

Me tropolitan

Mo bility

Hub

thinking beyond
transportation



**POLITECNICO
DI TORINO**

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Architecture Construction and City

Politecnico di Torino

2020 - 2021

Double degree

Architecture and Urbanism

Universidade de Brasília

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abstract

The presented thesis aims to strengthen the understanding of sustainable mobility's contribution to the cities, by addressing the extent to which urban mobility infrastructure can enhance the quality of the urban realm and vice versa.

The study is divided in four sections, the first two - 'theoretical framework' and 'an urban dilemma' - define sustainable mobility, the concept of mobility hubs and question how cities have been addressing it in urban redevelopment projects. The third and four sections, named 'local problematic' and 'the proposal', sharpen the framework of discussion to the area surrounding Berlin's Central Station and, by analysing the selected site and building scenarios, propose the MeMo Hub, a Metropolitan Mobility Hub.

The focus of this study is the city of Berlin, that has been suffering a wide range of transformations after the fall of the Berlin Wall. As part of the goal to rise the city's attractiveness worldwide and its wellbeing, the governmental institutions are promoting projects that follows the guidelines of sustainable mobility. It is crucial to understand the importance of public participation integrated in this process to achieve the common goal.

In this regard, MeMo Hub propose, by involving the stakeholders since the early stages of the planning, a mobility hub that is both source and destination for urban activity. Fostering a diversity of activities and improving the connection of the Central Station within the city, it creates a sense of place where the citizens of the rising district can belong.

This work is dedicated to my parents, brother and my best friends, thank you for all the love and support.

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1 theoretical
framework

1.1 defining sustainable mobility

The prevailing modern usage of the term sustainability finds its recent roots in the environmental movement. However, during the 1990s, sustainability grew beyond purely environmental concerns, as the “three dimensions” came forward: environmental, economic and social (or equity), the so-called “three E’s of sustainability”. However, there is no single definition for sustainability nor sustainable development, in fact, this overabundance of definitions range from macro-level perspectives to specific indicators in each of the sustainability dimensions.

Although the complexity of the concept is recognisable, the presented thesis has narrowed down the range of definitions of this term to apply it to the dimensions related to urban mobility. With the ongoing densification of the cities that prompt environmental and social challenges, the sustainability concept was rapidly adapted to the urban context.

The on going urbanisation and economic growth mean that people will be making more trips,

across longer distances, in more and larger cities across the globe. In the face of this growth, urban transportation systems must balance two basic needs. On the one hand, the need for transport to continue to contribute to economic development and human welfare and, on the other hand, the need to mitigate transport’s negative effects, both current and future. (ZEGRAS, Christopher, p.2, 2011.)

The idea of sustainability in the transport sector followed the global energy crisis of the 1970s that put into light concerns about transportation’s primary energy source, petroleum. It logically follows the evolution of society’s concerns about transport’s social, environmental and economic effects, particularly in the city. In the 1990s, after several reports, studies and initiatives from international governmental and non-governmental organisations, the conceptualisation of sustainable transport and its indicators was materialised. Despite the different approaches that varies from each institution, their defini-

tion share the basic concepts of accessibility, recognition of resource constraints (financial, economic, natural and cultural) and equity.

Mobility contributes to the creation of accessibility. Accessibility can be described as the “extent to which the land-use and transportation systems enable groups of individuals to reach activities or destinations”. As such, accessibility depends on the performance of the transportation system, on patterns of land use, on the individual characteristics of firms and people, and the overall quality of opportunities available. Accessibility also depends on the quality of our information and communication technologies, or ICTs. If accessibility is the desired outcome of the mobility system, then sustainably providing for accessibility is the ultimate objective of the mobility planning process. (ZEGRAS, Christopher, week 2, 2020).

Sustainability however, requires that we create current accessibility without damaging the possibilities for the future generations to enjoy at least the same levels of accessibility and well being. In other words, sustainable mobility requires that today’s mobility maintain the capability to provide non-declining accessibility over time. (ZEGRAS, Christopher, p.4, 2011.)

The Institute for Transportation and Development Policy, the World Research Institutes, GIZ, the European Institute for Sustainable Transport and the Partnership on Sustainable Low Carbon Transport (SLoCaT) have produced a set of indicators for sustainable transportation as basis for discussion. In general terms, the indicators are based on the three dimensions of sustainability outlined before (environmental, economic and social) and as a fourth dimension it measures good governance by the level of stakeholder involvement in the planning and decision process for transport policies and projects.

In 2017, at the Ecomobility World Festival in Taiwan, nine of the world’s largest city and transport NGOs launched the Share Mobility Principles

for Livable Cities, shared common principles that would guide urban decision-makers and stakeholders towards sustainable, inclusive, prosperous and resilient cities.

The first of these shared principles is “We plan our cities and their mobility together”, meaning that the way our cities are built determines mobility needs and how they can be met. In the urban space, there are two basic ways to enhance accessibility: improving mobility system, such as with more and faster connections or making the desired trip origins and destinations closer together. That means that the built environment, characterised by its urban form, influences the mobility system and vice versa. Consequently, the built environment can be planned and designed in such a way as to influence mobility towards desired outcomes.

One principle of achieving accessibility in cities is based on the physical concentration of people, services, economic activities and exchange, the distribution of those activities influence the travel distance, and thus, the relative travel cost implicit in traversing those distances by various modes available. That implies a particular attention to planning, designing, building and managing the specific local condition at human scale.

After experiencing widespread population loss in the second half of the 20th century, many inner cities have staged a revival, attracting residents and businesses back to city centres. Planning policies have changed towards compact city ideals of densification and mixed-use, with these policies supporting inner-city revival. Since the early 1990s, broader concerns about the effects of urban sprawl and the decline of city centres became aligned with an improvement understanding of their negative environmental impacts. As a result, compact city planning concepts were established, putting the mobility of people instead of vehicles in the centre of transportation planning and decision-making, thus

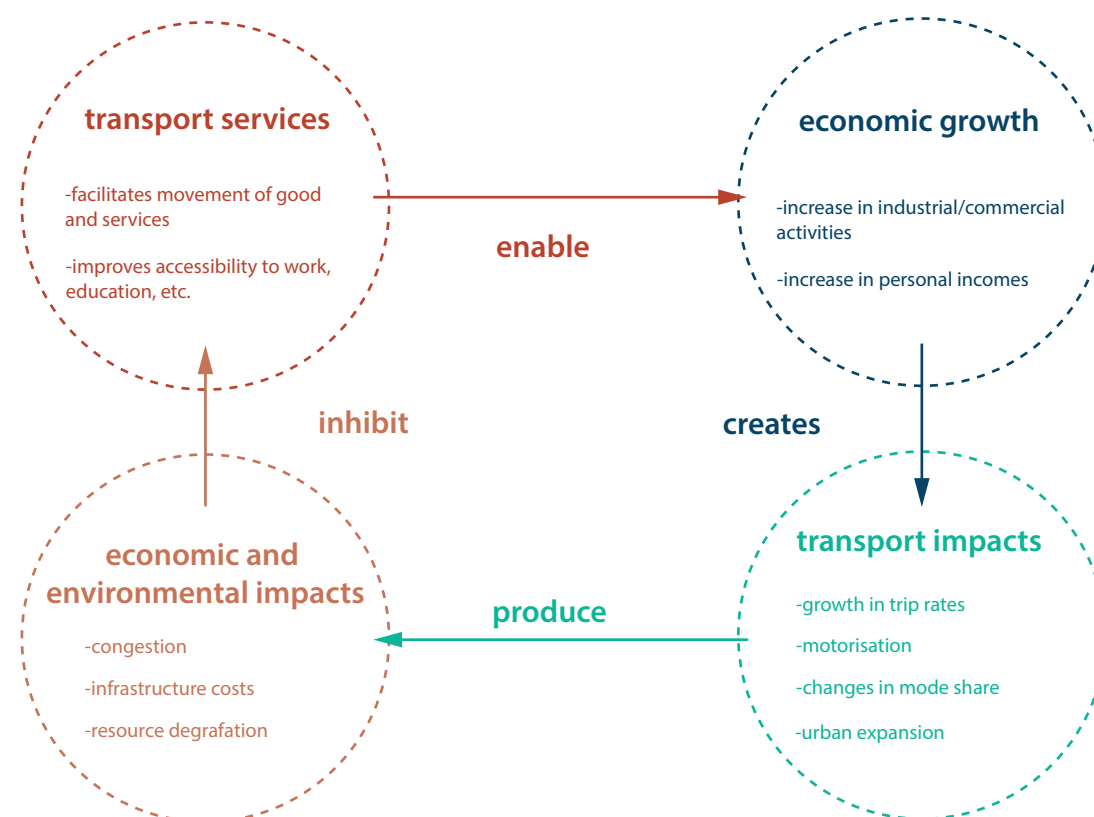


Table 1 - Ten key indicators for more sustainable transport

Dimension/Indicator	Underlying sustainability goal	Indicator type	Current availability of data
Environment			
Land consumption by transport infrastructure (as % of total surface)	Avoid sprawl and destruction of the environment by transport infrastructure	Effect/impact	Low
Transport GHG emissions per capita	Reduce transport contribution to climate change	Effect/impact	Medium
Percentage of population affected by local air pollutants (e.g. PM10 concentration, Non-Methane Hydrocarbons [NMHC] emissions,...)	Reduce detrimental effects on human health and the environment	Effect/impact	Medium
Equity/Social			
Road fatalities	Reduce the number of people killed or injured in road traffic accidents	Effect/impact	High
Modal share of PT/NMT	Foster transport modes that are both accessible for a large part of the population and environmentally sound	Outcome	Medium
Share of transport cost from total household expenditure	Provide affordable transportation for all members of the society	Outcome	Medium
Economy			
Minimum taxation on fuel	Consider the external costs caused by transportation based on fossil fuels	Performance	High
Transport investments by mode	Prefer transport modes that are accessible and environmentally sound	Performance	High
PKM/TKM per unit GDP	Decouple economic growth from transport demand	Effect/impact	Medium
Governance			
Participatory transport planning	Involve the public in the decision process for transport policies and projects	Performance	Low

Source: GIZ, Developing Practical Tools for Evaluation in the Context of the CSD Process, Eschborn 2011.

promoting increased urban densities and mixed use development integrated with public transport and pedestrian friendly urban neighbourhoods. (LSE CITIES, p. 8, 2015.)

The socio-spatial change that cities have been suffering over the past decades is being followed by the introduction of new vehicles and new services that are stressing existing regulations, business models and government revenue stream. Consequently, city governments, city residents and

those who provide transportation services are being forced to rethink the status quo. This discussion provide the opportunity to city planners to reshape urban transportation to better respond to the needs of the 21st century. (CHASE, Robin, week 1, 2020).

1.2 new mobility services

Such new technologies are known as “New Mobility”, term that comprehends shared vehicles, shared rides, shared data, electric motors, automated vehicles and on-demand delivery of both goods and services.

Shared mobility is one of the responsible factors for the shift in car use and ownership, car-sharing and ride-sharing provide a wide range of possibilities from rapid transit to moving people very densely per square meter. Either way, the shared vehicles allow the residents access to various services and jobs without the need to own a car. As aimed by the third Shared Mobility Principles for Livable Cities “we support the shared and efficient use of vehicles, lanes, curbs and land”, encouraging more trips and vehicles to be shared reduces congestion on our streets and at our curbs.

Microtransit, is another new category in the world of transportation. It refers to small vehicles, usually between six and twelve passengers that aggregate demand dynamically, this is very similar to ridesharing but associated with larger vehicles. This new category is very common in many emerging countries around the world. (BARBOUR, Natalia, week 1, 2020.)

One particularly important factor that has led to changes in urban mobility is the role of digital technologies. The development of the internet, to social media platforms and subsequently widespread smartphone and mobile computing device adoption have radically affected how we communicate, socialise, shop and consume media. Transport has also been greatly affected by innovation and communication technology, in the past decades public transport has been transformed by real-time information, online route finding and ticketing available through mobile devices. It also affected the experience of driving, through satellite navigation devices and online services such as parking availability platforms.

Recently, this change has increased significantly with the COVID-19 pandemic, which has restricted the daily movement of people but, on the

other hand, has encourage the adoption of more seamless modes of transportation, such as micro-mobility. As part of the “New Mobility”, micro-mobility is a new term that include the variations of small vehicles or Personal Mobility Devices, PMDs. While it started with bike sharing, electric scooters and electric bikes are have grown to become frequently chosen options.

Beyond digitalisation, new technology redirected the urban transport focus to the electrification of urban mobility systems. This electrification is focused primarily on allowing electric vehicles to operate with stored electricity, eliminating the requirement of a constant grid connection. This benefits the urban environment by eliminating air and noise pollution and fuel consumption.

The introduction of transit applications made possible to discover not only the best routes for subways and buses, but also include the options to travel by micromobility, Transportation Network Companies or by a shared vehicle. This lead to the concept of Mobility as a Service - or MasS - which means integration of different transportation modes into a seamless and convenient app, it also includes the idea of one payment system across these modes. (BARBOUR, Natalia, week 1, 2020). The importance of this integration will be further explained with the development of this study.

1.3

cycling

Despite the technological advances in the mobility area, traditional forms of transportation such as cycling and walking, also known as “active transportation”, are being brought back into light due their important contribution for the health, wellbeing and quality of life in cities.

Bicycles use less space on the road than cars and increasing the modal change from cars to cycling can lead to less congestion. The environmental benefit of not emitting air pollutants while most modes do, and the affordability of the purchase price and the maintenance costs are also factors that contribute to the adoption of the mode. Cyclists also have a positive economic impact, the average cyclist spends more shopping than the average motorised customer. Additionally, well designed cycling facilities reduce accident risks for cycling and increase road safety.

Many successful European cities view a vibrant cycling culture as providing competitive advantage over other cities in attracting businesses, tourists and key workers, and therefore, have adopted world leading approaches to encouraging and supporting cycling. Those actions, should go hand in hand with other measures, all of which should fit into the long term vision. (CIVITAS, p.5, 2016).

Promote cycling in the urban environment cannot be achieved only by top-down measure such as the investment in a bicycle path. A change in the behaviour is needed to encourage road users to leave their cars and switch to cycling or make new types of trips by bicycle. This change is achieved by support actions, including behavioural, cultural and legislative aspects as well as the creation of cycling organisations and the combination of cycling projects with high quality urban projects. In other words, to have a successful outcome, actions by different stakeholders must be coordinated and set in motion.

With the aim of facilitating, coordinating and promoting cycling, the German Federal Government has created a regulatory framework called the National Cycling Plan (NCP). According to the

Federal Ministry of Transport, Building and Urban Development, Germany is already in the top third of European countries in terms of cycle use, over 80% of all households have at least one bicycle. Also, over the period from 2002 to 2008, cycling increased by 17% nationwide in terms of the number of journeys. This is the highest rate of growth of all means of transport.

Bicycles are also an important economic factor in Germany, in recent years, around 4 million bicycles have been sold each year and the demand for the device continue to rise. Beyond the mere selling of bicycles, the cycling tourism contribute significantly in the economy. The total annual turnover in the cycle tourism sector is around 16 billion euros. Arithmetically, this safeguards around 278,000 full-time jobs in Germany. (Information based on data provided by the ZIV, the BMWi and the Federal Statistical Office)

The NCP 2020 is based on the vision of cycling as a system and to achieve so, it is necessary more than just cycle-friendly infrastructure, intensive communications and public relations activities are just as important. This includes incorporating cycling measures in planning activities at local authority level and as part of urban development assistance and neighbourhood enhancement programs.

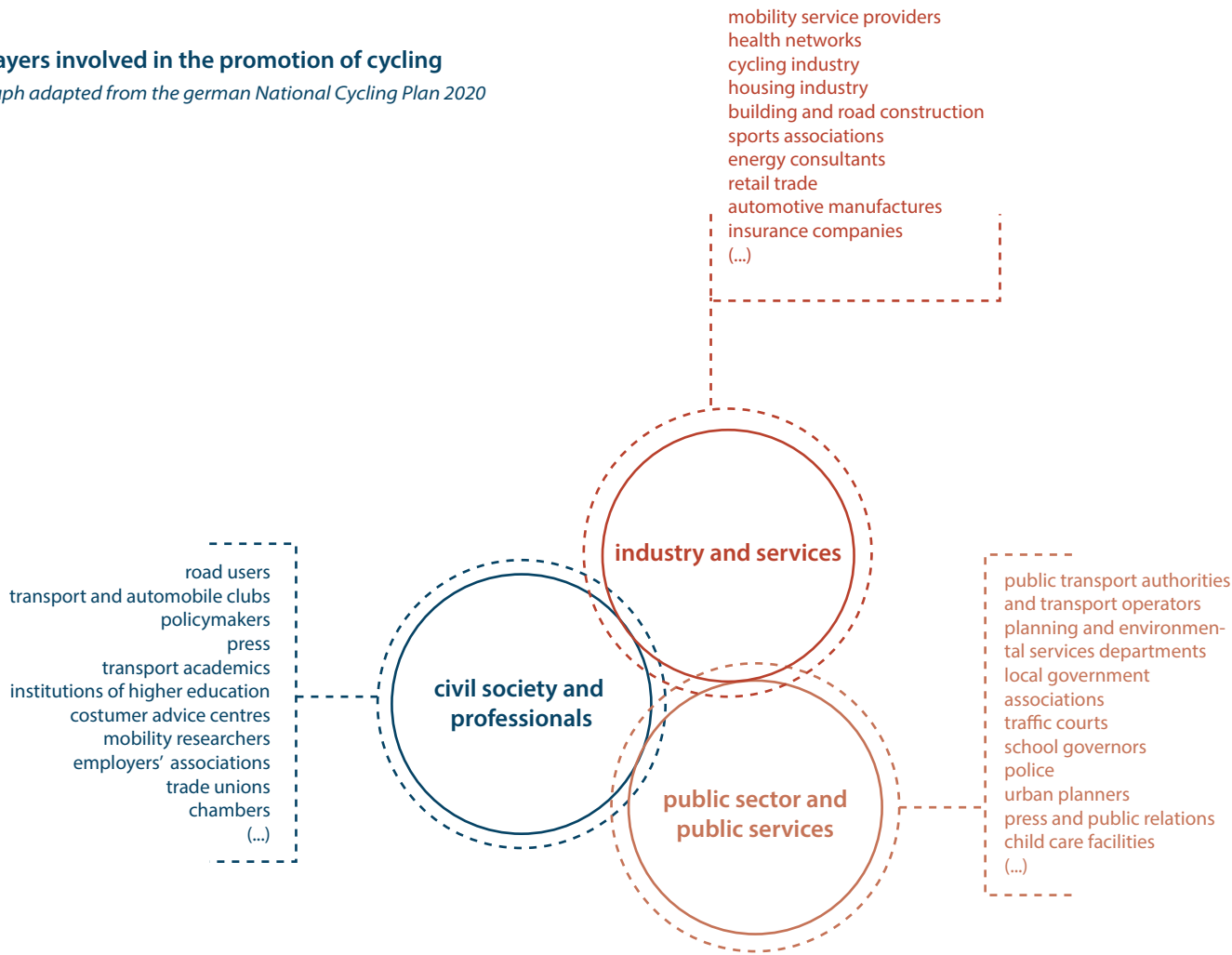
The German National Cycling Plan 2020 designates the roles of the Federal Government, federal states and local authorities to boost cycling in Germany as a whole. The Federal Government contributes by shaping the regulatory framework and providing funds within its area of responsibility and it is responsible for the construction and maintenance of the infrastructure. NCP has also successfully allocated the functions of promoter, facilitator, coordinator and catalyst to the governmental institutions by funding innovative projects and research and by disseminating examples of good practice. The funds committed under the NCP to date have thus provided a

major impetus and triggered positive effects.

The local authorities, on the other hand, have the responsibility for implementing specific measures on the ground, keeping in mind the principles of sustainable transport policy and the vision of “cycling as a system”.

On top of that, the NCP recognise that the efforts made by the federal and local government will not be successful unless they have societal support. Thus, non governmental institutions and citizens are called on to encourage cycling in their own environment.

players involved in the promotion of cycling
graph adapted from the german National Cycling Plan 2020



1.4 introducing mobility hub

To ensure that the existing connectivity continues to grow, in a time that new mobility services, infrastructure and amenities are evolving rapidly, mobility hubs present an opportunity to integrate different sustainable transportation options, ensuring the connectivity across the region. (AONO, Saki, p.4 2019)

“A mobility hub is a place of connectivity, where different modes of movement, from walking to high speed rail, come together seamlessly. A mobility hub is a place in the urban region in which there is an attractive, intensive concentration of employment, living, shopping and enjoyment around a transit interchange.” (METROLINX, 2008)

Among other benefits, mobility hubs minimise the ecological footprint in the region by reducing the dominance of private cars and connecting sustainable transportation options. It boost people to think multi-modally and is a complement and enabler of full digital integration services - Mobility as a Service (MasS). It ensures safety and security for all travellers as a place with a pedestrian oriented design, protecting passenger movement. It also embrace the technological innovations emerging of the so called ‘new mobility’ by adopting flexible design that will foster a sense of resiliency that will contribute to its viability in the long term.

As part of the definition of sustainable mobility, addressing equity is an important factor. Mobility hubs do so by providing a wide range of services that will help cover first and last mile travel for residents who reside outside the hub’s area of influence. Another facet related to accessibility is the cost of those services, fair subsidising programs and initiatives must be considered in order to make the mobility services viable for all citizens.

At the stage of implementation of the mobility hub, partnerships between public and private sector are vital to allow for a seamless integration between different services. These partnerships also optimise land value and create opportunities for

economic development. (AONO, Saki, p.6, 2019)

The interaction and balance between transportation, land use and placemaking functions, determine the success of the functionality of the hub, along with its flexibility to accommodate future growth as new technologies evolve. (Los Angeles City Planning Commission, 2016).

Nonetheless, mobility hubs have the potential to become the source and destination for urban activity. This important aspect addresses a dilemma of sustainable mobility that will be discussed in the next section.

The Nørreport Station in Copenhagen is an example of a transport infrastructure that goes beyond the function of a station, but creates an open and welcoming public space with specific consideration for the needs of cyclists and pedestrians.

The most important point of intersection of transport modes in Denmark is the Nørreport Station, the created urban landscape transforms Copenhagen’s busiest point into a unified flow integrated with the historic city center and the adjoining neighbourhoods.

The station was once a difficult place to navigate, however after the intervention of the architecture studio Cobe, it functions as an important public space where pedestrians have reclaimed priority.

in Copenhagen, 70% of all movement is on foot, bicycle or public transport.



Image 1 - Nørreport Station



Image 2 - Nørreport Station before Cobe's intervention



Image 3 - after Cobe's intervention

The project also met the need of a large-capacity bicycle parking, which challenged the design of the public space. Cobe’s solution was to place the bikes in well-defined areas slightly lowered into the ground, manoeuvre which create a clear indication of where to park and where to walk. The lowered aspect also contributes to the rainwater drainage and provide a calm visual expression.

Project: Nørreport Station
Location: Copenhagen, Denmark
Client: City of Copenhagen, Banedanmark and DSB
Size: 10,500m2
2,500 parking lots for bicycles



Image 4 - Nørreport Station

1.5

Berlin scene: data

As illustrated before, urban mobility in most cities of the developed world is changing. Cities are increasingly witnessing the impact of more disruptive change, whether as a result of technological innovation, socio-economic change or unexpected growth in urban cycling. The increasing relevance of the new mobility modes and the re-discovery of urban walking are shared experiences for many cities, becoming a central focus of urban transport policy in cities around the world.

In the case of the highly dynamic city of Berlin, the forward-thinking governments have implemented a series of progressive land-use and transport planning policies through investing heavily in public transport, walking, cycling and the public realm (LSE CITIES, p. 5, 2015). As described in the Berlin Strategy Urban Development Concept 2030, “Berlin will be a compact city in constant motion. It will be easy to get to, with a successful eco-mobility policy, and there will be no barriers to movement”. That is one of the goals set for Berlin to achieve by 2030, along with reinforcing neighbourhood diversity, improvement in terms of quantity and quality of green spaces, becoming a climate friendly metropolis and others.

The plan is based on Berlin’s qualities and is designed to maintain and reinforce them going forward to 2030. It also recognises the importance of public participation in the process and to create a collaborative dialogue within local government to make decisions for the common good. The following graphs used by BerlinStrategy illustrate the behaviour of Berliners and the existing transport infrastructure. This data showcase the strong foundation on which measures to encourage urban mobility are going to be built.

daily

20 km 70 min

The average distanced travelled by each Berliner

The amount of time each Berliner spends travelling

who owns what

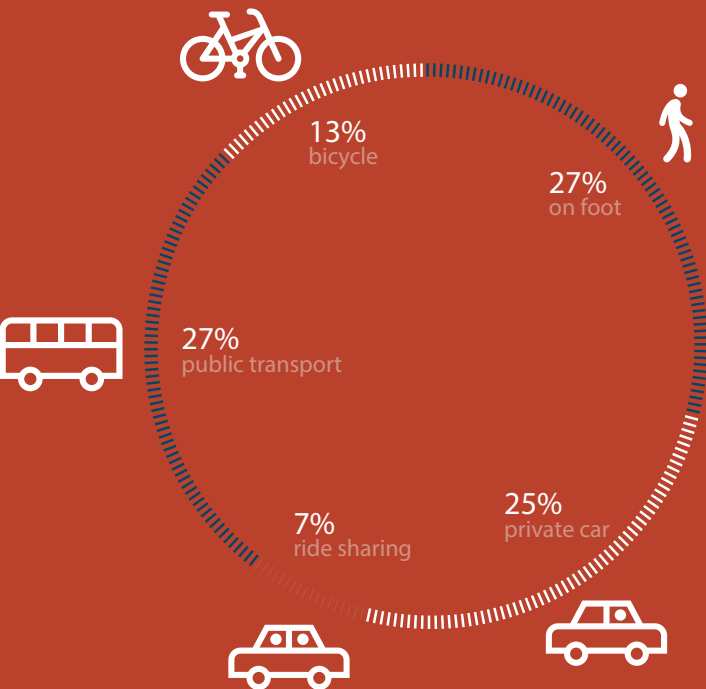


3 of 10 Berliners own their own car



7 of 10 Berliners own their own bicycle

how Berlin moves

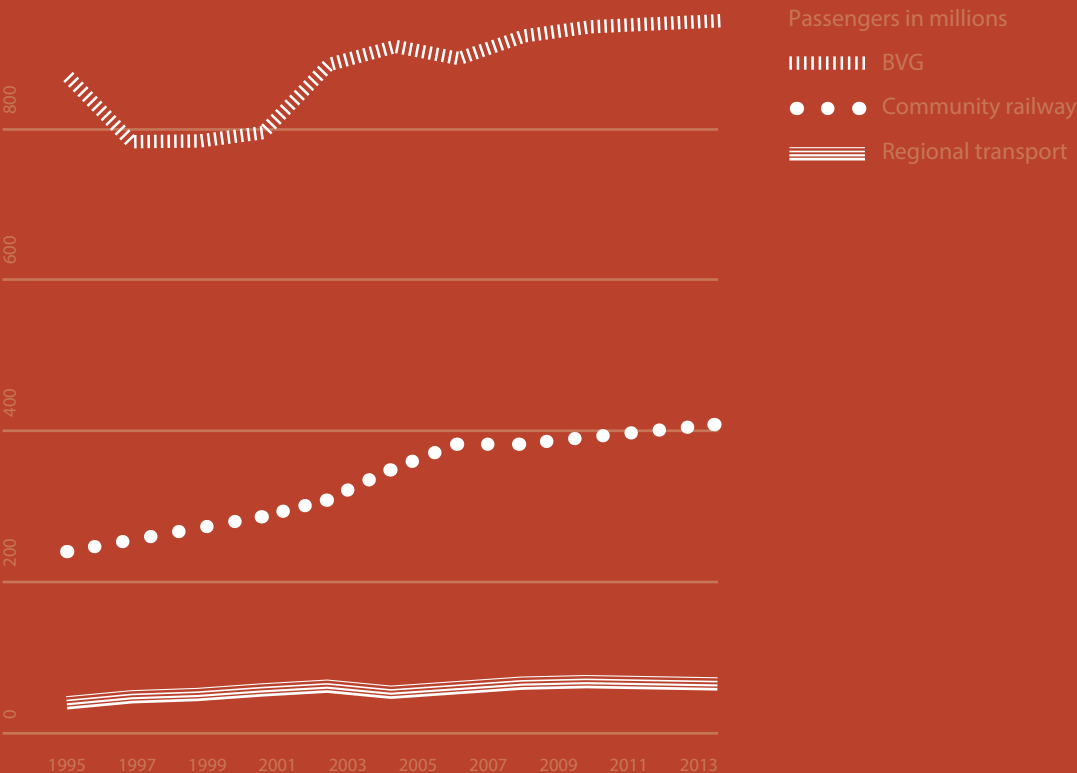


an excellent transportation network

The combined regional and suburban train, underground, tram and bus network covers a distance of some 1,900 km. Passengers can board and alight at over 3,100 stops.



Passenger numbers are increasing constantly. In 2013, 947 million passengers used the Berliner Verkehrsbetriebe BVG and 402 million travelled on suburban trains.



priority for cyclists

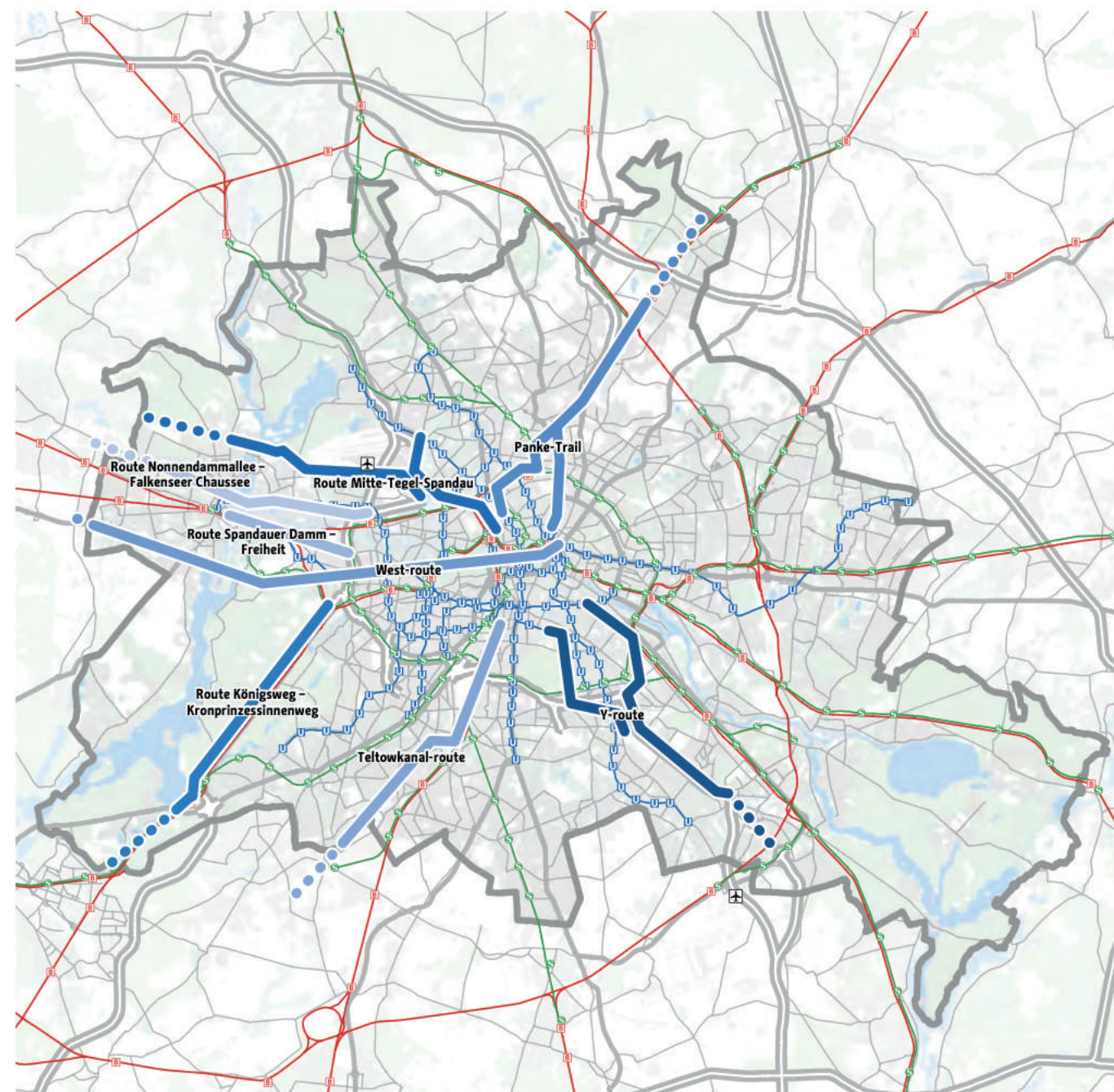


More and more Berliners are using bicycles to get around the city. According to multiple survey points throughout the city, there was an average of 40% more bikes on the roads in 2012 compared to 2004. They have well over 1,000 km of cycle lanes at their disposal, 662 km of which are specially constructed cycle paths, and 174 km bicycle lanes on the roadways.

Another data available by the Berlin Senate lay out the development of traffic in city and by doing so, this data serves as indicator of the long-term impact of traffic policy, demonstrating where action is in need, as well as the strengths of the policy.

In particular, the data regarding cycling infrastructure and the public transit network are the ones which interest the most this study.

Routes earmarked for possible high-speed bicycle connections in Berlin

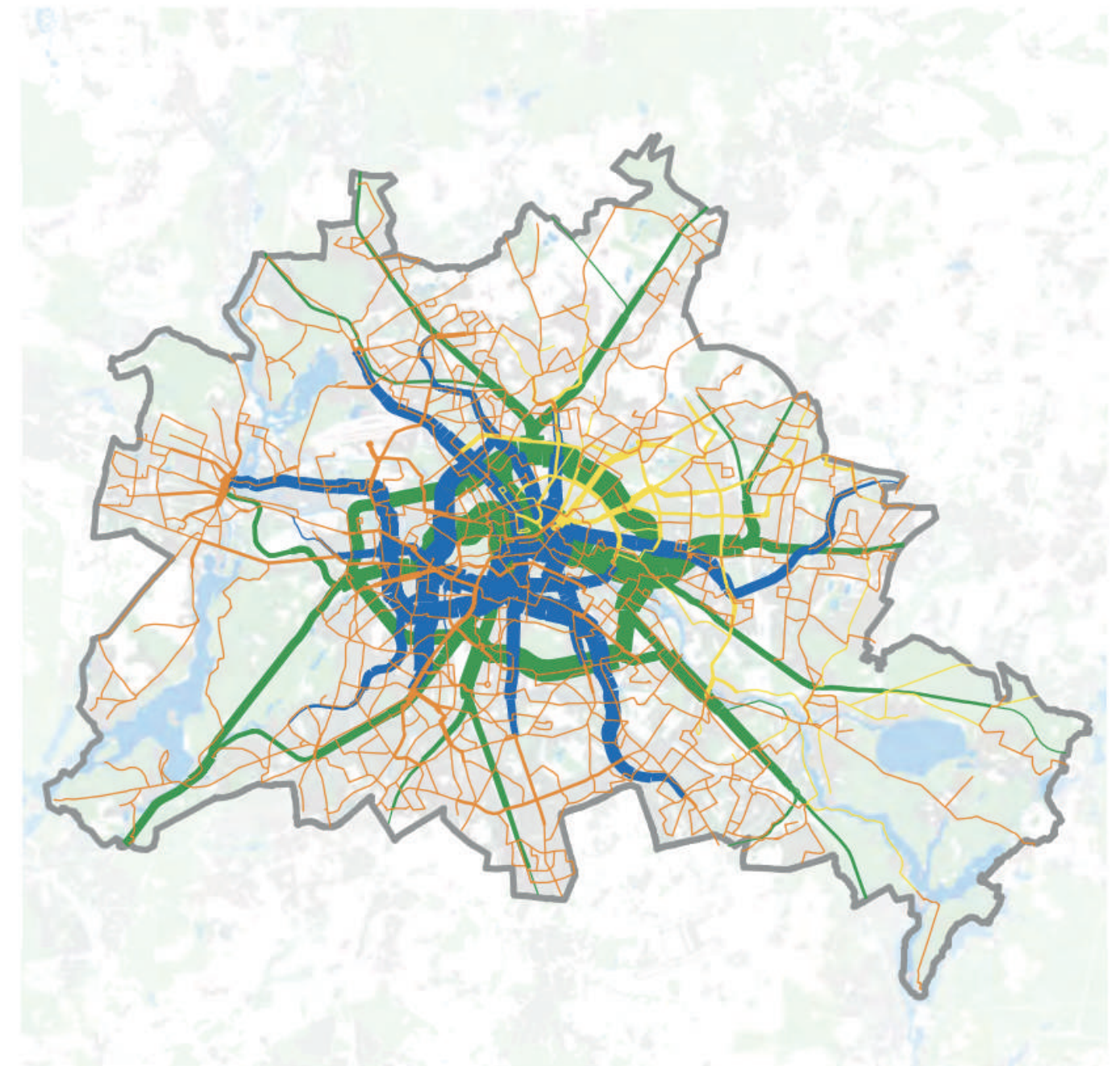


Priority of possible future high-speed cycle routes



U-Bahn
S-Bahn
Regional railways

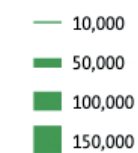
Average number of working-day passengers in the public transport network by transport mode



Number of U-Bahn passengers
per average working day



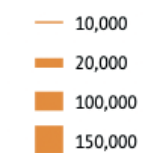
Number of S-Bahn passengers
per average working day

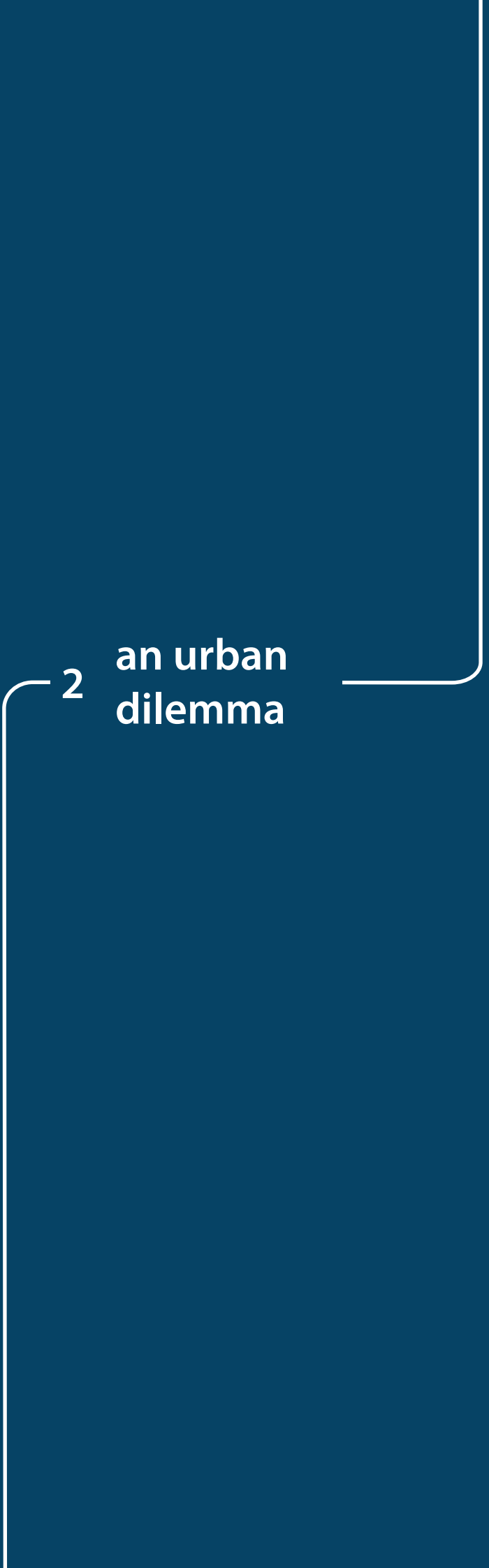


Number of tram passengers
per average working day



Number of bus passengers
per average working day





2 an urban dilemma

2.1 urban mobility and public space

Conceiving for a long time as two separate entities and neglected in the discourse on urban planning, the relationship between public space and urban mobility can create sustainable cities. An evidence of how the urban mobility and public space are directly connected, 'active transportation' modes such as cycling and walking, are the most environmentally and economically sustainable ways to move around the city and they both involve using public streets.

The intersection of them, is based on the fact that public spaces are not only places where activities take place, but are also places for people to come to, leave from and pass through, hence part of mobility. On that account, providing spaces in which people perform several activities and interact with each other, determines how they decide to move in, out and around the city and thus influences the city's sustainable mobility.

Streets have always played a role to the dynamic of the cities by facilitating economical and social interaction and promoting mobility. However, with the rise of the modernist concept of zoning, the practice of movement has strengthened its relationship with velocity and the private automobile, separating itself from public spaces. Consequently the urban environment has changed its form in order to satisfy the needs of a motorised population. Streets had turned into spaces for parking and had dismissed their character as area of interaction, diversity and exchange.

Re-qualification projects of the public space network via the integration of them with multiple means of movement, help re-balance the relationship between public space and urban mobility. (RAVAZZOLI, Elisa and TORRICELLI, Gian Paolo, p.40, 2017)

As said before, walking and cycling are activities that need to be used in the street. Investing in such ways is a tool to encourage people to take over the streets, improving the accessibility of the

neighbourhoods and the connection between them. Such measures make the movement throughout the city more pleasant and the public spaces more appealing, therefore, stimulating public interaction and involvement with society concerns.

Such interactions and human encounters have yet another beneficial effect: they are the basic prerequisite for social control and have a mitigating effect on crime and deviant behavior. (JACOBS, Jane, p. 38, 1996). In this regard, the integration between public space and urban mobility are crucial for the city's sustainability.

Francesco Careri in "WALKSCAPES: Walking as an Aesthetic Practice" defines the walker as a protagonist in the city, and his movements are inside the landscape, all visible features of the space, living architecture and construction, guided by the shapes and point of view in a complex radius of movement. In the last part of the book, the author concludes that walking the city consciously is an obligation to the professionals of the field of architecture and urbanism. Careri's research work safeguard walking as tool to read the city, in such manner, urban planners and decision-makers should act with the purpose to empower such tool.

A project that aims the revitalisation of a public space directly related to an existing transportation network by implementing active transportation, thus improving the relationship between urban mobility and public space is the Radbahn project.

2.2 case study: Radbahn Berlin

The rising demand for integration between transport modes in cities can only be fulfilled by making public transportation more attractive, affordable and efficient for the system, that

means that integrating the public network causing the minimal environmental damage is one of the most important aspects to look forward. (IYER, Shankar Narayanan, p.8, 2018). This concept act, in fact, as guidance to the Radbahn project.

The project has the goal of providing a traffic free movement for bikers in the city of Berlin under the city's oldest U-Bahn route, the U1. The approximate 9km track activates the neglected spaces in different neighbourhoods and environment conditions inside the city.

As displayed in the previous sections, cycling as a mode of transportation is a high rising phenomena around the world, specially in Berlin. However, the Senate administration was not catching up with this demand as the city expected, only until the COVID-19 pandemic has arrived, that initiatives like pop-up cycle paths were encouraged. Fortunately, the infrastructure that has the potential to meet this demand is already there: the elevated railway system of the Berlin metro line U1.

What differentiates the project from other cycling infrastructures is that Radbahn is based on conscious conduct of the existing urban spaces and resources and has the approach of thinking about traffic areas in a social and multifunctional way. For example, the considerations about what could support the efficiency of the track at specific surroundings, such as crossroads and side streets. (SCHELLE, Johanna, 2020)

A strong environmental component of the project is the implementation of kinetic energy sources units that would cover part of the route's energy demand. Summing that with the environmental benefits of encouraging active transportation, environmentally friendly mobility can be ensured.

The suburban stations that are part of the

U1 line are redefined as mobility nodes, with parking spaces for rental and privately owned bike, charging stations for electric vehicles and repair shop for cyclists.

To better articulate the path with the urban surrounding and to make the Radbahn attractive to all kind of users, the planners have distributed cafés, pocket parks and varied open spaces.

Published for the first time in 2015, the proposal generated a great amount of interest from cyclists, politicians and the media. In two weeks gained worldwide press coverage and even won a German Federal Ecodesign Award. The former editor of the architecture journal *Bauwelt*, architect Doris Kleilein said that "the Radbahn has sparked a debate that goes beyond mere traffic management, and questions the fundamental orientation of Berlin's urban development policies."

Although Berlin's state parliament took an interest in the project, the concept could not be included in the bicycle highway plan of the city. The bicycle highway study is restricted to cycling paths of at least four meters wide and have as few intersections as possible. The Radbahn average width is of three meters and has many more intersections than the average of an inner-city route.

So, the paper planes association took the task of calculating the significant advantages presented by the project for Berlin's economy, urban development and culture. The masterplan and the qualities of the concept were presented to the public in order to generate an open discussion about architectural and urban planning concerns, such as safety, the articulation of the intersections and costs.

Due the support from civil society groups, companies and research institutes and the support from the Federal Government and the City of Berlin, the Radbahn real-world laboratory project, named Radbahn Reallabor, in 2019,

Radbahn Berlin trajetory



Image 5 - The problem

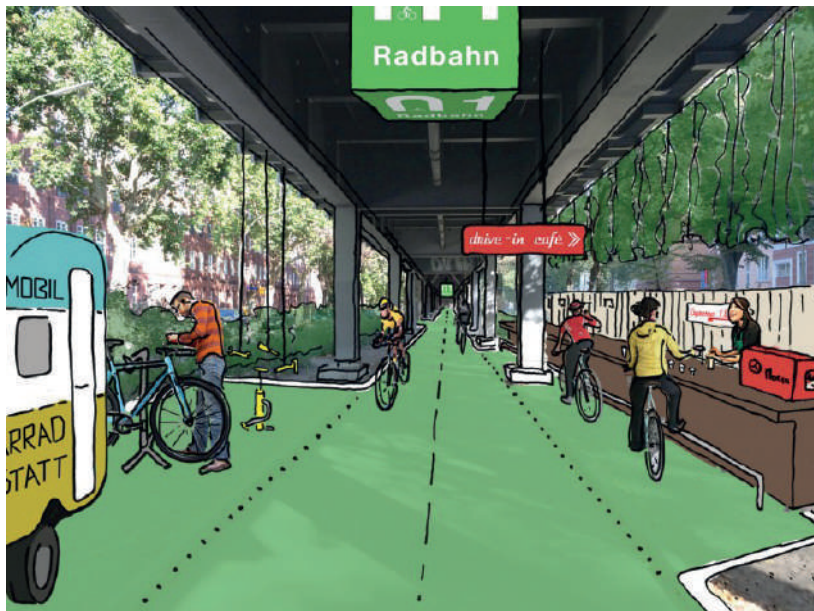


Image 6 - The vision, 2015



Image 7 - The concept, 2017

received a funding from the Federal Government and the State of Berlin as part of the “National Urban Development Projects”.

The Radbahn Reallabor, consists of three elements: showcase, detail study and documentation and evaluation. Radbahn turns into reality for approximately 200 meters in the centre neighbourhood Kreuzberg. The showcase will be created in cooperation with the local community, civil society initiatives, cultural actors, businesses, administration institutes and cyclists.

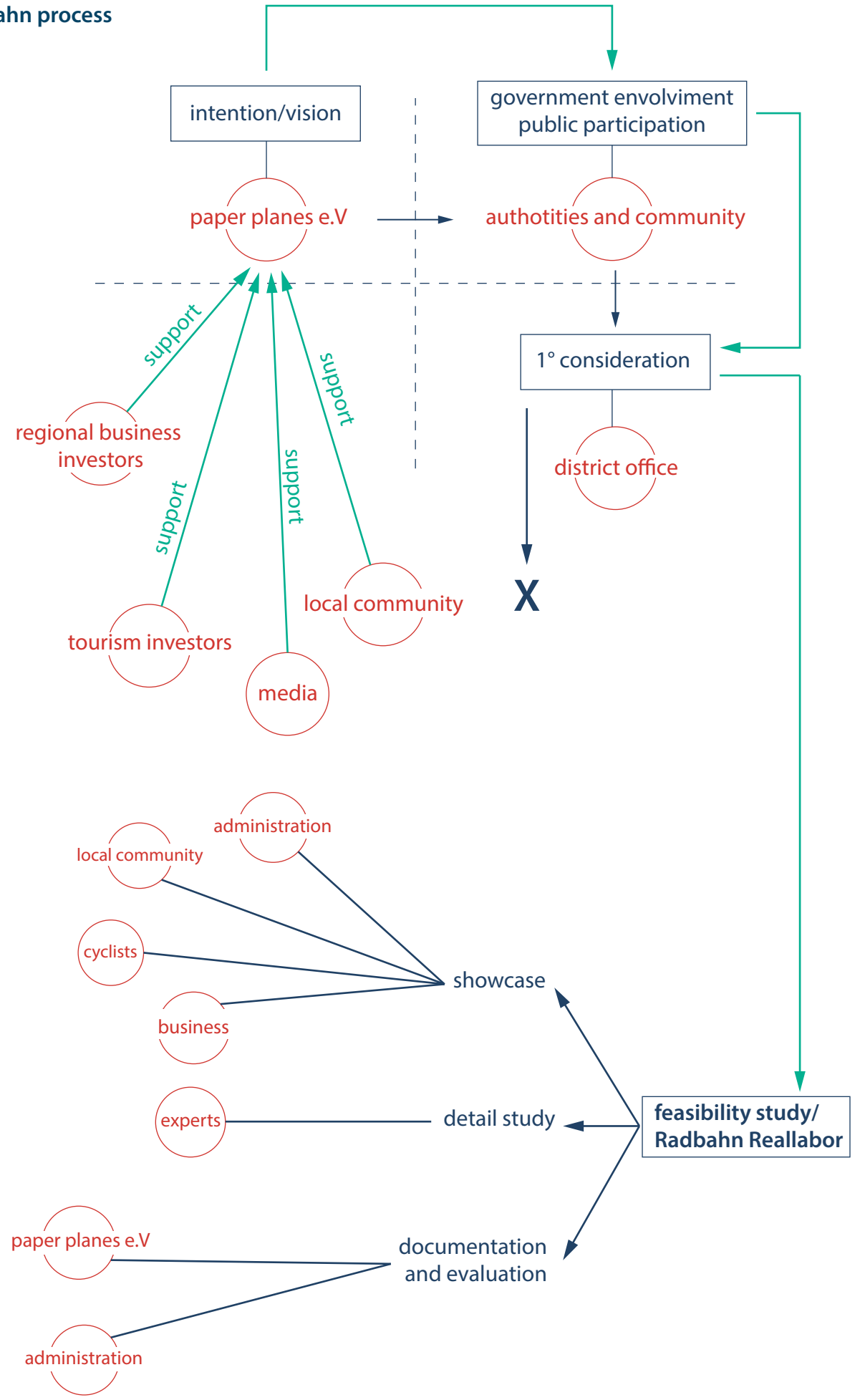
The Radbahn trial will be based on a detail study that examines and optimises the concept in cooperation with experts from various fields, including urban planning, mobility and innovation.

Radbahn influence the discussion of sustainable mobility far beyond Berlin limits, therefore, it must be carefully documented and evaluated.

The Radbahn Berlin is a reference project to the presented thesis on the grounds that supports sustainable mobility and consequently improve the quality of urban realm in areas where this relationship is not visible. Its process of planning, approval and implementation illustrate the importance of community participation as a strategy to overcome bureaucratic obstacles and to improve the project’s quality.

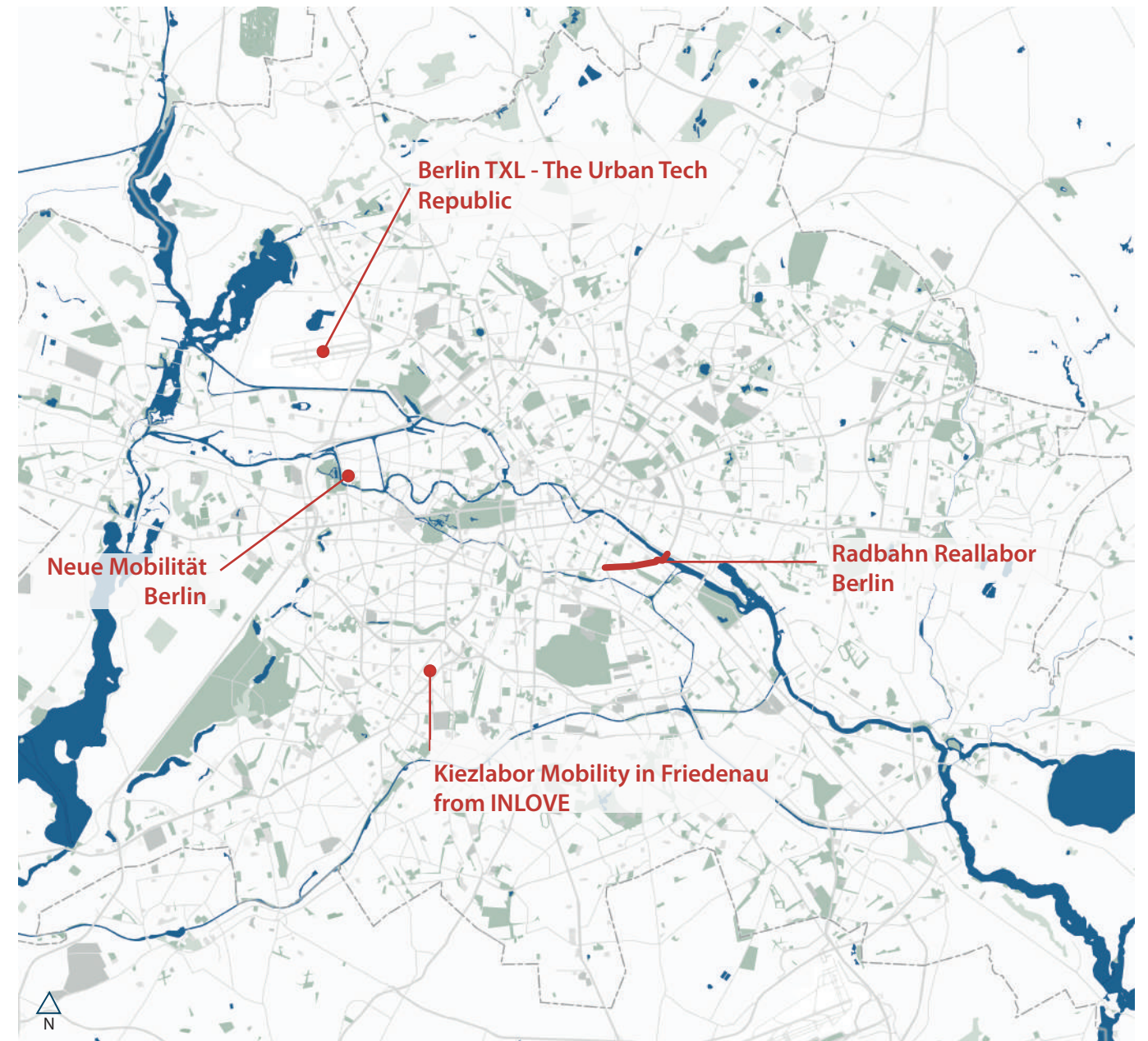


Radbahn process





2.3 a trending topic on projects



Like the Radbahn, many projects that address the importance of sustainable urban mobility and propose creative solutions are flourishing. For example, the new use of the former Tegel Airport, “Berlin TXL - The Urban Tech Republic”. The innovation park is going to be a place where technologies are researched, developed, produced, tested and exported. Among the six core themes that are going to be researched, I environmentally friendly transportation.

Another project, but of smaller scale is the Neue Mobilität Berlin. The project works on a parti-

cipatory basis, reallocating private parking spaces to implement parklets and sharing parking spaces for electric cars, e-scooters, bikes and cargo bikes. It acts on the area of Mierenforff-Island and Klausenerplatz-Kiez involving local actors and stimulating the development of future-oriented mobility concepts.

INLOVE Kiezlabor Mobility Initiative, on the other hand, is a laboratory where citizens can develop participatory ideas for their mobility needs and their districts challenges, where is possible to implemented them on a test basis and to pass on experiences.

2.4 Berlin scene: post German unification

Although Berlin's extensive transport infrastructure network provide its citizens accessibility from a high quality perspective, ironically enough, the Central Station (Hauptbahnhof) lack this accessibility to its immediate surrounding. In order to understand better this phenomena it is crucial to study the chronology of the site.

After Germany's unification in 1989, came a period where development forecasts predicted an economic boom and population growth, triggering development strategies with the objective to respond the predicted population and investments.

Another relevant aspect about the period after the reunification of Germany is that many properties had unclear landownership agreements, consequently most of the state-owned land turned into private property. This period marked a change in government's approach for urban development, the projects became from a social capitalistic direction, to a private investors' oriented. (OPINA, Maria del Pilar, p.13).

Berlin became subject to massive process of urban regeneration, such as the redevelopment of Potsdamer Platz and the Reichstag Building. Berlin's rail infrastructure was also found to be in need of modernisation. At the beginning of the 1990s, it was decided to implement a new concept for connecting Berlin to Germany's rail network. They key element of the concept was the development of a new north-south railway track, and its intersection with the existing east-west track was chosen to be the location of Berlin's new Main Station (Hauptbahnhof). The station was built for 1,2 billion Euros as a new star of architecture and engineering with a campaign that describing it as "the largest and most moderns crossing station in Europe".



Image 9 - Potsdamer platz, Berlin



Image 10 - Reichstag Building, Berlin



Image 11 - Reichstag Building, Berlin



Those regeneration projects are today part of the landmarks of the city. The presented map illustrate clearly the close proximity of the main touristic and historical points of the city with the site where the thesis project is located.

However, given the proximity to the former Berlin Wall, that used to pass on the other side of the Humboldthafen, the area around the new Central Station consists of inner-urban grey fields. Despite the project attractiveness, either businesses, entertainment or residential the project's success is still much dependent on their local and regional connectivity rather than long-distance connections.

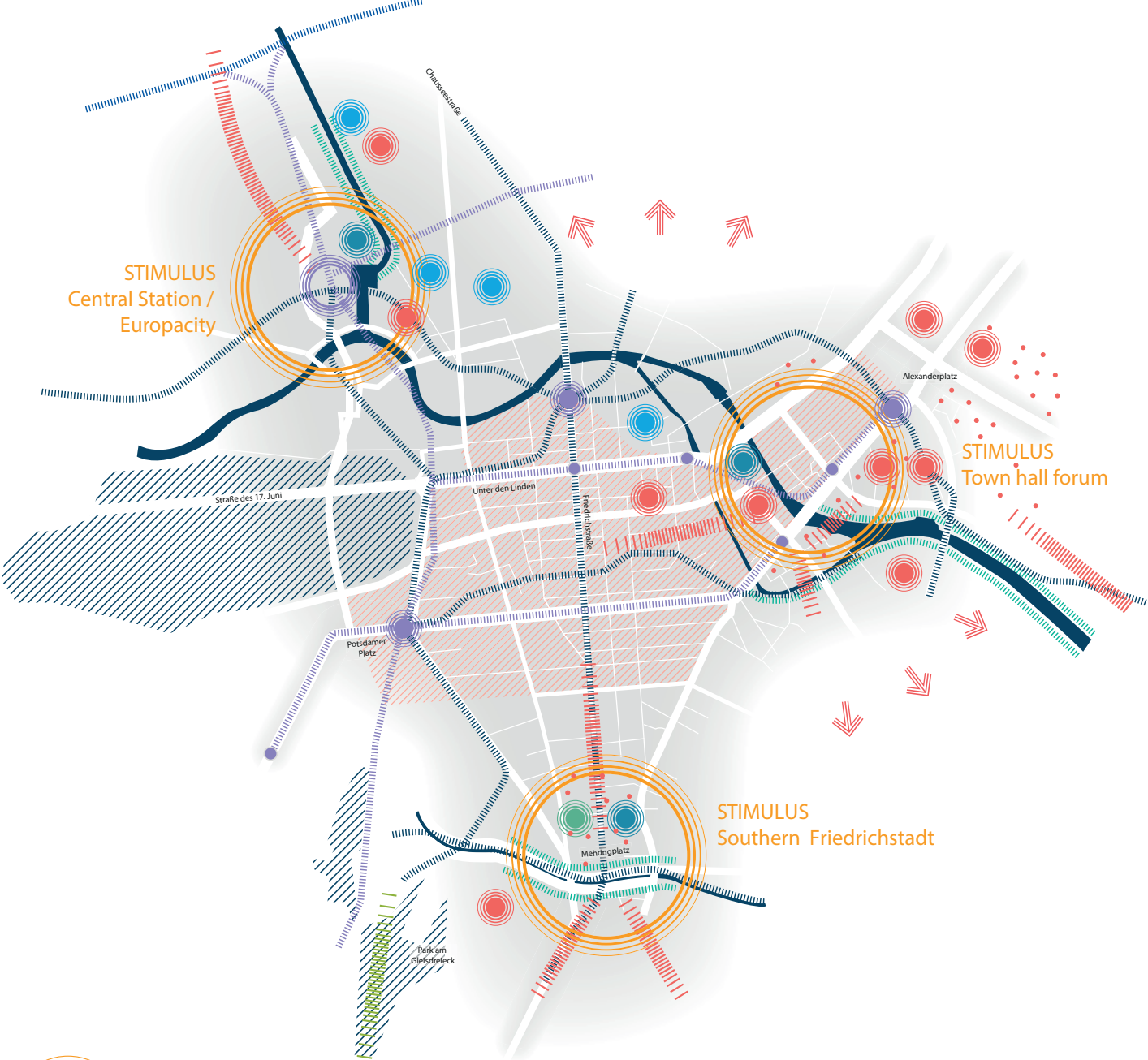
Nonetheless, the city of Berlin set its priorities in relation to the areas that are going to be developed in order to better integrate the city within itself and to increase its international influence. As part of the selected areas, there zone surrounding the Central Station is present. In order to better understand the transformations set on the Berlin Strategy 2030, the City of Berlin have analysed the urban environment from a neighbourhood scale.

The neighbourhood of Mitte, where the Central Station is located, is going to suffer a wide range of transformations with the goal of turning the area into the business, scientific and cultural focus of Berlin in the future. Those transformations are illustrated in the following map.



Image 12 - North-east aerial view of Berlin Central Station

Transformations in Berlin Mitte



stimulus

improving accessibility and city-friendly mobility

- strengthen local public transport network
- integrate efficient transport hubs at different levels
- underground, tramway, commuter train service under construction
- motorway planning

reinforcing diversity in neighbourhoods

- measures for enhancement and displacement processes
- bring potential housing sites and develop subsequent infrastructure
- control development pressure

laying the groundwork for a climate-friendly city

- optimise local green connections
- define green and other open spaces and adapt to climate change

growing the city and its green spaces together

- structure important locations with international influence using urban planning
- strengthen links between open spaces
- strengthen links between neighbourhoods
- make water sites accessible and attractive
- public green spaces
- public traffic access

strengthening the economy with smart knowledge

- use universities and research locations
- safeguard/develop industrial and commercial spaces

releasing energy through creativity

- stimulus for artistic and cultural productions
- capitalise more on tourism potential



Image 13 - Mobility in Berlin

Following the project of the Central Station, aiming to solve the connectivity problem, the Federal Government has planned an urban densification project of the area surrounding the station. This development is part of the stream of ambitious, comprehensive and integrated efforts to successfully re-make city-regions, and most prominently their core areas for the demands of a 21st century economy and society.

However, the complexity of this kind of project that is integrated with an important transit node is that, in theory, it offers a perfect solution to many of the challenges of a future-oriented urban renaissance plan. However, in practice, there are many obstacles in the way of achieving this vision. For example, public officials might emphasize public interest goals such as livable, affordable housing units while transport experts might prioritise issues of effective and sustainable urban mobility and connectivity. (PETERS, Deike, p. 4, 2009).

The particular challenges seen at the development project in Berlin is also witnessed in two other metropolitan cities, New York and London. The three cities are experiencing a high-profile redevelopment project around major stations situated in or immediately adjacent to the inner city. Another common characteristic is the timeline of those projects, the proposals were presented in the early 1990s, then hit various setbacks to formerly got back on track towards realisation in the 2000s. (PETERS, Deike, p. 6,2009).

The presence of these redevelopment projects in motion underline the significance of rail-based infrastructure in the postmodern, postindustrial urban fabric. They also demonstrate the new consensus among transport specialists, urban planners and political decision-makers that the integration between high-capacity transit network and land-use planning shape the cities and their surrounding regions to become more efficient, sustainable and successful.



3 local
problematic

3.1 a rising quarter

The presented thesis study the development course of the area surrounding the Central Station of Berlin, more precisely, the site north of the station on the margins of the Humboldthafen, the oldest port in the city, and with access by Fredrich-List-Ufer street. It is also part of this study, the analysis of local conflicts, stakeholders involved, in order to propose a project that will, strategically, attend the site's needs and the local community demands.

The complexity of the chosen area is a result of the immediate vicinity to the Central Station, to the government district and to the Humboldthafen basin. It is also near to the important architectural landmark Hamburger Bahnhof Museum, the recently build Futurium Museum and to the Charité hospital facilities.

The planning of this area started in 1994, when the Senate chose the project of Prof. Oswald Mathias Ungers the winner of the competition. The proposal from Prof. Ungers consisted of three main components, of which the Humboldthafen regeneration was one of them, the idea was based on a continuous redevelopment of the harbour basin along the Friedrich-List-Ufer, the Invalidenstraße, the Alexander-Ufer and the formerly so-called "Spreeuferstraße" including a superstructure of the Berlin-Spandauer Schifffahrtskanal in the area of the harbor neck and the confluence in the north. design kept the station building free with forecourts both to the north and to the south. He divided the environment into a urban quarter to the

west, with seven housing blocks, following the traditional Berlin block structure. These blocks should above all be used for business and office purposes.

The initial concept has evolved from Prof. Ungers, the B-Plan II-201, without ending the typical character of the area. Following this process, the plan was also divided into five parts in order to plan it in a higher level of detail: B-Plan II-201a, II-201b, II-201c, II-201da and II-201db. Most of the sites of this redevelopment were sold to private companies, event that generated a lot of criticism about the real intention of the project, and now are part of the Europacity proposal.

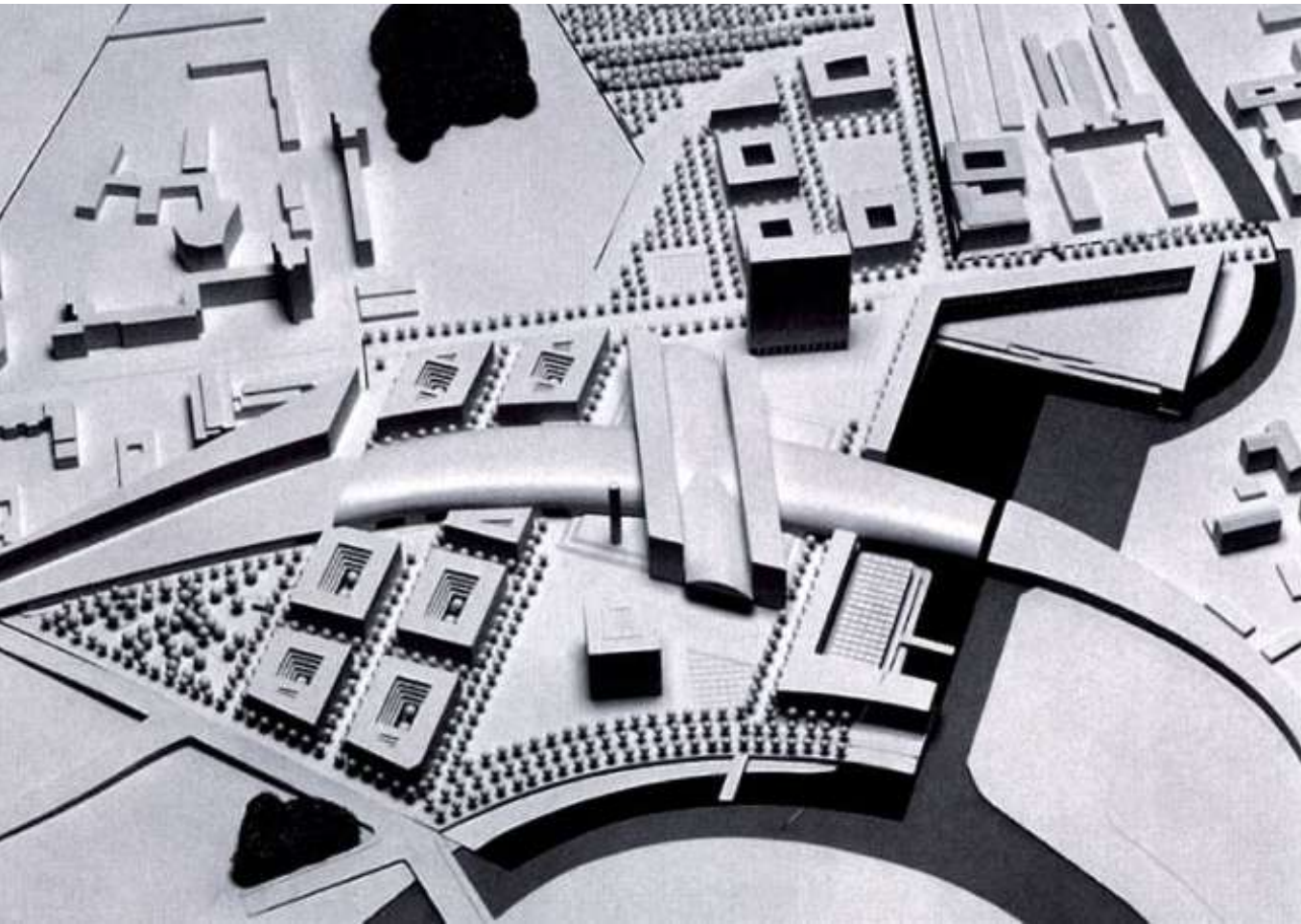
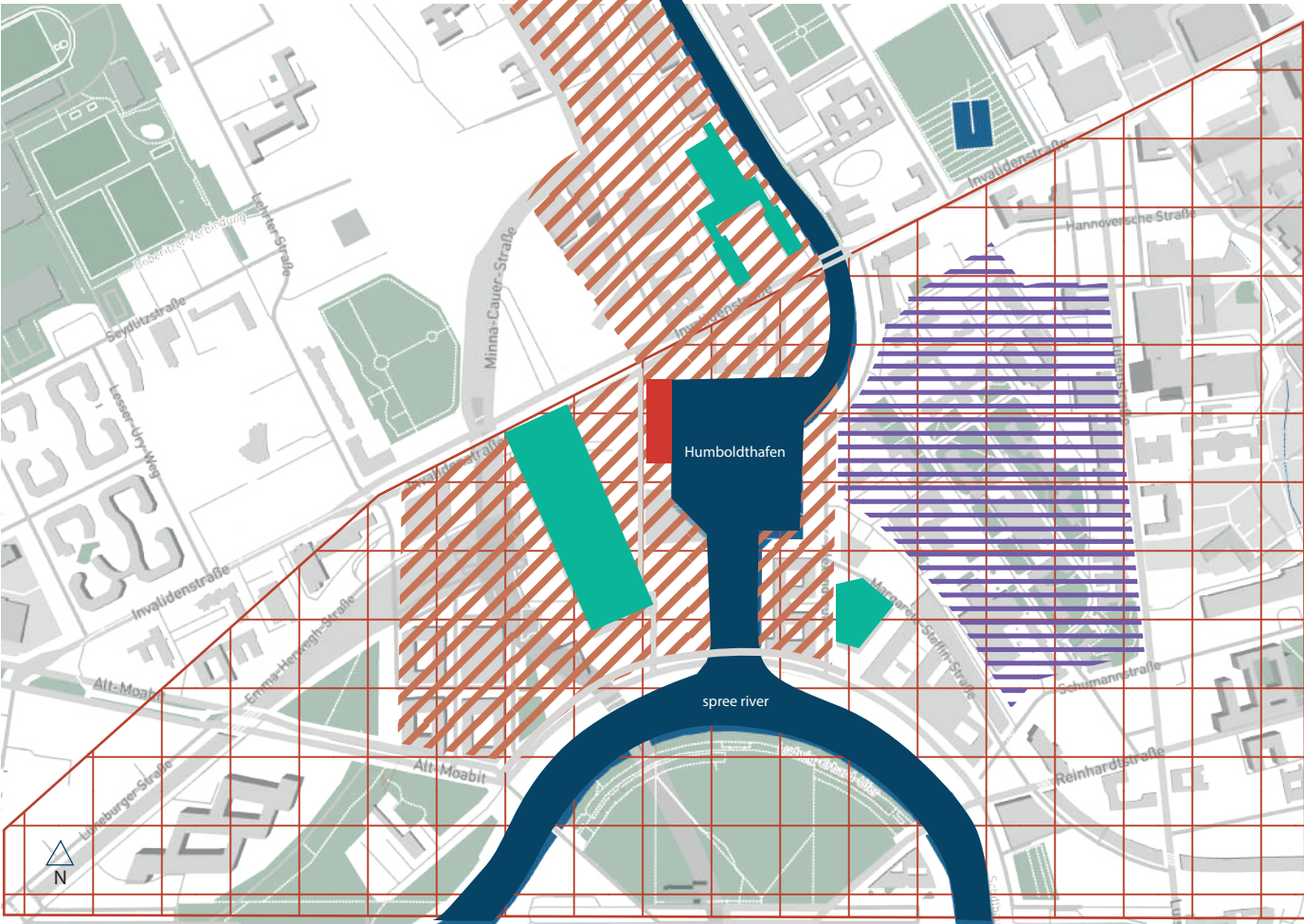


Image 14 - O. M. Ungers proposal

- site of interest
- landmarks
- europacity
- government district
- charité hospital campus



This development project takes the area between the Humboldthafen, Heidestrasse and Nordhafen, is Berlin's largest inner-city investment project. On an area seven times the size of Potsdamer Platz, a new city district is being created that, according to the client, represents an urban lifestyle.

However, the reviews speak of unimaginative architecture and a missed opportunity to create a modern, mixed quarter in the heart of Berlin. The critics are also based in the fact that the development is mostly in the hands of private investors, and the top-bottom decision-making is still untouched by the community.

The adjacent districts of Wedding and Moabit claim that there is no space for participation in the decision making of the project, in particular two citizens from Wedding, Yves Mettler and Alexis Heyman Wolff in 2018, created the "On the Border of EuropeCity" as a way to draw attention to the ongoing developments and address questions about the progress or urban, cultural and green spaces. They organised public walks, workshops and intervention in and around Europacity, bringing neighbours and specialists into dialogue with the new urban landscape.

The successive images show the participatory walk that happened in 2020, from Wedding towards the new quarter, carrying construction beams painted with "Europe Square" in different languages symbolised the desire from the community to have a say to demand more public space.

The architect Ulf Meyer criticised the development project in an interview for Mieter Magazine, declaration that reflects the negative feedback of Europacity. When the magazine asked about the biggest deficits in his opinion, Meyer replied by criticising the lack of attractive public spaces, specially in connection with the water, "the location on the water is a pound that could have been proliferated!", said the architect.



Image 15 - Manifestation for more public space



Image 16 - Manifestation for more public space



Image 17 - Manifestation for more public space



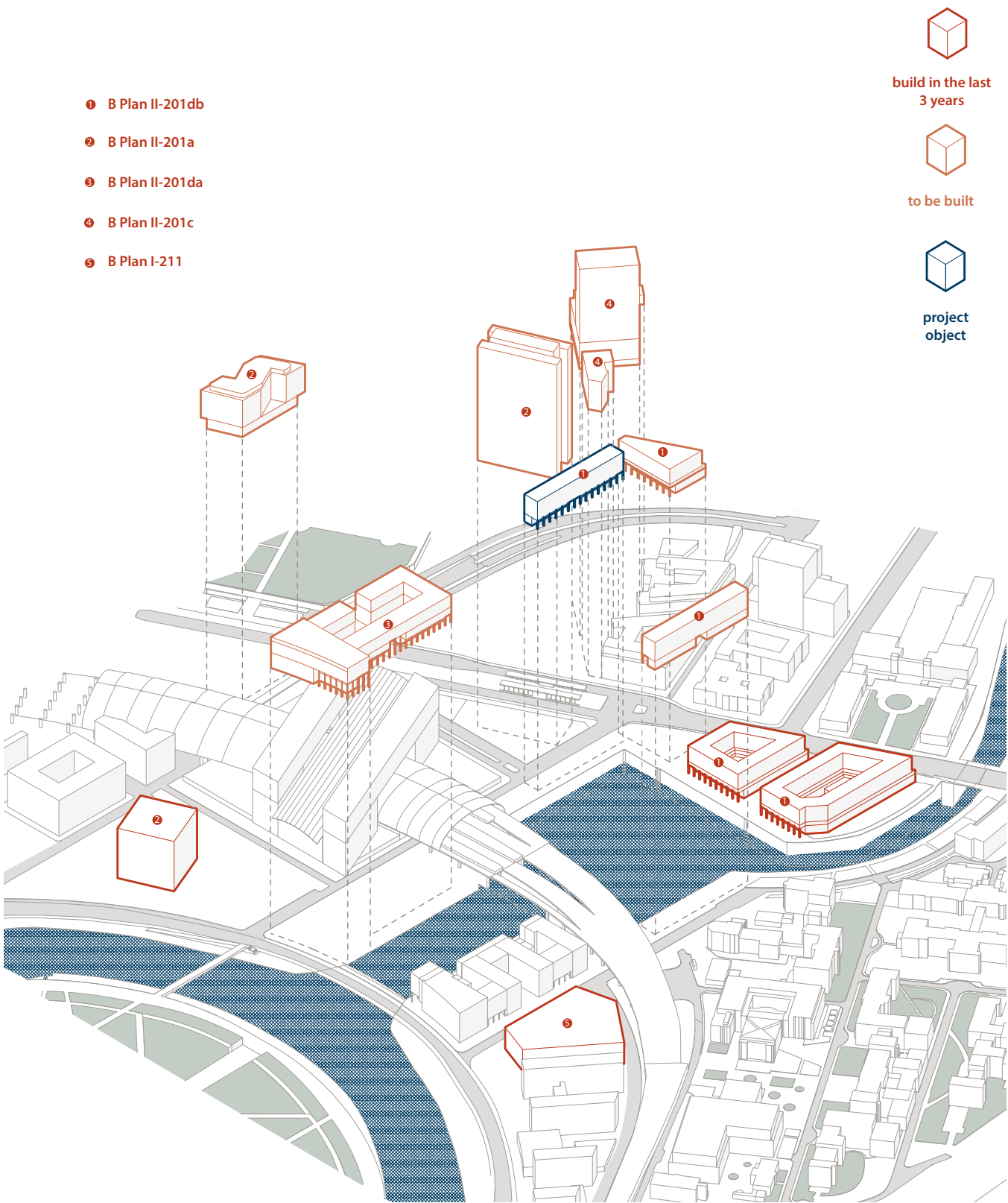
Image 18 - Manifestation for more public space



Image 19 - Europacity

3.1 the conflict

As exposed before, the studied area is suffering an intense redevelopment, phenomena visible in the following diagram.



The criticisms provided basis for discussion of the undeveloped buildings on the banks of Humboldthafen, which are also part of Europacity but still owned by the government, in fact, one of those buildings is the object of the presented work. After passing through a well regulated process with the participation of the local community, authorities at various levels and experts in the field, the B-Plan II 201db reached its approval. It determines guidelines for the development of the area, proposing a morphology that would be a base for further improvement. However, this development has not been able to follow its path due to the debate about the function that the upcoming quarter needs, that unfortunately is not matching the proposal.

This discussion became more relevant with the statement of Mitte Councillor Ephraim Gothe who believes that the straight and long buildings that margin Humboldthafen would block the path to the water, so as an alternative, it should create “a prome-

nade, benches, a path where people can find peace before they take the train”. Gothe also claims that discarding the development plan and design an attractive open space is an unanimously opinion on the district office of Mitte.

However, Berlin’s Senate Building Director Regula Lüscher has expressed fiscally concerns about the income and the attractiveness of the space without any commercial activity, like cafes and shops, that would invite people to occupy the space. Lüscher is an architect and urban planner that played an important role in developing Europacity’s masterplan and yet admits that would too do things differently today. One of the aspects that wasn’t taken into consideration in the development is the new mobility concept, according to her, there still has to be room for bicycles, electrical vehicles and car sharing stations and “it must be installed in such way that does not restrict public space”.



Image 18 - Yves Mettler & Alexis Hyman Wolff

the discussion

Mitte district office



Mitte Councilor



Ephraim Gothe

the area should be an attractive public space

Senate Building Director

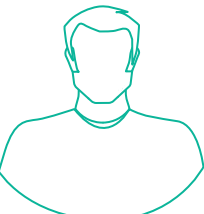


Regula Lüscher

What about the income? B-Plan II 201db is still the right direction to follow, it attracts people to site

Europacity is missing space for the future-oriented mobility with bicycles, electrical vehicles and car sharing stations

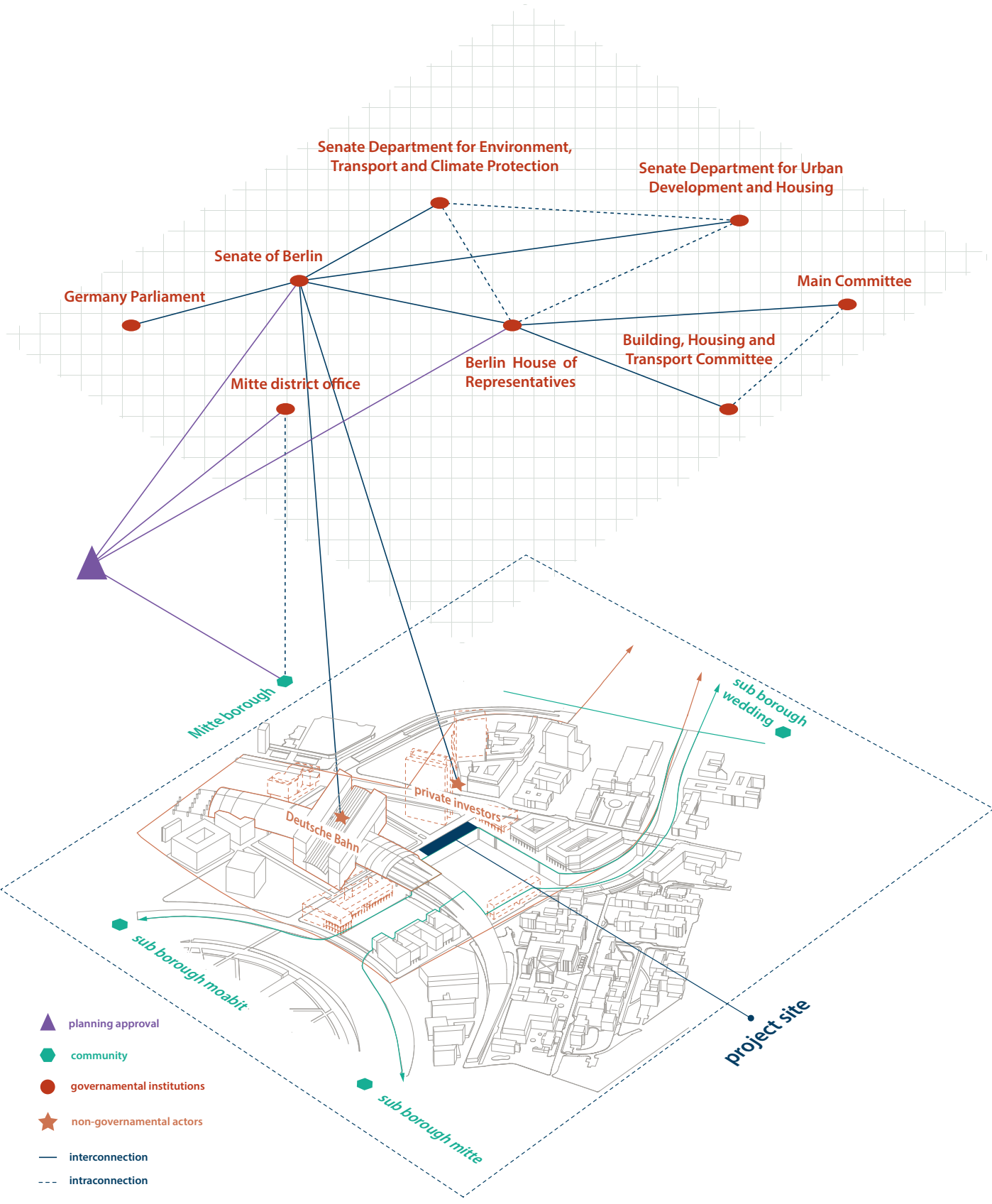
architect and urban planner



Ulf Meyer

what is missing is an attractive public space that takes advantage of the location near the water

actors network



3.2 analysis of the site

urban context analysis

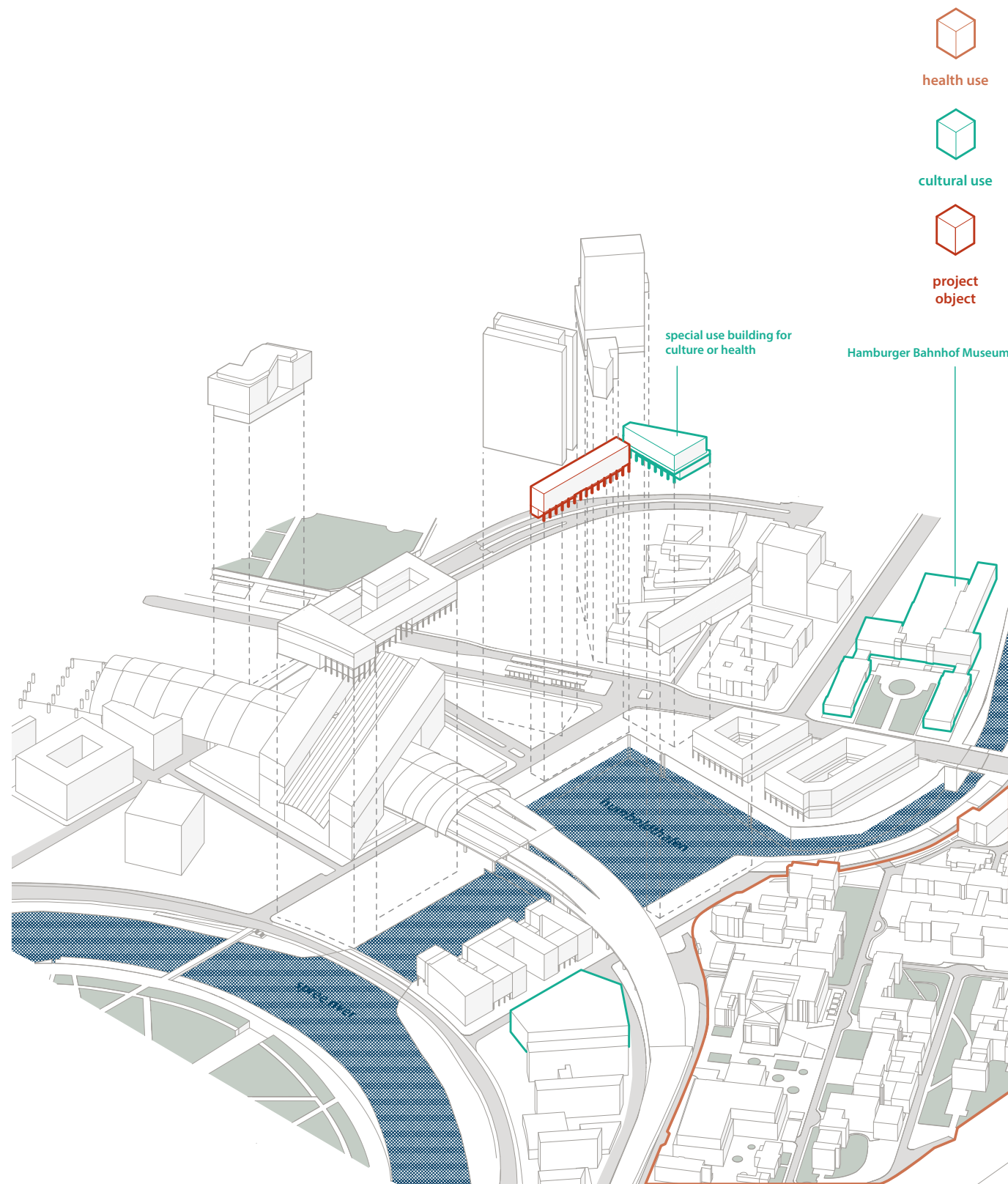


Image 19 - Buildings along river Spree



Image 20- Buildings along river Spree

traffic analysis - currently



subsidiary of the 100% state-owned Grün Berlin GmbH. that support the state of Berlin in creating new ways for cycling and strengthening the environmental network

counted bikes 2020: 590

existing parking spaces 2020: 311

required parking spaces by 2030: 974

- 1 cycling lane
- 2 bus stop
- 3 metro/train station
- 4 tram station
- 5 car parking
- 6 bike parking

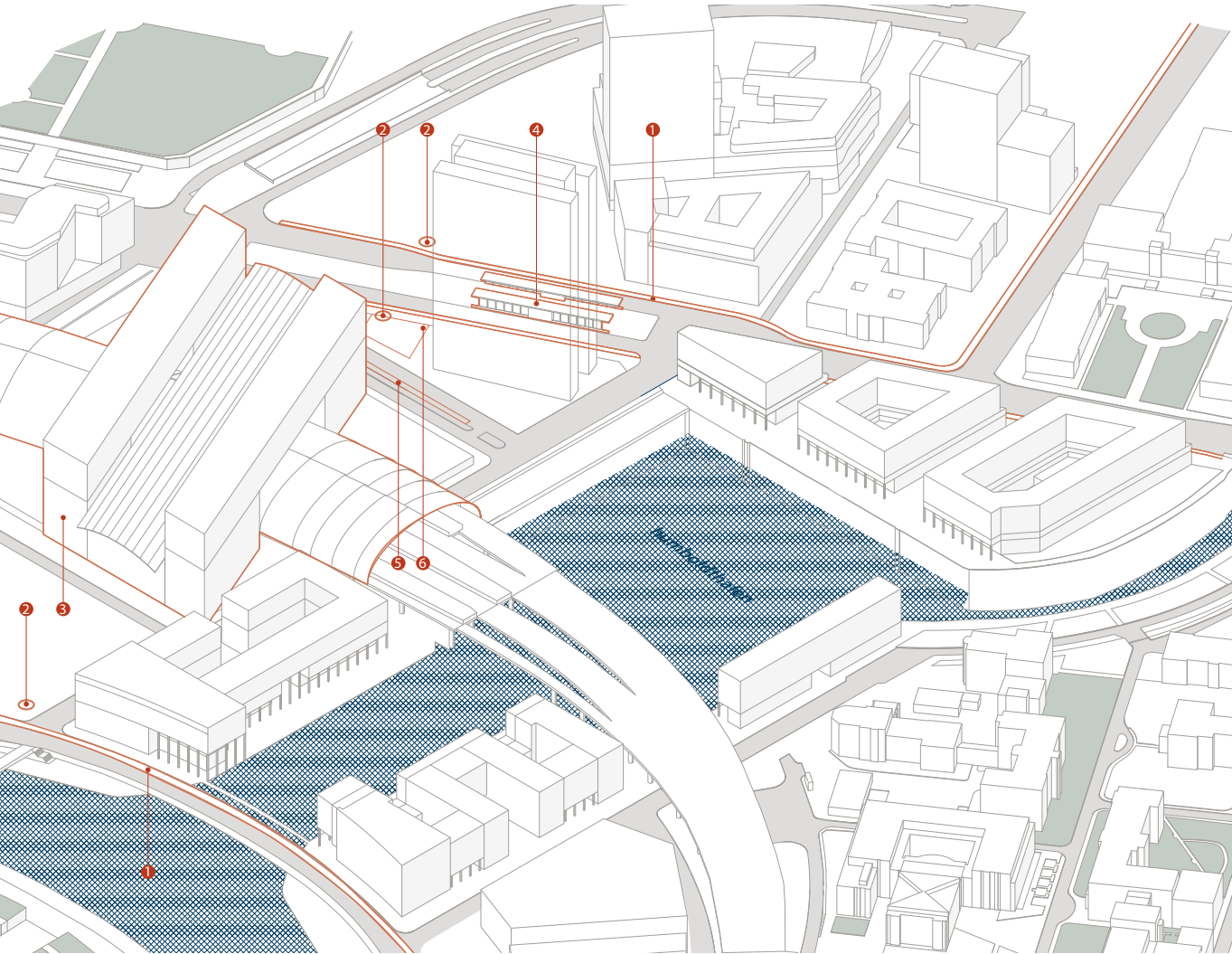


Image 21 - bike parking at Berlin Central Station (Hauptbahnhof)



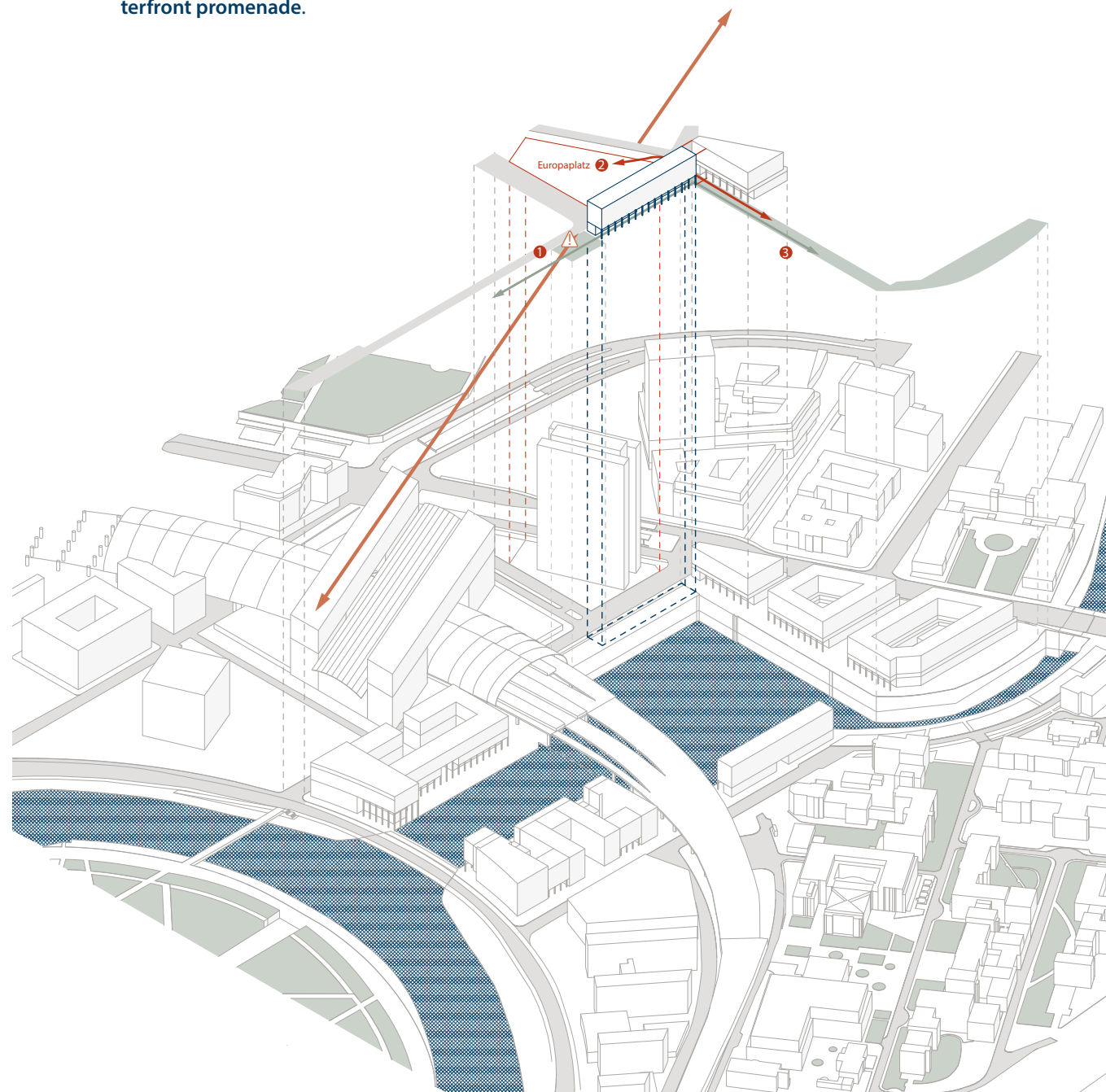
Image 22 - bike parking at Berlin Central Station (Hauptbahnhof)



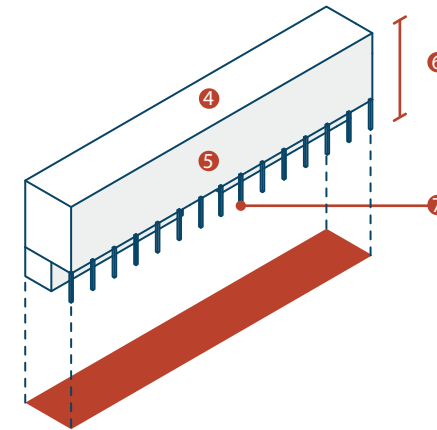
Image 23 - bike parking at Berlin Central Station (Hauptbahnhof)

concept characteristics of B-Plan 201db:

- ❶ the south part of the site must keep **free of building** over a length of 30 meters due the construction of the S Bahn 21 line, this area should be developed for recreation and transit purposes.
- ❷ **clear separation** of the building of interest and the corner building to create a promenade that will enable the access to Europaplatz
- ❸ to be proper linked to the harbour surroundings, it must create accessibility to the harbour basin via **public waterfront promenade**.

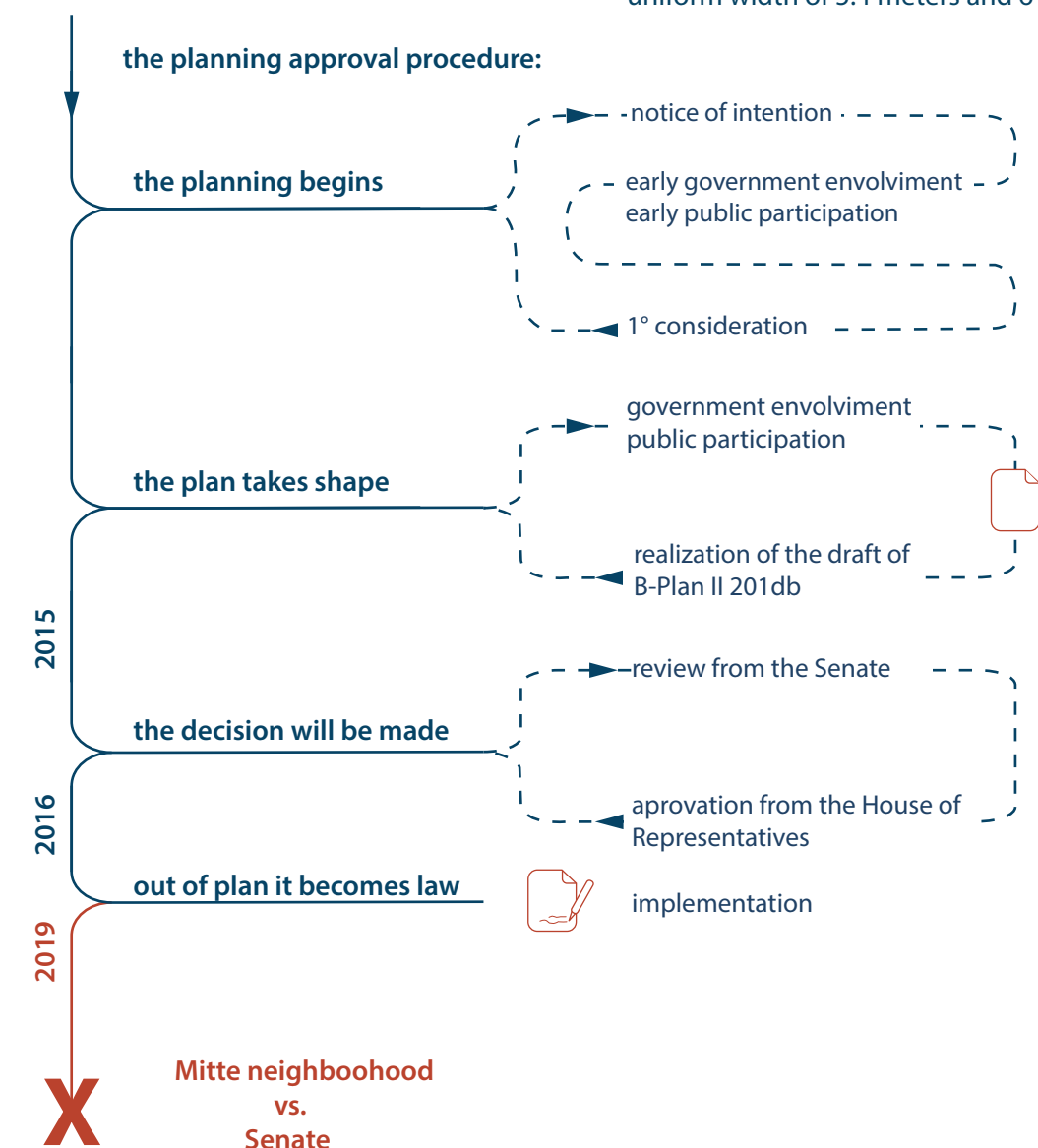


defined as a mixed use building



maximum ground area: 1045m²
maximum total area: 6960m²

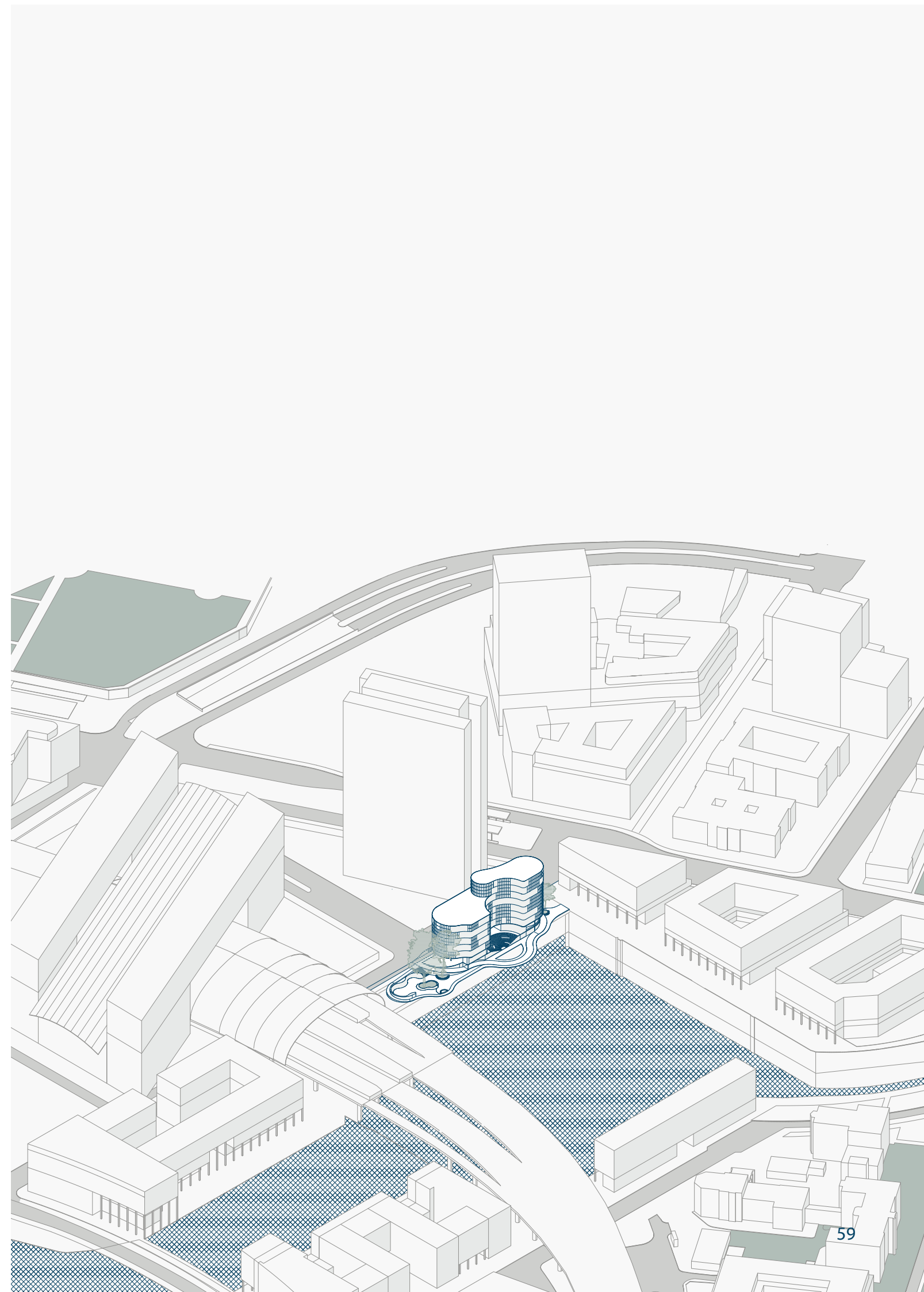
- ❹ the plan stipulates the obligatory **greening of the roof** surfaces of all blocks.
- ❺ due the small width of the site, **cantilevered elements** such as bay windows or balconies would extend beyond the bank walls and could have a **negative impact**.
- ❻ the **height** for all the blocks around the Humboldthafen are homogeneous, set at **60.3 meters above the sea level**. Since the waterfront promenade is set at 33.15 meters above the sea level, the building would have a total height of maximum 27.15 meters.
- ❼ **arcades on the water side** that follows the typology of the harbour redevelopment, therefore defined with an uniform width of 5.4 meters and 6 meters height.

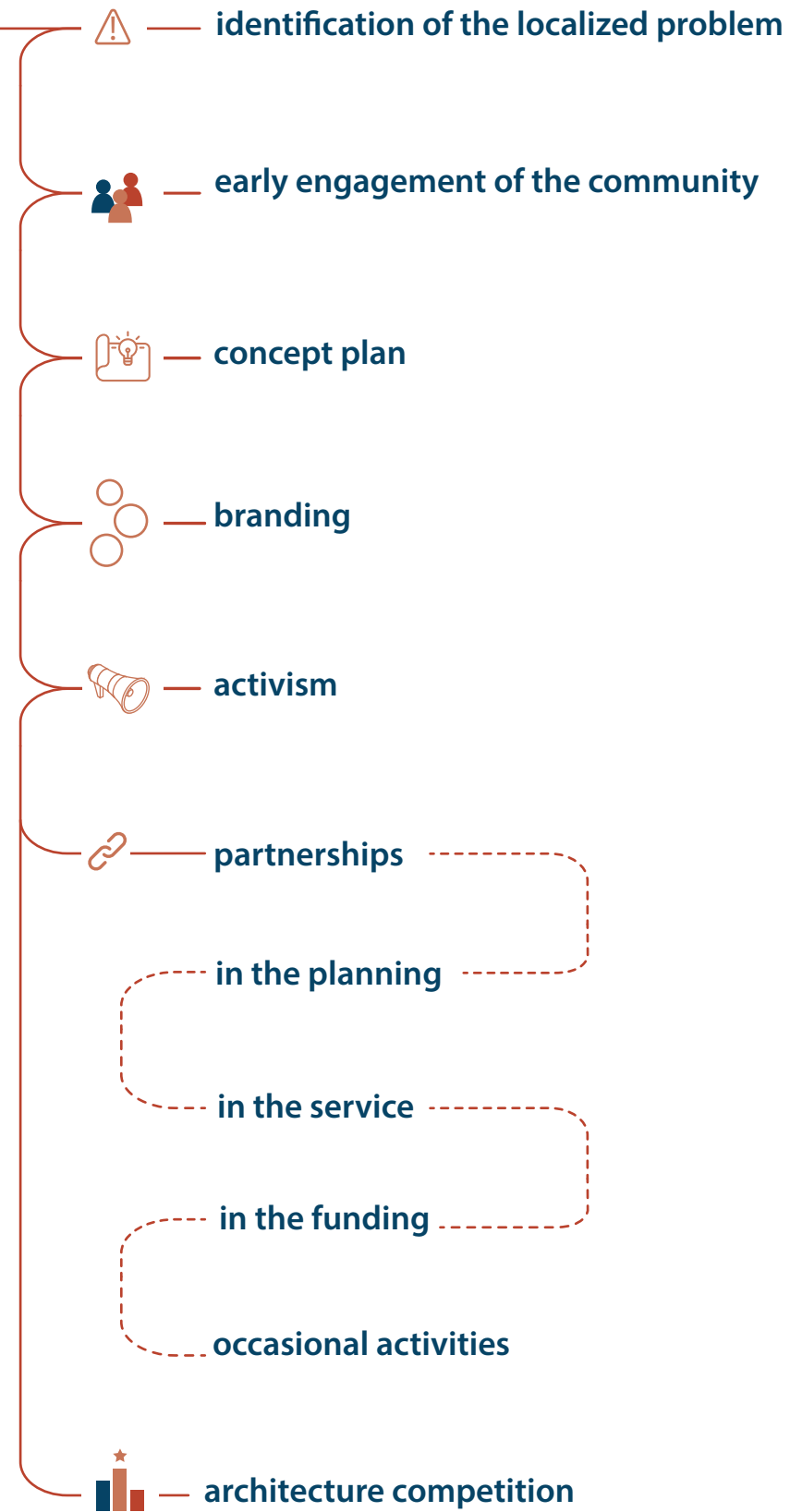


4 the proposal

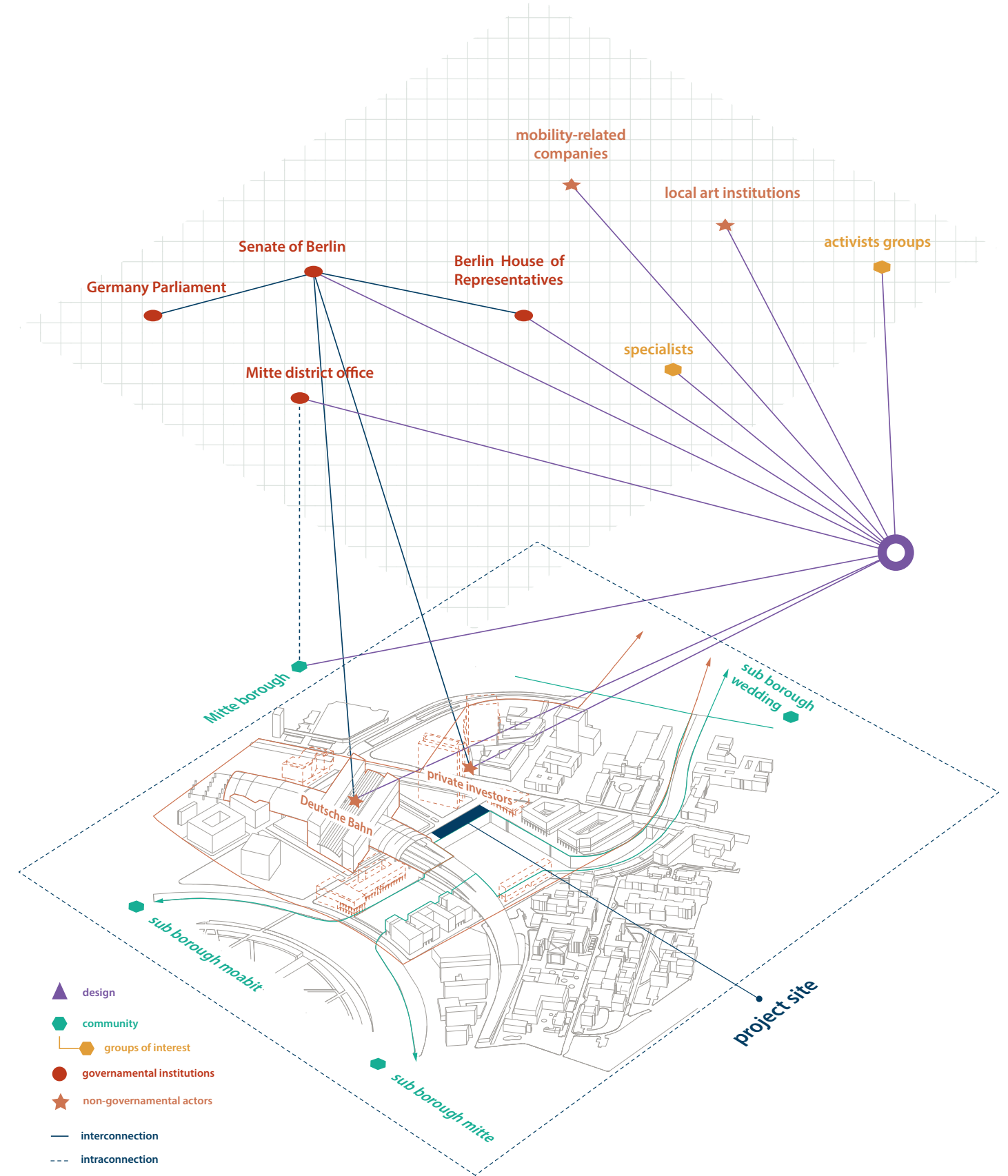
Me tropolitan Mo bility Hub

With this in mind, the thesis in question aims to participate in the debate through the MeMo Hub proposal, by describing the benefits of this mixed use building - with public space, mobility services and other related services - and presenting a strategy to its feasibility that integrates all the actors in the debate, from planning to implementation.





actors network related do the design process





early engagement of the community

As mentioned before, the community must be integrated in the planning from the beginning. Although the problems of the area are clear for some people, others are not aware of the possibilities that could improve the quality of the urban space in focus. Because of that, to initiate the planning, a site visit with representatives from neighbouring neighbourhoods, activist groups and private investors is vital for dissemination of the problems and early engagement.

4.2

concept



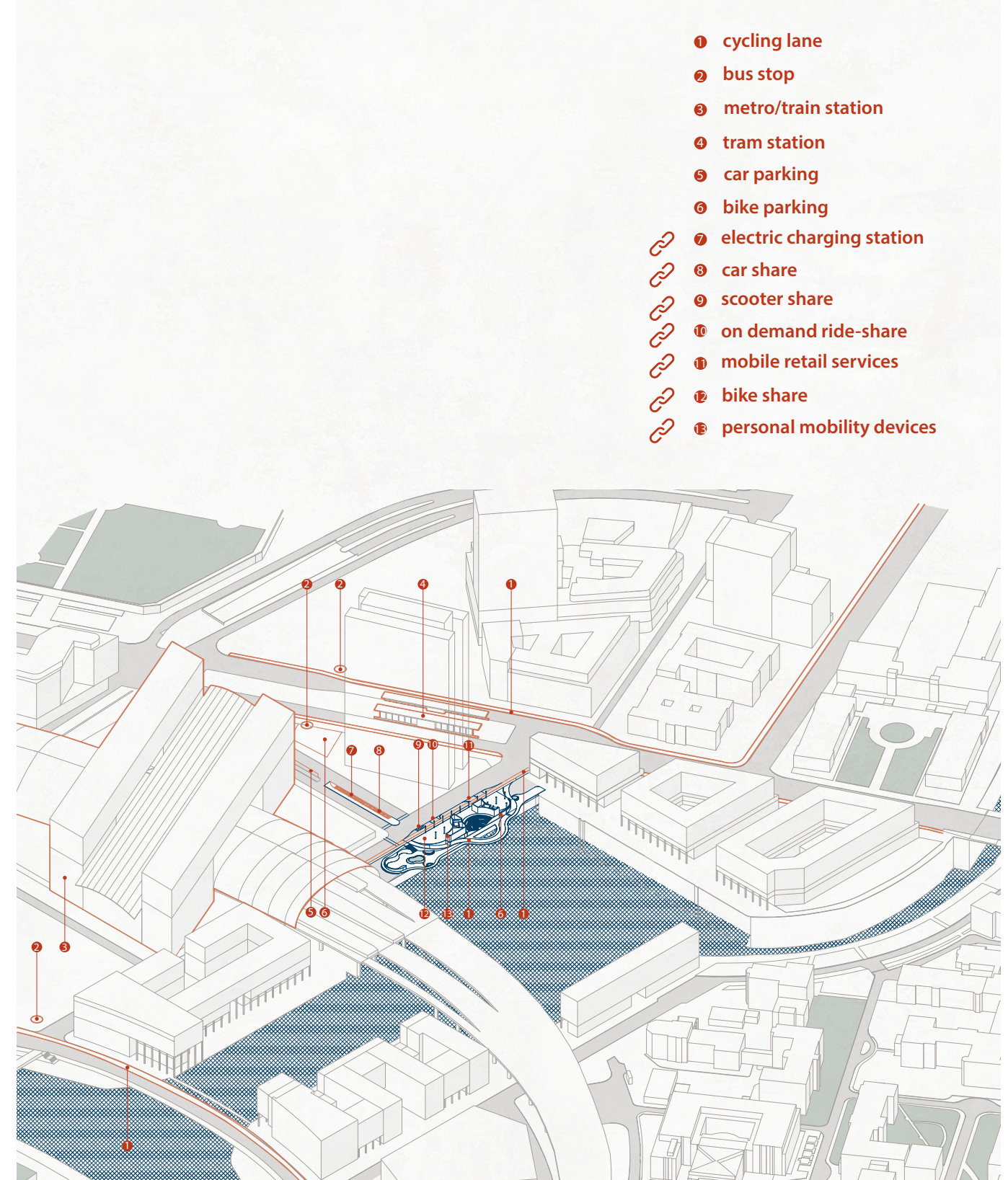
concept plan

The visit also show the opportunities and weakness of the site, factors which make the requirements of the stakeholders more realistic, enabling the hierarchisation of the measures that will meet the demands. This way, it is possible to set a timeline of the interventions that compose the project.

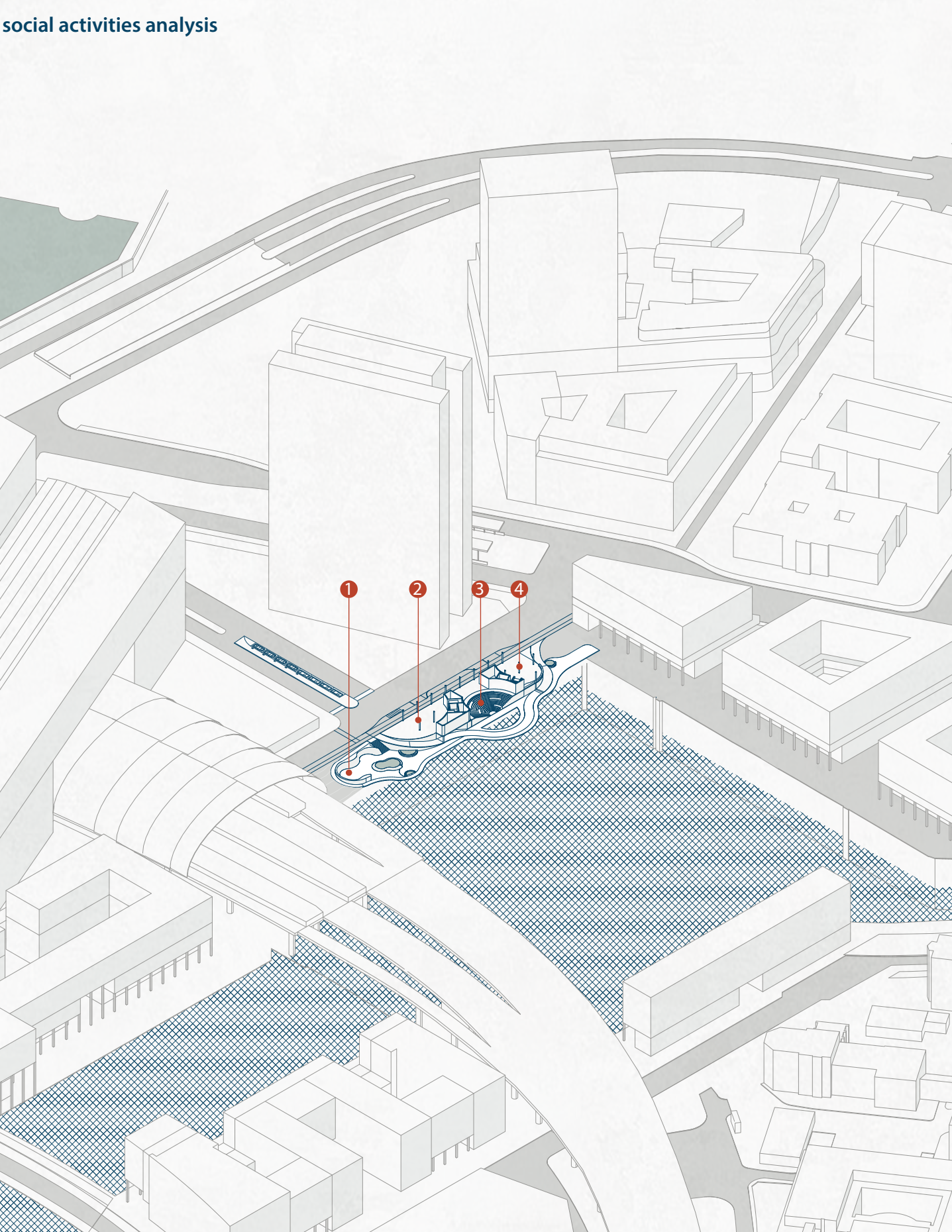
To the Metropolitan Mobility Hub (MeMo Hub), the timeline is set to be divided in two main phases. On phase one, first it will be implemented interventions at Friedrich-List-Ufer Street, where are going to be allocated new parking spaces for car sharing services, scooter sharing services, hop-on and hop-off spaces for on-demand ride-share, spaces for mobile retail services, electrical charging stations and a cycling path that connects the existing path of Invaliden Street and Rahel-Hirsch-Street. These interventions expand the possibilities of the user to chose their mode of transport, it integrates the existing infrastructure of train, metro, tram and bus, with new mobility services that cover the first and last mile of the passenger and incentive the use of sustainable modes.

Secondly, the construction on the water level - which is 2.7 meters below the street level - that attend part of the bike parking demand, offering space for 140 bicycles, focusing on short term parking. To access the parking, a path branches off from the cycle lane implemented in the street that descends 2.7 metres to water level following a curved path that intersects the two entrances of the bike parking.

traffic analysis with the proposed intervانتion

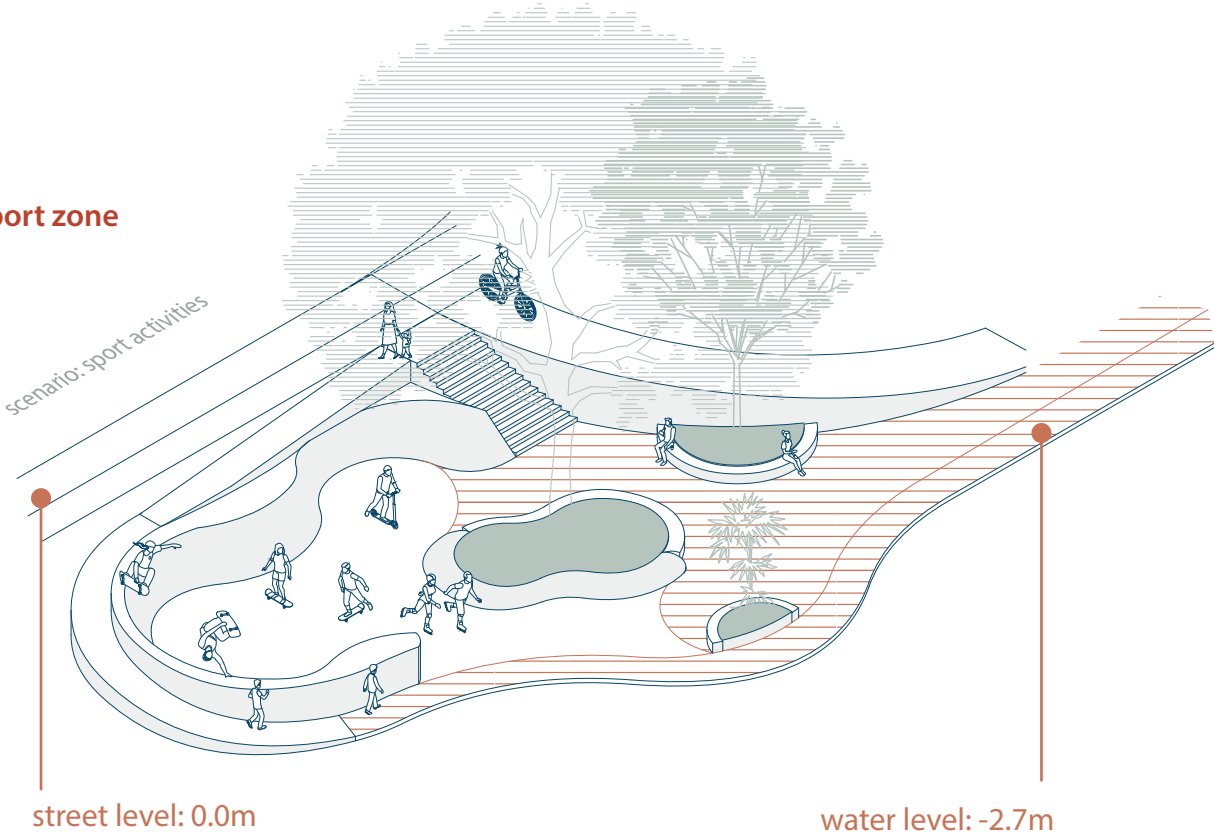


social activities analysis



Also part of phase one is a landscaping project at water level, connecting the promenade from the adjacent buildings of Humboldthafen margins, following the geometry of the smooth bicycle path that bring the user closer to the water, creating a distinctive space for contemplation and recreation. At the end of the path, there are benches and green focal points to relax and a skate park for the users of different mobility devices practice.

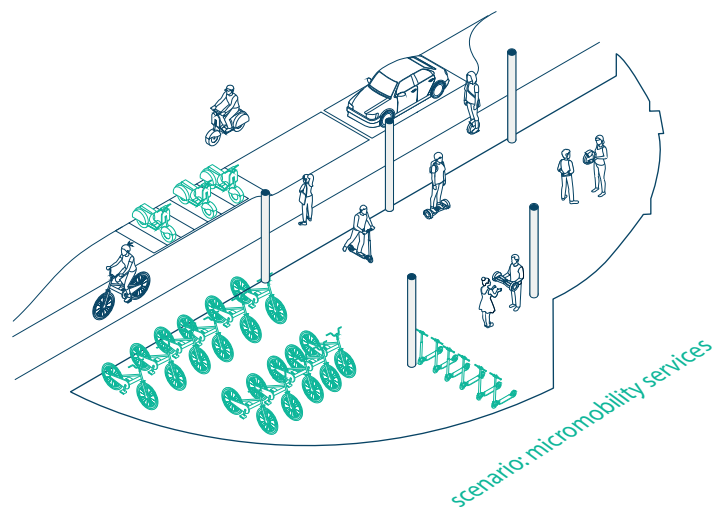
1 sport zone



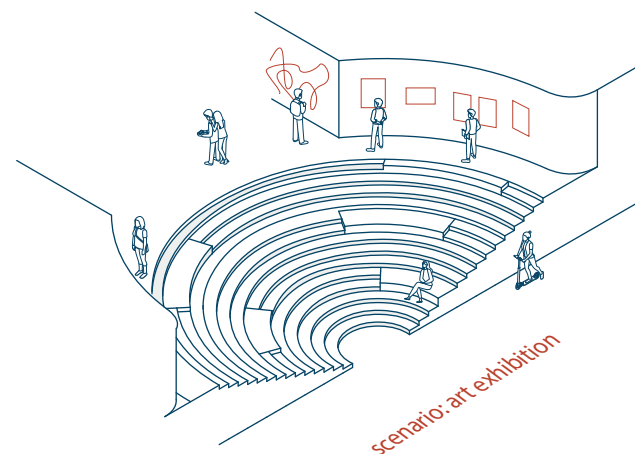
Above the bicycle parking, at street level, the project will be mostly permeable, intended for public use and giving access to the lower part of the project. However, this space is not only a passageway, but a space of permanence where spontaneous activities will take place. Activities which often take place in transport stations, but which the design of those stations does not take into consideration. It is not the case of MeMo Hub, these activities are embraced by the design.

To better foster these scenarios that would take place, the ground floor is divided in three zones: the intermodal zone, the cultural zone and the social zone. The intermodal zone is strategically located closer to the intersection of Friedrich-List-Ufer with Europaplatz, to the pedestrian crossing and to most of the street interventions, specially the scooter docking. The semicircular morphology is marked by the curved ramp of the cycling path and the structural core that is composed by the vertical connection to the elements of phase two, and space designated for micromobility companies to offer their services. Particularly, companies of Personal Mobility Devices (PMDs), such as electric unicy-

2 intermodal zone



3 cultural zone

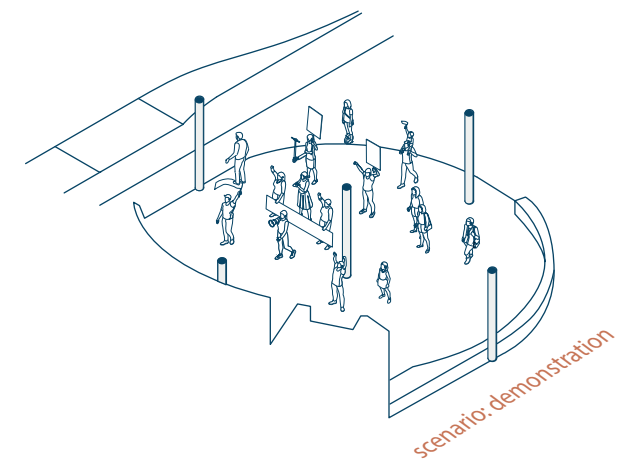
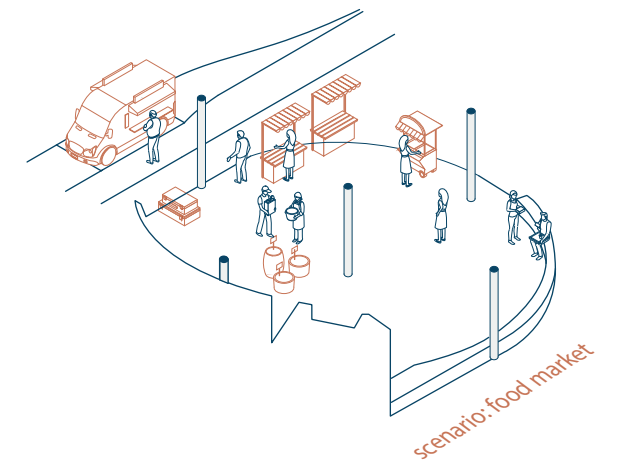
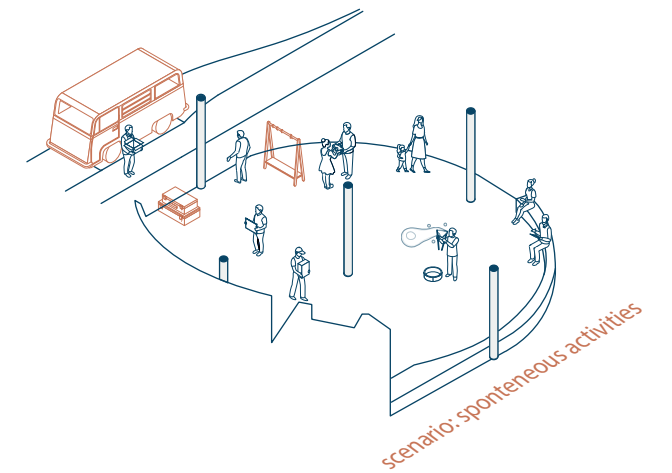


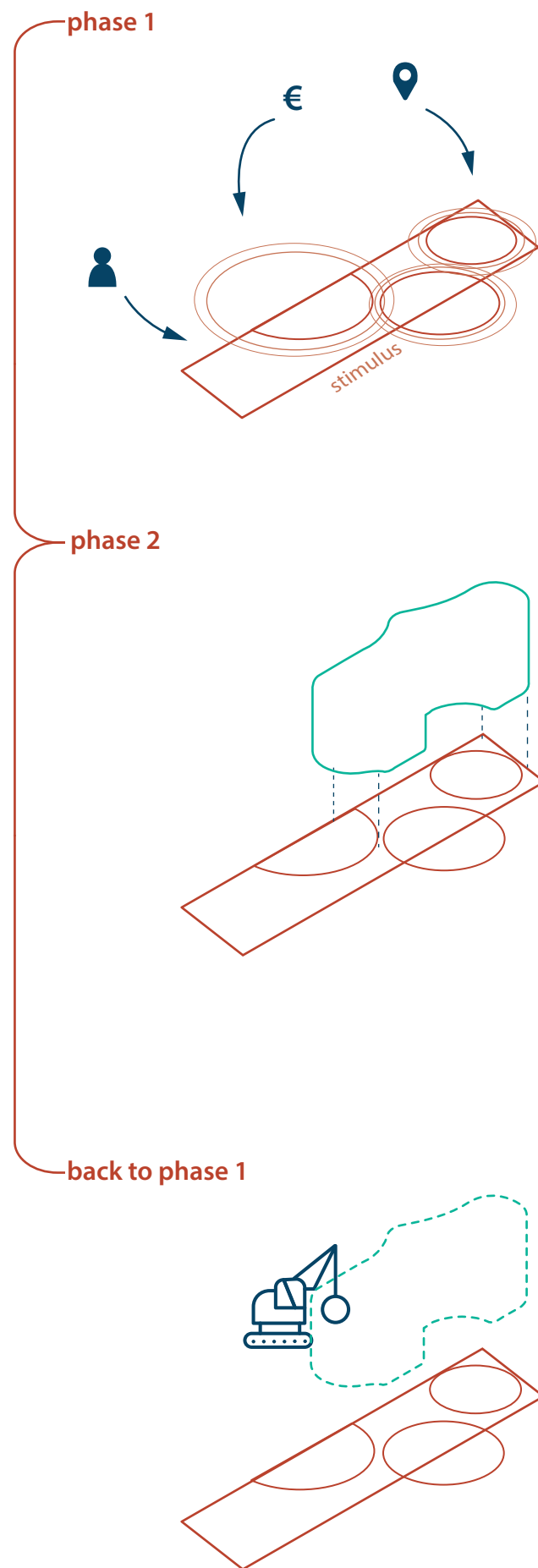
cles, hover boards and kick scooters. This service combined with the public space of the other two zones benefits the project by attracting people to enjoy the designed environment.

The cultural zone is characterised by a semi-circular staircase that faces the basin and creates an open theatre to foster artistic activities. It is located between the two curved structural core and takes advantage of the walls that limit the space as a canvas for murals and exhibitions. The other half of the circle that forms the amphitheatre is framed by the cycle path that descends into the water, bringing the water body into the project. This design choice gives an uniqueness character to the project and takes advantage of the benefits to the wellbeing caused by the presence of water in the environment.

The social zone, however, is a semi-open square, its circular form encourage social exchange and it is meant to host occasional activities such as food, book and flea markets. It is a great space to wait for the chosen transport mode and a meeting point. The activists groups that engaged in the planning of the project, for example, could gather there to demonstrate in favour of sustainable mobility and pedestrian-focused cities.

3 social zone



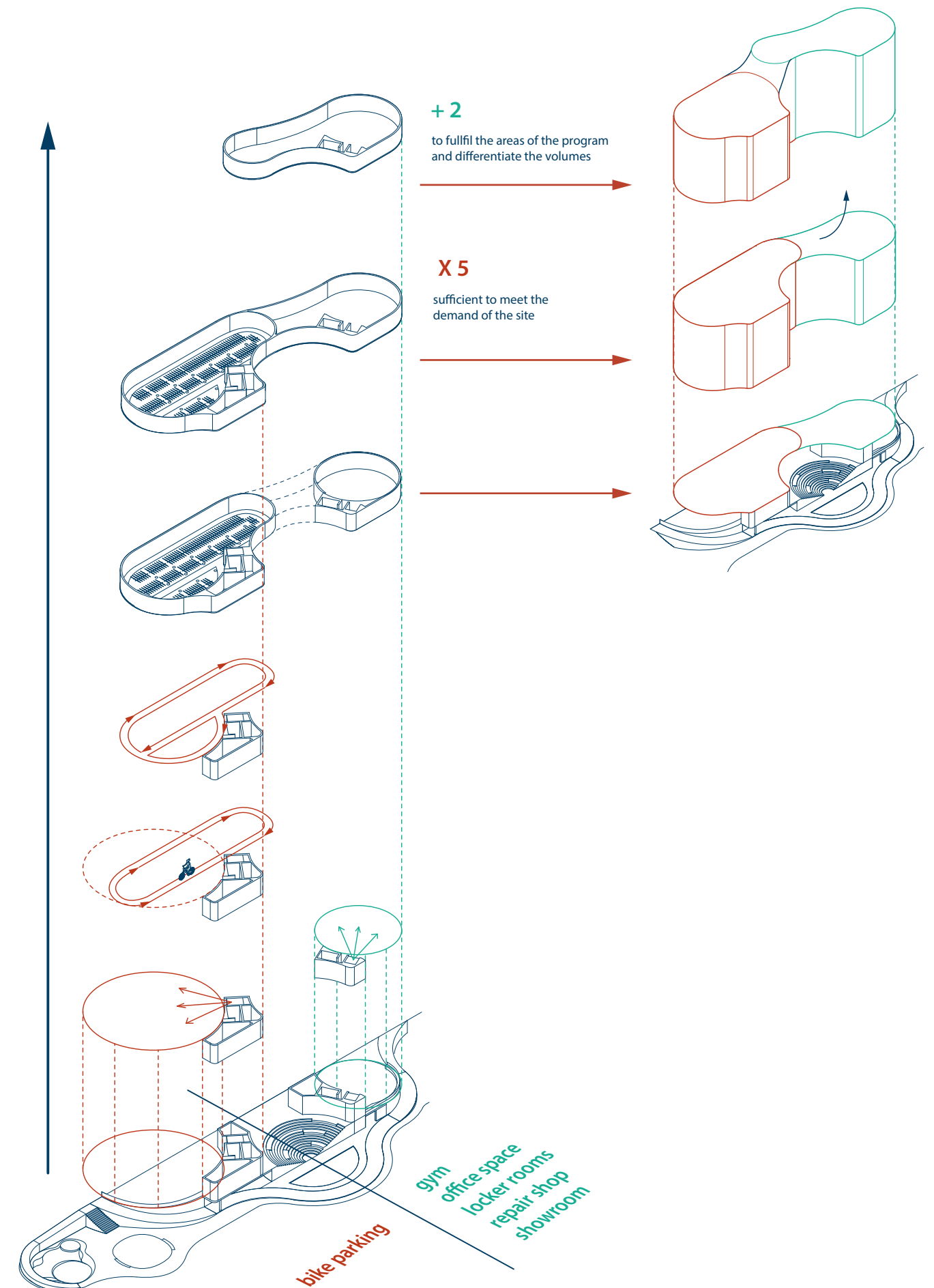


The elements that compose phase one can start working as soon as they are implemented, they are also the quickest and cheapest to implement and due to this, act as a catalyst for further development. By dividing the proposal in phases and activating the project from phase one, the community already starts to use the space, consequently, establishing a relationship with it and they get the feeling that change is underway.

Phase two, on the other hand, is meant to meet fully the demand for bike parking spaces and accommodate services that complement the functions of phase one, such as repair shops, showroom for new mobility devices, gym and office space for mobility startups.

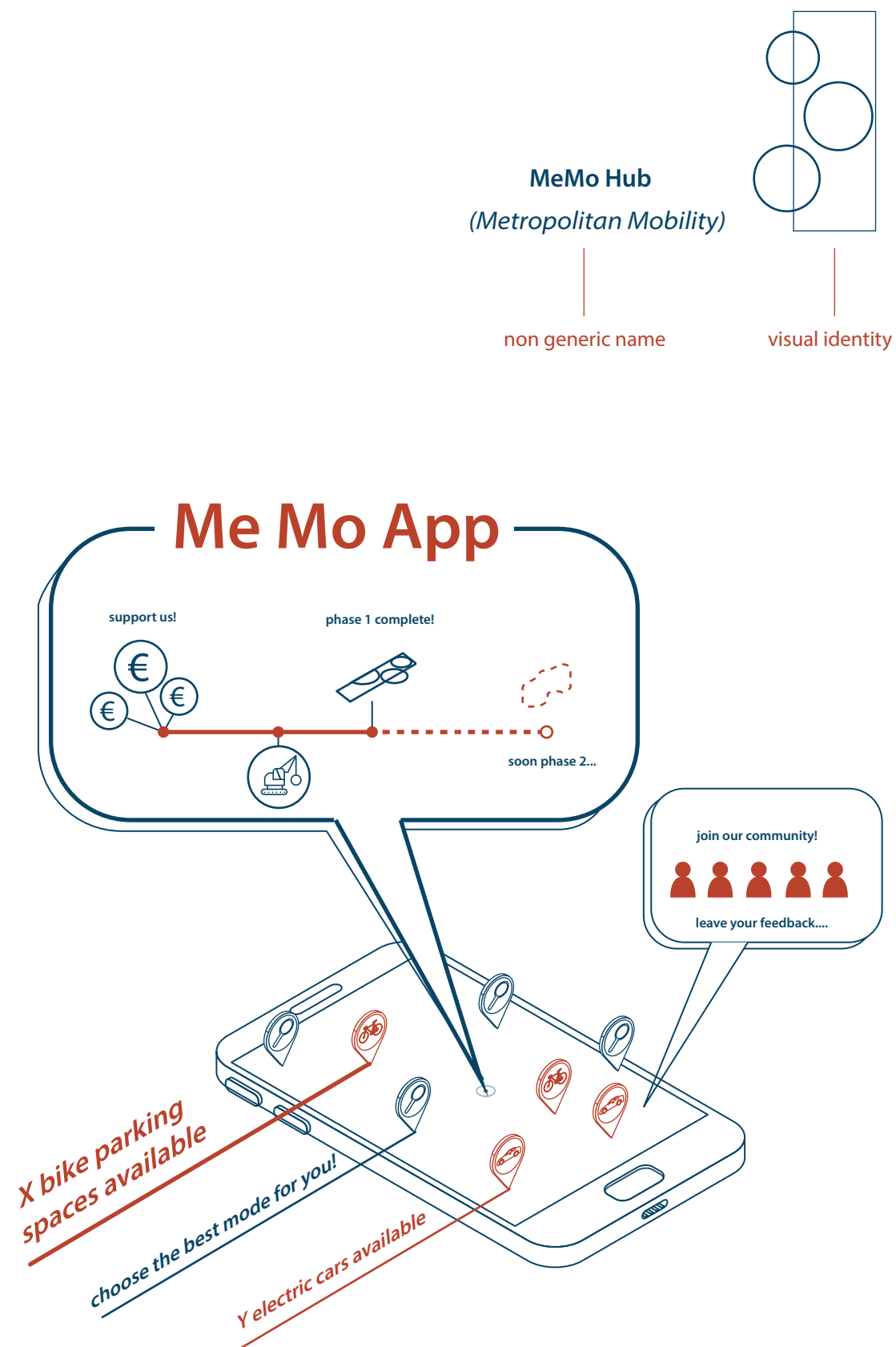
These two categories of functions are distributed over seven floors interconnected by two cores that are independent, each one comprising a lift and stairs. Although autonomous, the connection between the functions powered by each core exists and, internally, can vary depending on the services that are being connected. The morphology of the building reflects this partial separation that is also strengthened by difference of height between the two parts. The curved aspect of the project express a design choice that reinforce the fluidity favourable to cyclists.

Another interesting characteristic is that, if needed in the future, the second phase can be turned down and the main aspects of the proposal would still work on the ground and under-ground floor.





branding



After defining the concept of the proposal, the next step of the strategy is the branding. This phase comprises the development of a visual identity and the definition of a communication strategy which establish an online platform, in the form of a website and app, where users and investors can interact and be updated on the development of the project. The visual identity establish a relationship between the physical space and a 'brand', facilitating recognition by the community as a space belonging to them.

As part of the online platform, it is recommended a 'live timeline' to be provided. The timeline would mark the current phase of the project, from fundraising to the construction of the last stage. The platform would also show the timetables of the fixed means of transport and could help users to choose the best service for their journey. The project also foresees that this information will be physically available at the site and that the branding strategy would carry through to way finding signage, public art, streetscape design etc.



activism

The 'activism' is a stage where the strategic plan proposes the political participation of the promoters of the proposal in order to disseminate the debate on local issues and give strength to the MeMo Hub. This participation would take place in events organised by activist groups that mobilise the population to engage in projects for an urban space where pedestrians and cyclists are the main actors.

activists groups
that promote
cycling in Berlin





Image 24 - adfc manifestation in Berlin



partnerships

To ensure the MeMo Hub vision as a vibrant, well-connected place will require cooperation of a variety of parties through public and private realm partnerships. These partnerships can occur in different areas of the project, in the planning of the proposal, in the establishment of the offered services, in the funding and in the occasional activities that could happen in the building, as described below.

in the planning

the municipal government can help guide development around mobility hubs through different planning tools and incentives

in the service

partnership with **on-demand rideshare agencies** establishing drop on and drop off area and on street parking spaces for car share agencies;

integration with **micromobility companies** to cover the last mile by establishing anchoring points;

operate **mobile payment and trip planning apps**, by sharing valuable travel data such as preferred travel mode and destination;

involving mobility **startups**, fitness company, repair shop and bike stores etc, so accommodate their services inside the hub;

in the funding

partner with institutions on the area to help fund the project, also website would provide a platform for local investors to contribute

occasional activities

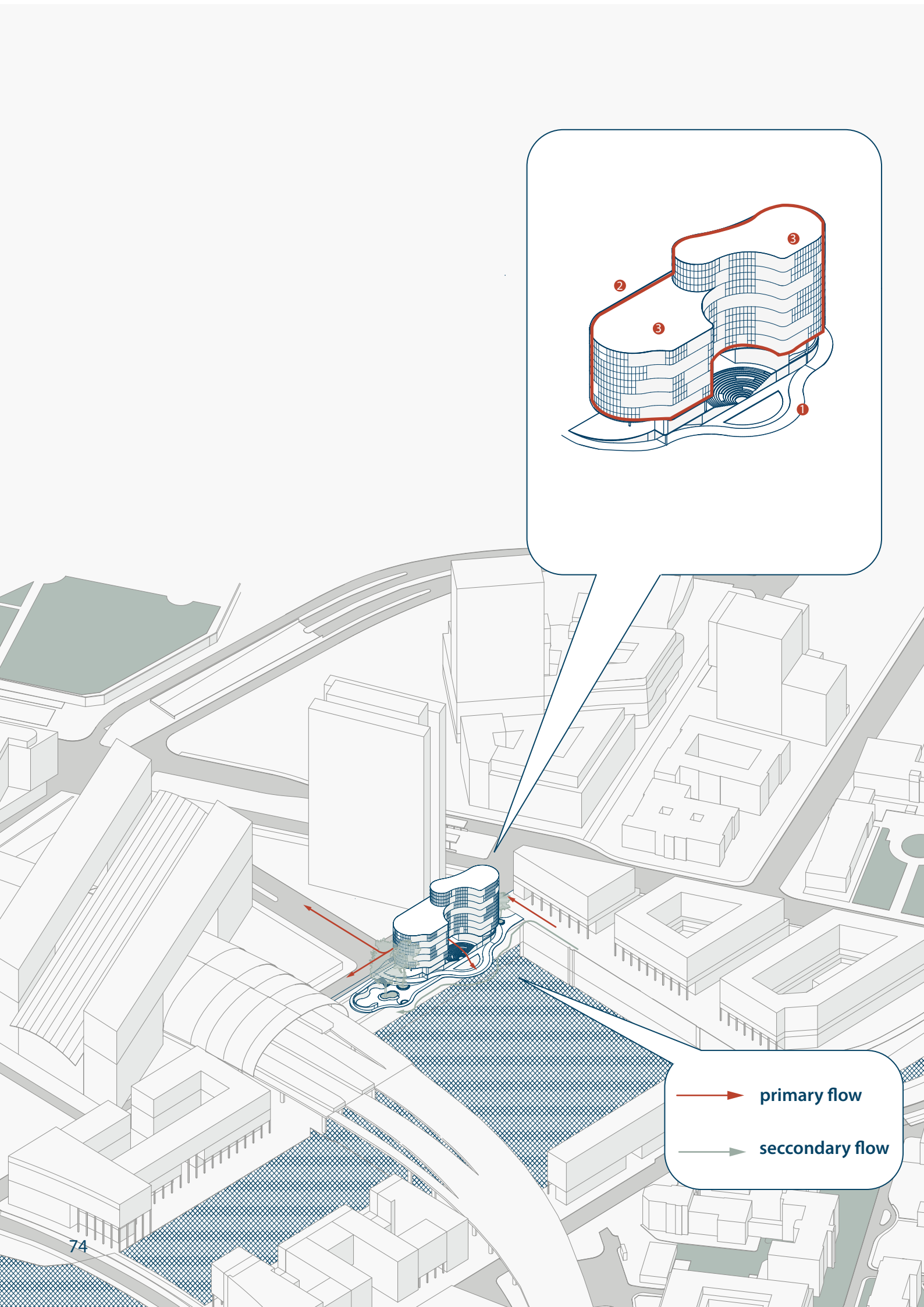
establishment of relation with the **local arts community** and related organizations to promote events and implement local art like sculptures and murals within the station.

partnership with Public Health and transit agencies to promote **education and awareness** about sustainable mobility.



architecture competition

The goal is to use this project as a tool that provokes the mobilisation of a wide range of actors aiming the change of use designated to this building by the government, described in B-Plan II 201db. After settling the vision for the site, from the scenarios built in the MeMo Hub proposal, an architectural competition for the building, based on the guidelines determined in this study, could be an interesting solution to engage local professionals and promote excellence of design.



- 1 the path that goes to the water level works the **topography** to create **accessibility** and, connecting with the semicircular staircase, forms a recreation space in direct contact with the water
- 2 **unique identity** to the building, specially in comparison to its urban surrounding
- 3 the two volumes of the building reflect from the outside how it works on the inside: the two volumes operate independently.

total area: 6110m²

total high: 29m

number of floors: 7

number of bike parking spaces: 1400

960m² —
underground plan

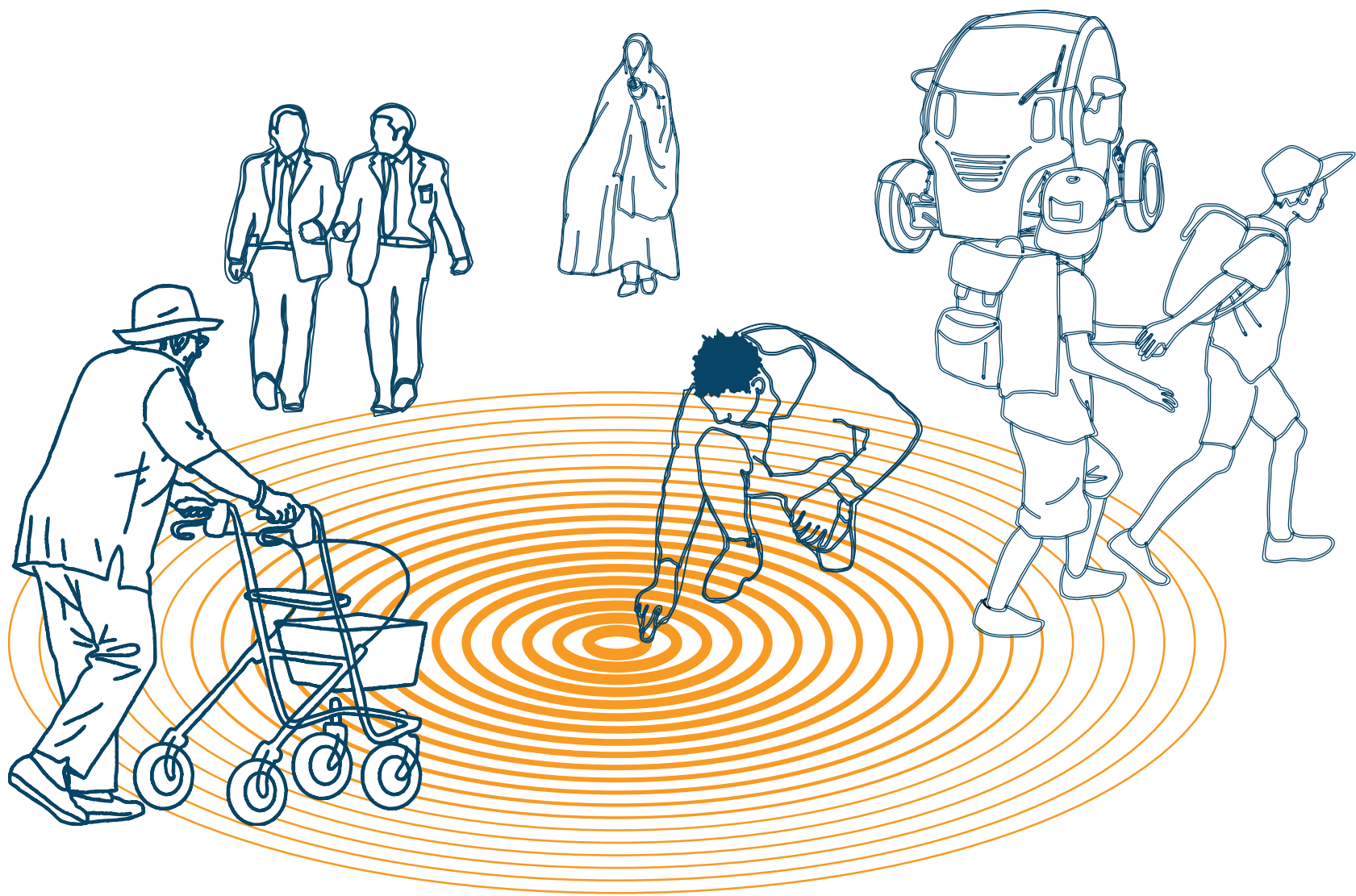
5 x 870m² —
plan type A

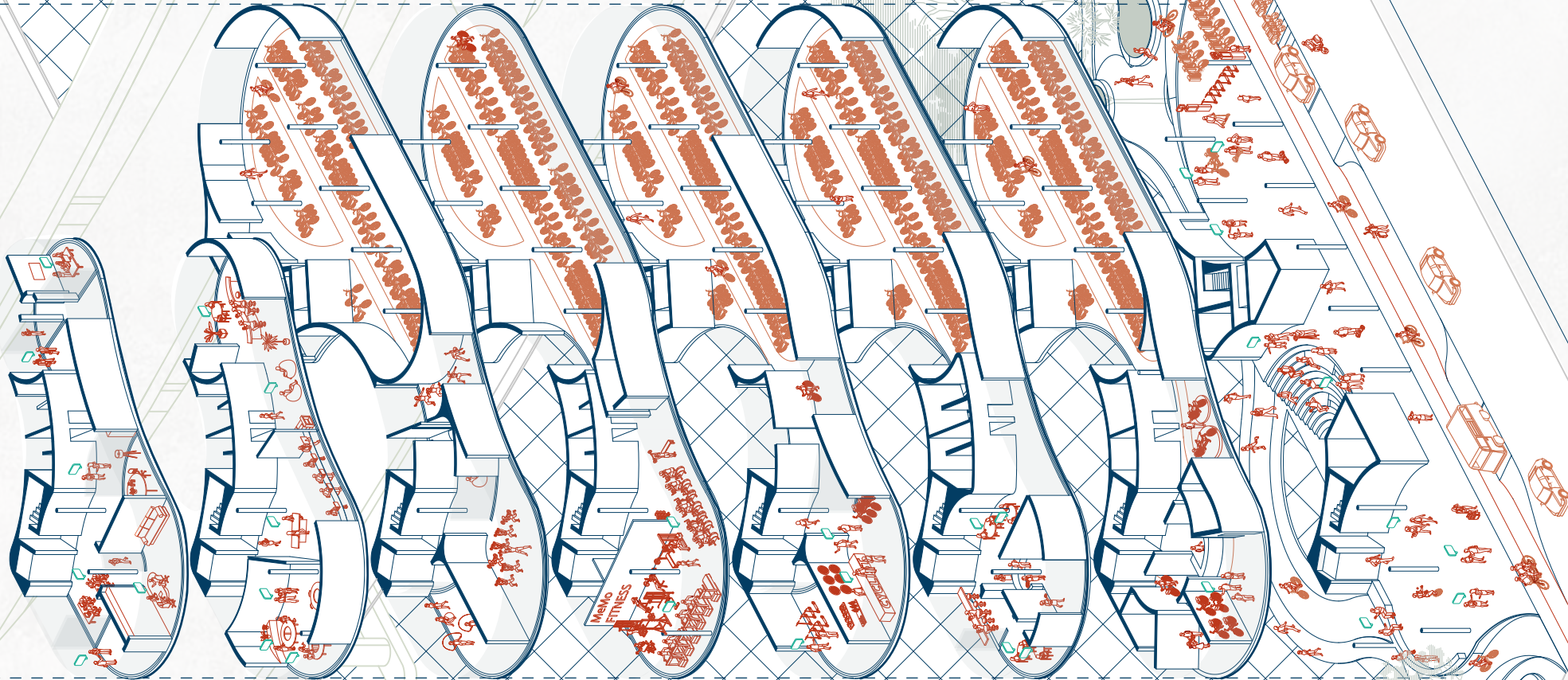
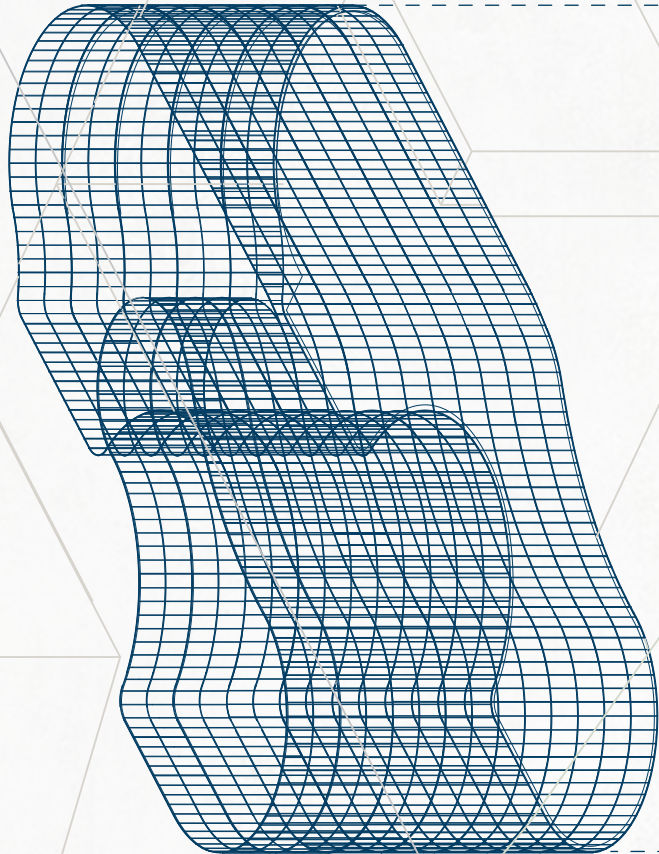
2 x 400m² —
plan type B

4.3 **benefits**

The realization of MeMo Hub would deliver various benefits to the area, apart from the increase of wellbeing and connectivity - as well as many others mentioned before - the economic benefits are significant.

It will empower the start-ups of the mobility area, fertile ground for innovative ideas, as well as provide connections between local economic and recreational sites.





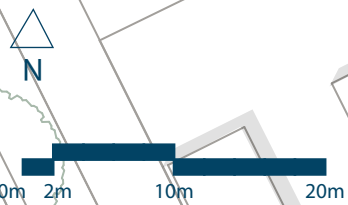
masterplan

section B

Section B

section A

section A



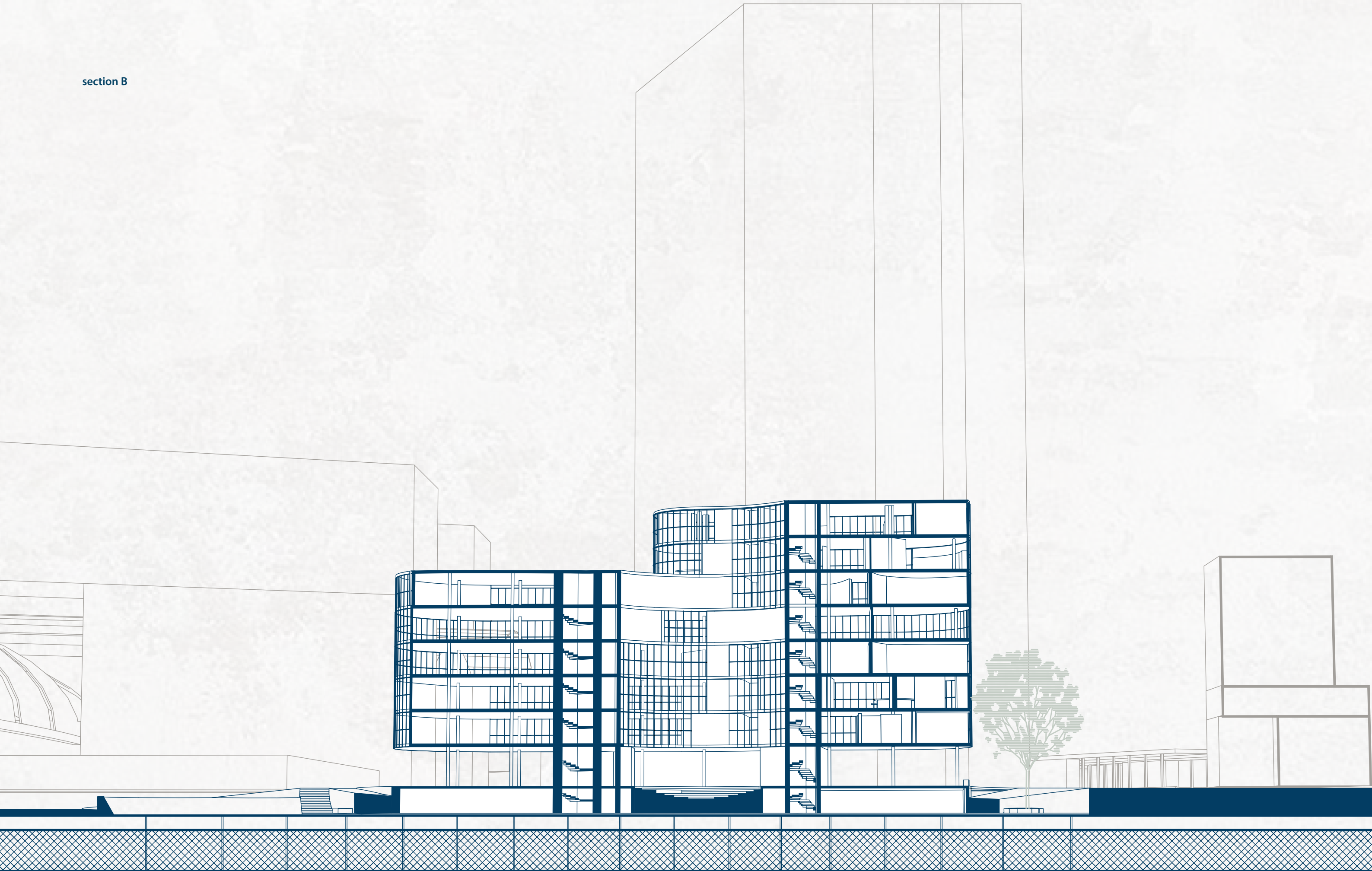
Friedrich-List-Ufer Street view

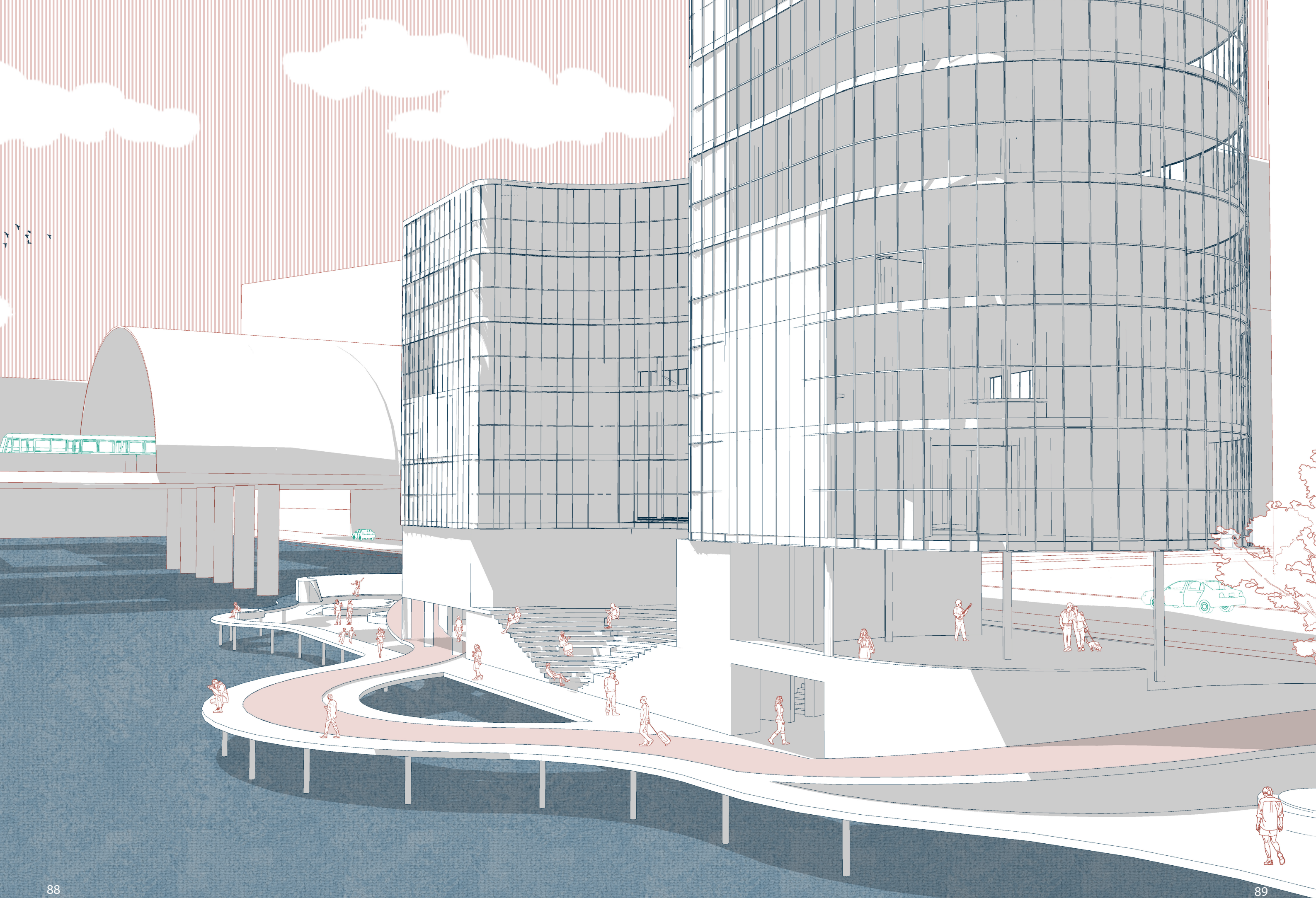


section A



section B





5 further
reflection

The presented thesis - Metropolitan Mobility Hub, thinking beyond transportation - illustrated the promising path that the area of sustainable urban mobility is following. Innovations which help the battle against climate change, improve the efficiency of urban transportation, encourage economic growth and therefore, improves the quality of the urban realm.

However, the cities regulations are not adapt to this change, consequently, disrupting the current status quo. This disruptions gives an opportunity to think about these regulations and to debate about the path that the cities are heading to. Is it the path that leads to a diverse and lively urban environment or it vision to fulfil private investment desires, neglecting the community's opinion?

One example of that is presented in the thesis by analysing the development project around Berlin Central Station (Hauptbahnhof), followed by a possible solution to the conflict between Senate's decision and the citizen's desires. The proposal combines the economic benefits of investing in the rising sustainable mobility sector, with the infrastructural need of the Central Station, also the community request for public space and the site's quality near the Humboldthafen basin. MeMo Hub empowers discussion about the poor definition of use that has been given to the building located in the heart of Berlin, with a range of qualities that can be exploited.

The project stimulates debate beyond Berlin, it will be taken to Brasilia, where the project will be further developed technically as a final thesis for the Architecture and Urbanism course at the University of Brasilia.

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6.1

image links

Image 1, 2, 3 and 4 : <https://www.cobe.dk/place/norreport-station>

Image 5 and 6: <https://www.stadtmacher-akademie.org/reallabor-radbahn-eine-verbindung-zwischen-mensch-und-stadt/>

Image 7: <https://worldlandscapearchitect.com/radbahn-a-journey-from-zoo-to-oberbaumbruecke-in-berlin/#.YBggKGRuft0>

Image 8: <https://www.facebook.com/radbahn/photos/1874283012829912>

Image 9: <https://br.pinterest.com/pin/75787206209021189/>

Image 10: <https://br.pinterest.com/pin/594756694536844819/>

Image 11: <https://archello.com/story/4259/attachments/photos-videos/1>

Image 12: <https://archello.com/story/4259/attachments/photos-videos/2>

Image 13: <https://www.stadtentwicklung.berlin.de/planen/stadtentwicklungskonzept/de/berlinstrategie/index.shtml>

Image 14: https://www.stadtentwicklung.berlin.de/planen/hauptstadt/dokumentation/en/wettbewerbe/lehrter_bhf.shtml

Image 15, 16, 17, 18: <https://amrandvoneuropa.city/>

Image 19 and 20: https://www.schueco.com/web2/om/architects/magazine/all_contributions/office_business_berlin_31.01.17