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University of Antwerp

Eco-engineering the cities of tomorrow

Master SUBE stakeholder event

Thursday 25th April 2024

Programme

18:00	Welcome and introduction
18:30	Introduction to the SUBE MSc programme – collaboration opportunities
19:10	Keynote speeches
20:00	Network walking dinner
21:30	End of event

Welcome addresses

Steven Van Passel

Vice-rector Valorization & Development

University of Antwerp

University of Antwerp · GHENT UNIVERSITY · KU LEUVEN

Karolien De Wael

Chair Department of Bioscience Engineering

University of Antwerp

University of Antwerp GHENT UNIVERSITY KU LEUVEN

Mieke Uyttendaele

Director of Education

Faculty Bioscience Engineering

Ghent University

University of Antwerp GHENT UNIVERSITY KU LEUVEN

Erik Smolders

Dean

Faculty Bioscience Engineering

KU Leuven

University of Antwerp GHENT UNIVERSITY KU LEUVEN

MSc in Sustainable Urban Bioscience Engineering

Curriculum and collaboration opportunities

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Master Sustainable Urban Bioscience Engineering

Tom Tytgat

Department of Bioscience Engineering

University of Antwerp

University of Antwerp GHENT UNIVERSITY KU LEUVEN

Universiteit Antwerpen
Faculteit Wetenschappen

Introduction of the Master Sustainable Urban Bioscience Engineering

Prof. dr. ir. Tom Tytgat

University of Antwerp

GHENT UNIVERSITY

KU LEUVEN

Why was this Master created?

Responding to societal changes

RAPID WORLDWIDE URBANISATION

INCREASING PRESSURE ON ENVIRONMENT

CONTINUOUS ATTENTION FOR SUSTAINABILITY

WICKED PROBLEMS

Futureproof engineering profile

TECHNOLOGICAL COMPETENCES

21ST CENTURY SKILLS

MULTIDISCIPLINARY COMPETENCES

INTERNATIONAL & INTERCULTURAL COMPETENCES

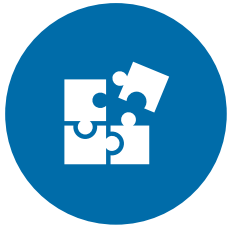
What is it exactly?

University of Antwerp
GHENT UNIVERSITY
KU LEUVEN

Bioscience engineers who provide sustainable and (eco)technological solutions for **urban environmental challenges**, taking insights from relevant expertise domains into account.

NEW, UNIQUE

INTERNATIONAL



COMPLEMENTARY

MULTIDISCIPLINARY

COLLABORATION

Our focus on an International Program

ADDED VALUE

Functionality of the programme

Global urban environmental challenges

Opportunities for international collaboration

Students

Preparing for future international work field

International students & staff - *international classroom*

International & intercultural competences in the programme

Work field

International collaborations

Design of the programme

Concept

1st Master Year

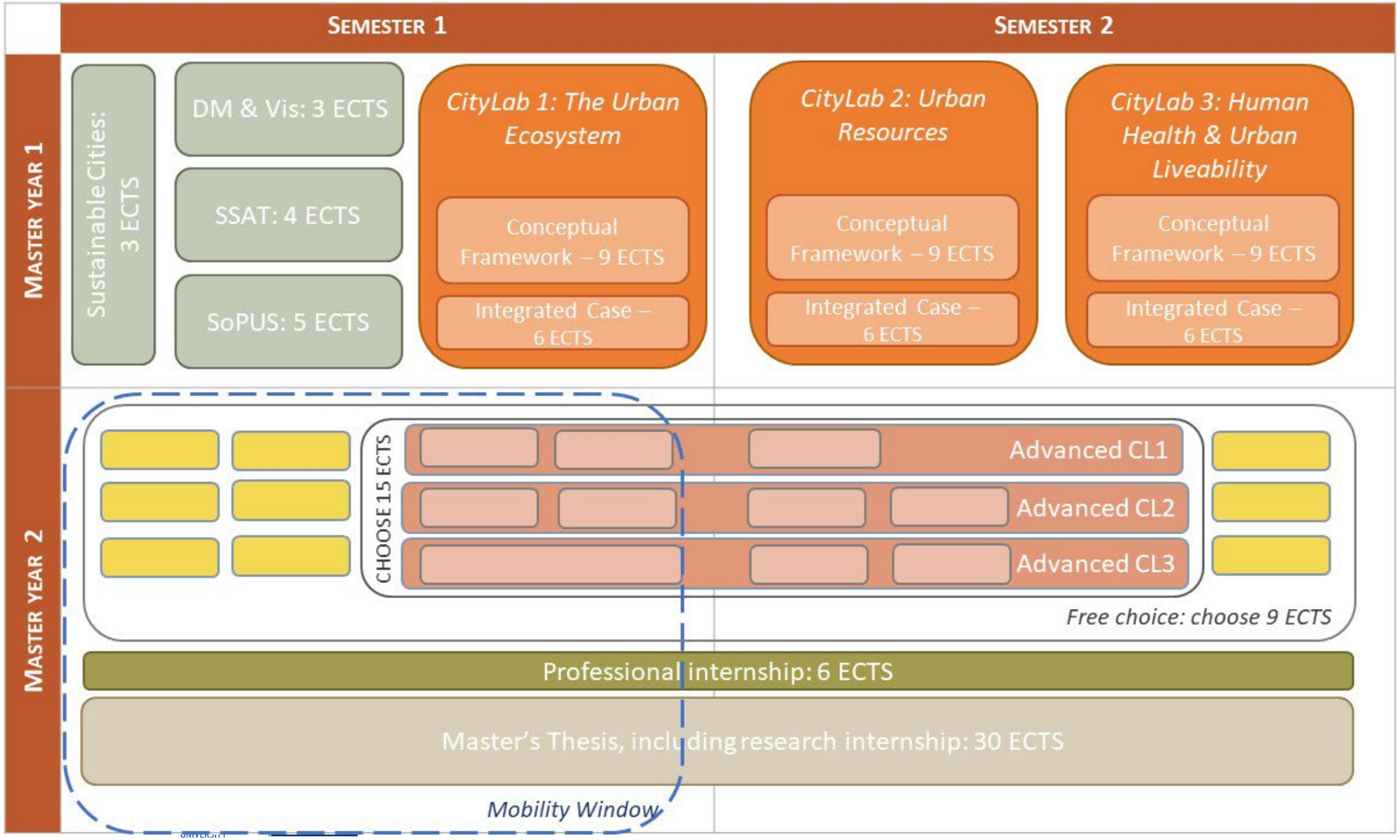
Introductory courses
3 multidisciplinary CityLabs

2nd Master Year

Specialist electives
Internship
Master's Thesis

2 year fulltime programme (120 ECTS)

English spoken


SEMESTER 1
SEMESTER 2
MASTER YEAR 1
MASTER YEAR 2
Sustainable Cities: 3 ECTS
DM & Vis: 3 ECTS
SSAT: 4 ECTS
SoPUS: 5 ECTS
CityLab 1: The Urban Ecosystem
Conceptual Framework – 9 ECTS
Integrated Case – 6 ECTS
CityLab 2: Urban Resources
Conceptual Framework – 9 ECTS
Integrated Case – 6 ECTS
CityLab 3: Human Health & Urban Liveability
Conceptual Framework – 9 ECTS
Integrated Case – 6 ECTS
CHOOSE 15 ECTS
Advanced CL1
Advanced CL2
Advanced CL3
Free choice: choose 9 ECTS
Professional internship: 6 ECTS
Master's Thesis, including research internship: 30 ECTS
Mobility Window

The start of the programme

- **What is a Sustainable City?**

  → The focus of the first course students have

- **Looking further than only engineering aspects**

  → Societal perspectives on urban sustainability

  = basic principles on urban sociology, planning, economics and legal frameworks

  + introduction on the complementarity of these disciplines in urban bio-science engineering

- **Necessary skills to tackle the challenges**
  - Data management and Visualisation
  - Spatial and Sustainability Analysis Tools

The core of the first year

- **The next step is providing/giving the students a broad knowledge about urban challenges**
- **This is done during 3 different multidisciplinary CITYLABS**
  - The Urban Ecosystem
  - Urban Resources
  - Human Health and Urban Liveability

- **The next three speakers will give more detail on the content of those CityLabs**

What is a CITYLAB?

- **Every CityLab consist of 2 parts:**
  - Conceptual Framework (9 ECTS) and Integrated Case (6 ECTS)

- **Focus of the Conceptual Framework is to provide the students the context, knowledge and skills to understand, investigate and engineer solutions**

  = The theoretical base

What is a CITYLAB? The Integrated Case

- **Next step is to use all their previous knowledge and start working on a real-life case**

What is a CITYLAB? The Integrated Case

- **Next step is to use all their previous knowledge and start working on a real-life case**

- **For this we are always looking for:**
  - Interesting and challenging cases
  - Involved stakeholders to provide background and realism to the case

- **Hopefully, we can count on you to help us with this?**

Becoming a specialist…

- In the second year, students will have the opportunity to dive deeper into advanced courses and become a specialist

- Several advanced electives are provided based on one of the CityLabs

…. and more

- **The students will have a mandatory Internship for a minimum of 25 working days**

- **Are you interested? Take a look at the website**

- **A Master thesis:**
  - Individual, multidisciplinary and scientific research project on an urban environmental issue

Your involvement is welcome

- **Interested in being informed about the Master?**
- **Or ready to join us and be involved in**
  - Guest lectures
  - Internship positions
  - Contributing during the Integrated Case with a case or as stakeholder
  - Becoming member of our Advisory Board

- **You can contact us**
  - via sube@uantwerpen.be
  - by scanning the QR code
  - or find us during the network event

Universiteit Antwerpen
Faculteit Wetenschappen
GHENT UNIVERSITY
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Towards a Sustainable Future

Citylab 1
The Urban Ecosystem

Roeland Samson

Department of Bioscience Engineering

University of Antwerp

University of Antwerp GHENT UNIVERSITY KU LEUVEN

Citylab: The Urban Ecosystem Conceptual Framework

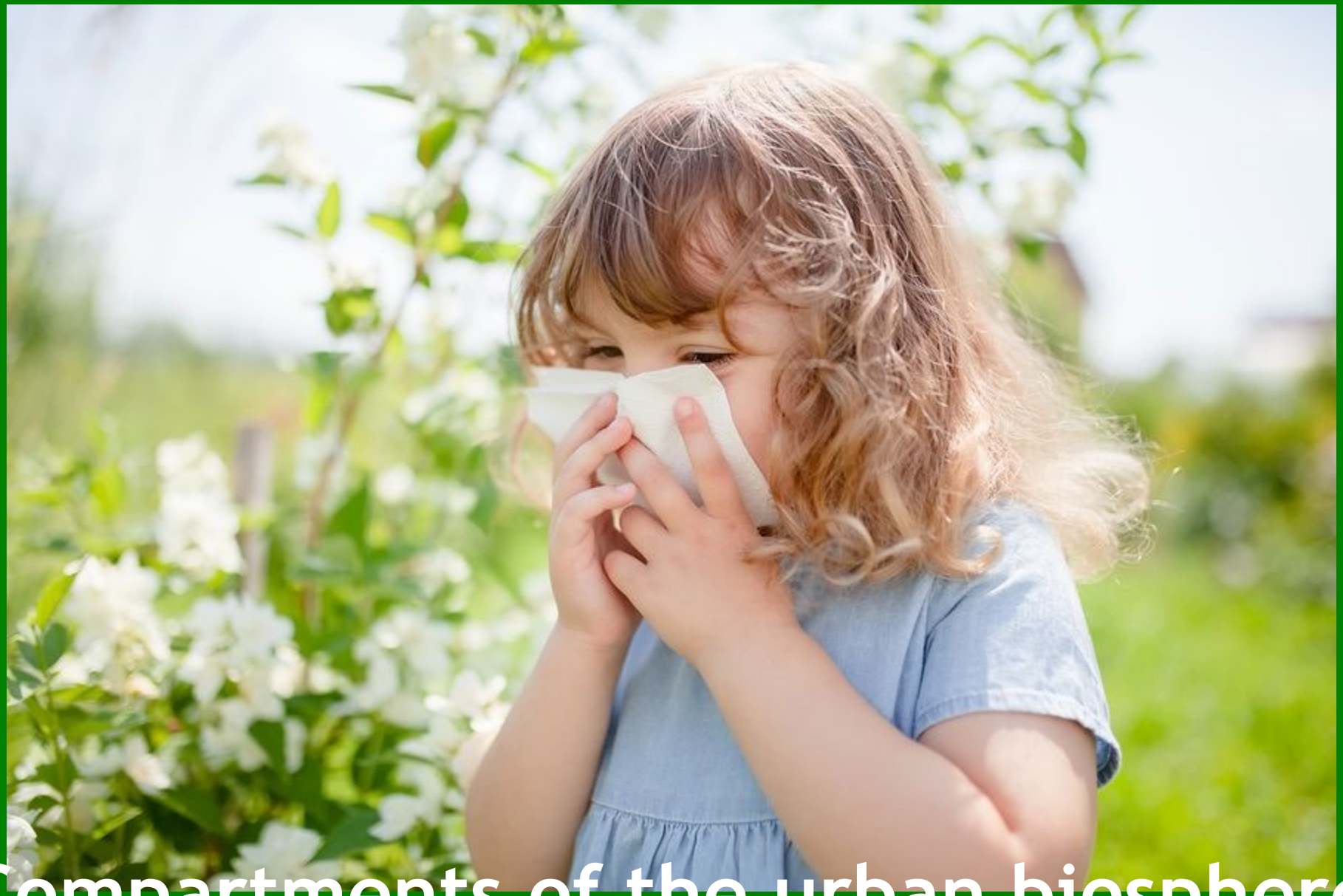

Urban Ecological Spheres

Urban Ecological Spheres


The Urban Climate

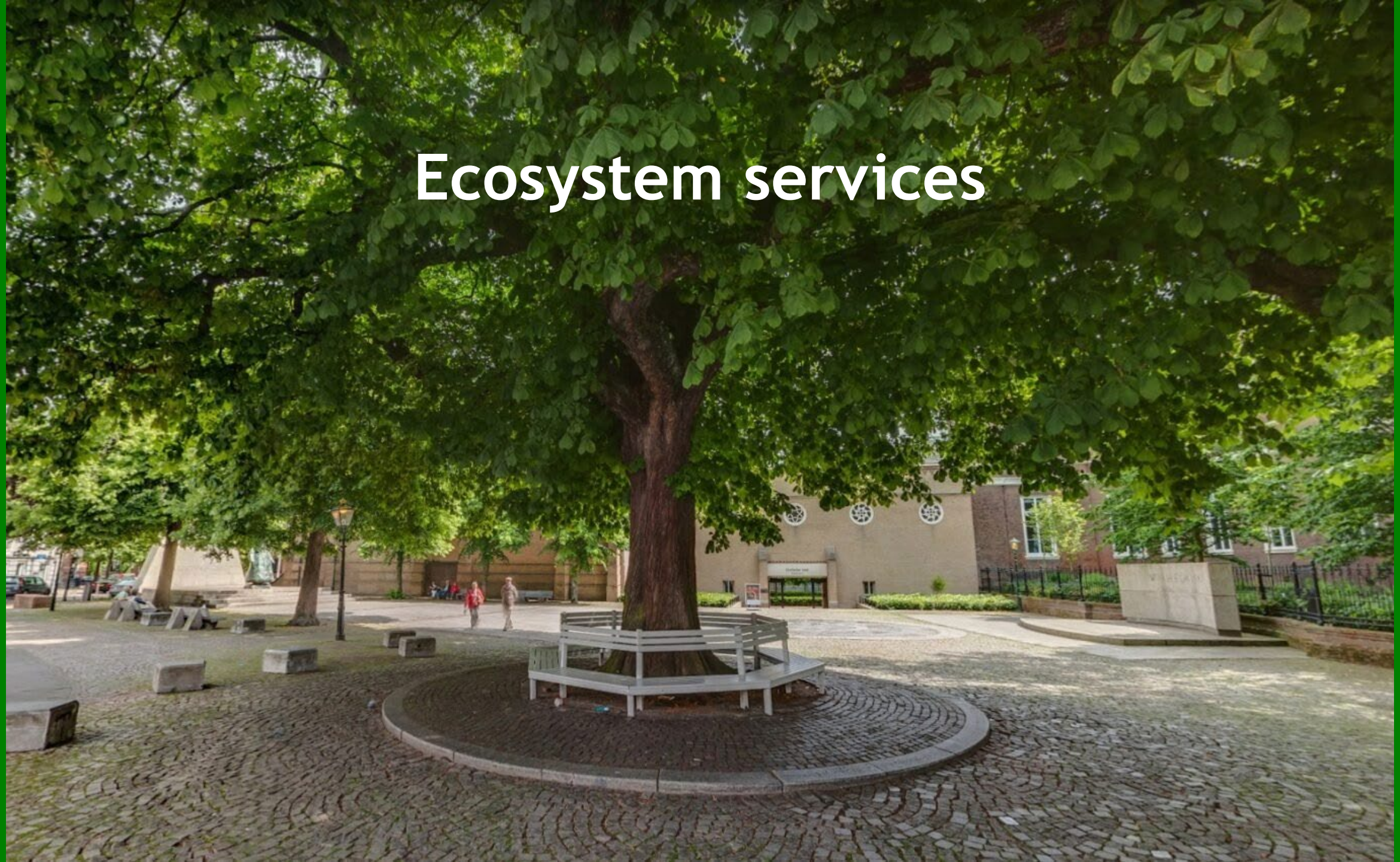
Compartments of the urban biosphere

Compartments of the urban biosphere



Compartments of the urban biosphere

Ecosystem services




Solutions


Frank Machalowski

Citylab 2
Urban Resources

Gijs Du Laing

Faculty of Bioscience Engineering

Gent University

University of Antwerp GHENT UNIVERSITY KU LEUVEN

Citylab 2: urban resources

Gijs Du Laing

Siegfried Vlaeminck, Anastasia Papangelou, Sammy Verbruggen

Liesbeth Jacxsens, Diederik Rousseau, Marjolein Vanoppen

GHENT UNIVERSITY

Universiteit Antwerpen

Citylab 2: urban resources

key urban challenges related to resources

water

energy

food

materials

Citylab 2: urban resources

key urban challenges related to resources

technological/conceptual solutions

Citylab 2: urban resources

key urban challenges related to resources

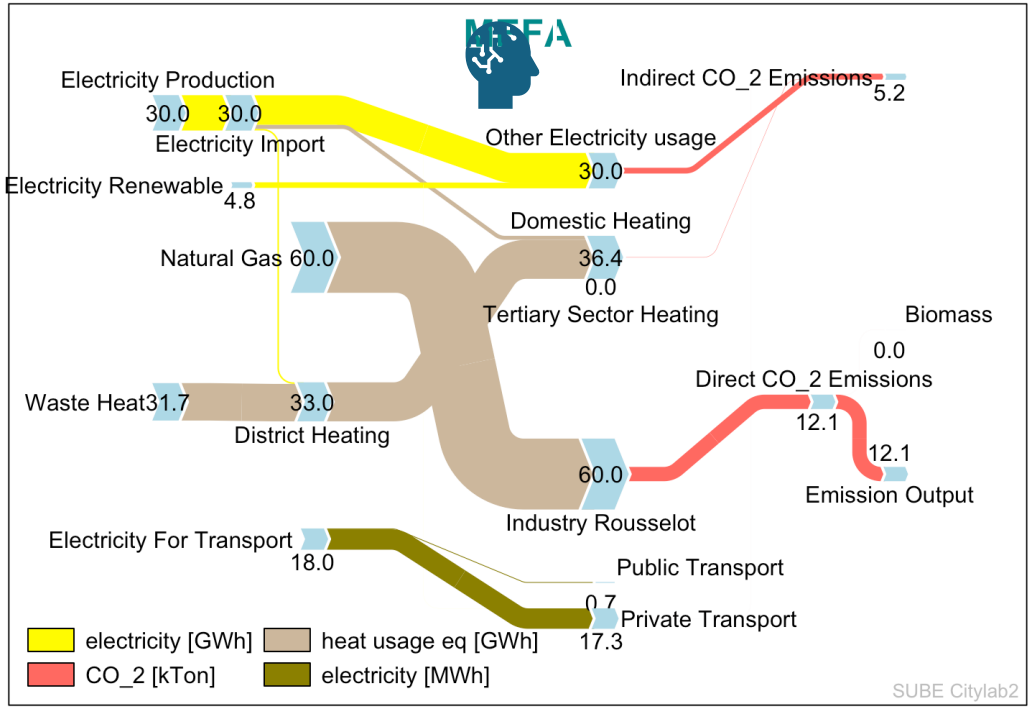
technological/conceptual solutions

non-technological challenges

decision-making using multiple criteria

Citylab 2: urban resources

(analytical) methods and tools (e.g. LCA, MFA/EFA)



Citylab 2: urban resources

Integrated case study: redesign city district

Carbon reduction

General goal	Achieve net-zero carbon emissions by 2050
Objectives	Transition to 100% renewable energy sources for all district energy needs by 2040. Attain a 50% increase in efficiency in all buildings by 2040. Establish a zero-emissions transportation system by 2050, with a focus on electrification and sustainable public transit.

Nutrient and organic waste management

General goal	Establish a circular nutrient economy, minimizing waste and optimizing resource use by 2050.
Objectives	Develop and apply 100% nitrogen recovery from wastewater and organic waste by 2050. Maximize the amount of nutrients recovered from wastewater and organic waste and their reuse within the district.

Water sustainability

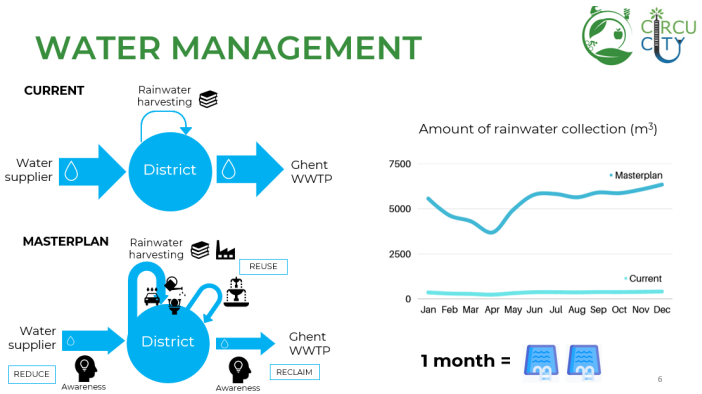
General goal	Attain a sustainable water management systems with a focus on conservation, quality, and resilience by 2050.
Objectives	Reduce per capita water consumption by 50% by 2045. Implement 100% sustainable urban drainage systems and rainwater harvesting in all new developments by 2040. Achieve 100% water neutrality in industrial water usage by 2050.

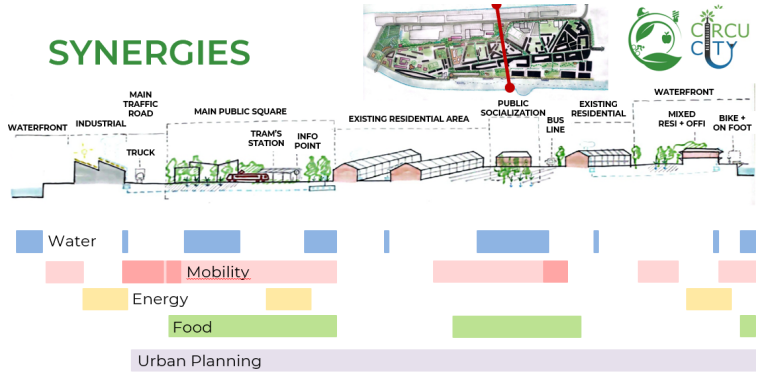
Citylab 2: urban resources

Integrated case study: redesign city district

Citylab 2: urban resources

Integrated case study: redesign city district





Citylab 3
Human Health & Urban Liveability

Ben Somers

Faculty of Bioscience Engineering

KU Leuven

University of Antwerp GHENT UNIVERSITY KU LEUVEN

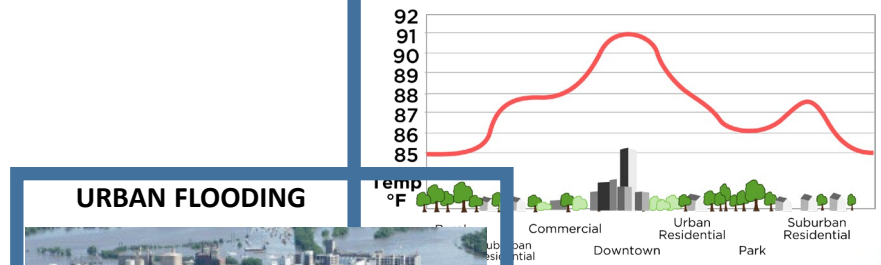
CITY LAB 3

HUMAN HEALTH & URBAN LIVEABILITY

KU LEUVEN *UANTWERPEN*

URBANIZATION & HEALTH

URBAN HEAT ISLAND PROFILE



URBAN FLOODING

URBAN DROUGHT

Satellite image of the Chennai reservoir before the drought (left) and during the drought (right).
Source: Maxar Technologies

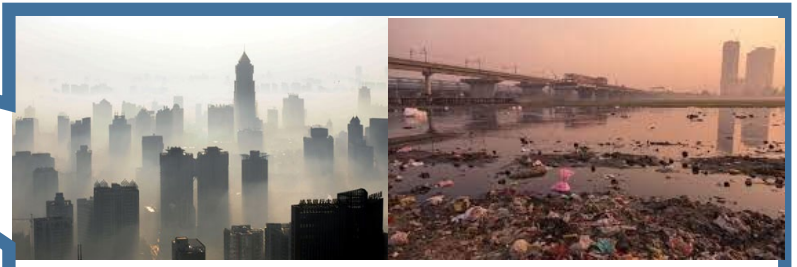
NOISE POLLUTION

SMELL POLLUTION

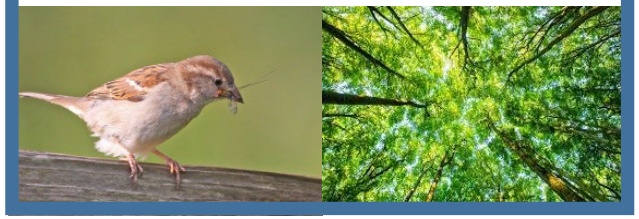
LIGHT POLLUTION

View of London light pollution at night from space © Vladi333/Shutterstock

AIR, WATER & SOIL POLLUTION



BIODIVERSITY LOSS

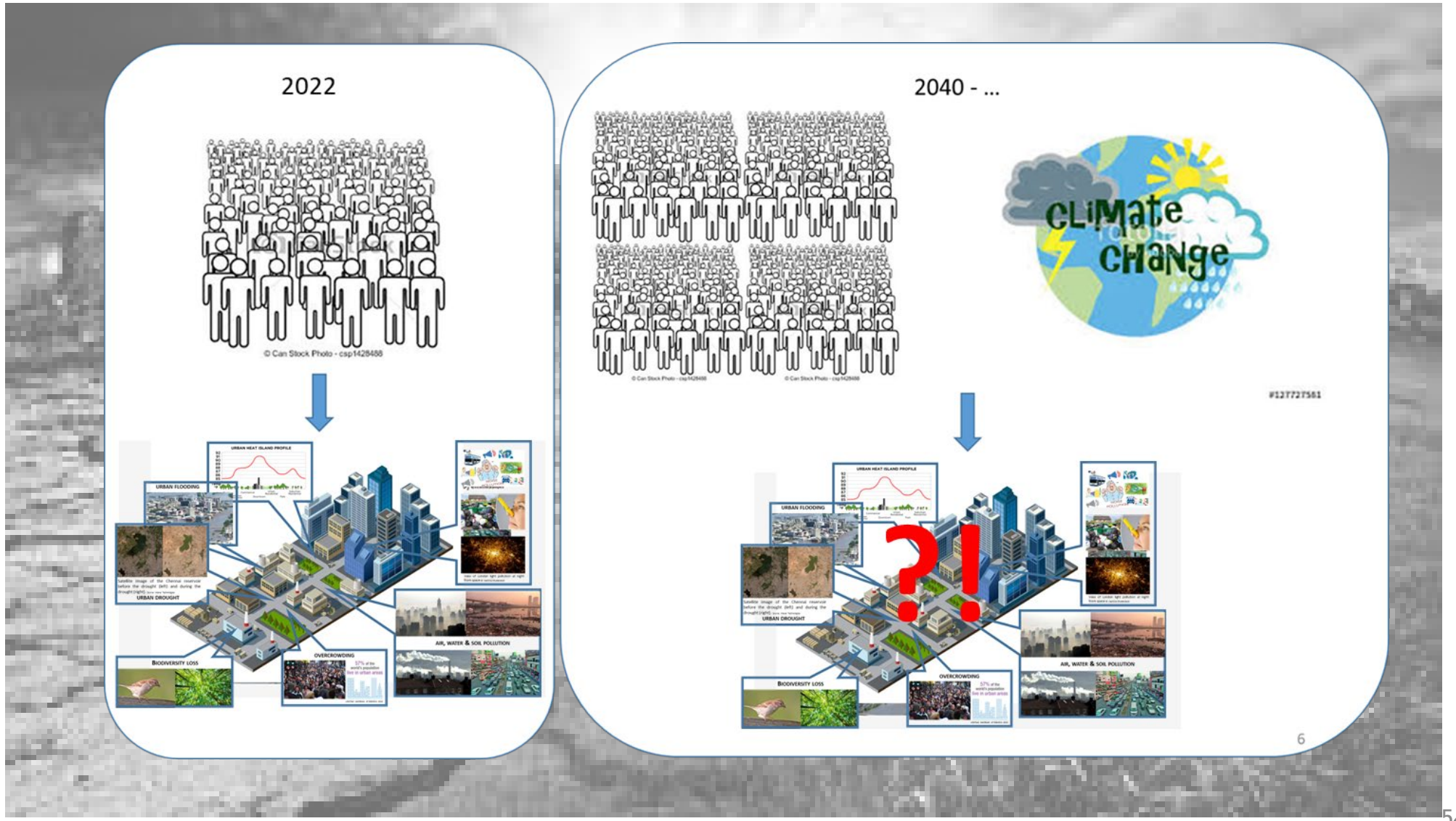


OVERCROWDING

57% of the world's population live in urban areas

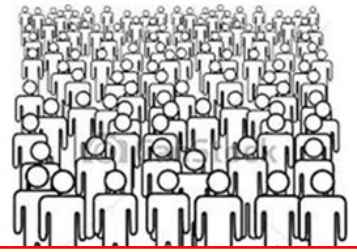
UNCTAD Handbook of Statistics 2022

Challenges of Urban Environmental Health

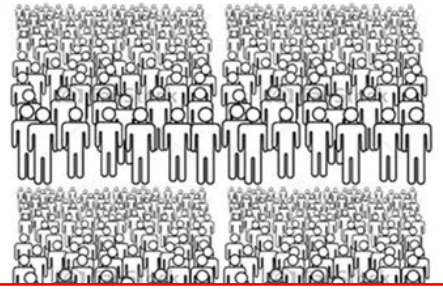


Challenges of Urban Environmental Health

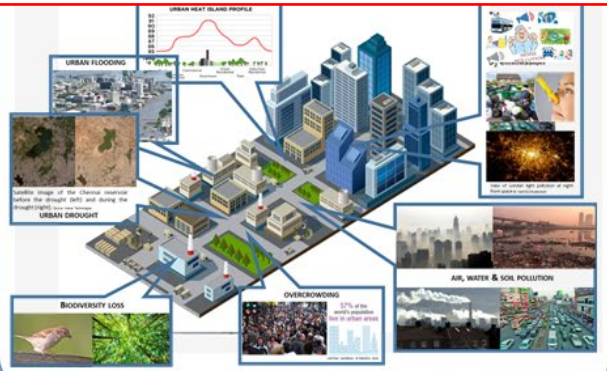
2022



2040 - ...



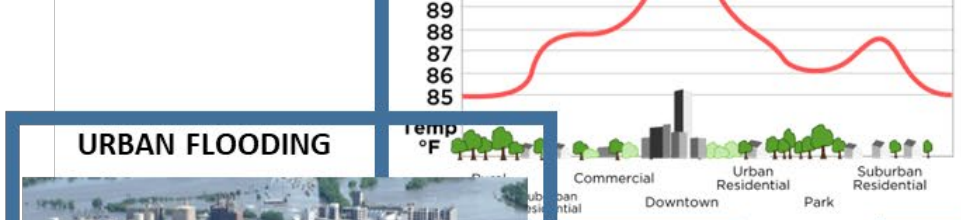
THE MAIN CHALLENGE:
HOW CAN WE ENSURE THE QUALITY OF LIFE IN OUR CURRENT AND FUTURE CITIES?!

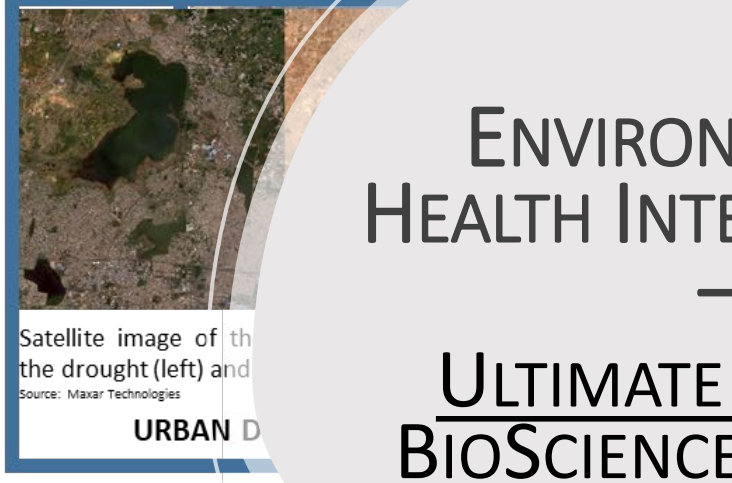


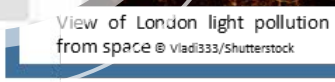
6

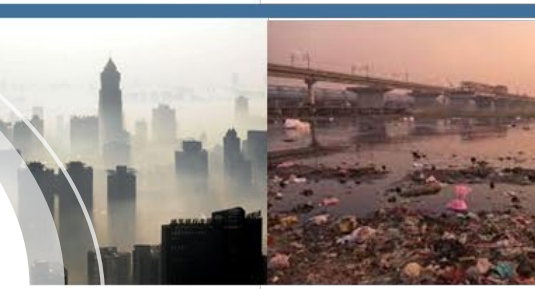
URBANIZATION & HEALTH

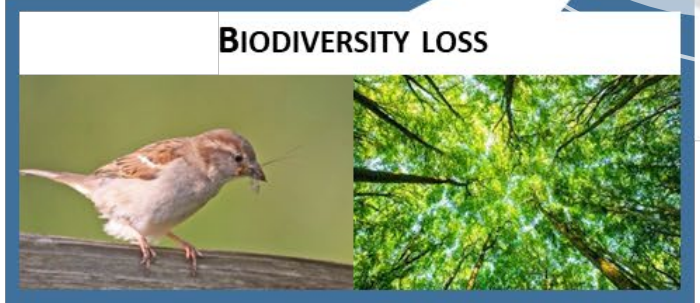
ENVIRONMENTAL HEALTH INTERVENTIONS – ULTIMATE GOAL OF BIOSCIENCE ENGINEER











CITY LAB 3

CONCEPTUAL FRAMEWORK

Module 1 *prof. Ben Somers*
Introduction to Urban Environmental Health

Module 2 *prof. Irina Spacova*
Urban Disease Mechanisms and Epidemiology

Module 3 *prof. Irina Spacova*
One Health in Cities – Concepts & Engineering Solutions

Module 4 *prof. Ben Somers*
Measuring & Modeling Environmental Exposure and Health Response

Module 5 *prof. Liesbet Vranken*
Economic Aspects of Urban Improvements & Health

Module 6 *prof. Ben Somers*
Integrated Case: Human Health & Urban Liveability

CITY LAB 3

Responses from practice and local government

Keynote addresses

Antwerp Climate Action Plan: working towards a climate-neutral and climate-resilient city

Vincent Van Ryssegem

Environment & climate change coordinator
City of Antwerp

University of Antwerp
GHENT UNIVERSITY
KU LEUVEN

Antwerp Climate Action Plan: working towards a climate-neutral and climate-resilient city

SUBE Stakeholder event “Eco-engineering the cities of tomorrow” - 25th April 2024

Antwerpen voor Klimaat

© Frederik Beyens

1 Section on Climate & Environment

2 Antwerp Climate Action Plan

3 Heating Network

4 EU Mission Climate Neutral Cities

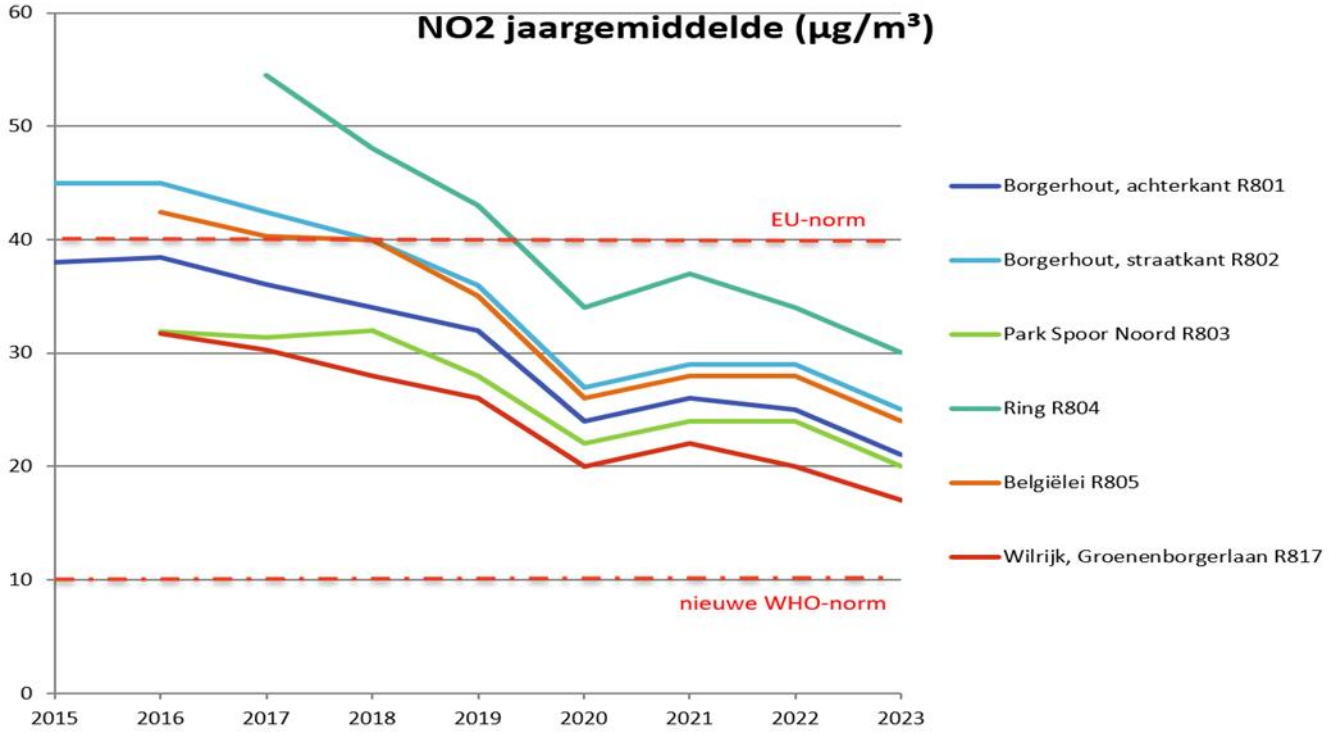
5 Tackling the UHI effect

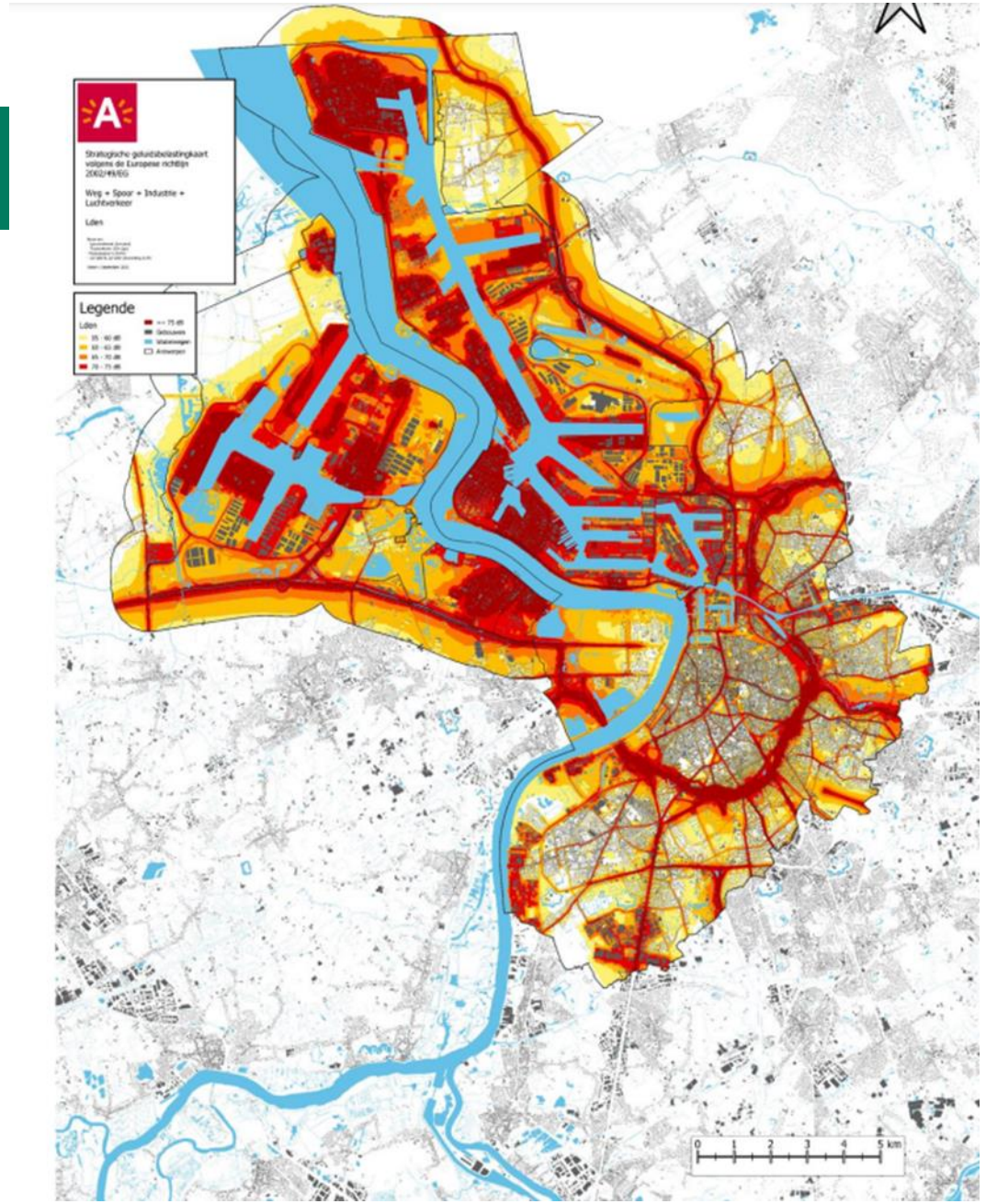
6 Circular Water

© Victoriano Moreno

City of Antwerp
Section on Climate & Environment

Air Quality & Noise Reduction





Antwerp Climate Action Plan

Climate mitigation

1. Energiezuinig Wonen
2. Naar een Modal Split 50/50
3. Energiebesparing in Diensten en Industrie
4. Hernieuwbare Energie, Restwarmte en elektrificatie vervoer

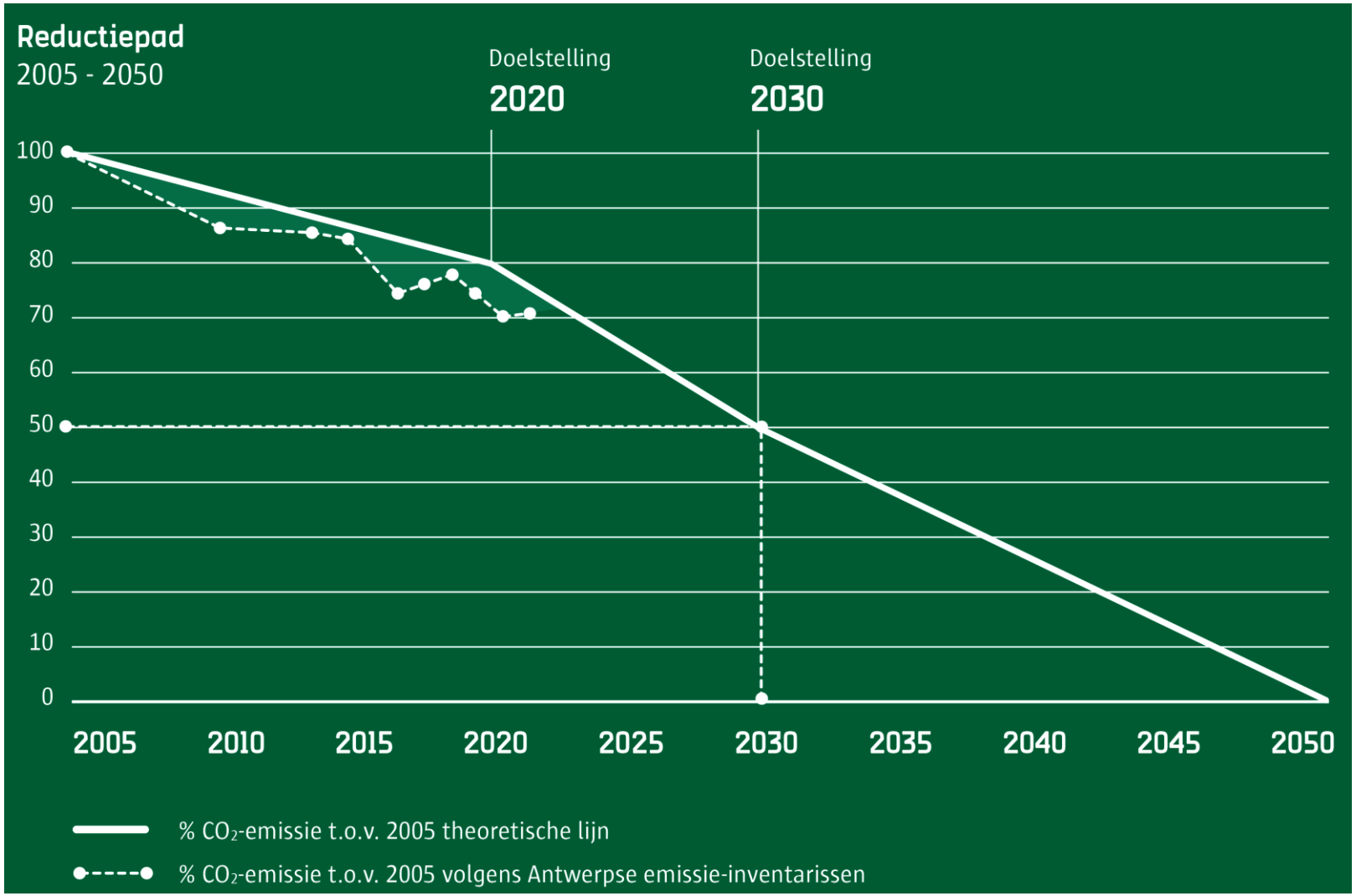
Climate adaptation

5. Een Klimaatveilige en Leefbare Stad
6. Antwerpen maakt Ruimte voor Adaptatie

7. Circular City
8. Lead by example

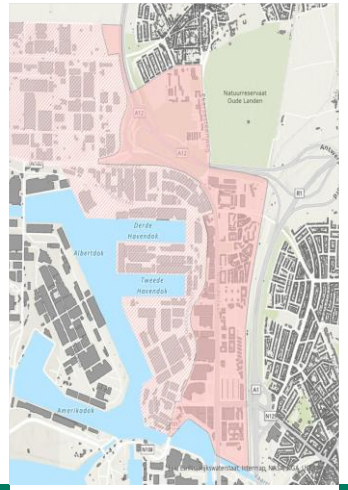
Antwerpen voor Klimaat

Our Ambition



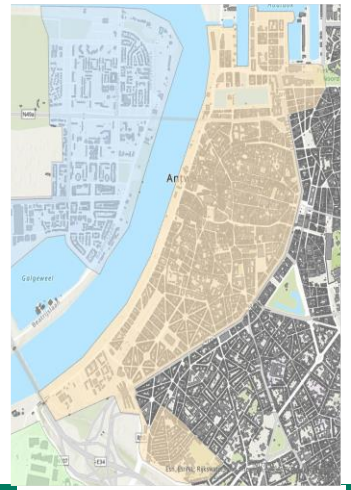
Antwerpen voor Klimaat

Antwerp Heating Network



Antwerpen
Noord

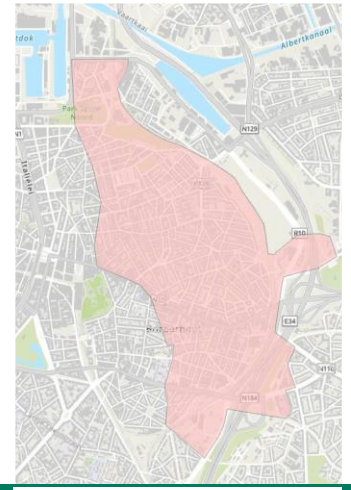
Linkeroever



Antwerpen
Centrum

Hoboken

Blue Gate
Kiel



Slachthuissite

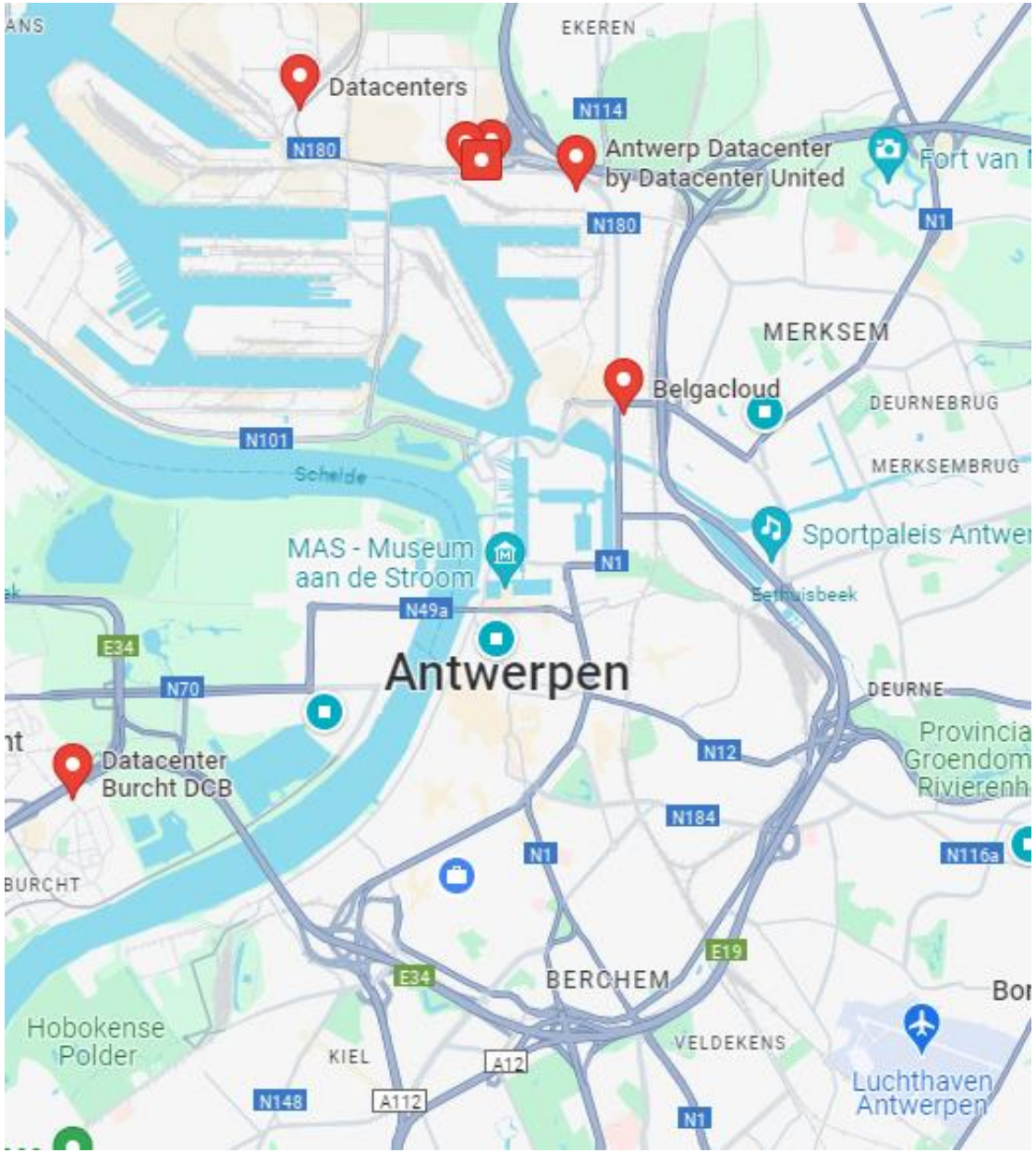
Stuivenberg

Riothermal: Slachthuissite/Stuivenberg

- Central Heat Pump installation 24 MW
  - Water to water heatpump 15 MW (effluent)
  - Air to water heatpump 9 MW
- 3-pipe system Aquafin to Slachthuissite
- Bivalent network Slachthuissite
  - Summer regime (cooling)
  - Winter regime (low-temperature heating 45°C)
- Monovalent network Stuivenberg + Trix
  - Heating at 65°C
  - City buildings connection engagement
  - Expansion to existing buildings

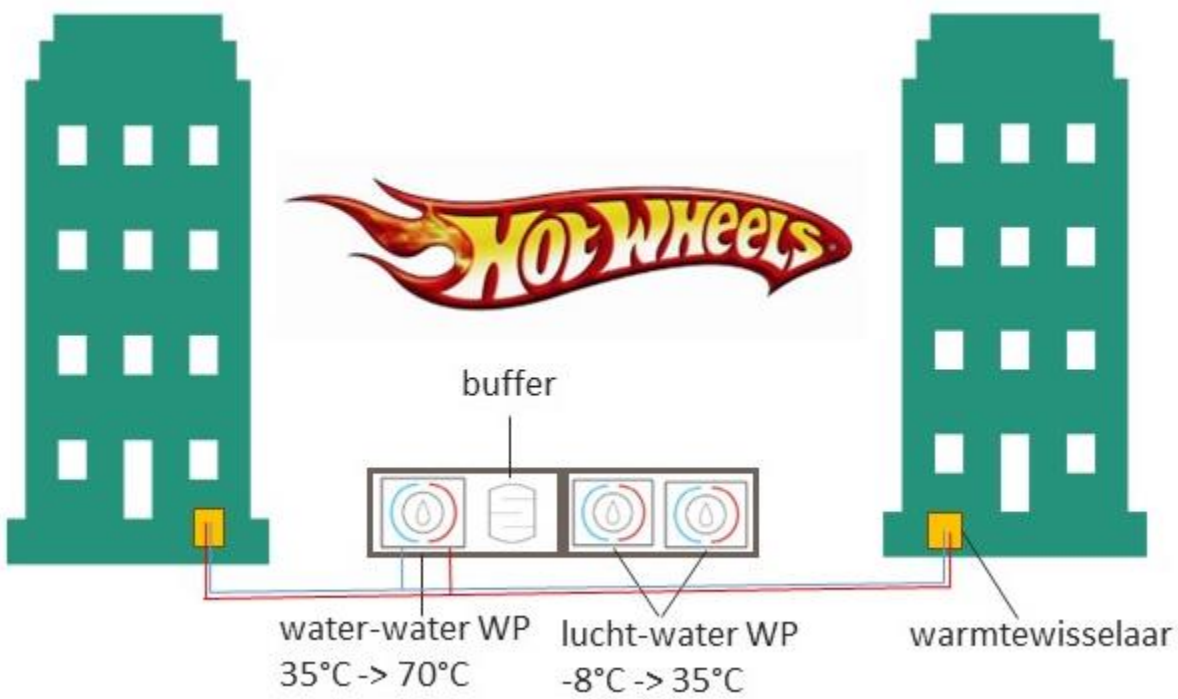
Other heat sources

- Datathermal opportunities
  - Expansion of large regional datacenters
  - Wasteheat recovery 25°C - 30°C
  - Extra source LT networks
  - Policy?
- Excess heat subway tunnels
  - Large subway tunnel network underneath the city



Mobile Fossil-free Energyhub

- Goal: buildings on-time heat grid ready
  - Fossil-free : 2-stage heat pump system
  - Temporary & removable: pending connection to heat network



EU Mission
100 Climate Neutral Cities

Project Left bank 2030

NET ZERO CITIES

EU MISSIONS
100 CLIMATE-NEUTRAL AND SMART CITIES

Selected cities

- 377 candidates
- 100 EU cities + 12 external cities
- Belgium: Antwerp, Leuven, Brussels, La Louvière

Antwerpen voor Klimaat

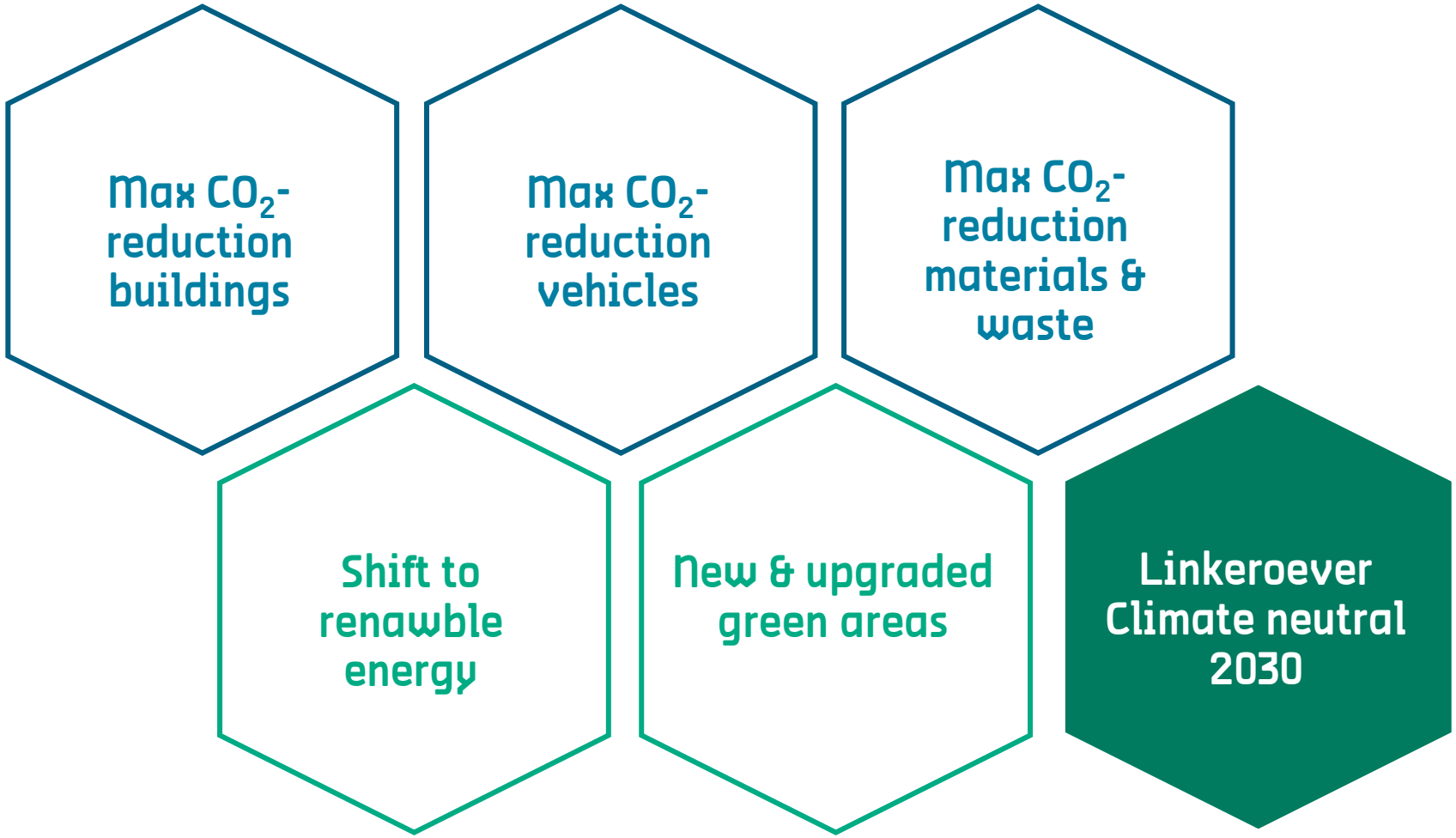
Why the Left Bank district?

- Workable, realistic scale
- Diverse (residential) typologies and demographics
- Ongoing/planned projects (heat networks, Europark, Scheldeboorden, RUPs Katwilgweg, FAB-181, Regatta …)

Opportunities

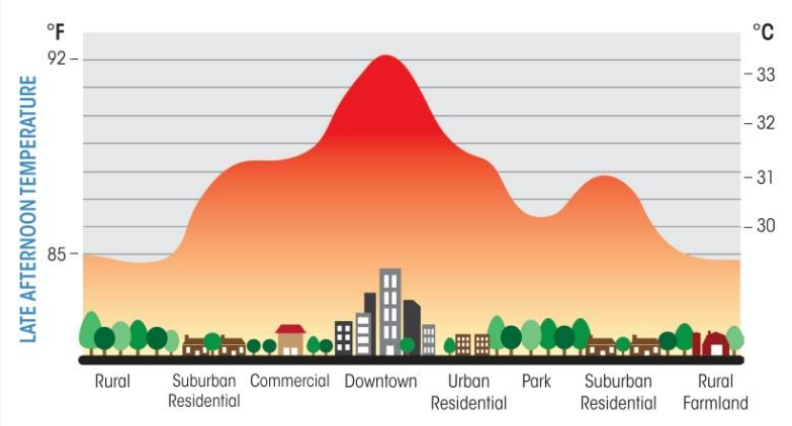
- Making climate policy visible and clear
- Testing area-oriented climate action
- Opportunity for integrated cooperation within the city and with partners
- Strengthening of our resources

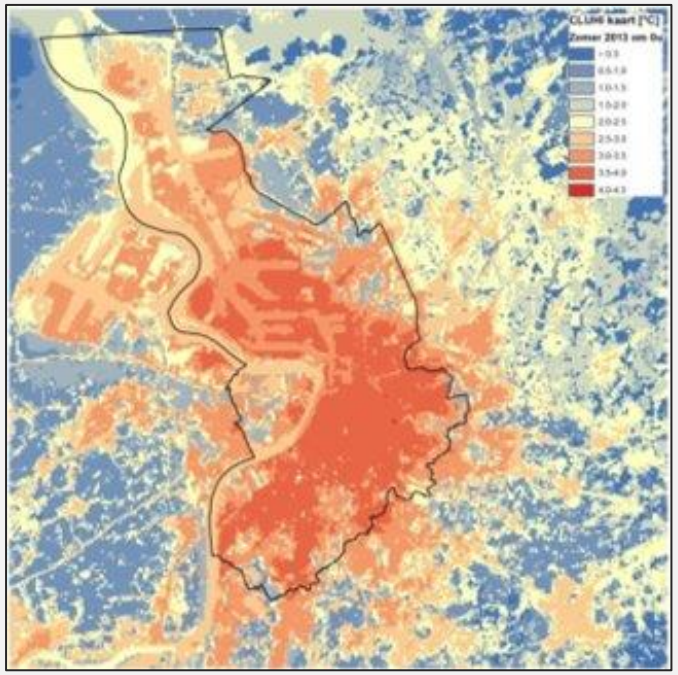
The road to a fossil-free district



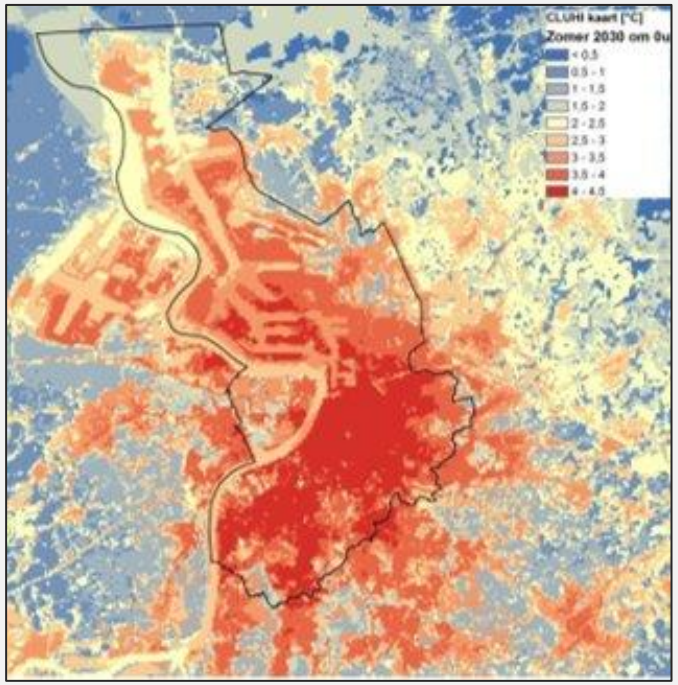
Urban heat island effect (UHI)

- Global temperature is rising
- In addition, night temperature in the city will be higher because of **UHI**
  - Today t°-difference at night = **4 to 9°C**
  - in 2030 effect **+ 50%**





2013

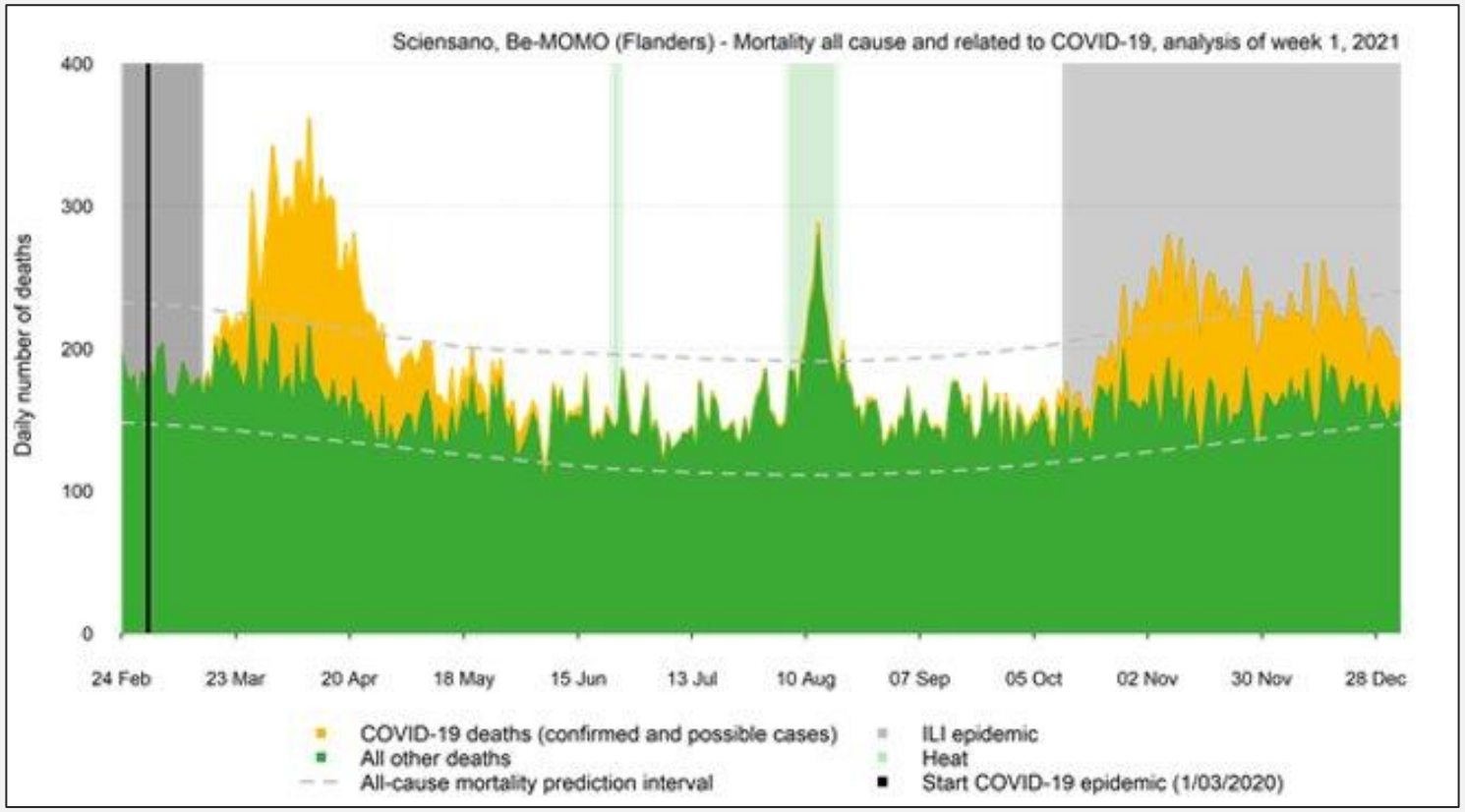


2030

vito

Urban heat island effect (UHI)

- Health and wellbeing - More hospital admissions and deaths (+- 2000 in Flanders in 2021)
- Especially – children (< 4 year), elderly (> 65 year) and people with conditions
- Excess mortality ~ Covid

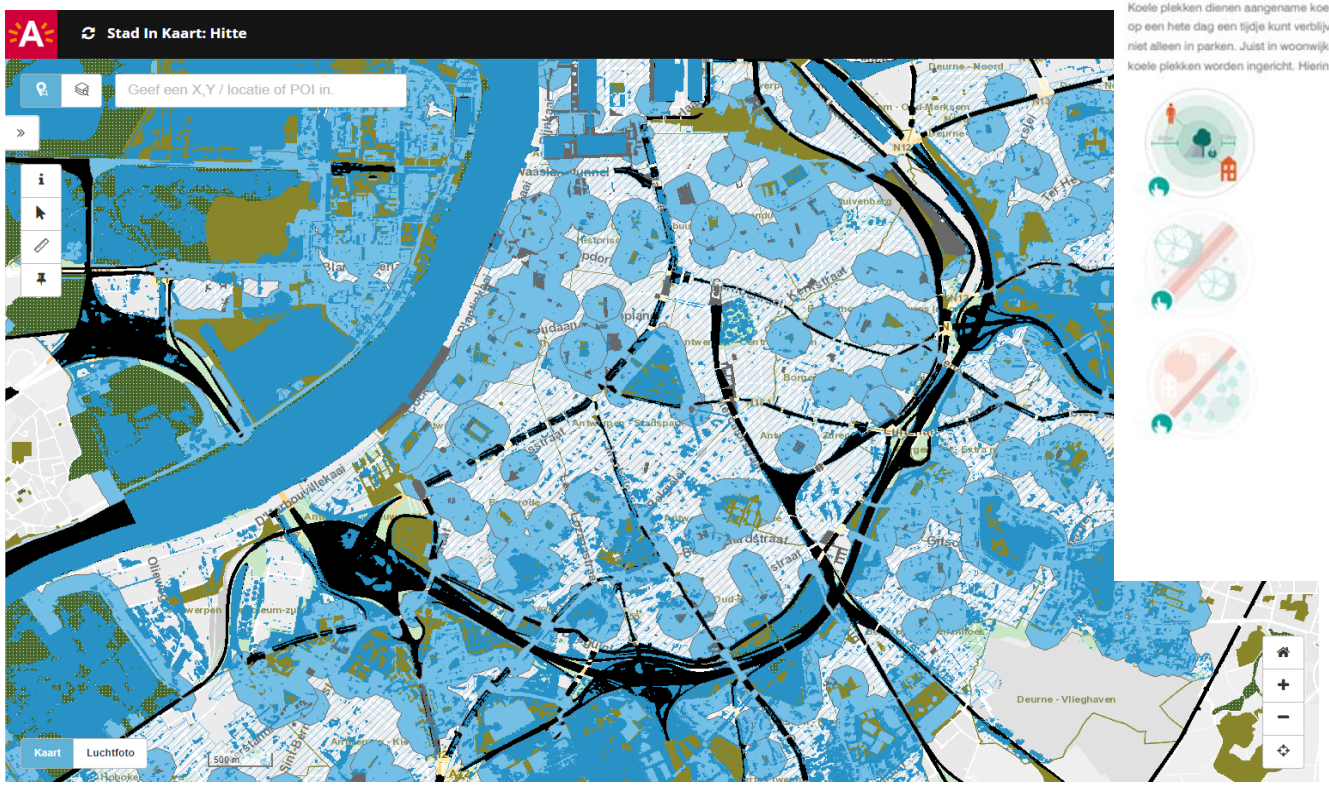


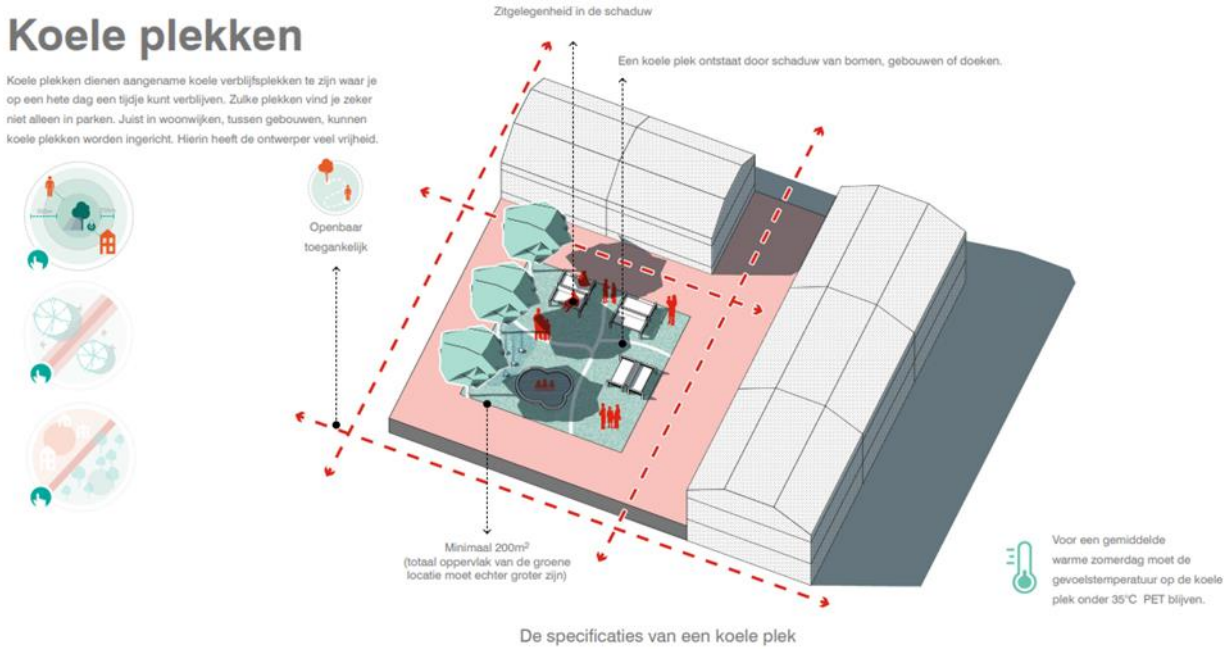
Actions against UHI

- More high-quality trees for shelter
- Focus on vulnerable target groups
- Soil covered by vegetation
- Street gardens
- Open air water facilities

Cooling spots

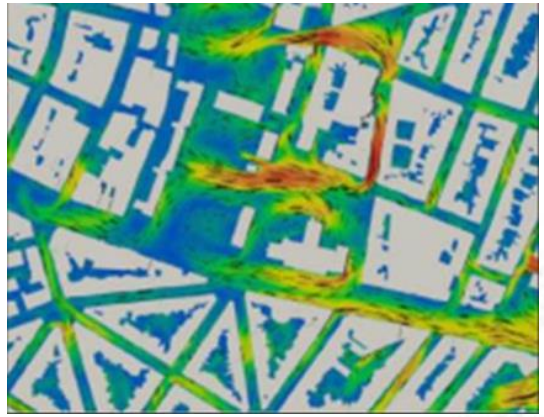
- Map showing shortage of cooling spots in Antwerp





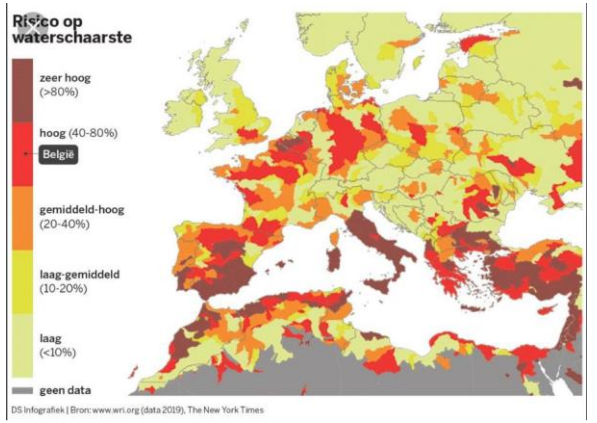
De specificaties van een koele plek

Climate axis – Ventilation of cool air



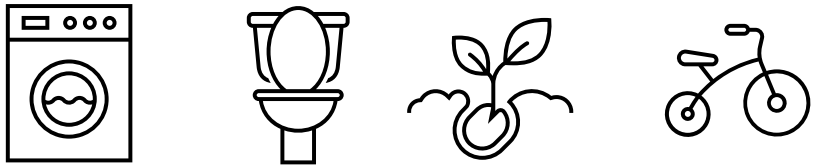
Need for circular water

strategic irrigation of green areas, including in public spaces
1,2 million m³/year



Replenishment of main ponds (and ground water)
4,5 million m³/year

Residential water use for toilets, washing machine, garden, …
12 million m³ / year



Vision on circular water

Solution 1: Reuse of rainwater

- Individual rainwater reservoirs
- Collective rainwater reservoirs

Rainwater on roofs
13,5 million m³ / year

Rainwater on roads
11,8 million m³ / year

Solution 2: Circular water network

- To use permanent low quality water sources

Permanent groundwater drainage
4 million m³/ year

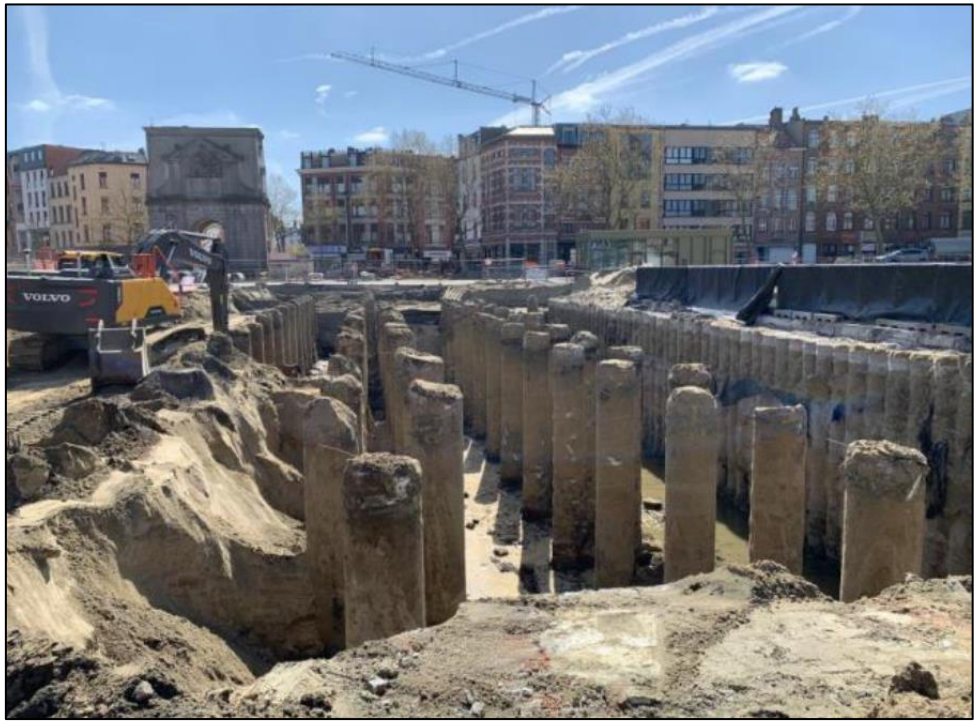
Treated wastewater
20 million m³/ year

Solution 1: Reuse of rainwater – reuse roof water

Individual
Rainwater reservoirs

City rainwater reservoirs

Collective rainwater reservoir
South Park



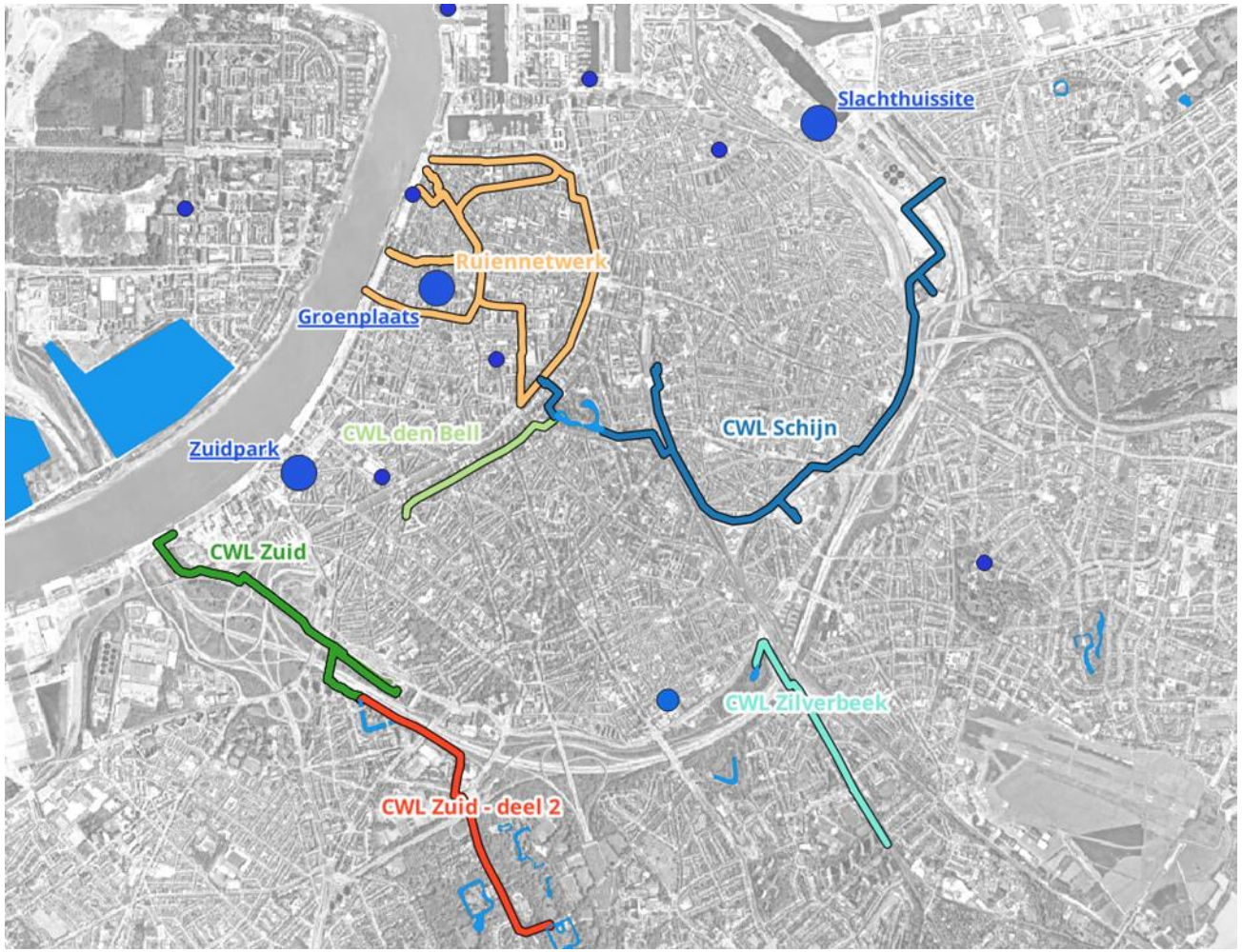
Solution 2: Circular water network

Low quality water sources

Permanent groundwater drainage

Treated wastewater

Network of circular water pipes



Antwerpen voor Klimaat

Thank you for your attention!

Vincent Van Ryssegem

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