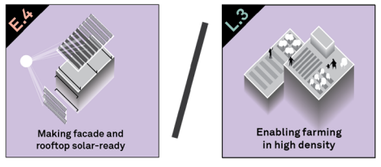


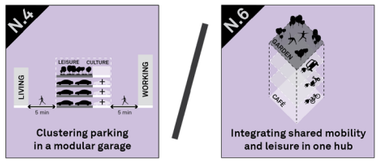


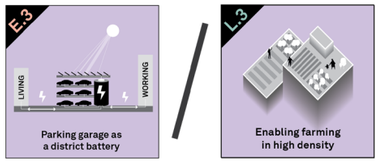


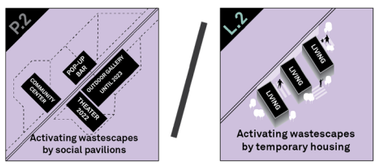


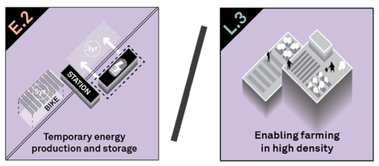
Mutually exclusive:

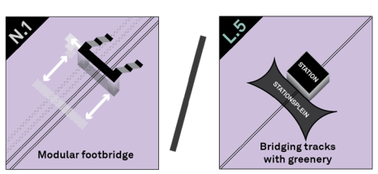








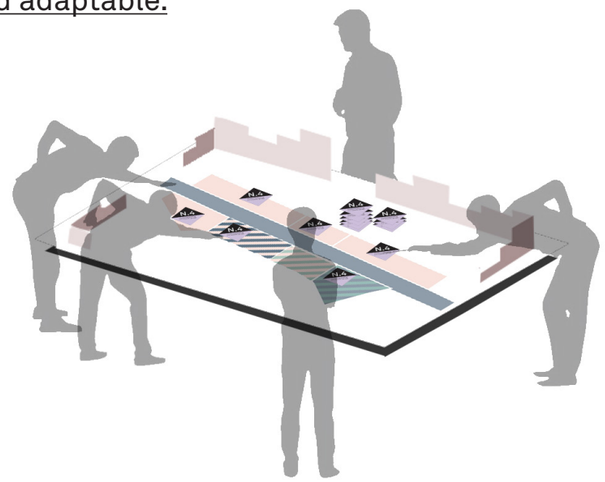




Bergen op Zoom 2026: New energy

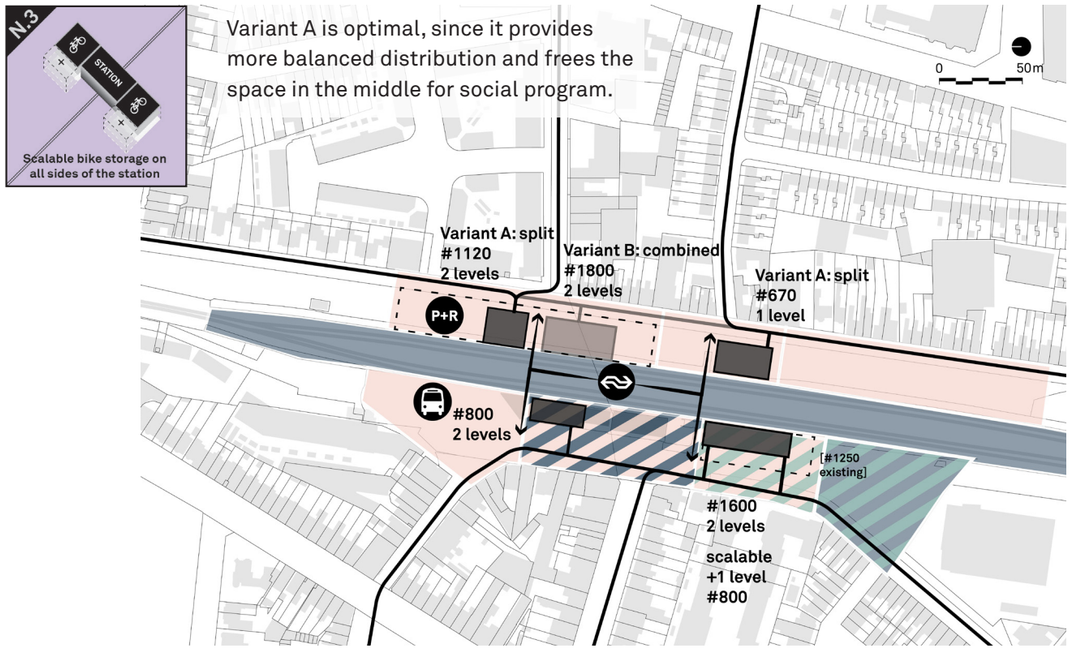
Applying patterns

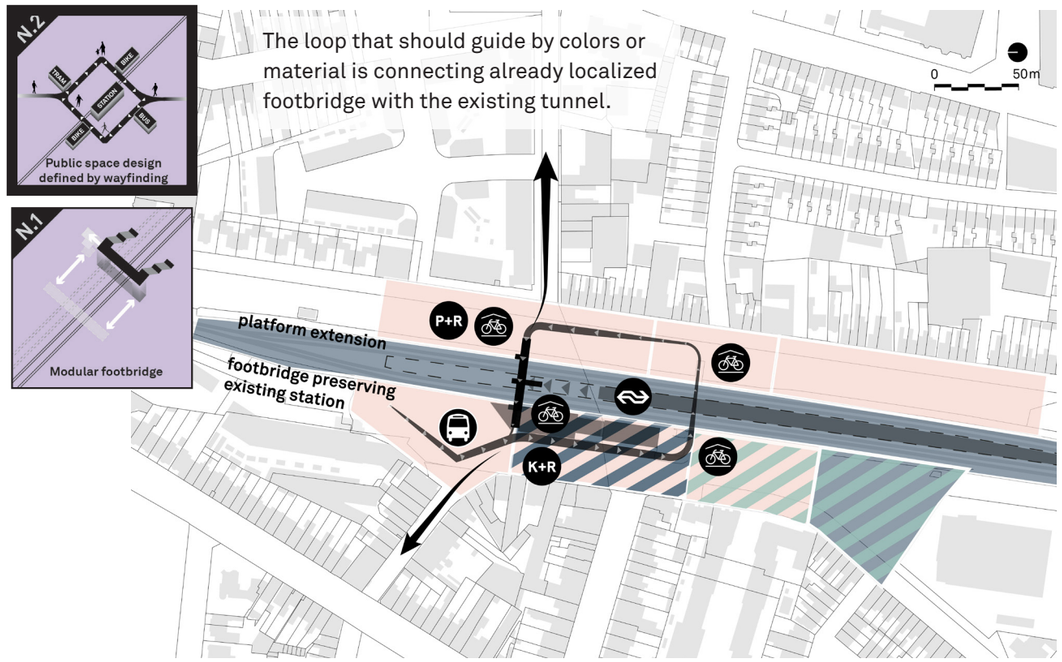
Node: Minor intervention in the existing station without demolition, shortening distances between modes of transport, making station facilities compact and adaptable.

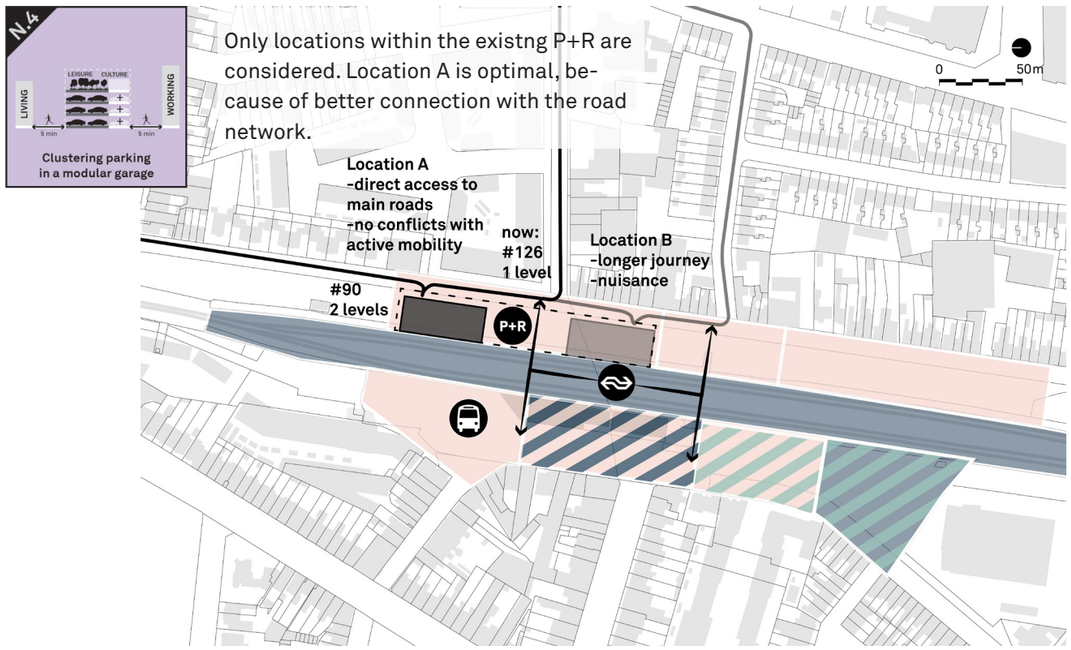


Legend

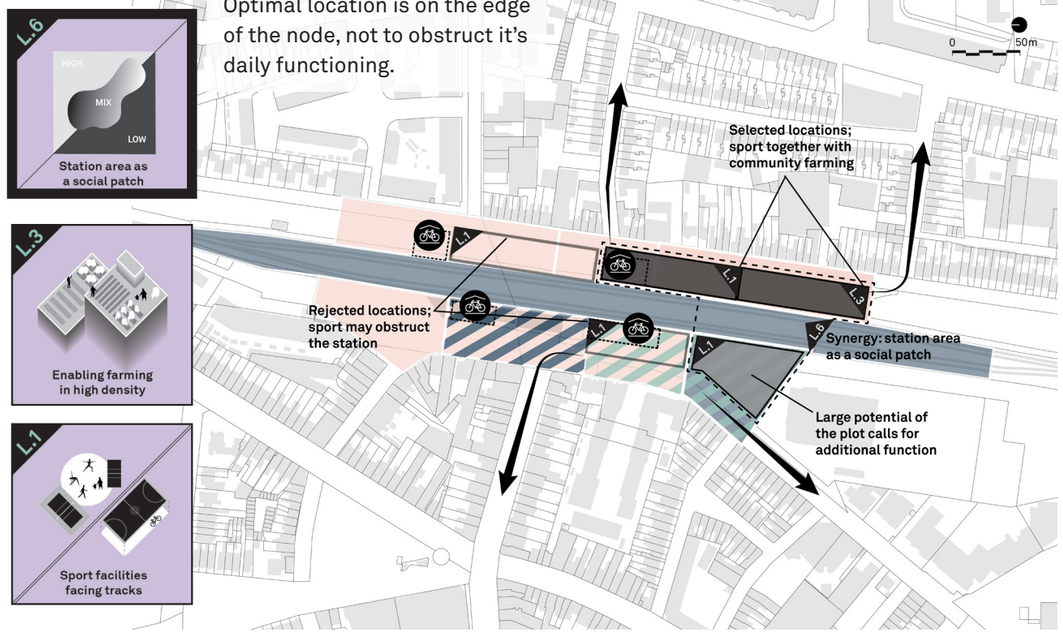
- Railway company (NS/Prorail)
- Municipality
- Building owned by NS, plot by municipality
- Owned by NS/Prorail, potential to be redeveloped by private sector
- Owned by municipality, potential to be redeveloped by private sector

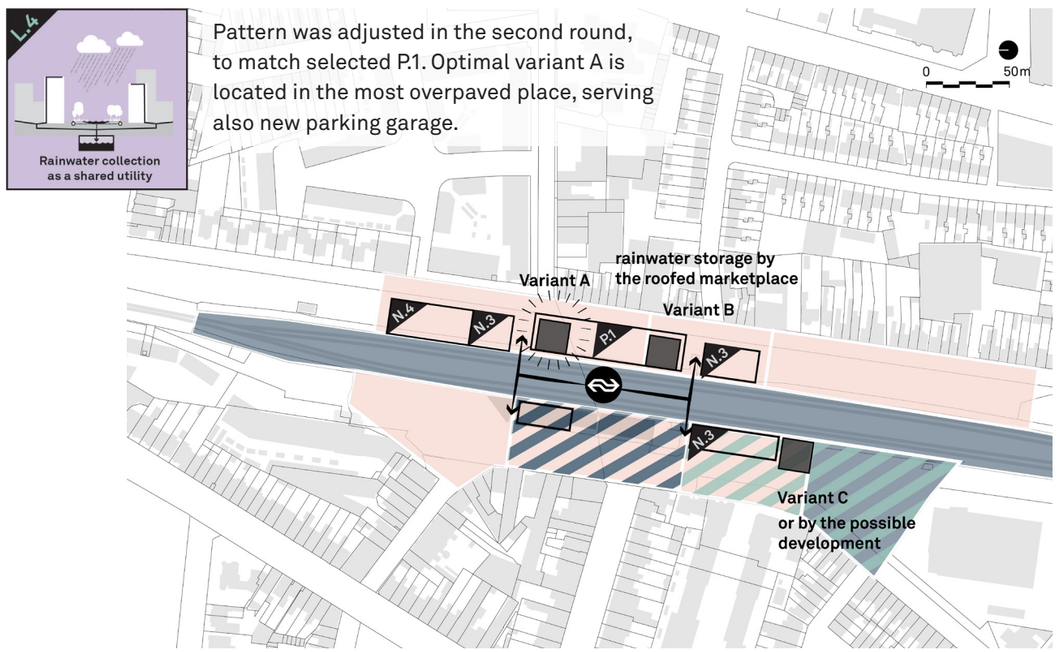




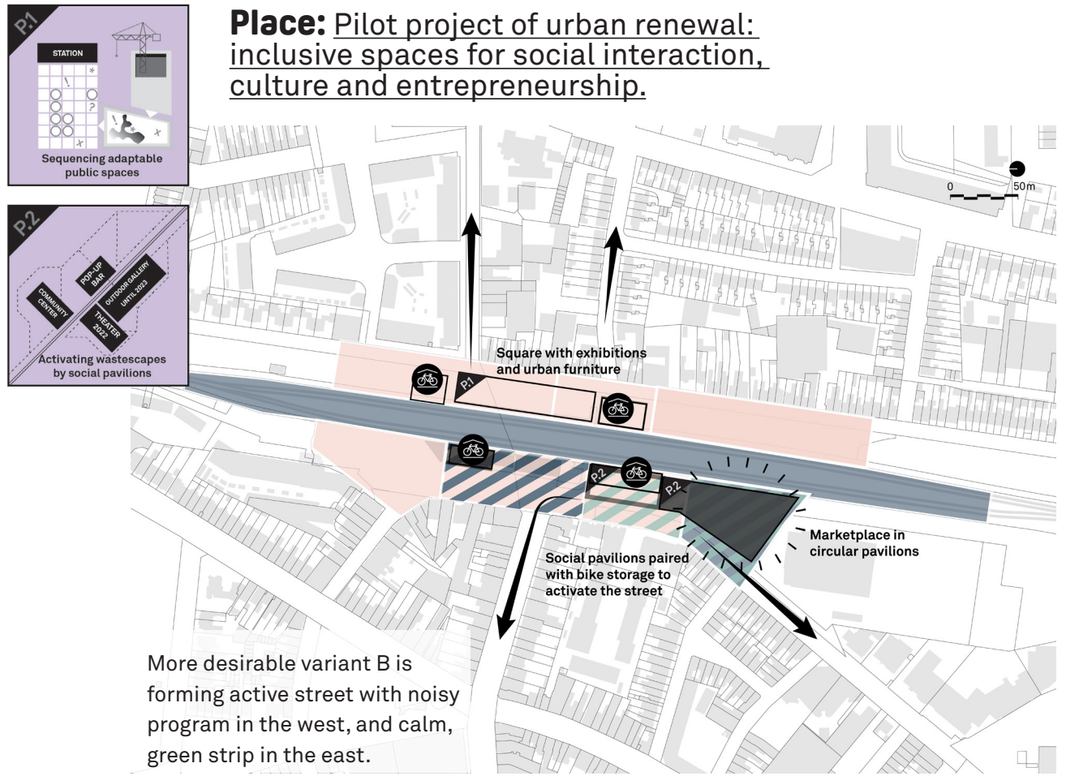


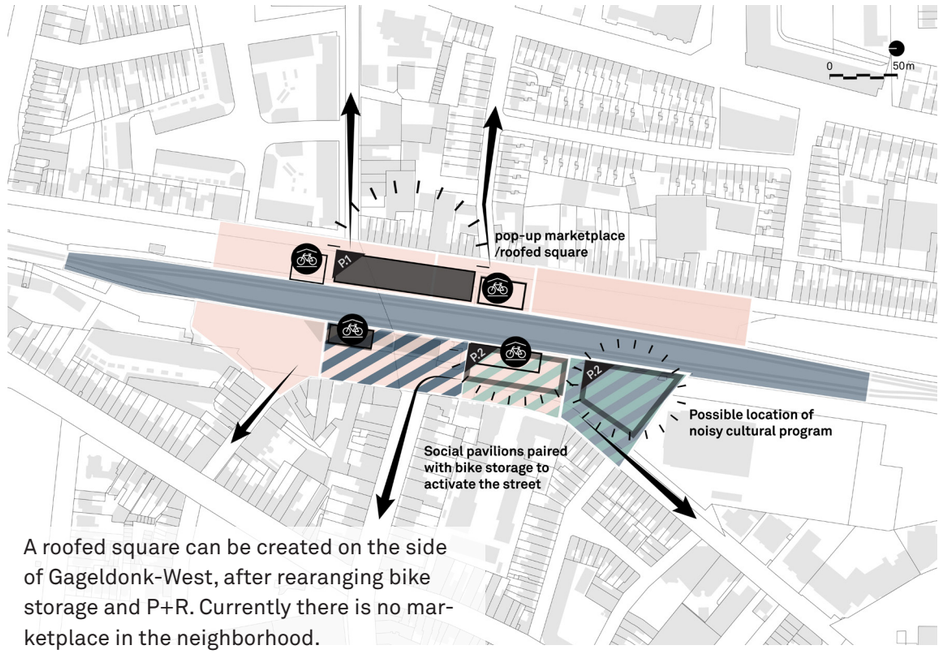
Livability: Station area as an adaptable pocket park co-created by residents of Centrum and Gageldonk-West.

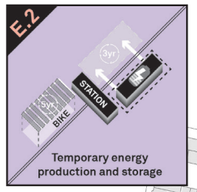


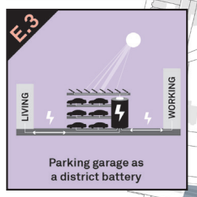


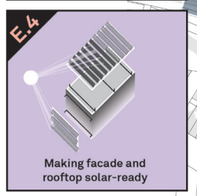
Place: Pilot project of urban renewal: inclusive spaces for social interaction, culture and entrepreneurship.



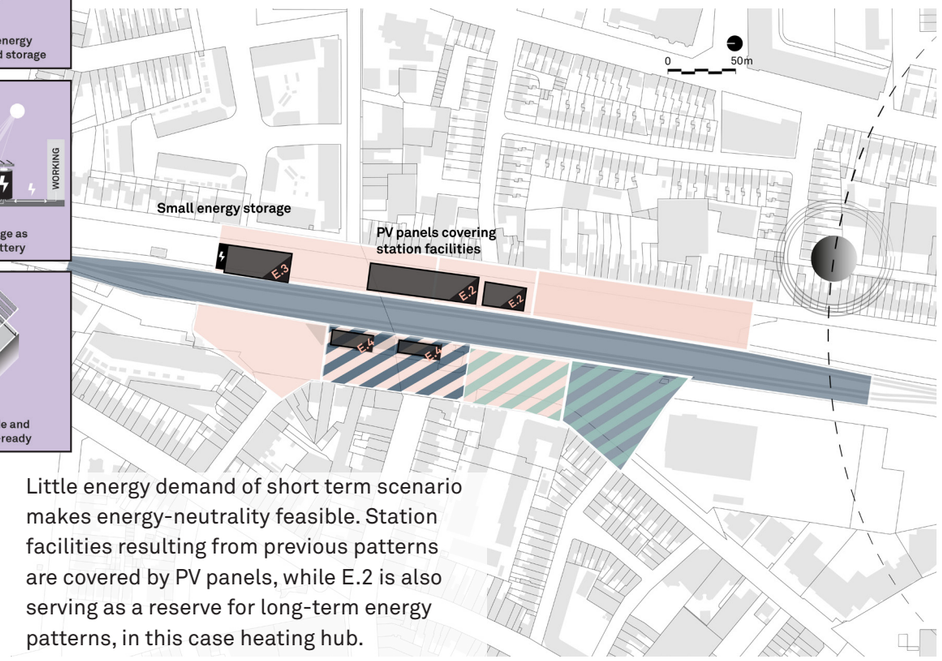




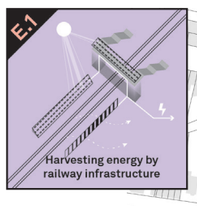


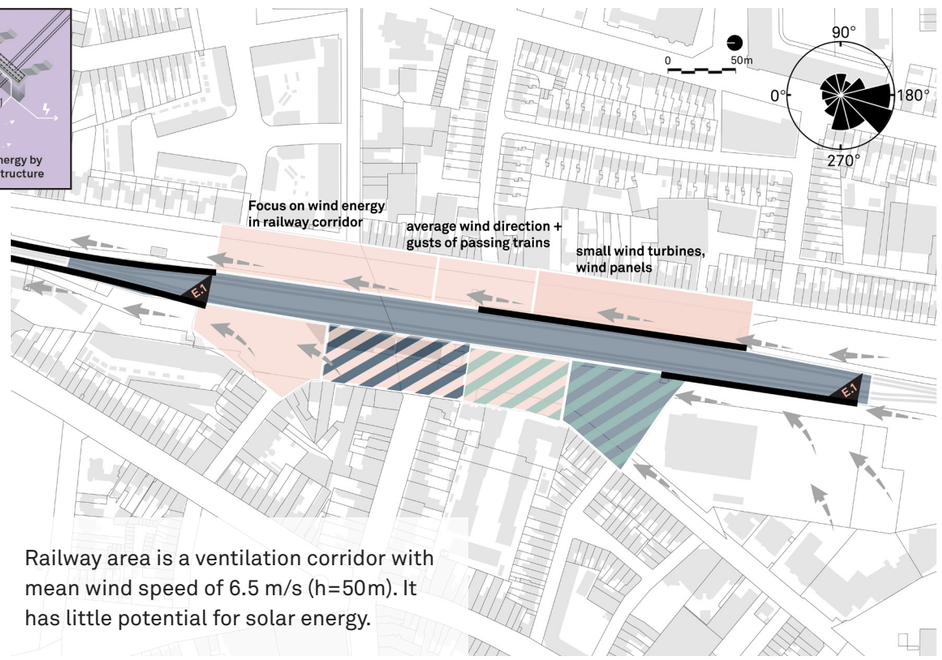


Energy: Energy-neutral temporary program, station area as a testing lab for small-scale wind turbines and storage.



Little energy demand of short term scenario makes energy-neutrality feasible. Station facilities resulting from previous patterns are covered by PV panels, while E.2 is also serving as a reserve for long-term energy patterns, in this case heating hub.

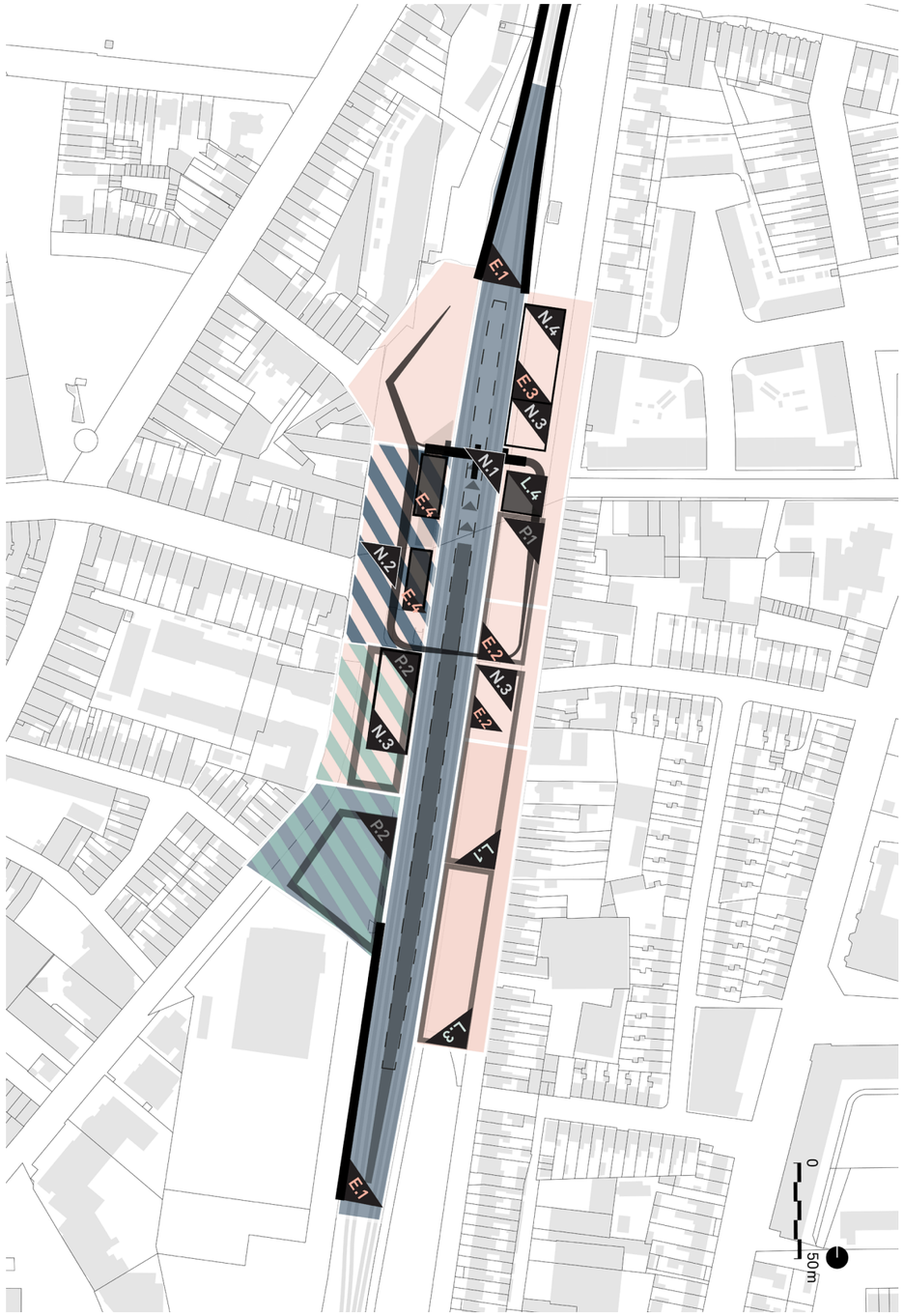




Source: https://globalwindatlas.info/

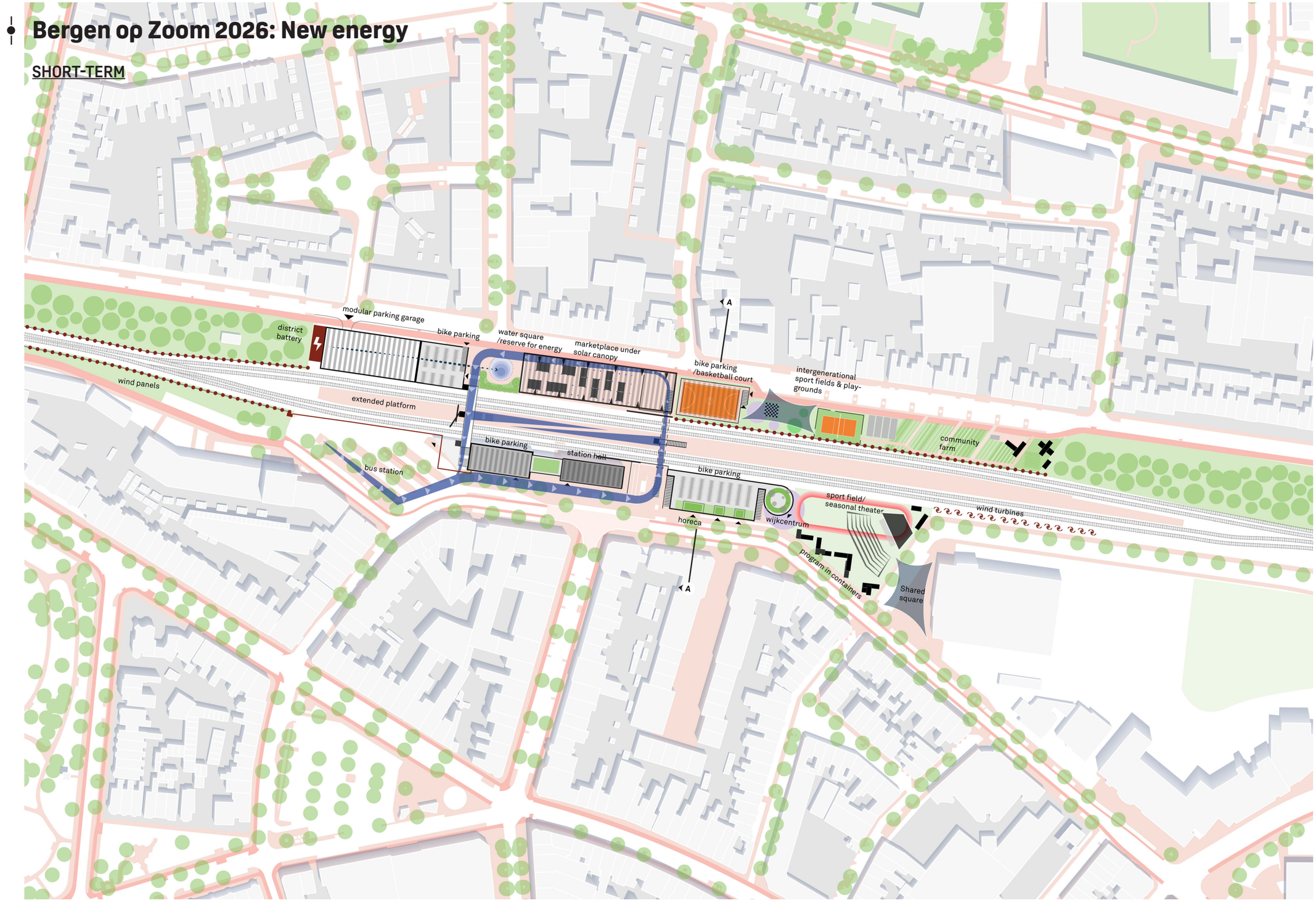
Railway area is a ventilation corridor with mean wind speed of 6.5 m/s (h=50m). It has little potential for solar energy.

Final configuration

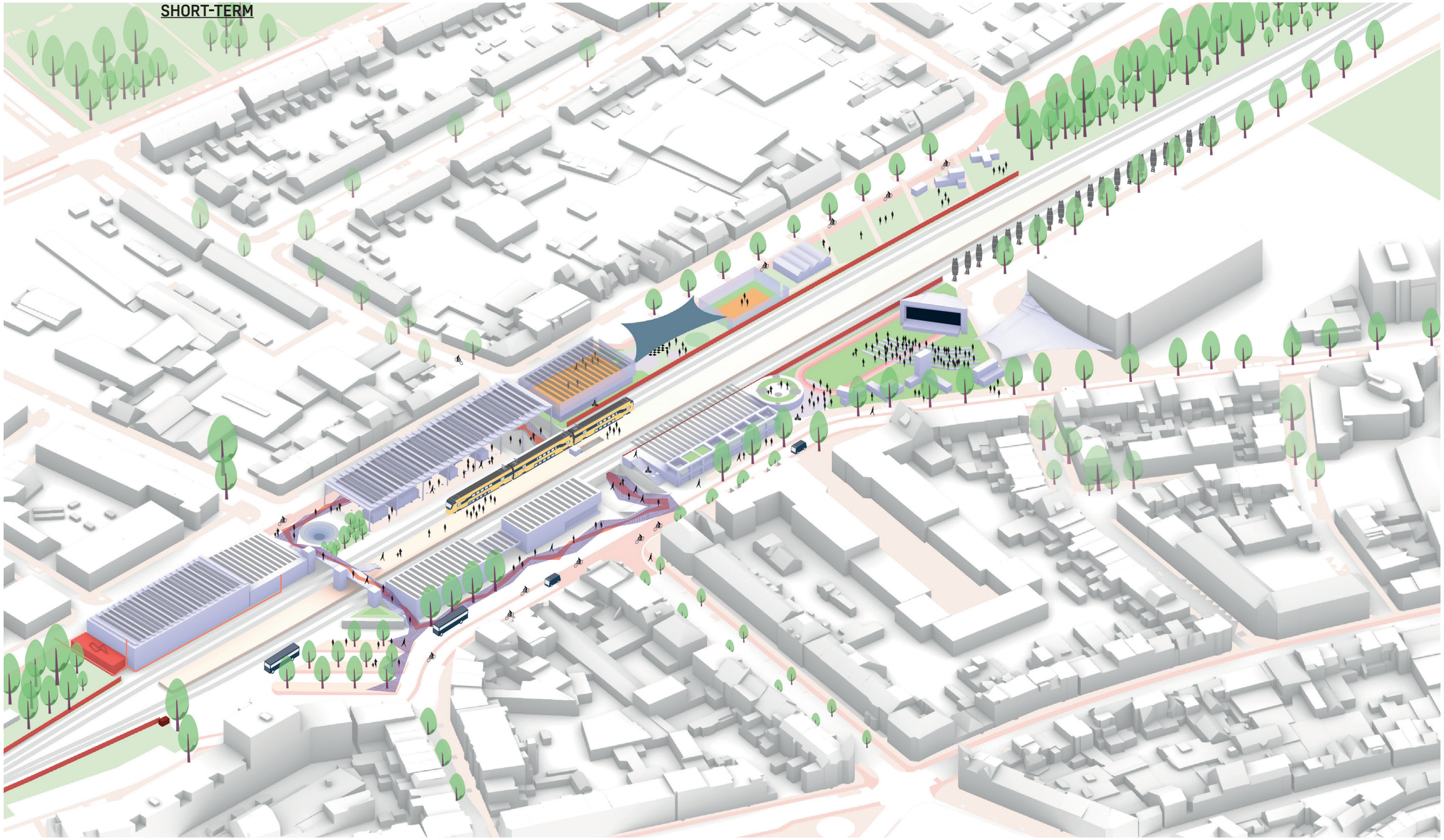


Site plan
1:2000

0 50m

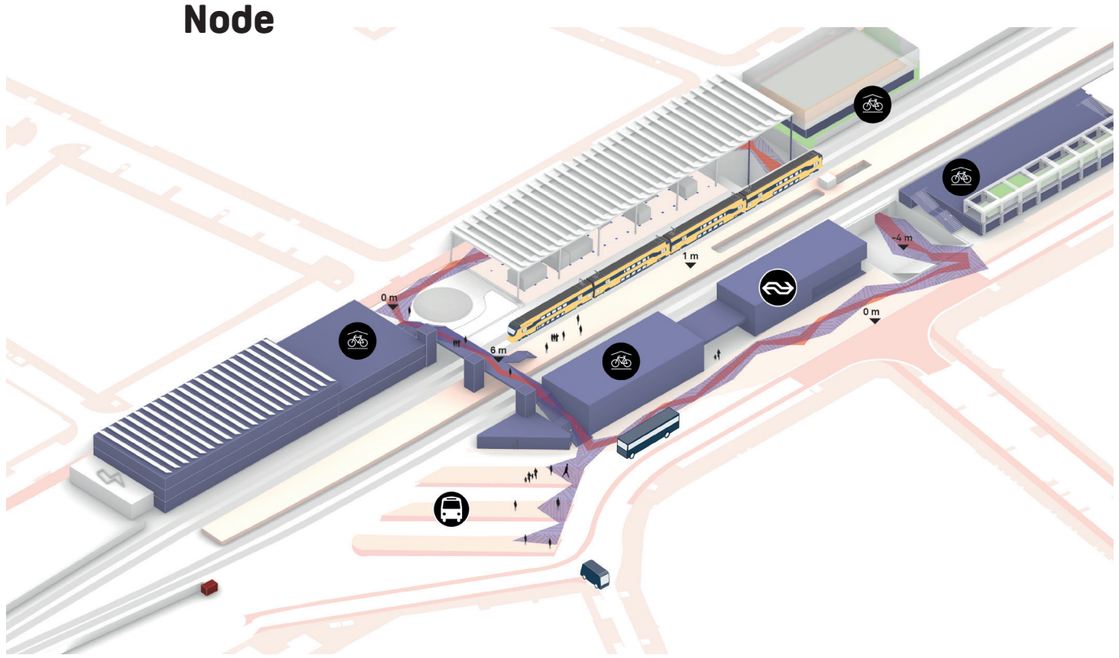


Bergen op Zoom 2026: New energy

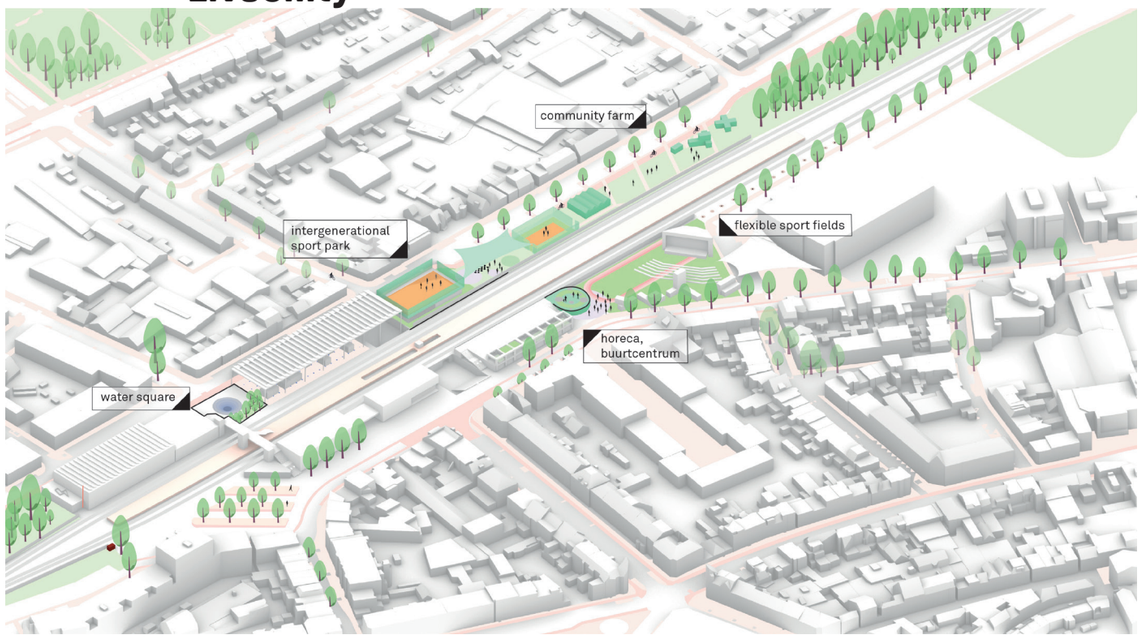


Bergen op Zoom 2026: New energy

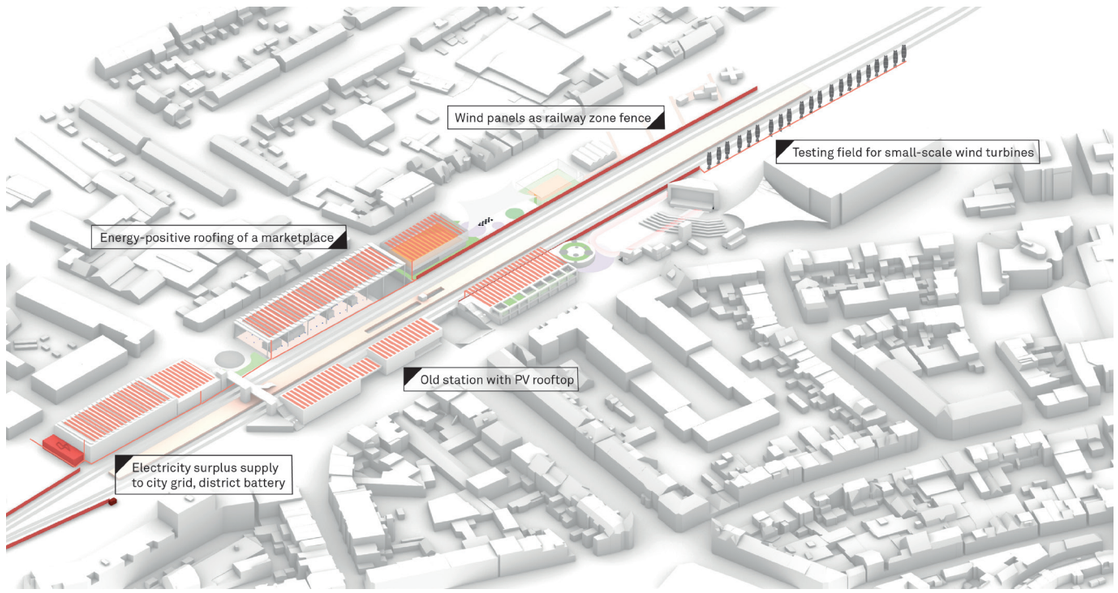
Node



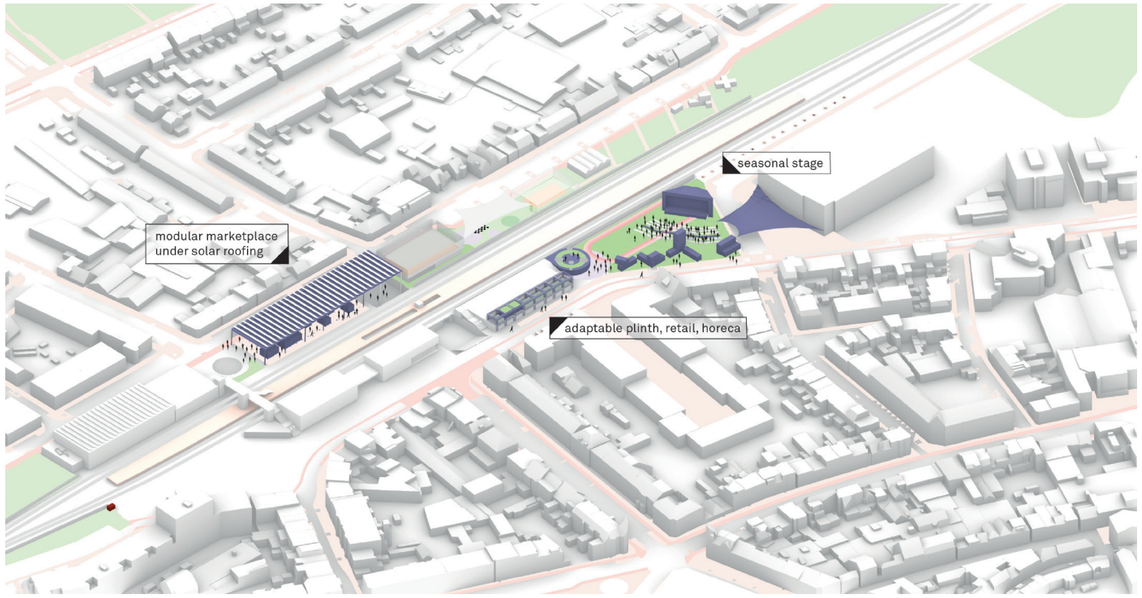
Livability



Energy



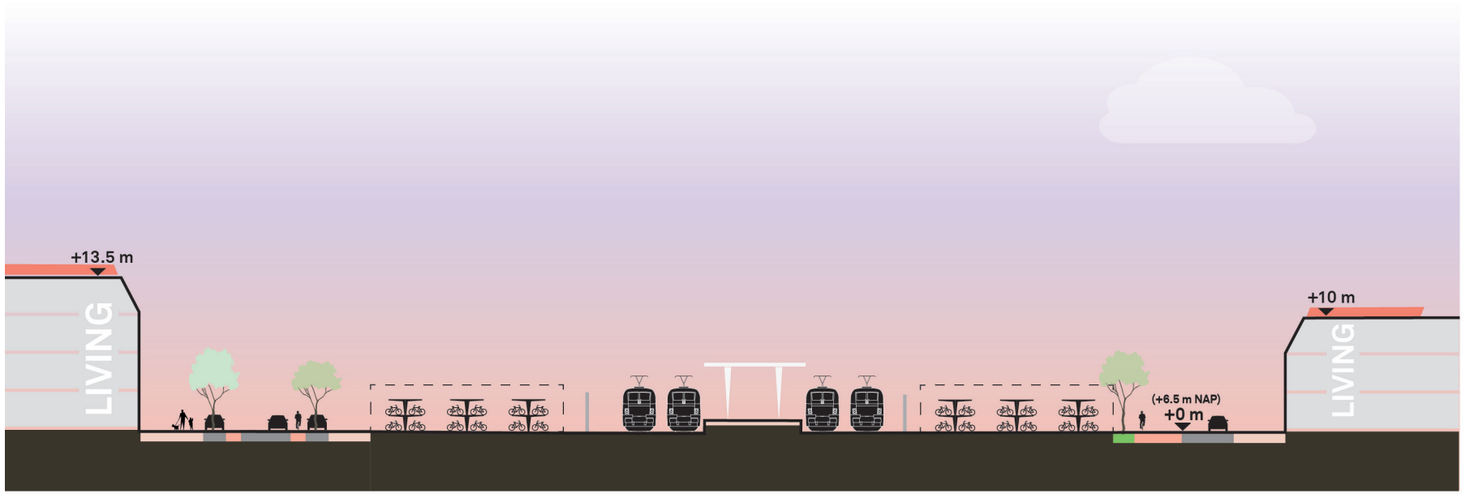
Place



Bergen op Zoom 2026: New energy

SHORT-TERM

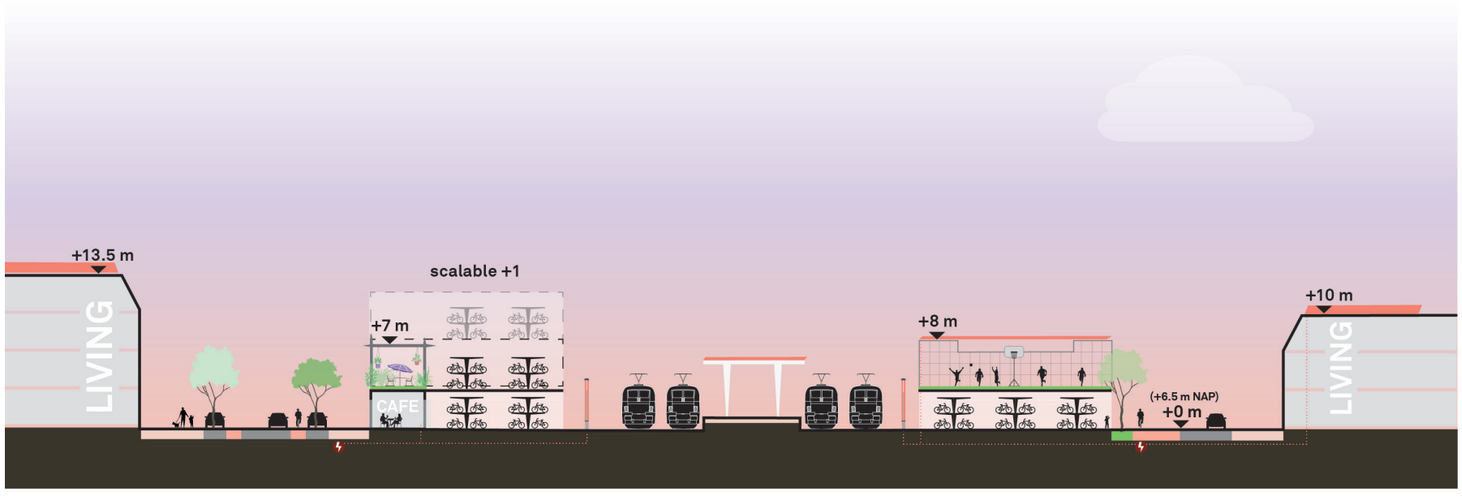
Section AA
2021



Section AA
2026

Visible patterns:

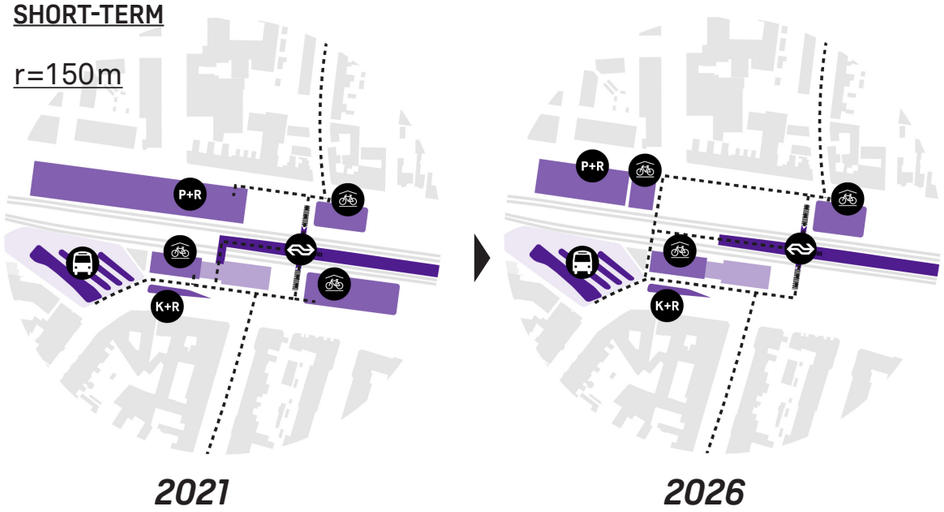




Bergen op Zoom 2026: New energy

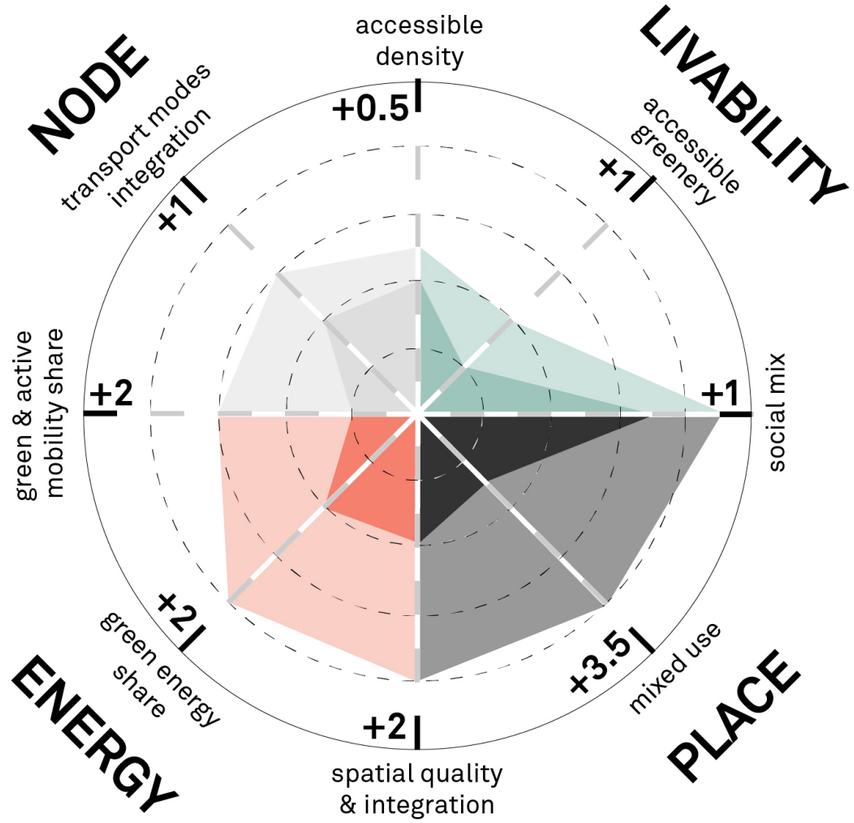
SHORT-TERM

r=150m



Node	Desired modal split	33% bike / 35% walking / 25% OV / 7% car
	Distance for change OV/train	65 m bus-train
	Estimated daily ridership	8 500
Livability	Green areas	0.83 ha (ground)
	Number of new residents	-
	Green areas per capita [1]	-
Place	Number of new employees	-
	FSI	-
	Mixed use	50% retail / 30% horeca / 20% social /
Energy	Estimated energy demand [2]	-
	Solar potential [3]	6.02 GWh/yr
	Potential surplus	-

[1] Rooftop greenery is counted as 50% of ground.
[2] Assuming that all new buildings have A+++ energy label and energy consumption is 50 kWh / m2
[3] Assuming 1276 kWh/yr/m2 based on globalsolaratlas.info



This scenario aims to reduce demolitions in the area, only properly use the existing potential. Intensity means to maximize social interactions per square meter. The largest new structures are solar canopies, covering the existing station building and local flea market on the opposite side of tracks. This space will be co-created by residents.

Experimental electricity generation will take place in normally not accessible railway area. Due to a wind corridor, especially small-scale wind turbines or wind panels are worth exploring. Generated electricity will cover the demand of existing station, social pavilions and marketplace. Also the solar potential is substantial, due to introduced PV canopy over the marketplace and rooftops of station facilities. The surplus will supply the local grid.

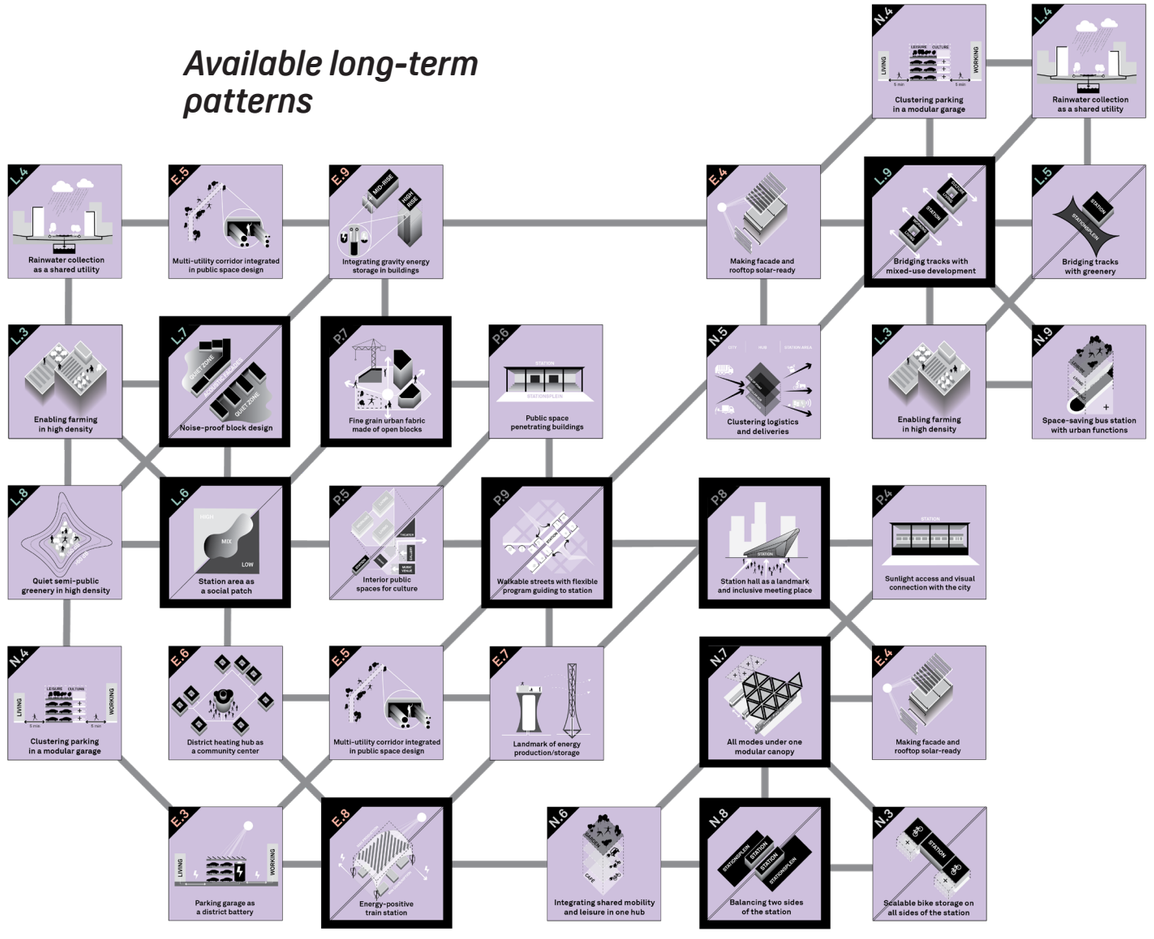
The existing station hall can be preserved. Scenario makes the station more accessible by foot and shrinks the distance of change from bus to train by introducing a footbridge. The increased score of place, energy and livability comes from activation of infrastructural buffers, wastescapes and lawns.

TSAD using temporary structures can be the first step of urban recovery. Seasonal cultural and sport program in the station area has potential because of its location and shortage of in leisure areas in mostly residential surroundings.

6.2 ¦ Bergen op Zoom 2040: Glocal transition

LONG-TERM SCENARIO





What if...

After the pandemic, work from home is trending, and it results in a revival of small cities. Irregular working hours, one or two days a week are blurring the old rush hours. European rail policies, train become a default intercity and international travel. People from Randstad but also from Antwerp could decide to move to calmer Bergen op Zoom, only the station area is still off-putting.

Luckily, the municipality can count on the support from central government. The station fits within a special programme and subsidy schemes for adaptable nodes and sustainable district heating in postwar neighborhoods.

Developing a new station could help the city to benefit from the new trend and finally catch up with the energy transition. The challenge is to make the new station, energy infrastructure and housing harmoniously coexist in a relatively small area.

Bergen op Zoom 2040: Glocal transition

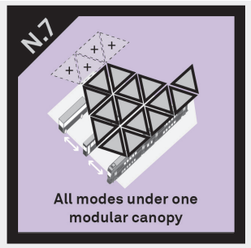
Pattern selection

Node

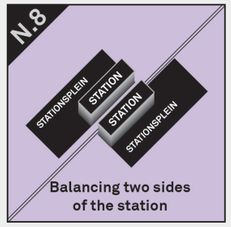
Problem Tunnel as a barrier, long distance between bus station and platforms, generic public spaces.

Potential Improved quality of the connector guiding passengers, optimizing P+R and bike storage.

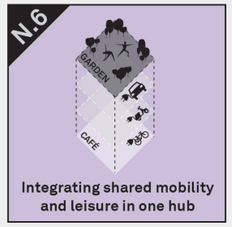
Goal New adaptable train station bridging two neighborhoods and minimizing distances between modes of transport.



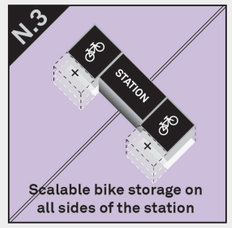
It may be a base ingredient of a more compact, modular node, while synergizing with P.3 and N.8.



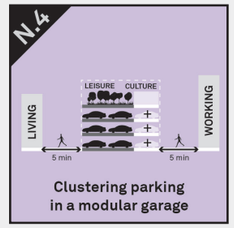
A new station should have a coherent spatial quality and balanced distribution of facilities for Centrum and Gageldonk-West.



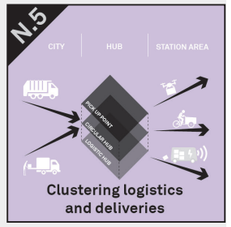
In the long term, station facilities should stimulate transition to shared mobility.



In higher density bike storage needs to be rearranged and integrated with other functions.



Pattern allows to serve the new development and move parking out of the center of the station area.



Pattern may serve the new program and reduce nuisance from streets of residential neighborhood.

Livability

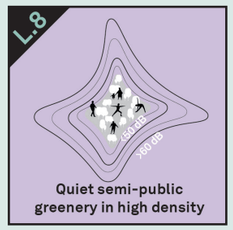
Problem Lack of green spaces for leisure and social interaction, lack of social amenities.

Potential Good social mix of the neighborhood, station area as a transition zone between two districts of different socio-economic profiles.

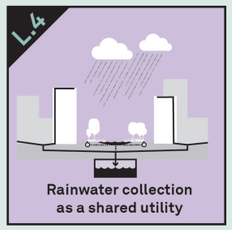
Goal Maximum social cohesion between Centrum and Gageldonk-West, new development with social amenities complementing the context.



Pattern will allow to preserve and improve existing social mix. New social amenities need to be introduced.



New development should respond to shortage of public greenery in the station area.



Pattern may help to improve the station as a meeting place with pleasant microclimate.



This pattern can provide more active use of few green spaces around the station.

Place

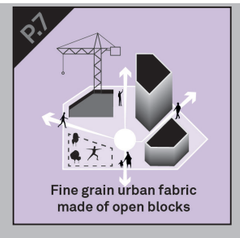
Problem Poor continuitiy of functions and public spaces from Centrum to Gageldonk-West, lack of active streets and urban functions.

Potential Activating streets parallel to tracks and empty plots.

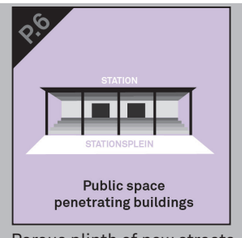
Goal Dense (>2 FSI), mixed use neighborhood improving spatial and functional continuity between Centrum and Gageldonk-West.



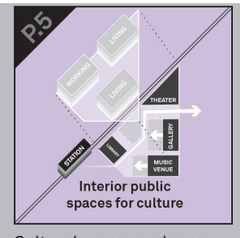
Existing Stationstraat has little potential, this pattern allows to shape new active streets.



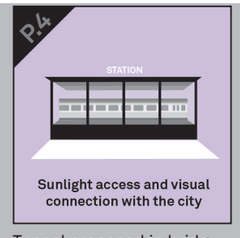
Pattern will be used to introduce social activities to station squares until long-term transformation.



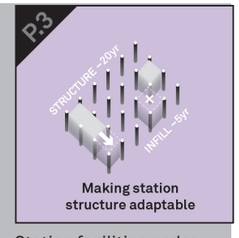
Porous plinth of new streets and the connector may blur the barrier between Centrum and Gageldonk-West.



Cultural program along new streets will fill the niche in this part of the city.



Tunnel proposed in bridging part must not repeat the flaws of the existing one, sunlight and visual connections are essential.



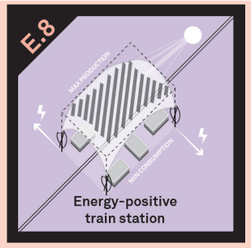
Station facilities under the main canopy N.7 can be designed as adaptable pavilions.

Energy

Problem No district heating and green energy generation, low energy labels of most of the buildings and the station.

Potential Potential for new district heating and wind energy (wind tunnel south-north).

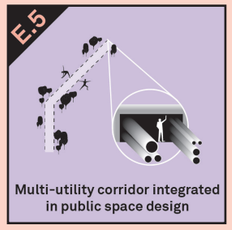
Goal Energy-neutral station area as a landmark of energy transition, integrating district heating for Gageldonk-West.



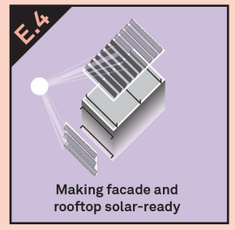
A new station should contribute to the energy transition of Centrum and Gageldonk-West.



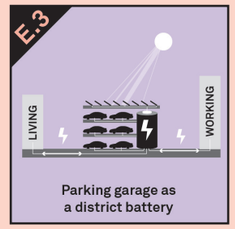
Pattern is essential for the station to support Gageldonk-West in energy transition.



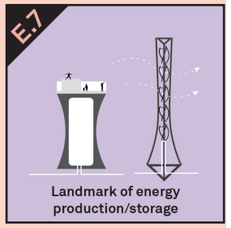
Formation of new streets and heating hub create an opportunity to use this pattern.



Pattern is necessary to make the new development energy neutral, according to the required energy labels.



Clustered parking garage for the new development gives an opportunity to use this pattern.



Station area will be already equipped with heating hub, a landmark itself, which should stand out.

Rejected long-term patterns:



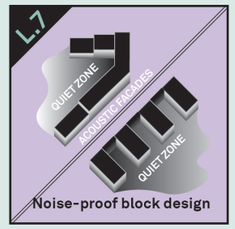
Although the layout of the bus station can be improved, introduction of urban functions above conflicts with canopy N.7 and P.3.



This pattern limits a chance to develop an adaptable node. The height difference would challenge the bike connection.



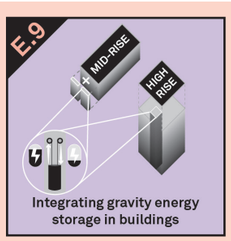
Green connection east-west has no ecological potential and would bring little improvement for people at a high cost.



Limited space to shape urban blocks and relatively little noise from the railway tell to reject this pattern.

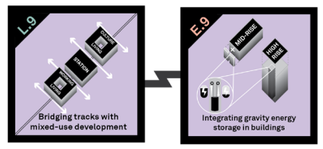


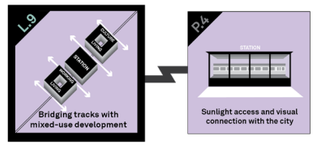
The main focus of the station is on adaptability and energy generation, iconic design is not a priority for this local station.

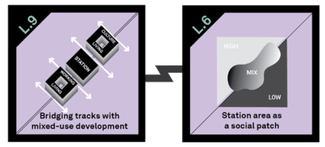


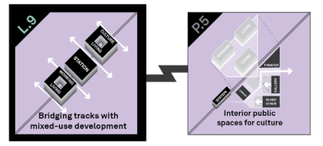
Limited space, high cost, and little potential for high-rise development tell to reject this pattern. .

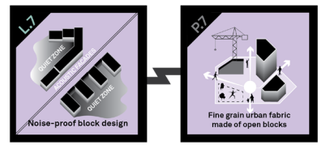
Tensions:

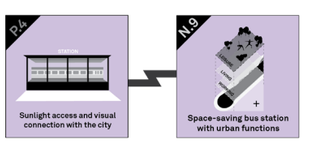


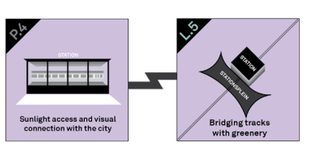


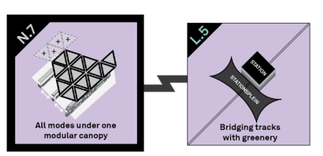




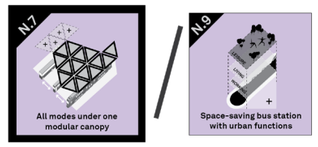


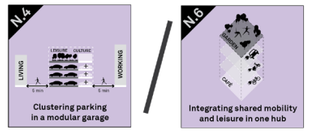


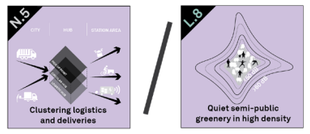


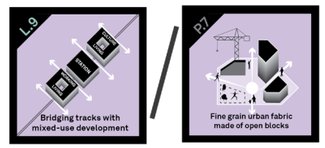


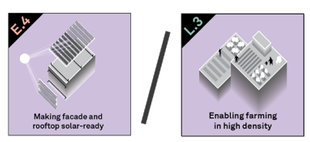
Mutually exclusive:

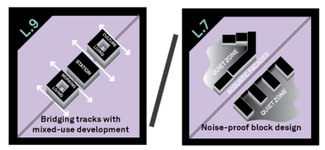


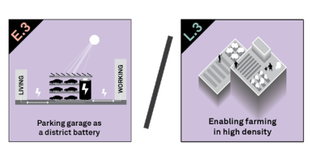


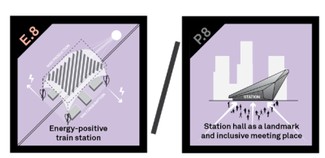








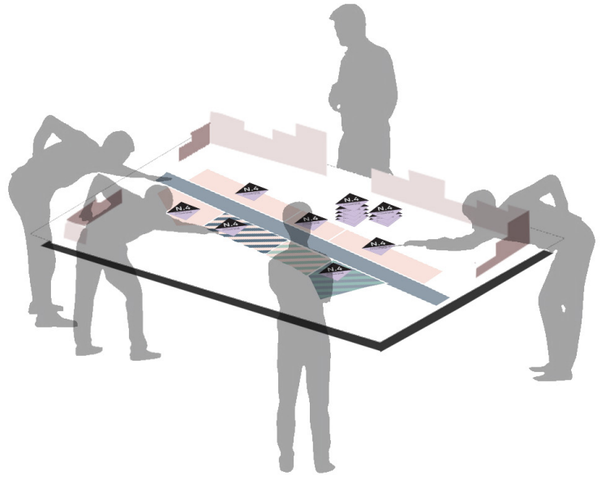




Bergen op Zoom 2040: Glocal transition

LONG-TERM

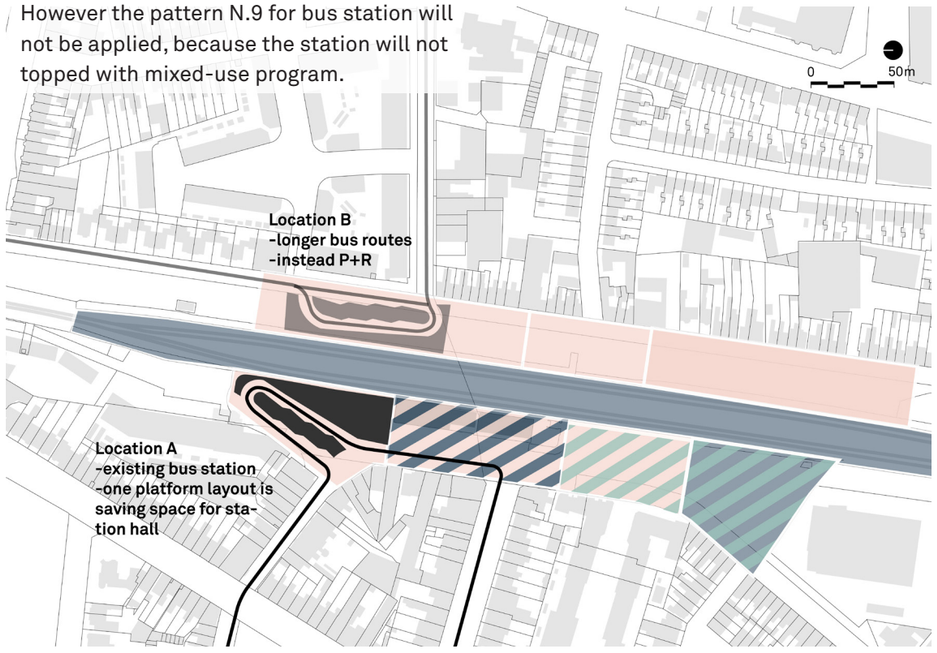
Applying patterns

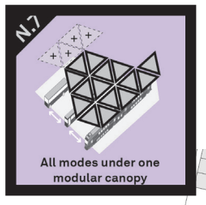


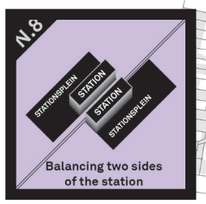
Legend

- Railway company (NS/Prorail)
- Municipality
- Building owned by NS, plot by municipality
- Owned by NS/Prorail, potential to be redeveloped by private sector
- Owned by municipality, potential to be redeveloped by private sector

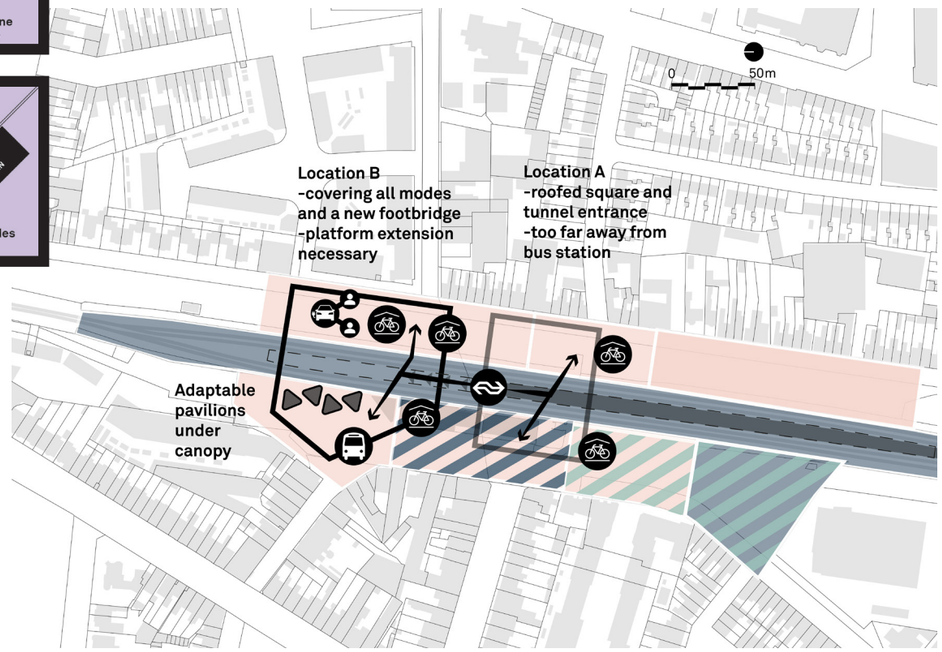
Layout of the bus station will be optimized to introduce station hall under the canopy. However the pattern N.9 for bus station will not be applied, because the station will not topped with mixed-use program.

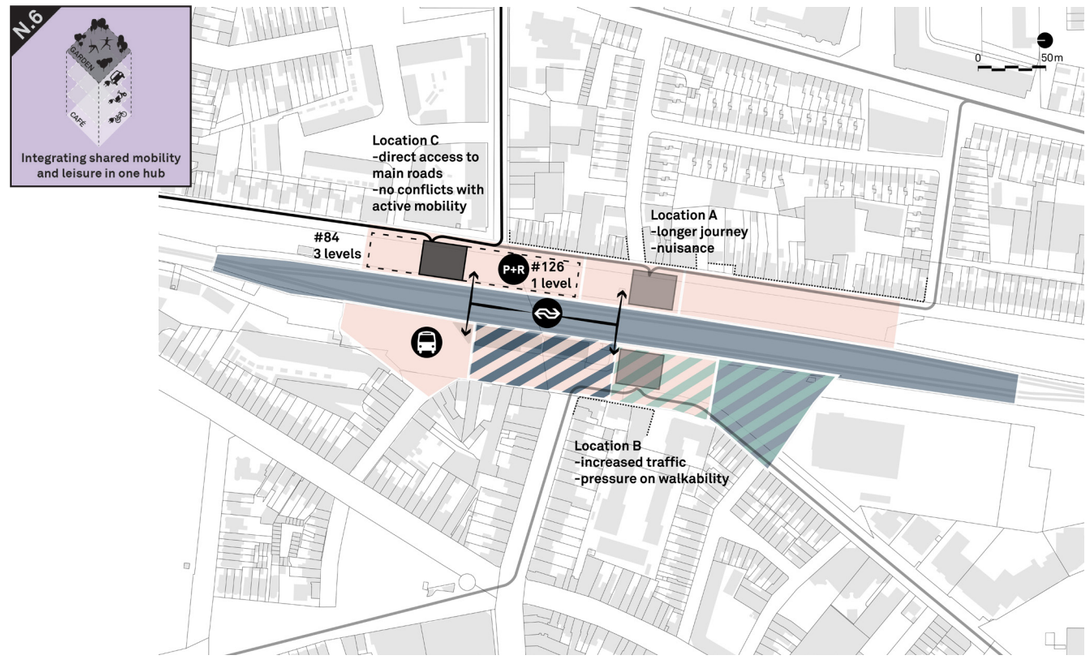


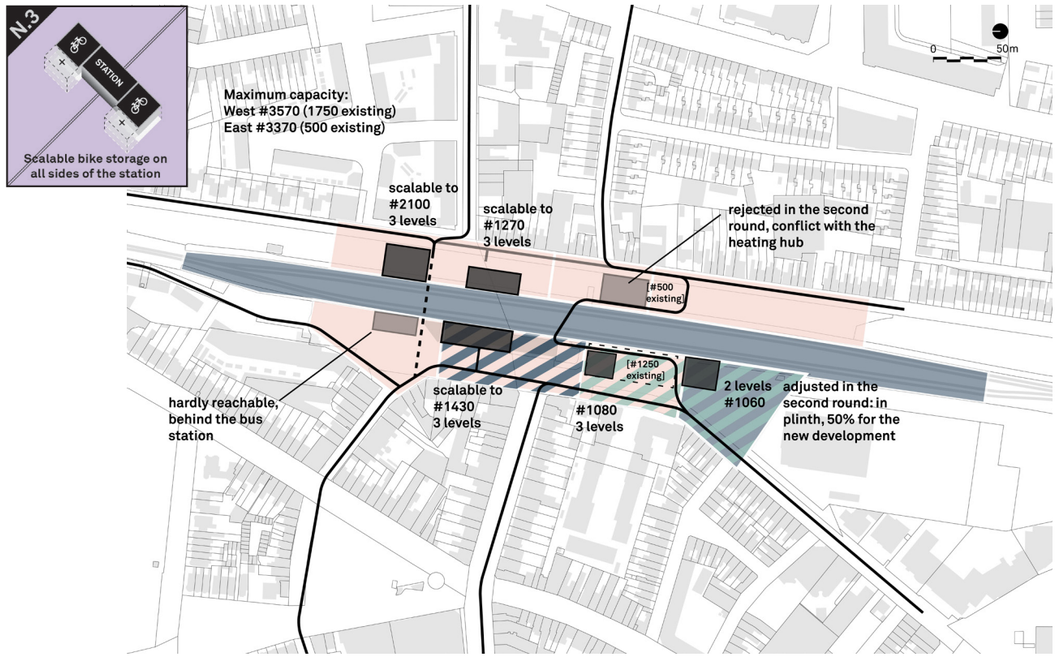


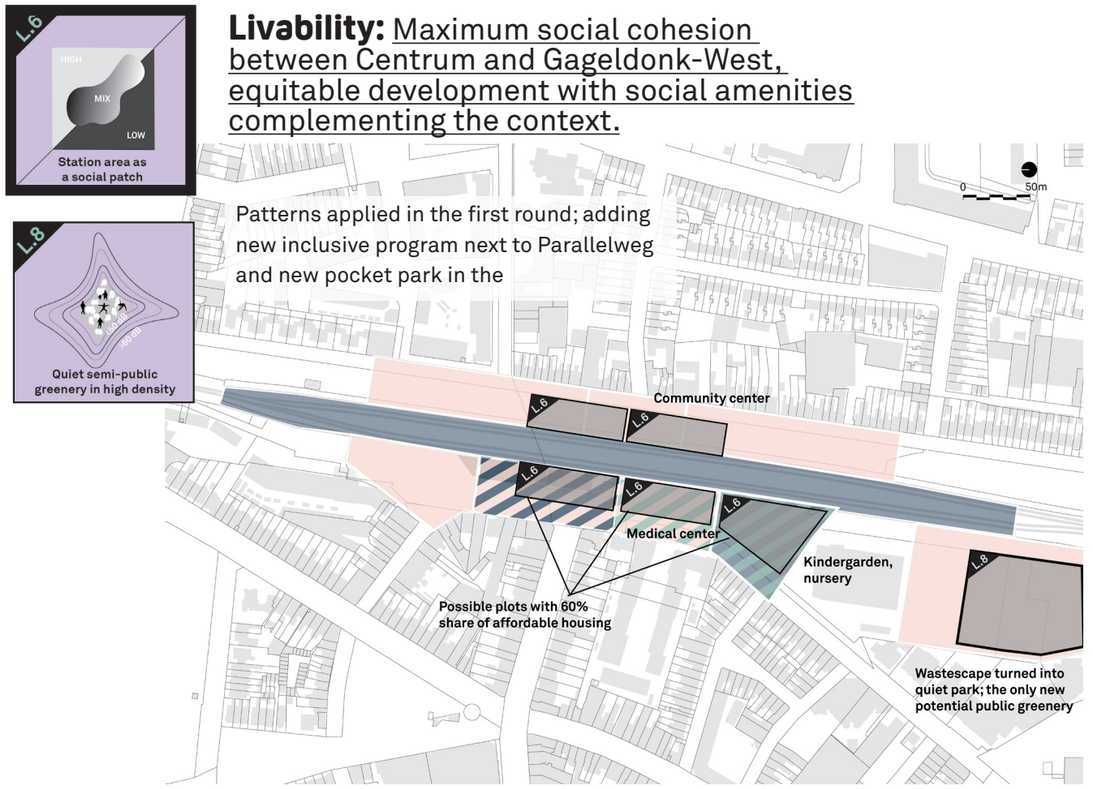


Node: New adaptable train station bridging two neighborhoods and minimizing distances between modes of transport.

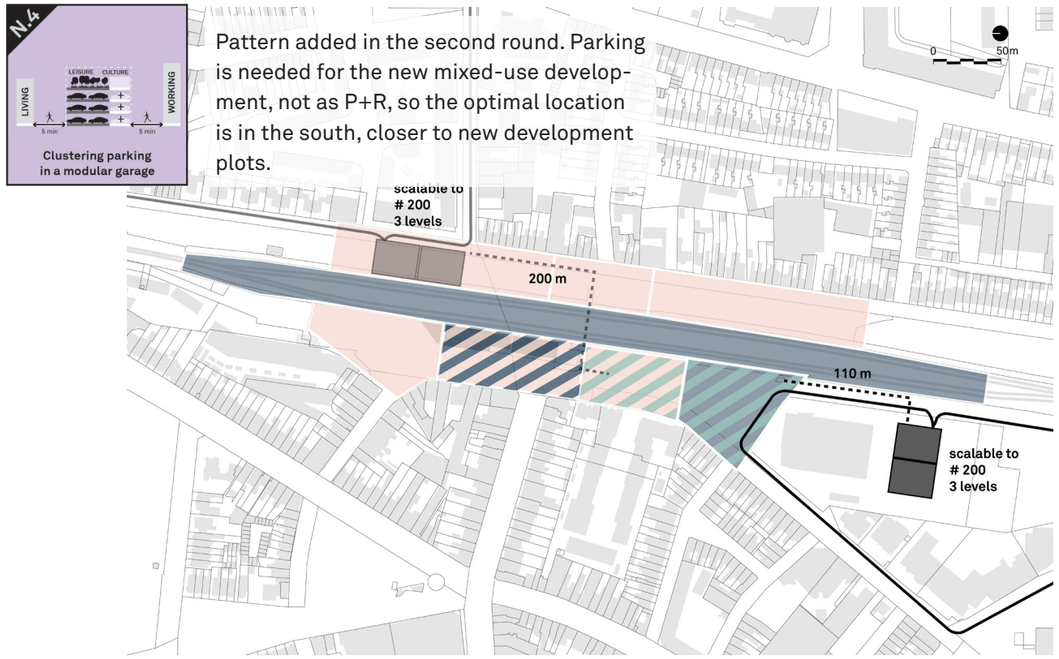


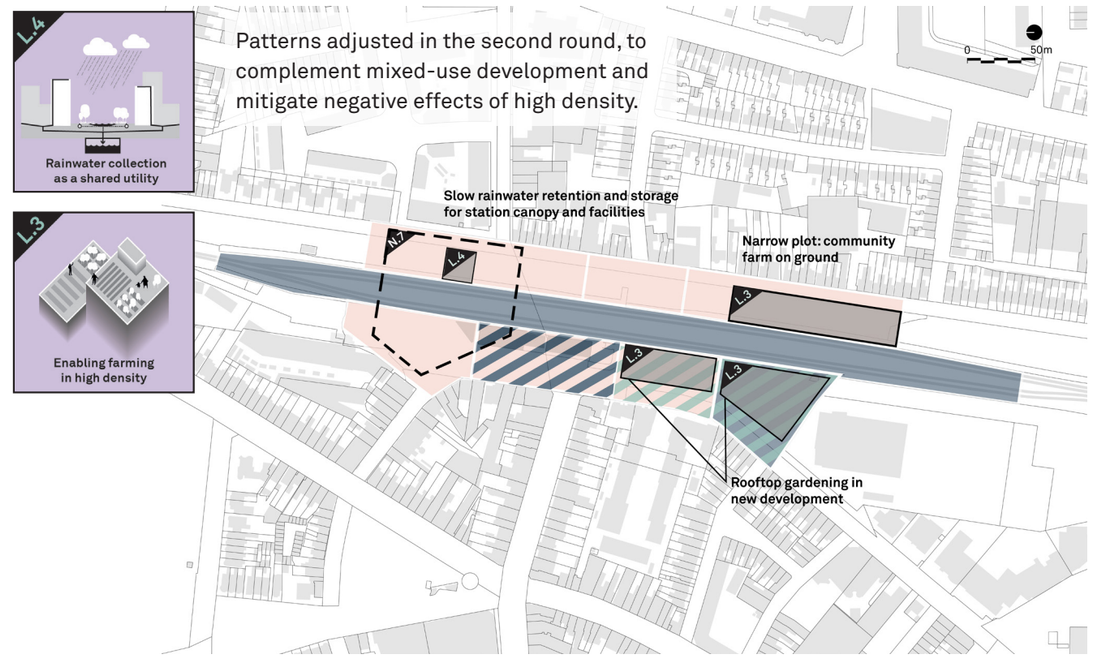




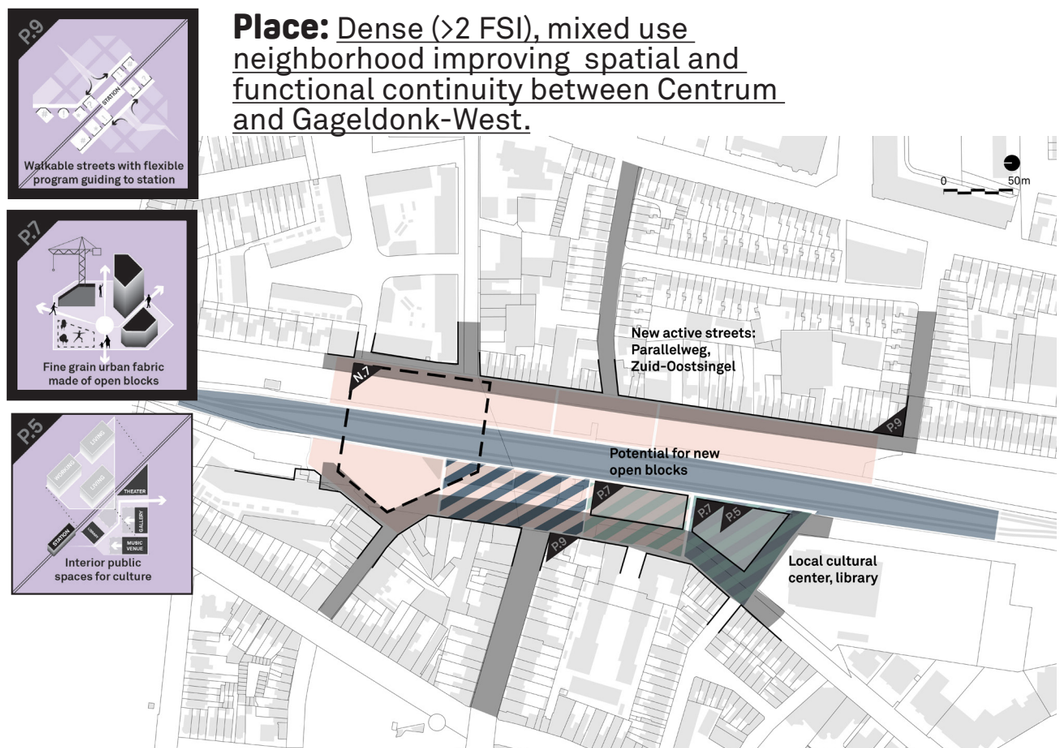


Livability: Maximum social cohesion between Centrum and Gageldonk-West, equitable development with social amenities complementing the context.

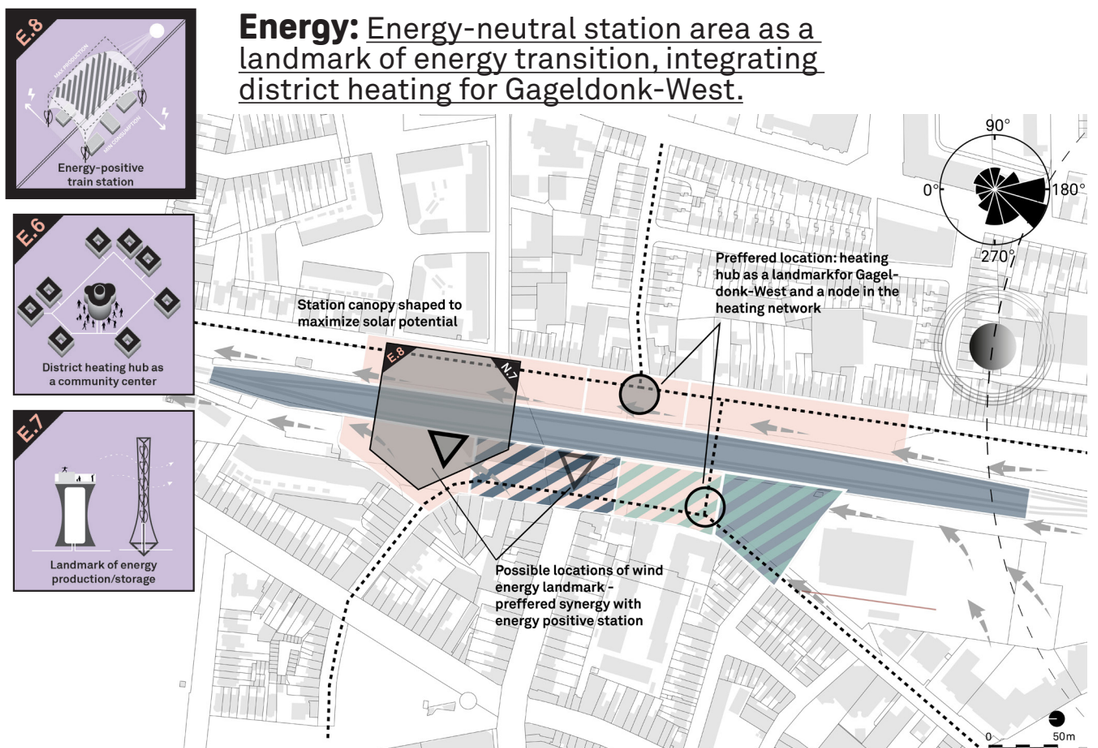


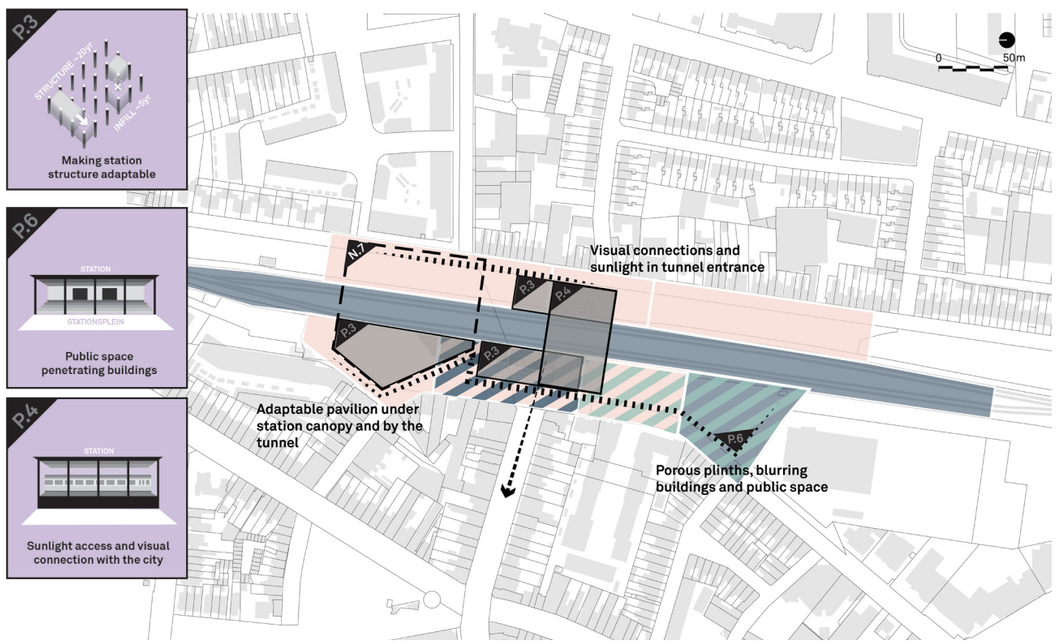


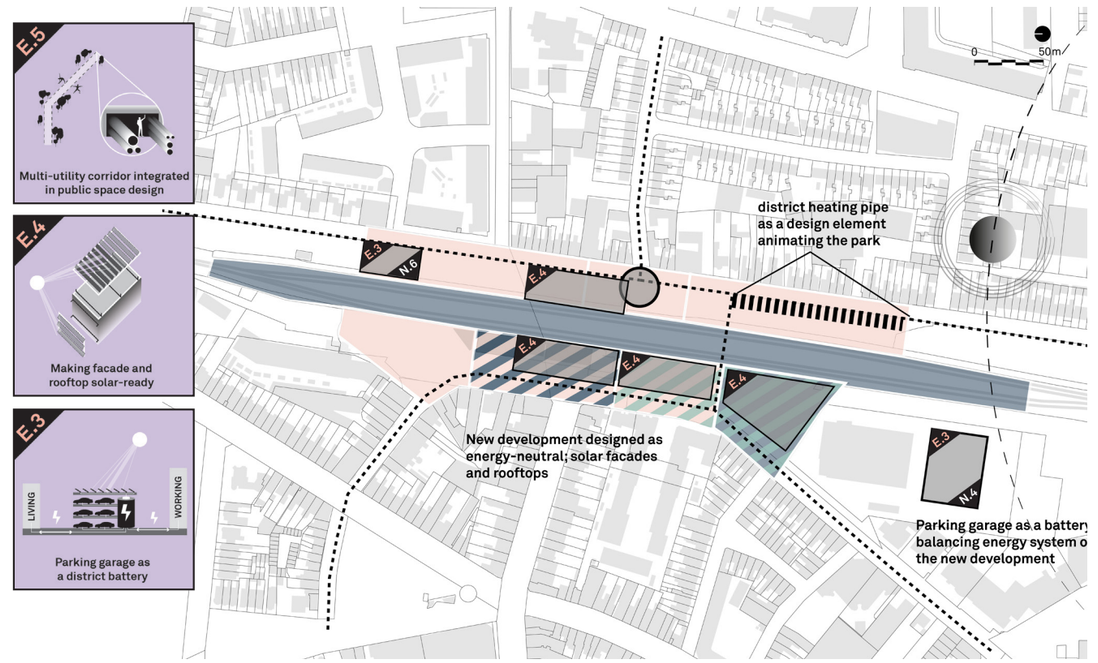
Place: Dense (>2 FSI), mixed use neighborhood improving spatial and functional continuity between Centrum and Gageldonk-West.



Energy: Energy-neutral station area as a landmark of energy transition, integrating district heating for Gageldonk-West.

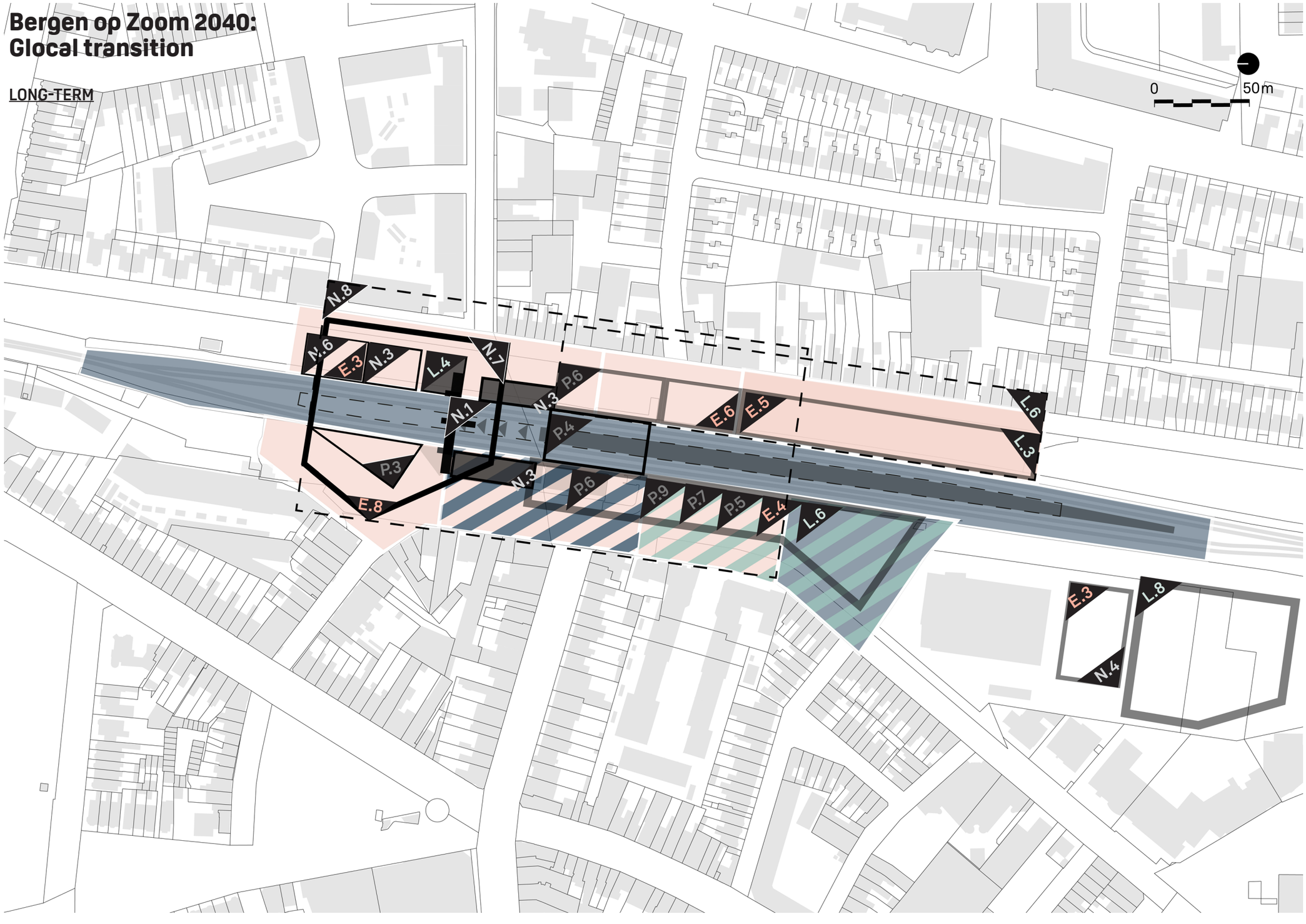






Bergen op Zoom 2040: Glocal transition

LONG-TERM

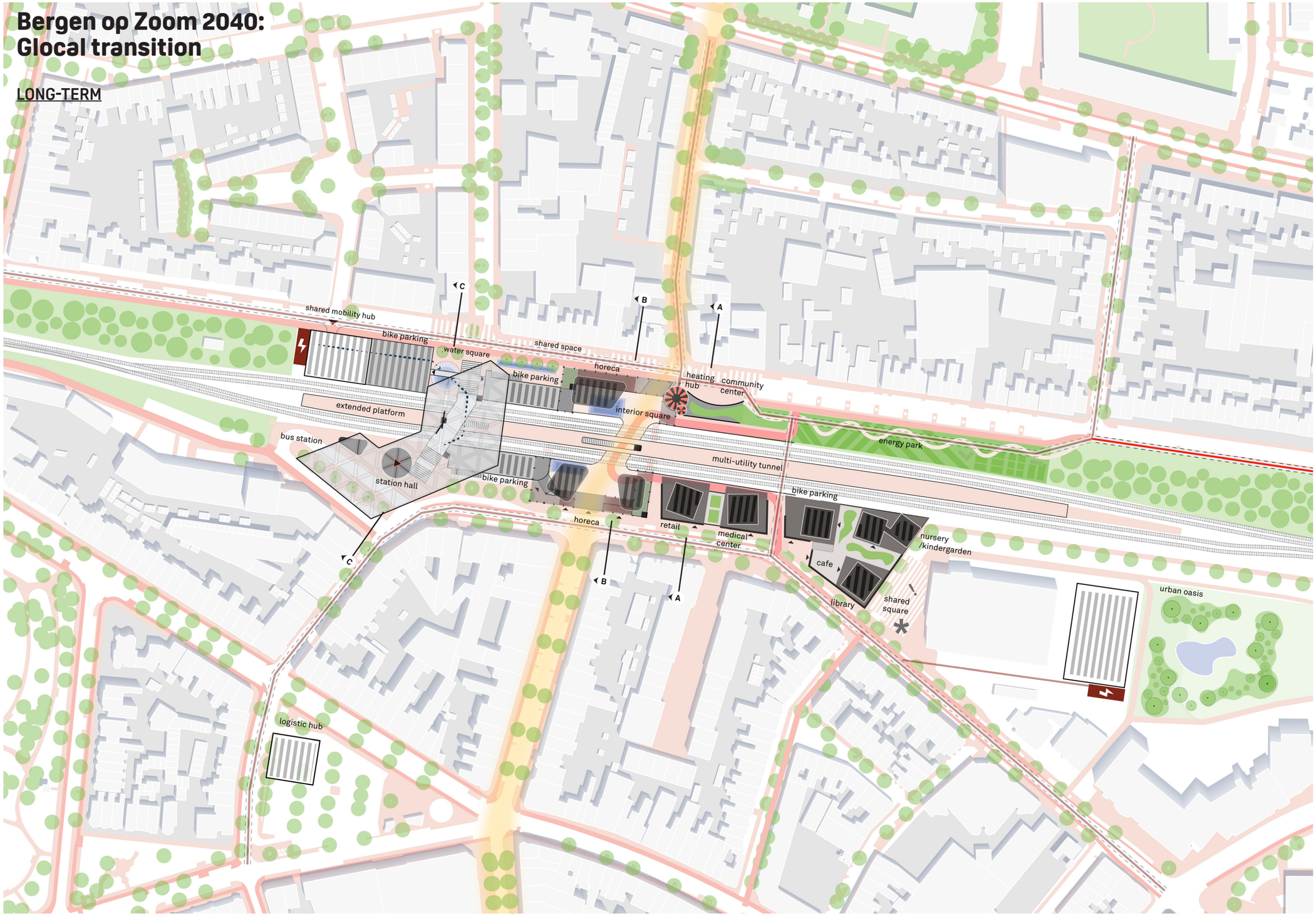


Bergen op Zoom 2040:
Glocal transition

LONG-TERM

Site plan
1:2000

0 50m



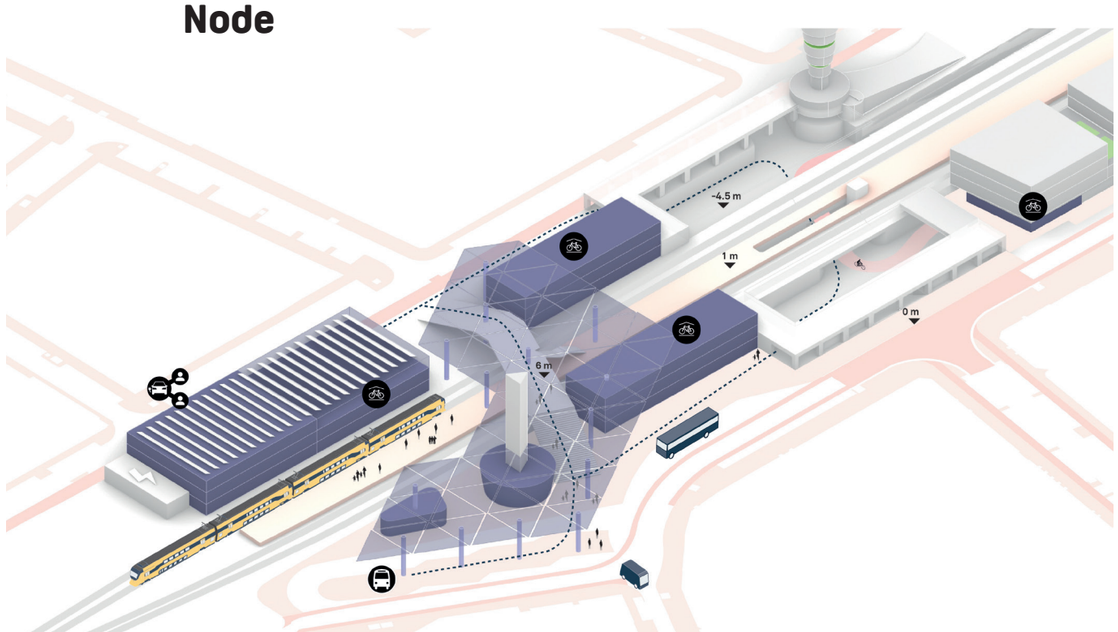
Bergen op Zoom 2040: Glocal transition

LONG-TERM

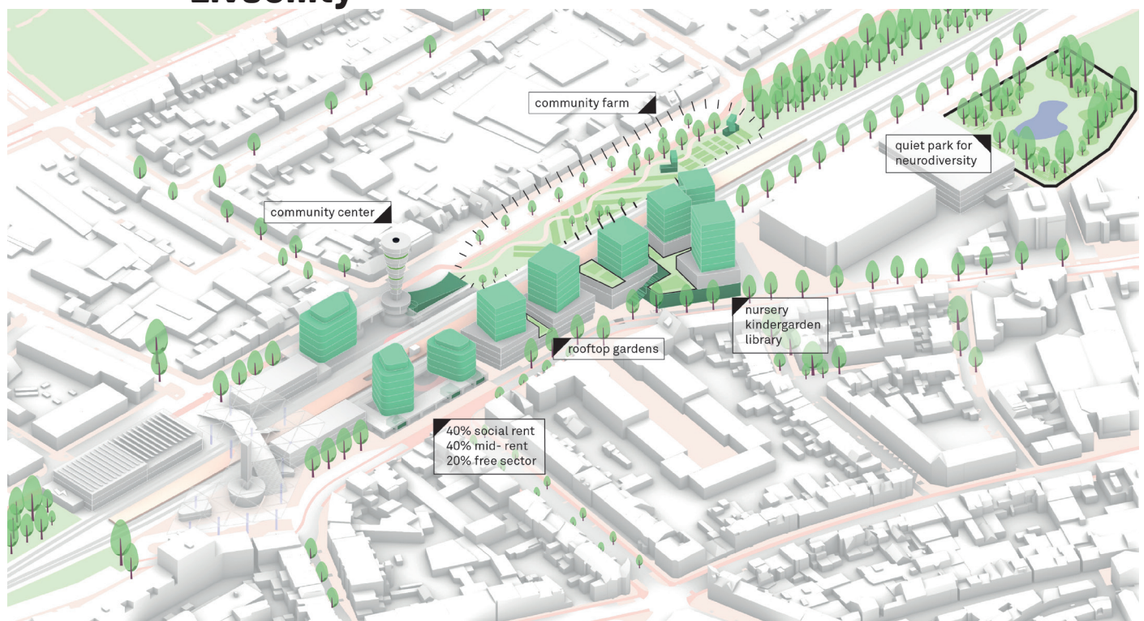


Bergen op Zoom 2040: Glocal transition

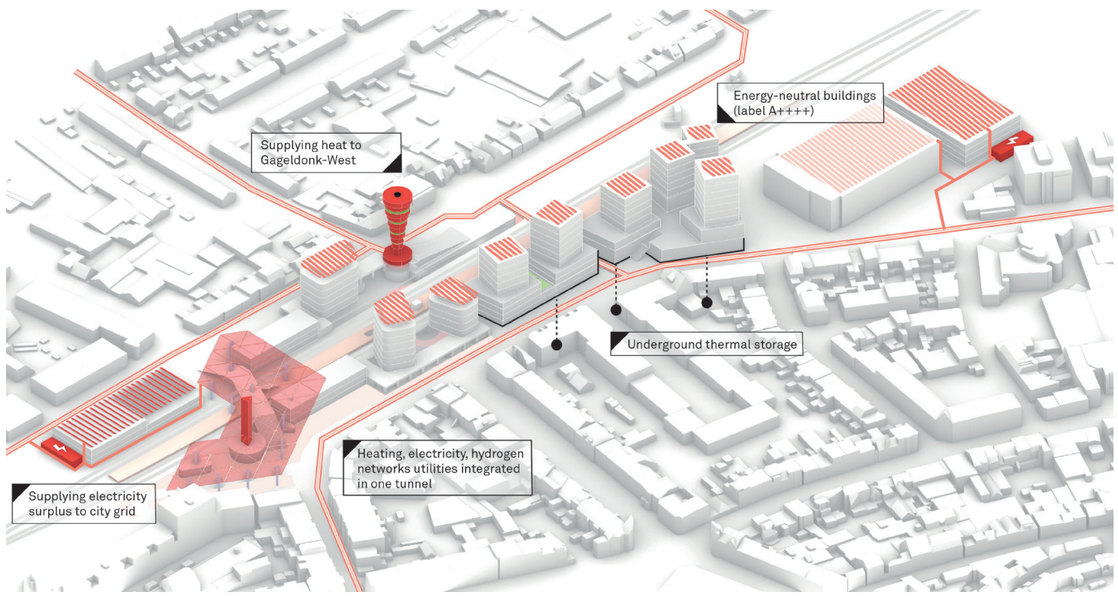
Node



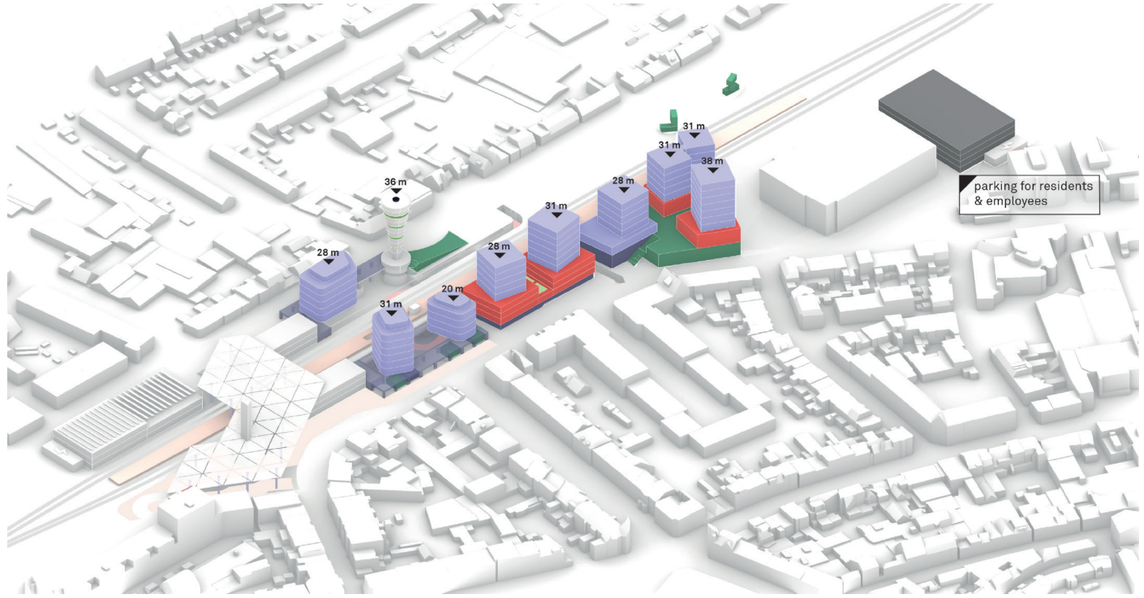
Livability



Energy



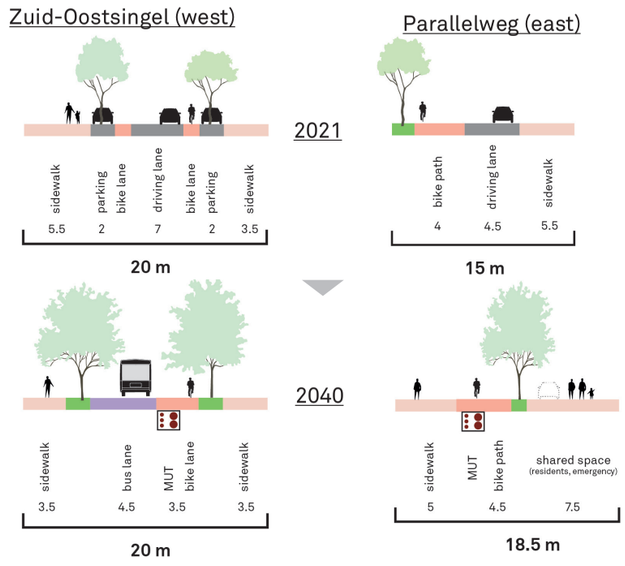
Place

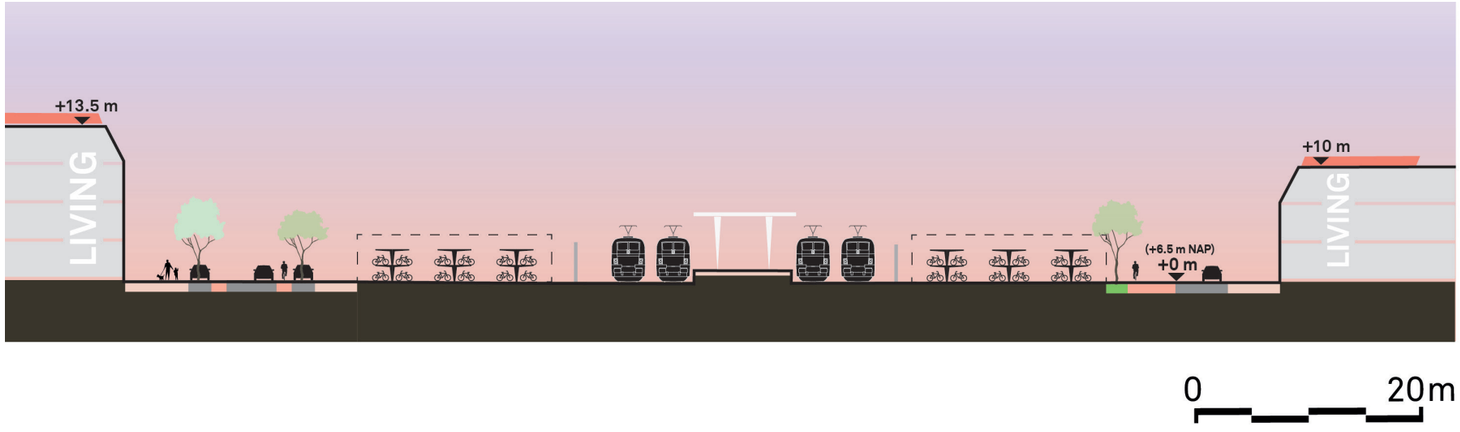


Bergen op Zoom 2040: Glocal transition

LONG-TERM

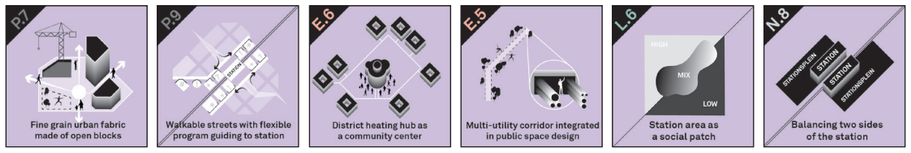
Section AA
2021

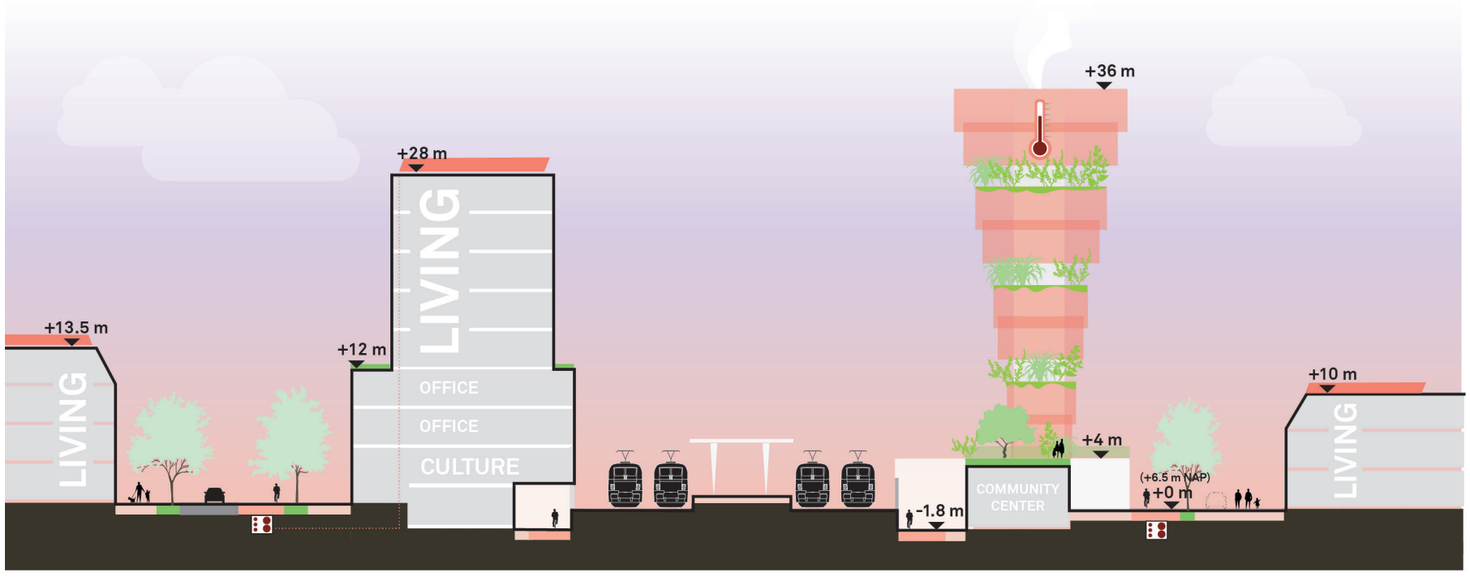




Section AA
2040

Visible patterns:





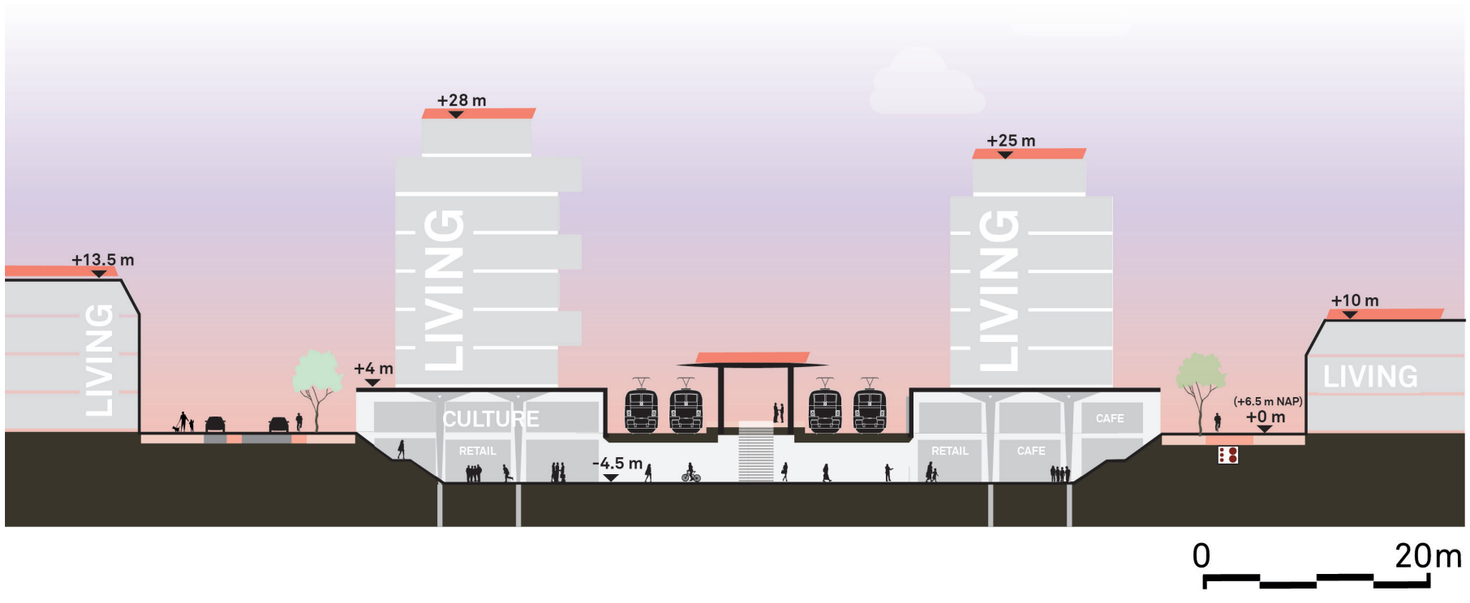
Bergen op Zoom 2040: Glocal transition

LONG-TERM

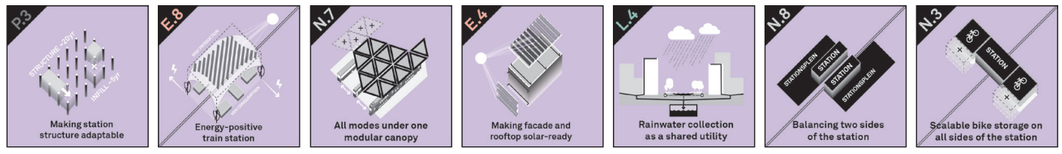
Section BB
2040

Visible patterns:

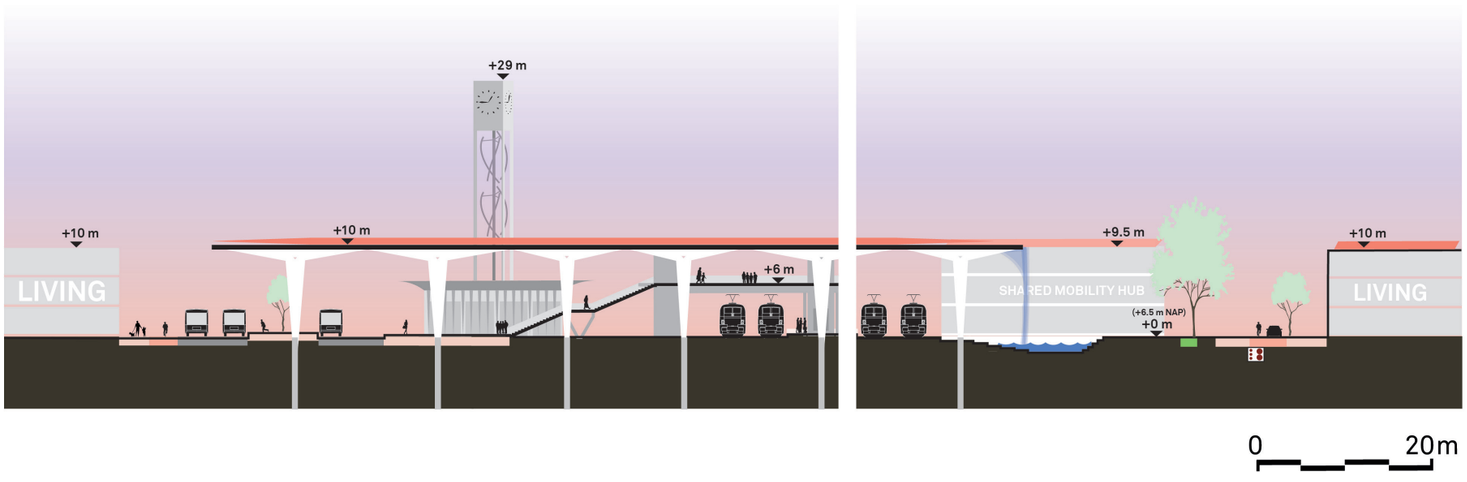




Visible patterns:



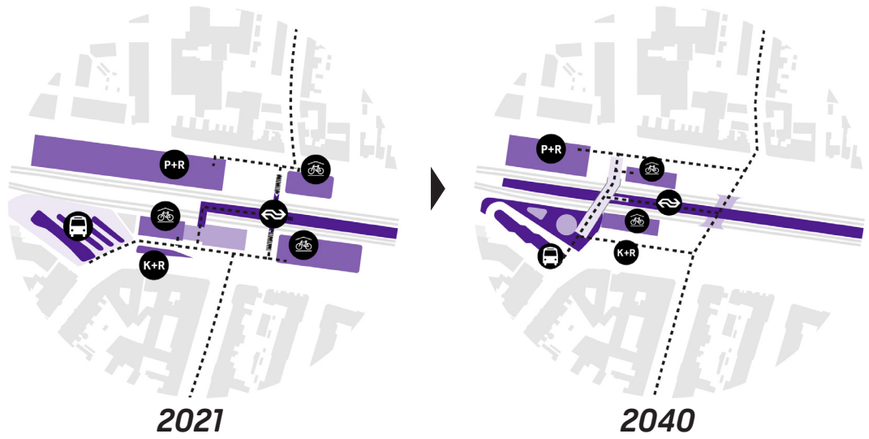
Section CC
2040



Bergen op Zoom 2040: Glocal transition

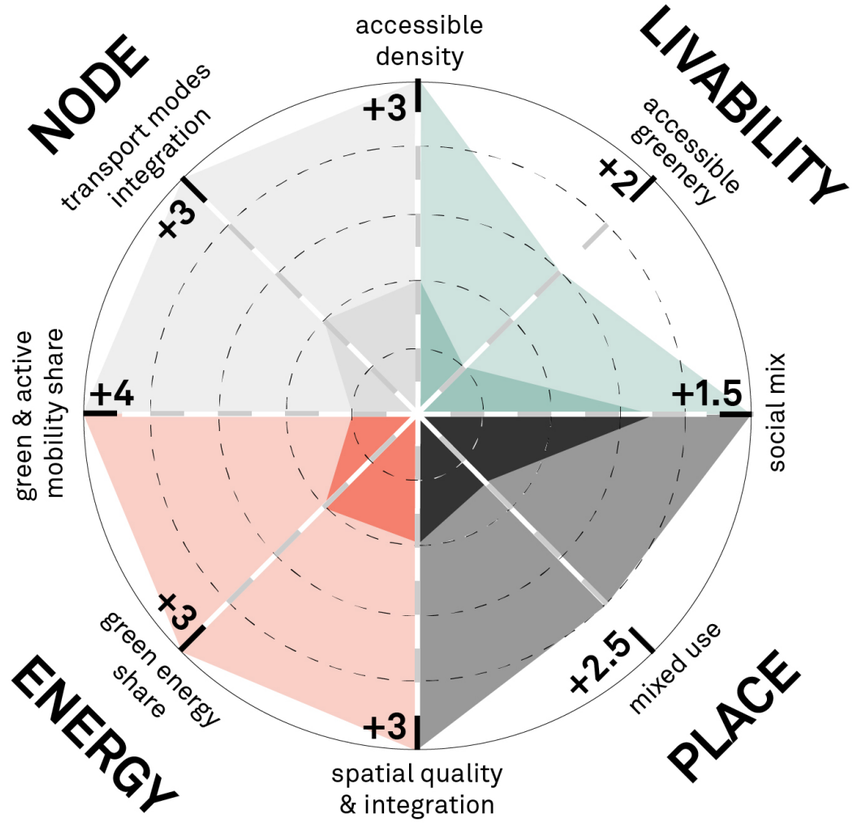
LONG-TERM

r=150m



Node	Desired modal split	41% bike / 35% walking / 22% OV / 2% shared car
	Distance for change OV/train	35 m bus-train
	Estimated daily ridership	12 000
Livability	Green areas	0.90 ha (rooftop) 1.36 ha (ground)
	Number of new residents	474 (158 homes)
	Green areas per capita [1]	22.79 m² (9m² min.; 50m² recommended by WHO)
Place	Number of new employees	475 (4.758 m² of coworking)
	FSI	2.44 (only built-up plots, including public spaces)
	Mixed use	59% living / 22% working / 8% social / 11% retail
Energy	Estimated energy demand [2]	1.07 GWh/yr
	Solar potential [3]	10.77 GWh/yr station; 1.98 GWh/yr buildings
	Potential surplus	11.68 GWh/yr

[1] Rooftop greenery is counted as 50% of ground.
[2] Assuming that all new buildings have A+++ energy label and energy consumption is 50 kWh / m2
[3] Assuming 1276 kWh/yr/m2 based on globalsolaratlas.info



Scenario scores particularly good as energy node. Good results are partly an effect of the decision to split the connector between two user flows:
1/ The northern footbridge providing direct connections from bus station to platforms and parking facilities under one canopy.
2/ The southern tunnel extending the stationstraat, adding retail and adaptable program, and allowing bicycle connection east-west.
Large canopy of the station is a major contribution to the solar energy potential.
As estimates show, the station area may substantially contribute to the urban energy system.

However there was an attempt to introduce a new park, it may be too isolated to be a successful place for the station area, but due to no alternative it still may attract new residents and employees. Still, scenario has the lowest score in livability due to low share of accessible greenery within the whole station area.

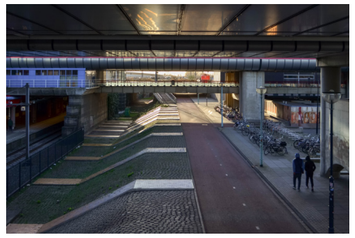
Proposed massing is a demonstration of densification adjusted to conditions of a small city. Such redesigned station will allow to increase the role of railway, busses and active mobility, but foremost fill the niche in functional and urban structure of Bergen op Zoom, in its very core.

Amsterdam Sloterdijk

Fieldwork











Fieldwork route and points of interest. Source: own work, Google Earth









Perception of users, on-site interviews and reviews in the Internet:

Good connection to the city centre, but difficult to get to on foot as you walk from the neighbourhood. You don't always understand where to go

Freezing and no place to sit down if you have to wait for a bus.

Flixbus passengers have to wait on the cold street. It is a terminal that has a lot of movement but it would have to have more facilities for those who travel like the central station of Amsterdam. There is little signage on how to get to the bus stops.

Most cluttered station that exists you have to check out to get on a different platform ridiculous layout you know something badly designed if you need additional instructions to use it.

It's a station I try to avoid as much as possible, you can get crazy from all these fences and barriers. Elevators are in awkward places, very bad for the disabled.

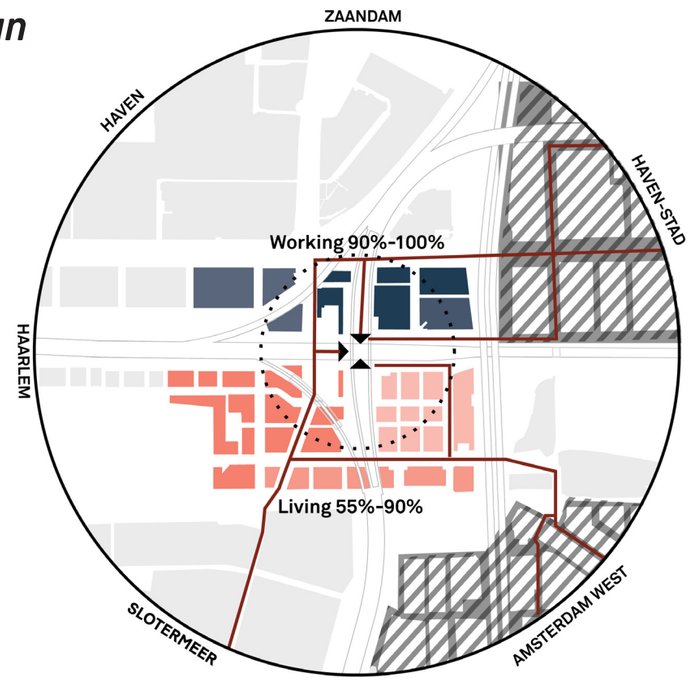
This station is very unclear and some traces are hard to find. Here is clearly a need for a better route indication. I also travel a lot internationally but I have not found the right track anywhere so difficult.

Terribly cluttered station and you often have to check out before you have to go to another track, which costs extra. I avoid this station if possible.

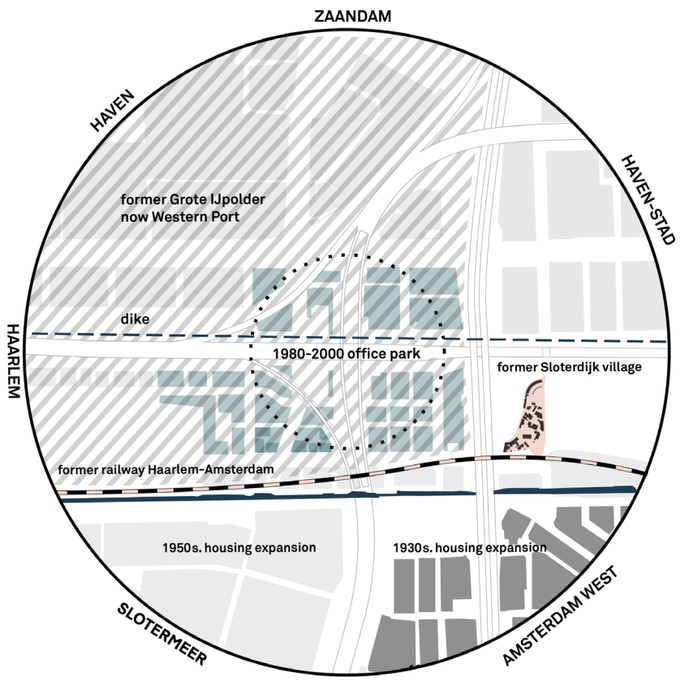
Amsterdam Sloterdijk

Context scan

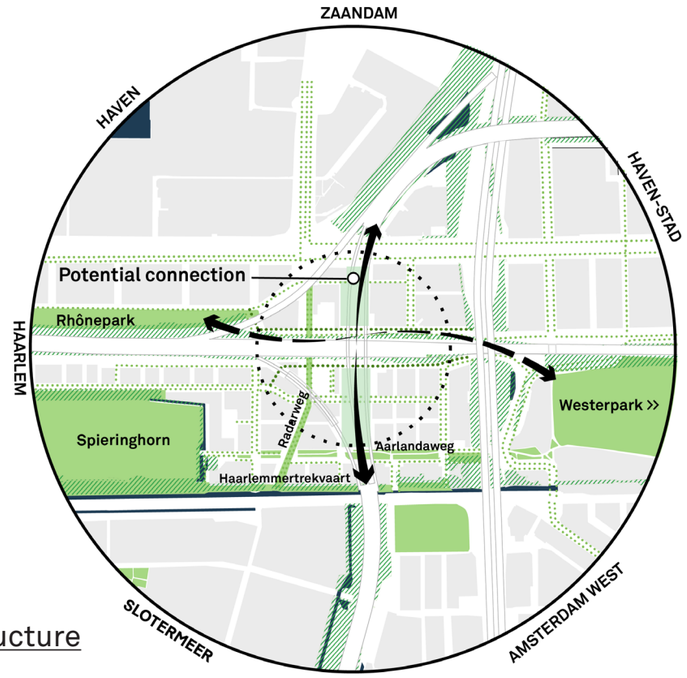
MACRO SCALE
R=1000 m



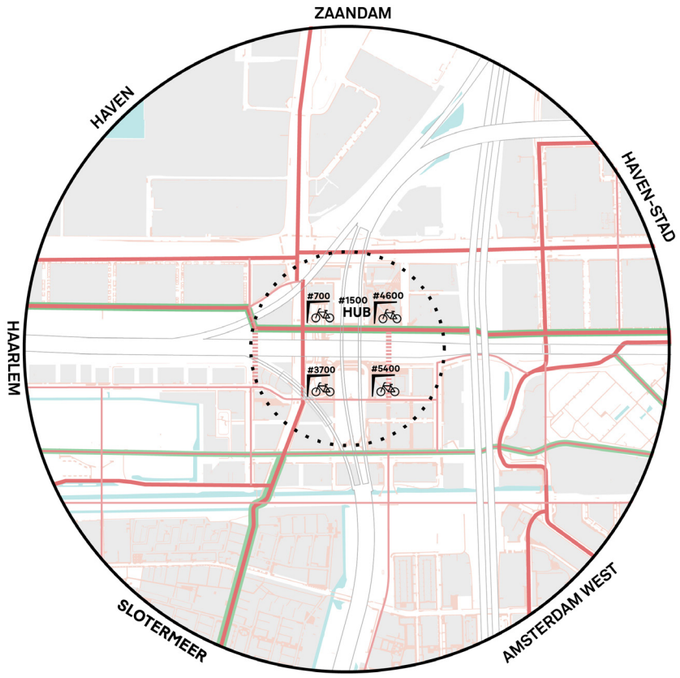
Train station as a bridge



History



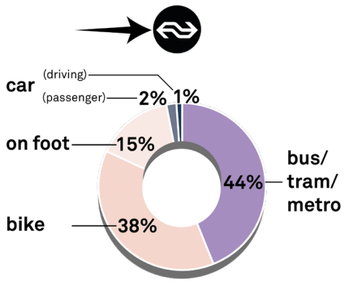
Blue-green structure

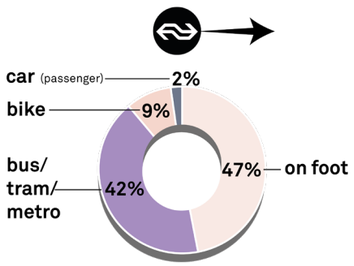


Active mobility and plinths

Amsterdam Sloterdijk

Bridging the node



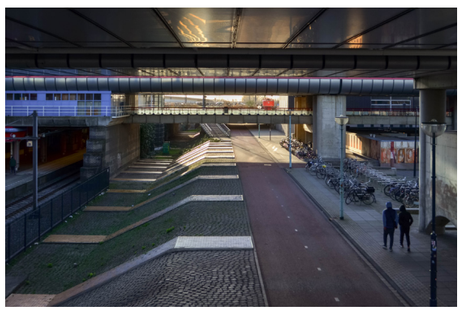


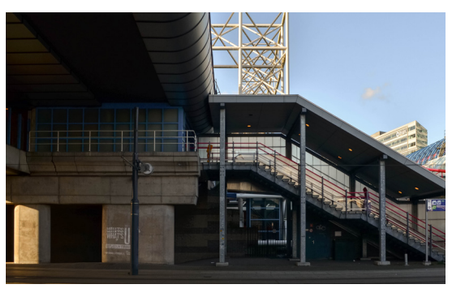
Modal split for arrivals and departures from the station, 2019. Source: https://dashboards.nsjaarverslag.nl/reizigersgedrag/

In this part potential changes in the connector will be decided. Selected layout will be a canvas for applying patterns in the next step. Patterns will shape the desired quality and program.

Car infrastructure covers large part of the node, while it has marginal share in the modal split. Distances between modalities needs to be shorten and stops rearranged as they are spread on all sides of the station.



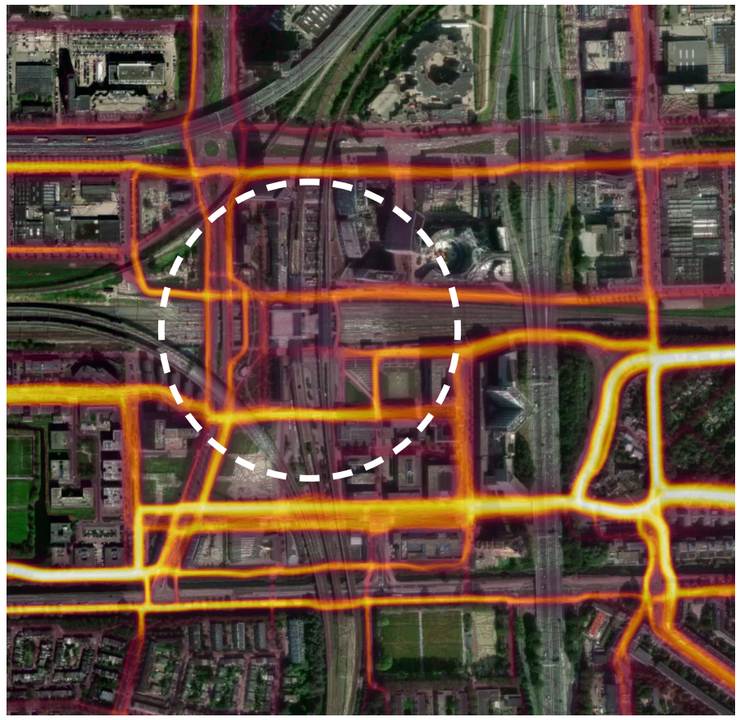






Pictures from the site visit
Source: author.

Activities heatmap

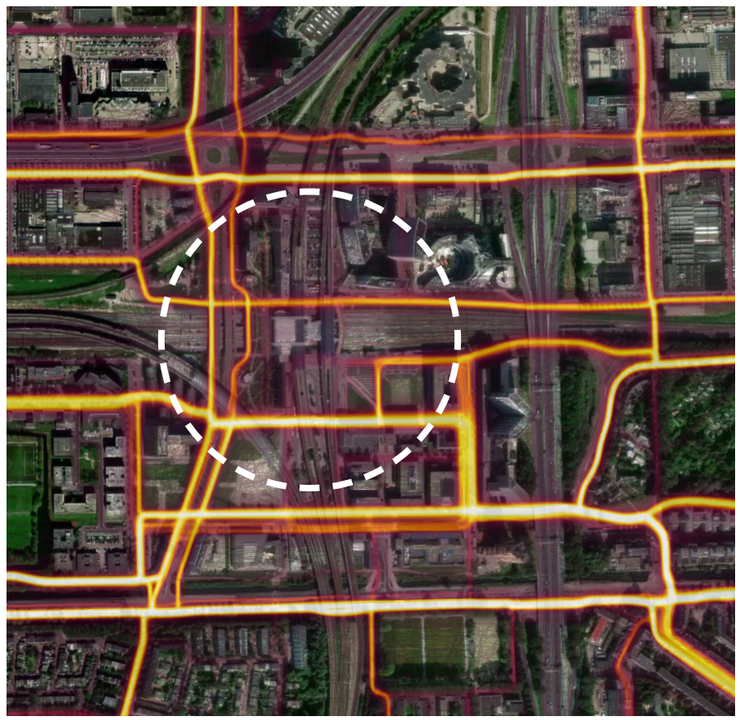


Running

Due to poor spatial quality and unclear layout, the station is avoided.

Cycling

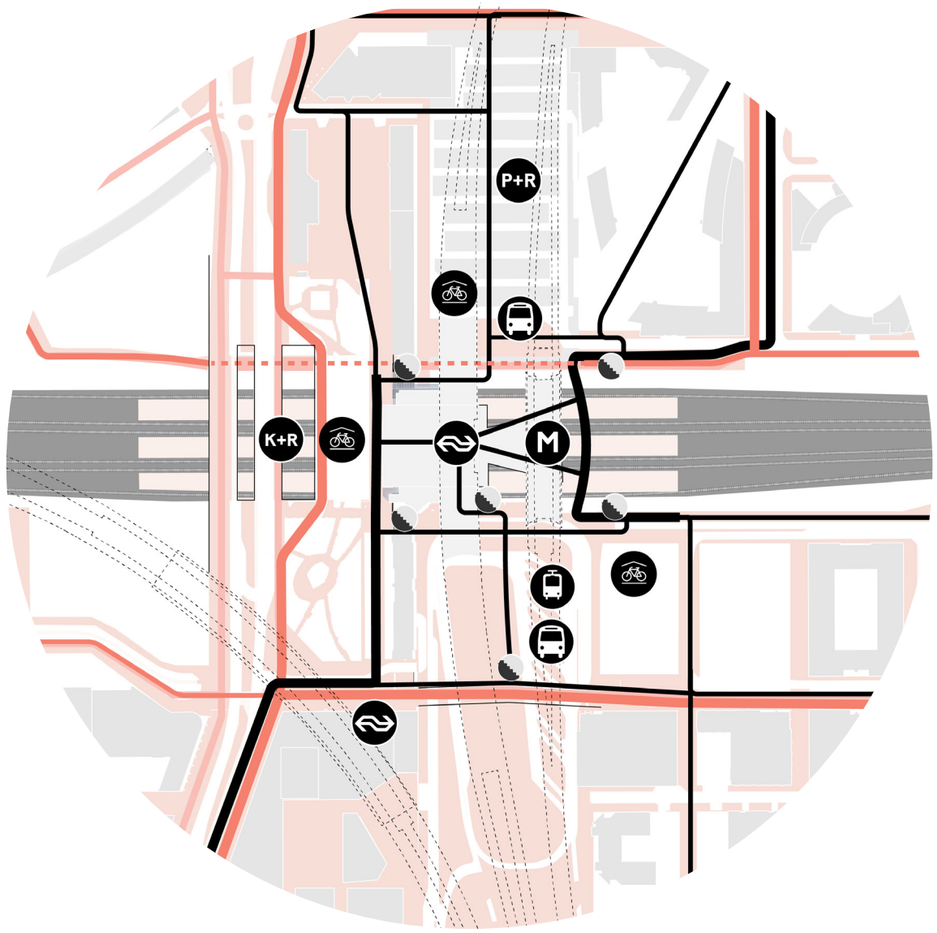
Poor connections north-south, pasarelle acts as a barrier, alternative to crowded route east-west needed



Strava activities heatmap.
Source: strava.com

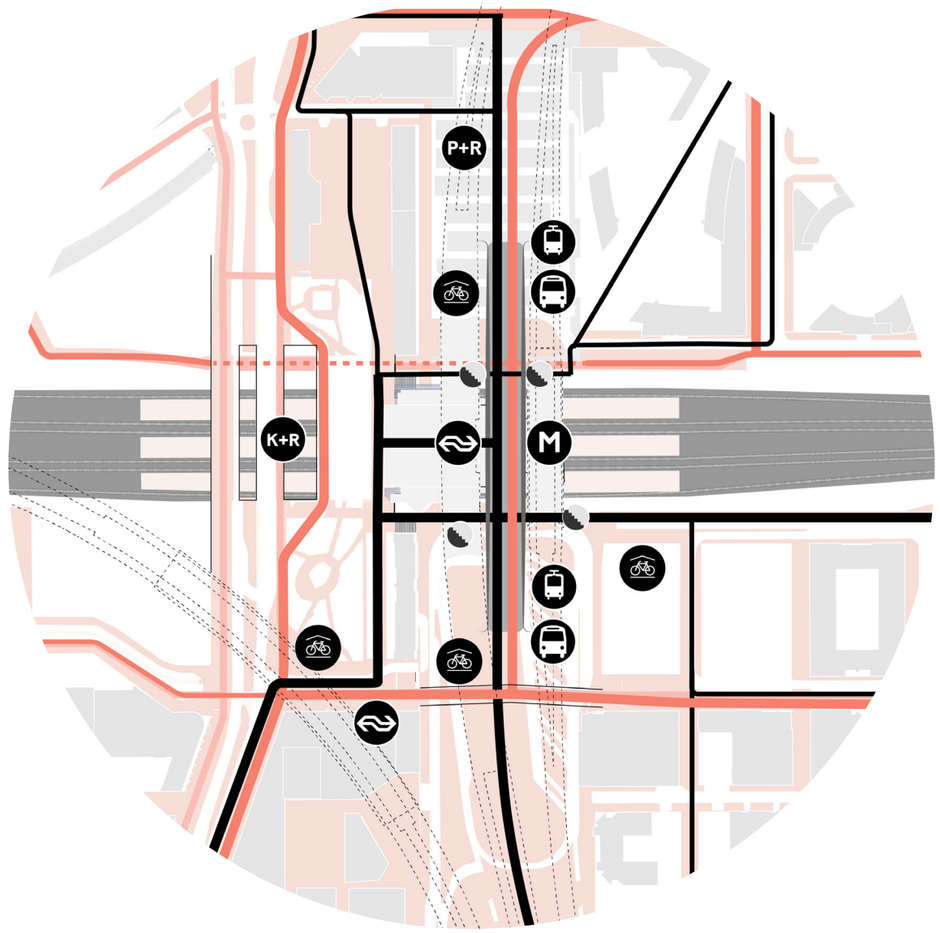
Amsterdam Sloterdijk

Bridging the node



Existing

The node is confusing mainly due to lack of clear connection north-south. Existing pasarelle is oriented towards dead streets instead of bus or tram stops and lengthens the walking distance within the node.

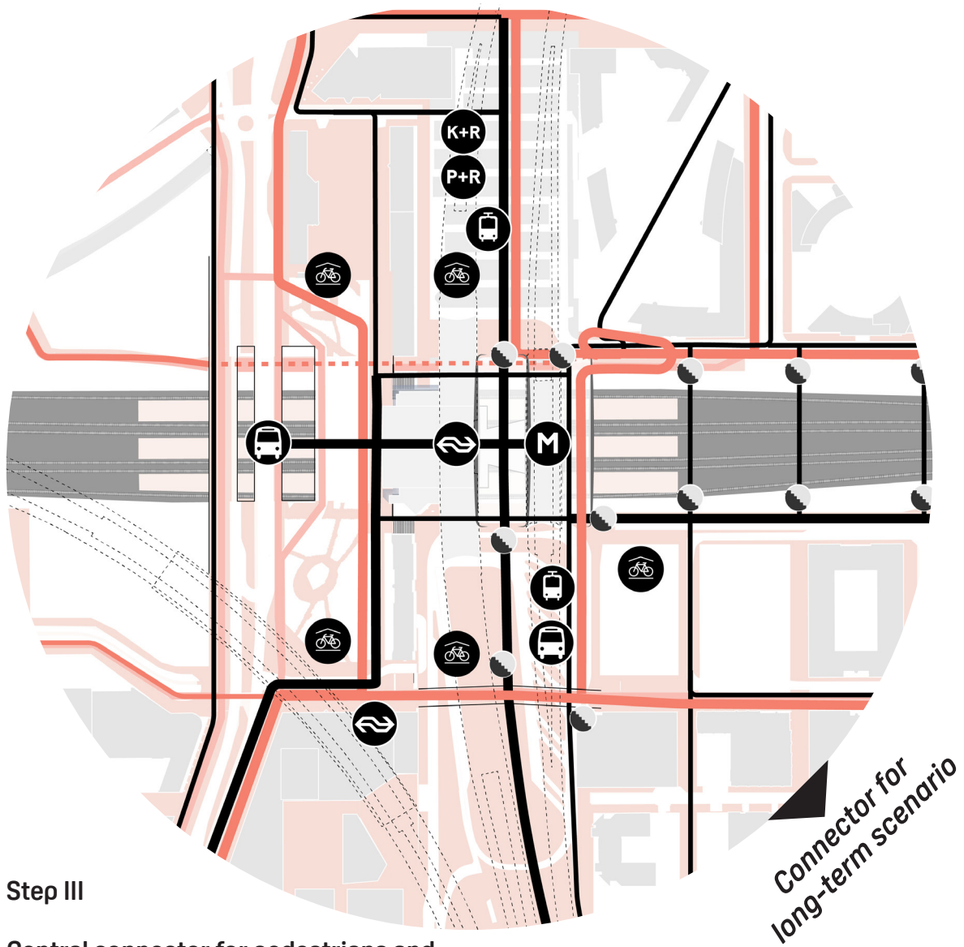


Step I

Sloping connector in between of two viaducts. However this solution may seem optimal, a busy cycling route will be fragmenting the node; it should be located outside of the center. It also requires construction of a large ramp, acting as an obstacle. The central strip is also a reserve for the potential third viaduct (high-speed trains).

Amsterdam Sloterdijk

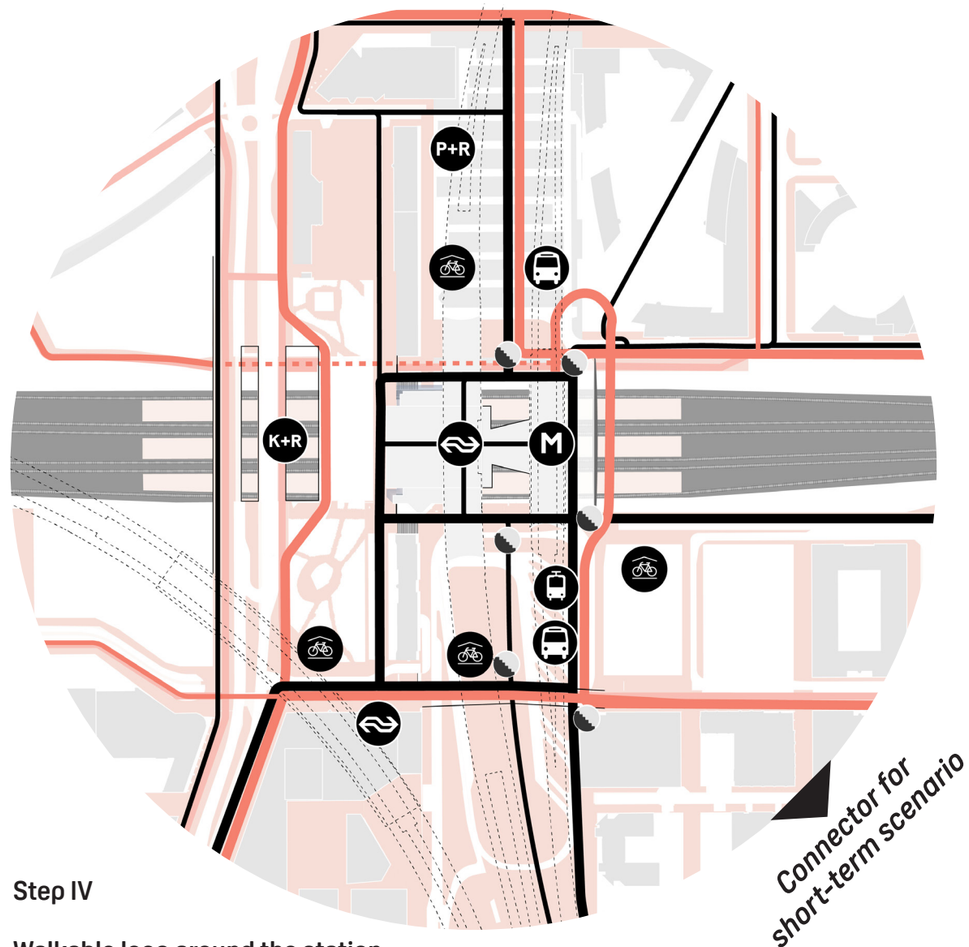
Bridging the node



Step III

Central connector for pedestrians and cycling bridge as “omloop”.

The connector and boulevards between viaducts are dedicated to pedestrians, while bike bridge avoids the station in the east. Ramp in the northern side can be integrated in new over track block, while in the south there is no need for it, existing bridge is already on a good level +6.2 m . This is a long-term solution requiring overhaul of pasarelle and central part of the station.



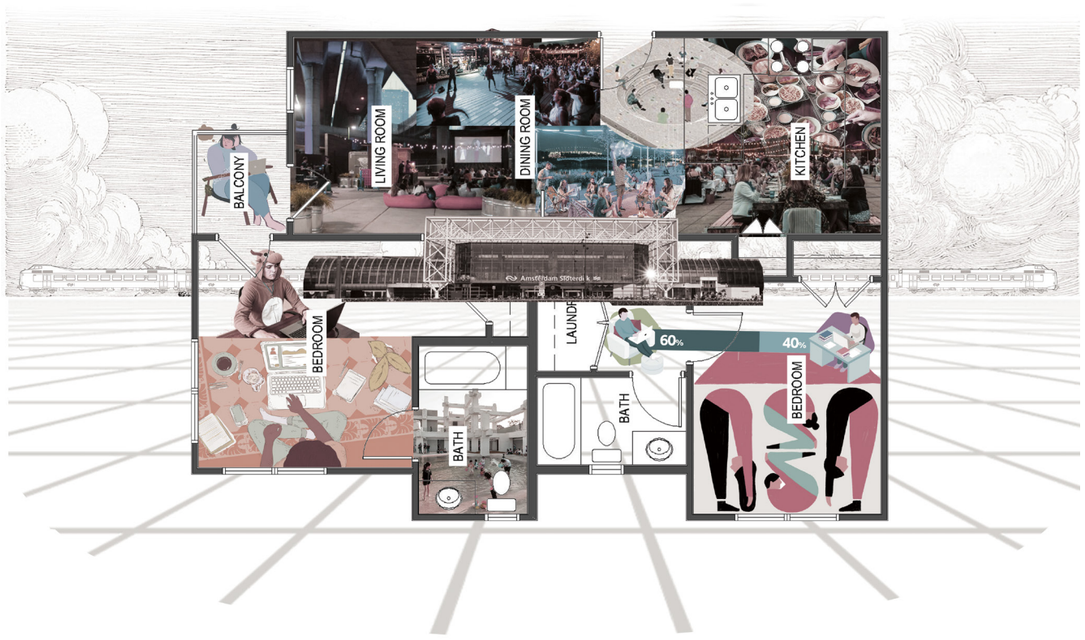
Step IV

Walkable loop around the station facilities, separate cycling bridge

Node can be simplified also in short-term, with minimal intervention in the existing station building. continuation on the level of Orlyplein +6.2 m, an elevated loop simplifying connections between modes of transport. Cycling bridge is separated, to avoid collision with passengers changing trains from lower to upper platforms. ramp is located in the space that could not be built up anyway.

6.3 ¦ Amsterdam Sloterdijk 2026: Home office hub

SHORT-TERM SCENARIO

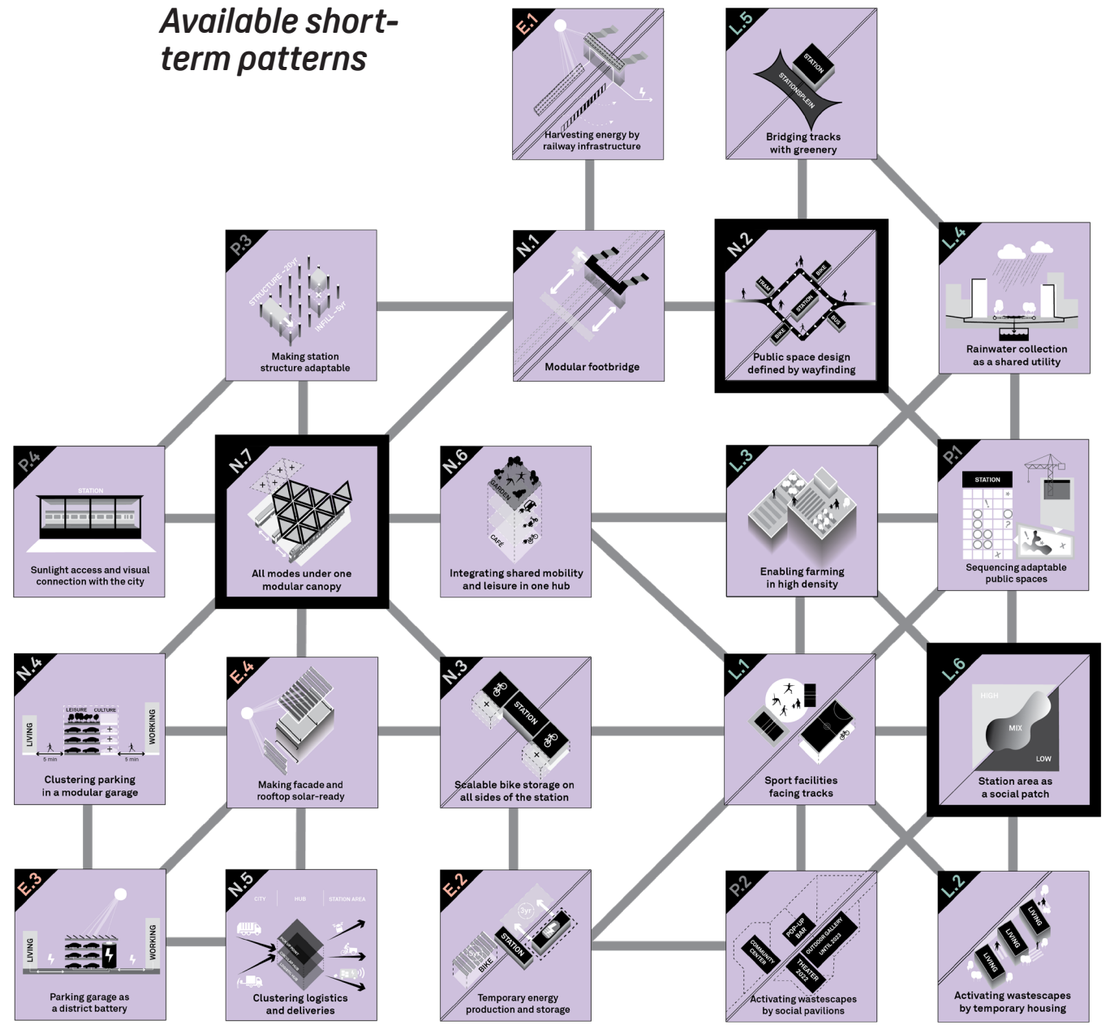


What if...

Since the end of the pandemic, working from home becomes widespread in Amsterdam. Few thousands of new residents of recently completed development is seeking social interaction next to their home office. Yet, Sloterdijk is still a dysfunctional and overpaved node.

Vacant officies from the 90s. are suddenly becoming hip - the new post-industrial. Creative community is looking for a new party place and flexible spaces. The last free plots in the area have development scheduled in 2-5 years, but municipality decides not to wait and use this window of opportunity to activate the station area.

This scenario attempts to explore if coliving and sharing can be a cure to densified station area, and how to introduce clarity to the overcomplicated node by temporary means. New train station should be an urban living room, in the middle of a calm home office.



Amsterdam Sloterdijk 2026: Home office hub

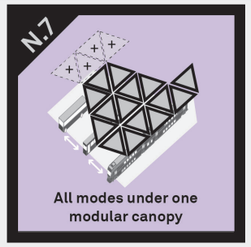
Pattern selection

Node

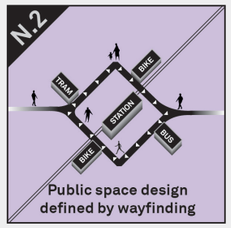
Problem Lack of clear connection north-south, and between the modalities. Fragmented, space consuming station facilities.

Potential Location of the station between Amsterdam-West and Haven-Stad. Optimization potential of Piarco- and Carascoplein (P+R, bus/tram station).

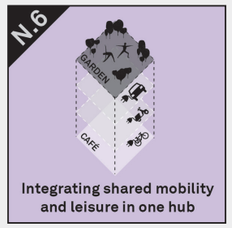
Goal Clear, intermodal connector on one level, embedded in walkable, car-free public spaces.



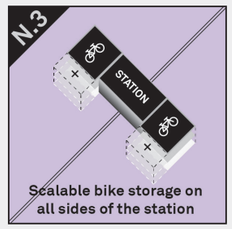
Better shelter is needed for two bus stations and tram stop, could be used also for the new footbridge N.1.



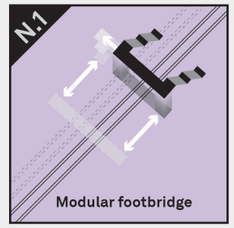
There is a need to create a clear connection of spatial quality between fragmented modes of transport.



It may replace P+R used only by 1% of passengers, free up space for L.1/P.1/P.2 and house community center.



Multi-level bike storage can free up space for other patterns and efficiently utilize space under viaducts.



Pattern allows to replace the existing footbridge which does not provide a clear connection north-south.

Livability

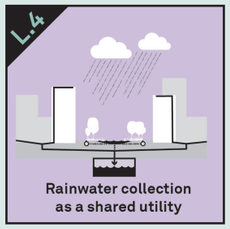
Problem Lack of social amenities, overpaved business district as a heat island.

Potential Underused infrastructure buffers offer large potential for leisure and biodiversity.

Goal Leisure hub with green and blue infrastructure complementing planned high-density development.



Sport facilities in home office hub should be accessible to new residents of all ages.



It is important to improve the microclimate and slow down water retention in overpaved node under the viaducts.



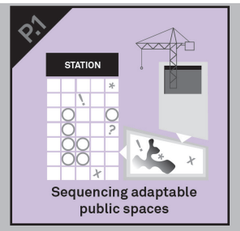
Pattern allows continuation and expansion of the existing Tuin van BRET.

Place

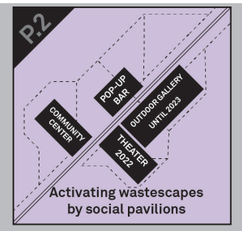
Problem Monofunctional business district without continuity of urban fabric and active streets between Haven-Stad and Amsterdam-West.

Potential Potential to become a local centrum connecting Haven-Stad and Amsterdam-West

Goal Empty plots with temporary program stimulating social interaction for new residents.



Pattern will be used to introduce social activities to station squares until long-term transformation.



Pattern can introduce demanded social program for home office hub: restaurants, pop-up stores, cultural venues.

Energy

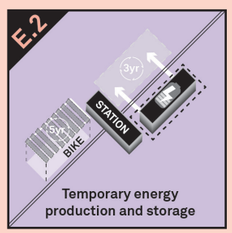
Problem No green energy generation, fragmented underground utilities restricting development.

Potential Strategic location of the station in the electricity grid, in proximity to the harbor. Potential for solar and wind energy (wind tunnel south-north).

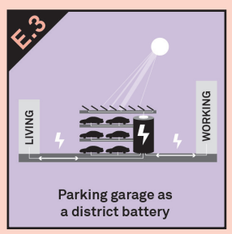
Goal Maximizing green energy harvest from buffer spaces and infrastructure.



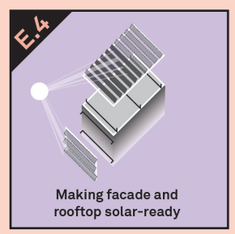
Fenced railway area and platforms in Sloterdijk have potential for solar energy generation due to their width and south orientation.



Temporary program should be energy-neutral. Solar canopies and mobile batteries can synergize with P.1, P.2.

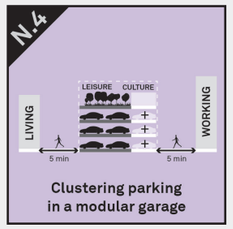


Shared mobility hub can serve as a battery for the whole station, supplying it with electricity at night.

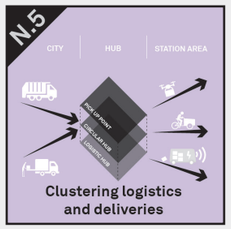


Pattern allows Hemboog and existing station hall to reduce their energy demand by PV panels.

Rejected short-term patterns:



Planned densification solves parking within each plot. P+R is used only by 1% of passengers, shared mobility is more relevant.



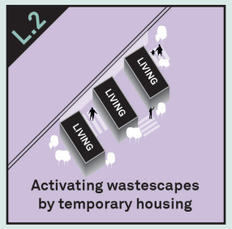
In the short term there is not enough program planned or active streets to make this pattern relevant.



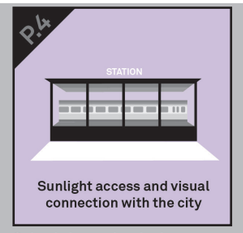
Scenario does not aim to change the social mix, introduce housing or social amenities.



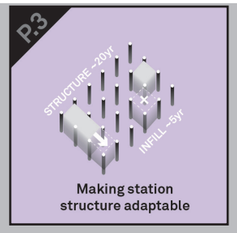
Orlyplein already realizes the pattern, another quality green connection would be a long term option.



Existing empty plots should rather mitigate the pressure of densification by leisure program than add new housing.

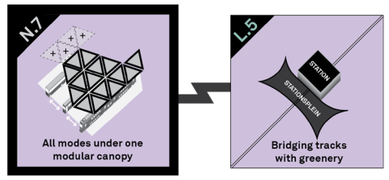


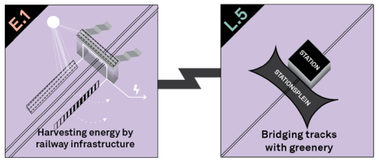
Orlyplein and existing station hall are blocking the sunlight access to lower platforms and cannot be changed in the short term.

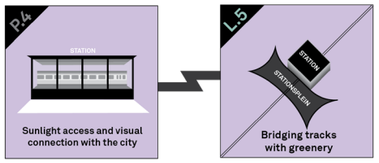


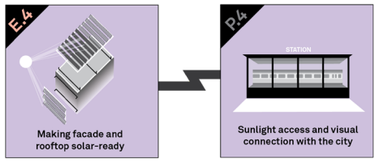
Major intervention in station structure would mean partial demolition, which scenario aims to avoid.

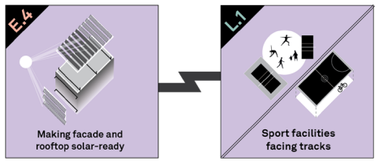
Tensions:

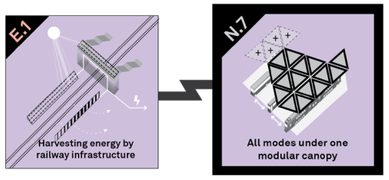




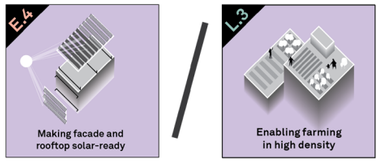


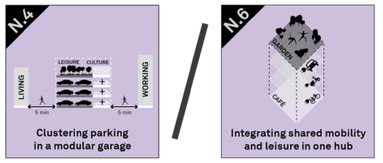


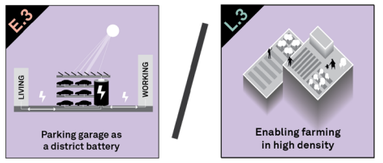


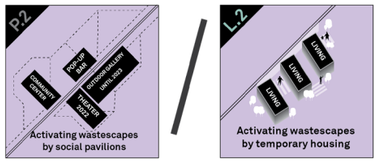


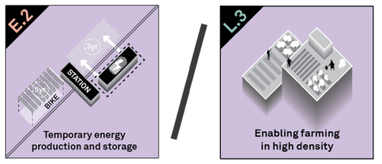
Mutually exclusive:

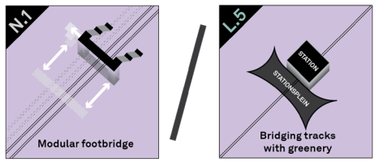






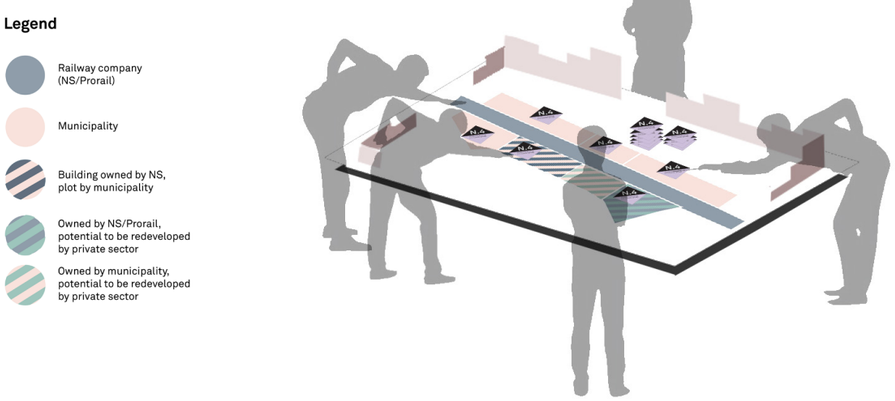


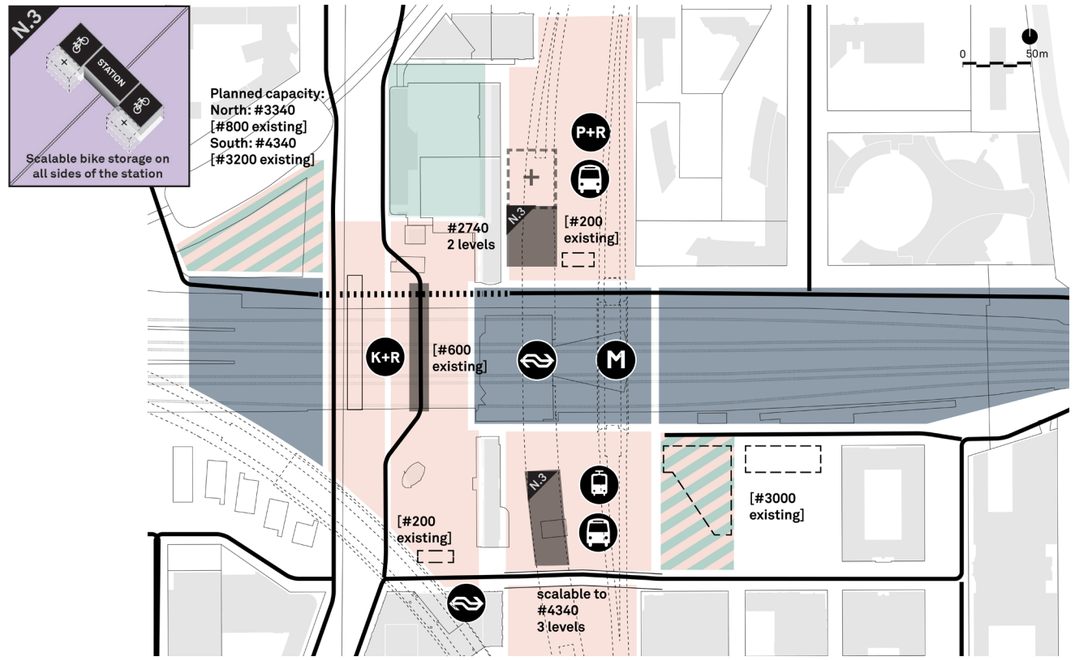




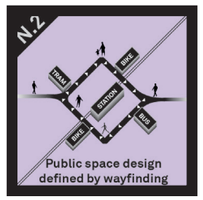
Amsterdam Sloterdijk 2026: Home office hub

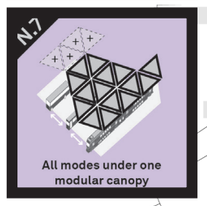
Applying patterns

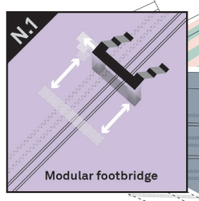


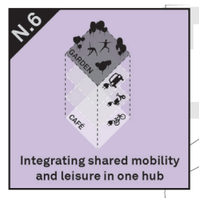


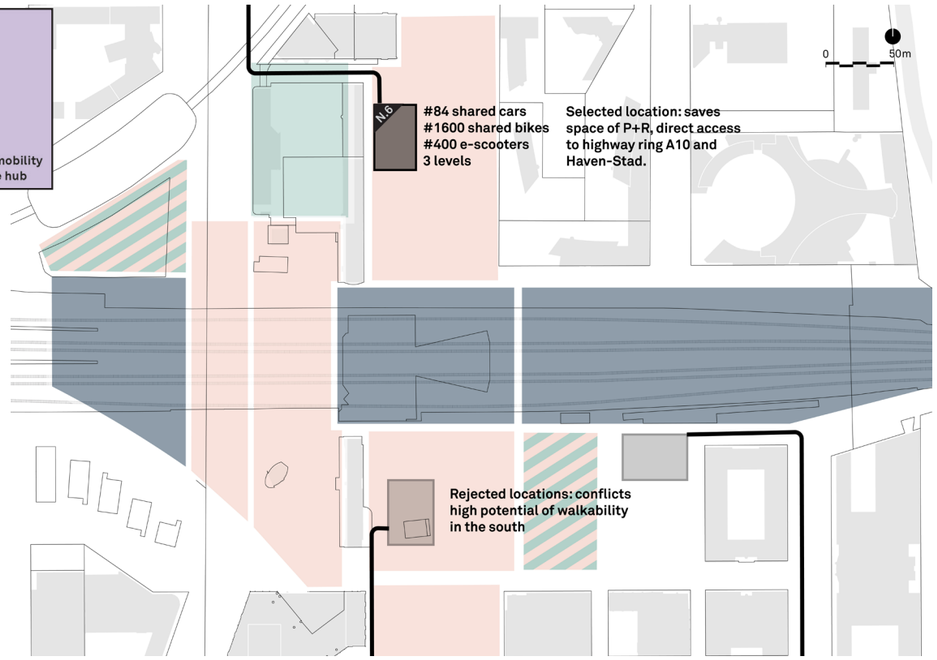
Node: Clear, intermodal connector on one level, embedded in walkable, car-free public spaces.



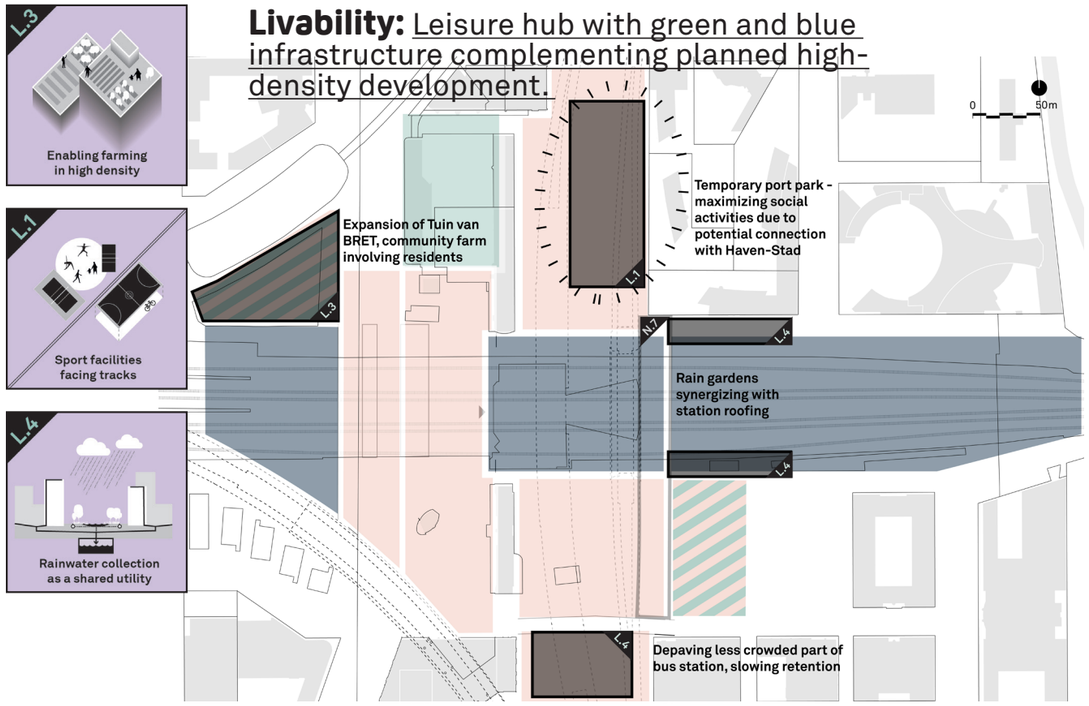




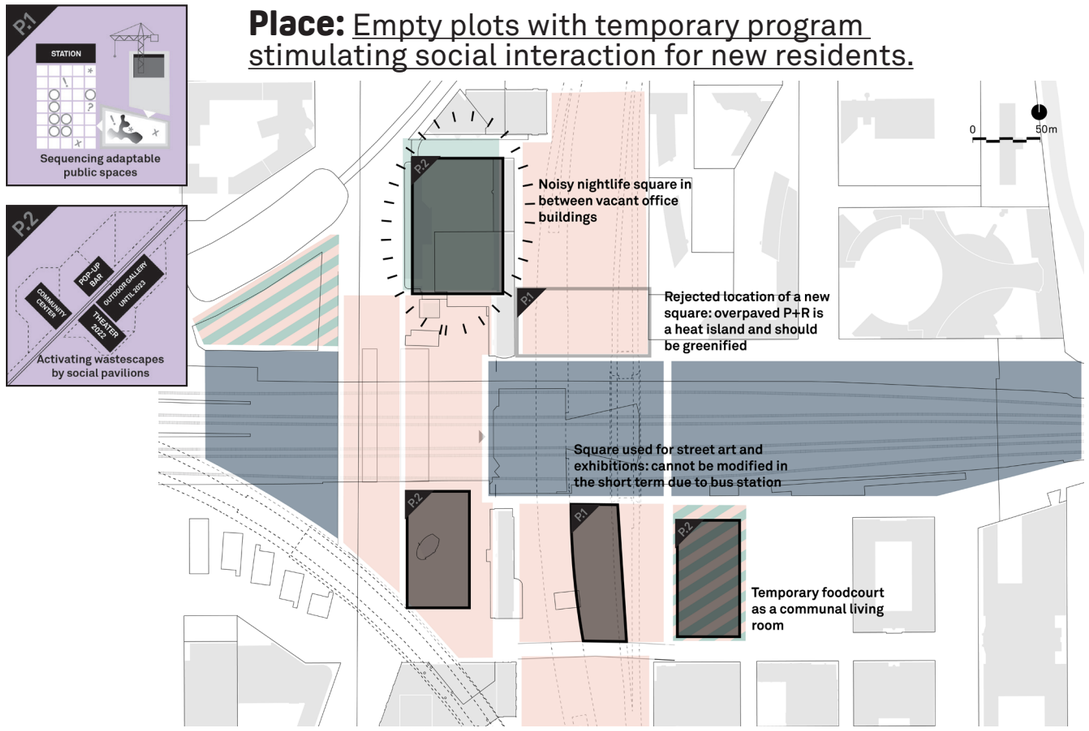




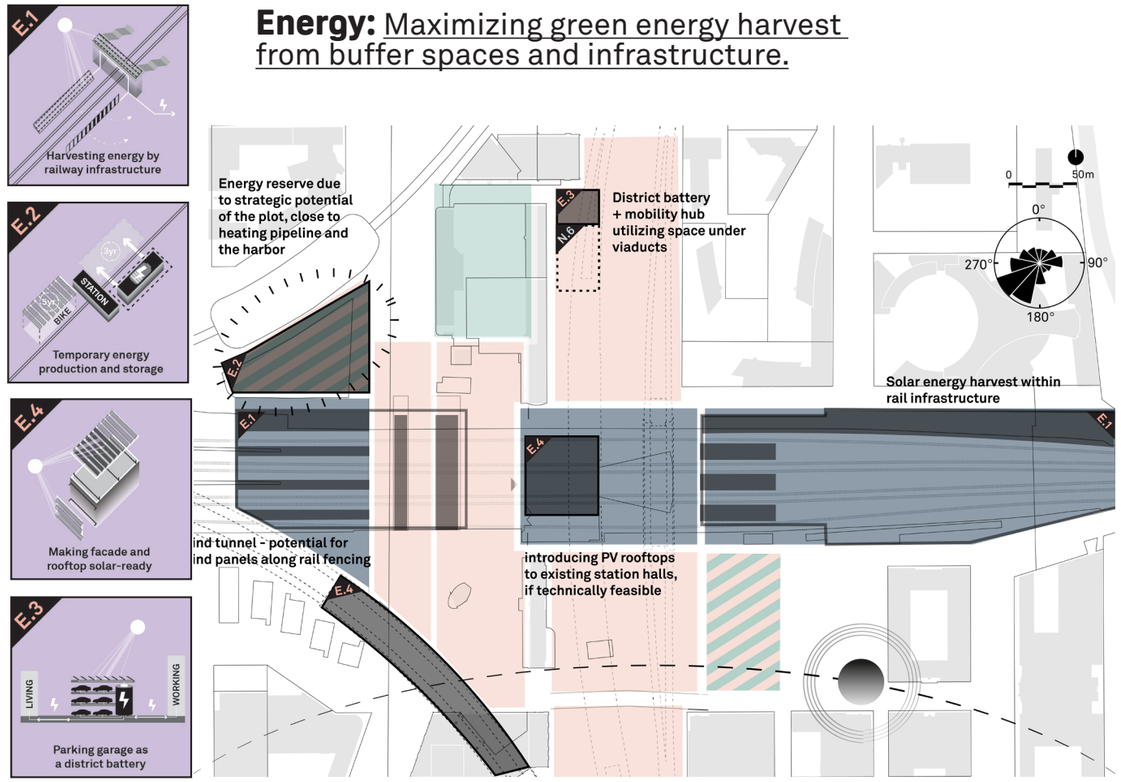
Livability: Leisure hub with green and blue infrastructure complementing planned high-density development.



Place: Empty plots with temporary program stimulating social interaction for new residents.

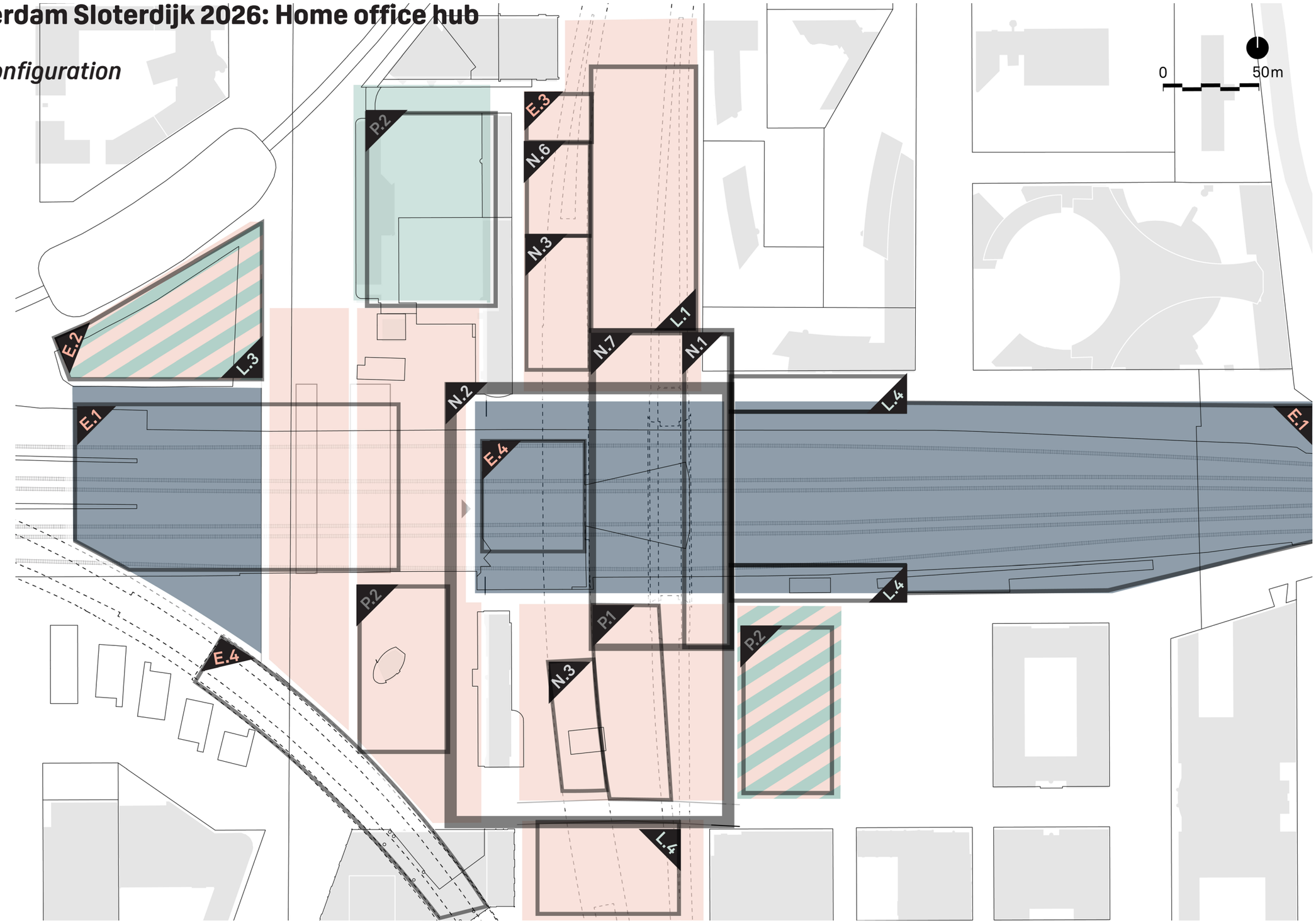


Energy: Maximizing green energy harvest from buffer spaces and infrastructure.



Amsterdam Sloterdijk 2026: Home office hub

Final configuration

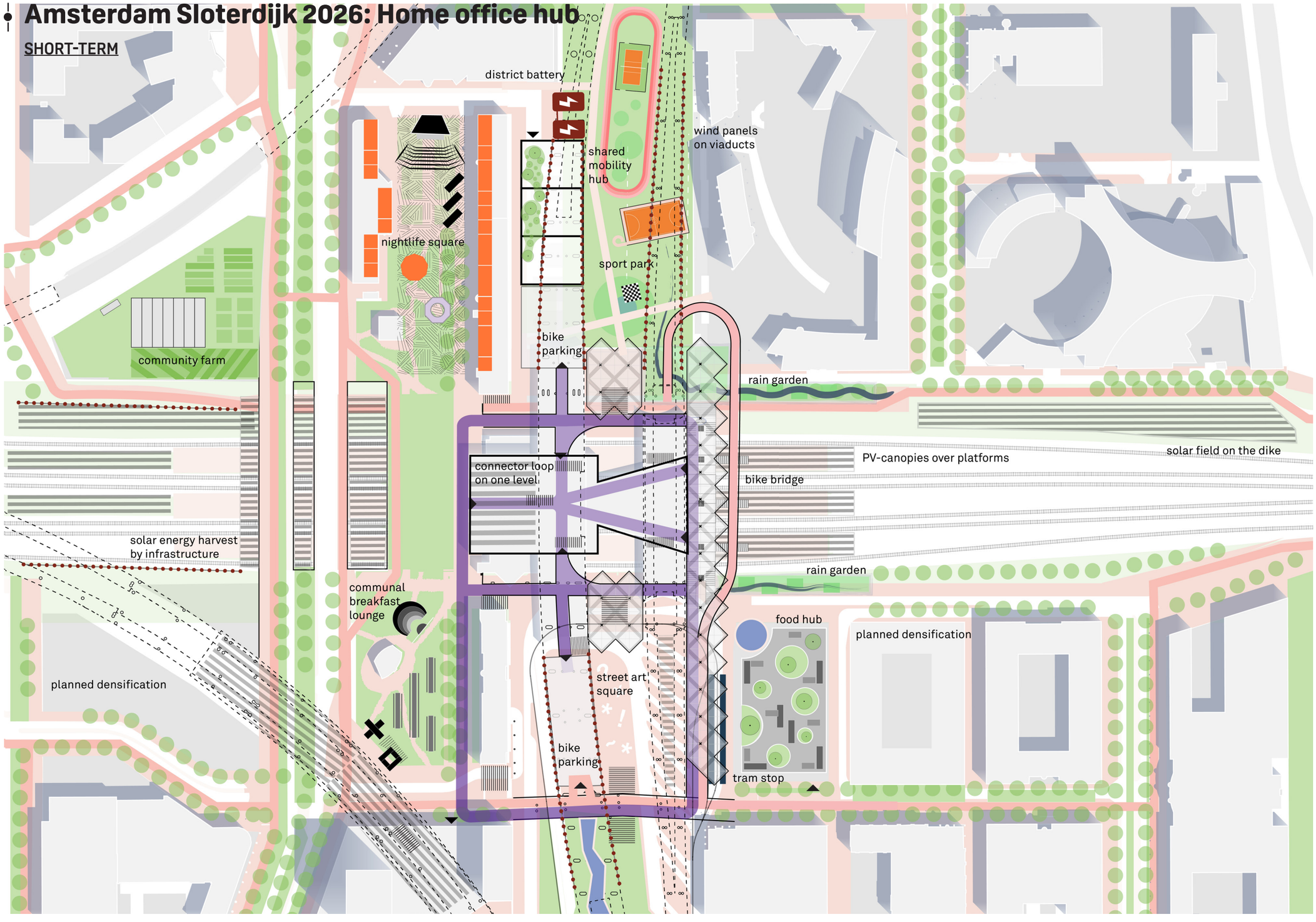


Amsterdam Sloterdijk 2026: Home office hub

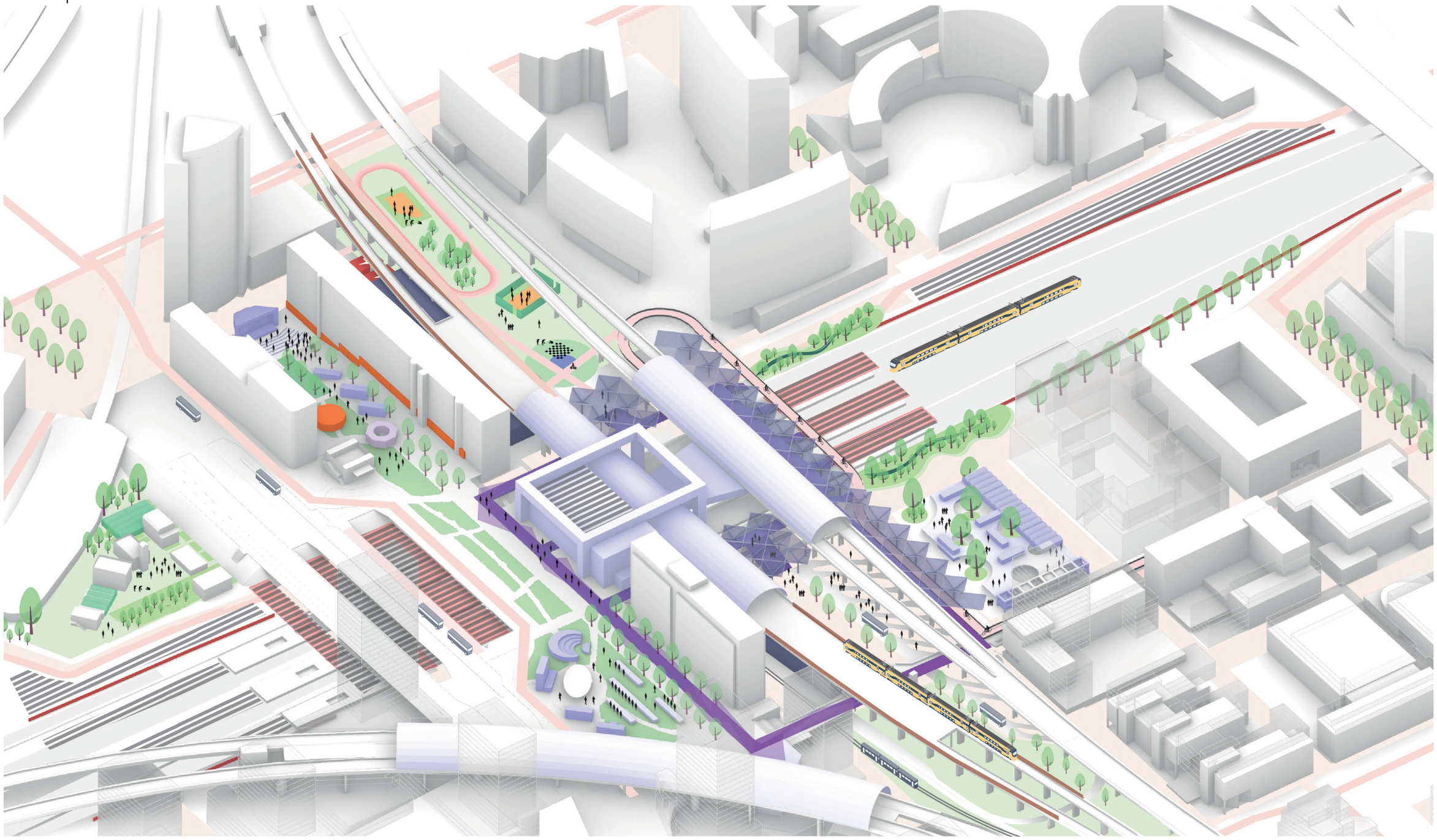
SHORT-TERM

Site plan
1:2000

0 50m

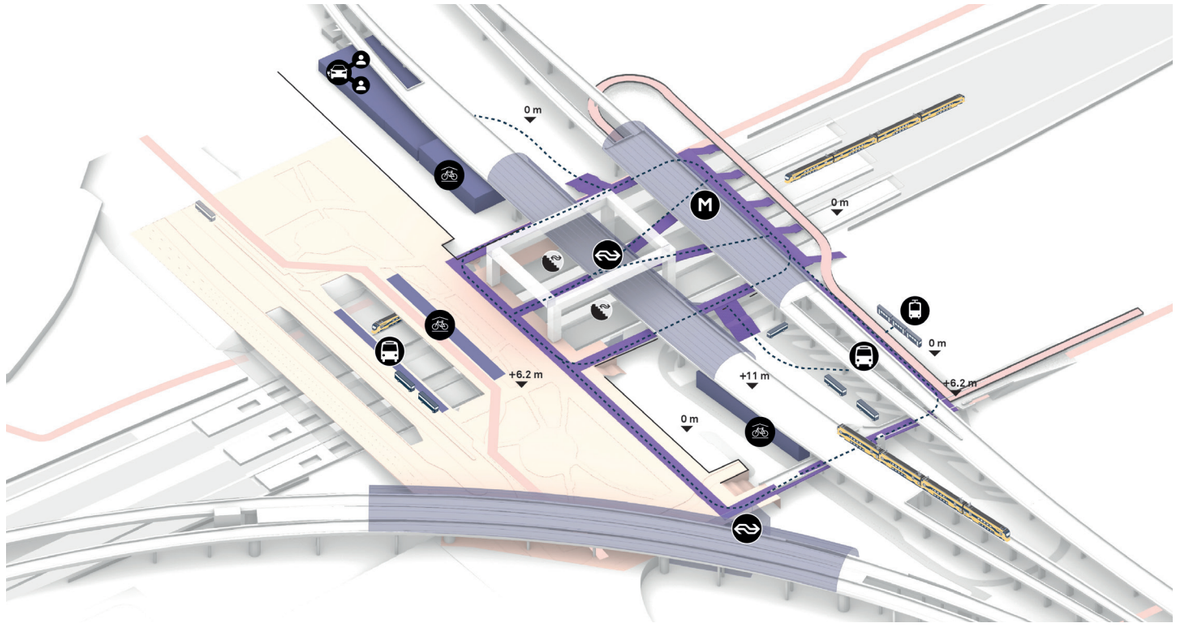


Amsterdam Sloterdijk 2026: Home office hub

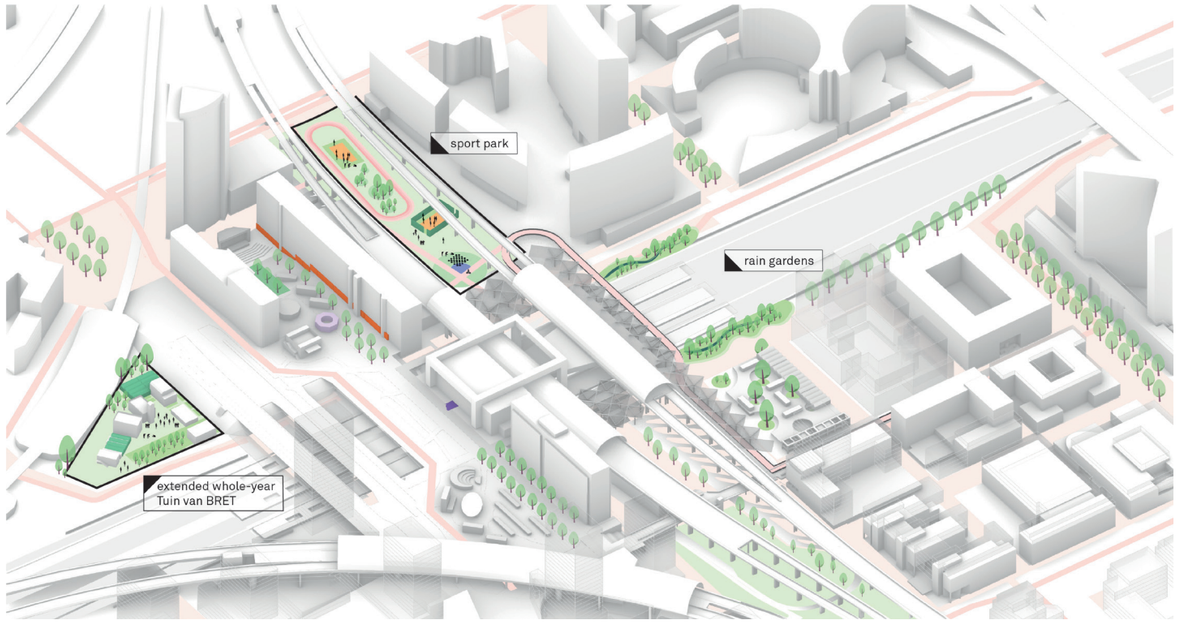


Amsterdam Sloterdijk 2026: Home office hub

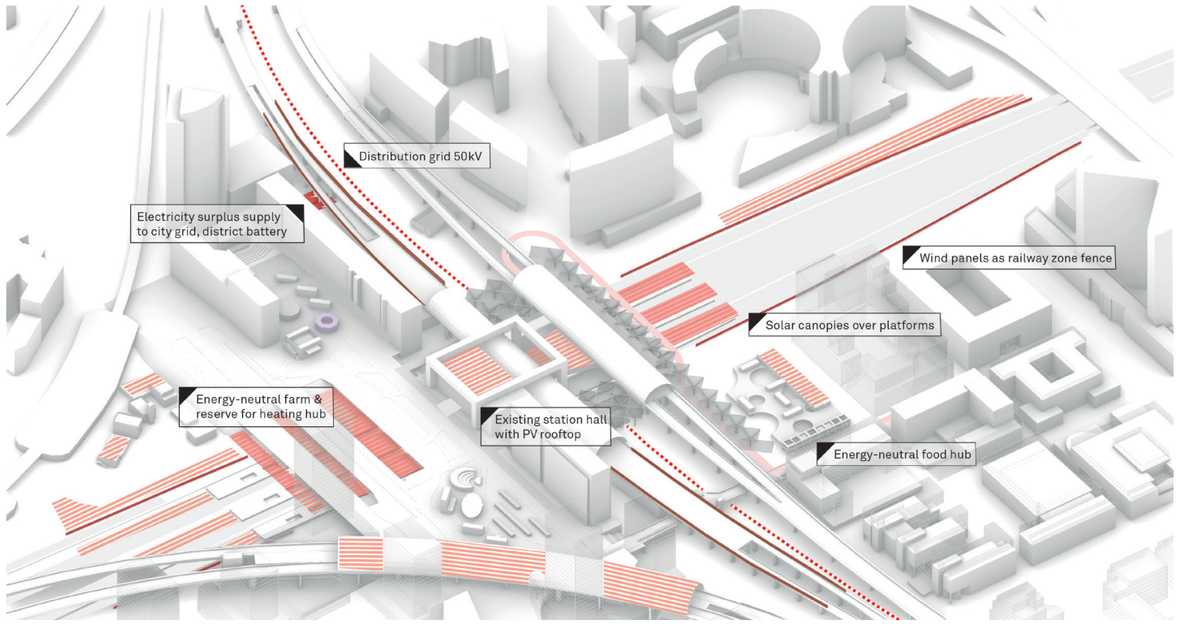
Node



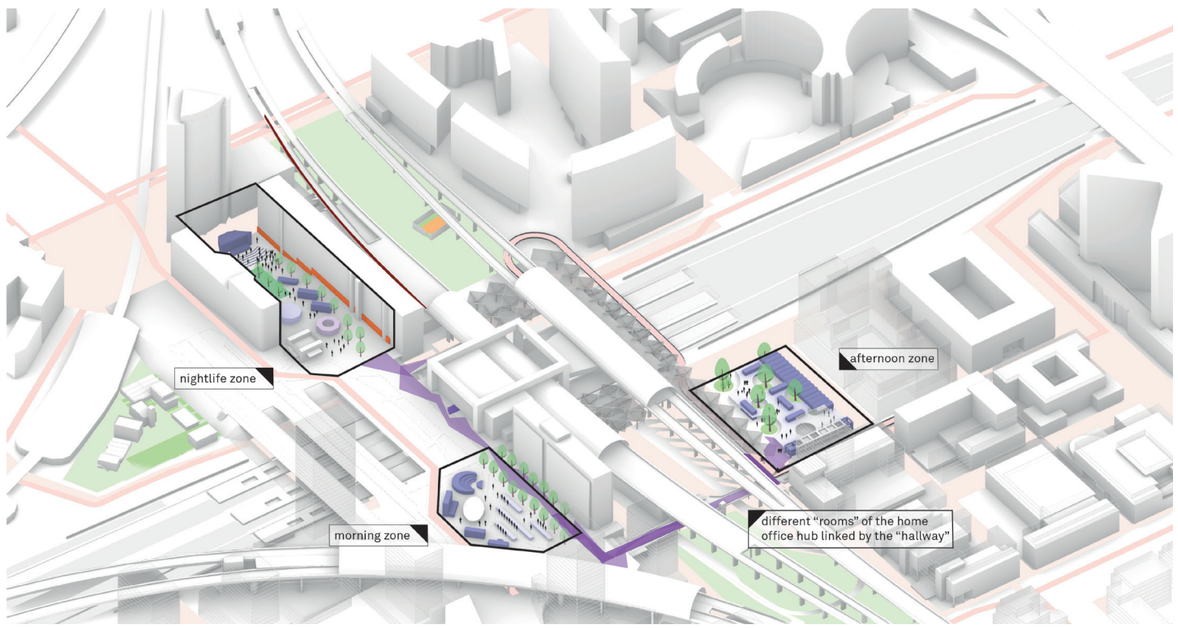
Livability



Energy



Place



Amsterdam Sloterdijk 2026: Home office hub

Visible patterns:

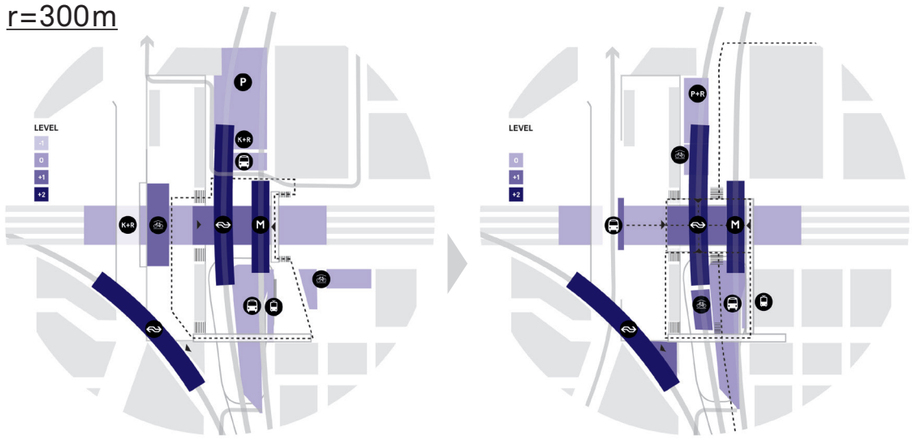


Section CC
2026



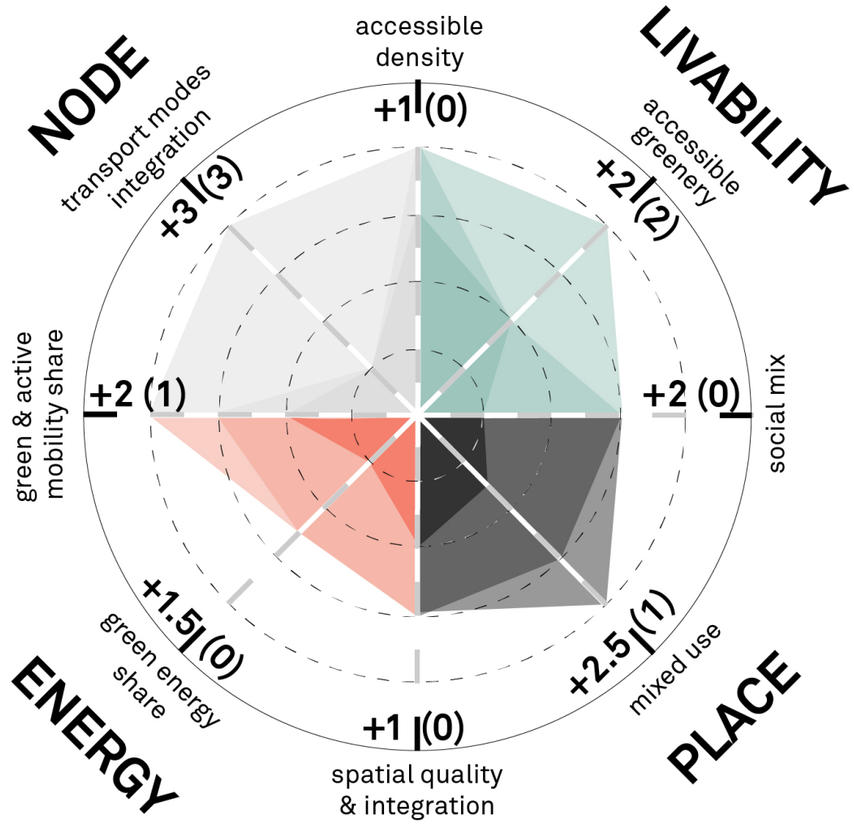
Amsterdam Sloterdijk 2026: Home office hub - assessment

r=300m



Node	Desired modal split	33% bike / 30% walking / 35% OV / 2% shared car
	Distance for change OV/train	125 m bus/tram-train
	Estimated daily ridership	76 500 (based on current trend)
Livability	Green areas	4.13 ha (ground)
	Number of new residents	4500 (planned densification Sloterdijk-Centrum)
	Green areas per capita [1]	9.19 m^2
Place	Number of new employees	-
	FSI	-
	Mixed use	60% horeca / 40% social
Energy	Estimated energy demand [2]	-
	Solar potential [3]	17.51 GWh/an rail infrastructure
	Potential surplus	-

[1] Rooftop greenery is counted as 50% of ground.
[2] Assuming that all new buildings have A+++ energy label and energy consumption is 50 kWh / m2
[3] Assuming 1276 kWh/yr/m2 based on globalsolaratlas.info



Relatively small intervention of a loop extending the level of Orlyplein, could already bring demanded clarity to the station, and form a “balcony” connecting it with public spaces below. A big obstacle is a space-consuming bus station in Carascoplein. It was completed in 2014, and temporary means are not sufficient for such a large transformation. However, parking lot in Piarcoplein is a different case: it corresponds only to 1% of modal split and can be easily compressed in a modular garage under the viaduct.

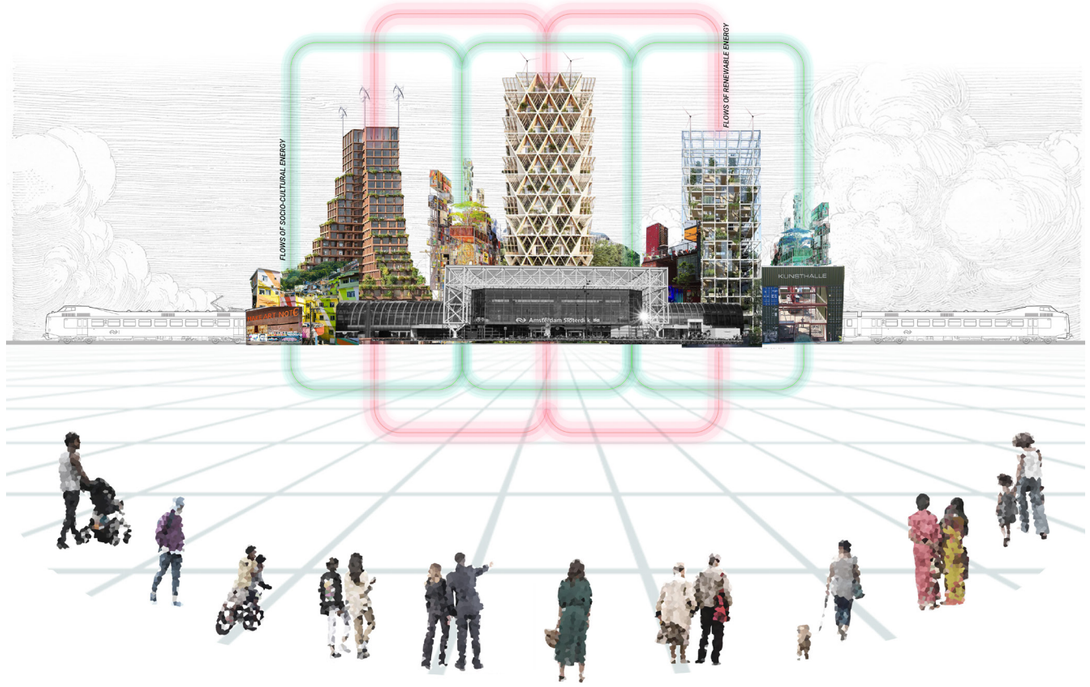
Piarcoplein is introducing a new quality of green spaces, which allows this scenario to score high in livability. However, the scenario is mainly addressing the needs of new residents, not considering more inclusive program. In fact it may exclude anybody from essential professions, not working from home.

Green energy is generated mainly by PV panels covering the railway area, and in a local heating hub, potentially a green hydrogen hub using former gas infrastructure.

Seasonal and temporary functions in pavilions are activating the plots waiting for development, but are not radically changing the existing mixed use defined by long-term structures.

6.4 Amsterdam Sloterdijk 2040: Inclusive city over tracks

LONG-TERM SCENARIO

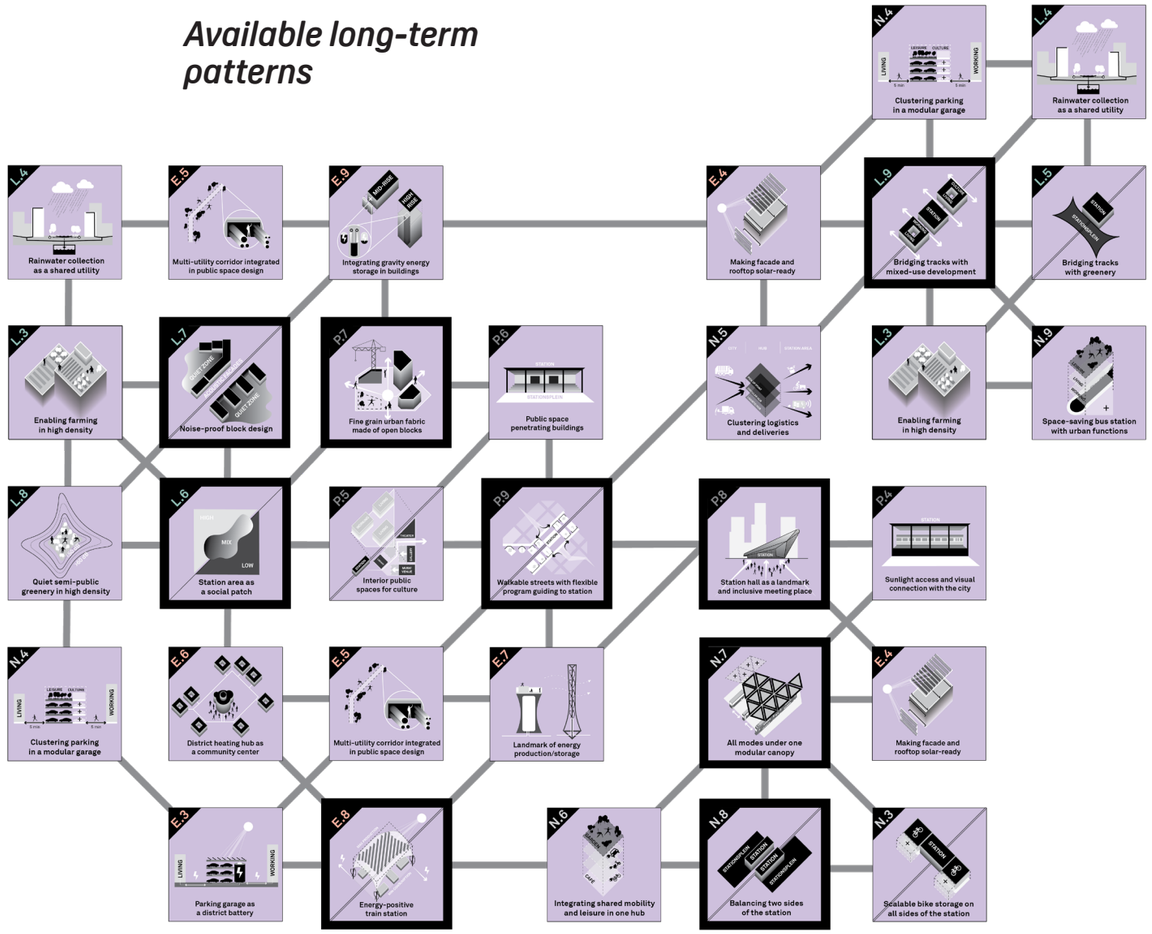


What if...

In 2030 due to political instability abroad, migration to Amsterdam intensifies. New districts become instantly cosmopolitan. Haven-Stad is in development, but there is also some dissapointment. It is already clear that and it will not meet the soaring housing demand and it does not yet have a clear urban center.

Municipality is obliged by a new global climate agreement to be energy-neutral by 2050, as a part of decentralization of energy system. Hence, they are investigating the chance to build many affordable homes without compromising green energy goals. Luckily, since a new government, social housing can count on generous governmental subsidies.

Meanwhile, a delayed reconstruction of the station is finally about to happen. Municipality together with NS and Prorail decides to join forces and integrate the design and development of new housing and mobility hub for Haven-Stad. The railway canyon of Sloterdijk Centrum is being finally covered.



Amsterdam Sloterdijk 2040: Inclusive city over tracks

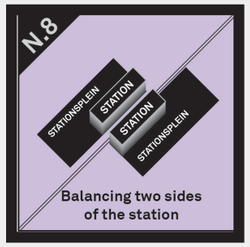
Pattern selection

Node

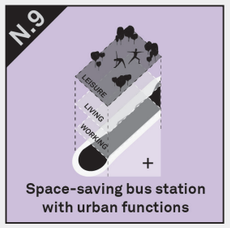
Problem Lack of clear connection north-south, and between the modalities. Fragmented, space consuming station facilities.

Potential Location of the station between Amsterdam-West and Haven-Stad. Optimization potential of Piarco- and Carascoplein (P+R, bus/tram station).

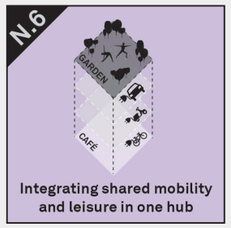
Goal Space-saving station facilities integrated in urban fabric to allow maximum densification.



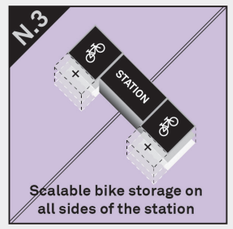
Only properly designed two-sided station can connect Haven-Stad and Amsterdam West.



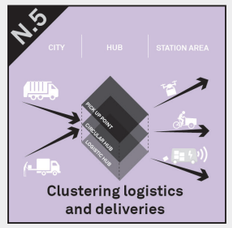
Pattern could save space for leisure, allow more densification and make node more compact.



It may replace P+R used only by 1% of passengers, free up space for L.1/P.1/P.2 and house community center.



Multi-level bike storage can free up space for other patterns and efficiently utilize space under viaducts.



Pattern allows to maximize walkability of new streets around the station and reduce nuisance.

Livability

Problem Lack of social amenities, overpaved business district as a heat island.

Potential Underused infrastructure buffers offer large potential for leisure and biodiversity.

Goal Densification over tracks (>3 FSI) with complete social amenities and green spaces.



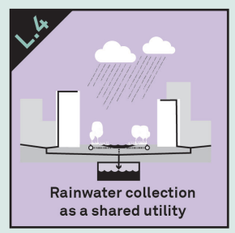
Pattern allows to realize the core of the scenario and introduce high density over the railway area.



New development should come with complete social amenities, which are missing in the business district.



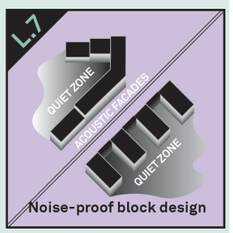
Pattern could be used for new over-track development, to provide green public connections north-south.



Pattern could improve water management in high density, overpaved neighborhood.



Beside energy production, rooftops of new development, should be used for gardening and social integration.



Pattern is necessary to mitigate the noise from viaducts.

Place

Problem Monofunctional business district without continuity of urban fabric and active streets between Haven-Stad and Amsterdam-West.

Potential Potential to become an urban center connecting Haven-Stad and Amsterdam-West.

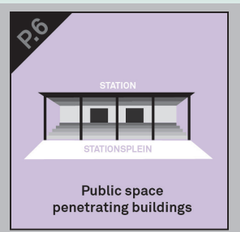
Goal Sloterdijk station as a keystone of vivid urban center with active streets.



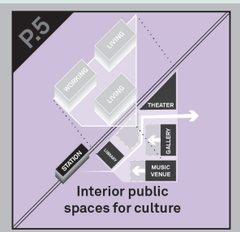
Radarweg is the only planned active street in Sloterdijk. Streets parallel to tracks should support it .



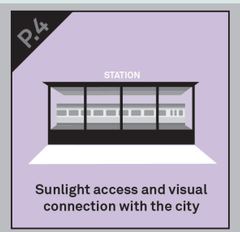
Station hall could become a main square. The neighborhood is missing meeting places of high spatial quality.



Pattern will add spatial quality to new streets, extending their profile and blurring the barrier of tracks.



Sloterdijk is missing spaces for culture, pattern will help to utilize the potential of active streets, P.9.



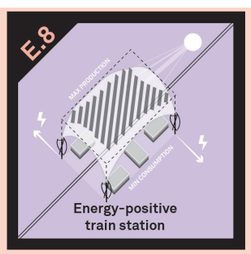
New station hall should improve sunlight access in lower platforms, entrance should be visually connected.

Energy

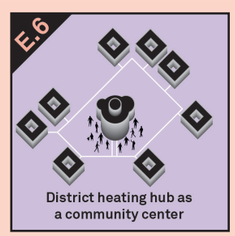
Problem No green energy generation, fragmented underground utilities restricting development.

Potential Strategic location of the station in the electricity grid, in proximity to the harbor. Potential for solar and wind energy (wind tunnel south-north).

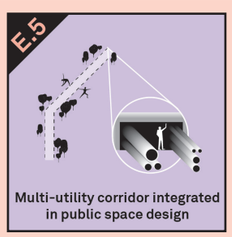
Goal Integrated green energy system of train station and new development as a landmark of energy transition.



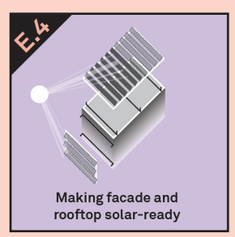
New station building should use the potential of the location to maximize green energy generation.



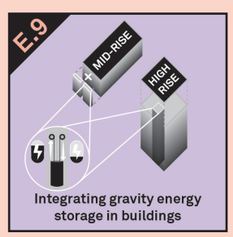
New development could have new sustainable district heating, independent from existing waste-to-energy plant.



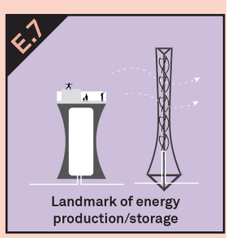
Energy infrastructure should be used as an advantage, not an obstacle in public space design.



All new buildings should be designed for solar energy harvest, as it is challenging to achieve energy neutrality in high-density.

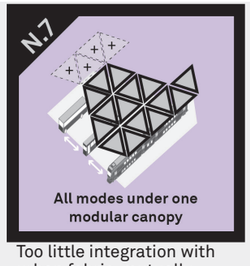


Decentralized energy storage in new development is important for energy-neutrality of new development.

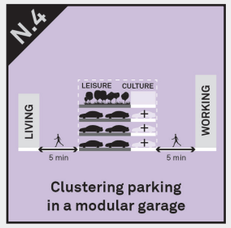


Landmark generating electricity can guide passengers to the station and mark the center of the neighborhood.

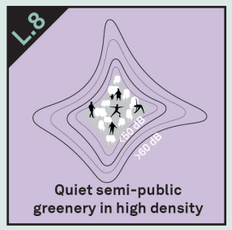
Rejected long-term patterns:



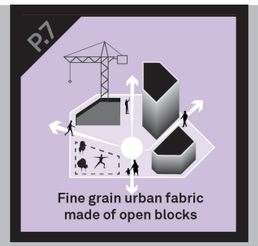
Too little integration with urban fabric, mutually exclusive with new bus station N.9.



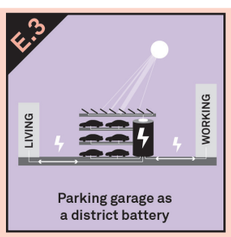
P+R is now used only by 1% of passengers, shared mobility hub is more relevant in the long-term



Pattern cannot be fully applied to over track development as it requires ground access, and due to noise from viaducts.

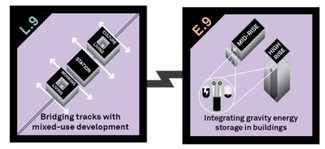


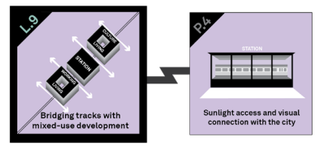
Tension with P.5. Interior spaces for culture require large podium and development of the whole block

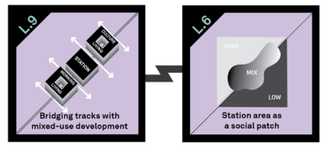


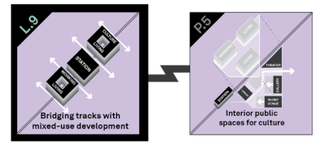
More efficient and reliable energy storage solutions should be considered in the long term, such as gravity storage.

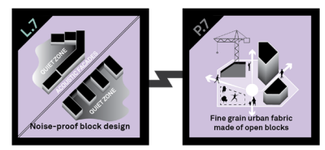
Tensions:

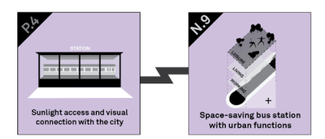


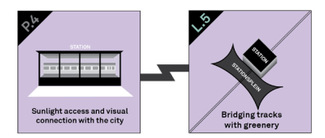


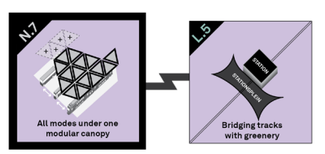




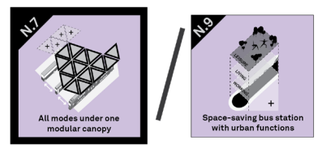


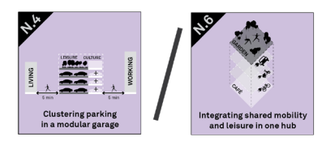


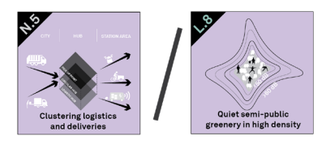


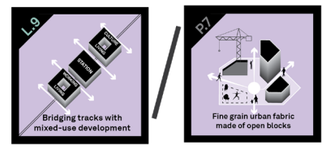


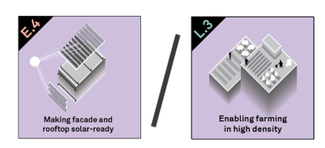
Mutually exclusive:

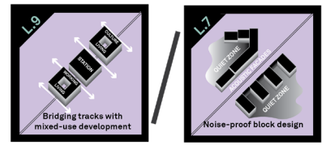


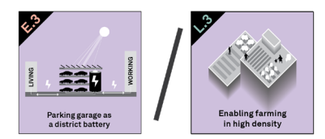


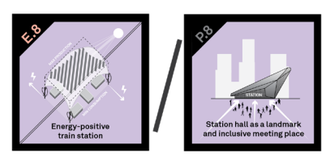






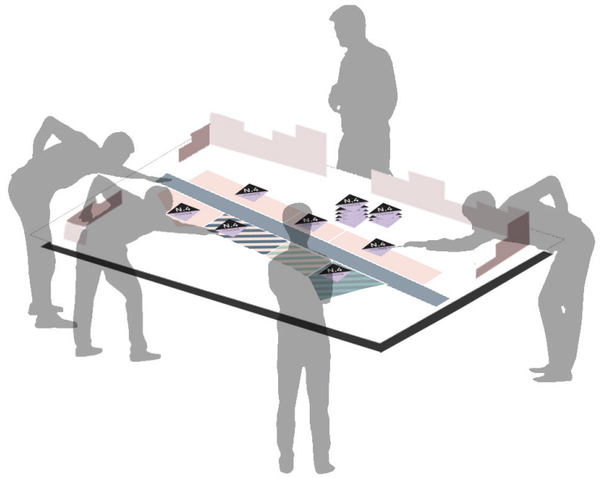






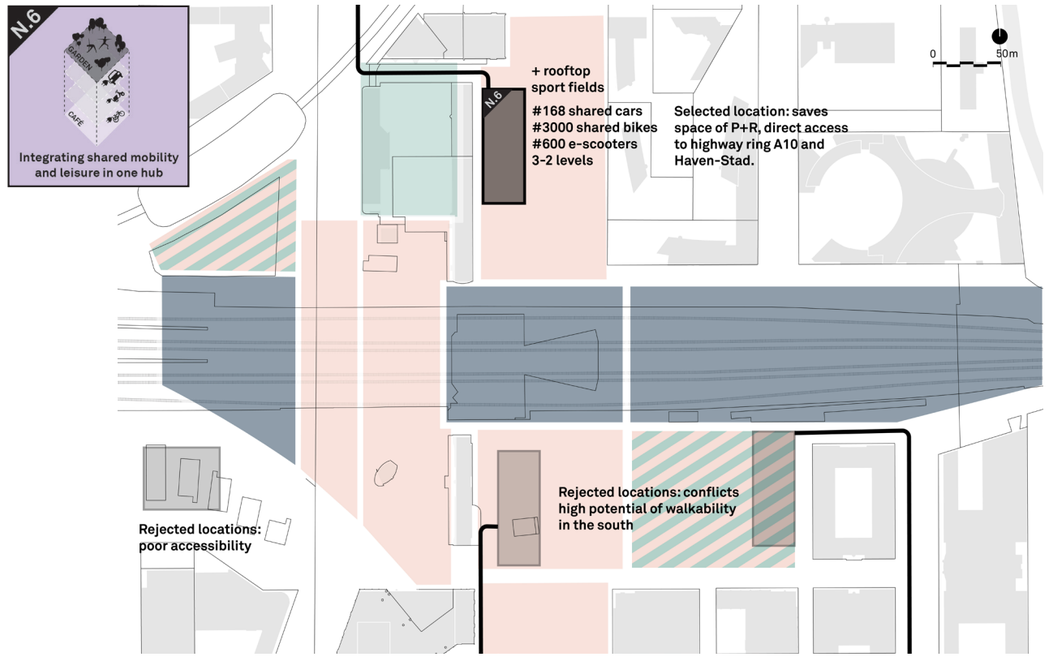
Amsterdam Sloterdijk 2040: Inclusive city over tracks

Applying patterns

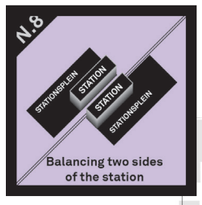


Legend

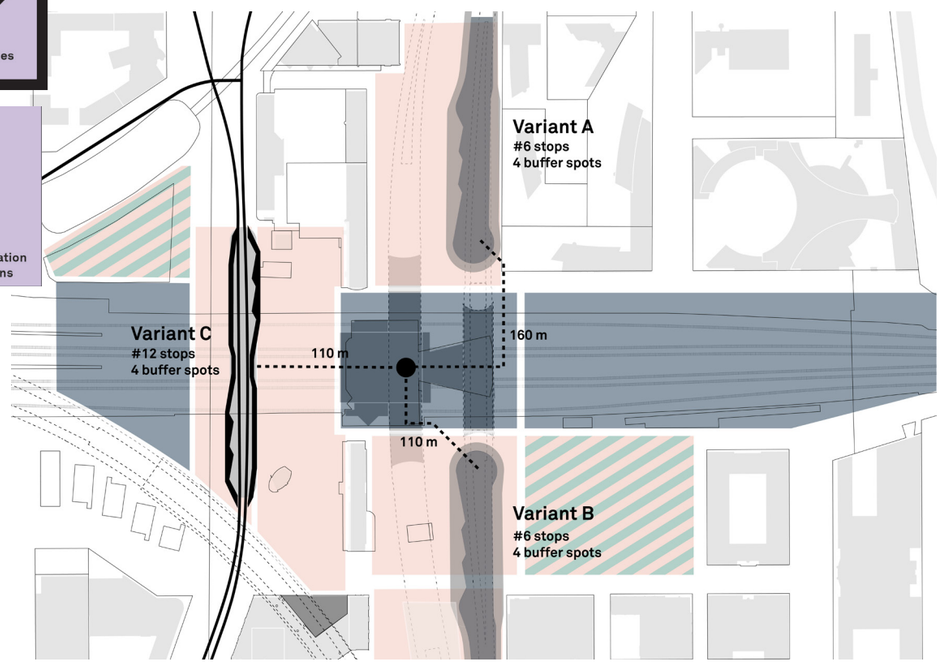
- Railway company (NS/Prorail)
- Municipality
- Building owned by NS, plot by municipality
- Owned by NS/Prorail, potential to be redeveloped by private sector
- Owned by municipality, potential to be redeveloped by private sector

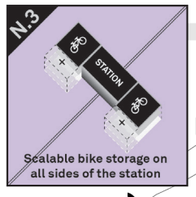


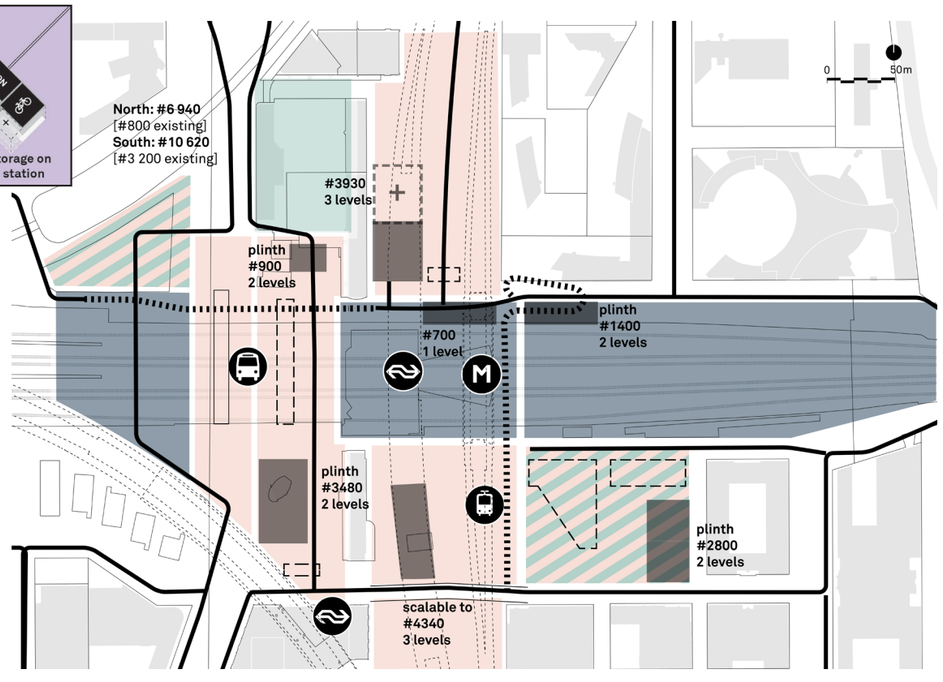
Node: Space-saving station facilities integrated in urban fabric to allow maximum densification.

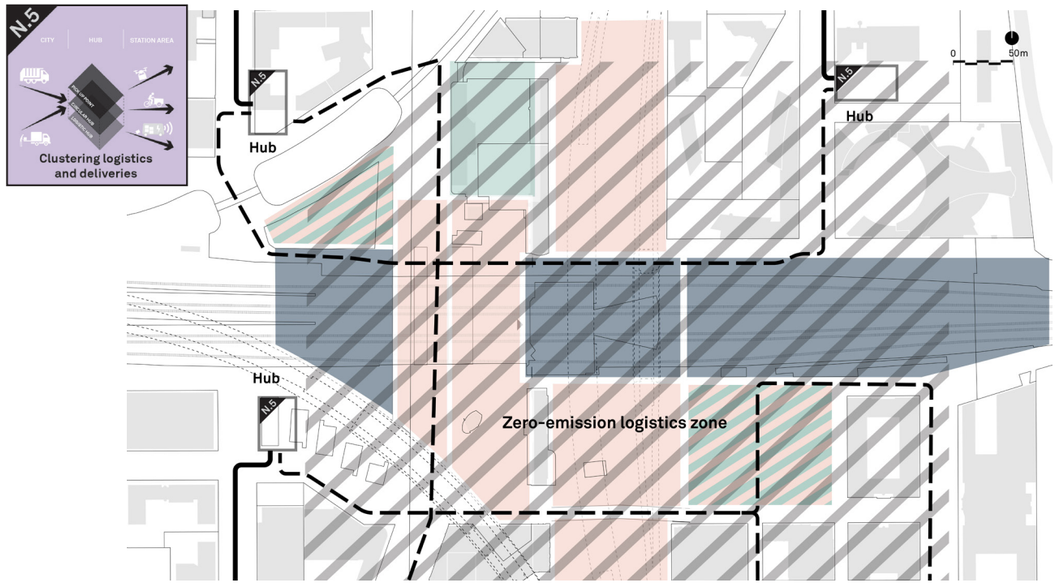


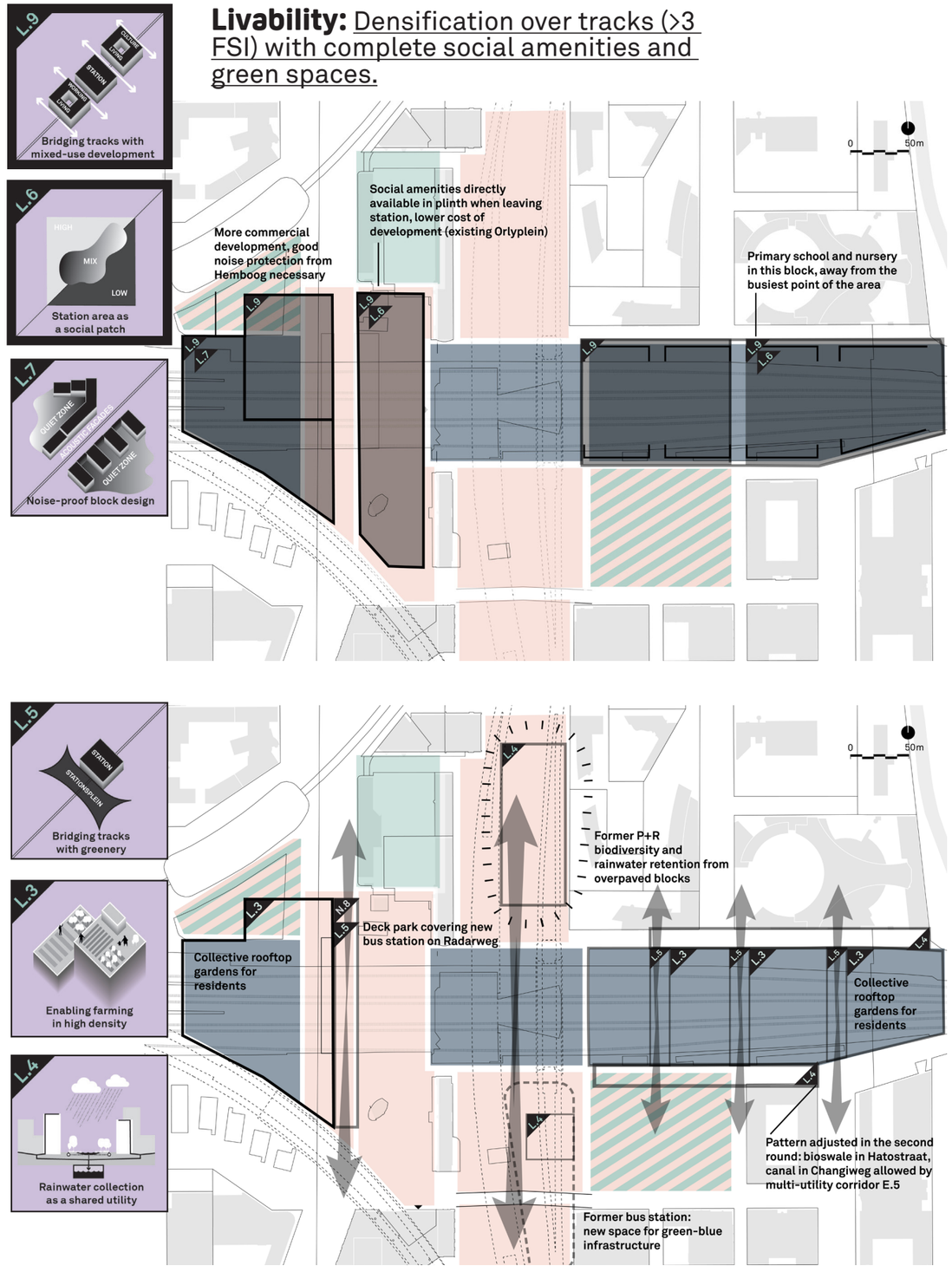




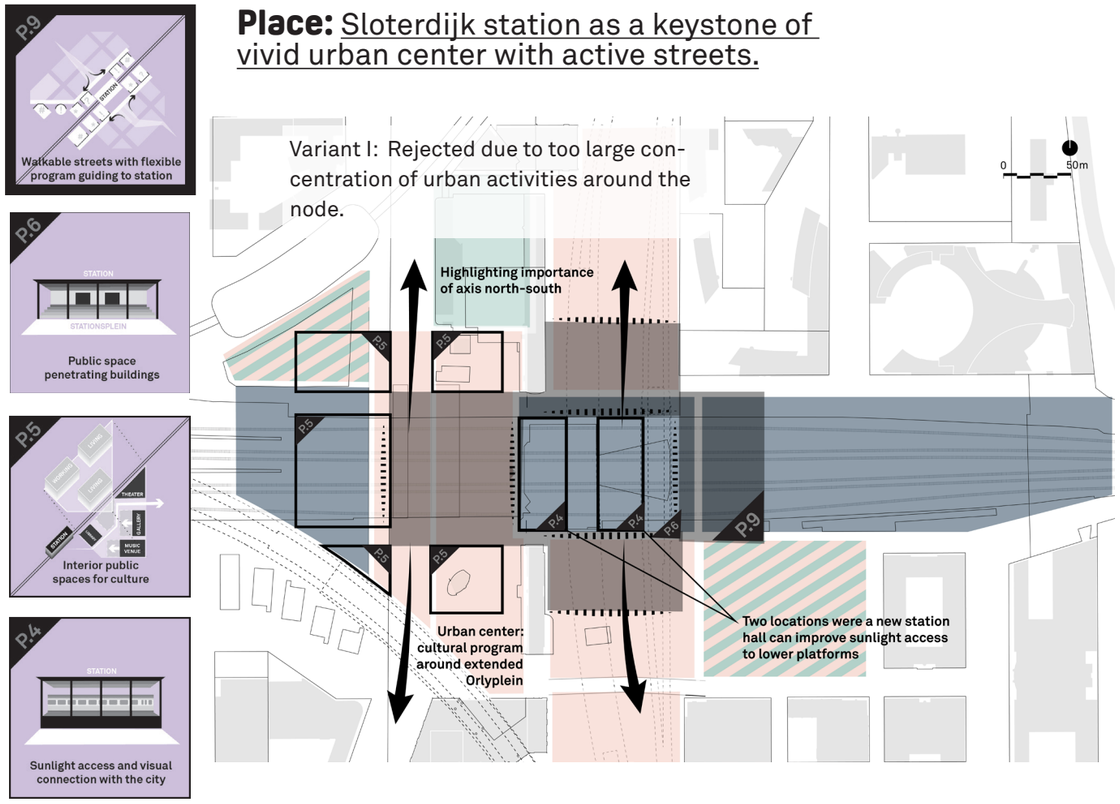




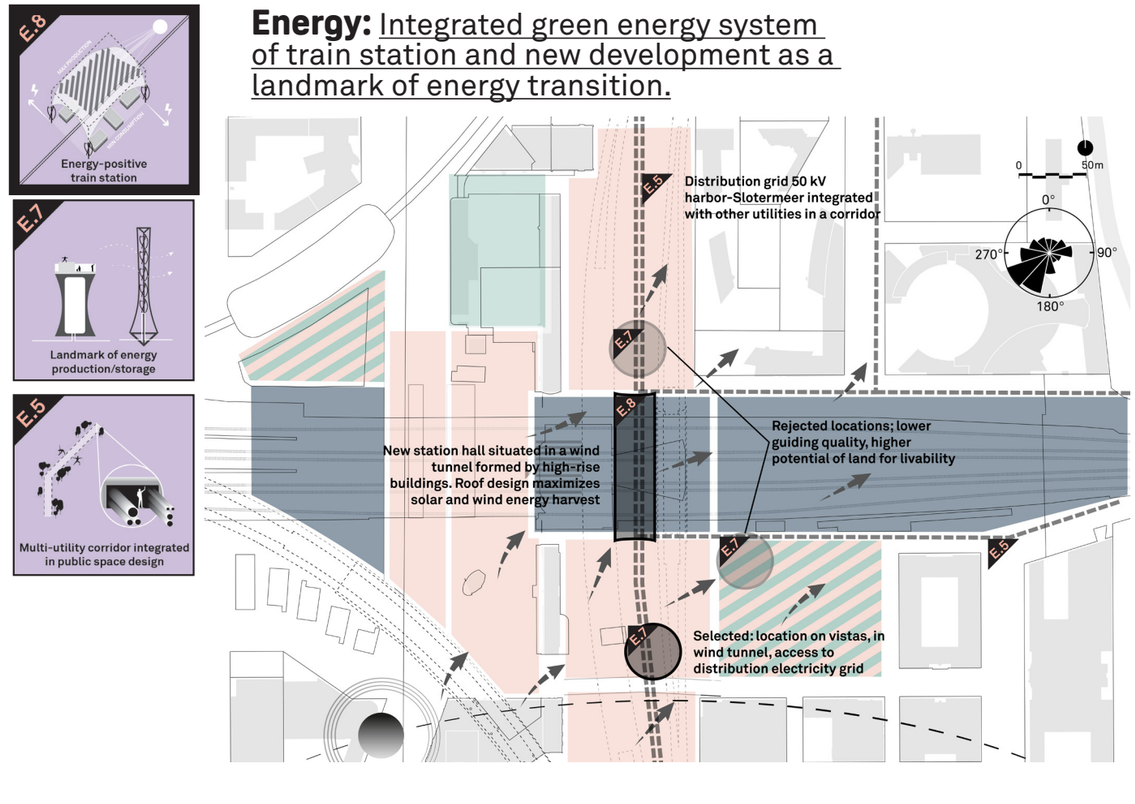

N.5
CITY
HUB
STATION AREA
Clustering logistics and deliveries
Hub
Hub
Hub
Zero-emission logistics zone
0
50m

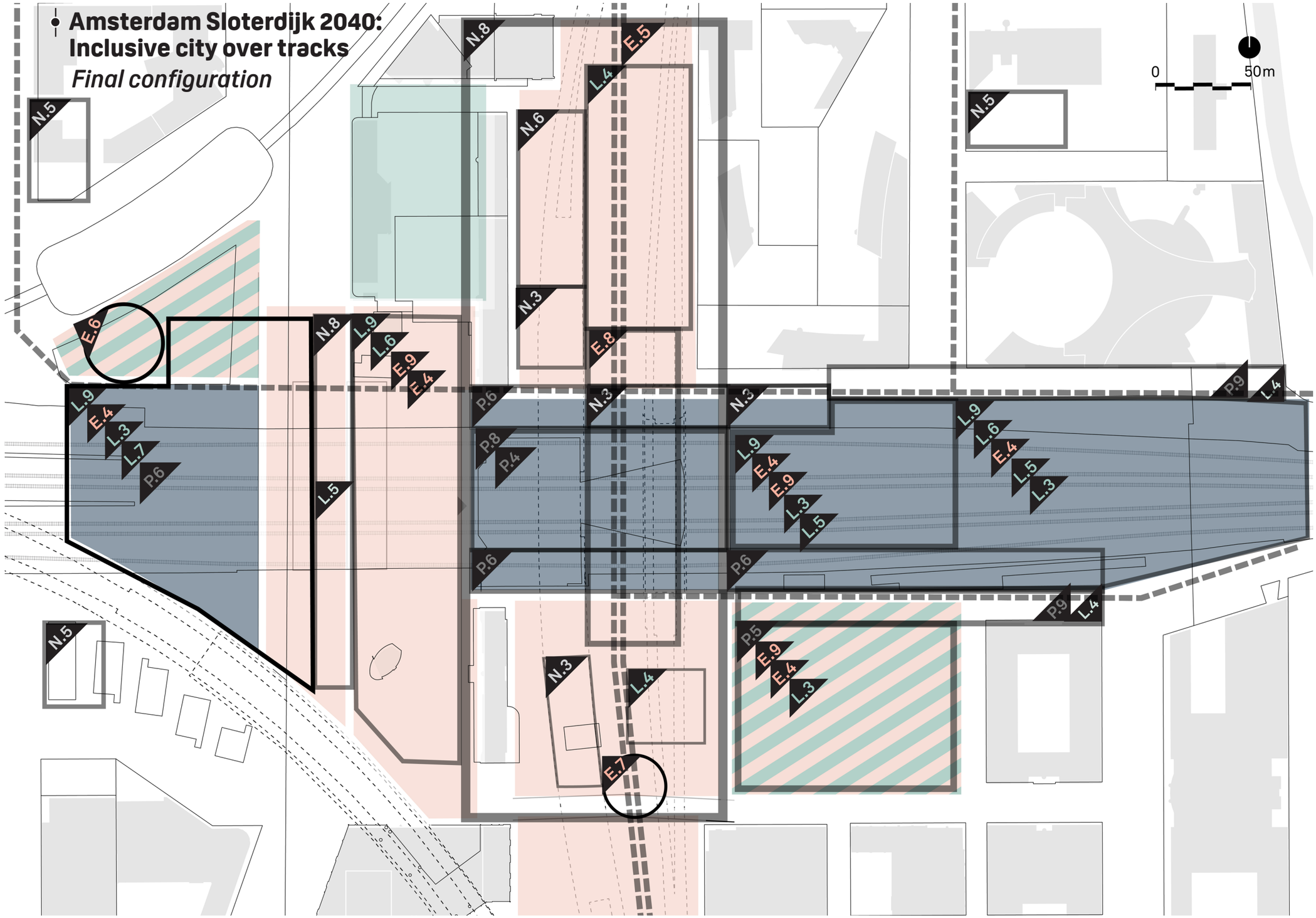

L.9
CENTRE
STATION
HIGHWAY
Bridging tracks with mixed-use development
L.6
HIGH
MIX
LOW
Station area as a social patch
L.7
QUIET ZONE
HORSESHOE BLOCK
QUIET ZONE
Noise-proof block design
Livability: Densification over tracks (>3 FSI) with complete social amenities and green spaces.
More commercial development, good noise protection from Hemboog necessary
Social amenities directly available in plinth when leaving station, lower cost of development (existing Orlyplein)
Primary school and nursery in this block, away from the busiest point of the area
0
50m
L.5
STATION
STATIONSPLEIN
Bridging tracks with greenery
L.3
Enabling farming in high density
L.4
Rainwater collection as a shared utility
Collective rooftop gardens for residents
Deck park covering new bus station on Radarweg
Former P+R biodiversity and rainwater retention from overpaved blocks
Collective rooftop gardens for residents
Pattern adjusted in the second round: bioswale in Hatostraat, canal in Changiweg allowed by multi-utility corridor E.5
Former bus station: new space for green-blue infrastructure

Place: Sloterdijk station as a keystone of vivid urban center with active streets.



Energy: Integrated green energy system of train station and new development as a landmark of energy transition.




Amsterdam Sloterdijk 2040:
Inclusive city over tracks
Final configuration
0
50m
N.5
N.8
E.5
L.4
N.6
N.3
E.8
E.6
L.9
L.6
E.9
E.4
P.6
N.3
N.3
P.9
L.4
P.8
P.4
L.5
L.3
L.7
E.5
P.5
N.3
L.4
E.7

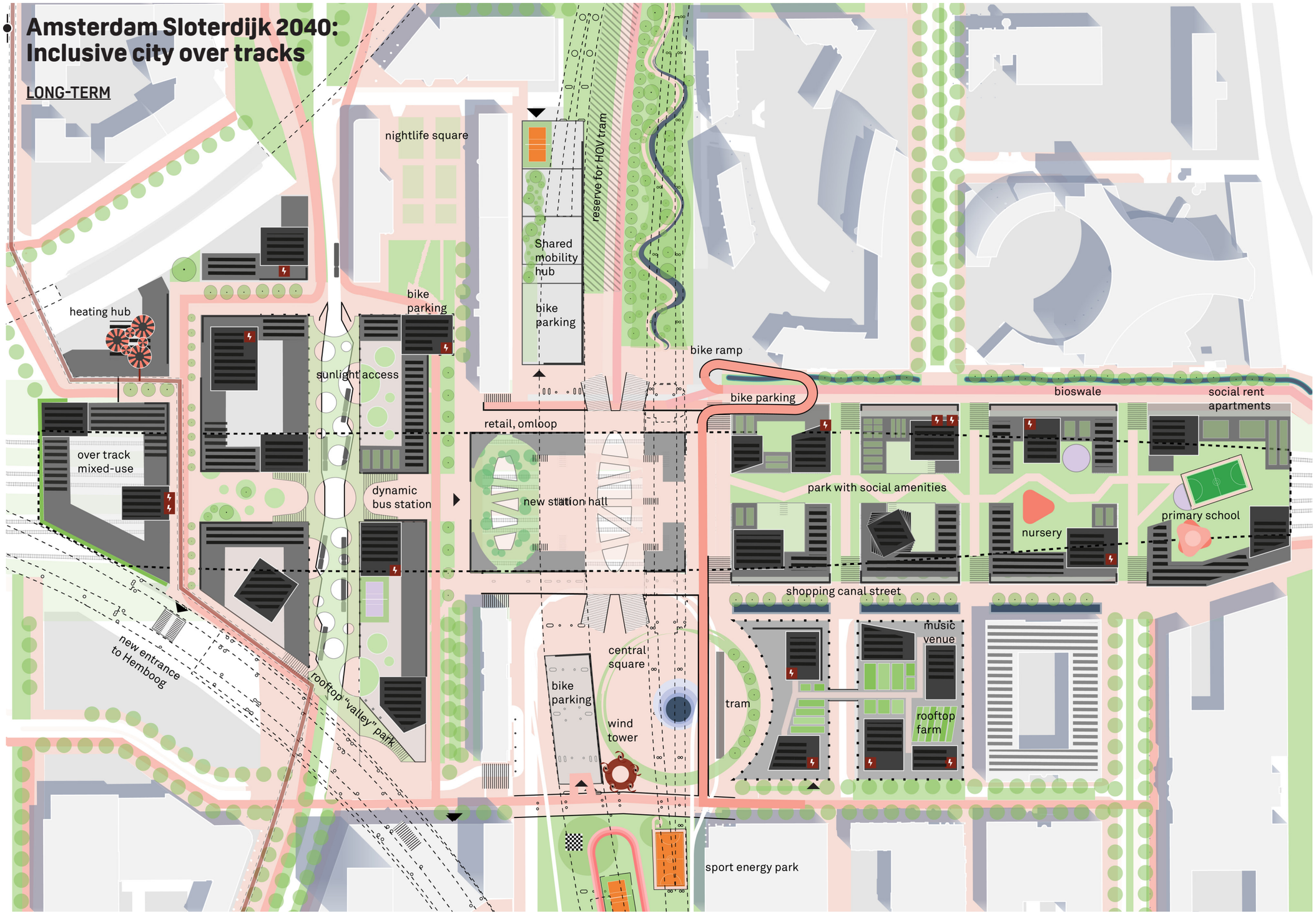
Amsterdam Sloterdijk 2040: Inclusive city over tracks

LONG-TERM

Site plan
1:2000

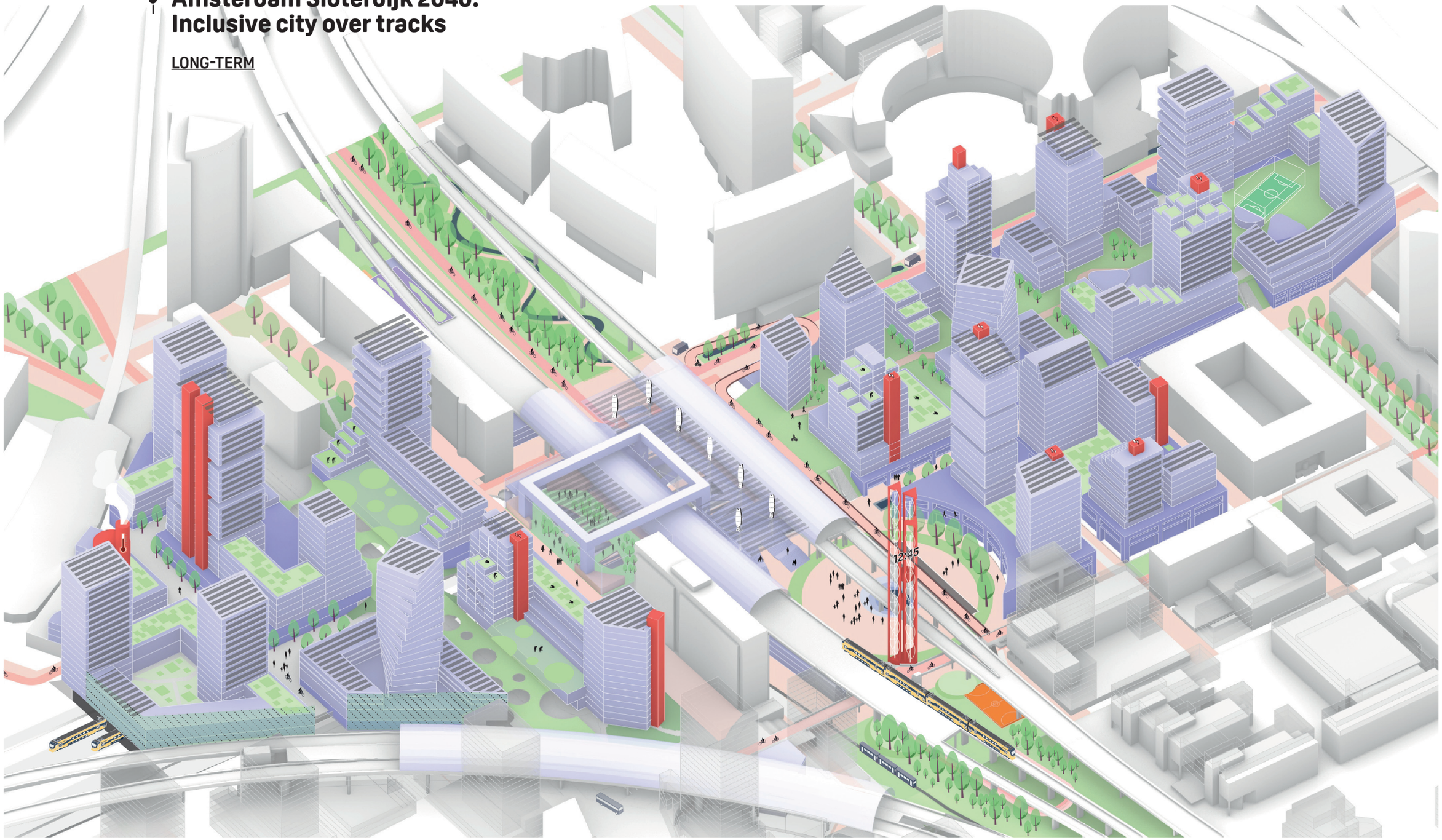
0 50m

- active plinth
- bridge
- PV rooftop
- gravity battery
- urban canal
- bioswale



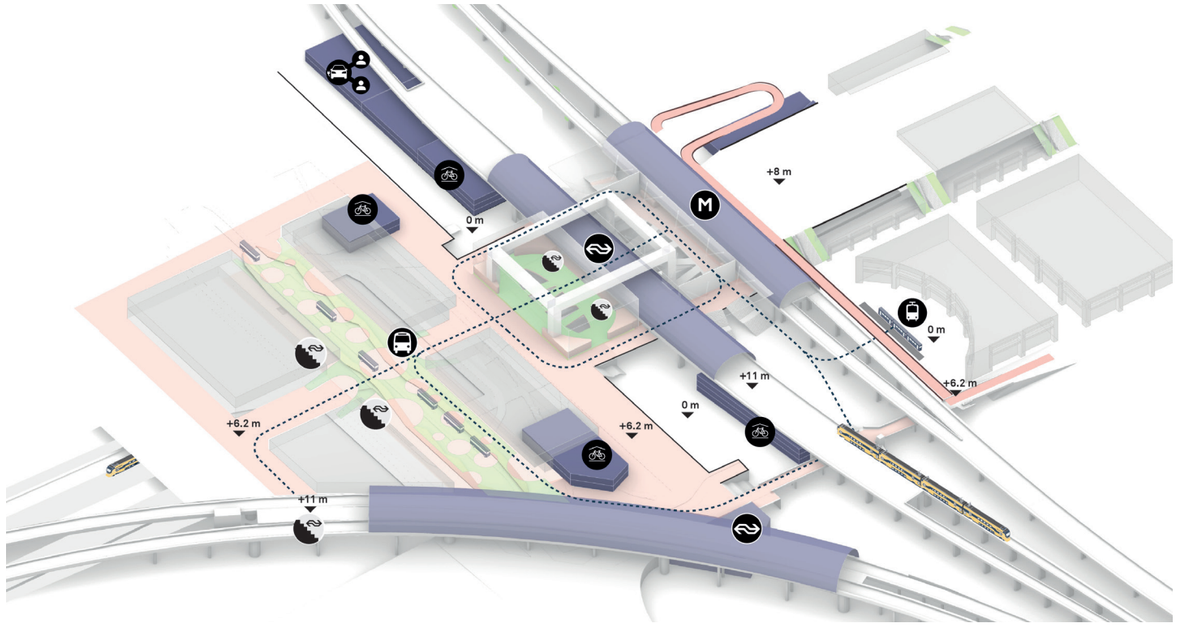
Amsterdam Sloterdijk 2040: Inclusive city over tracks

LONG-TERM

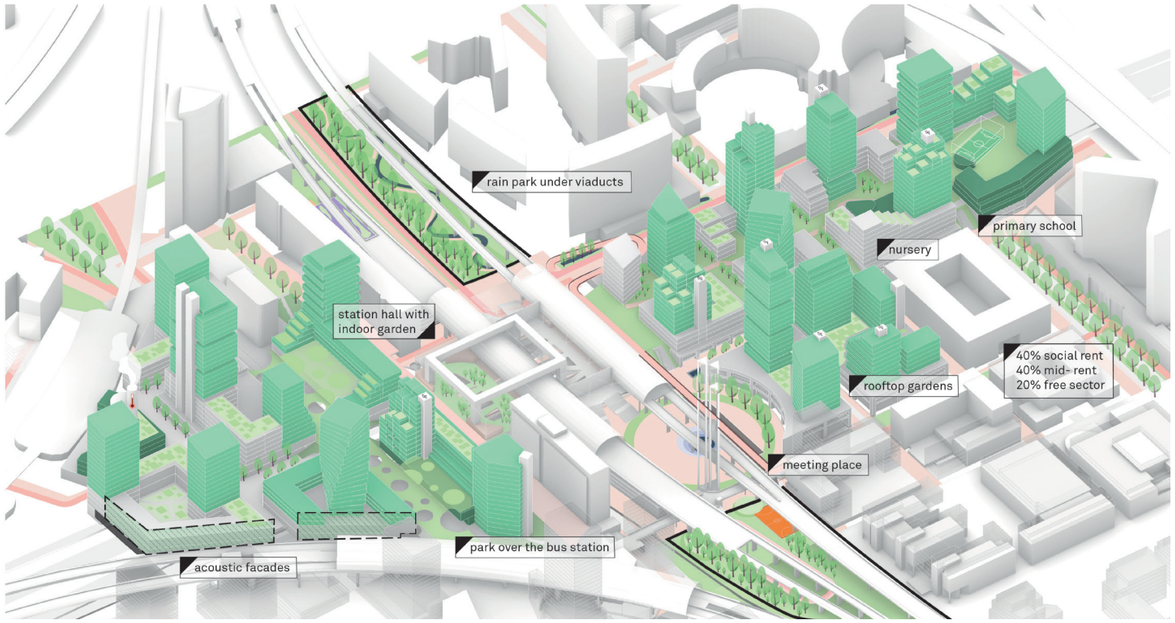


Amsterdam Sloterdijk 2040: Inclusive city over tracks

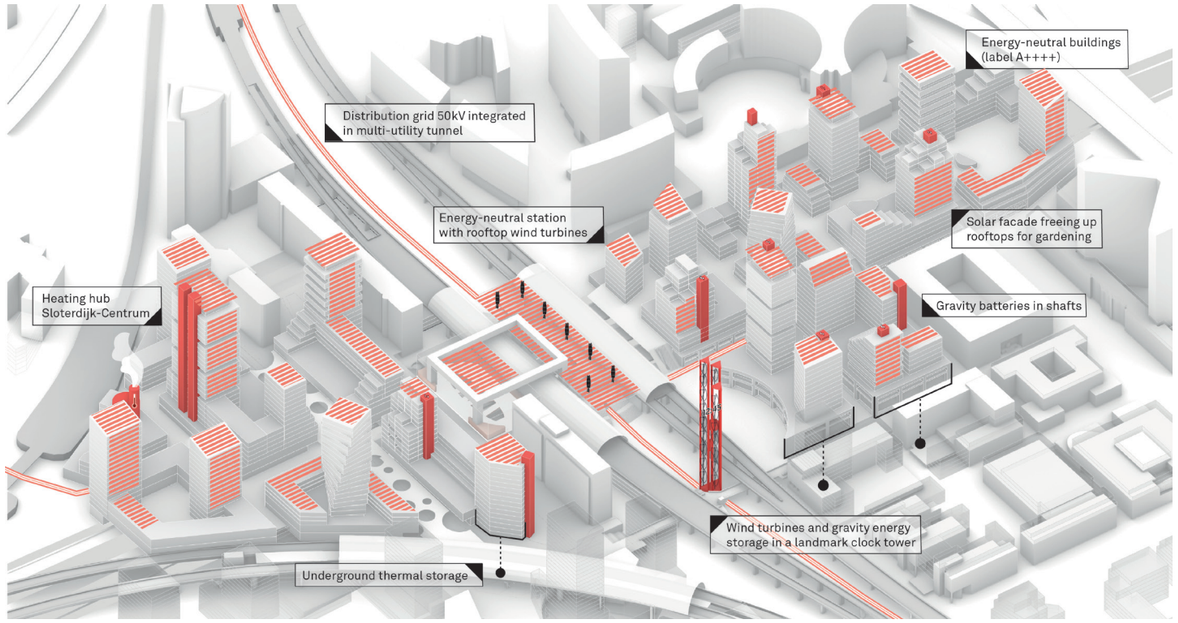
Node



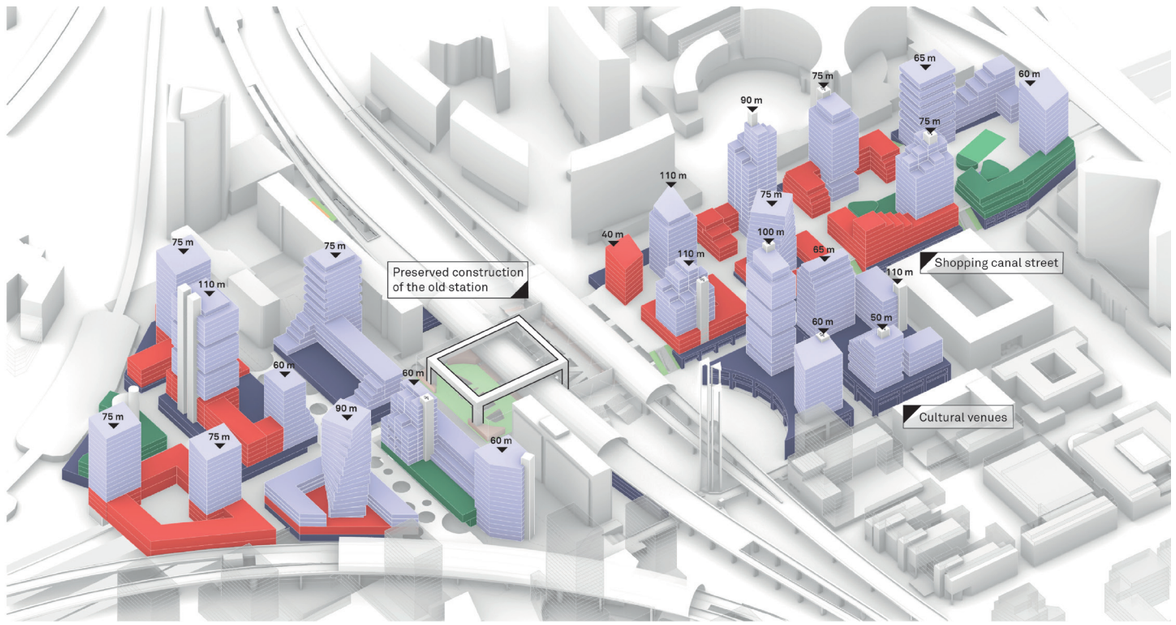
Livability



Energy



Place

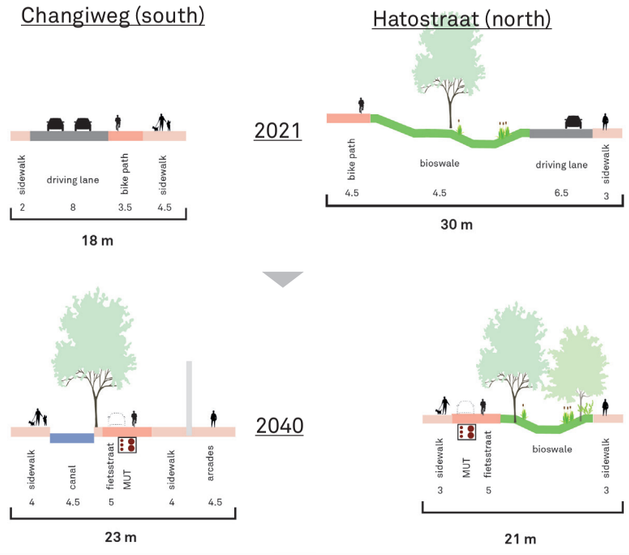


Amsterdam Sloterdijk 2040: Inclusive city over tracks

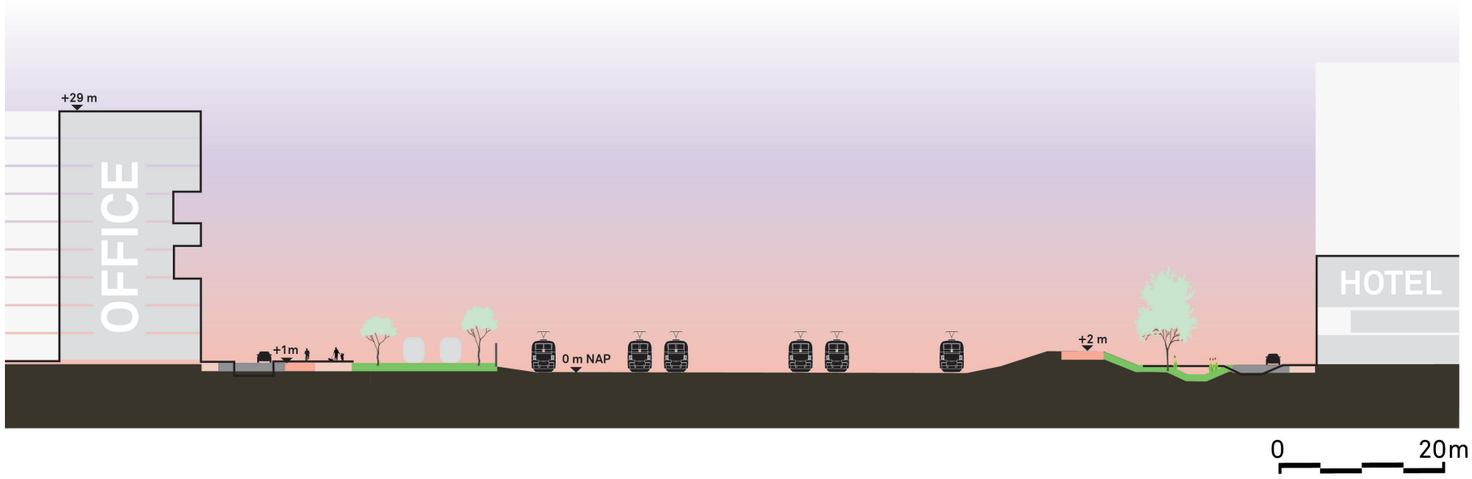
LONG-TERM

Changiweg (south)

Hatostraat (north)



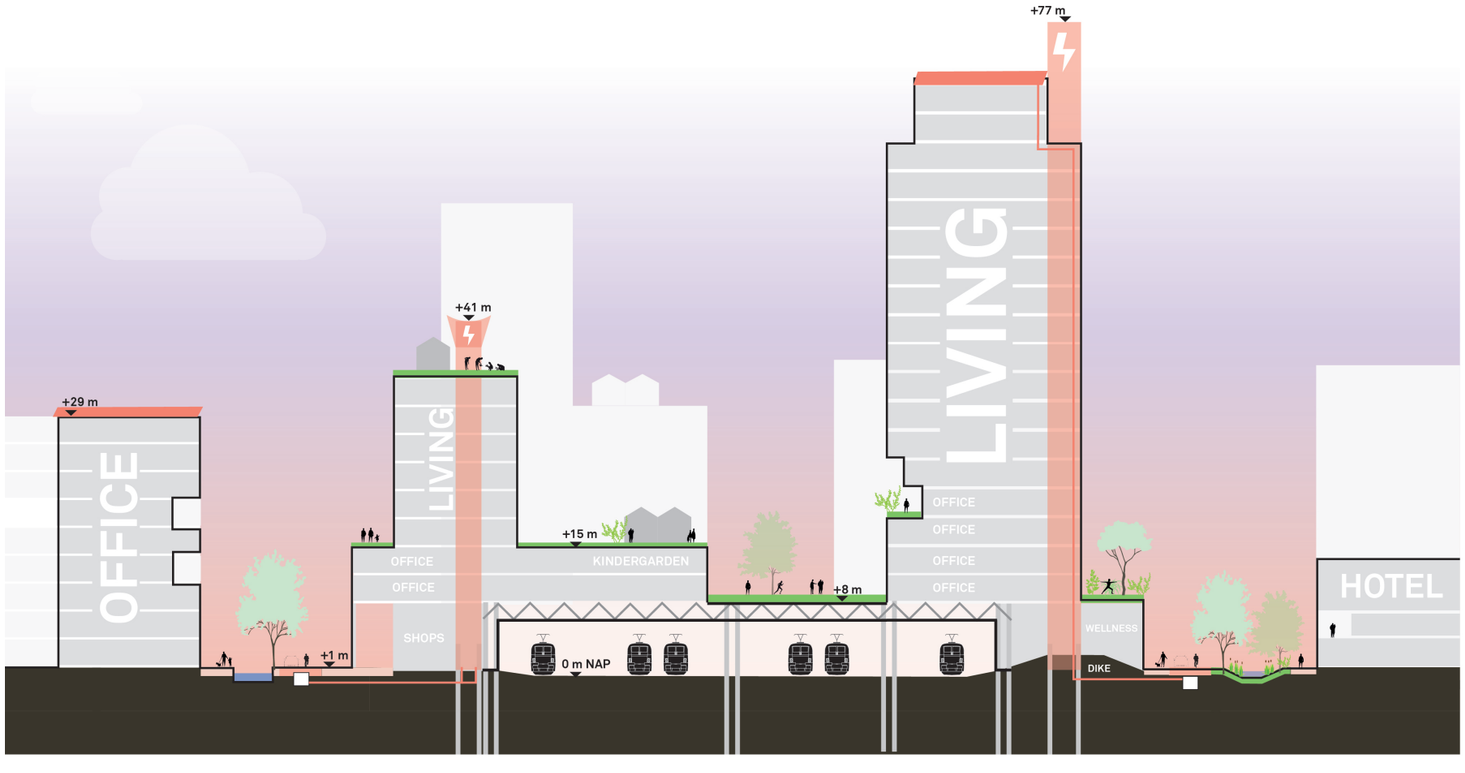
Section AA
2021



Visible patterns:



Section AA
2040

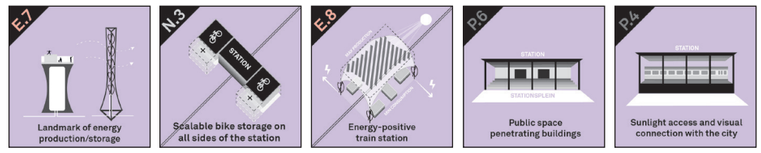


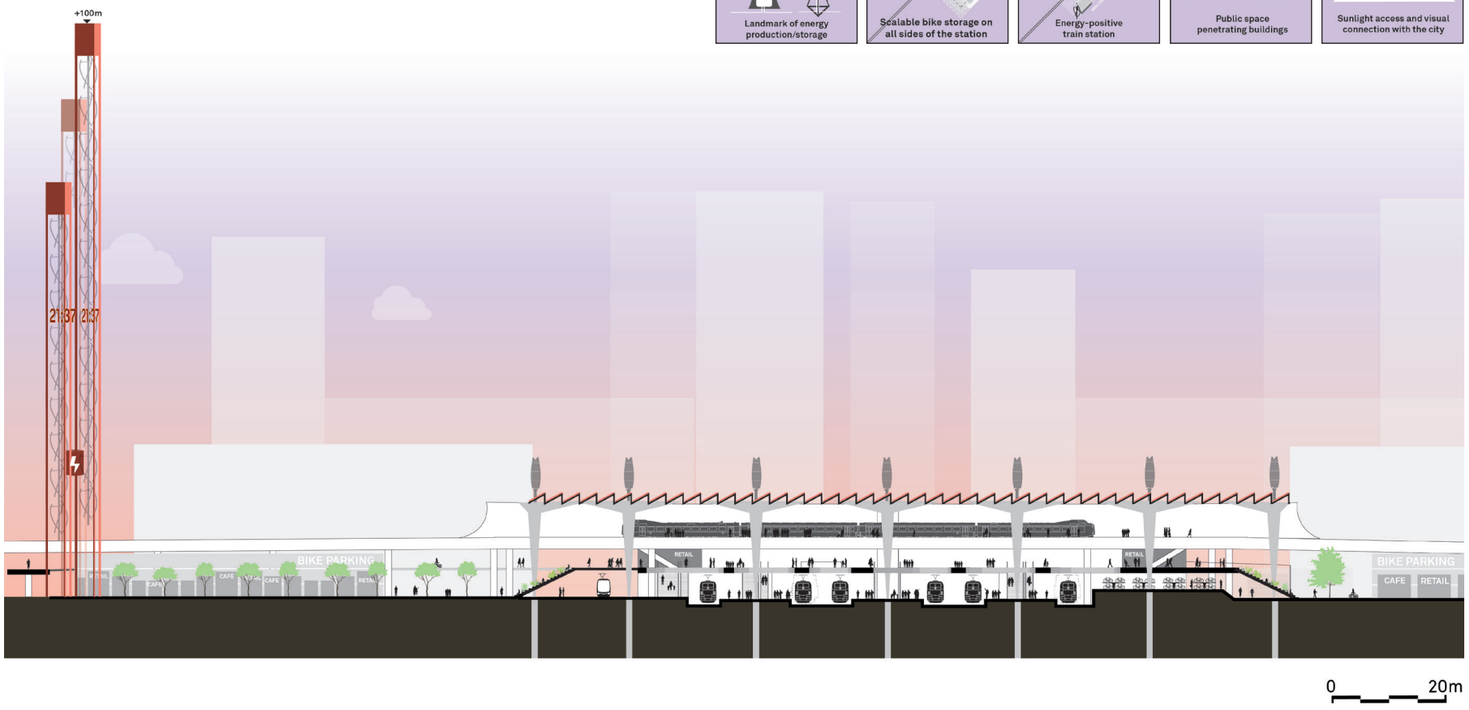
Amsterdam Sloterdijk 2040: Inclusive city over tracks

LONG-TERM

Section BB 2040

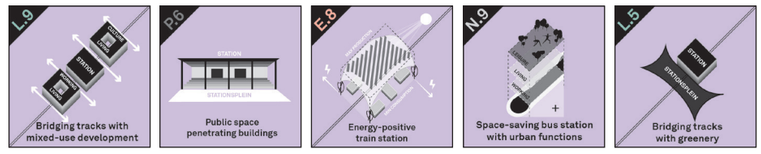
Visible patterns:





Section CC 2040

Visible patterns:

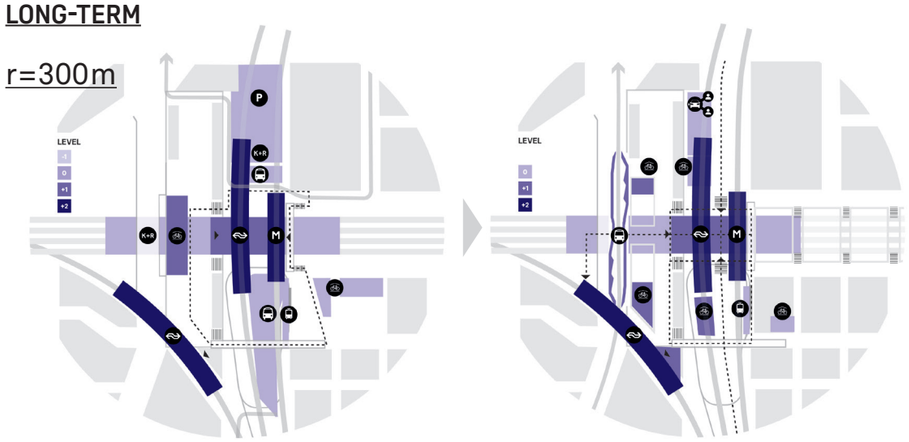




Amsterdam Sloterdijk 2040: Inclusive city over tracks

LONG-TERM

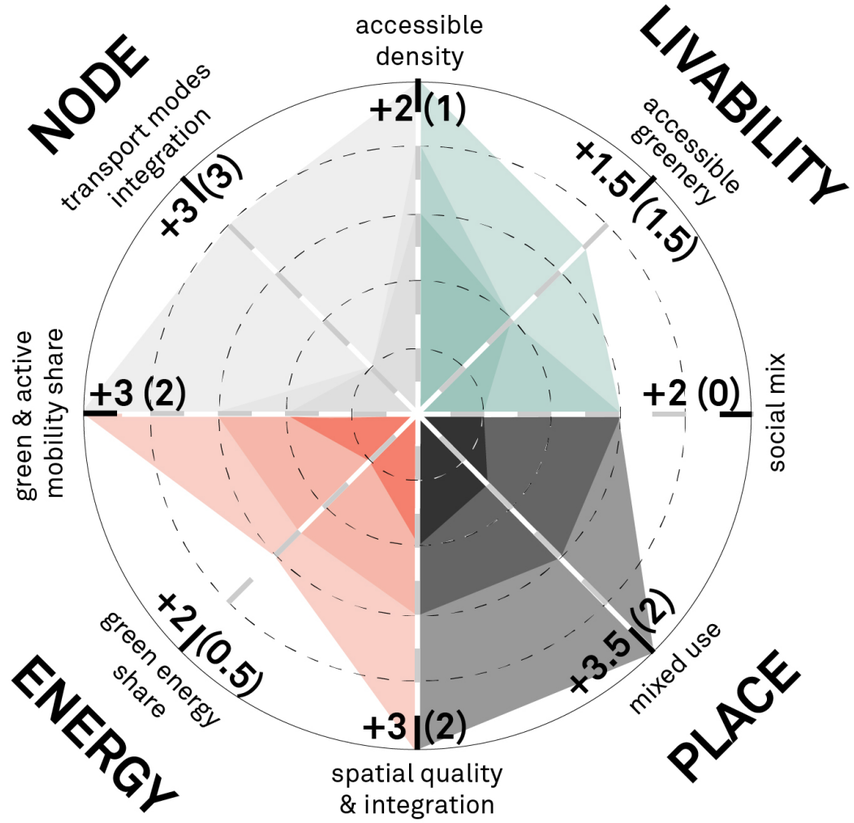
r=300m



2021 *2040*

Node	Desired modal split	35% bike / 35% walking / 28% OV / 2% shared car
	Distance for change OV/train	85 m bus-train / 75 m train-tram
	Estimated daily ridership	130 000 (based on current trend)
Livability	Green areas	2.69 ha (rooftop) 3.54 ha (ground)
	Number of new residents	6 200 (2 066 homes)
	Green areas per capita [1]	9.93 m^2 ($9m^2$ min.; $50m^2$ recommended by WHO)
Place	Number of new employees	5 682 (56.819 m^2 of offices/coworking)
	FSI	3.25 (only built-up plots, including public spaces)
	Mixed use	61% living / 23% working / 9% social / 7% retail
Energy	Estimated energy demand [2]	13.5 GWh/yr
	Solar potential [3]	18.82 GWh/yr buildings; 7.81 GWh/yr station
	Potential surplus	5.68 GWh/yr

[1] Rooftop greenery is counted as 50% of ground.
[2] Assuming that all new buildings have A+++ energy label and energy consumption is 50 kWh / m2
[3] Assuming 1276 kWh/yr/m2 based on globalsolaratlas.info



This scenario is an example that extreme densification and integration of station and the city may hinder some qualities within the rose model, and do not lead to the full balance. Even if scenario was equipped with patterns from all dimensions.

Transport modes integration cannot reach the highest score, because intermodal hub integrated with high-density mixed use may in fact lack clarity of independent train station. High rise buildings are limiting visibility, between modes of transport. Crowded public spaces with active plints and complex program may be distracting and slowing down. For better score, such a complex node should offer parallel connections of different qualities, instead of one, main street between bus and train stations.

Achieving energy-neutral or positive buildings can be challenging. High rise buildings are limiting solar energy harvest of the neighboring rooftops. Solar facades and small wind turbines placed on rooftops may be a necessity to achieve energy neutrality. It may be possible to shape wind tunnels by strategically locating high rise buildings, so that wind energy has maximal potential. Here, it is the case of wind tower generating electricity for the station hall.

While municipality expects maximum 40% of living in the mixed use in Sloterdijk-centrum this scenario turns around the proportions. Over track densification means it is possible to reduce the building heights, proposed towers are not higher than 110 m (150 considered in plans).

07 Conclusion

RQ

How can train station areas development
in the Netherlands
allow
adaptable and equitable densification,
and catalyze
energy transition?

SQ1 How do we define TSAD and what does it tell us about the contemporary relationship between the train station and the city?

SQ2 What is neoliberalization and how does it influence TSAD in the Netherlands?

SQ3 What are the spatial implications of energy transition for train stations?

SQ4 How to achieve dense and equitable living environment in station areas?

SQ5 How to plan and design adaptable train stations of the future?

SQ6 How TSAD can contribute to energy transition?

One cannot forecast *the* future, but rather attempt to research and design diverse futures. Four scenarios I introduced aimed to demonstrate how pattern language can be applied not only in different sites, but also different socio-economic realities. What if a city goes bankrupt, shopping streets go vacant and social problems intensify? How a station area should respond to that? What if a new national program subsidizes energy transition in small cities, so they experiment with innovations on railway wastescapes? What if a trend of working from home results in a revival of small cities?

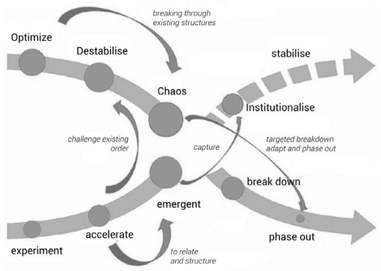
Design scenarios have shown that applying patterns to the same site but during different socio-economical realities can bring different outcomes. Also, patterns passed the test of transferability; after multiple design iterations, I achieved a set of 36 patterns that may be applied in most of train station areas in the Netherlands. Of course, local conditions are predefining which clusters of pattern language will be adequate. The pattern language turned out to be also a decision-making tool. Selection can be based on potential synergy, more tension between selected patterns mean more design challenges.

My first conclusion from research by design was that train stations' role in urban fabric is two-fold: they are simultaneously a connector and attractor. in the Dutch context they often act as a bridge connecting two districts of contrasting typo-morphology and socio-economic status: a historical city center and post-war expansion. Train stations as attractors are "condemned" to be the center of urban activities.

SQ1 & **SQ2** were answered in the Chapter 3 *Theory* in my essay *Train stations: catalysts of sustainability transitions or hubs of capital allocation?* [p. 50]. Train Station Area Development (TSAD) is an emerging study field distinct from Transit Oriented Development. It deals with holistic approach to train stations and surrounding urban development in European cities, often historical and of high-density, while TOD originates from suburban contexts of Americas and modern urban fabric in Asia, where it reduces car dependency.

The rail renaissance Europe has been experiencing since the 1990s. has also its dark side. Train stations were one of the main areas of neoliberal restructuring, in other words, railway grounds were privatized and developed by private investors to maximize profit. Now, the first generation of office parks and shopping malls is already obsolete and often demolished, after only two-three decades. In the Netherlands large cities often struggle with affordable development around the stations in the context of soaring real estate prices, but also with dissonant heritage of once moneymaking development. This development was not available for train stations smaller than around 10K daily ridership in the network.

SQ3:I have learned that spatial implications of energy transitions are partly unpredictable. It is challenging, but design can still address the unknown, after all in five more years, new energy storage technology may be available for urban areas. That is why station areas should introduce energy zoning, including also future spatial reserves (ie. with short-term land use).



X-curve of transiton manegement. Source: Drift [2017]

Socio-technical transitions are very dynamic by nature. According to the X-curve model (Drift, 2017), transition can unfold chaotically and rapidly once a critical mass is reached. But before a snowball effect, a slow and long experimentation phase is needed. Looking at sustainable energy innovations that are sprouting since the Paris Climate Agreement, and how the climate crisis became one of the leading themes in the Dutch election campaign in 2021, I think we can expect the exponential transition pace in the coming decade. Of course, fueled by the climate crisis, only exacerbated by the pandemic and neoliberalism.

SQ4: Densification is challenging for inclusive city. As observed in Atlas on the case of Breda, housing in station area often results in change of existing social mix, as new developments led by private developers are profit-oriented and focus on premium apartments for sale. Design scenarios proposed specific locations for affordable and commercial housing within each block to provide the optimal social mix. Some plots in station area are more expensive to develop than others (ie. over track developlment), and there less equitable development is feasible. However, commercial part of the project should always be used to fund social program, not increase profit. Densification in station areas must provide new social infrastructure: schools, kindergardens, community or medical centers, not to act as a parasite on the existing public goods.

SQ5: Lack of national agenda often makes the design process vulnerable to local politics or ad hoc concepts that fix that shape the station area for decades (ie. Herleen). The pattern language I created aimed to collect and test solutions that every station may need to face the energy transition and densification. Adaptable train station of the future should be planned using systematic approach, like the proposed pattern language, that helps to shape diverse station areas, leaving space for contextual design, yet in terms of program addressing nationwide urgencies. I would like to point out the need for coherent national agenda for train stations areas, which is necessary to fully utilize their potential.

Ambitious visions 2040+ are hindering the potential of station areas, available *here and now*. Temporary land use policy should become a standard in station areas. Now it is an exception visible in major cities, where it is often bottom-up, that happened despite the planning policies, rather than thanks to it. In fact, every train station area could have a dedicated long-term and short-term vision.

If I had to point out one element of train stations where adaptability is badly needed, it would bike storage and parking garages. Mobility transition is inherently linked with densification and energy transition, so the basis for future-proof train station is to provide scalable parking facilities that allow to completely change proportions between shared mobility, individual cars and bikes, during few years, without demolition. As analyzed cases have shown, train stations are so dynamic that soon after completion long-term design may become obsolete. Parking facilities should not take shape of intricate, concrete-consuming underground structures, as it is often now.

SQ6: Train stations often have important node function in various networks (mobility, energy infrastructure, green&blue, public spaces), which results in good potential to become catalysts of energy transition. Their role can be twofold.

Firstly, as demonstrated by design scenarios, train stations can become landmarks of energy transition. Not just architectural sculptures, but esthetic infrastructure that efficiently generates energy, and brings social change. Secondly, they may be a good start to build energy-neutral and then energry-positive neighborhoods, supporting the city centers in the transition.

When discussing the role of TSAD in energy transition, it is important to reconsider the limitations of urban landscape protection. I argue that energy transition hidden under same brick facades will not have effect on behavioural change, as a visible shift in the built environment. The success of the French nationwide program for eco-quartiers shows how the form of new urban development can become a landmark of sustainability. Coherent climate-proof solutions are visible in the design of new districts across the country, even though they differ on the contextual level. Special boards are informing the public on carbon dioxide savings or green energy generation and urban blocks are shaped to maximize the solar energy harvest and minimize cooling in the summer.

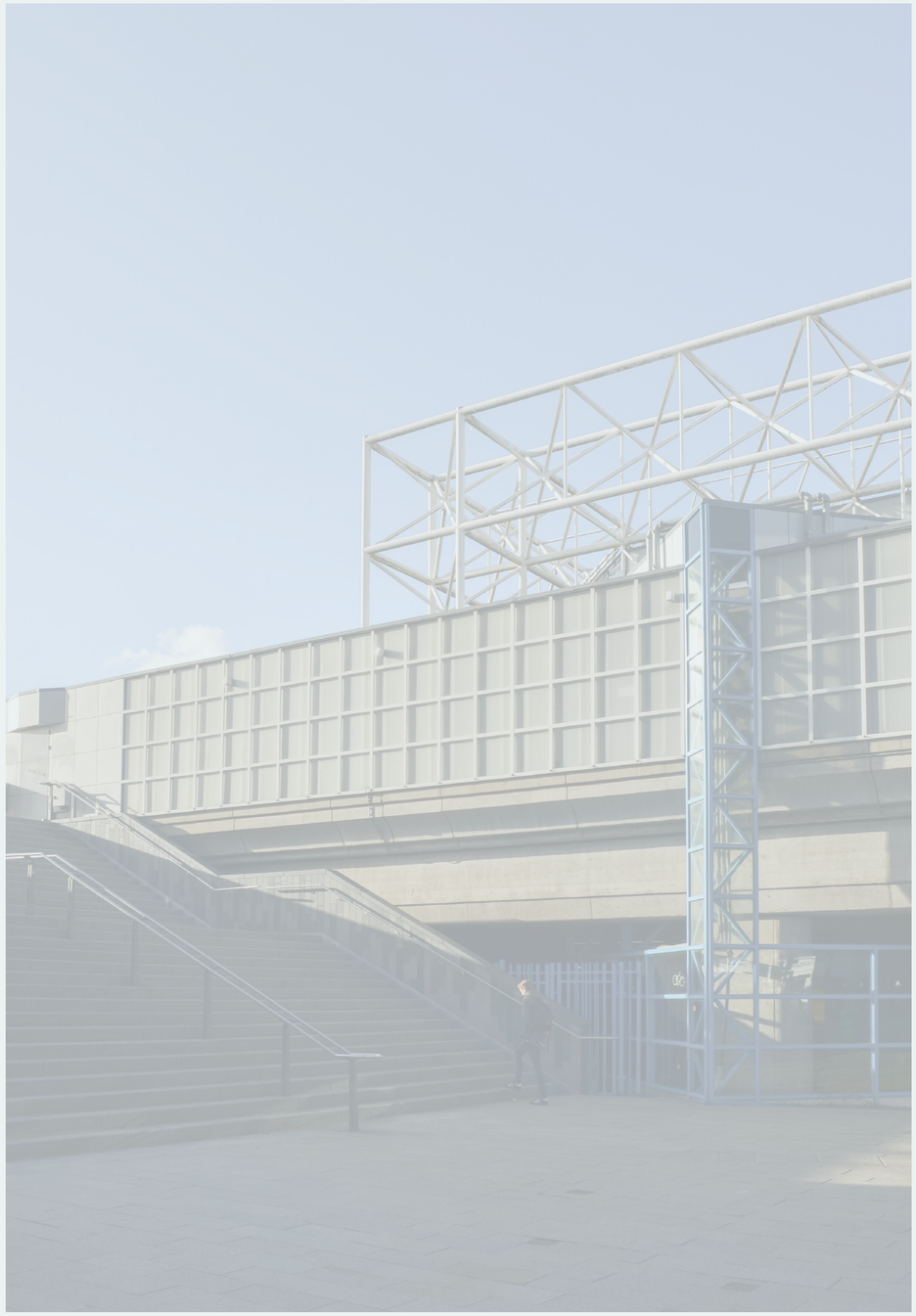


Ecoquartier Caserne de Bonne in Grenoble as a landmark for energy transition. Source: https://www.agencedevillers.com/archives/719

To conclude design scenarios, as seen on the example of Sloterdijk, large train stations may require foremost “soothing” design interventions, to relieve the pressure of densification. At the same time, following the case of Bergen op Zoom, in many small stations, activation can be seen as priority. Stagnating, desolate train station became a symbolic image of peripheries. This image is stigmatizing many small cities experiencing the exodus of a young generation, which often starts from commuting to middle school by train.

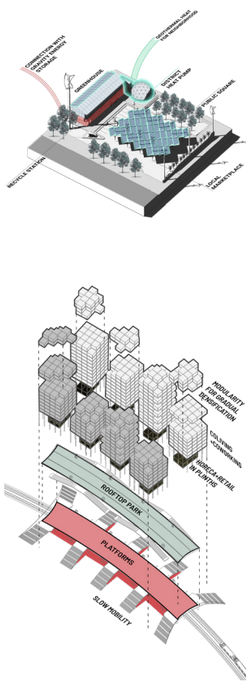
In the Netherlands, since the Vinex program, there is a tendency to develop suburban stations, used by people commuting to Randstad, but living in a smaller city. Such stations, indicated in the analysis part, can be also developed using the pattern language. They are rarely seen as areas for densification, but energy transition, and community-building around the station remain adequate.

08 Reflection



Qualities of density, and urban transformation, themes of this year's Design of the Urban Fabrics Graduation Studio was an entry point to explore the future-proof configurations of train station areas.

Initially, my motivation was fueled by ordinary frustration by the never discussed shortfalls of contemporary, celebrated designs of train stations in Breda, Utrecht or Arnhem, among others. After the first year of my master at TU Delft, they seemed to me like a wasted potential, and a burden of future generations, rather than benchmarks.



Own work from Q3 & Q4 of Master studies.

Then, curiosity led me to research the other side of the coin of train station renaissance experienced since the 1990s: marginalization of small stations and neoliberalization of the large. The topic was also little discussed in the literature, which ensured me of following the right path.

The Urbanism track with its diverse assignments in the first year has helped me to define my interests as a designer, and pursue them in this graduation project. After the first two quarters of trial and error, I think that the third and the fourth quarters formed me as designer. It was then, when I consciously applied the Delft holistic approach to urbanism. In Q3 with a team I prepared a regional strategy for circular construction and demolition of energy infrastructure. It was a great lesson on the new decentralized energy system, socio-technical transitions, phasing and stakeholder analysis. In Q4 in turn, I explored the interactions between architecture and urban design, as a part of Architectural Design Crossovers elective studio. I developed a concept of future-proof metro station with adaptable densification program. It has brought me closer to the answer on my question on role of railway infrastructure in the future city.

In my professional life before my master studies I was involved in design and planning of metro lines. Of course there was little time for reflection, but mostly on-site problem solving. In the beginning I have seen my graduation project as an opportunity to position train station development in a wider, political and economic context. I did not wanted to do again a regular one-site design assignment, but to get a big picture of the problem across the Dutch rail network and strive for maximum transferability. Initially this seemed ambitious, but I am glad it turned out to be feasible.

Societal and scientific relevance

Redevelopment of train station areas is a common challenge in most of urban areas in Europe, thus also an opportunity to address social urgencies and climate crisis. However, since its advent in the 1980s, redevelopment projects are mostly dealing with real-estate moneymaking. In the current neoliberal paradigm, only major stations, well-positioned in the international network, were flanked by business parks, shopping malls, hotels or convention centers, while the rest experienced stagnation or decline.

The research has shown that it is also the case in the Dutch network, in fact, rail can be used to highlight the regions endangered by peripheralization. Roughly 63% of analyzed train stations can be labelled as “loosers”, of the neoliberal game as they failed to attract external capital to realize the TSAD project.

By my project, I want to make a point that densification in train station areas should not be perceived as a way to finance the rail infrastructure and bring profit, but as a chance to relieve the housing crisis and create future-proof living environment.

One of the main design conclusions is a necessity to introduce a coherent national agenda for train stations, only then we can tackle the challenges of housing and climate crisis. Uncoordinated effort of municipalities will not bring the same effect. At the same time train stations as a design assignment should respond to subtleties of the local context and not be subject to bland uniformization (but now a sustainable one) as in the 1970s.

Through my integral approach to train station areas I would like to contribute to the emerging study field of TSAD. It is an interdisciplinary field, to which various authors from urban studies, economics, transport, applied research in urban planning and design or architecture have contributed. The topic of neoliberalization in the Dutch context and marginalization of smaller stations is not sufficiently covered, but could help with setting sustainable ambitions for cohesive development of the rail network.

Reflection on methodology

A pattern language has played a bigger role in my project than initially expected. However, since the beginning I wanted it work as a relational tool: on the one hand to be well suited to capture the complexity of train station areas, on the other, to have a very approachable form, comprehensible for all stakeholders in the development process.

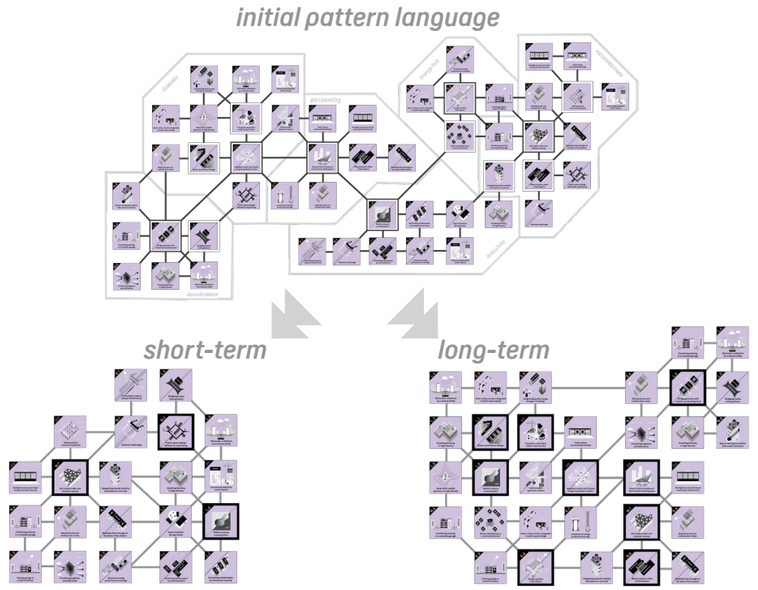
I think it proved to be well-suited as my leading research by design method, especially it allowed to integrate the interdisciplinary nature of the topic. However, at the beginning it was challenging, creating patterns was slow process requiring a lot of attention and hindering other parts of the project. It became very rewarding at the end, when all components started to fit and work as expected.

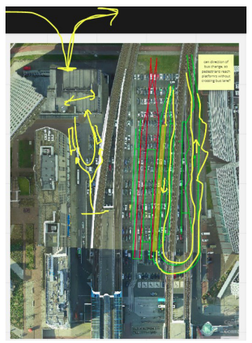
I discovered that the conceptual framework drafted at the begging of the project was not guiding sufficiently at the later stage: how to come from the stage of decontextualized patterns to the site-specific design. Then I realized that research by design needs to be systematized to embrace the complexity of train stations and urban fabric. As a result, in the middle of the project I defined a five-step design process that helped me to move forward and fill the gap in my overarching framework. I think it is transferable to every case of TSAD and I hope to make use of it in my professional life.

After my P4 I conducted a small workshop in order to test and improve the pattern language. I invited five participants, all having background in Urbanism, and little to average knowledge of the sites. They received description of pattern cards, problems and potentials of the site, and scenario goals. I asked them to select the patterns for one scenario and consider their location.

Three participants have come to similar selection as proposed in the scenarios. Two participants have selected slightly different patterns, which resulted from their own interpretation of patterns and little knowledge of the site. All of the participants have indicated that they have impression of too many rules, which complicate the process. At the same time, the selection and applying process was not guiding enough if participants had insufficient knowledge of the site.

As a response to that, I made the process of appling and selecting patterns more transparent, and split the scheme of synergies into short term and long term boards. After these changes I repeated the experiment with the same five participants. The results improved, in all cases they have come to the same choices, as proposed in the scenarios.





Sketches for potential bus .tram station in Sloterdijk. Source: PosadMaxwan

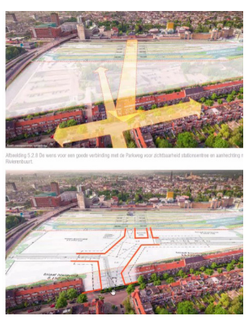
This humble attempt of workshops made me realize, that any pattern language should be actually developed through workshops, negotiations and in a interdisciplinary team. After all, Christopher Alexander's first pattern language was the result of an extensive groupwork. A master thesis, exploratory research prepared in pandemic isolation with limited external feedback is not a favorable environment to do so. As a matter of fact, my proposal should not be read as a comprehensive catalog for "the future" of train stations in the Netherlands. It was an experiment, to use the pattern language in the context of train stations and address a selection of spatial problems I discovered in my research.

Nevertheless, after the whole process I am still in favor of a pattern language as a design method for this complex topic. It can be an innovative approach useful to form a future agenda for train station areas on the national level. After my graduation I am planning to approach Bureau Spoorbouwmeester and NS with this topic.

Interactions between practice and academia

As a designer at PosadMaxwan I was part of a team working on strategy and a spatial framework for Amsterdam Sloterdijk station area. Professional work was a parallel process to research by design in this graduation project. It was also an important, empirical input to the generation of patterns. In the course of the project I found myself constantly maneuvering between research and design, between practice and academia. Despite careful planning, work in the practice included a large dose of uncertainty: what will be my share in different stages of the project, how will they influence my academic exploration.

The professional project studied also feasibility of over-track densification in Sloterdijk. It had quite integral approach to node and place planning – next to massing and forming public spaces we planned a future layout of station facilities, tram and bus stops. However, the station hall itself was still treated as a separate assignment for a different project.



Shaping the north entrance to Groningen Station, planning regulations. Source: Posad-Maxwan.

What stroke me in this and other station area projects is long-term planning. Long-term solutions are considered almost exclusively, and vision post-2040 is the ultimate goal. While it also means that the current dysfunctional node will still be there in five years, with the same flaws that could be solved by a modest intervention, as demonstrated in short-term design scenario for Sloterdijk.

The project in the practice was a result of negotiation between the PosadMaxwan team and the client consisting of five parties: Gemeente Amsterdam, NS Stations, ProRail, Vervoerregio Amsterdam, and Provincie Noord-Holland. It was quite rewarding to reflect upon professional teamwork and tackle the alternative version of the project on my own.

Subjectivity is inherent to individual design assignment. On the other hand, I learned from practice that it is almost a rule that station areas have the most complex clients among urban design project, even though usually all the involved parties are public. The risk of subjectivity was reduced in the case of

Sloterdijk, but not in Bergen op Zoom.

Limitations

Of course, a pattern language as a method has its limitations. Proposed catalog of patterns is not a comprehensive catalog of solutions for future train stations, nor the ultimate building blocks. In reality, a pattern language would never be an individual assignment, but an evolving outcome of teamwork, workshops, feedback loops. I wanted to point out the potential of integral approach to train station areas, where the pattern language allows site-specific design and cohesive response to climate and housing crisis at the same time

When working with a pattern language, I discovered that it creates risks for design. If treated as a closed catalogue it may be hindering creativity of on-site design. However, when a pattern language is iteratively shaped by design, it has a power of systematizing design solutions, to make sure they work in large and small stations. I hope I was able to mitigate risks and benefit from its potential.

Despite the urge to address affordable housing in station areas, I have to admit that its success mostly depends on matters that are beyond the scope of this project: public subsidies, financial feasibility, construction cost estimation. In urban design scale I could locate the affordable housing in relation to train station and include social facilities in the development to make station area act as a social patch.



Covid measures introduced in NS train stations. Source: https://bit.ly/2SH2Ejn

When we look at daily life of our cities in the context of Covid-19 pandemic, train stations were arguably the most affected areas. Public transport and especially intercity trains were particularly hit by the pandemic. In 2020 NS reported 55% shrinkage of passengers compared to 2019. Following the government measures, since March 2020 trains became dedicated to provide safe commute for essentials professions.

Here I would like to point out that my perception of the project sites may be biased by the stillness of the pandemic. I was not able to observe the rush hours, the crowds and nuisance so challenging for livability in station areas. I had to rely on scarce pre-pandemic memories.

Regarding the influence of the pandemic on day to day process, I would like to stress that full online education is not an environment a graduation project like this could benefit from. More interaction with fellow students, academic events, exchange of knowledge or proper fieldwork would have been an added value.

Reflection on data collection

The largest obstacle was data collection on energy use. It turned out to be scattered between many private service providers, registered per postcode area, not consistently per block. An attempt to systematize the data on energy use per urban blocks in given station areas could have been a project on its own. For that reason, the project has no ambitions on calculating the energy generation

and demand in chosen sites. Agency Generation.Energy working closely with PosadMaxwan was an important source for me, thanks to which I could base the energy side of the project on informed speculation. Data on housing program and local developments was also fragmented, but widely available on real estate websites and in local newspapers.

Reflection on ethics

In many countries with weak (or market-oriented on purpose) planning systems, densification has a very pejorative meaning, as it is driven by real estate speculation; only market decides where to densify. This often leads to lower quality of life, and overloaded public infrastructure. In the Netherlands, municipalities have the agency. Nevertheless, densification, even if consciously shaped by planners, can still deteriorate livability and create social tensions.



Planned timber skyscraper next to Rotterdam Centraal. Source: https://bit.ly/3i5bL82

High-density living environments with horizontal mixed use are not yet common and we can only speculate how they will influence the urban life, and will they be able to attract diverse social groups. Still, I have the impression that it is too often perceived as a panacea for all contemporary urban problems. Short-time scenario for Sloterdijk was my response to this doubt; what if the redevelopment focuses only on relieving the pressure caused by already planned densification.

I think that real-life review of the housing development comes after a decade since completion. In case of train stations it is around half of that time, when it becomes clear what works and what will require future interventions. It may take years, before the change is appropriated by users of the area, so the design of train station areas should always involve co-creation, and follow the concept of an open city (in terms of planning) as understood by Richard Sennett (2006), and open building, (in terms of building design), as defined by John Habraken (1961).

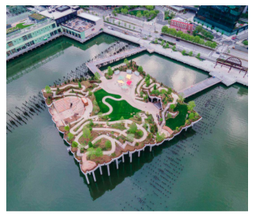
To build or not to build – that is the question of sustainability. Train stations and their surroundings are one of the largest infrastructural projects in cities, hence their carbon footprint is one of the largest, even though it is the price of increased share of sustainable mobility.



Interview with Lacaton & Vassal: http://www.reduce-reuse-recycle.info/Projekt_3_0_id_21.html

Sometimes it is better not to build at all, as powerfully proved by projects Lactonase, Pritzker laureates in 2021. In 1996 they were commissioned to redesign a square in Bordeaux. However, after a thorough study they convinced the municipality to leave the form of the square untouched, only introduce a proper maintenance, and temporary interventions, because the square already functioned so well.

Last but not least, in the current densification and greenification fever I would like to advocate for design minimizing the consumption of concrete. Densification in train station areas in the next decade can be a great prospect for a “revolution in wood”; a widespread use of cross-laminated timber. This means moving from the material responsible for 8% of global CO2 emissions to carbon sequestration. Rotterdam and Eindhoven are advanced with their plans for timber skyscrapers in their station areas. In that way, hopefully, the use of reinforced concrete will be reserved only for building cores, foundations and necessary infrastructure.



Park Little Island in NYC. Source: https://bit.ly/3yRXYYC

Here as warning I would like to give an example of recently completed park on Hudson River in New York. A private investor made 1 ha of over-water park possible due to $260 mln and 132 of concrete piles in the riverbed. It may be hard to find an example of more obnoxious greenwashing. Complex infrastructure nodes, like train stations, are especially prone to it, when big investments are involved, and “wow” effect is needed.

Any decision on demolition or over site development bares especially high carbon footprint. I experienced that when working on the case of Sloterdijk, in practice and on my own. Everything in the site was younger than 35 years, yet demolition seemed to be an obvious solution. By short-term scenarios I would like to advocate for optimizing the node and placemaking by light interventions in the existing structure.

Potential for transferability

Transferability within the stations of Dutch rail network is one of the goals of the project. That is why I chose a pattern language as a key method to systematize my research by design. However, the the project deals with challenges and conditions of the rail network which are very specific to the Dutch context, I argue that the logic of a pattern language and proposed assessment framework (the rose model) can be applied to other cases of station area redevelopment in Europe.

Design scenarios for Bergen op Zoom aim to be relatable to other small cities in the Netherlands, facing the renovations of train stations scheduled for the coming years, but at the same time endangered by peripheralization. Of course, architectural design should remain contextual, but program and spatial layout of station area may be related to other small cities.

The complexity of the node of Amsterdam Sloterdijk and context of a large business district is unique on the national scale, so scenarios proposed for this site are not directly transferable. Nevertheless, this station area may become a breeding ground for innovative solutions, as the aftermath of the crisis 2008 has shown. Temporary social-oriented projects like student village, pavilion BRET, depaving of Orlyplein, development of affordable housing or farm from shipping containers has set the bar for station areas. In that sense, Sloterdijk, if developed properly, can become a pattern language itself, which configurations could be applied to other station areas across the Netherlands.

I am sure that findings from this master thesis will allow me to grow as a designer in practice. After graduation I am continuing my work at PosadMaxwan, it is probably a matter of time, when our team will deal with another case of train station area.

Maciej Górz

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