

SUSTAINABLE MOBILITY IN POST-INDUSTRIAL DEVELOPMENT

*A research to sustainable mobility in post-industrial development applied
to Merwe-Vierhavens, Rotterdam*



PRESENTATION OUTLINE

2/49

- 1** Context
- 2** Theory + analysis
- 3** Strategy
- 4** Conclusion

MOBILITY SHIFT

The use of vehicles with internal combustion engines results in excessive CO₂ emissions and other environmental issues. - Fulton et al., 2017

Together with non-motorized transportation, electric, hybrid, shared and autonomous vehicles could be revolutions to engage towards a sustainable way of mobility use. - Transport & Environment, 2019



▲ De Toyota Mirai elektrischmodel © Toyota

'Waterstof? Niemand ontkomt er aan', claimt Toyota

Hoewel steeds meer autofabrikanten waterstof niet langer zien als energiebron voor personenauto's, blijft Toyota naar eigen zeggen 'vol inzetten' op een zogenoemde waterstofsaamenleving. „Dat gaat verder dan auto's alleen. We kunnen er niet omheen en zullen het straks allemaal gebruiken.“

Roland Tamming 07-12-20, 10:00
Laatste update: 11:46



▲ Greenwheels beeld in Delft uit met vijf deelauto's © Benno Zandig

Greenwheels breidt uit in Delft met vijf deelauto's

Met meerdere mensen een auto delen die niet van jezelf is, om zo het aantal voertuigen op de weg te beperken en de CO₂-uitstoot te verminderen. De gedachte achter Greenwheels slaat aan in Delft, want het bedrijf breidt in de stad uit met vijf nieuwe deelauto's in de rode bedrijfskleur.

Peter van de Stadt 24-12-20, 14:05
Laatste update: 16:08



▲ Een UberGreen auto staat aan de rotonde voor de vestingdeuren van Uber Green © Uber

Uber-chauffeurs worden verplicht elektrisch te rijden

Taxiplatform Uber maakt de overstap naar elektrische taxi's, te beginnen in Amsterdam in 2025. Chauffeurs die het niet zien zitten om een elektrische auto aan te schaffen, of het niet kunnen betalen, mogen dan niet langer voor Uber rijden.

Ton Voermans 30-12-20, 08:19
Laatste update: 10:13



▲ De beroeemd Renault 5 komt terug als elektrische auto © Renault

Grootse plannen bij Renault: beroemd 'Vijfje' herleeft als elektrisch model

De Renault 5 komt terug: zojuist wakte de Franse automaker het beroemde model weer tot leven in de vorm van het studiemodel '5 Prototype'. Uiteindelijk verschijnt het nieuwe 'Vijfje' daadwerkelijk op de weg als volledig elektrische auto, als onderdeel van een reeks grote vernieuwingen bij Renault.

Roland Tamming 14-01-21, 12:04
Laatste update: 12:13



▲ Hoeveel herleeft 'Viermaal' met elektrische auto's? © Peter Hitz

In een schone auto over een filevrije snelweg, is dat haalbaar?

WELKOM 2021 Zoeven in een elektrische auto over een lege snelweg. Wordt dat 2021? Of staan we na de vaccinaties weer dagelijks met rokende brandstofauto's in de file?

Ton Voermans 08-01-21, 14:17
Laatste update: 14:27



▲ De deelscooters van GO Sharing rijden al in vier plaatsen: Joure, Tilburg, Breda en Oosterhout (Bno). Het bedrijf wil het wettigheidsgebied uitbreiden naar Waalwijk. © Photo: Ron Stegema

Gaat Waalwijk aan de elektrische deelscooter? GO Sharing staat in de startblokken

WAALWIJK - Inwoners van Waalwijk moeten binnenkort rijjes kunnen maken op groene elektrische deelscooters. Het bedrijf GO Sharing staat in de startblokken om zijn werkgebied verder uit te breiden. „We willen in Waalwijk eerst vijftig scooters plaatsen“, sluis een woordvoerder. „Dat kunnen er later meer

01 CONTEXT



Development Port of Rotterdam (Port of Rotterdam, 2018)

INDUSTRIAL SHIFT

(Heavy) industry is moving out of the cities, which leaves these sites prime for **redevelopment** - Van der Knaap, 2002

There is need for **1 million homes** before 2030, in form of **densification** instead of **expansion** - Kajsa Ollongren, 2018

MOBILITY SHIFT

The use of vehicles with internal combustion engines results in excessive CO₂ emissions and other environmental issues. - Fulton et al., 2017

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Location:
Merwe-Vierhavens

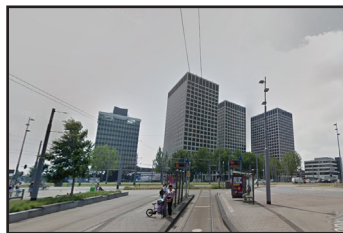
01 CONTEXT

Merwe-Vierhavens:

- ± 100 ha
- Developed 1910-1915
- Largest fruit port worldwide
- Focus of Municipality of Rotterdam
- Potential growth area
- Innovation District



01 CONTEXT



Marconiplein



Van Helmontstraat



Keileweg



Images from Google Maps 2018

01 CONTEXT



Marconistraat



Galileistraat



Lekhaven



Images from Google Maps 2018

PROBLEM STATEMENT:

'Industrial sites need to be redeveloped as the industry is moving out and the current urban structure is not fit for the new functions.

This, together with densification and other environmental challenges causes pressure on open space, which results in social, economic and environmental unsustainability'

HYPOTHESIS:

'The mobility shift towards sustainable principles can be a way to steer the development of post-industrial sites towards a sustainable environment'



RESEARCH QUESTION:

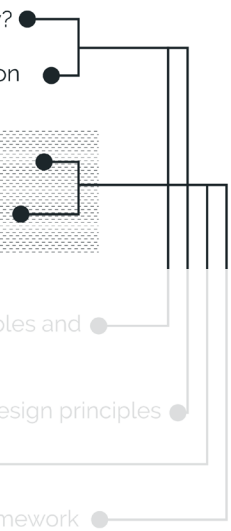
'How can sustainable mobility guide the redevelopment of post-industrial sites towards a sustainable environment?'

RESEARCH QUESTIONS

- 1 What are the different principles of (sustainable) mobility?
- 2 What spatial factors should be considered in the transition towards a sustainable mobility network?
- 3 How can this transition be applied to the case of M4H?
- 4 How can the case of M4H be used to guide other cases?

RESEARCH AIMS

- 1 Finding the relation between sustainable mobility principles and development challenges
- 2 Finding ways to translate mobility concepts into urban design principles
- 3 Revealing potentials of urban development in M4H
- 4 Translating case specific design elements to general framework



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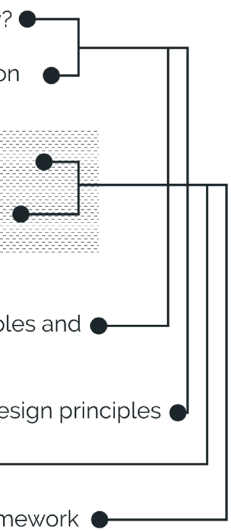
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1

Defining the mobility transition

Infographic
PUBLIC TRANSPORT
as part of Sustainable Mobility

RATIONALE
Creating the urban fabric that is at the heart of sustainable mobility is a complex task. It requires a holistic approach that considers the needs of all stakeholders, from the public to the private sector. This involves a combination of policy, planning, and investment. The goal is to create a system that is efficient, equitable, and sustainable.

ENVIRONMENT
The development of public transport is a key element of sustainable mobility. It helps to reduce the number of cars on the road, which in turn reduces greenhouse gas emissions and improves air quality. Public transport also helps to reduce the need for parking spaces, which can be used for other purposes such as housing or green spaces.

TRAIN
Trains are the backbone of many public transport systems. They offer a fast and reliable mode of transport that can cover long distances. However, they also have a high energy consumption and a large carbon footprint. To make them more sustainable, it is important to invest in energy-efficient technologies and to encourage the use of electric or hydrogen-powered trains.

METRO
Metros are high-capacity public transport systems that serve urban areas. They are typically faster and more frequent than other modes of transport. However, they also have a high energy consumption and a large carbon footprint. To make them more sustainable, it is important to invest in energy-efficient technologies and to encourage the use of electric or hydrogen-powered metros.

TRAM
Trams are a type of public transport that runs on tracks in the street. They are typically slower and less frequent than other modes of transport. However, they also have a lower energy consumption and a smaller carbon footprint. To make them more sustainable, it is important to invest in energy-efficient technologies and to encourage the use of electric or hydrogen-powered trams.

BUS
Buses are a common mode of public transport that can serve a wide range of urban areas. They are typically slower and less frequent than other modes of transport. However, they also have a lower energy consumption and a smaller carbon footprint. To make them more sustainable, it is important to invest in energy-efficient technologies and to encourage the use of electric or hydrogen-powered buses.

OTHER
Other modes of public transport include ferries, cable cars, and monorails. Each mode has its own characteristics and challenges. To make them more sustainable, it is important to invest in energy-efficient technologies and to encourage the use of electric or hydrogen-powered vehicles.

2

Translation into development patterns

PT.1

TRANSFER HUBS
A transfer hub connects and directs the public transport network at various levels of the urban fabric. It is a key element of sustainable mobility that helps to reduce the number of cars on the road and improve air quality.

DENSITY ●●●●●
ACTIVITY ●●●●●
ACCESSIBILITY ●●●●●

CITY | HIGH | DENSITY | BOWLS **PT.3 | DENSITY | BOWLS**

CHALLENGE
Public transport lines are linear elements that are limited in size and direction. To ensure the use of an interconnected public transport network is reward.

SOLUTION
A transfer hub is a public transport network provides the possibility for travelers to transfer easily between transport lines and/or modes of transportation modes like trams, buses, and ferries. At a transfer hub, various lines are connected which extends the public transport network of the given location. A transfer hub provides more options for travelers to reach different destinations.

PT.4 TRANSFER HUBS **PT.2** HIERARCHY NETWORK **SM.1** TRAVEL RESTRICTIONS **SM.2** SOCIAL SAFETY

PT.3 DENSITY ZONES **PT.4** STATION VIABILITY **SM.3** LAND USE **SM.4** WITH CONTEXT

3

Implementation of sustainable mobility in the redevelopment process

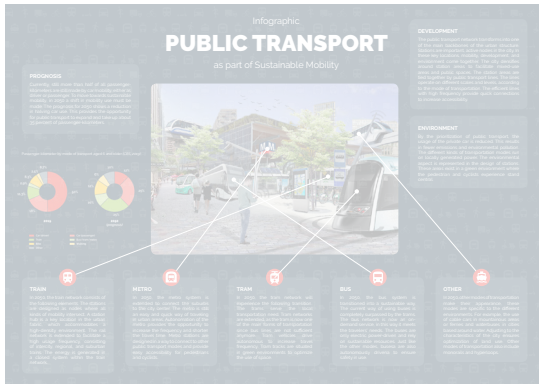


01 CONTEXT

'How can sustainable mobility guide the redevelopment of post-industrial sites towards a sustainable environment?'

1

Defining the mobility transition



2

Translation into development patterns

PT.1

TRANSFER HUBS
A transfer hub connects and divides the public transport network. It consists of 2 or more intersecting public transport modes and/or lines.

DENSITY ●●●●○
ACTIVITY ●●●●○
ACCESSIBILITY ●●●●○

CITY | NH | BLK | BORG PT3 SM3 SH3
SM2 SM4 CM2

CHALLENGE

Public transport lines are linear elements that are limited in size and direction. To enhance the use, an interconnected public transport network is needed.

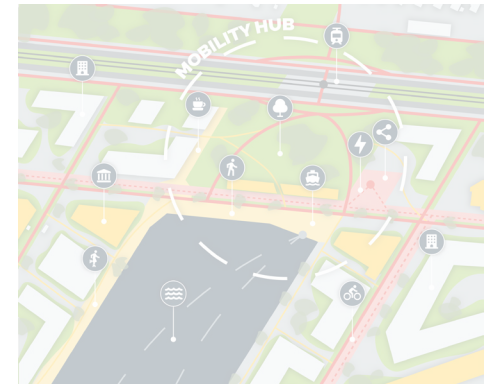
SOLUTION

A transfer hub in a public transport network provides the possibility for travelers to transfer easily between transport lines and/or kinds of transportation modes like trams, ferries, and buses. At a transfer hub, various lines are connected which extends the public transport network of the given location. A transfer hub creates more options for travelers to reach different destinations.

<p>PT4</p> <p>TRANSFER HUBS</p>	<p>PT2</p> <p>HIERARCHY NETWORK</p>	<p>SM4</p> <p>TRAVEL DESTINATIONS</p>	<p>SM2</p> <p>SOCIAL SAFETY</p>
<p>PT3</p> <p>DENSITY ZONES</p>	<p>PT4</p> <p>STATION VIABILITY</p>	<p>SM3</p> <p>LAND USE</p>	<p>SM4</p> <p>PATH CONTEXT</p>

3

Implementation of sustainable mobility in the redevelopment process



01 CONTEXT

'How can sustainable mobility guide the redevelopment of post-industrial sites towards a sustainable environment?'

1

Defining the mobility transition

Infographic
PUBLIC TRANSPORT
as part of Sustainable Mobility

PROCESSES
Public transport is a key part of an urban mobility strategy. It provides a sustainable, efficient and accessible means of transport for all citizens. It is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

DEVELOPMENT
Public transport is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

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TRAIN
The train is a key mode of public transport. It is a fast and efficient means of transport that can carry a large number of passengers. It is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

METRO
The metro is a key mode of public transport. It is a fast and efficient means of transport that can carry a large number of passengers. It is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

TRAM
The tram is a key mode of public transport. It is a fast and efficient means of transport that can carry a large number of passengers. It is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

BUS
The bus is a key mode of public transport. It is a fast and efficient means of transport that can carry a large number of passengers. It is a key element of a sustainable urban mobility plan (SUMO) and is essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

OTHERS
Other modes of public transport include bicycles, scooters and taxis. These modes are also important for a sustainable urban mobility plan (SUMO) and are essential for reducing greenhouse gas emissions, improving air quality and reducing congestion in cities.

2

Translation into development patterns

PT.1

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A transfer hub connects and directs the public transport network. It consists of 2, 3 or more intersecting public transport modes and/or lines.

DENSITY ●●●●●
ACTIVITY ●●●●●
ACCESSIBILITY ●●●●●

CITY | HIGH | DENSITY | BONUS **PT.3 | DENSITY | BONUS**
STATION | HIGH | DENSITY | BONUS

CHALLENGE
Public transport lines are linear elements that are limited in size and direction. To enhance the use of an interconnected public transport network is needed.

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A transfer hub in a public transport network provides the possibility for travelers to transfer easily between transport lines and/or modes of transportation modes like train, tram, and bus. At a transfer hub, various lines are connected which allows the public transport network of the given location. A transfer hub provides more options for travelers to reach different destinations.

PT.4 **PT.2** **SM.1** **SM.2**
TRANSFER HUBS **HIRARCHY NETWORK** **TRAVEL RESTRICTIONS** **SOCIAL SAFETY**

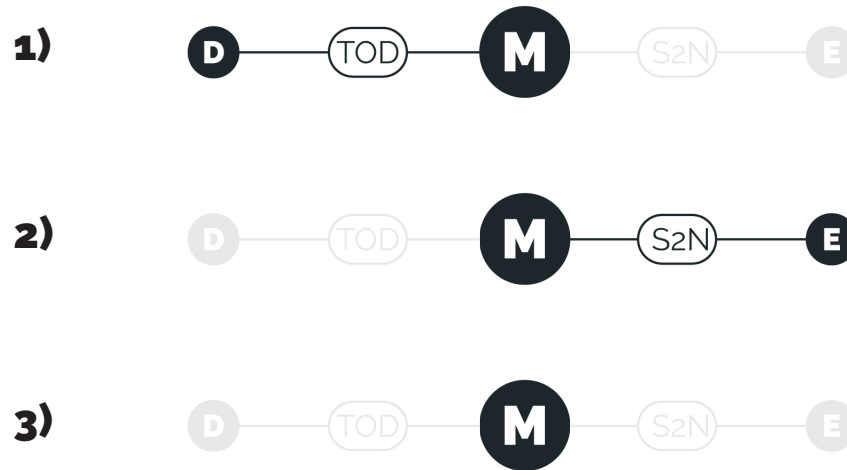
PT.3 **PT.4** **SM.3** **SM.4**
DENSITY ZONES **STATION VIABILITY** **LAND USE** **WITH CONTEXT**

3

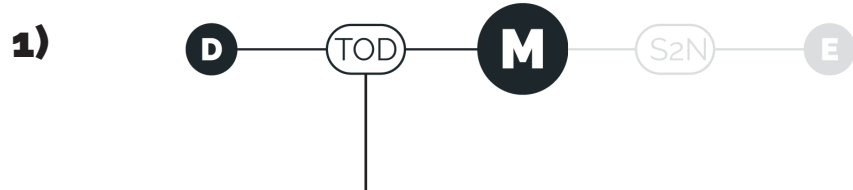
Implementation of sustainable mobility in the redevelopment process



02 THEORY+ANALYSIS



- M** Mobility
- D** Development
- E** Environment
- TOD** Transit Oriented Development
- S2N** Strategy of the Two Networks



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Strategy of Transit-Oriented Development (TOD)

Main development is spatially focused around transit stations to integrate *transit* and *land use* - Zhang, 2007

Key components of successful TODs are *density*, *transit accessibility* and *pedestrian friendliness* - Dittmar & Ohland, 2012

02 THEORY+ANALYSIS

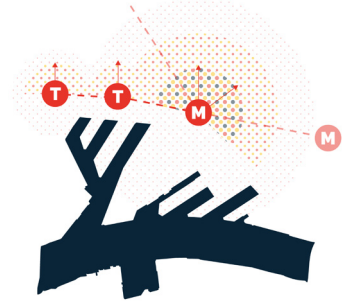
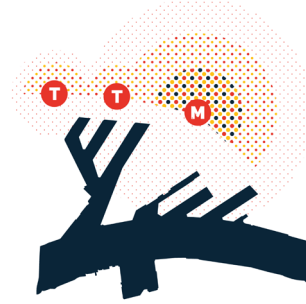
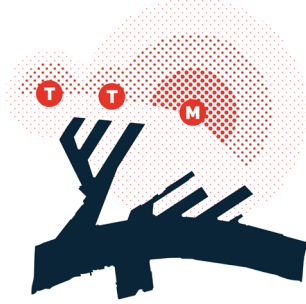
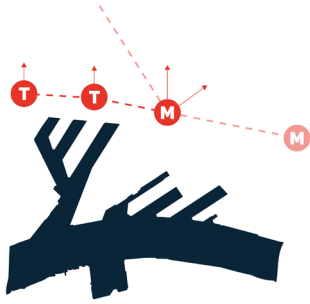
Accessibility

Building density

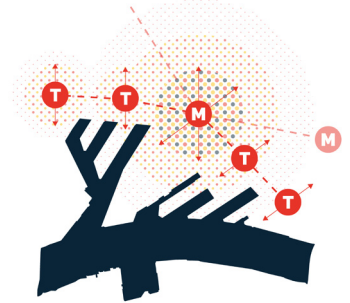
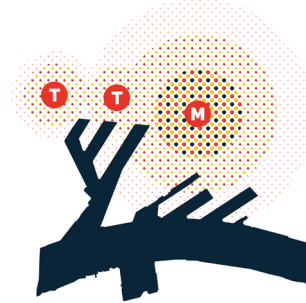
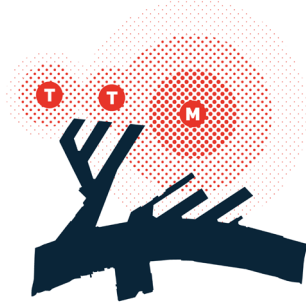
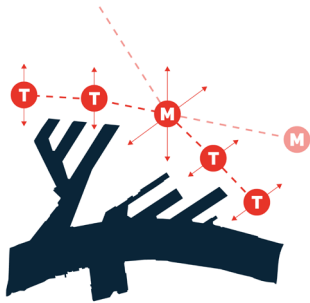
Function diversity

TOD conclusion

Current M4H:



Potential M4H:



2)



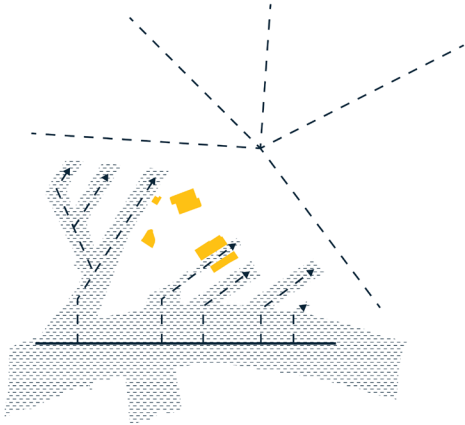
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Strategy of the Two Networks (S2N)

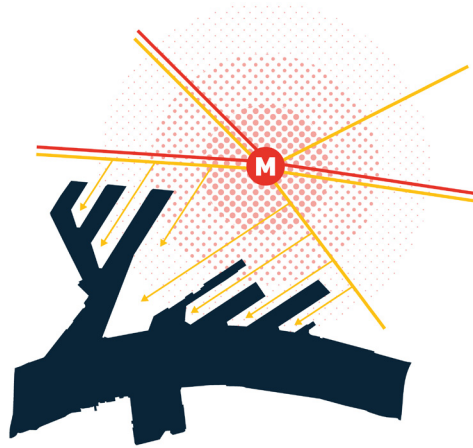
*A guiding model for planning and design considering the **carrying structures** of the urban landscape - Tjallingii, 2005*

*The **water network** and **traffic network** are interrelated and considered **equal** in design - Tjallingii, 2015*

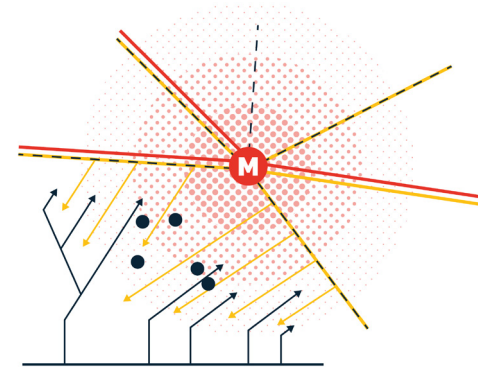
Slow network M4H



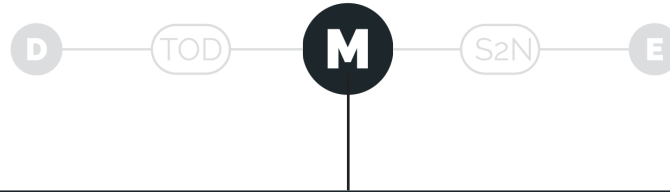
Fast network M4H



Slow + fast network M4H



3)



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Sustainable Mobility

*'To ensure that our **transport systems** meet **society's economic, social and environmental needs** whilst minimising their **undesirable impacts** on the economy, society and the environment'* - European Commission, 1992

SUSTAINABLE MOBILITY

BEHAVIOURAL TRANSITION

Influenced by urban design

TECHNOLOGICAL TRANSITION

Influences urban design

Public transport

Slow mobility

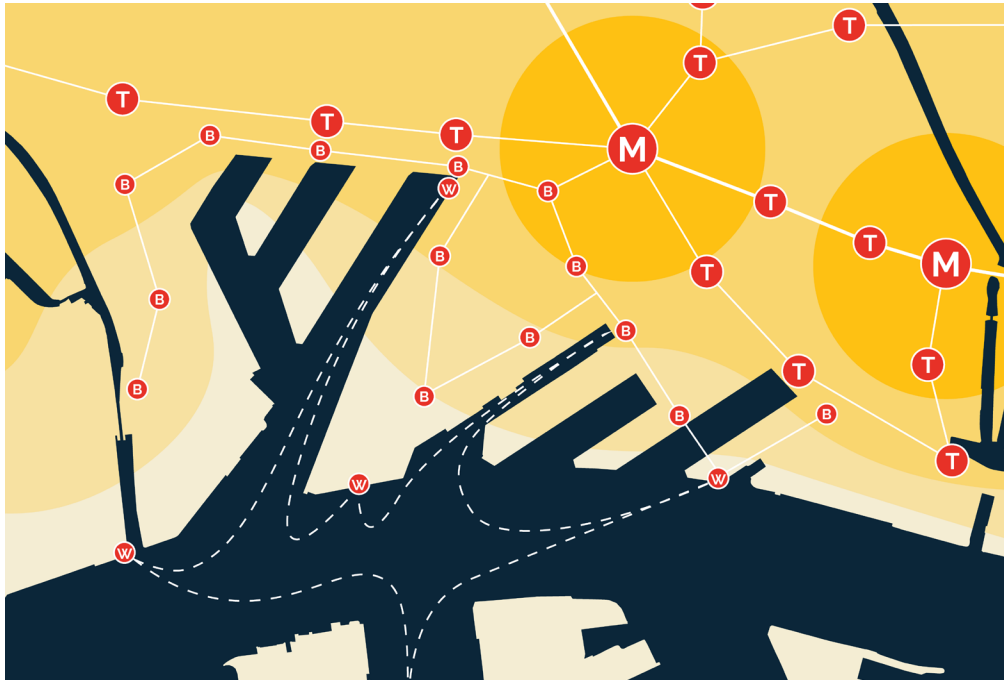
Sharing network

Clean mobility

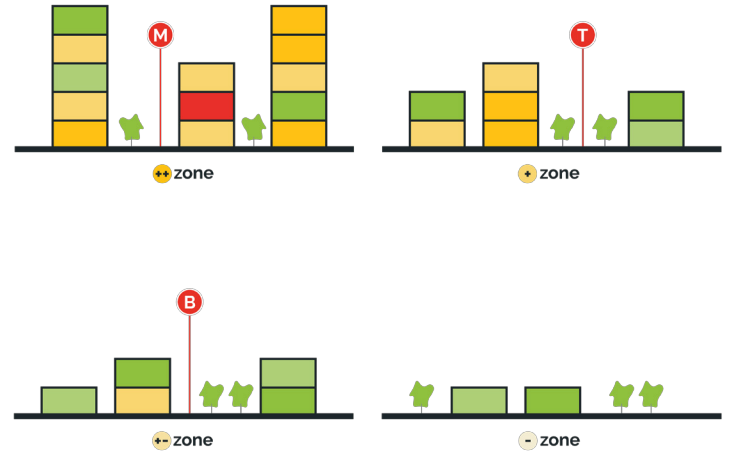


02 THEORY+ANALYSIS

Public transport

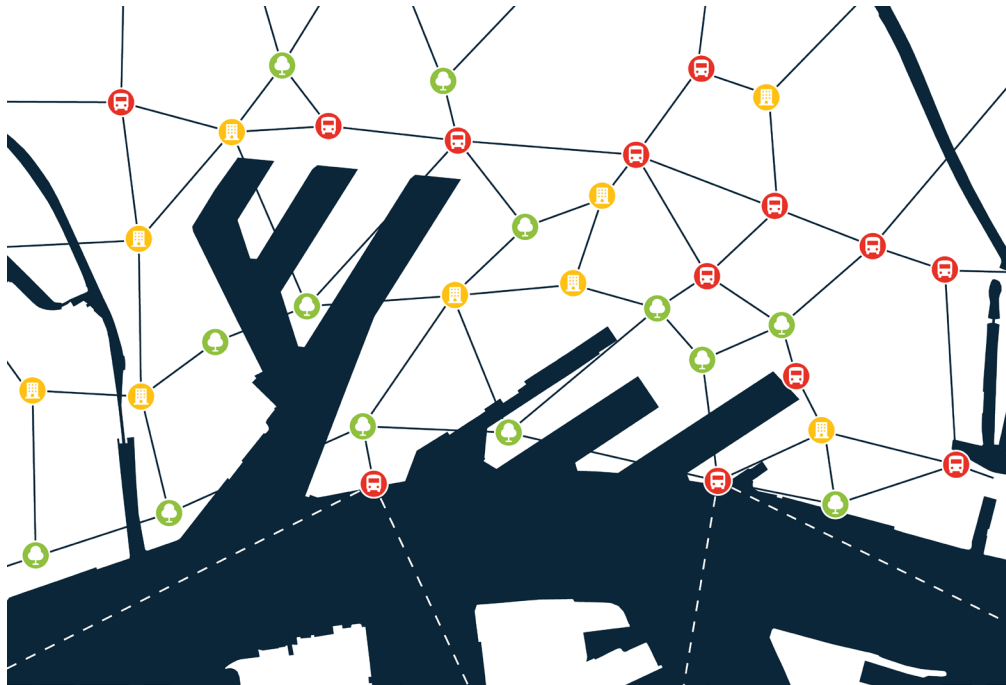


Density zones



02 THEORY+ANALYSIS

Slow mobility



Network of destinations



 Public transport



 Public space



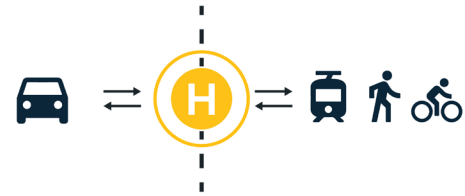
 Buildings

02 THEORY+ANALYSIS

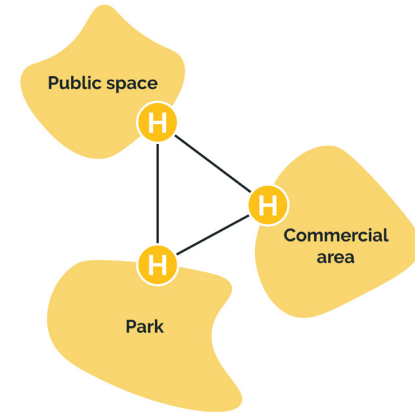
Sharing network



Entrance zones

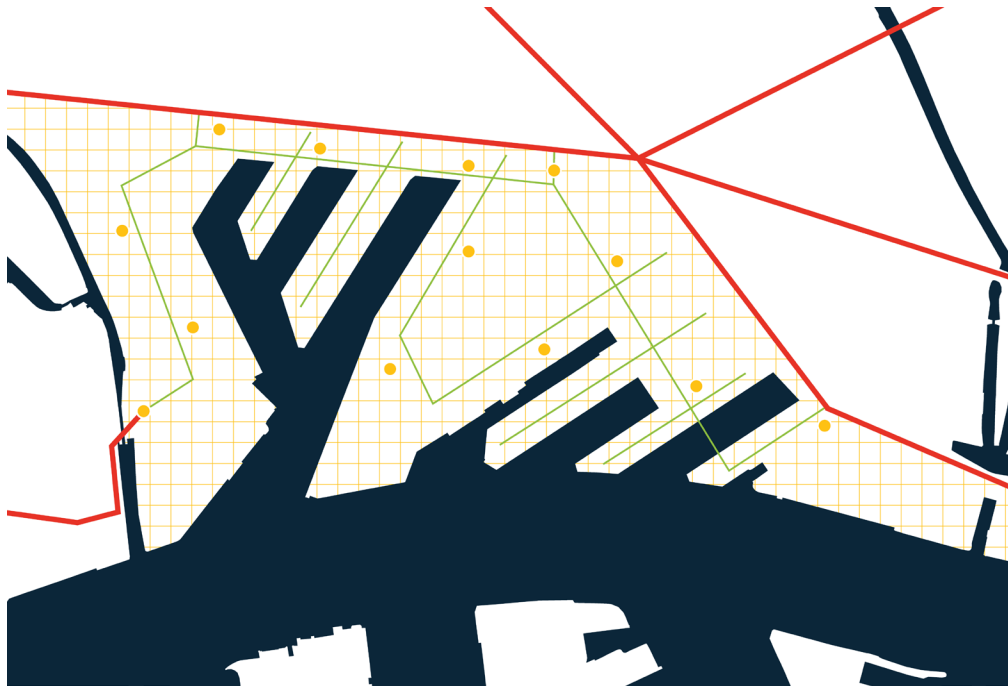


Mobility hubs

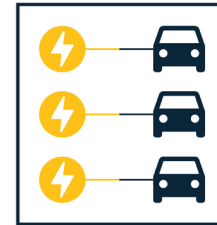


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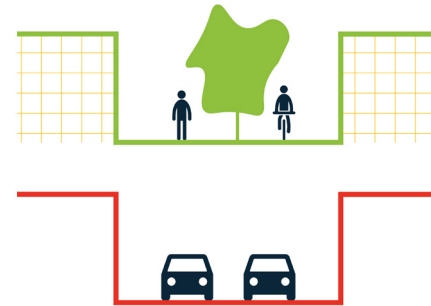
Clean mobility



Charging network

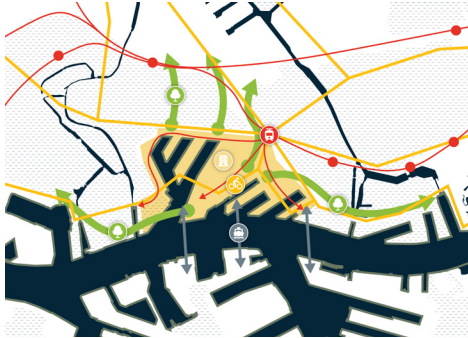


Street layout



03 STRATEGY

Key-elements city scale



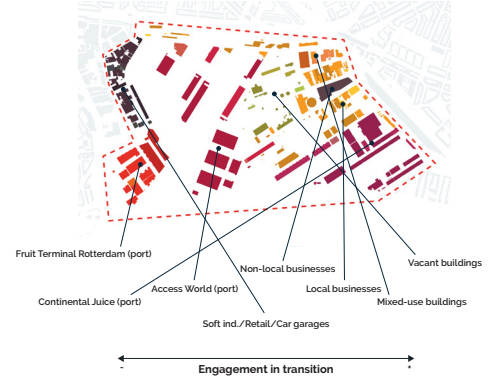
Key-elements local scale



Timeline



Stakeholders



Design intervention



03 STRATEGY

Key-elements city scale



Key-elements local scale



Timeline



Stakeholders



Design intervention



03 STRATEGY

KEY-ELEMENTS LOCAL SCALE

- 1) Main Road
- 2) Local Streets
- 3) Green Network
- 4) Water Network
- 5) Buildings



LEGEND

- Entrance hub
- Sharing hub
- Central activity
- Slow road
- Local public
- Tram line
- Metro stop
- Waterbus line
- Monument
- Iconic buildings
- Build up area
- Water
- Greenery
- Active waterfront

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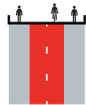
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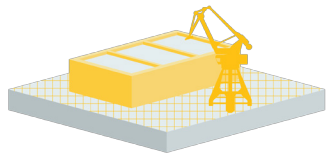
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- Greenery
- Active waterfront

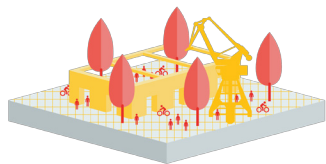
03 STRATEGY

KEY-ELEMENTS LOCAL SCALE

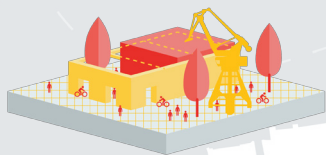
- 1) Main Road
- 2) Local Streets
- 3) Green Network
- 4) Water Network
- 5) Buildings



Low density



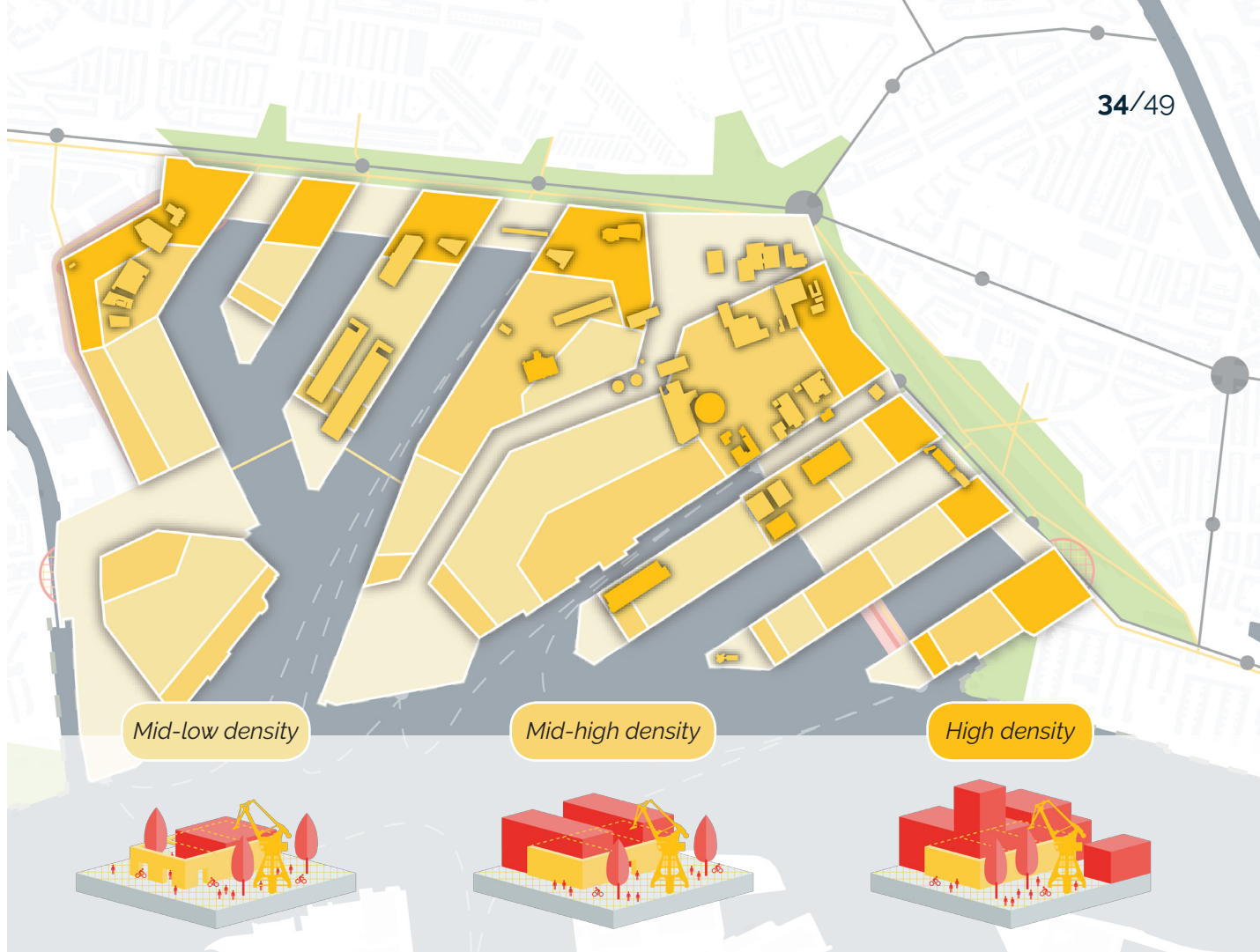
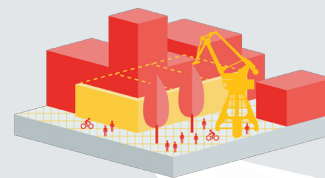
Mid-low density



Mid-high density

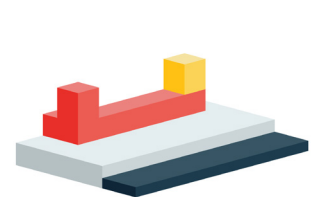
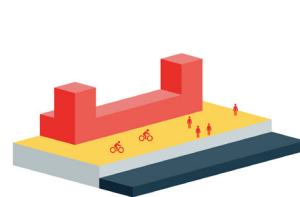
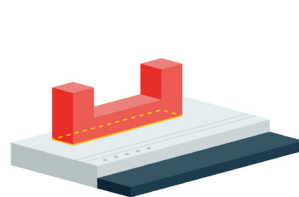
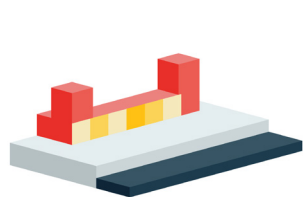
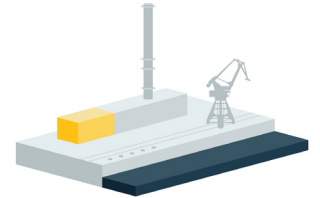
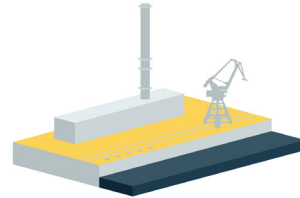
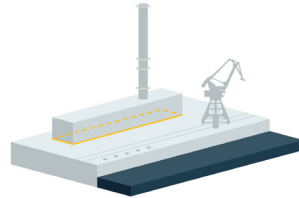
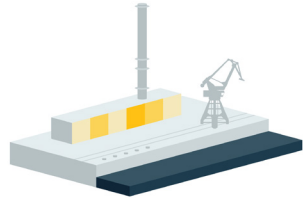
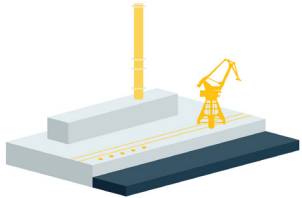


High density



03 STRATEGY

INDUSTRIAL CHARACTER M4H



Non-functional elements

Facades

Block/plots

Open space

Functions



03 STRATEGY



GROTE MERWEHAVEN

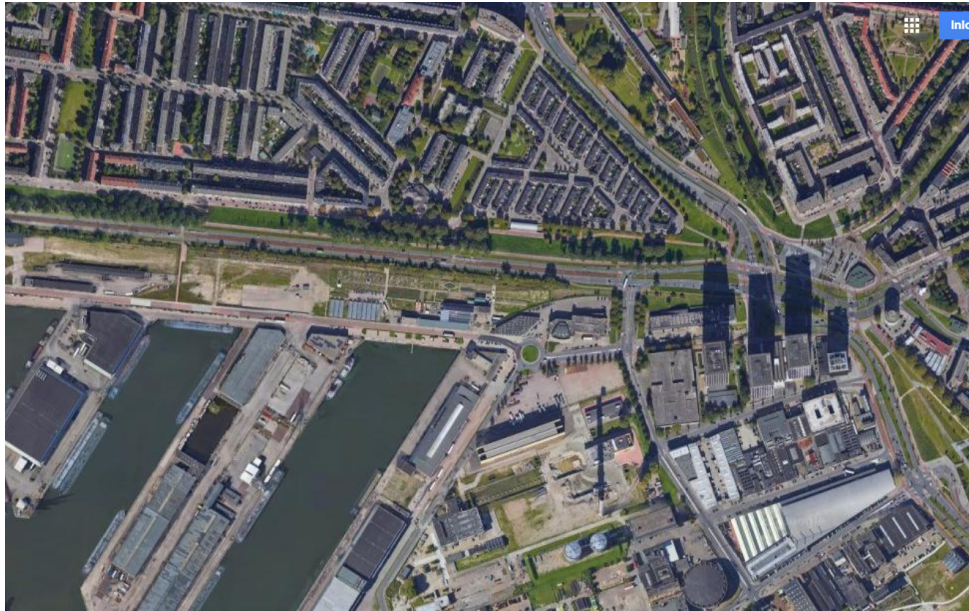


FERRO DOME PLEIN

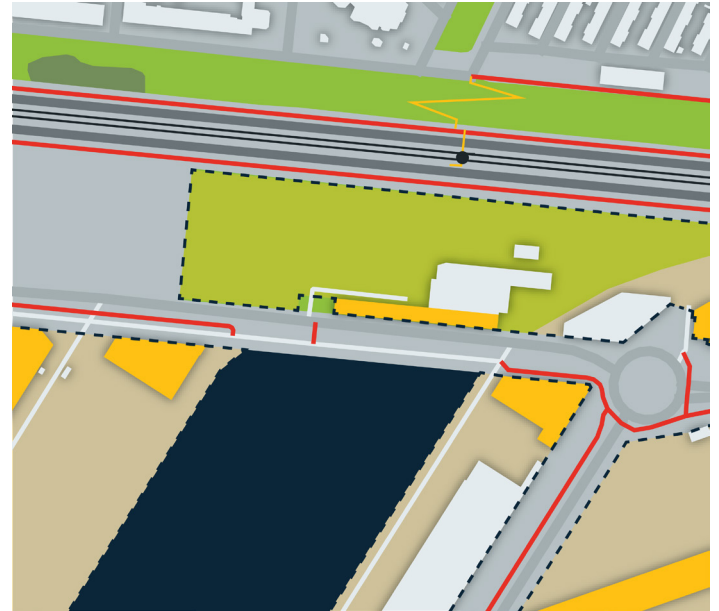


03 STRATEGY

DESIGN INTERVENTION CURRENT SITUATION



Current situation from Google Maps, 2019



03 STRATEGY

DI - CURRENT SITUATION

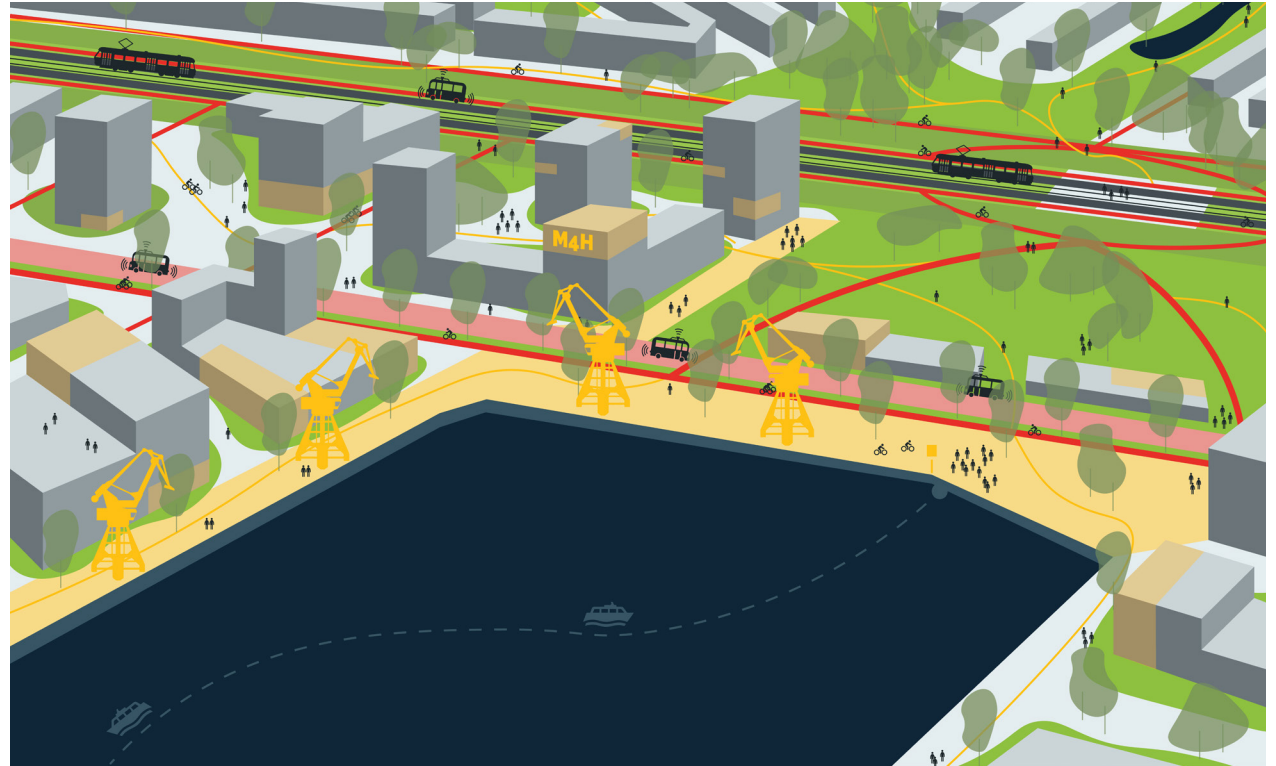
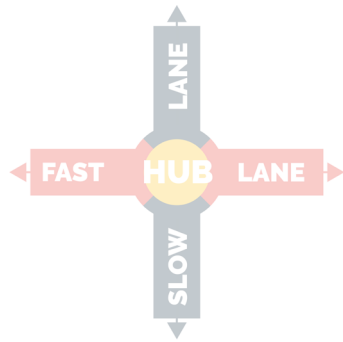


Google

Current situation from Google Maps, 2019

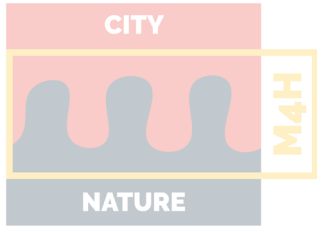
03 STRATEGY

DI - NEW SITUATION



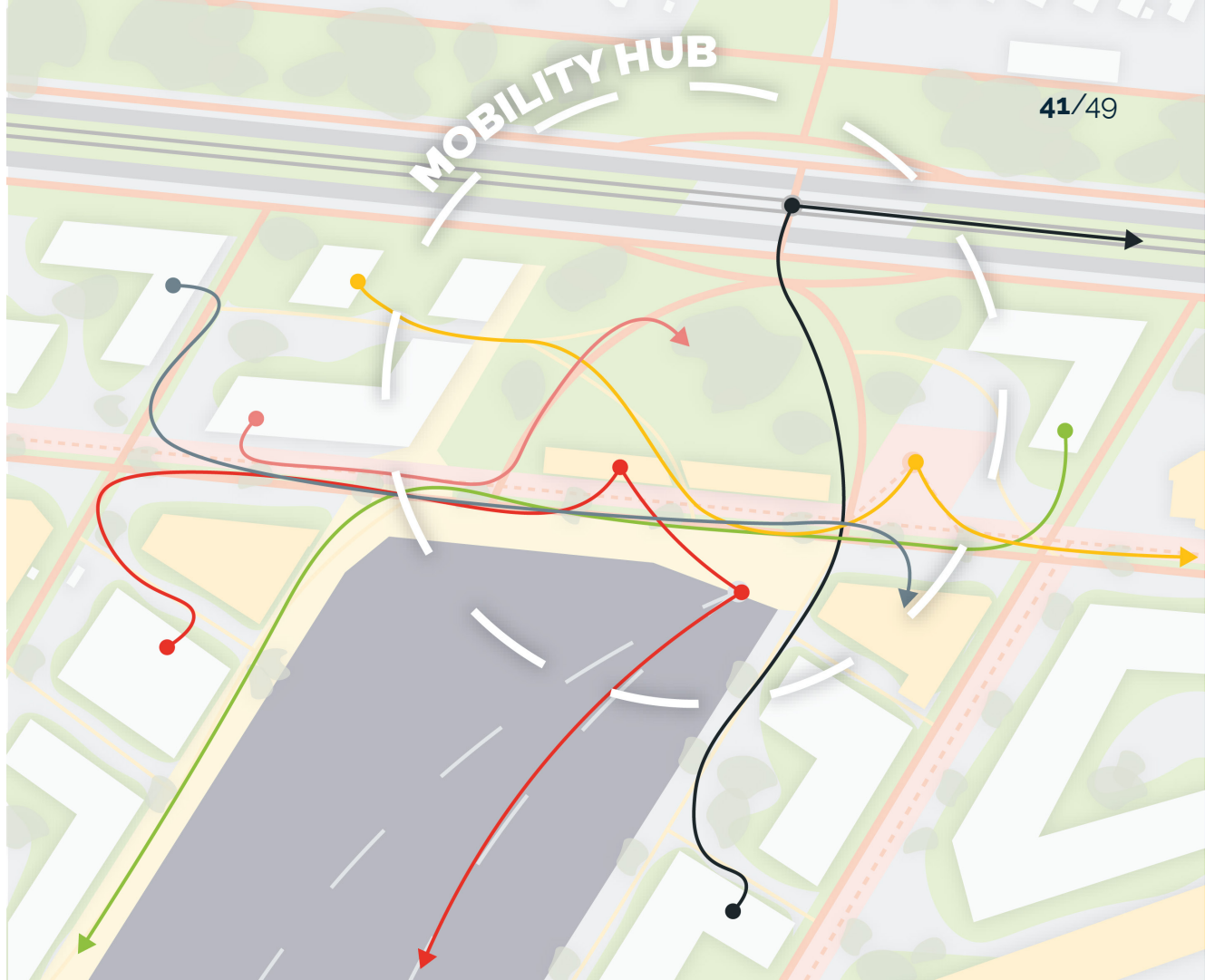
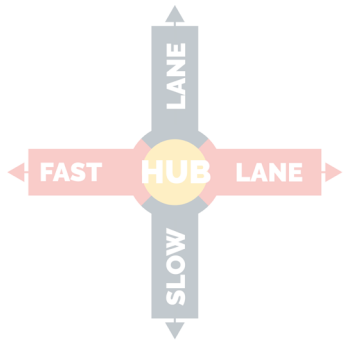
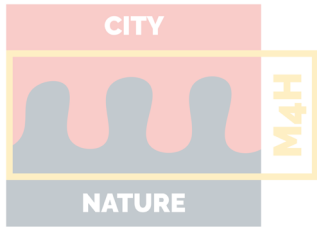
03 STRATEGY

DI - NEW SITUATION



03 STRATEGY

DI - ACTIVITY



03 STRATEGY

DI - NEW SITUATION




PUBLIC TRANSPORT (PT)

SLOW MOBILITY (SM)

SHARING NETWORK (SN)

CLEAN MOBILITY (CM)

PT.1



TRANSFER HUBS

PT.2



HIERARCHY NETWORK

SM.1



TRAVEL DESTINATIONS

SM.2



SOCIAL SAFETY

PT.3



DENSITY ZONES

PT.4



STATION VISIBILITY

SM.3



LAND USE

SM.4



PATH CONTEXT

PT.5



STATION ACCESSIBILITY

PT.6

TITLE

SM.5



PHYSICAL SAFETY

SM.6



PATH QUALITY

PT.7

TITLE

PT.8

TITLE

SM.7

TITLE

SM.8

TITLE

SN.1




TRANSITION ZONES

SN.2




PARKING HUBS

CM.1



CHARGING NETWORK

CM.2




LOCAL POWER GENERATE

SN.3



COMMUNITY

SN.4



CENTRALITY

CM.3



NO EMISSION ZONE

CM.4

TITLE

SN.5

TITLE

SN.6

TITLE

CM.5

TITLE

CM.6

TITLE

SN.7

TITLE

SN.8

TITLE

CM.7

TITLE

CM.8

TITLE

NR.

image/diagram

TITLE
Short description


DENSITY ●○○○○
ACTIVITY ●○○○○
ACCESSIBILITY ●○○○○
----- ●○○○○

SCALE RELATED TO

CHALLENGE
Explanation

SOLUTION
Explanation

PT.1



TRANSFER HUBS
A transfer hub connects and densifies the public transport network. It consists of 2 or more intersecting public transport modes and/or lines.

DENSITY ●●●●○
ACTIVITY ●●●●○
ACCESSIBILITY ●●●●○
----- ○○○○○

CITY | NBH | BLK | **BDNG** PT2 SM1 SN1
SN2 SN4 CM1

CHALLENGE
Public transport lines are linear elements that are limited in size and directions. To enhance the use, an interconnected public transport network is needed.

SOLUTION
A transfer hub in a public transport network provides the possibility for travelers to transfer easily between transport lines and/or kinds of transportation modes like trains, trams, and buses. At a transfer hub, various lines are connected which extends the public transport network of the given location. A transfer hub creates more options for travelers to reach different destinations.

Infographic

PUBLIC TRANSPORT

as part of Sustainable Mobility

PROGNOSIS

Currently, still more than half of all passenger-kilometers are still made by car mobility, either as driver or passenger. To move towards sustainable mobility, in 2050 a shift in mobility use must be made. The prognosis for 2050 shows a reduction in halving car use. This provides the opportunity for public transport to expand and take up about 35 percent of passenger-kilometers.

Passenger-kilometer by mode of transport aged 6 and older (KbZ, 2020)

Mode	2020 (%)	2050 (prognosis) (%)
Car (driver/passenger)	50	10
Train	11.3	10
Bus	8.2	10
Bicyclist	2.9	6
Other	25.7	24

DEVELOPMENT

The public transport network transforms into one of the main backbones of the urban structure. Stations are important, active nodes in the city in these key locations, mobility, development, and environment come together. The city densifies around station areas to facilitate mixed-use areas and public spaces. The station areas are tied together by public transport lines. The lines operate on different scales and levels, according to the mode of transportation. The efficient lines with high frequency provide quick connections to increase accessibility.

ENVIRONMENT

By the prioritization of public transport, the usage of the private car is reduced. This results in fewer emissions and environmental pollution. The different kinds of transportation modes run on locally generated power. The environmental aspect is represented in the design of stations. These areas exist in a green environment where the pedestrian and cyclists experience stand central.

TRAIN

In 2050, the train network consists of the following elements: The stations are designed as nodes where all kinds of mobility intersect. A station hub is a key location in the urban fabric, which accommodates a high-density environment. The rail network is extended to facilitate a high usage frequency, consisting of intercity, regional, and suburban trains. The energy is generated in a closed system within the train network.

METRO

In 2050, the metro system is extended to connect the suburbs to the city center. The metro is still an easy and quick way of traveling in urban areas. Automation of the metro provides the opportunity to increase the frequency and shorten the travel time. Metro stations are designed in a way to connect to other public transport modes and provide easy accessibility for pedestrians and cyclists.

TRAM

In 2050, the tram network will experience the following transition. The trams serve the local transportation need. Tram networks are extended, as the tram is now one of the main forms of transportation since bus lines are not sufficient anymore. Tram vehicles drive autonomously to increase travel frequency. Tram tracks are situated in green environments to optimize the use of space.

BUS

In 2050, the bus system is transformed into a sustainable way. The current way of using buses is completely surpassed by the trams. The bus network is now an on-demand service, in this way it meets the travelers' needs. The buses are only electric, power-driven and rely on sustainable resources. Just like the other modes, buses are also autonomously driven to ensure safety in use.

OTHER

In 2050 other modes of transportation make their appearance. These modes are specific to the different environments. For example, the use of cable cars in mountainous areas or ferries and waterbuses in cities based around water. Adjusting to the characteristics of the city ensures optimization of land use. Other modes of transportation also include monorails and hyperloops.

Infographic SLOW MOBILITY

as part of Sustainable Mobility

PROGNOSIS
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Infographic SHARING NETWORK

as part of Sustainable Mobility

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Infographic CLEAN MOBILITY

as part of Sustainable Mobility

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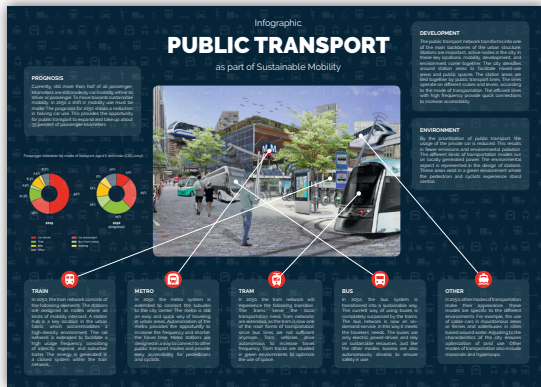
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04 CONCLUSION

'How can sustainable mobility guide the redevelopment of post-industrial sites towards a sustainable environment?'

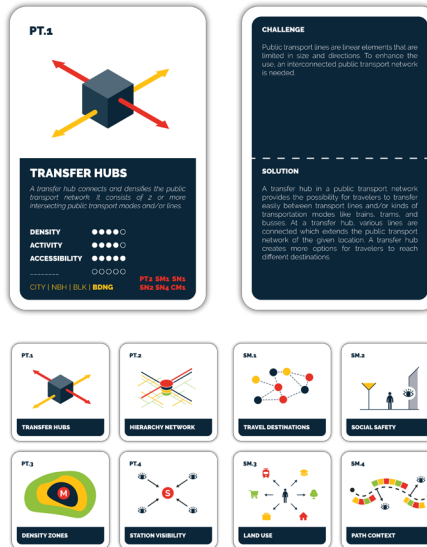
1

Defining the mobility transition



2

Translation into development patterns



3

Implementation of sustainable mobility in the redevelopment process



