

CIRCULAR AREA DEVELOPMENT

A baseline measurement and development vision for the
International Knoop XL

Commissioned by:
Municipality of



MANAGEMENT SUMMARY

TOWARDS A FUTURE BUTTON XL

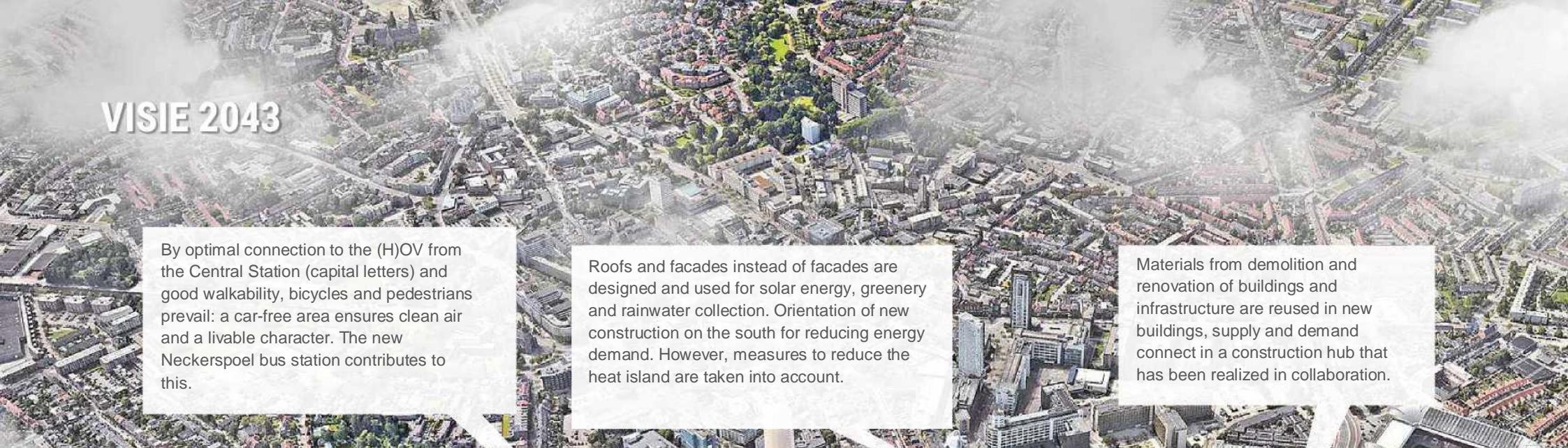
The International Knoop XL, the area north of the Central Station, represents a major metamorphosis. Metabolic was asked to think about this early in the development process from an integral sustainable and circular perspective. That is why Metabolic carried out an analysis of municipal policy, and carried out a baseline measurement of the spatial characteristics and the dust flows through the area. From there, Metabolic identified opportunities and hotspots for the Knoop XL and developed a development vision.

Sustainability and circularity means a broad view for us: urban ‘metabolism’, the metabolism through a region, we look at from the themes of climate resilience, water, biodiversity, materials, energy and mobility.

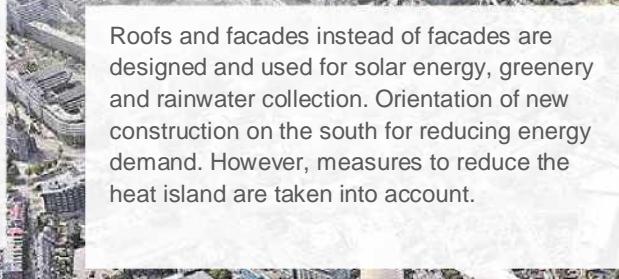


Source: Development vision Fellenoord, KCAP Architects&Planners, 2010

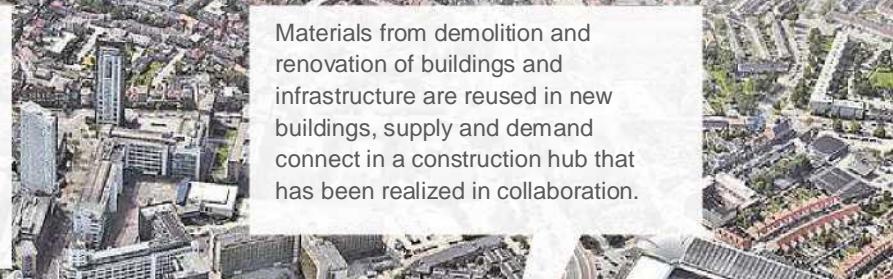
VISIE 2043



By optimal connection to the (H)OV from the Central Station (capital letters) and good walkability, bicycles and pedestrians prevail: a car-free area ensures clean air and a livable character. The new Neckerspoel bus station contributes to this.



Roofs and facades instead of facades are designed and used for solar energy, greenery and rainwater collection. Orientation of new construction on the south for reducing energy demand. However, measures to reduce the heat island are taken into account.



Materials from demolition and renovation of buildings and infrastructure are reused in new buildings, supply and demand connect in a construction hub that has been realized in collaboration.



The area brings Technology, Design and Knowledge together and offers a showcase for the Brainport by using new techniques in the field of solar energy, nature-inclusive design, plastic recycling and material innovation on facades and in public spaces.



The Dommel and the Fellenoord become green veins through the district, which promote climate resilience, biodiversity and a healthy city.



The subsurface is cleverly used for climate adaptation, sanitation and energy supply (Hot Cold Storage). It is connected to residual heat from the TU/e.



Waste is collected separately from households and businesses. The Knoop XL works towards 0% residual waste through compost containers, recycling and smart logistics.

RECOMMENDATIONS DEVELOPMENT BUTTON XL



No regrets circular area development

- A construction hub (space demand approximately 5,000 m²)and cooperation between parties for connecting construction and demolition calendars.
- Use of rainwater for, for example, flushing vacuum toilets, washing facilities or irrigation of gardens or public greenery
- Set strict requirements for residential insulation, passive house standard and material use, also with a view to both energy and material savings and the heat island.
- Use roofs and facades instead of façades for generating solar energy and integrating greenery on roofs; Possibly also urban agriculture on roofs.
- Take advantage of the transformation of the area for the design of logistics regarding waste treatment and the placement of compost containers for food waste.



Typical Button XL

- Due to its central location, short walking distance and good cycling and (H)OV possibilities, the Knoop focuses on a car-free area, with possible further growth into a car-free area and the focus on cyclists and pedestrians.
- Climate adaptation and nature-inclusive design as a key principle for the development of the area.
- Infrastructure makes room for greenery for climate resistance (to at least 40% green), released material from demolition infrastructure (8,000 tons of asphalt, concrete) can be reused high-quality
- Dommeldal greening, connecting, widening and connecting under the railway with the Gender to create a large green city strip.
- Showcasing new technology for e.g. solar energy, plastic recycling and material innovation through linking with Technology, Design and Knowledge of the TU/e and Design Academy.
- Connection to residual heat from Eindhoven University of Technology is a logical option for Heat Cold Storage (WKO).

DEVELOPMENT PRINCIPLES

1. Reduce consumption

- **Minimize (sustainable) energy demand** through insulation, passive house standard .
- Minimal use of **materials** during construction.
- **Avoid, reduce and reuse waste.**

2. Focus on synergy

- Link between **Technology, Design and Knowledge** (proximity TU/e, design academy).
 - Local **exchange of residual flows** (building materials, rainwater).
- **Synergy of supply and demand of** (sustainable) energy at district and city level: exchange, storage and marketing of flexibility.
- **Flexible design** of buildings and public space in terms of construction, materials and climate resistance (underground space).
- **Multimodal hub of** mobility: (H)OV connections, cycling and walking routes and connections to the Brainport region ensure an emission-free, efficient switching machine.

3. Switch between building, area and the rest of the city

- **Closing at building level:**
 - **Material use:** Insight into the urban mine.
 - Passive and modular **construction**, high-quality insulation.
- **Closing at area level:**
 - Smart **water storage and management**.
 - **Transport** is shared and becomes emission-free.
 - **Energy supply** and renewable energy, heat supply (WKO, heat networks).
 - **Waste management:** waste separation and logistics.
- **Close at regional level:**
 - Connecting **green structures** with main structure.
 - **Value residual flows.**
 - See how different areas can have synergy. With a view to exchanging, for example, building materials.

o 4. Making climate resilience visible

- **Green** as a pleasant experience and distinctive character.
- **Climate resistance** as a business card (in parks, facades, roofs).
- **Greening** and preventing hardening (reduction of infrastructure).
- **Integrating biodiversity** into the area.
- Multifunctional adaptive green and blue (e.g. city gardens).

Points of attention:

I Make trade-offs from a broad sustainable perspective:

- Approach the developments transparently and create insight into the **trade-offs** between climate adaptation, green and sustainable energy: This requires a data-driven approach with a broad view.
- The same applies to underground trade-offs between WKO and new sanitation.

II Monitor progress towards a sustainable and circular Button XL:

- Monitoring progress in areas such as material use, energy and climate adaptation from this research is crucial for **ensuring sustainability and circularity**.

The demand for raw materials that cannot be met through synergy can be achieved through production and procurement by using clean, renewable, or otherwise environmentally beneficial sources. In addition, it is important to get feedback on how the system works in order for it to function optimally. This includes the creation of transparent data and an information network (e.g. a material passport). Then we look at the scale at which different cycles can be closed.

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INTRODUCTION &



INTRODUCTION

The International Knoop XL, the area north of the Central Station, represents a major metamorphosis. The area wants to become an international metropolitan residential, working and residential area and the central hub of Brainport Eindhoven. An area with international allure and a hub of modalities.

This transformation will take place in the next 20 years, and an area vision is currently being drawn up together with developers. There is a unique opportunity to provide insight into the opportunities and hotspots for integrating sustainability and circularity at the area level. Consultancy Metabolic has extensive experience with circular and sustainable area development, and has been approached to draw up a vision from this perspective in the development process around the International Knoop XL.

The aim of the research is to draw up an area vision and a development framework for the International Node XL from an integral sustainable and circular perspective.



TRAINING

Several parties are preparing plans for developments that are expected to take place in the next twenty years at the International Knoop XL. To steer this transformation in the right direction, the municipality is working on a development vision and a development framework, in collaboration with, among others, a process office, urban planning office and mobility experts. Metabolic has been asked to think about this from an integral sustainable and circular perspective.

Sustainability is an important pillar in the policy of the municipality of Eindhoven, and must therefore also be integrated into the area vision. Central themes in this sustainability policy are the energy transition, waste, green environment, sustainable mobility and climate adaptation. The earlier and clearer the vision on these topics can be given to developers, the better the developments can be aligned in this area.

Sustainable and circular area development

Circular area development is a relatively new field of work. Many innovations in the field of circular construction primarily focus on the building itself. Here, for example, we look at the impacts that material choices entail and energy-efficient construction. All these interventions are extremely useful, especially when the market is challenged to sustainable innovations.

However, a large part of the impact for which the built environment is responsible is determined at area level. It is precisely at the area level that choices are made about infrastructure and mobility, and the place that various functions such as living, working and recreation are given in the urban environment. This not only affects the type of mobility, but also our energy supply and sanitation. Even if we look at ambitions in the field of climate resilience, there are important considerations to be made: Do we want to absorb peak showers with façade greenery and roof gardens? Or is there enough undeveloped space and urban greenery at area level? It is therefore a unique opportunity to take a first step towards circular area development for the International Knoop XL with a vision and development framework.



Source: Development vision Fellenoord, KCAP Architects&Planners,
July 2018

ADJUSTMENT & PROJECT PURPOSES

Project objectives

Four goals have been formulated for the project:

- To gain insight into the functioning of the current system in the field of sustainability and circularity by carrying out a baseline measurement of the area.
- Identify opportunities and hotspots for integrating circularity and sustainability into the transformation of the International Node XL.
- Develop a development vision and development framework for the themes of climate resilience, water, biodiversity, materials, energy and mobility from an integral sustainable and circular perspective.
- Attending the area sessions and design workshops around the larger development trajectory of the area to further explain the development vision.

Outcomes

We work towards these goals in four deliverables:

- Analysis of municipal policies and objectives in the field of sustainability and circularity.
- A baseline measurement of the area: Dust flow analysis of materials, energy and water and a spatial analysis.
- The main opportunities and hotspots for integrating circularity and sustainability within the development of the area.
- A sustainable and circular development vision and development framework for the transformation of the International Knoop XL.

ANALYSIS COMMON POLICY

- AND OBJECTIVES

SPECIAL ANALYSIS AND STOFSTROOMANALYSE FOR EIKXL

- OPPORTUNITIES AND HOTSPOTS

A CIRCULAR AREA VICE FOR EIKXL

AREA VISSION & AREA



The results of this research will be taken into account in the entire development process around the International Knoop XL. This research fits within the first of the 3 development trajectories, as drawn up by APPM:

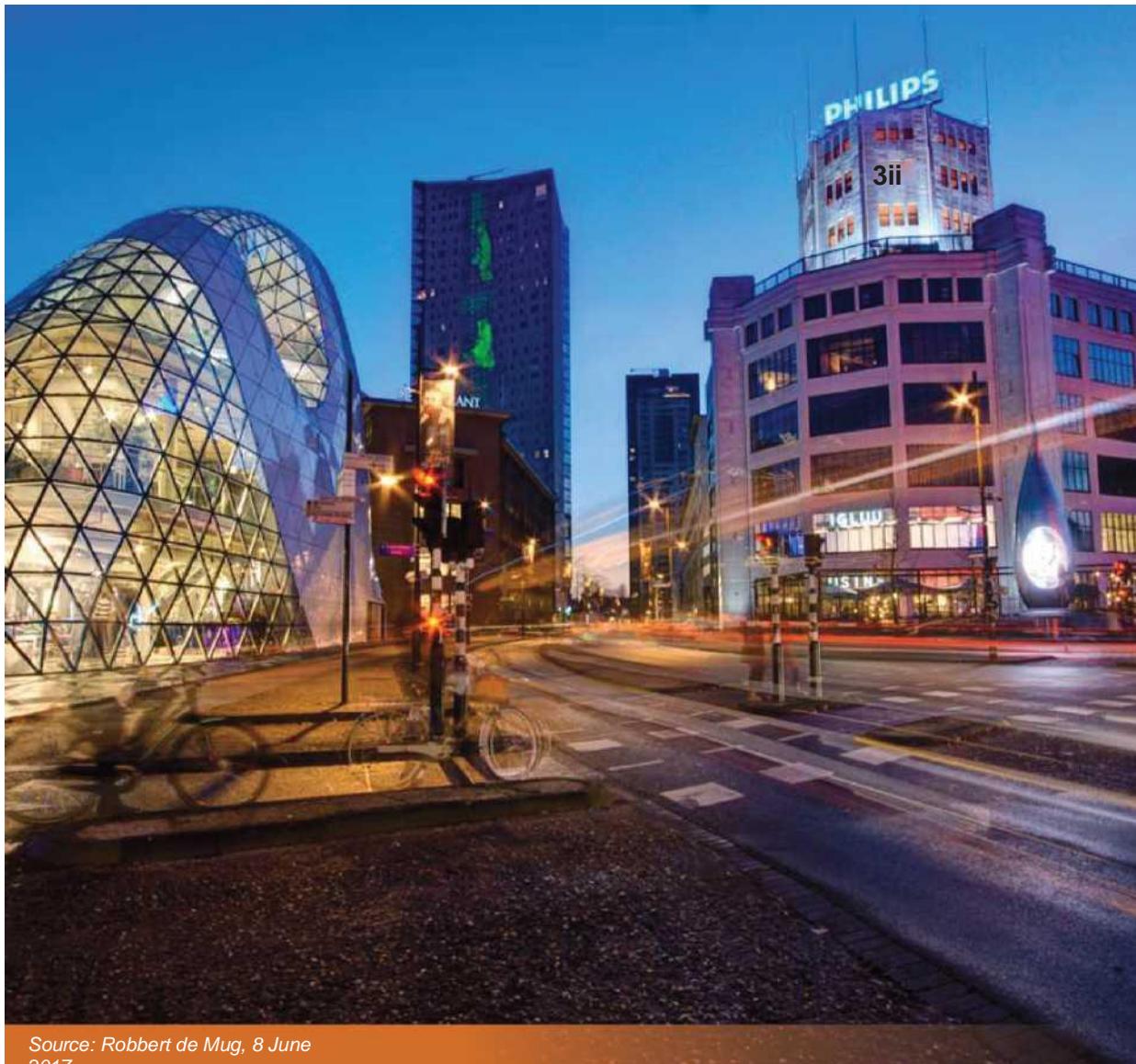
1. Achieving sustainable urban scale jump.
2. Strengthen breeding ground innovative top region.
3. Keeping the business climate attractive through optimal (international) connections.

The results of this research were discussed and tested during the area sessions and design workshops, where the transformation is being designed together with the municipality, developers and landowners in the area. This research will serve as a basis for discussion during these meetings, so that a sustainable vision can be developed together with all stakeholders in the area.

ACHTERGROND



THE PLANS FOR EIKXL: VISION AND



Source: Robbert de Mug, 8 June
2017

The development of the International Knoop XL promotes the business climate of Brainport Eindhoven and should become an international metropolitan residential, working and residential area. The area is the central hub of Brainport Eindhoven, where the region is connected at all scales by (H)OV and bicycle. The station environment is also the place for the new knowledge and service economy. A metropolitan area with space for living, working and relaxation. The International Knoop XL fits in with the growth of the center of Eindhoven and aspires to a high density and a high degree of functional mixing. Meeting, exchange, innovation and experimentation are central. As a central point in the innovation ecosystem of campuses and distributed innovative companies, the heart of Brainport Eindhoven is created, which is still missing.

These plans can be summarized in four main ambitions:

- Interaction Environments for the New Economy.
- Node of sustainable mobility.
- The highest living environment.
- Landscape as location factor.

CIRCULAR DEVELOPMENT EIKXL

A SUSTAINABLE AND

Metabolic approaches sustainable urban development through the lens of circular economy from a broad and holistic perspective. Metabolic identifies 7 different aspects that need to be considered to systematically highlight solutions:

Materials are continuously recycled in a high-quality way.

All energy comes from renewable sources.

Water is extracted in a sustainable way and resource recovery is maximized.

Biodiversity is structurally supported and strengthened.

Society and culture are preserved.

Health and well-being of people and nature are structurally supported.

The value of human activities is expressed more broadly than financially.



Figure 1: Seven pillars of a circular economy. (Source: Metabolic).

Towards an INTEGRAL CIRCULARY AND

We are working towards an integrated area vision for the International Knoop XL. We approach this from three central themes, from which we carry out the baseline measurement, identify opportunities and hotspots in the area and ultimately draw up development frameworks and a vision.

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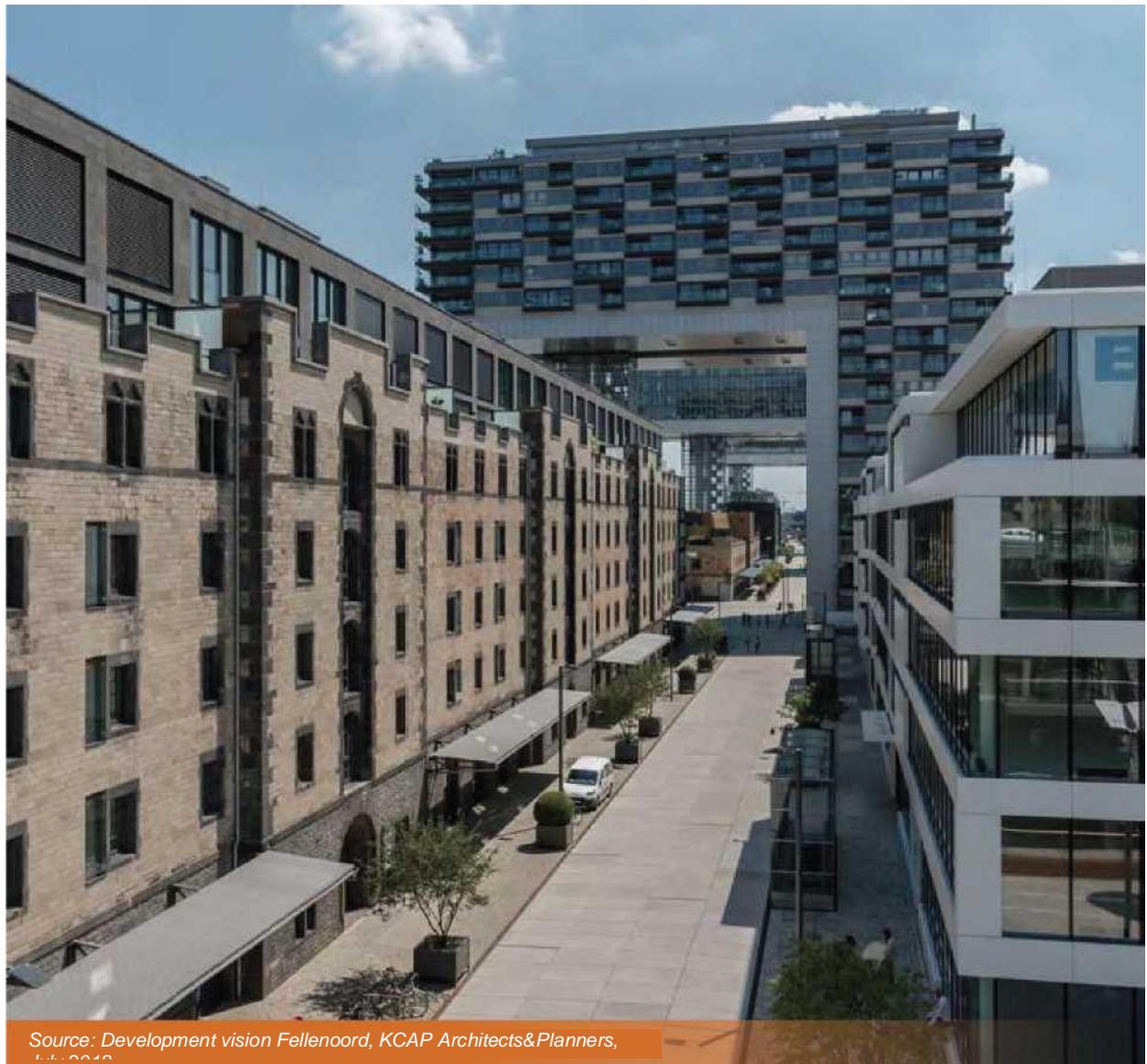
The **high-quality reuse of materials**, given the large construction and demolition task that goes hand in hand with the transformation of the area.

000

Climate resilience, water and biodiversity: These are crucial components for a healthy, sustainable and resilient city.

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Energy and **mobility** are an important pivot with the energy transition and the position of the International Knoop XL as an international transport hub.



Source: Development vision Fellenoord, KCAP Architects&Planners,
July 2016

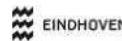
ANALYSE BELEID EN DOELSTELLINGEN



CIRCULAR AND SUSTAINABLE POLICY AND OBJECTIVES

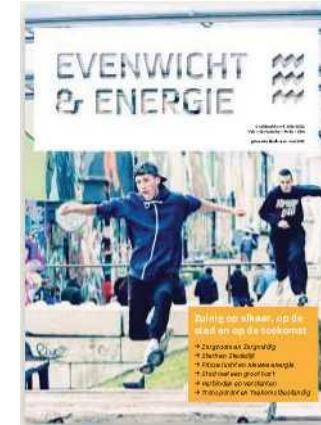
The municipality of Eindhoven has high ambitions for sustainability and circularity. She also continues to sharpen her ambitions for urban development. The current policy and plans on circularity, climate and sustainability have been analysed, so that the sustainability vision for the International Knoop XL fits in with this.

In this way it can also be determined what the contribution of the International Knoop XL can be to achieve the set goals and ambitions.



Climate Plan 2016 - 2020

Reducing CO₂ emissions and adapting to climate change



Some important publications are the Coalition Agreement 2018-2022, the Climate Plan 2016-2020, Eindhoven Circular: Towards a circular economy 2018-2020, and various policy plans in areas such as green, water, soil etc.

CIRCULAR POLICY AND OBJECTIVES

The analysis of the policy and objectives shows that in Eindhoven the circular economy, CO₂ reduction and nature and basic social needs play an important role in overall area development. Mobility (transfer hub, sustainable mobility hub) and climate adaptation (given the low location of the area) are also important themes for the International Knoop XL.

Some important ambitions for the region and the Knoop XL are shown on the right.

The following pages indicate for all objectives whether they apply specifically to EIKXL.

Circular and sustainable Eindhoven

- Eliminate household **residual waste**.
- 100% **circular by 2050** (national target).
- **Green-blue interventions for climate resilience.**
- **Energy neutral** by 2045.
- **Building natural gas-free.**

Typical ButtonXL

- **Mobility** is an important issue: **efficient switching machine**; Lots of space for bikes and pedestrians.
- **Landscape as a** business climate factor.
- Cross-over between **Design, Technology and Knowledge**.



CIRCULAR POLICY AND OBJECTIVES

MANUFACTURED POINT OBJECTIVE

			JAARTAL POLICY DOCUMENT	BUTTON XL
AA MATERIALS / CIRCULAR ECONOMY				
Primary raw materials	50% less use of primary raw materials (mineral, fossil and metals)	2030	Healthy and future development.	0
Waste reduction	0% residual household waste	2020	Healthy and accommodating.	●
Built environment	Waste-free as soon as possible through circular waste treatment At least 15% old concrete processed in vowels, tiles and curbs (concrete chord)	N/A 2018	Eindhoven Circular Concrete agreement	0 ●
Socially responsible	Integrating circularity in area development and land sales Setting up a framework for circular purchasing and procurement	N/A 2017	Eindhoven Circular Eindhoven Circular	● 0
Purchasing (MVI)	Monitoring CO2, resource and money savings	N/A	Climate plan	0
Circular	100% circular	2050	Eindhoven Circular	0
\$ ENERGY				
Renewable energy	200,000 solar panels	2020	Climate plan	0
CO2 reduction	55% less CO2 emissions compared to 1990: up to 2.15 tonnes CO2 emissions per inhabitant per year	2030	Climate plan	0
Municipal organisation	95% less CO2 emissions compared to 1990: up to 0,2 tonnes of CO2 per inhabitant per year 100% durable and 100% emission-free	2050 2025	Climate plan Climate plan	0 0
Natural gas-free	As many new buildings as possible free of natural gas Municipal buildings free of natural gas	2020 2025	Climate plan Coalition agreement	● 0
	Built environment natural gas free	2050	Coalition agreement	●
Energy neutral	Rental properties have an average A+ label Both new construction and renovation carried out energy-neutrally Eindhoven is completely energy neutral	2030 2035 2045	Climate plan Land Policy Note Eindhoven Circular	0 ● ●

MANUFACTURED POINT	OBJECTIVE	JAARTAL	POLICY DOCUMENT	BUTTON XL
4» GREEN ADMINISTRATION				
Greening	Greening for climate resilience Utilize natural processes and promote green experience	N/A	Coalition agreement Green policy plan	• •
Green-blue interventions	Making public space more sustainable with the use of circular materials In order of preference: water storage in greenery, new water systems, clean rainwater not in sewers and remedying flooding, slowing down and draining rainwater.	N/A N/A	Eindhoven Circular Green policy plan	• •
Landscape as a location factor	Landscape as a business climate factor and to promote quality of life	N/A	Coalition agreement	•
Biodiversity	Developing ecological greenery to increase biodiversity, intensification of compounds and preference of local plant species	N/A	Green policy plan	•
CLIMATE ADAPTATION				
Climate adaptation	100% climate proof	2050	Climate plan	
Green-blue interventions	Integrating climate resistance in the selection of the soil type, elevation and buildings New buildings and public spaces must be sustainable and climate-adaptive, greening and promoting compaction	2020 2021	Climate plan Land Policy Note	• •
Hardening	Design standards for flooding integrated into area development and construction Reducing hardening to minimise waterlogging and heat stress	N/A N/A	Sewage plan Sewage plan	• •

MANUFACTURED	OBJECTIVE	JAARTAL	POLICY DOCUMENT	BUTTON XL
INFRASTRUCTURE & MOBILITY				
Focus on active transport	A city, with where it can walk more, cycle and use public transport, and where it should be priority for the car.	N/A	Mobility vision Eindhoven on Road	●
Growth in the share of public transport and bicycles	A growth of the share on foot and bicycle by 10%, growth of the share of public transport by 50%, decrease of the share of car by 9% compared to 2012	2025	Mobility vision Eindhoven on Road	●
Sustainable Automobility	8,000 electric cars registered	2020	Climate plan	○
	Emission-free supply of the inner city	2025	Coalition agreement	●
	60,000 fewer fossil cars compared to 2016	2030	Climate plan	○
	Zero-emission vehicles only	2050	Climate plan	●
Public transport	7 out of 10 taxis are electric	2020	Climate plan	○
	Buses are fully electric	2020	Climate plan	○
Charging infrastructure	Covered network of charging stations and fast charging stations, extra benefits EVs such as cheaper parking rates	N/A	Coalition agreement	●
Modality Button XL	Efficient switching machine for all modes: from (H)OV and first & last mile connections to fast cycling and walking routes	N/A	Development vision Fellenoord	●
	Station area becomes a hub of sustainable mobility: international, national, regional and local	N/A	Development vision Fellenoord	●
Compaction	Promote compaction with focus on pedestrian network, public transport, cycling routes and traffic rotation on the ring road	N/A	Development vision Fellenoord	●
UH MAATSCHAPPIJ AND CULTURE				
Social cohesion	Promoting social context through greening and more car-free traffic.	N/A	Coalition agreement	●
Culture	Promotion of cultural offerings in Eindhoven	N/A	Coalition agreement	●
Cooperation	Develop plug-in-city office: Workplace for Circular Thoughts and Sharing Economy	2018	Eindhoven Circular	○
	Developing Brainport Industries Campus: bringing together innovative (supplying) manufacturing companies and institutes from the Brainport region	N/A	Eindhoven Circular	○
Participation	Actively involve residents, civil society organisations and other partners	N/A	Coalition agreement	●
	Involving residents in the Brainport economy and circularity via quadruple-helix governance style	N/A	Coalition agreement	●
Promoting circularity	Nudging, stimulating and raising awareness of circularity through e.g. sustainable organisation	N/A	Eindhoven Circular	○

MANUFACTURED POINT	OBJECTIVE	JAARTAL	POLICY DOCUMENT	BUTTON XL
HEALTH & WELCOME				
Quality of life	Knoop XL offers a high quality of life, attractive living environments, healthy city and urban culture	N/A	Development vision Fellenoord	●
	Focus on sustainable urbanisation and transport-oriented development to promote quality of stay	N/A	Development vision Fellenoord	●
Loneliness	Fight loneliness and connect	N/A	Coalition agreement	●
Security	Use of technology, design and knowledge to promote safety	N/A	Coalition agreement	●
€ ECONOMY AND INNOVATION				
Circular jobs	15,000 additional jobs through transition to circular economy	2020	Climate plan	0
Promoting circularity	Boosting circular economy in manufacturing industry in connection with the rich, province, companies and the Brainport Industries Campus	N/A	Eindhoven Circular	0
Cooperation	Set up a city-wide knowledge centre in the field of circularity	N/A	Eindhoven Circular	0
	Stimulating local sourcing and looking at total chain and life cycle	N/A	Eindhoven Circular	0
Entrepreneurial climate	Strengthening and connecting entrepreneurs	N/A	Eindhoven Circular	●
	Attract technical talent, prevent numerus fixus and improve accessibility	N/A	Eindhoven Circular	0
Innovation ecosystem	Creating interaction environment through crossovers between design, knowledge, technology, market, education and government	N/A	Development vision Fellenoord	●

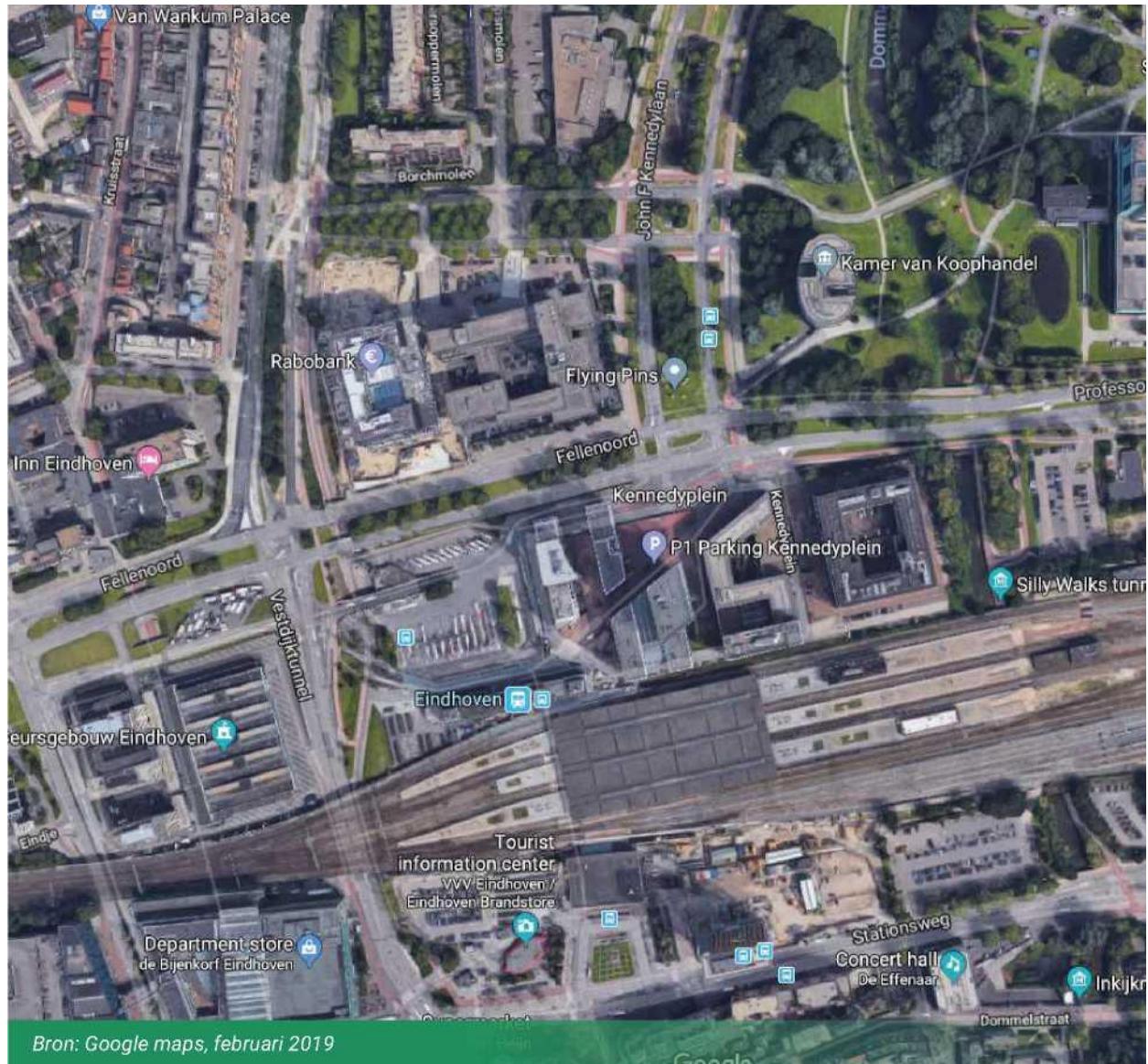


EEN NULMETING
VAN HET GEBIED

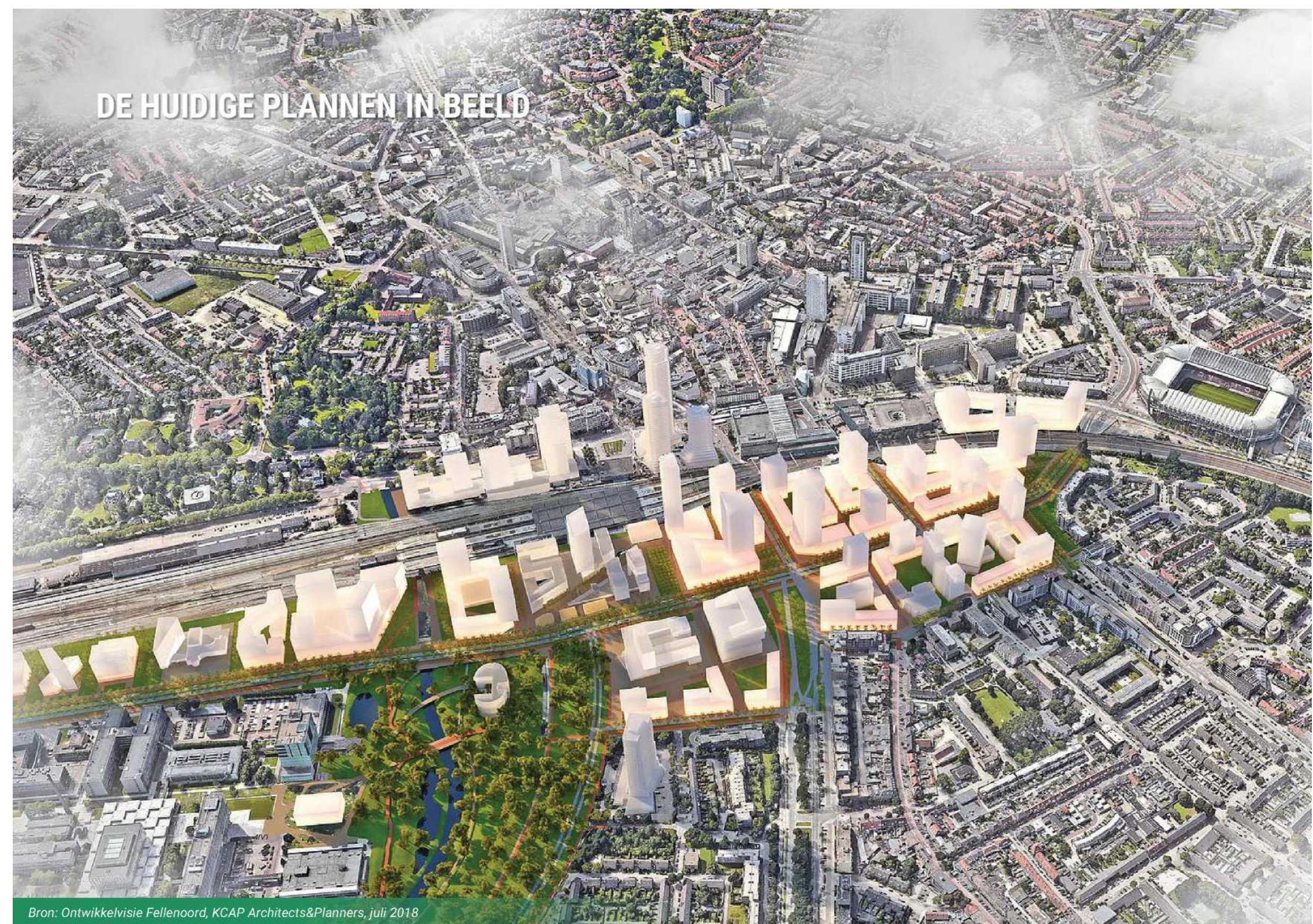
A DEFINITION: THE ‘CANVAS’ FOR SUSTAINABLE

We carried out a baseline measurement for the International Knoop XL to provide insight into how the system functions. We do this for a business as usual (BAU) scenario in which the current plans are implemented. This gives us insight into what opportunities and hotspots there are for integrating sustainability and circularity and where there is room for interventions. We did this by performing two analyses:

- **Material flow analysis:** by analysing the ‘metabolism’ of materials, water and energy through the area, it becomes clear how the system now functions and where the greatest impact can be achieved: For example, is there a lot of potential for sustainable energy generation, or can building materials be cleverly reused?
- **Spatial analysis:** spatial analysis of the area on climate resilience, water, biodiversity, health, materials (the urban mine) and mobility provides insight into the frameworks within which sustainability and circularity can be implemented.



DE HUIDIGE PLANNEN IN BEELD



Bron: Ontwikkelvisie Fellenoord, KCAP Architects&Planners, juli 2018

THE SKIN PLANS: SPACE USE

The International Knoop XL offers many possibilities with its central location, but is currently mainly characterized by office buildings and infrastructure. The municipality is the largest owner and the area has a low building intensity. This offers great potential for sustainable redevelopment. The spatial vision of the KCAP proposes the following transformations:

- **Fellevoord becomes a city boulevard.**
- **There will be plenty of room for the Dommel Valley.**
- **The Button becomes a multimodal node.**

In addition, there is a first proposal for the new building made by KCAP, visually displayed on the previous page. The gross floor area (GVO) of the new building is as follows:

Total plinths	531.150	m ² BVO
Total towers	295.300	m ² BVO
Total BVO	826.450	m² BVO

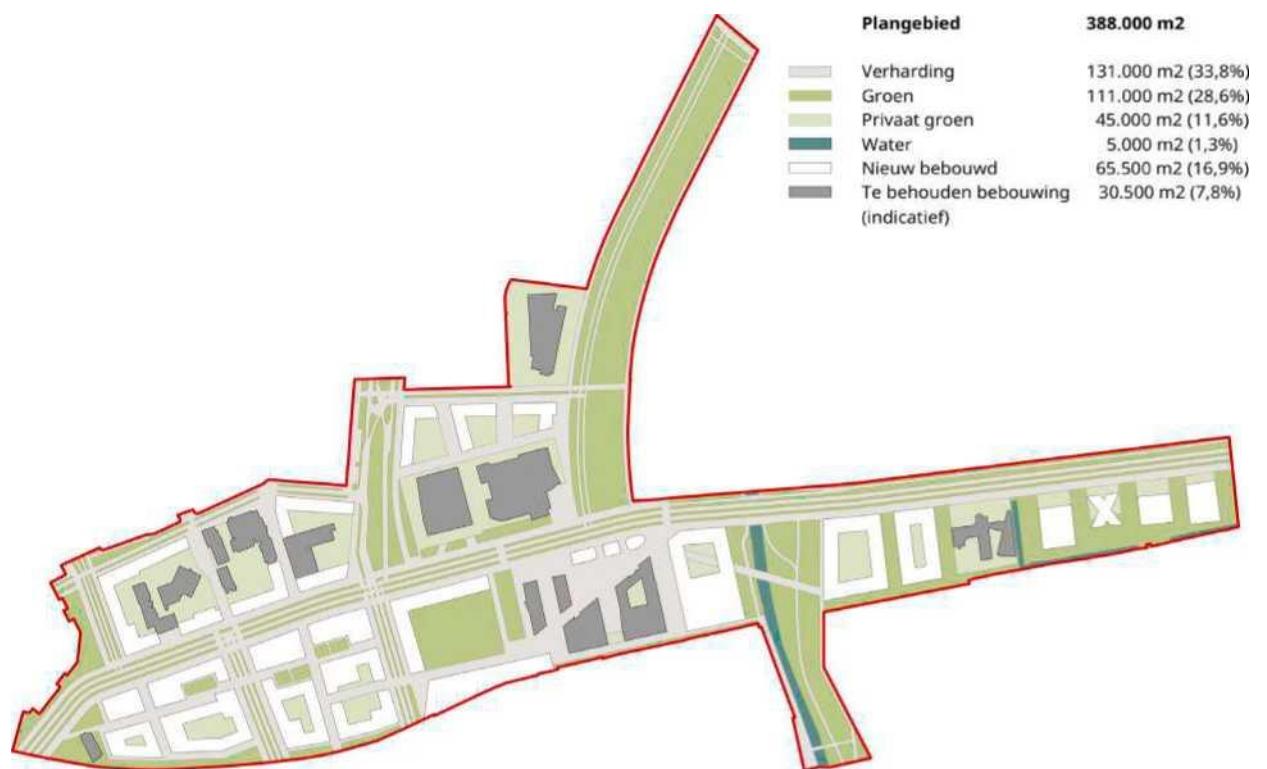


Figure 2: Indication land use development vision. Source:
KCAP

An important distinction can be made between the **building level** (construction, precise subdivision) and the **framework** (which functions come true in the public space) in the area. This project focuses on **a baseline measurement** and identifying **opportunities and hotspots** for both levels: where are the possibilities for making the International Knoop XL future-proof in the field of circularity and sustainability? Where can great successes be made?

4A. SPECIAL ANALYSIS

SPECIAL ANALYSIS

With the spatial data obtained through the municipality, we analyse the spatial environment on the basis of the three themes, in order to gain insight into the current state and the opportunities and hotspots in the area: What spatial features offer what possibilities? The following spatial analyses have been carried out:

Materials:

- Existing buildings and construction & demolition.

COO

Climate resilience, water and biodiversity:

- Green-blue structures and connection to ecological main structure.
- Biodiversity.
- Heat and water stress.

O^oC

Energy and mobility:

- Sustainable accessibility of the area (walking, cycling and public transport).
- Accessibility by car & electric transport.
- Air quality.
- ATES capability.

4B. STOFSTROOMANALYSE



Figure 3: (The demarcation of) the current buildings of the International Knoop XL (Source: data KCAP).

4A. SPECIAL ANALYSIS

4B. STOFSTROOMANALYSE

POTENTIAL

! Opport

! Challenges



The demolition and transformation must take into account the circular disassembly or demolition in order to optimize the amount of usable materials.



*Implementation van een bouwmaterialenplan om zo
reducing emissions from construction
logistics and promoting the storage of
secondary materials.*



*A lot of road surface is released.
Large streams of demolition waste
are released. Potential urban mine
infrastructure: asphalt (6486 tonnes),
concrete (1690 tonnes) and vowels
(67).*



*Many buildings will be demolished in the next
15 years, so a lot of materials will be released
(8,320 tons per year). These can be
processed in high quality. An analysis with an
urban mining model at the area level could
provide an overview of this.*

Source: data
KOAP

METABOLIC


29

CIRCULAR DEVELOPMENT EIKXL

LEGEN

□ Outline

■ Water

■ Buildings EIKXL

■ Planning
demolition ■

4A. SPECIAL
ANALYSIS

4B. STOFSTROOMANALYSE

GREEN AND BLUE

! Opportunities • Challenges

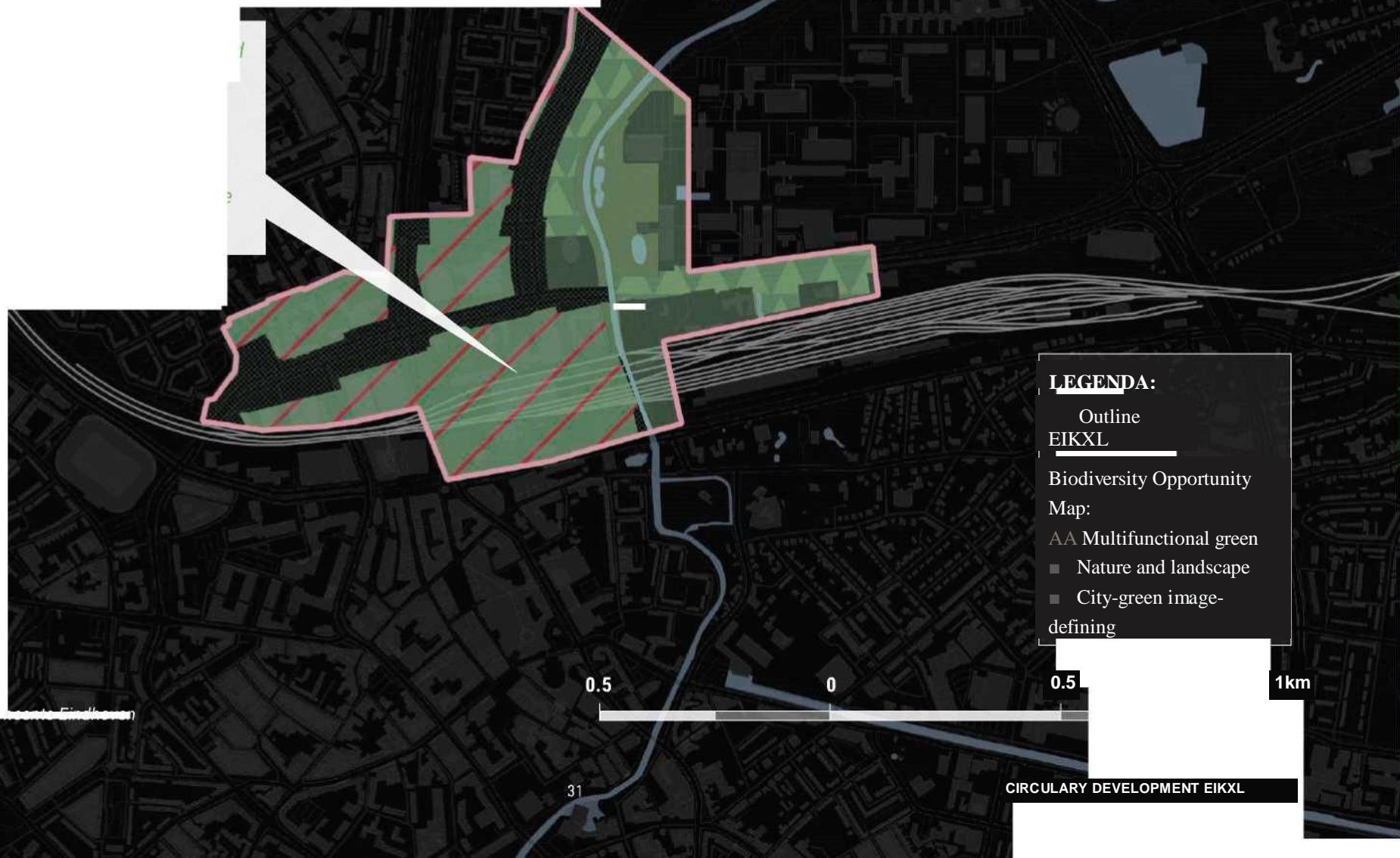


33.4% of the area is now green. This provides a good basis for water storage. Now that construction is increasing, greenery is extra important. Connection to the main ecological structure is important for biodiversity. Emphasizing this connection could encourage walking.

**4A. SPECIAL
ANALYSIS****4B. STOFSTROOMANALYSE**

KANSENKAART NATURAL

! Opportunities • Challenges



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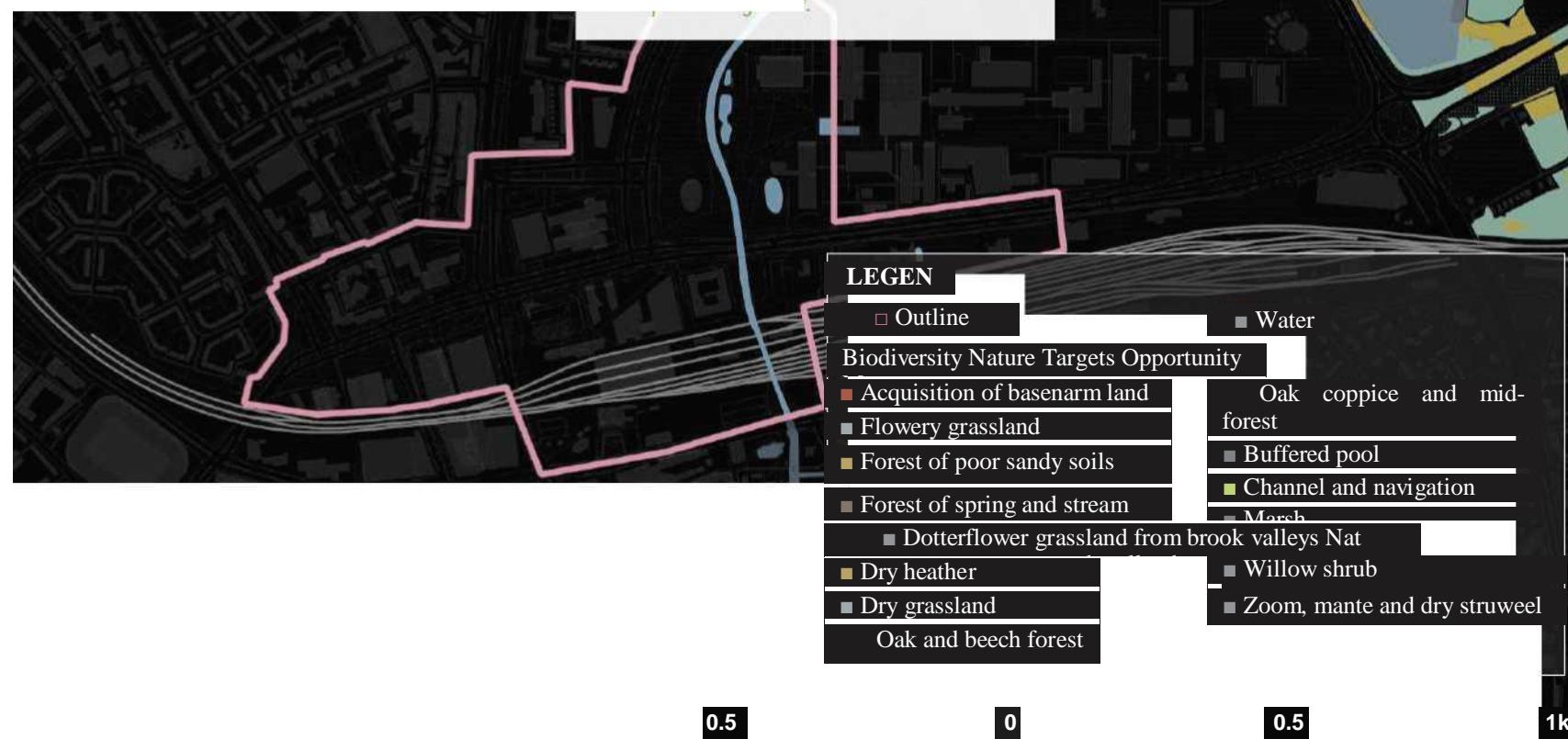
A large part of the greenery in the area is classified as image-defining. Green could serve as a business card within this area. This contributes to the objective of having landscape as a location factor. This can also contribute a lot to the water collection within the area.

Source: GIS-lagen Municipality of Eindhoven

4A. SPECIAL ANALYSIS

OPPORTUNITIES

! Opportunities • Challenges



Source: GIS-lagen Municipality of Eindhoven



4B. STOFSTROOMANALYSE



green within the area with a view to biodiversity, so that it also offers space for flora and fauna in the city. This data is currently missing for the specific area.

CLIMATE

! Opportunities • Challenges



In the southwest of the area, flooding is expected with a shower of 60 mm/h. There is already a lot of water infrastructure in the soil. It is important to introduce more greenery to the surrounding buildings to retain this water. The area in the immediate vicinity of Fellenoord is also prone to flooding.

4A. SPECIAL ANALYSIS

HITTESTRE

SS Taking heat stress into account is an important part of a climate-resilient area. In view of the developments of the built environment within Knoop XL, we must also take into account the development of a heat island.

A Hotspot:

The urban heat island can pose health hazards and needs to be addressed in urban and petrified areas within EIKXL.

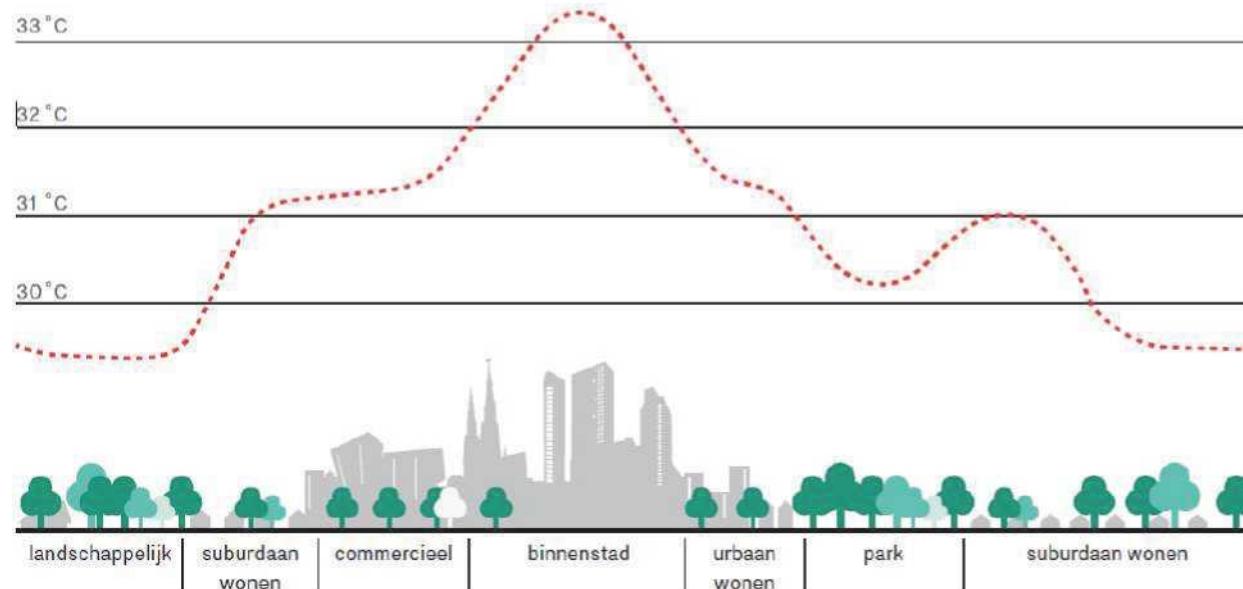


Figure 4: The temperature in the inner city can be up to 4 to 5 degrees Celsius higher than in landscape areas (Source: EPA, 2008).

4B. STOFSTROOMANALYSE

O Opportunity:

In the current plans, both the Fellenoord and the green area around the Dommel will become more intensively green. Reduction of hardening and urban greenery contribute to reducing heat stress. Under the crown of a tree, the temperature can be as much as 15 degrees Celsius lower than a few meters away and the cooling effect of a park can be measured even 2 kilometers away.

O Opportunity:

At building level, solar shading, material use, ventilation and building orientation can be taken into account (TNO, 2014).

Sources: Rovers, V., Bosch, P., Albers, R., van Hove, B., Heusinkveld, B. G., Hartogensis, O. K., ... & Groot, A. M. E. (2014). Climate proof cities: Final report 2010-2014. Knowledge for Climate; EPA (Environmental Protection Agency); Reducing Urban Heat Islands - Compendium of Strategies; United States Environmental Protection Agency, 2008; Bade, T. and Tonneijck, F. (2011). 'Modelling the benefits of urban forests for sustainable management?'; ELCA research workshop, Brussels, May 24th 2011; 4 p.

4A. SPECIAL
ANALYSIS

AVAILABILITY OV, FIETS AND

! Opportunities • Challenges

4B. STOFSTROOMANALYSE

There is a lot of focus on the car, while the area is optimally connected to public transport. The proposal to create a bus terminal under the area could ease the burden on the area in terms of transport movements.



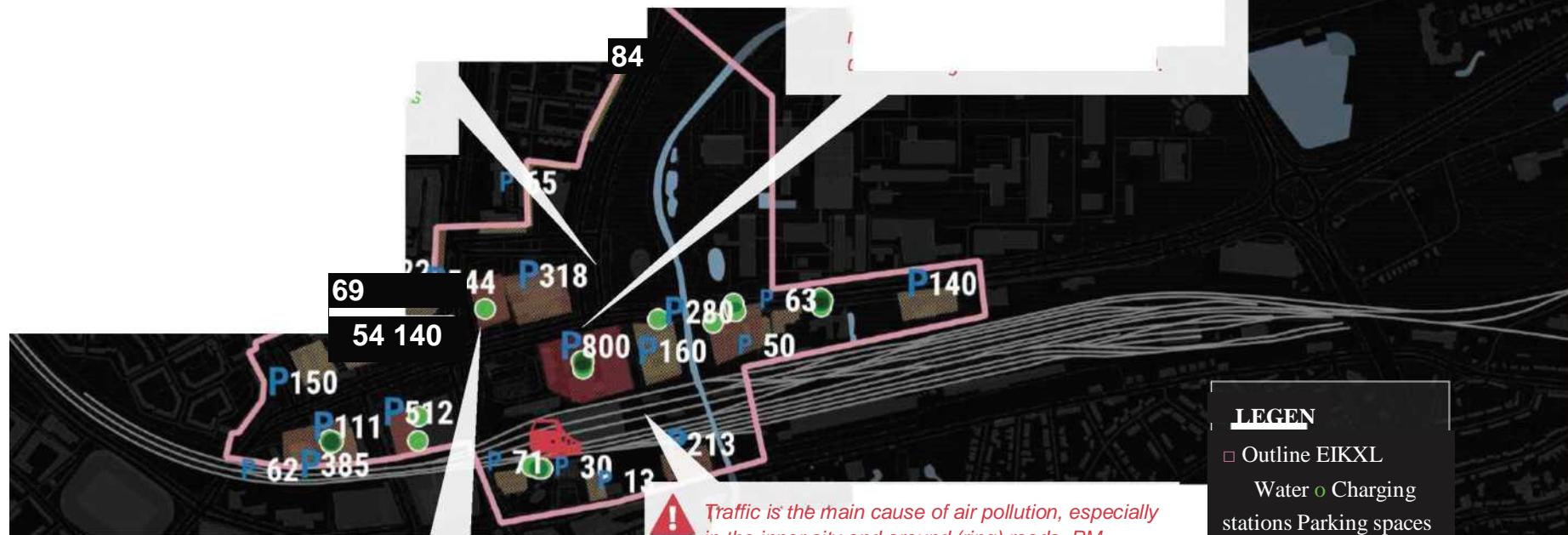
The plans for the new Neckerspoel bus station offer opportunities for a better and cleaner connection with the rest of the city and the region.

The entire area is within walking distance: Within 9 minutes, 97% of the area can be reached by foot. A large part can be walked within 5 minutes (the CBS uses <1 km as a walking distance, which amounts to a 10 minute walk).

4A. SPECIAL ANALYSIS

AUTON

! Opportunities • Challenges



There are already electric charging stations within the area. This offers possibilities in the future for introducing a combination with energy with, for example, a smart grid.

⚠️ Traffic is the main cause of air pollution, especially in the inner city and around (ring) roads. PM₁₀ (55%) and NOx (20%) have the greatest effect on the environmental-related burden of disease in the Netherlands (RIVM, 2016). The transition to electric driving will contribute to solving NOx bottlenecks in the coming years.

LEGEND

- Outline EIKXL
- Water ○ Charging stations
- Parking spaces (zones):
 - 0 - 200
 - 201 - 400
 - 401 - 600 ■ 600+

Source: GIS-lagen Municipality of EIKXL

0.5

0

0.5

1km



Supply and waste logistics will have to be taken into account during development. The targets indicate that the inner city must be supplied emission-free by 2025.

*There are 4,944 car parks within the area.
This is equivalent to approximately 53,400 m². This space could also be used for other purposes.*

AVAILABILITY

4A. SPECIAL ANALYSIS

4B. STOFSTROOMANALYSE

! Opportunities • Challenges



Source: *Atlas of the subsurface Eindhoven* (<https://eindhoven.nazca4u.nl/atlas/>)

LEGEND

- Outline EIKXL
- Water

0.5

1km

O

There are already many WKO systems within the area, the subsurface within the area is also very full. The existing systems, underground functions, but also how the systems affect groundwater levels and quality, for example, must be taken into account.

There are already many WKO systems within the area, the subsurface within the area is also very full. The existing systems, underground functions, but also how the systems affect, for example, groundwater level and quality must be taken into account.

STOFSTROOMANALYSE: INFORMATION IN THE



What is a dust flow analysis?

A dust flow analysis, also known as Material Flow Analysis (MFA), is a systematic assessment of dust flows and stocks of (raw) substances within a system, with a defined scope in terms of space and time. For the KnoopXL, we have modelled the flows of materials, energy and water through the area per year in a 'business as usual' scenario, based on current plans up to 2043.

The result of this analysis is visualized in a so-called Sankey diagram. The Sankey diagram shows from which sources a 'flow' comes (on the left side), how it is used or transformed within the area (center) and how the 'flow' eventually leaves the system and is processed (on the right side of the diagram).

What can you do with a dust flow analysis?

Physical flows are the basis of many environmental impacts that determine the degree of sustainability and resilience of a system. Think of the energy we use to heat a building or the materials needed to build houses and the building waste that is released during the demolition. This is how we gain insight into:

- What is the **dynamics** of the system: How do materials, energy and water flow through the area and how do they relate to each other?
- Where are the biggest **hotspots** in terms of impact (in terms of material use, energy consumption or emissions) in the system?
- Where are **opportunities** for sustainability and synergy in the system: Can we reuse outgoing currents or can we use roofs for energy generation?

APPOINTMENTS & AM; CALCULATION

The current programming and characteristics of the area are the starting points in the analysis, a business as usual scenario. It implements the current plans without additional measures and interventions in the area of the energy and raw materials transition, or changes to existing plans for demolition, renovation and new construction. This allows the opportunities and hotspots to be determined in order to reduce the 'footprint' of the area. The calculations come from our models and are based on figures from the scientific literature and results and data from previous projects of Metabolic. By combining these figures with the construction and demolition task of the area, a prediction has been made of the material flows. This also takes into account the increase in inhabitants and the associated consumption patterns.

Assumptions in the calculation:

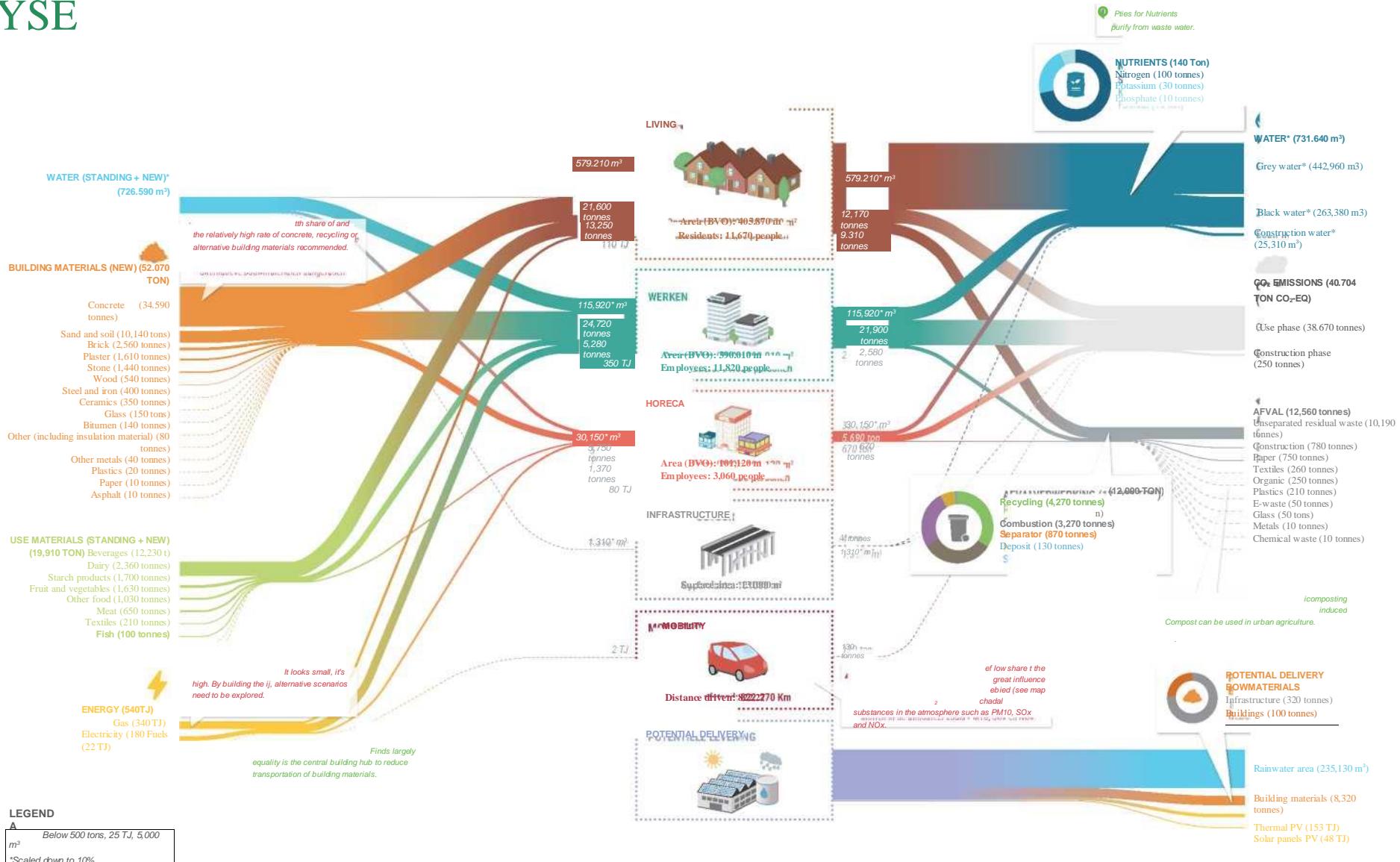
- Based on the programming **of KCAP**, we determine **how much is being built and demolished**.
- Time horizon: **25 years** (until 2043).
- Dust streams shall be **normalised to** use over **1 year**.
- Construction and demolition infrastructure not included.

Calculation:

- Required and released **building materials** over the entire time horizon.
- **Energy and water consumption** through construction and demolition.
- **Energy and water consumption** during use of the final buildings.
- The emissions caused by mobility, but also the construction and use of the buildings.
- Theoretical potential **thermal and solar energy** when installing solar panels.
- Theoretical potential **for rainwater collection** when taken into account during construction.

4A. SPECIAL ANALYSIS 4B. STOFSTROOMANALYSE

STOFSTROOMANALYSE



VIEWS FROM STOFSTROOMANALYSE

Water

- There is a high input of water in the area, mainly due to the use of residents. In view of a changing climate and changing weather conditions, we must also consider increasing drought.

Building materials

- The new construction task requires 52,000 tonnes of building material per year: Concrete, in particular, is an important hotspot with 67% of total demand and high embedded energy and CO₂ impact.

Energy

- The building task provides an energy task of 10 TJ per year, mainly by transporting building materials: A construction hub could provide a solution.
- For the total energy demand, gas is still taken into account in the business-as-usual scenario, but this will increasingly shift to sustainable alternatives: this should be taken into account in the electricity grid.

Outputs

4 Water

- There is also a high output of water in the area, exploring options to recover nutrients from water should be explored.
- The roofs in the area are able to meet 9% of the water demand.

CO₂emissions

- During the construction and use phase, there is an emission of 40,000 tonnes of CO₂- equivalent per year, for 95% from the use phase.

Waste

- A third of the waste is already recycled, but there is also a lot of incineration (26%). Here lies an opportunity to integrate better waste separation in the newly built area by, for example, placing compost containers underground.

POTENTIAL DELIVERY

4B. STOFSTROOMANALYSE

MATERIALS

16%

8,320 tonnes of demolition waste released

By reusing demolition waste generated, the **use of materials** in the new building can potentially be reduced by **16%**.

WATER

9%

30 m³ rainwater on roofs

By collecting rainwater on all roofs, 9% of the water demand can be collected, equal to **26 Olympic swimming pools**. For example, use for flushing vacuum toilets, washing facilities or irrigation of gardens or public greenery.

ENERGY

27%

onnie-energy

By installing solar panels on the available roof surface, 27% of the energy demand can be met: enough for the **electricity demand of 4,400 households**

COMPLETE CONCLUSIONS



Bron: Ontwikkelvisie Fellenoord, KCAP Architects&Planners, juli 2018

- The International Knoop XL is still characterized by office buildings and infrastructure, but offers great potential to become a sustainable and future-proof area.
- Due to its central location and good accessibility with (H)OV, bicycle and walking, there are opportunities to make it a car-free or even car-free area.
- The large building task brings with it a high demand for building materials (concrete) and energy, here are opportunities for circularity.
- The transformation also offers opportunities for redesigning the energy system. For example, the roofs potentially provide 20-35% of the required demand for PV, and there are opportunities for CHP and heat networks.
- Biodiversity and climate resilience must be promoted, the space created by reducing the infrastructure and the Dommel offer opportunities for greening and connection to the main ecological structure.

KANSEN & HOTSPOTS



OPPORTUNITIES AND HOTSPOTS

From the baseline measurement of the area, we have identified opportunities and hotspots based on the spatial characteristics and dust flows that flow through the area. We have summarized these into a top 5 of opportunities and hotspots for both the building level and the framework of the area.

These opportunities and hotspots are eventually combined with the baseline measurement and municipal policy to arrive at a development vision and development framework for the International Knoop XL.



Source: Development vision Fellenoord, KCAP Architects&Planners,
EIKXL 2010

HOTSPOTS & OPPORTUNITIES: CONSTRUCTION LEVEL

High demand **for building materials** (52,000 tons) per year as a result of the more than 800,000 m² BVO building assignment: 67% of that is concrete.

Construction task creates large **energy demand** (10 TJ per year) by transporting materials.

The **water consumption** of the built environment is high (over 700,000 m³ or 290 Olympic swimming pools per year)

Building **natural gas-free** requires new forms of heating, the region has few local sustainable heat sources and this can be a major burden on the grid.

Generating **solar energy (potentially 27% of energy demand)** and integrating greenery is a challenge when building in height.

Both in construction (**passive construction**, remountable construction, splitting houses, recycled concrete) and demolition (**circular demolition**) there are opportunities for circularity. Mapping the **urban mine** at area level in cooperation (e.g. with the Green Business Club) creates a basis for reuse.

A **construction hub** (space demand about 5,000 m²) and **cooperation** between the parties can bring great savings and synergy (**up to 66% less fuel**).

Use roofs for rainwater collection (9% of total water demand), and make sure that **water storage is arranged at building level**.

Strict requirements for insulation of homes and the smart integration of **Heat Cold Storage (WKO)** and **use of substrate**.

Generating **solar energy and integrating greenery on roofs (potentially 27% generation)** and facades; Possibly **urban agriculture** on roofs.

@ HOTSPOTS & OPPORTUNITIES: RAAMWERK

Car use causes poor **air quality** (PM10 and NOx responsible for 75% environmental-related disease burden) and **a lot of space use** (Fellenoord sometimes up to 100 meters wide, parking spaces take up 54,000 m² within the area).

Despite the fact that a lot of waste is already recycled, a **significant proportion (44%)** of the **waste is still incinerated**.

The area is characterized by a lot **of infrastructure and hardening (33% of the area is green)**, which poses a risk to climate resilience.

Waterlogging in the southwest and around the Fellenoord at 60 mm / hour waterfall.

The use of the **subsurface** becomes a challenge with new **sanitation** and **heating of the area (WKO)**.

Central location, short walking distance and good bike and (H)OV accessibility offers unique opportunity for **car-free** area and focus on **the bike and pedestrians**.

Transformation of the area offers opportunities for **waste separation at** the source and placement of **compost containers for** food waste.

Infrastructure can be converted to **green** for **climate resistance (to at least 40% green)**, material released from demolition infrastructure (8,000 tons of asphalt, concrete) can be **reused in high quality**.

Greening, connecting and **widening Dommeldal**, and connecting under the track with the Gender to create a large green city strip.

Arranging water storage at building level to prevent transport and **smart use of subsurface** for WKO. The proposal for a park on top of Neckerspoel bus station offers possibilities for water retention.

ONTWIKKELVISIE EN ONTWIKKELKADER



TOWARDS A

We are working towards a development vision and development framework, where the question is: **How do we make the area future-proof, sustainable and circular?**

There is a unique opportunity to turn the International Knoop XL into a sustainability champion. We must set the bar high for this, and maintain flexibility to even raise ambitions in the future. Due to the large transformation and central location

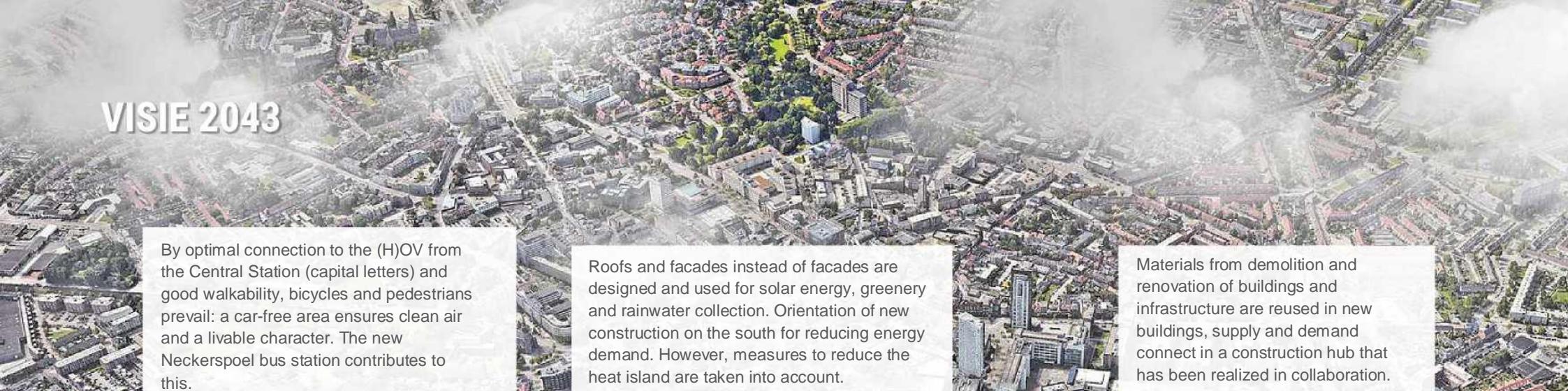


Bron: Ontwikkelvisie Fellenoord, KCAP Architects&Planners, juli 2018

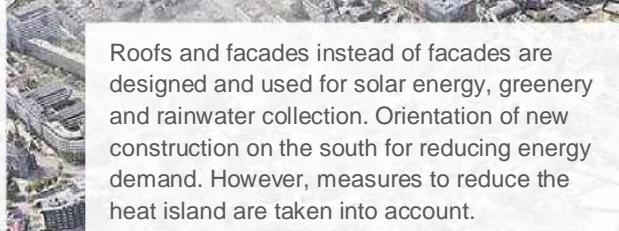
The vision for the International Knoop XL is also in line with the sustainable objectives of the Municipality of Eindhoven. This transformation offers a unique opportunity to make big steps in the sustainable ambitions of the municipality. We have highlighted some objectives to which the vision contributes.

of the area, there are opportunities to use area development to lead by

VISIE 2043



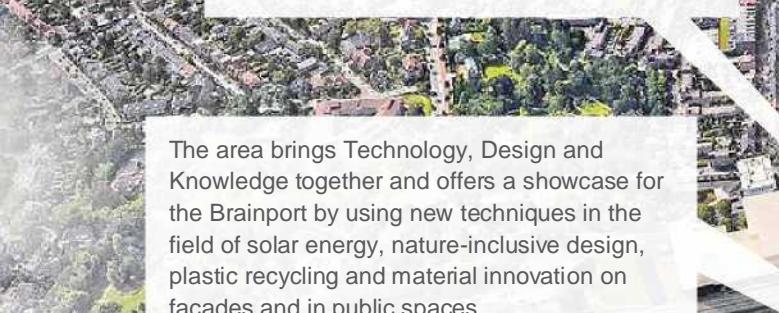
By optimal connection to the (H)OV from the Central Station (capital letters) and good walkability, bicycles and pedestrians prevail: a car-free area ensures clean air and a livable character. The new Neckerspoel bus station contributes to this.



Roofs and facades instead of facades are designed and used for solar energy, greenery and rainwater collection. Orientation of new construction on the south for reducing energy demand. However, measures to reduce the heat island are taken into account.



Materials from demolition and renovation of buildings and infrastructure are reused in new buildings, supply and demand connect in a construction hub that has been realized in collaboration.



The area brings Technology, Design and Knowledge together and offers a showcase for the Brainport by using new techniques in the field of solar energy, nature-inclusive design, plastic recycling and material innovation on facades and in public spaces.



The Dommel and the Fellenoord become green veins through the district, which promote climate resilience, biodiversity and a healthy city.



The subsurface is cleverly used for climate adaptation, sanitation and energy supply (Hot Cold Storage). It is connected to residual heat from the TU/e.



Waste is collected separately from households and businesses. The Knoop XL works towards 0% residual waste through compost containers, recycling and smart logistics.

o DEVELOPMENT VISSION:



Vision

The Knoop XL uses its transformation to reduce the consumption of raw materials and takes an exemplary role on the way to the national vision to be 100% circular by 2050. In a construction hub, the materials from the demolition of buildings and the large number of roads around the Fellenoord are temporarily stored and reused in new buildings. The ambition of 15% old concrete processing can be raised. By understanding the urban mine, supply and demand can be smartly matched. The planned construction in the Knoop XL takes lifespan, flexibility, impact of materials and design for disassembly into account in the design and the municipality rewards circularity in the land issue. In addition, there is room in the area for making circularity visible by Techniek, Design and Kennis: public space in parks and around the Dommel demonstrate technology and logistics regarding e.g. composting and plastic recycling. Local businesses are encouraged to use each other's residual flows to make the residents of the Knoop XL aware of the raw materials they use.

Ambition of the municipality

- 50% less use of primary raw materials by 2030.
- 0% residual household waste in 2020.
- At least 15% old concrete processed in rivets, tiles, curbs.
- Integrating circularity into area development and land sales.

LEGENDA:

- Ambition not achievable within Knoop XL
- Ambition challenging within Knoop XL
- Ambition achievable within Knoop XL

©oo DEVELOPMENT: CLIMATE CONFIDENTIALITY, WATER AND



Vision

There are great opportunities within the area to take climate resilience as a starting point in the design of the area. The Knoop XL makes the often invisible themes of climate resilience and biodiversity visible in the streets. Here there are great possibilities for the confluence of the 'left and right hemispheres of the brain', technology and design. The Button XL combines compaction with greening: asphalt and concrete turn into green strips, roofs and facades to reduce flooding and heat stress. Water storage is natural where possible, regulated at building level with buffer zones. A healthy Dommel gets a prominent place where local plant species are made visible to visitors. A strong connection with the main ecological structure ensures a high biodiversity. The new Dommel Passage makes this connection attractive to wanders.

Water purification takes place visibly, for example in a Biopolis around the Dommel. Urban agriculture, perhaps on city roofs, and edible plants and trees promote social cohesion and play an educational factor.

Ambition of the municipality

- 100% climate-resilient buildings and public space.
- Reducing hardening to minimize waterlogging and heat stress.
- Develop ecological greenery to increase biodiversity, intensify connections.

LEGENDA:

- Ambition not achievable within Knoop XL
- Ambition challenging within Knoop XL
- Ambition achievable within Knoop XL

© DEVELOPMENT VISSION: ENERGY



Vision

The Knoop XL will be the example of an energy-supplying and emission-free area in Europe. It has everything for this: a central location, excellent (H)OV connections and connection with technology and knowledge of the TU/e and Design Academy. Proximity and fast connections lead to deployment on bicycle, (electric) public transport, shared mobility and new services as an alternative to car ownership and use (from car-poor, to car-free to car-free). It is then sent to a car-free area. Its transformation has been carried out according to the passive house standard, making the area energy efficient and bringing the benefits to the residents. The Knoop XL smartly connects to TU/e heat sources, and uses solar panels on roofs and facades, in combination with greenery. A smart grid reduces peak loads on the grid. Parking hubs outside the area and shared bikes and scooters provide space gains and a pleasant living environment.

Ambition of the municipality

- Built environment natural gas free by 2050.
- Eindhoven energy neutral in 2045.
- Zero-emission vehicles only in 2050.
- A city, with where it can walk more, cycle and use public transport. A car-free area, and eventually a car-free area.

LEGENDA:

- Ambition not achievable within Knoop XL
- Ambition challenging within Knoop XL
- Ambition achievable within Knoop XL

DEVELOPMENT PRINCIPLES

Developing an area is not something you do alone. To anchor the sustainable vision in the larger development of the Knoopp XL, we have drawn up four development principles that can give direction to the process.

© REDUCING USE

- Minimize (**sustainable**) energy demand.
- Minimal use of **materials** during construction.
- Avoid, reduce and reuse waste.

@ INFORMATION ON SYNERGY

- Link between **Technology, Design and Knowledge** (proximity TU/e, design academy).
- Local **exchange of residual flows** (building materials, rainwater).
- **Synergy of supply and demand of** (**sustainable**) energy at district and city level: exchange, storage and marketing of flexibility.
- **Flexible design** of buildings and public space in terms of construction, material and climate resistance (underground space).
- **Multimodal hub of mobility:** (H)OV connections, cycling and walking routes and connections to the Brainport region ensure an emission-free, efficient switching machine.

O Requirements for monitoring and reduction of construction waste in lot and infrastructure developments.

Orientation

buildings on south, southeast and southwest for lower net energy use of passive buildings.

O Deterring cars within the area reduces emissions.

O Connecting green structures in the area, in addition to nature-inclusive building on the plots connection between the plots through connecting routes in the area.



O Opportunities A Challenges

Existing buildings must be renovated for energy savings and made suitable for natural gas-free heating.

O High-quality insulation and passive house standard reduce energy demand.

O Use of rainwater for, for example, flushing vacuum toilets, washing facilities or irrigation of gardens or public greenery.

Exchanging residual heat (WKO) is difficult due to a 'full' surface.

O More concrete elaboration of smart grid for peak reduction.

Building hub for materials requires space during the transformation (5,000 m²) and also reduces energy consumption.



O Asphalt and concrete released (10,000 tonnes) for demolition infrastructure directly reused in construction assignment.

O Circular procurement in new construction and demolition.

O Transport modes are interlinked, focus on bicycle and pedestrians and sub-concepts.

O Water-efficient installations and equipment (cranes / showers) can be included in renovations and new construction.

Figure 6: Opportunities and challenges for reducing consumption and focusing on synergy.

DEVELOPMENT PRINCIPLES

The demand for raw materials that cannot be met through synergy can be achieved through production and procurement by using clean, renewable, or otherwise environmentally beneficial sources. In addition, it is important to get feedback on how the system works in order for it to function optimally. This includes the creation of transparent data and an information network (e.g. a material passport). Then we look at the scale at which different cycles can be closed.

(Jh) CHANGES BETWEEN BUILDING, AREA AND REST OF THE CITY

Closing at building level:

- Material use:** Insight into the urban mine.
- Passive and modular construction,** high-quality insulation.

Closing at area level:

- Smart water storage and management.**
- Transport** is shared and becomes emission-free.
- Energy supply** and renewable energy, heat supply (WKO, heat networks).
- Waste management:** waste separation and logistics.

Close at regional level:

- Connecting **green structures** with main structure.
- Value residual flows.**
- See how different areas can have synergy. With a view to exchanging, for example, building materials.



Figure 7: Opportunities and challenges for switching between different levels.

Collecting
transport at parking hubs
switch to (H)OV and bicycle.

DEVELOPMENT PRINCIPLES

© VIEWABLE MAKING OF CLIMATE CONFIDENTIALITY

- **Water and heat** as a starting point for the design of the area
- **Green** as a pleasant experience and distinctive character.
- **Climate resistance as** a business card (in parks, facades, roofs).
- **Greening** and preventing hardening (reduction of infrastructure).
- **Integrating biodiversity** into the area.
- Multifunctional adaptive green and blue (e.g. city gardens).

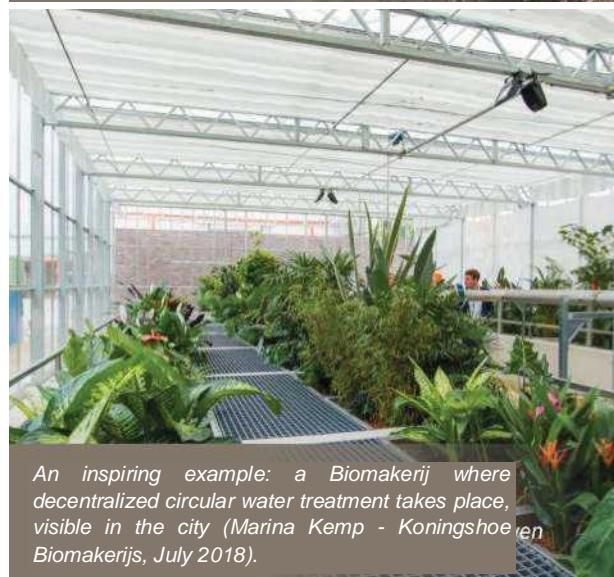
ATTENTION POINTS:

Make trade-offs from a broad sustainable perspective:

- Approach the developments transparently and create insight into the **trade-offs** between climate adaptation, green and sustainable energy: This requires a data-driven approach with a broad view.
- The same applies to underground trade-offs between WKO and new sanitation.

I Monitor progress towards a sustainable and circular Button XL:

- Monitoring progress in areas such as material use, energy and climate adaptation from this research is crucial for **ensuring sustainability**.



NEXT STEPS

A baseline measurement of the area, and resulting opportunities and hotspots, provide a good basis for a development vision and development principles. To further facilitate the process of area development of the International Knoop XL, we see a number of possible next steps:

Calculating proposed interventions and translating them into **spatial preconditions**. This can also be done in different **scenarios**, e.g. for heat and mobility (automatic, fully electric). This also takes into account **which** functions and interventions **where can** countries in the area.

The **calculation of business cases** within the area, in order to gain more clarity about the economic and ecological conditions of various interventions. Collaboration and co-creation through stakeholder sessions is of great importance.

Gap analysis of existing plans: which part of the ambitions is possible given the spatial characteristics (for municipality and landowners).

Inspiration session with Eindhoven University of Technology and the Design Academy for the development of the area.

Interesting for further exploring and accelerating the circular economy within Eindhoven:

- Mapping the stocks of materials in the built environment (**urban mine**).
- Drawing up **business cases** for the high-quality use of residual flows in the Eindhoven area
- Setting up a **monitoring framework** for the transition to a circular economy in the municipality of Eindhoven as a whole.

ANNEX

PROPOSED MEASURES ON BUILDING

Measures at building level

- Design for disassembly.
- Passive house standard for all new constructions.
- Use of secondary materials for construction process.
- Offer connection to the WKO/heating network.
- Incorporate circular construction into land issue and contracting.
- Maximum energy generation, meet NZEB requirement.
- Use of renewable materials.
- Building-level material passport.
- Flexible, redundant and adaptive design.
- Climate-proof design buildings.

AND AREA LEVEL

Framework level measures

- Orientation buildings on south, southeast and southwest.
- Reserve space for a construction hub during transformation.
- Slopes and rising terraces from the south.
- Smart grid with area-level batteries.
- Urban mining at field level.
- Recovery of raw materials from wastewater streams.
- Water treatment as a park and biorefinery.
- Central composting of GFT waste.
- Space for 'parking' shared mobility (bicycle, scooter, car), parking hubs outside the neighbourhood.
- Biodiversity guide lines.
- Set up the street as a living space.

ANNEX

ADDITIONAL OPPORTUNITIES

Materials:

- Requirements for **monitoring and reduction of construction waste** in lot and infrastructure developments within the area.
- Clarity on **material passports** for both public spaces and buildings. Possibility to do this together with an organization such as the Green Businessclub.
- **Circular tendering** for new construction and demolition, materials with low MKI value.
- **Infrastructure to better facilitate waste separation**, for example by placing vermicompost containers.

Climate resilience and biodiversity

- Creating a **management and monitoring plan** contributes to maintaining biodiversity and ecosystem services during the use phase.
- **Local food production**, for example by urban agriculture or planting fruit trees and other edible plants. By involving local residents, social cohesion can be increased.

O

Water

- Research potential of using **purified greywater** for toilets, for example.
- **Water-efficient installations and equipment** (cranes/showers) can be included in renovations and new construction.
- **Water purification as a city park** (see example Biopolis), to increase awareness and social cohesion and possibly to link an educational factor to it.

O

Energy

- Balancing the impact of providing energy locally versus using external sources.
- **Passive house** standard for new construction: obliging new buildings to comply with the Passive House guidelines, whereby the benefits must also explicitly be passed on to the residents.
- More concrete elaboration of **smart grid** for peak reduction.
- Connection to **residual heat sources** of the TU Eindhoven.

C

Mobility:

- Incentives for **shared mobility** (focus on bicycles, scooters).
- Do not limit shared cars to **mobility hubs**, but also use them on the lots.

COLOFO N

ACTEURS:

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Martin Tauber (*Metabolic*)
Jorrit Vervoordeldonk (*Metabolic*)

GRAFICAL FOREGOING:

Marta Sierra García (*Metabolic*)

DECIDED BY:

Municipality of Eindhoven

** EINDHOVEN

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