

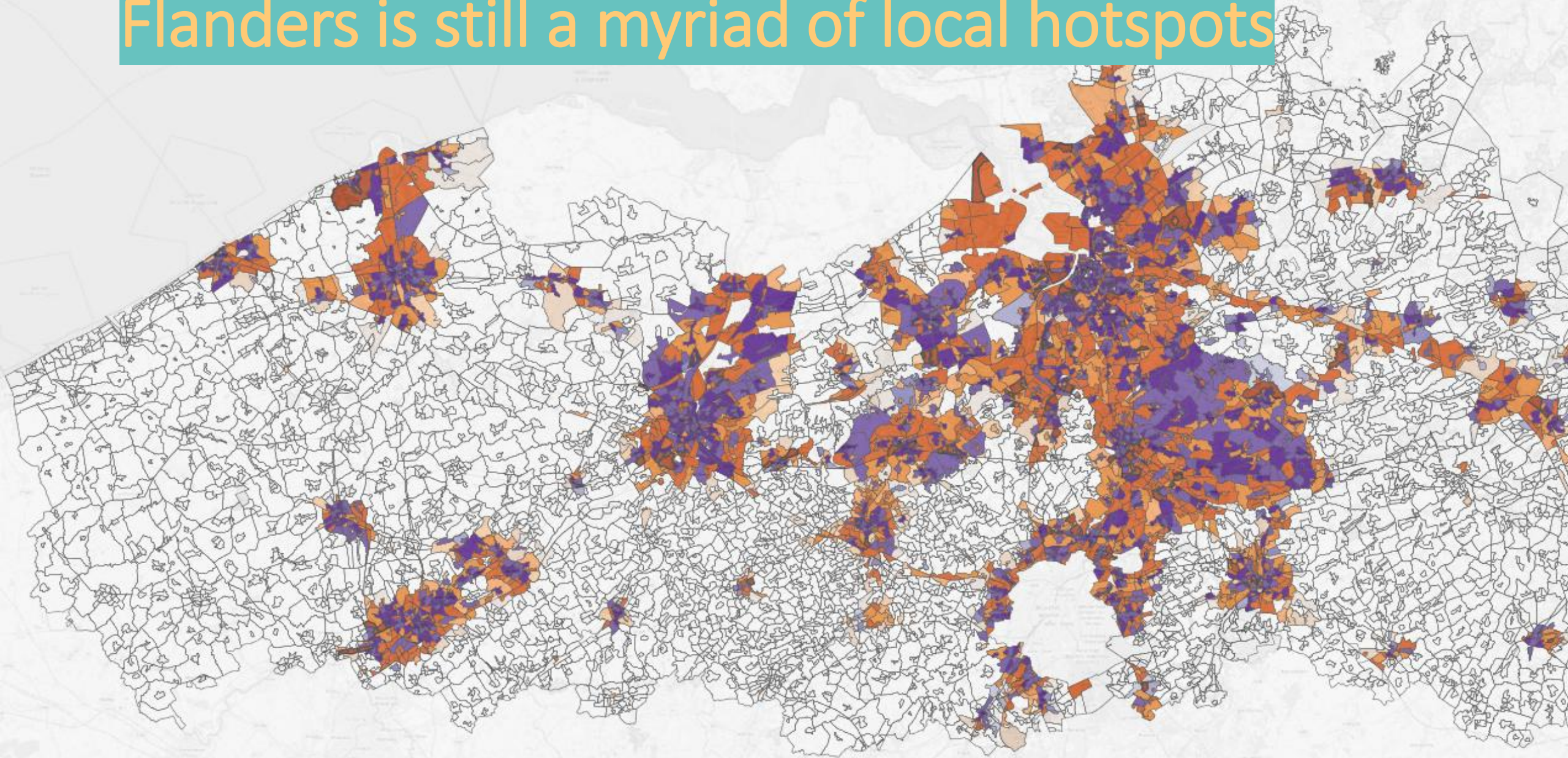
BEYOND VIRTUAL REALITIES: AIR QUALITY DIGITAL TWINS CONNECTING SIMULATIONS, POLICY AND REAL LIFE IN URBAN NEIGHBOURHOODS

Christophe Stroobants
Flanders Environment Agency



Co-funded by
the European Union

Flanders is still a myriad of local hotspots





Model maps



Traffic



Compare

Data clouded our view of reality

Gathering all elements for a hotspot analysis is a big chore



Realtime vs. historic



Solutions?



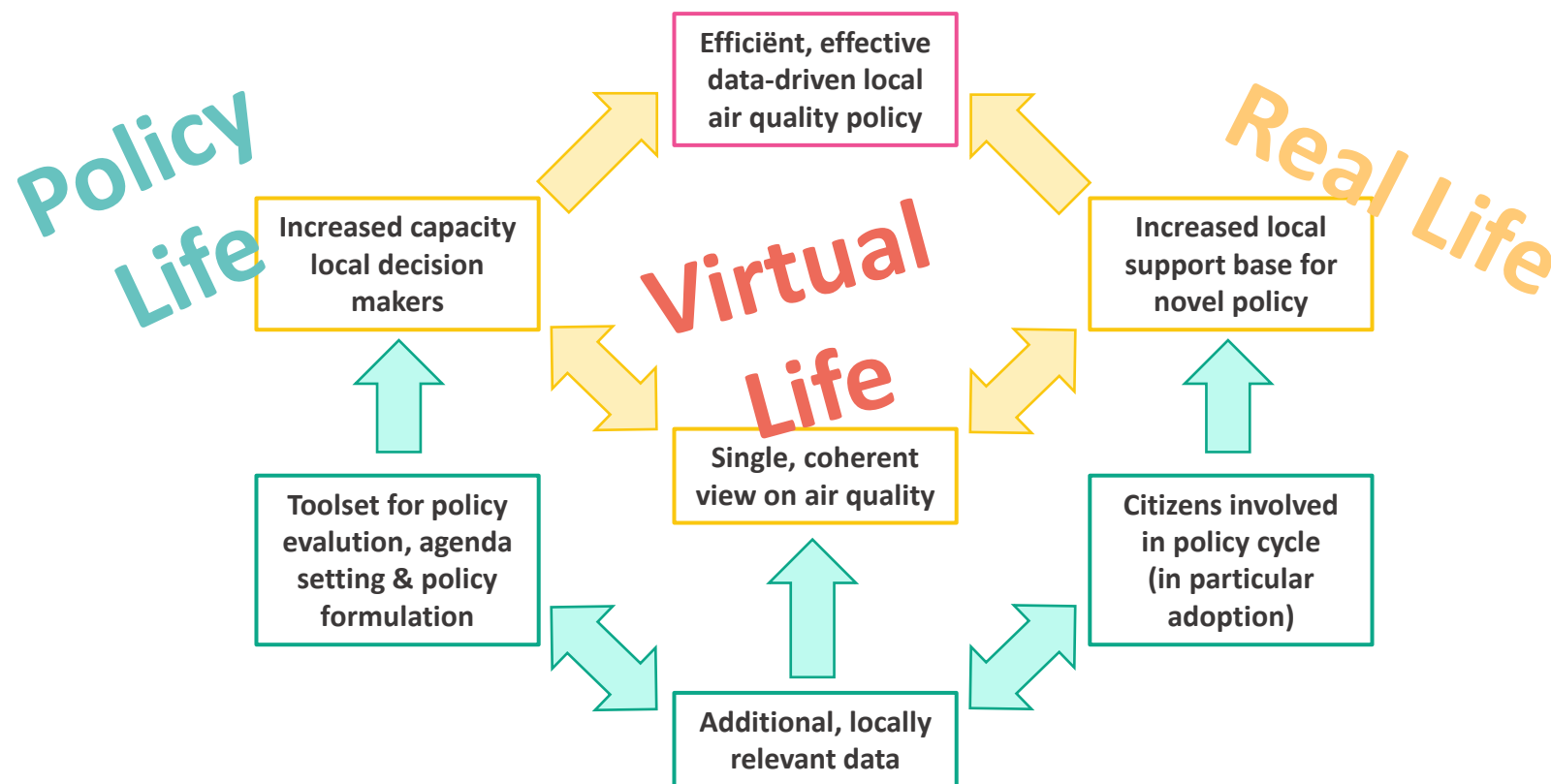
Measurements

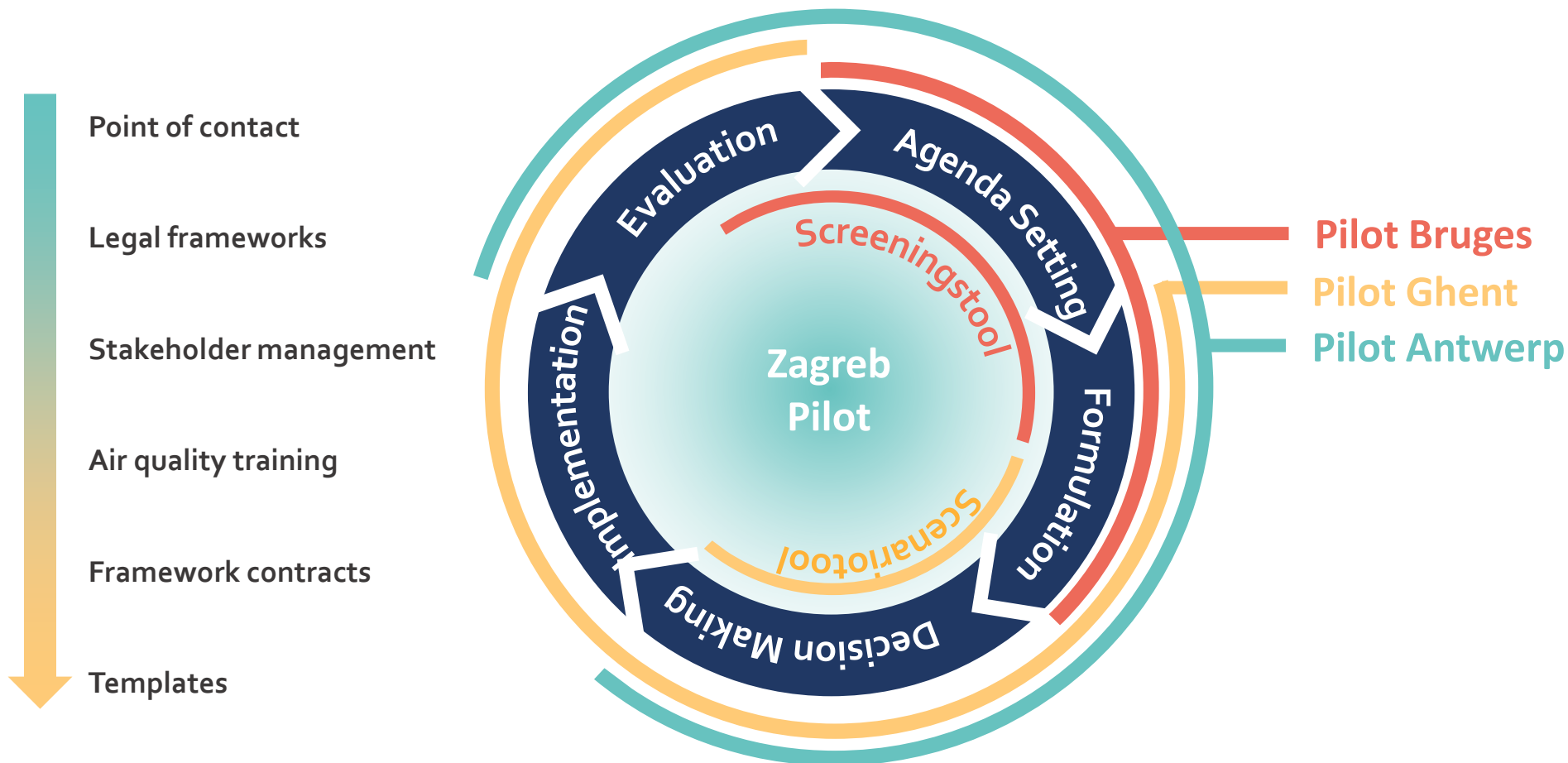


Citizen Science

Scope







CityTRAQ's Digital Twin

A single, coherent view from source to effect



- 84% approval rate during pre-release
- Key functionalities:
 - Identify bottlenecks by adjusting concentration ranges on the map
 - “Drill through” to retrieve modeled time series for a specific point
 - Difference maps to explore changes over the years geographically
 - Model based source apportionment
 - Explore industrial emissions
- Analysis for a medium-sized city takes about **half a day**



Co-funded by
the European Union

Vlaanderen VMM.VLAANDEREN.BE

MIJN BURGERPROFIEL

HULP NODIG ?

Screening lokale luchtkwaliteit

Met deze tool kan je knelpunten en beleidsprioriteiten op lokaal niveau identificeren. Dat helpt je om vervolgens gerichte maatregelen te bepalen voor een betere luchtkwaliteit.

LUCHTKWALITEIT OVERHEDEN

Deel online f in X

Start de screeningtool >

Beschrijving

Om lokale besturen te ondersteunen om tot een lokaal luchtbeleidsplan te komen, heeft VMM een stappenplan ontwikkeld. Een eerste stap hierbij is om een knelpuntanalyse te doen. Daarvoor ontwikkelde VMM de tool 'screening lokale luchtkwaliteit', die het voor lokale besturen mogelijk maakt om knelpunten en beleidsprioriteiten op lokaal niveau te identificeren als opstap naar het bepalen welke maatregelen best overwogen worden. Dit vormt een eerste essentiële stap naar coherente, effectieve en datagedreven actie(plannen) op lokaal niveau. Deze tool bundelt in concreto de visualisatie van gegevens die momenteel slechts verspreid te vinden zijn en voegt hieraan mogelijkheden toe voor diepere analyse.

Voorwaarden

1. Ambition phase

Empathize and define challenges

- Building a neighbourhood coalition
- Identifying local challenges
- Shared ambition/vision/direction

ATMO-Street

Flanders' reference model



Reference monitoring
network

Industrial emissions
Agriculture emissions
Shipping emissions

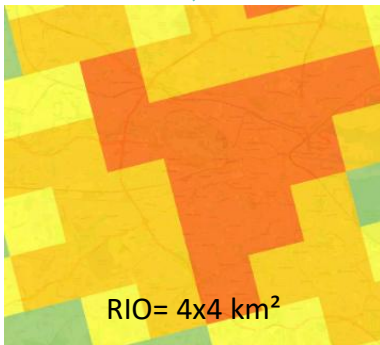
Passenger
Fleet & intensity
Lorry, HDV, bus
Fleet & intensity



GRB (3D)

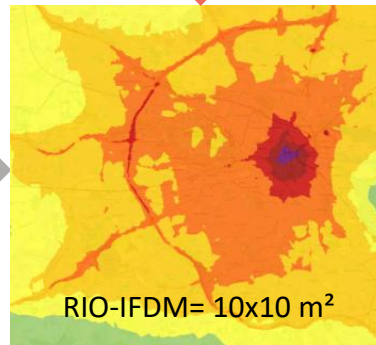


SMART
INTERPOLATION
Land use & Kriging



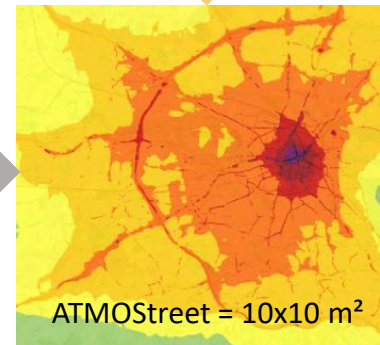
RIO= 4x4 km²

BI-GAUSSIAN PLUME
Double counting



RIO-IFDM= 10x10 m²

OSPM MODEL



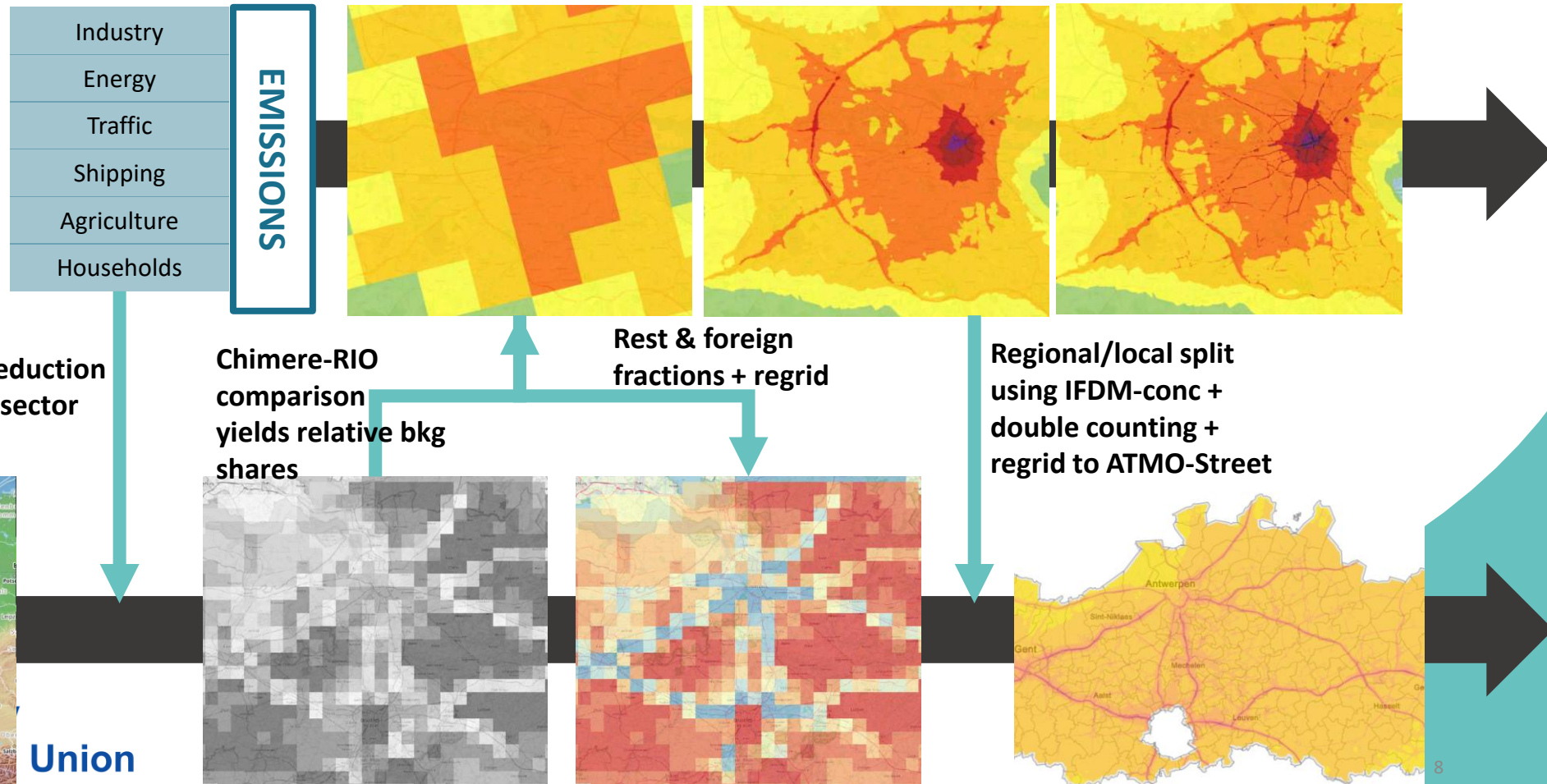
ATMOStreet = 10x10 m²



Co-funded by
the European Union

Screening tool

ATMO-Street based source apportionment



Screening tool

ATMO-Street based source apportionment



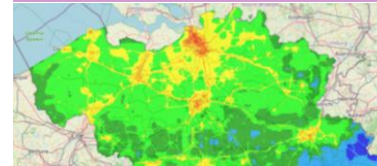
Industrial emissions

A screenshot of the ATMO-Street software interface displaying a table of industrial emissions data. The table has multiple columns with headers in Dutch, including 'Naam', 'Adres', 'Activiteit', 'Middel', 'Menge', 'Emissie', 'Middel', 'Menge', 'Emissie', and 'Middel'. The data rows are organized by location and activity.

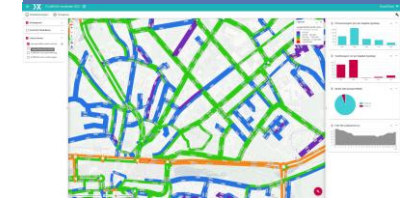
Yearly AQ 2019



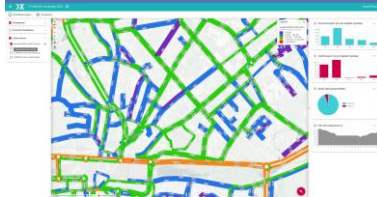
Yearly AQ 2023



Lorry, HDV, bus
Fleet & intensity



Passenger
Fleet & intensity



Agriculture emissions

A screenshot of the ATMO-Street software interface displaying a table of agriculture emissions data. The table has multiple columns with headers in Dutch, including 'Naam', 'Adres', 'Activiteit', 'Middel', 'Menge', 'Emissie', 'Middel', 'Menge', 'Emissie', and 'Middel'. The data rows are organized by location and activity.

Yearly AQ 2022



Shipping emissions

A screenshot of the ATMO-Street software interface displaying a table of shipping emissions data. The table has multiple columns with headers in Dutch, including 'Naam', 'Adres', 'Activiteit', 'Middel', 'Menge', 'Emissie', 'Middel', 'Menge', 'Emissie', and 'Middel'. The data rows are organized by location and activity.

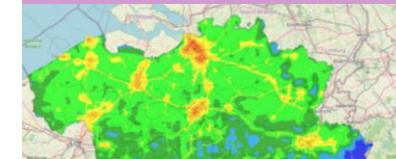
Yearly AQ 2021



GRB (3D)



Yearly AQ 2024



Co-funded by
the European Union

Screening tool

ATMO-Street based source apportionment

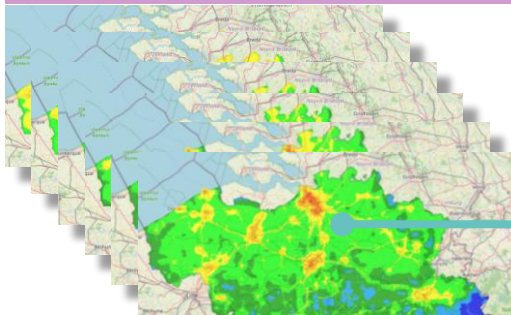


Industrial emissions

Passenger
Fleet & intensity



Yearly average AQ maps



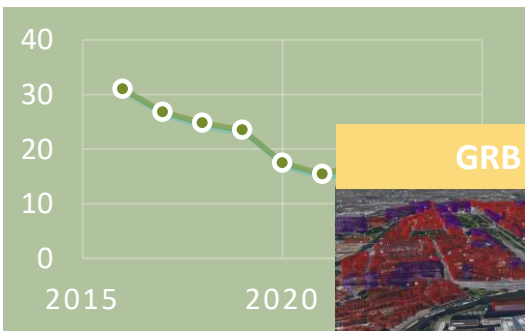
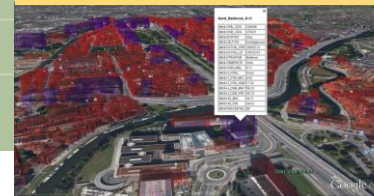
Agriculture emissions

Lorry, HDV, bus
Fleet & intensity



Shipping emissions

GRB (3D)



Co-funded by
the European Union

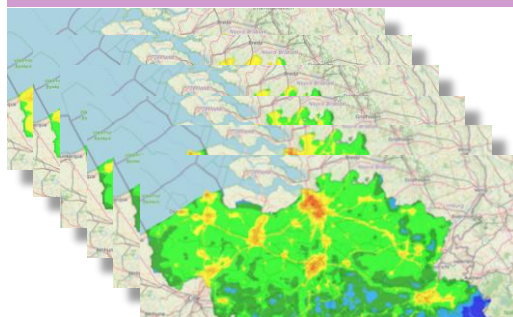
ATMO-Street based source apportionment



Traffic contributions

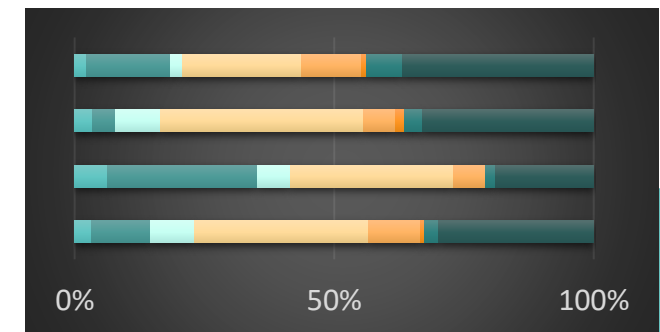
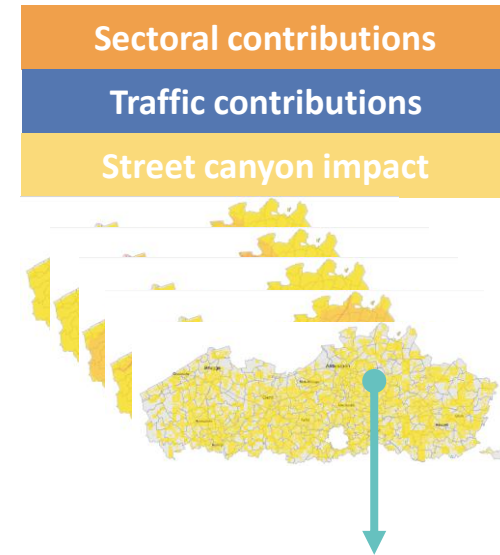
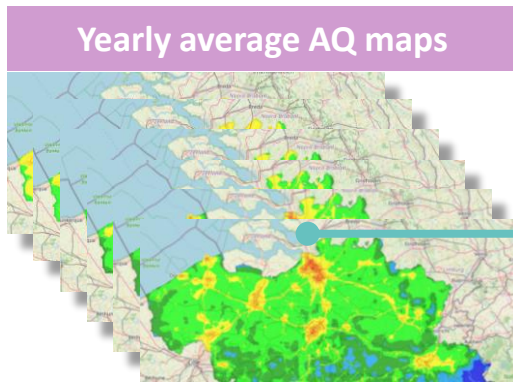


Yearly average AQ maps



Screening tool

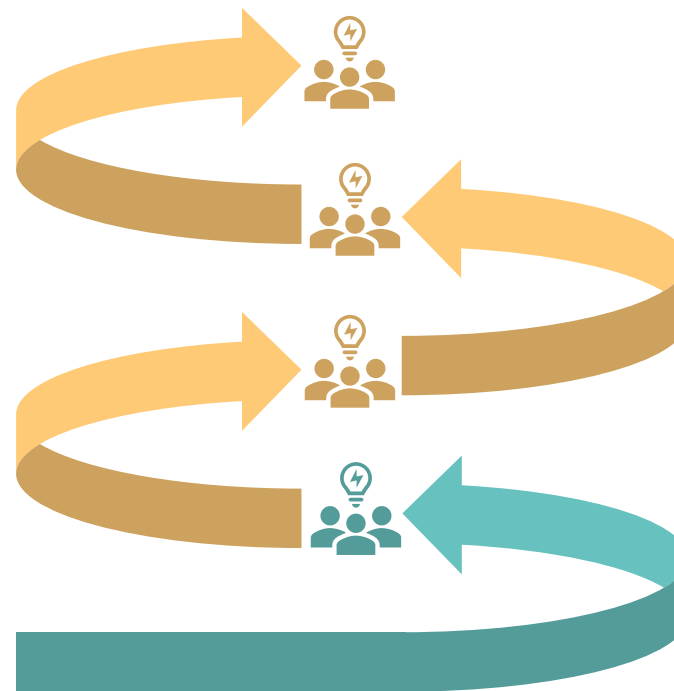
ATMO-Street based source apportionment



Co-funded by
the European Union

CityTRAQ's Digital Twin

A highly approved simulation environment



2. Exploration phase

Ideas, virtual prototypes & tests

- Explore policy options
- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation

1. Ambition phase

Empathize and define challenges

- Building a neighbourhood coalition
- Identifying local challenges
- Shared ambition/vision/direction



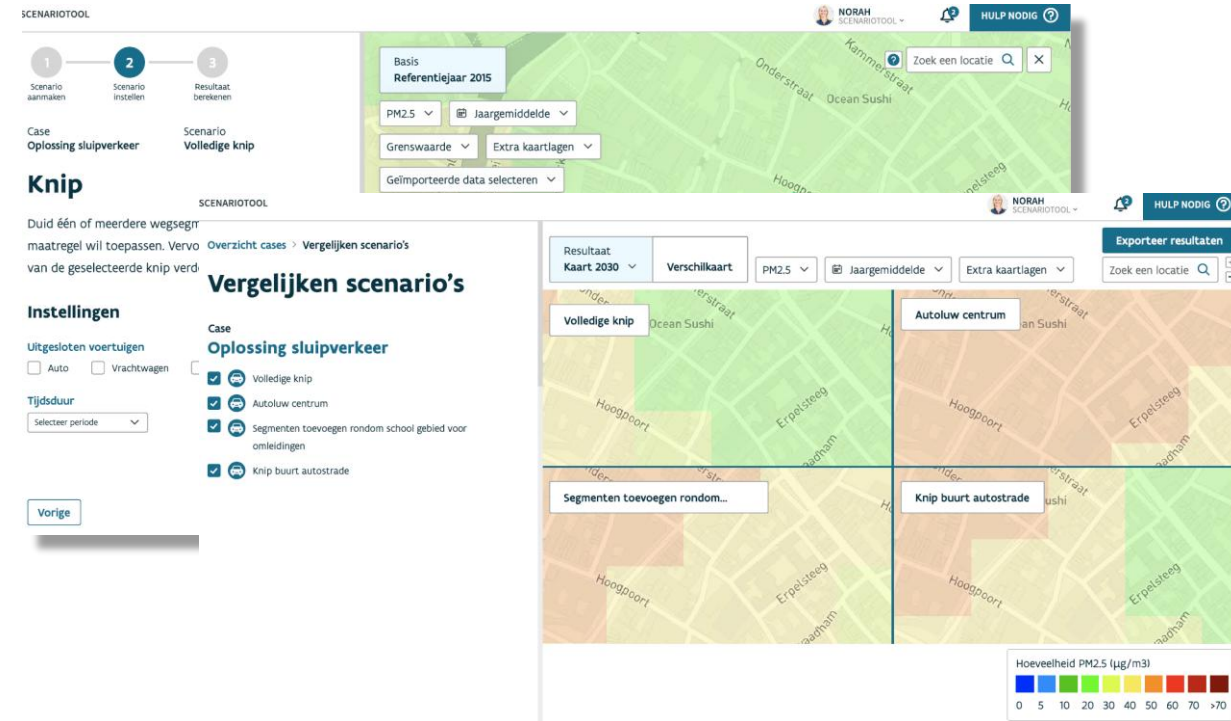
Co-funded by
the European Union

CityTRAQ's Digital Twin

A highly approved simulation environment



- Co-developed with >20 local authorities
- High approval rate:
 - 45% would definitely use the tool
 - 55% would consider using it
 - None reject
- Full suite of measures



2. Exploration phase

Ideas, virtual prototypes & tests

- Explore policy options
- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation



Co-funded by
the European Union

CityTRAQ's Digital Twin

Case highlights

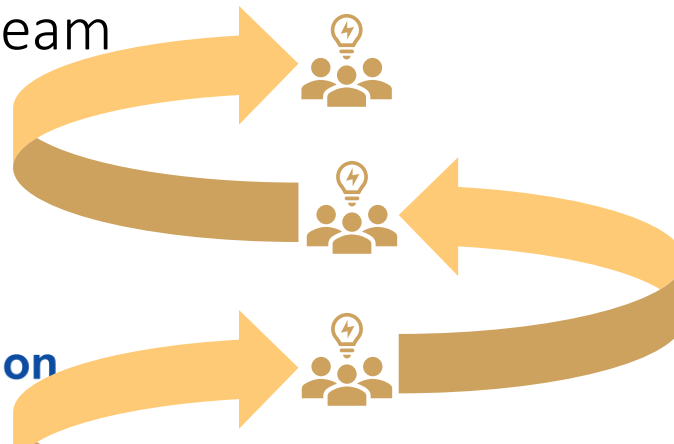


Case study Roeselare

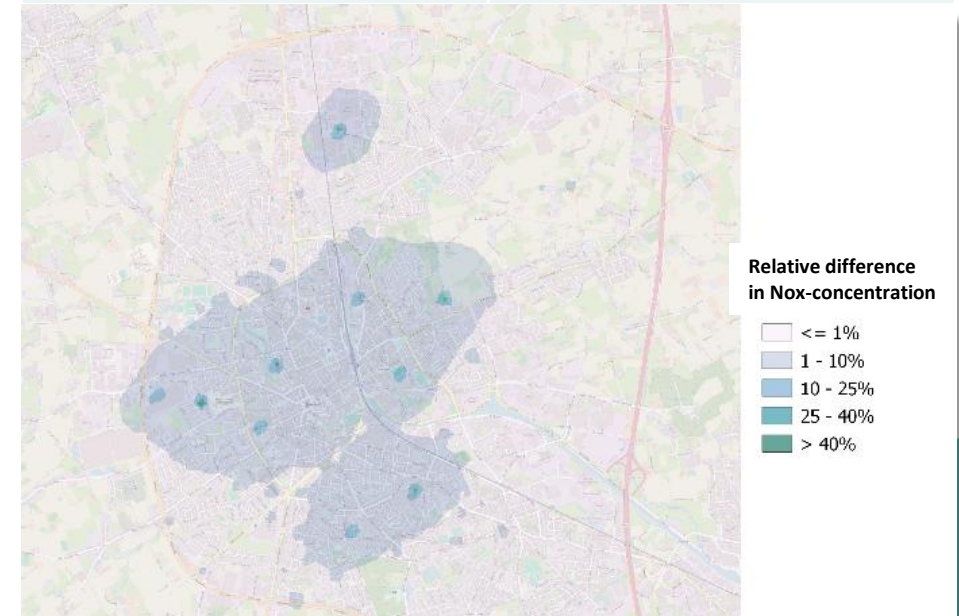
- Full screening of **mobility and climate plans**
- Exploring additional action
- Incorporated into **urban planning regulations**
- **Briefing** new policy team



Co-funded by
the European Union



Zero emission power generators	
Local effect	> 20 %*
City wide effect	Up to 5 %



- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation

CityTRAQ's Digital Twin

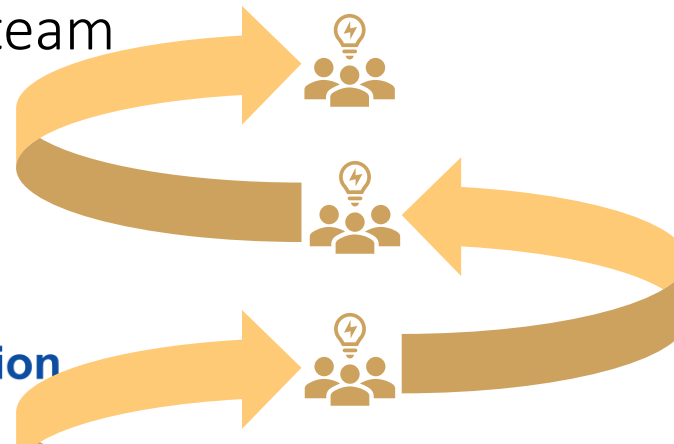
Case highlights

Case study Roeselare

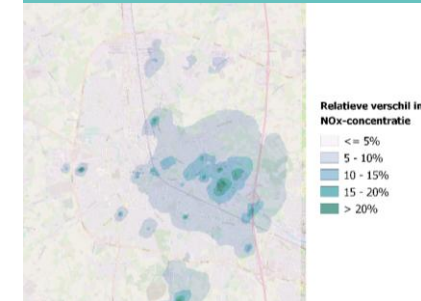
- Full screening of **mobility and climate plans**
- Exploring additional action
- Incorporated into **urban planning regulations**
- Briefing** new policy team



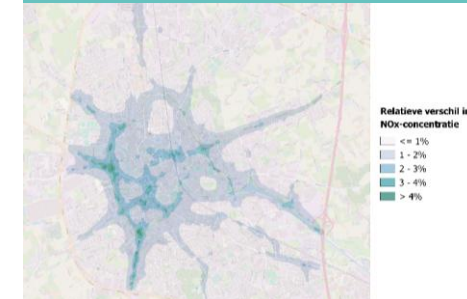
Co-funded by
the European Union



Industrial climate action



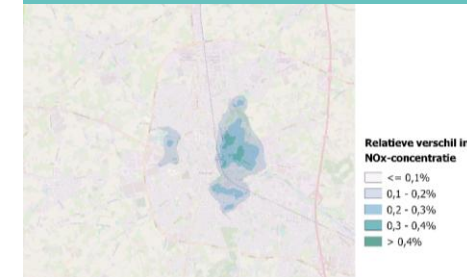
Modal shift



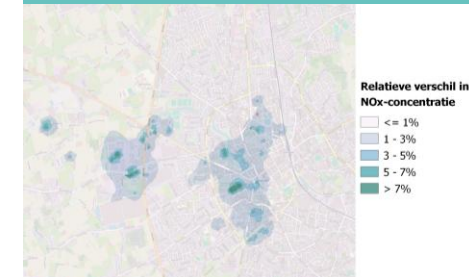
15% Freight reduction



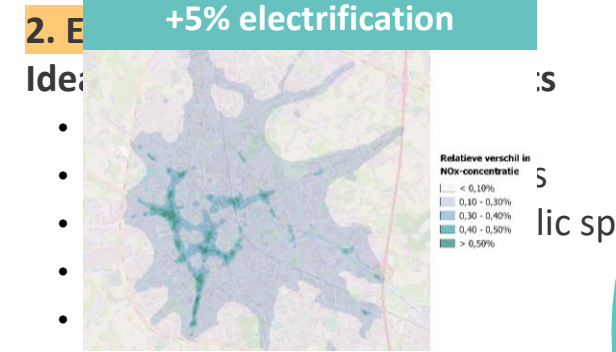
Increased insulation



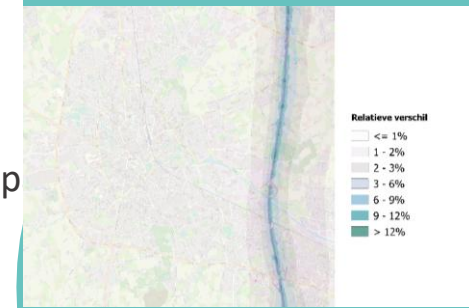
District heating



+5% electrification



90 km/h speed limit



CityTRAQ's Digital Twin

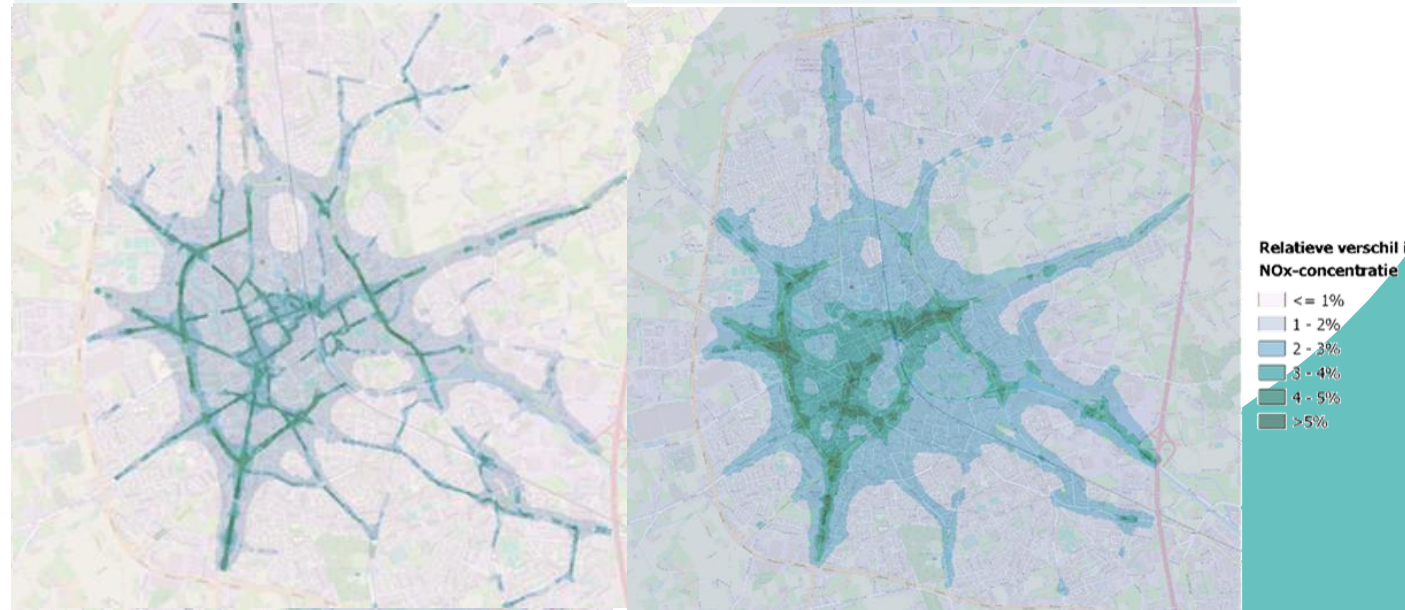
Case highlights



- Up to 3 year **sooner air quality improvement**
- 13% additional space for **economic development**
- € 30M in **health cost savings** yearly

All traffic related measures (excl. energy)

Local effect	> 5%
City wide effect	1,5 – 2,5 %



Co-funded by
the European Union

CityTRAQ's Digital Twin

Case highlights



Case study Sint-Niklaas

- Comprehensive hot spot screening and ambition formulation
- Identification of affected vulnerable functions within 200m
- General liveability index at neighbourhood level



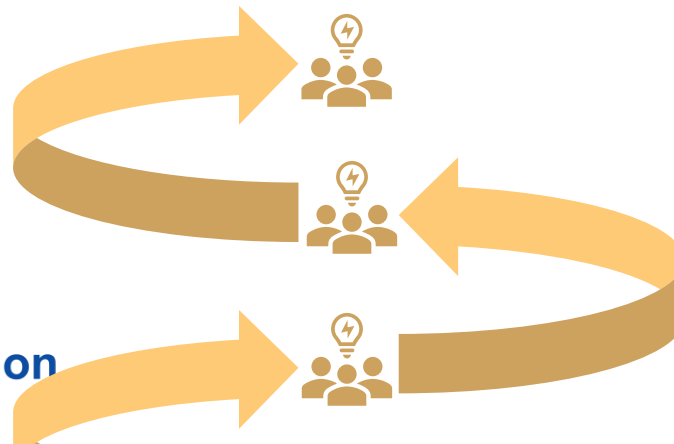
2. Exploration phase

Ideas, virtual prototypes & tests

- Explore policy options
- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation



Co-funded by
the European Union



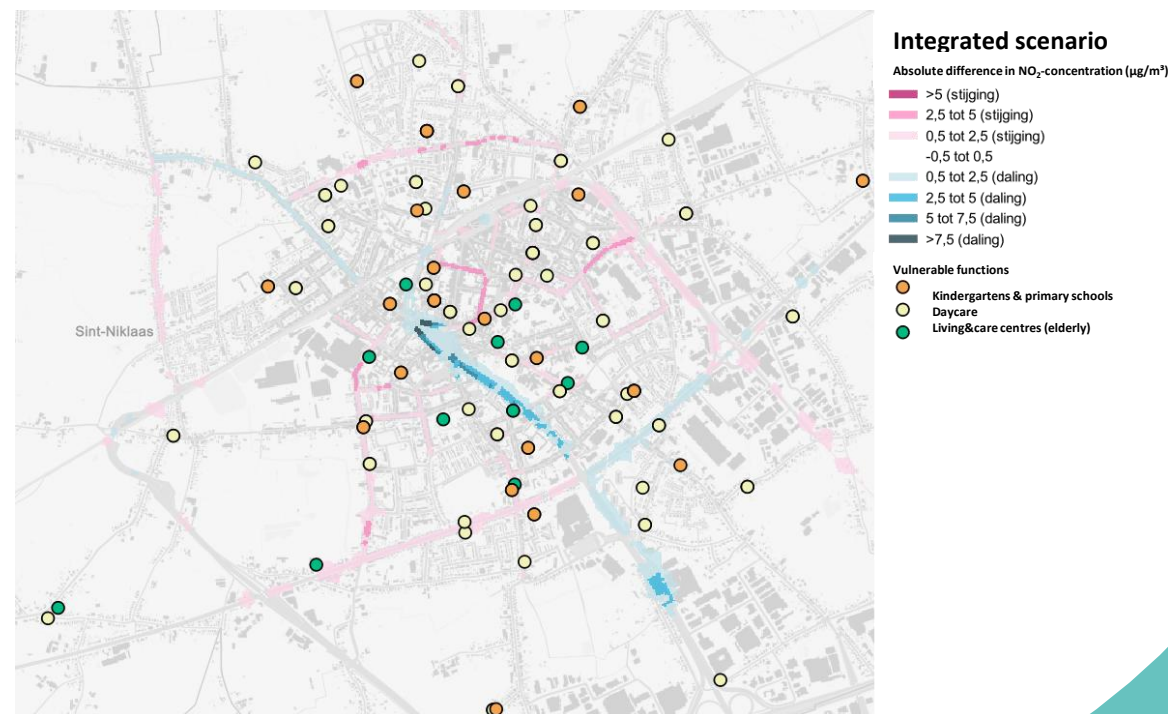
CityTRAQ's Digital Twin

Case highlights



Case study Sint-Niklaas

- Major **air quality improvements** alongside central axis with adjacent vulnerable functions
- Areas requiring **flanking policy**, to be developed over end of '26
- Integrated scenario paints **complete picture across policy levels**



2. Exploration phase

Ideas, virtual prototypes & tests

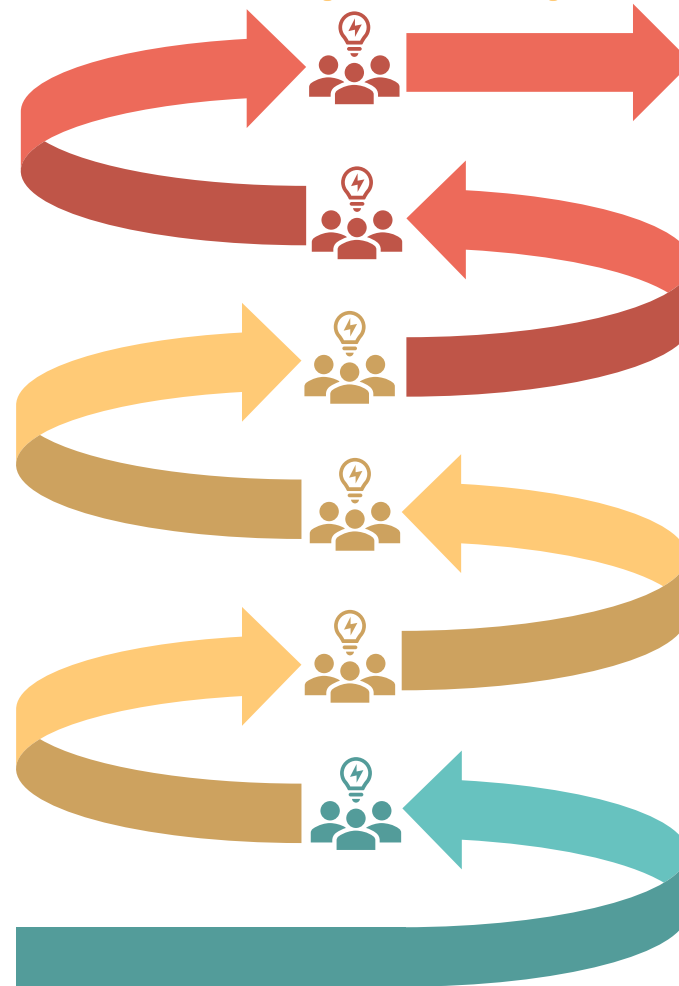
- Explore policy options
- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation



Co-funded by
the European Union

CityTRAQ's Digital Twin

Keys to co-creative policy making



3. Implementation phase

Temporary setups & implementation

- Scenario co-design
- Visualising solutions
- Co-evaluation of impact
- Implementation

2. Exploration phase

Ideas, virtual prototypes & tests

- Explore policy options
- Determine shared scenarios
- Designing solutions for public space
- Simulating impact
- Optimisation

1. Ambition phase

Empathize and define challenges

- Building a neighbourhood coalition
- Identifying local challenges
- Shared ambition/vision/direction



Co-funded by
the European Union

CityTRAQ's Digital Twin

Keys to co-creative policy making



Real co-design

- Participative sensor screening for objective baseline, illustrating **50% traffic reduction** post hoc
- Iterative **data cafés** increase public support and developed **alternate policy scenario**
- Temporary setups to capture **experiential feedback** through **experimentation**
- Alternate scenario **recognized as superior**, practical feasibility to be determined



Co-funded by
the European Union

CityTRAQ's Digital Twin

Keys to co-creative policy making



What is a data café?

The concept of a data café is similar to hackathons in that it revolves around community generated data. In a data café most of the data is generated and analysed by experts who highlight specific events or effects from the datasets. The data café therefore focuses on **discussing solutions** rather than working with or interpreting the data.

How does it work?

Set up a temporary bar with drinks & snacks at a place where local inhabitants to freely walk in and out of the café. They can discuss local policy, the experiment & results. This setup allows for **discussions**, mitigating resistance to the introduced measures and gathering valuable input for flanking policies to reach desired effects.



Various approaches to build support base throughout our process

Broader and tailored process facilitation – with residents or internal local government

- Workshops – building sensors, data analysis, experimental design
- Training – school programs, basic air quality education
- Participation – Local champions, learn-do-reflect, policy co-creation, data café
- Impact – Living labs, pilot projects, citizen science



Co-funded by
the European Union

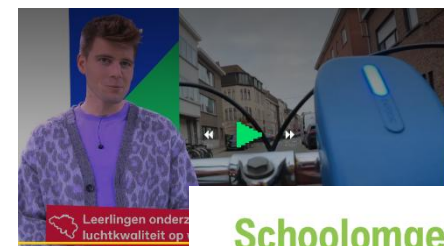
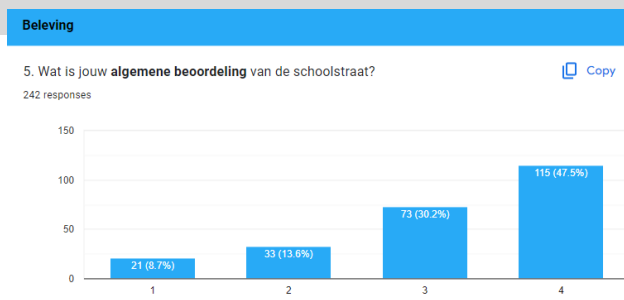
CityTRAQ's Digital Twin

Keys to co-creative policy making

Behavioural change

Experiments in primary, secondary and higher education with educational packages and students' own experiments

- **Modal shift** away from passenger cars **-20%**
- Increase in **active & collective** modes by **+7%**
- Nearly doubling of the **reported personal action perspectives +71%**



Schoolomgeving Herzele
verbeteren met een schoolstraat?

DENK MEE, MEET MEE, VOLG MEE!



Co-funder
the European Union

Wat vind jij van de tijdelijke schoolstraat in de Burgemeester Matthysstraat?

CityTRAQ's Digital Twin

Keys to co-creative policy making



- CityTRAQ tools:
 - make complex and large datasets **insightful and actionable**
 - are a direct **stepping stone for policy** implementation
 - convince both policy makers & citizens, **inspiring co-creative policy making**
- Challenges remain how we translate ins and outs:
 - We need to find **key end points** that connect to citizens' worlds
 - A gap remains between **how ideas are formulated** and the input models require
 - People make simulations a reality: tools are only a means to an end, set up processes and create a **support base**



Co-funded by
the European Union