

Welcome to the workshop series

DRIVEN by DATA

The mFUND Workshops Series about Mobility in Europe

In collaboration with the

European Institute of Innovation and Technology (EIT) Urban Mobility



Workshop No. 16

Two Wheels Ahead - The Future of Cycling Infrastructure in Europe

Federal Ministry for Digital and State Modernisation (BMDS)

Division DP 20

24.06.2025



www.linkedin.com/groups/12778505





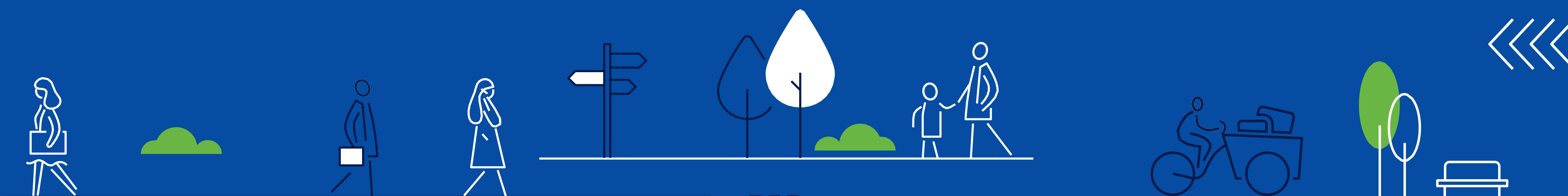
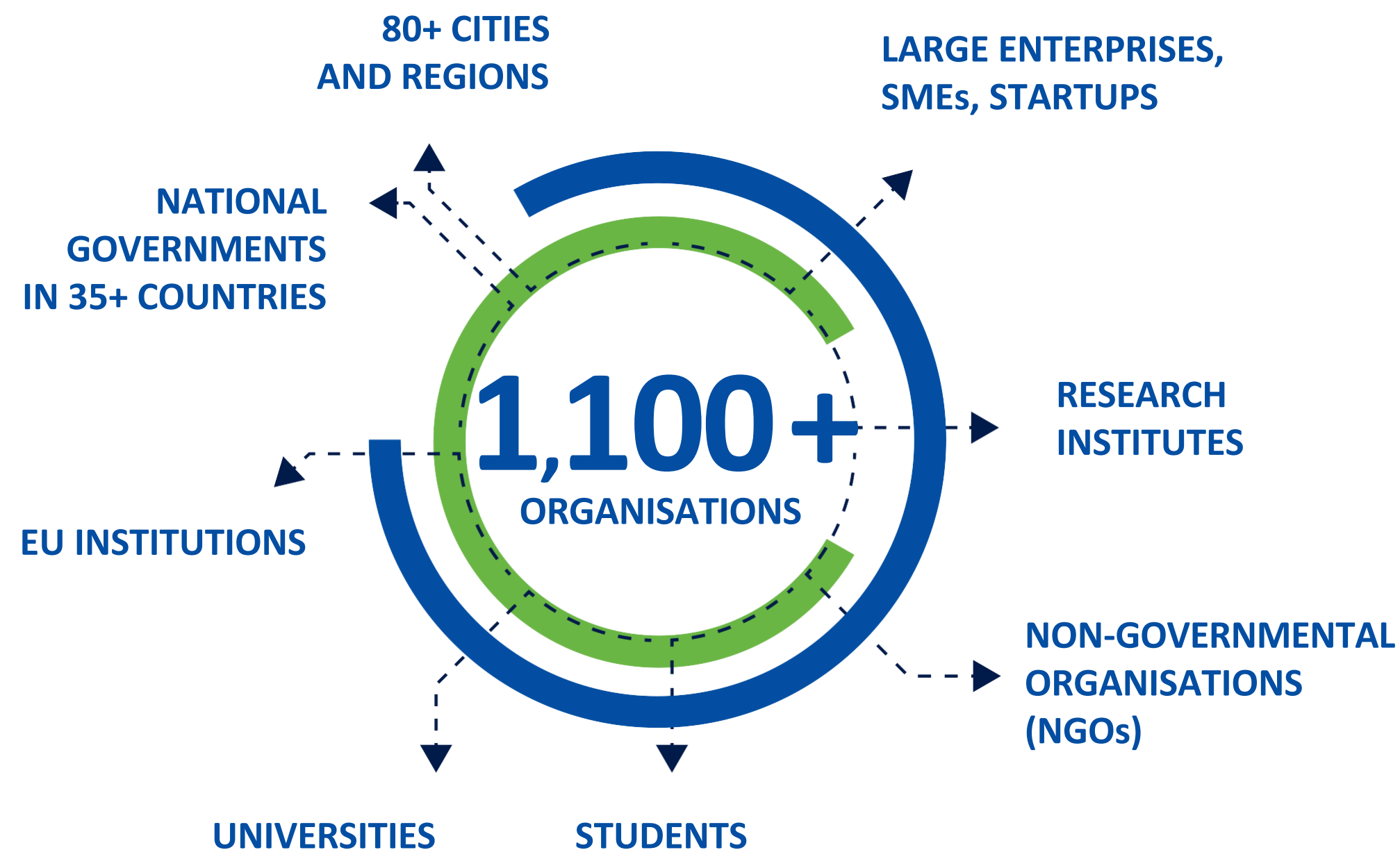
Co-funded by the
European Union

MOBILITY FOR MORE LIVEABLE URBAN SPACES

eiturbanmobility.eu

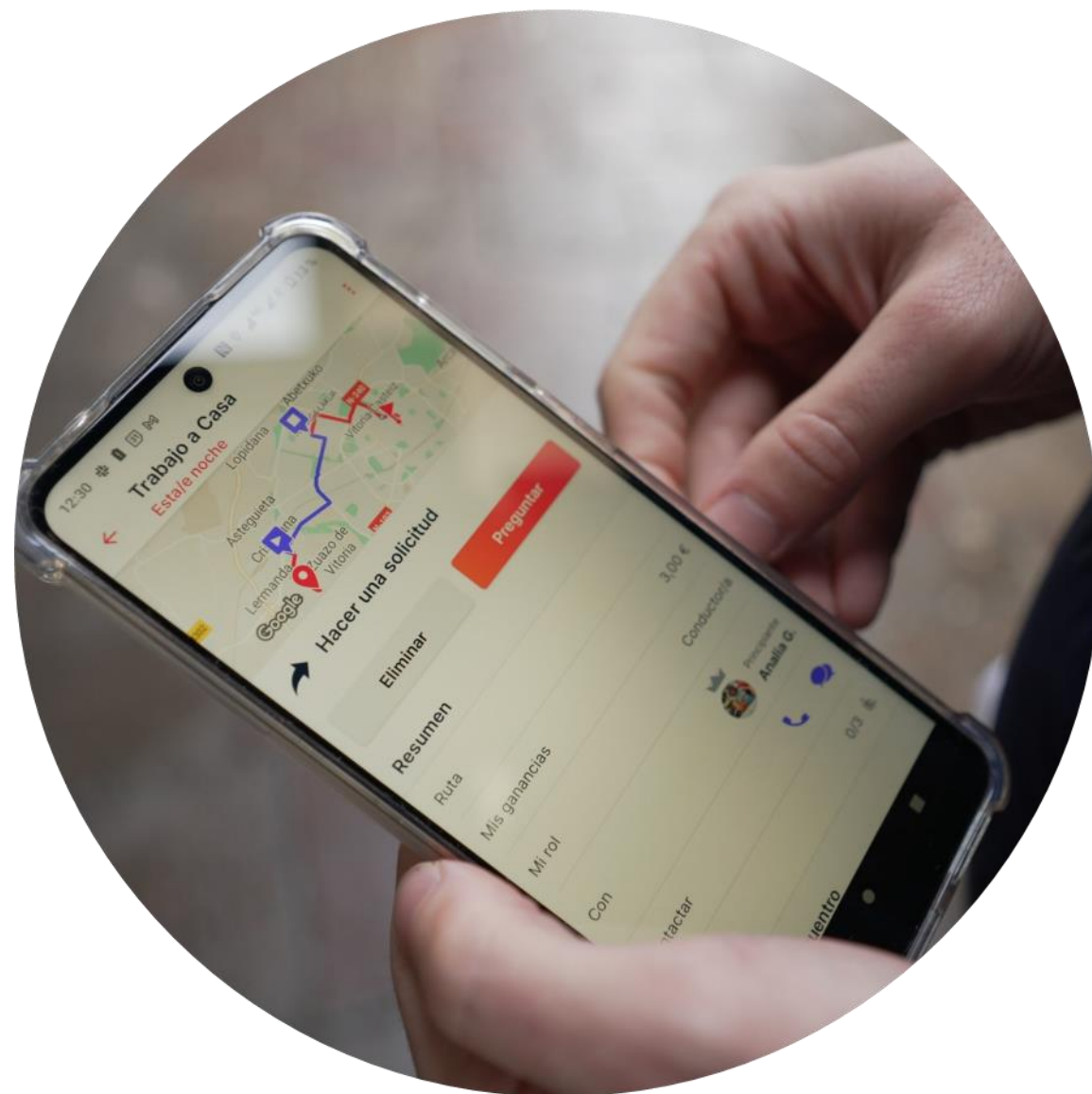


We are the largest European innovation community for urban mobility



WHAT WE DO

EIT Urban Mobility is accelerating the urban mobility transition



Fostering innovation



Liveable urban spaces



**Making Europe's economy
more competitive**



MATCH AND CONNECT

Connecting private and public sector partners to access markets, talent, finance and knowledge

480+

solutions showcased on our Mobility Innovation Marketplace



TALENT TO BUSINESS

Fostering entrepreneurship through practical learning

32,000+

learners enrolled in Urban Mobility Explained (UMX) courses



INNOVATIONS TO MARKET

Piloting market-ready solutions in cities

200+

new solutions introduced to the market since 2020



STARTUPS TO SCALE

Boosting startup growth for long-term impact

450+

startups supported

Creating impact in cities
across Europe

315+
PILOTS IN

145+
CITIES



Innovation funding mechanisms and strategic actions

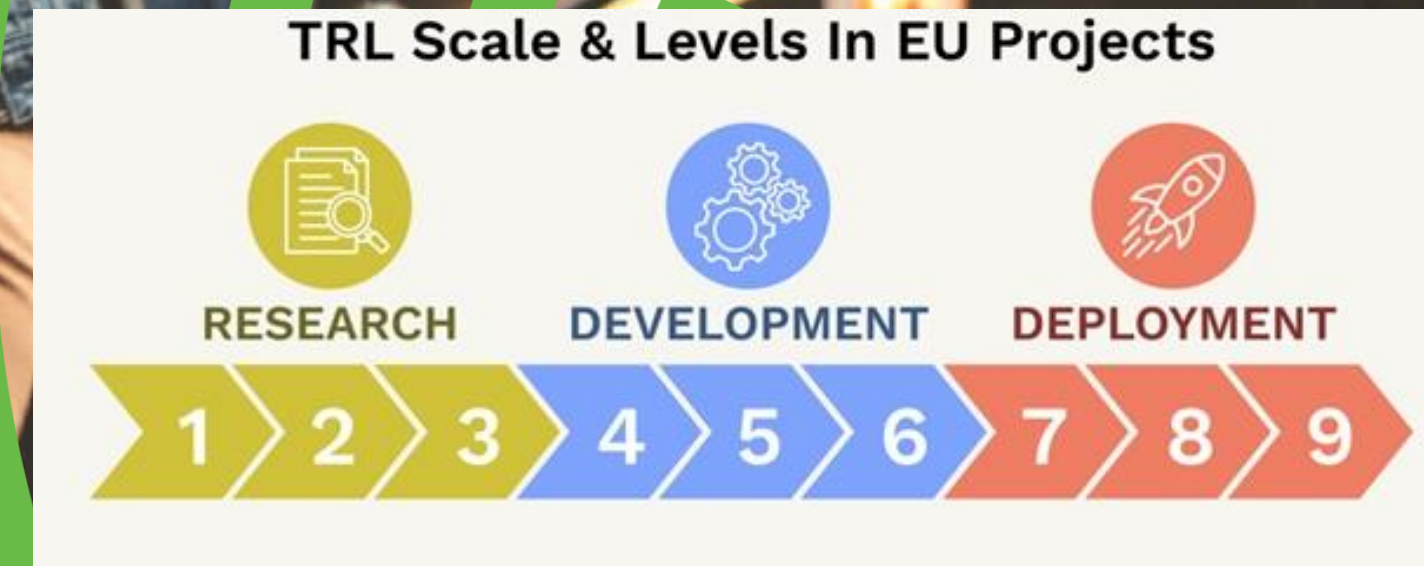


- Pan-European, multi-disciplinary consortium projects to develop and pilot a product/service/solution **[Innovation Open Call]**
- Mono-beneficiary startup/SME projects to demonstrate fast innovation with an end-client **[SME Market Expansion Call + RAPTOR Call]**
- Go-to-market support to commercial partners to upscale their solutions into other EU markets **[Innovation Advisory Services]**
- Support to identify, apply for and secure alternative European funding for urban mobility projects **[Horizon Lab]**

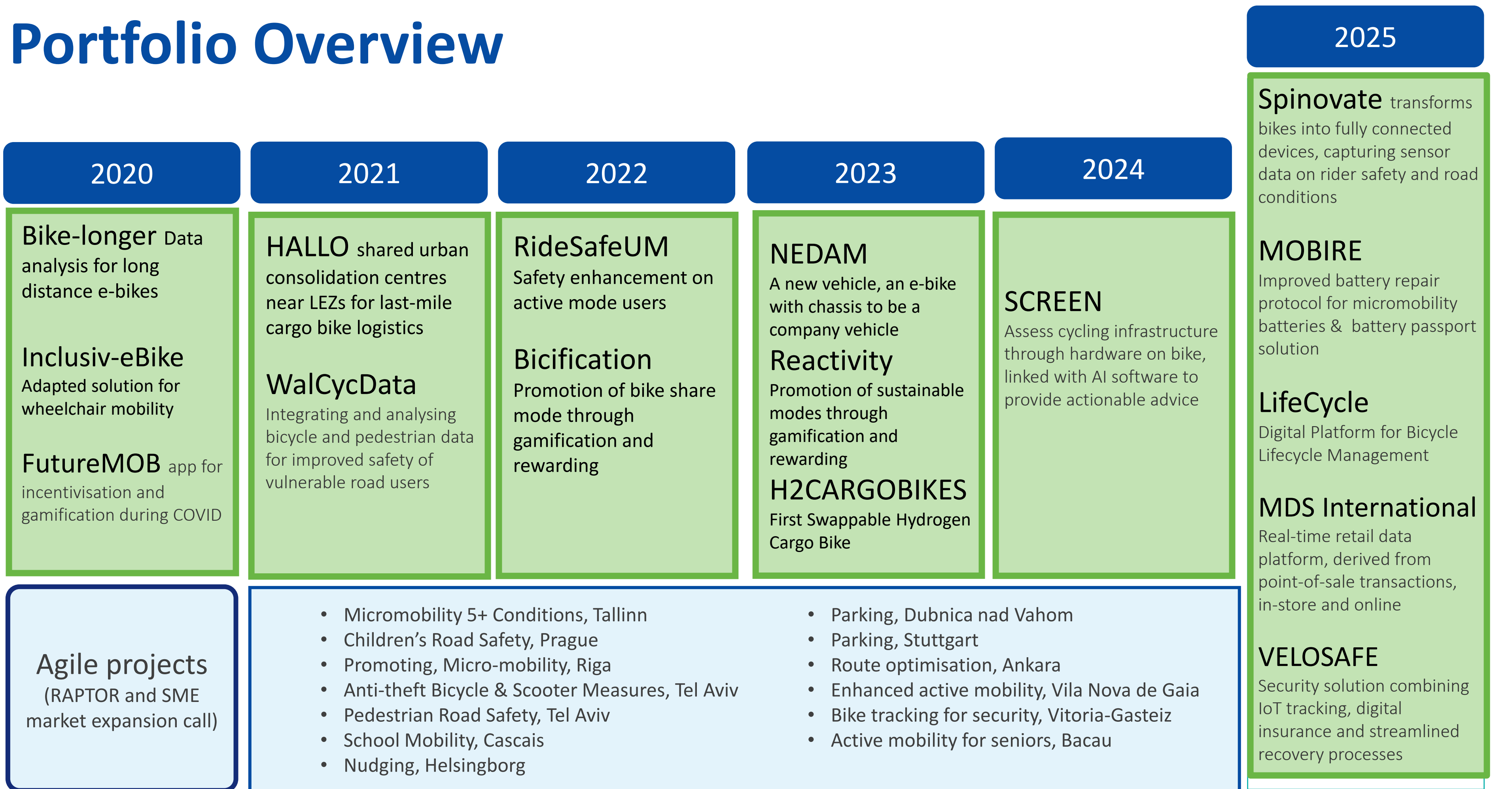
Innovation projects

Accelerating change towards sustainable mobility for cities

- ✓ Respond to pressing urban mobility challenges
- ✓ Focus on the last stages of product development, piloting and preparation of the market deployment
- ✓ Empower companies, SMEs & startups to scale and commercialise innovative mobility solutions.



Portfolio Overview



EIT URBAN MOBILITY ACTIVITIES ON CYCLING & DATA

35
Equity
startups

10+
Urban Mobility
campus courses



>> **Unlocking the future of mobility
with European data spaces (2023)**

DOWNLOAD

Horizon Europe:

- Trans-Safe
- Unchain
- URBANE

Strategic Innovation Open Call 2026-2028

Launch date: 19 June 2025
Deadline: 23 September 2025



Main aspects to consider: Seeking new innovations that tackle the **most pressing urban mobility challenges**. Solutions should demonstrate **strong potential for scalability and market adoption**. Projects should foster **collaborative innovation** – whether across the value chain or other strategic partnerships- with **a clear pathway to market deployment** by the project's end.



Consortium: Minimum of 2 partners from 2 different EU Member States or associated countries to HE. At least one commercial partner and 1 demo hosts.



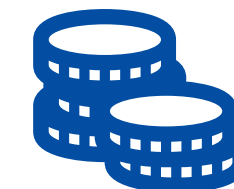
Mandatory elements: KPIs marketed innovation (EITHE2.4) or startup created (EITHE4.4); minimum 35% co-funding



Start date: Jan-Feb 2026



Project duration: up to 24 months



Budget: up to 2M€

Topic scope

Addressing one or several high impact markets

URBAN
LOGISTICS



PUBLIC
TRANSPORT



MOBILITY DATA
MANAGEMENT



ELECTRIFICATION
OF TRANSPORT
AND ALTERNATIVE
FUELS



HEALTH AND
MOBILITY



Mobility data management



- **Data-driven solutions that enhance the performance, efficiency and responsiveness of urban mobility systems** through e.g. the use of advanced analytics, AI, quantum technology or real time data – in alignment with EU-level interoperability and data governance efforts (e.g. common data spaces, European data standards, open digital infrastructures). Solutions that enable cities and public authorities to make **data-informed decisions** – particularly for the design and implementation of Sustainable Urban Mobility Plans (SUMPs), inclusive/participatory planning and citizen engagement, resilience and disruption response, or regulatory monitoring and enforcement (e.g. Low Emission Zones) – are particularly encouraged.
- All solutions should adhere to principles of **data privacy, interoperability, replicability and scalability, while demonstrating a clear pathway to sustainable deployment and uptake.**

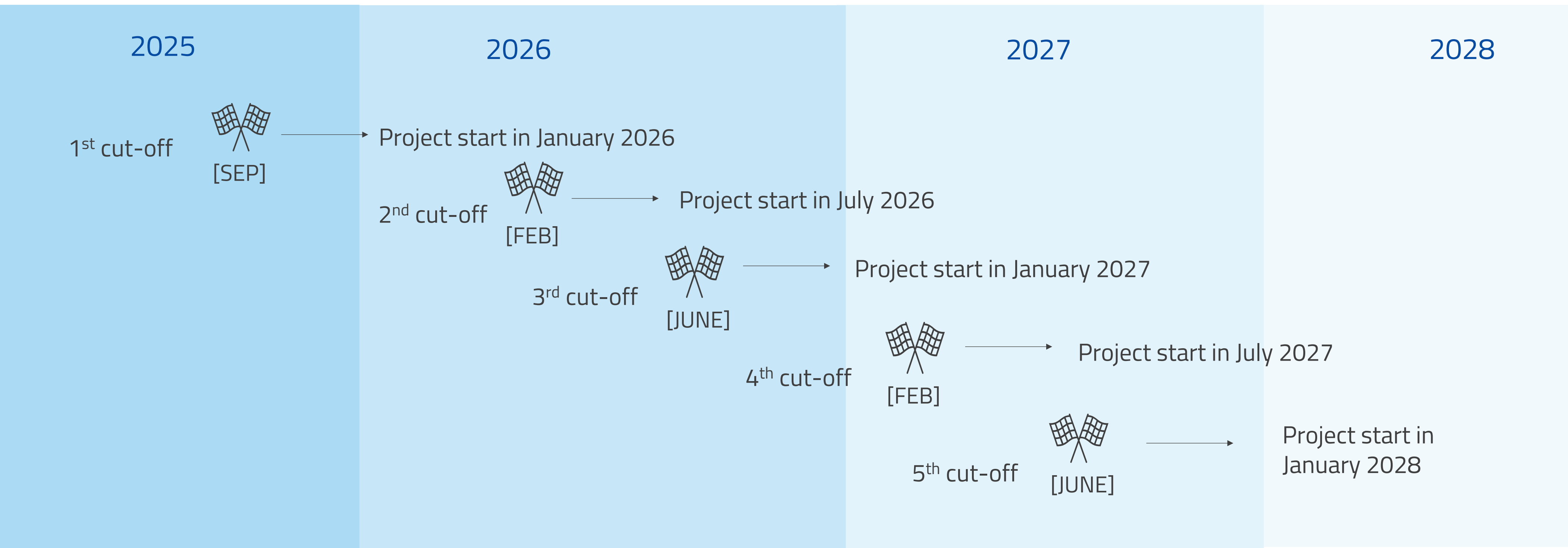
Health and mobility



- Solutions that promote **active mobility as a foundation for healthier urban lifestyles**, by improving safety, convenience, inclusivity and integration within the urban environment, facilitating a modal shift towards active modes. Proposals should go beyond typical behavioural change campaigns, to include **innovative and market-oriented solutions that strengthen the European cycling industry and align with the goals of the European Declaration on Cycling**. Digital or public space design innovations must demonstrate a disruptive approach and clear potential for adoption by public authorities.
- This topic also includes innovations that **monitor, reduce, or mitigate the health impacts of air and noise pollution** in urban mobility systems – including solutions for cleaner transport, reduced exposure, and health-informed planning.



Call timeline



All projects must end by **31 December 2028**

What's next?

- ❑ Strategic Innovation Open Call - EIT Urban Mobility
- ❑ Join **EIT Urban Mobility Innovators platform – Call Matchmaking Group**:
<https://innovators.eiturbanmobility.eu/page/strategic-innovation-open-call>
- ❑ Join the **Call info sessions** (register via the Call Matchmaking Group)
- ❑ General questions about the call can also be addressed to:
innovationcall@eiturbanmobility.eu



Join us on the journey to accelerate the transition to sustainable urban mobility!

EIT Urban Mobility Headquarters
info@eiturbanmobility.eu

EIT KIC Urban Mobility S.L.
Payfit, Calle de Pamplona 104
08018 Barcelona, Spain

eiturbanmobility.eu

For more information

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CYCLING INFRASTRUCTURE ASSESSMENT



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Urban Mobility

Co-funded by the
European Union



FACTUAL



fluctuo
Mobility enablement



**SOCIAL TECH
PROJECTS**
INNOVATION FOR A BETTER FUTURE

OUR APPROACH

Improve road **safety** for bike users and **grow cycling**



**Identify & fix the
most unsafe
areas for bikers**



**Improve under-
used routes with
the most potential**



**Grow the modal
share of cycling**

Our credo : multi-source data integration

1. On-the-Ground Data (Sensors & Cameras mounted on Bikes)

- Lane width, pavement quality, cracks, potholes
- Separation from traffic & real-world cycling conditions

2. Static Data (Population & Points of Interest)

- Key destinations: workplaces, schools, transit hubs
- Potential cycling demand & urban mobility context

3. Dynamic Data (Traffic, Shared Bikes Usage, Pollution, etc.)

- When, where, and how many cyclists use the lanes (fixed counters, usage fo share bikes)
- Interaction with car traffic, pollution levels, and safety risks

STEP 1: MAPPING



STEP 1

We map the city & choose the areas to evaluate



STEP 2

We collect data on cycling infra with cameras and sensors



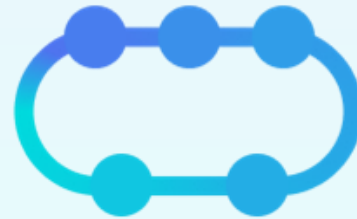
STEP 3

We process the data with computer vision tech



STEP 4

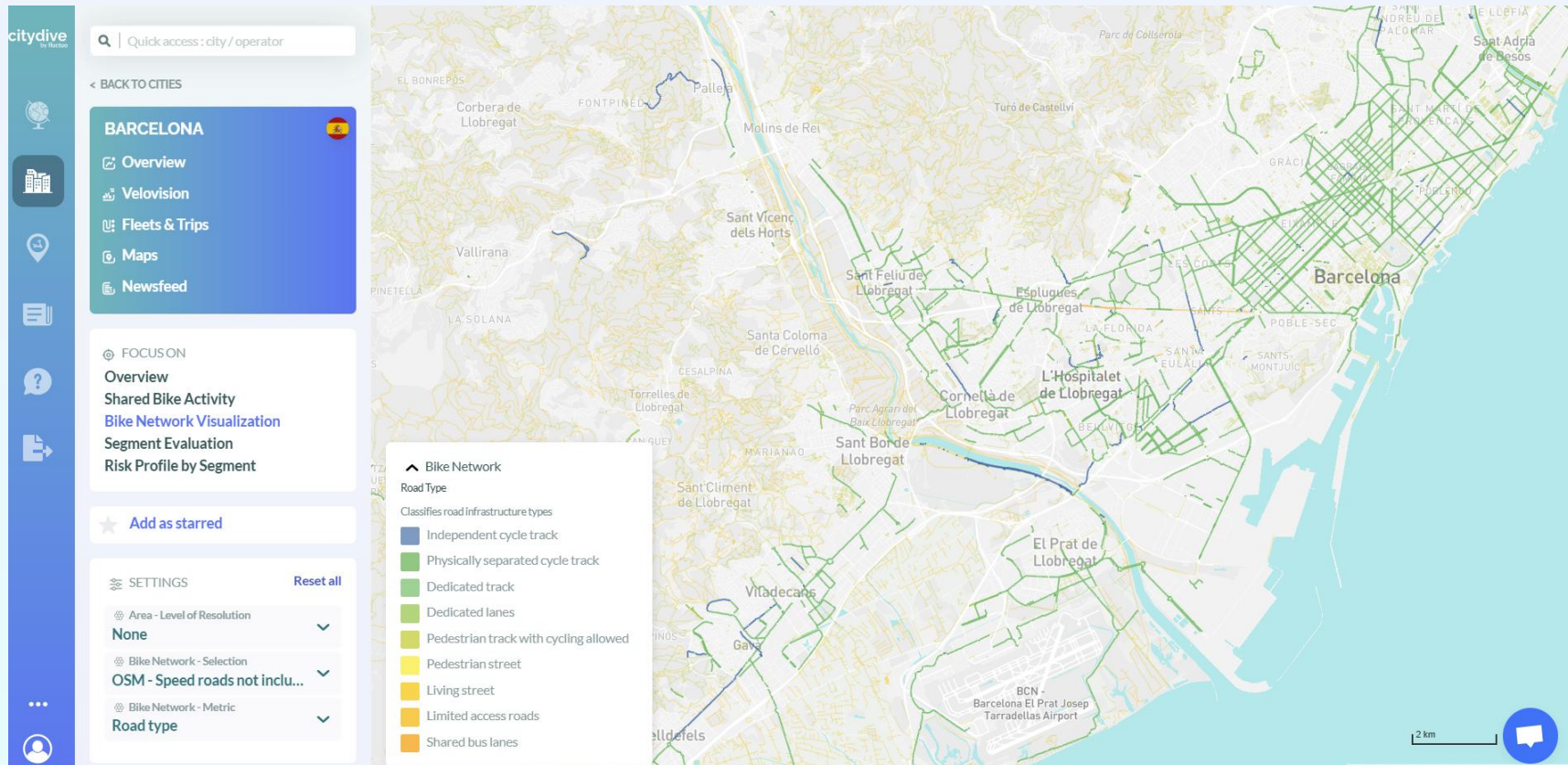
We deliver recommendations and priorities



STEP 5

We repeat to assess the ROI of the investments in infra

STEP 1: MAPPING



STEP 2: DATA COLLECTION



STEP 1

We map the city & choose the areas to evaluate



STEP 2

We collect data on cycling infra with cameras and sensors



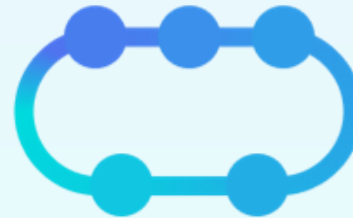
STEP 3

We process the data with computer vision tech



STEP 4

We deliver recommendations and priorities



STEP 5

We repeat to assess the ROI of the investments in infra

STEP 2: DATA COLLECTION



Geo-located images and sensor data

Cycle lane scanning to evaluate safety, pavement issues, comfort and environmental conditions

- Geo-located Images Every 10 Meters
- Face and Vehicle Plate Anonymization
- High Precision Sensors
 - Pavement Roughness (m/s^2)
 - Noise sensor ($\pm 1 \text{ dB}$)
 - Air quality and Gas pollutant sensors
- Cycle Lane Width Sensor
 - Lane Width Detection:



STEP 3 : DATA ANALYSIS



STEP 1

We map the city & choose the areas to evaluate



STEP 2

We collect data on cycling infra with cameras and sensors



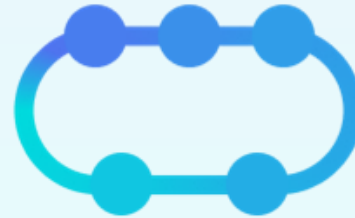
STEP 3

We process the data with computer vision tech



STEP 4

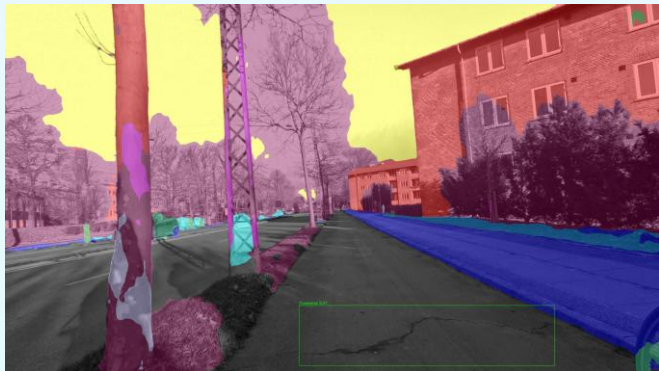
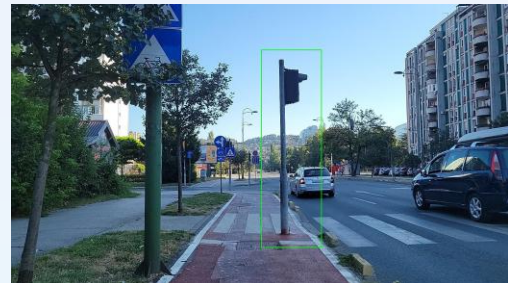
We deliver recommendations and priorities



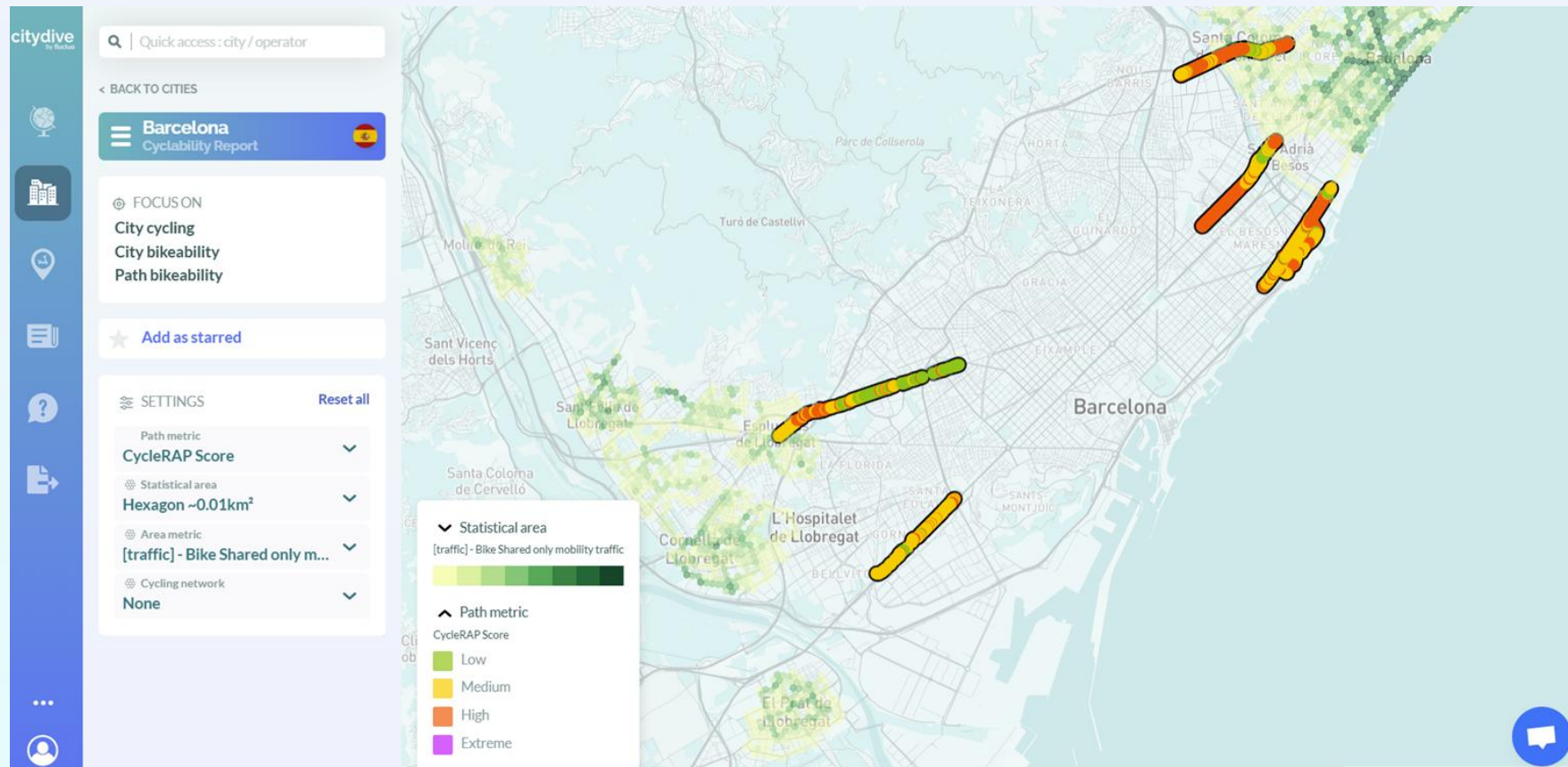
STEP 5

We repeat to assess the ROI of the investments in infra

STEP 3a: DATA ANALYSIS



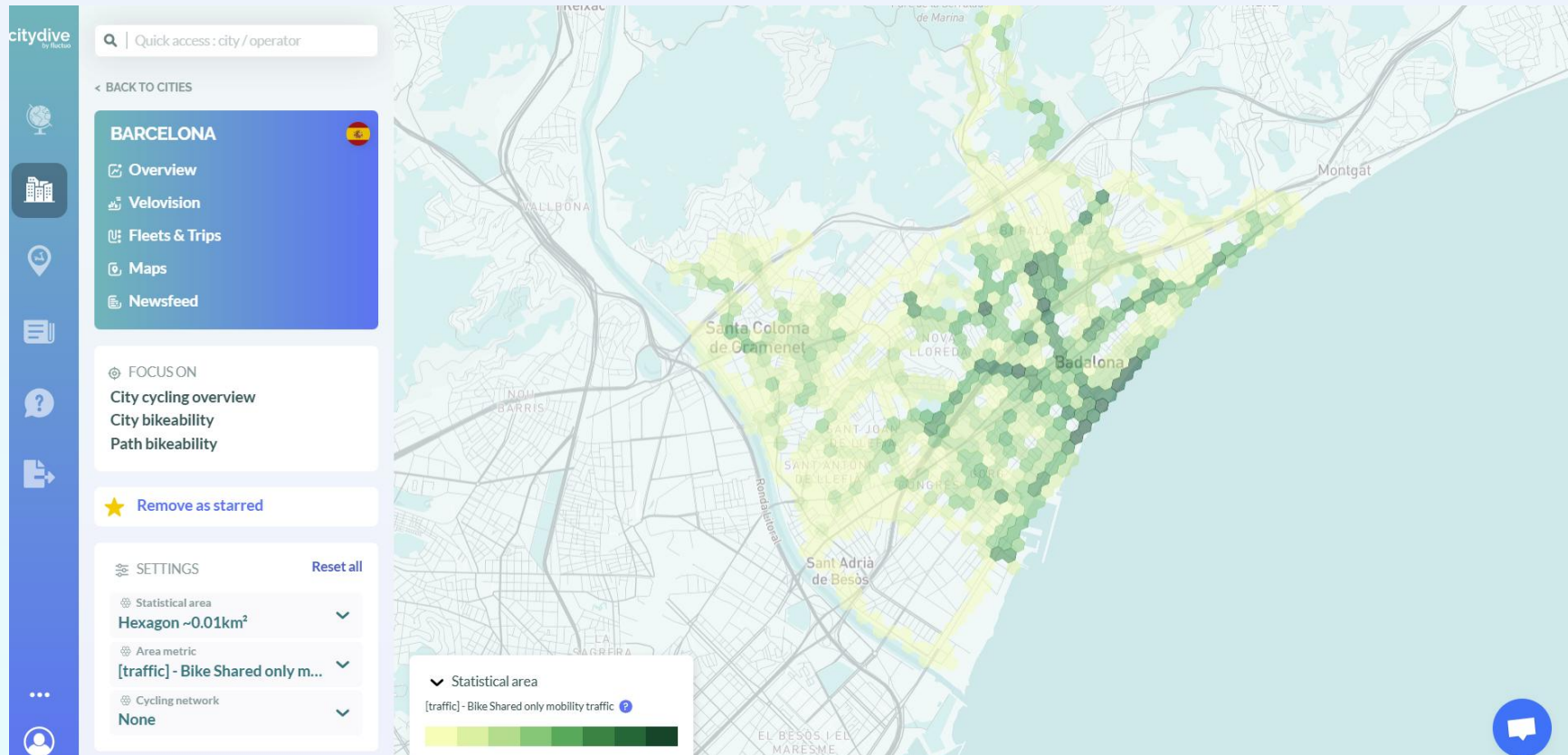
STEP 3a: DATA ANALYSIS



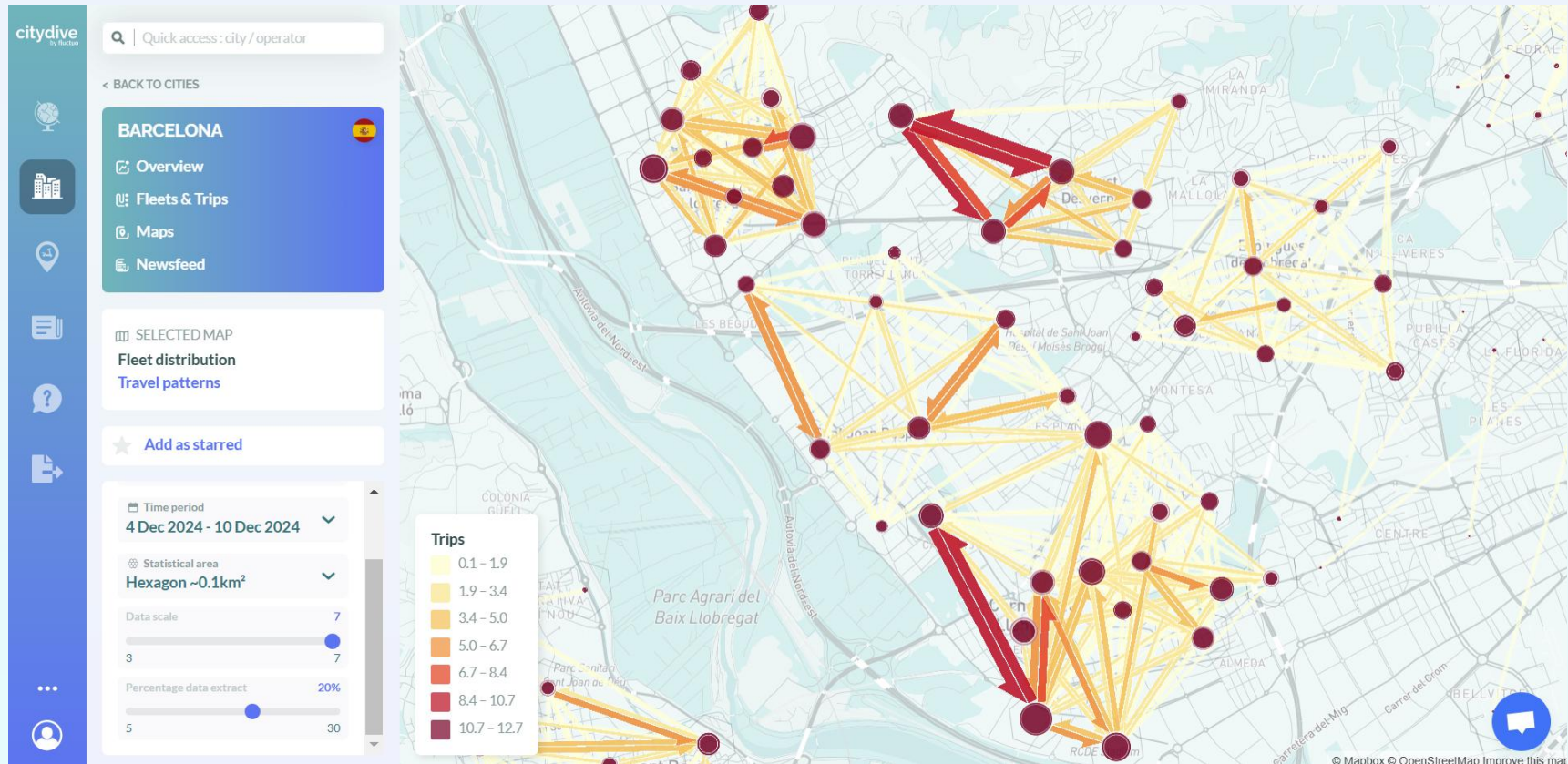
STEP 3a: DATA ANALYSIS

The screenshot displays the CityDive Barcelona Cyclability Report. The main map shows a highlighted cycling path through Barcelona, color-coded by its quality. The path starts in the center, goes right, then loops left and right. A legend at the bottom left shows the color coding: Low (green), Medium (yellow), High (orange), and Extreme (purple). The interface includes a sidebar with navigation options like 'City cycling', 'City bikeability', and 'Path bikeability'. On the right, there are three 'Cyclist View' panoramas showing street scenes from the path.

STEP 3b: DATA ENRICHMENT



STEP 3b: DATA ENRICHMENT



STEP 4: RECOMMENDATIONS



STEP 1

We map the city & choose the areas to evaluate



STEP 2

We collect data on cycling infra with cameras and sensors



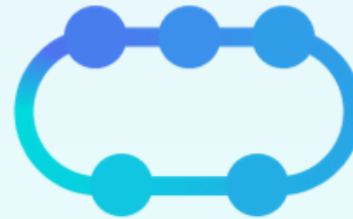
STEP 3

We process the data with computer vision tech



STEP 4

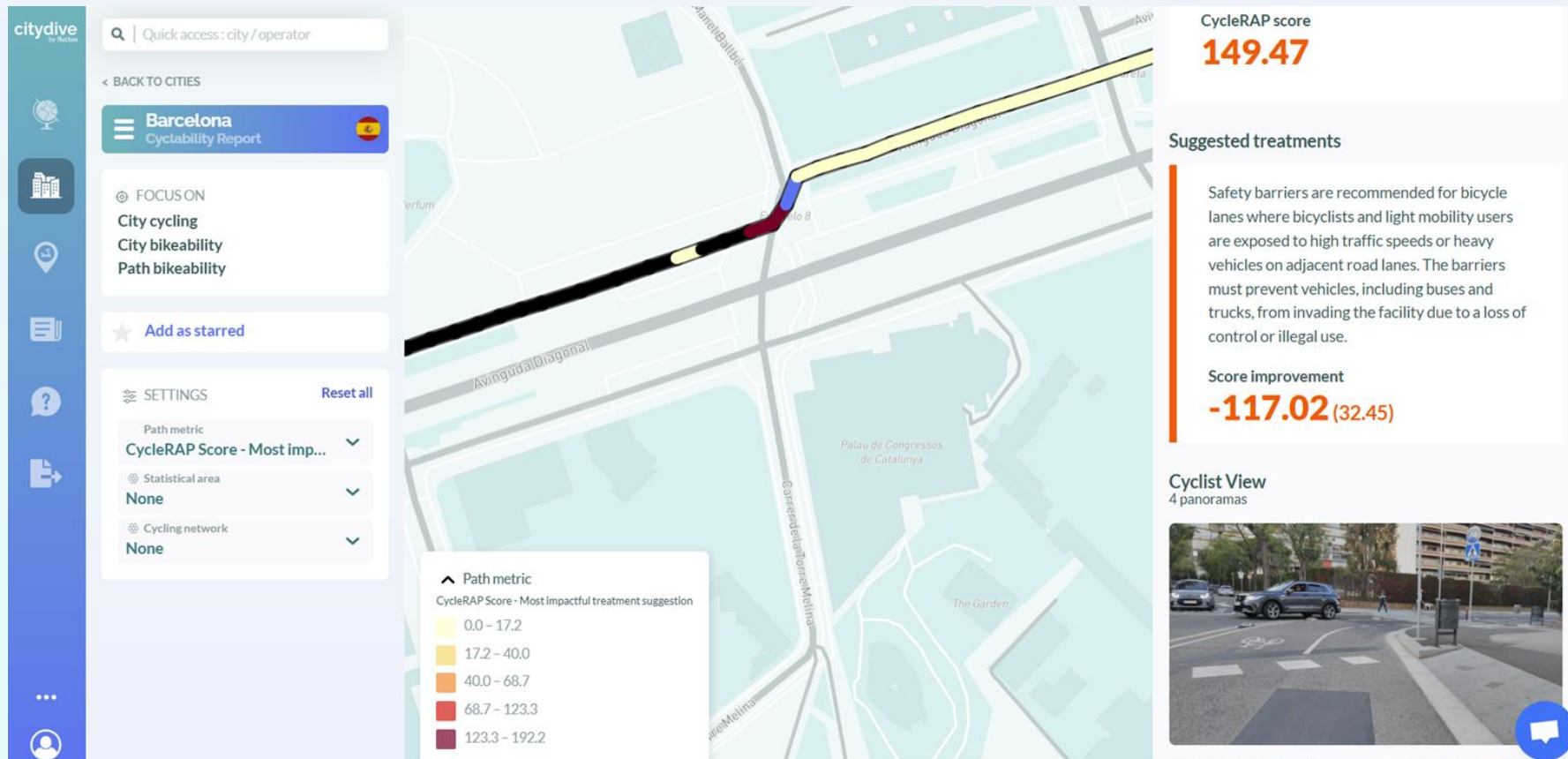
We deliver recommendations and priorities



STEP 5

We repeat to assess the ROI of the investments in infra

STEP 4: RECOMMENDATIONS



STEP 4: RECOMMENDATIONS

citydive
by Metropia

Q | Quick access : city / operator

< BACK TO CITIES

BARCELONA



Overview

Velovision

Fleets & Trips

Maps

Newsfeed

FOCUS ON

Overview

Shared Bike Activity

Bike Network Visualization

Segment Evaluation

Risk Profile by Segment

★ Add as starred

SETTINGS

Reset all

Path selected

All paths



Main metric

CycleRAP - Global Score



Additional metric

None



Risk Profile by Segment

Segments ranking

Currently sorted by: CycleRAP - Global Score

CycleRAP - Global Score



Path: 136

Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Extreme
125.9



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 110

Extreme
71.96



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 111

Extreme
89.27



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 112

High
64.84



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 113

High
64.84



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 114

High
64.84



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 115

High
64.84



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 116

Extreme
225.66



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 117

Extreme
152.77



Bicivia 5: Pg. Santa Coloma - Rambla del Fondo

Segment: 136 - 118

Extreme
225.66



Why Data Integration has Been Challenging ?

Dynamic Data is Hard and Expensive to Collect

- Multiple sources with different formats & resolutions
- Expensive (floating car data)
- Collected over varying time periods (sometimes outdated), making synchronization difficult

Data Availability Vary Significantly Across Cities

- It makes it challenging to scale solutions and standardize algorithms and data visualizations.

On-the-Ground Data is Collected Only Once

- The timing of data collection is crucial : measurements taken at different hours / days can lead to misinterpretations and incomplete assessments.

What Have We Learnt ?

Leveraging Universal Data Sources

- Roads, Bike Lanes, and POIs → OpenStreetMap (OSM) as a consistent and scalable reference
- Fixed Bike Counters & Shared Bike Traffic → Reliable indicators of ridership and cycling trends

Prioritizing Cost-Effective Sources

- Focus on affordable & scalable datasets to maximize impact

Time Sensitivity Matters

- Data older than 4 years should not be used, as it may not reflect actual trends

Adapting to cities needs

Basic cycling data is relevant for early-stage cities

- Goal: Foundational data for cycling planning, infrastructure expansion, and promotion.
- Identifies key routes and cycling patterns.
- Sets priorities for initial infrastructure development.

More complex and detailed data is relevant for advanced-stage Cities

- Goal: Infrastructure improvement, cycling experience enhancement, and usage growth.
- Enables real-time monitoring and performance evaluation.
- Supports targeted interventions for safety, connectivity, and comfort.
- Ideally includes cycling user insights.

INTERESTED ?



Learn more at
velovision.citydive.eu



– EMOTION SENSING FOR (E-)BICYCLE SAFETY AND MOBILITY COMFORT

■ Peter Zeile | Martin Soutschek

 **Universität Stuttgart**
Institut für Arbeitswissenschaft und
Technologiemanagement IAT

 **KIT**
Karlsruher Institut für Technologie

 **PARIS
LODRON
UNIVERSITY
SALZBURG** **ZGIS**

OSNABRÜCK

DIE | FRIEDENSTADT

outdooractive

mFUND DRIVEN by DATA Workshop #16, 24.06.2025
Two Wheels Ahead - The Future of Cycling Infrastructure in Europe

Gefördert durch:



**Bundesministerium
für Digitales
und Verkehr**

aufgrund eines Beschlusses
des Deutschen Bundestages





The Project

Emotion Sensing for (e-)bicycle safety and mobility comfort (ESSEM)

Isn't it all about emotions?



Image source: Pixabay, Üserr: Ben_Kerckx // User: PublicDomainPictures

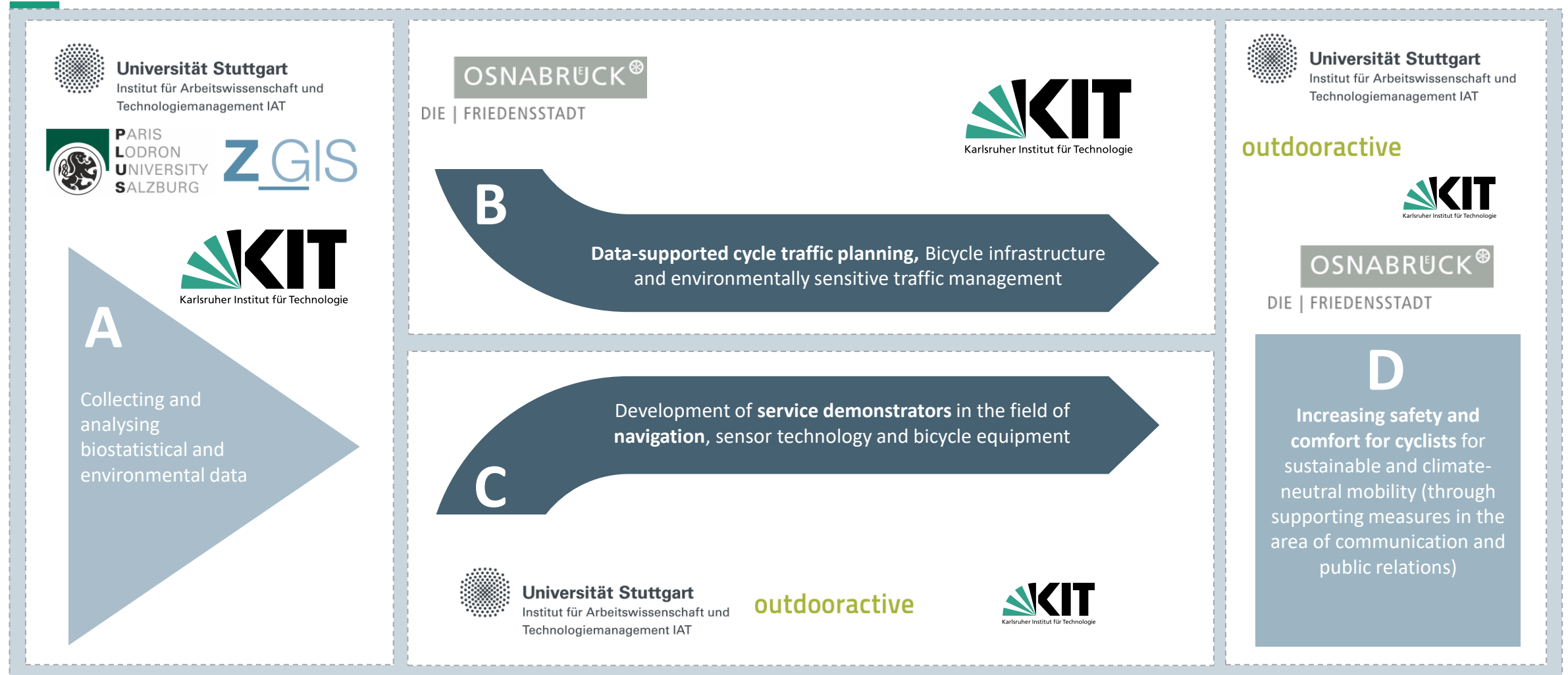
Do you like cycling?



Image source: AI generated, ChatGPT

ESSEM – Project Overview

Project consortium

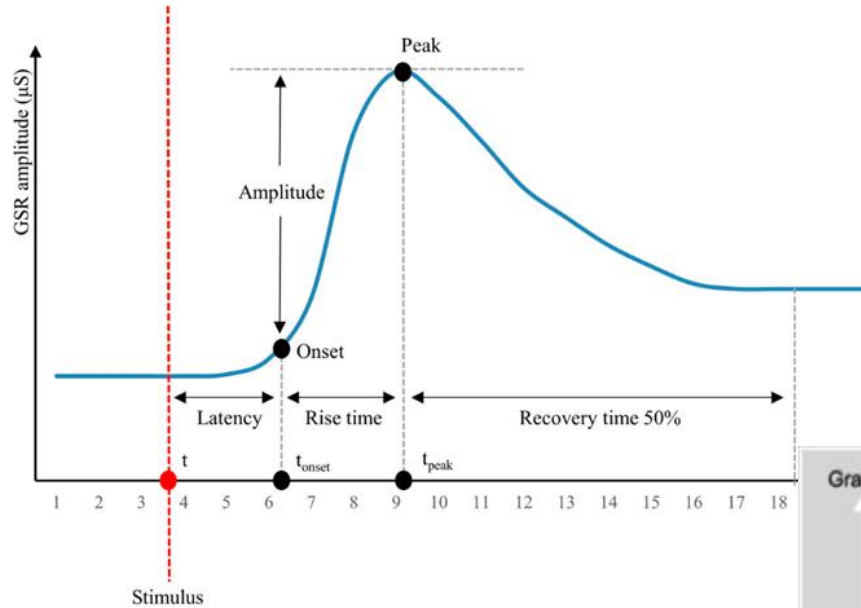




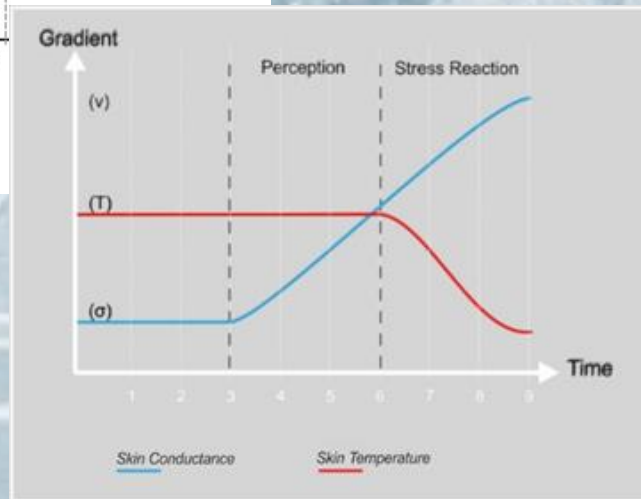
Emotion Sensing-Method

Emotion Sensing und Cycle Mobility

How to measure “Stress”?



Detection of spontaneous reactions of the autonomic nervous system

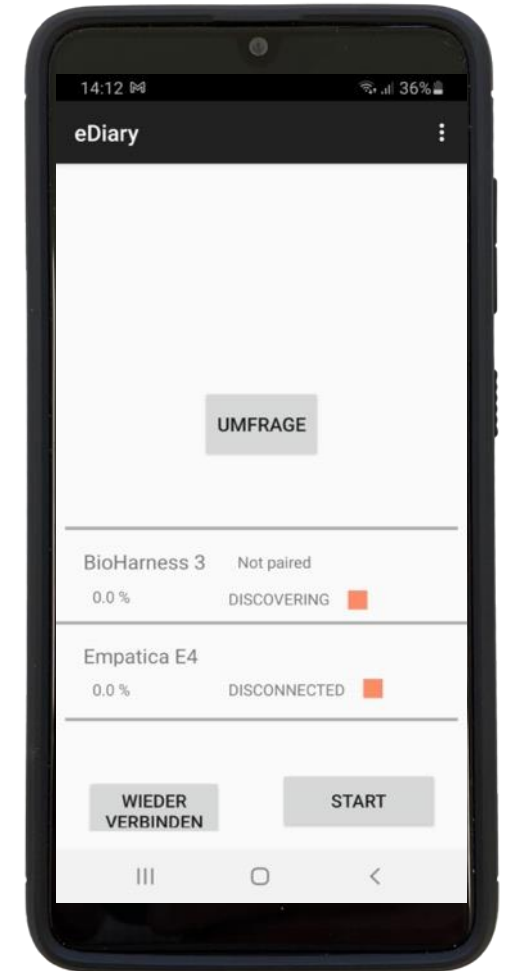


Seconds	Electrodermal Activity	Skin Temperature	
1	0	0	Normal Move
2	0	0	
3	1	0	
4	1	0	Perception
5	1	0	
6	1	-1	
7	1	-1	← Moment of Stress (MOS)
8	1	-1	
9	0	-1	
10	0	-1	Seconds of Stress (SOS)

Emo-Cycling-Data Collection

Setting

- **Free rides:** equipped with **Empatica E4** smartband and smartphone with **E-Diary app** installed
- Recording of **electrodermal activity** (skin conductivity and temperature)
- Recording of **everyday cycling trips** over a **period of 2 weeks** with **free choice** of route
- Data collection periods:
09/2022
02/2023 und 09-11/2023
- Answering a **standardised questionnaire** (individual personality traits, mobility behaviour, accident experience, ...)



Emo-Cycling-Data Collection [Free choice of routes]

Experiment

- Participants: 116
- Duration: 914 h
- Detected MOS: 53.796

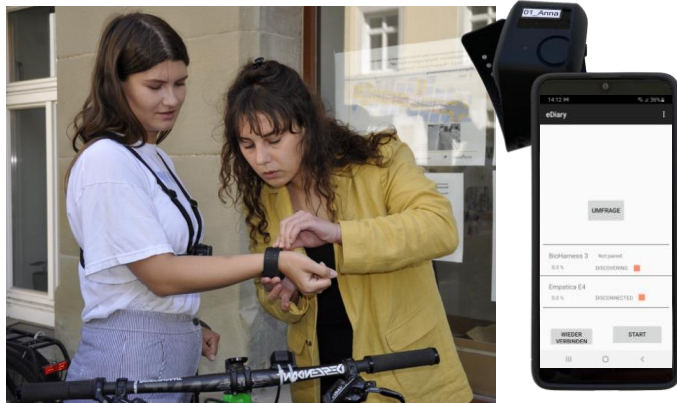
Some facts:

- Average age:
47 years
- Gender:
42% female
42% male
1% diverse
14% not answered
- Types of cyclists:
59% Everyday Cyclists
21% Interested Cyclists
7% Fearless Cyclists



From measurement to interpretation

Data collection & Citizen workshops



Data Collection

Interpretation of the measurement results & identification of the need for action

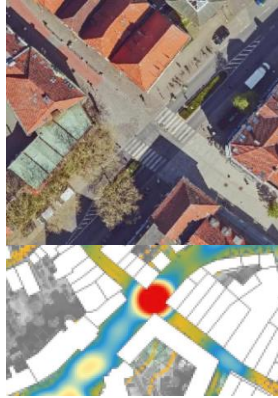
Results in Osnabrück

Identification of stress hotspots

Conflict of Use



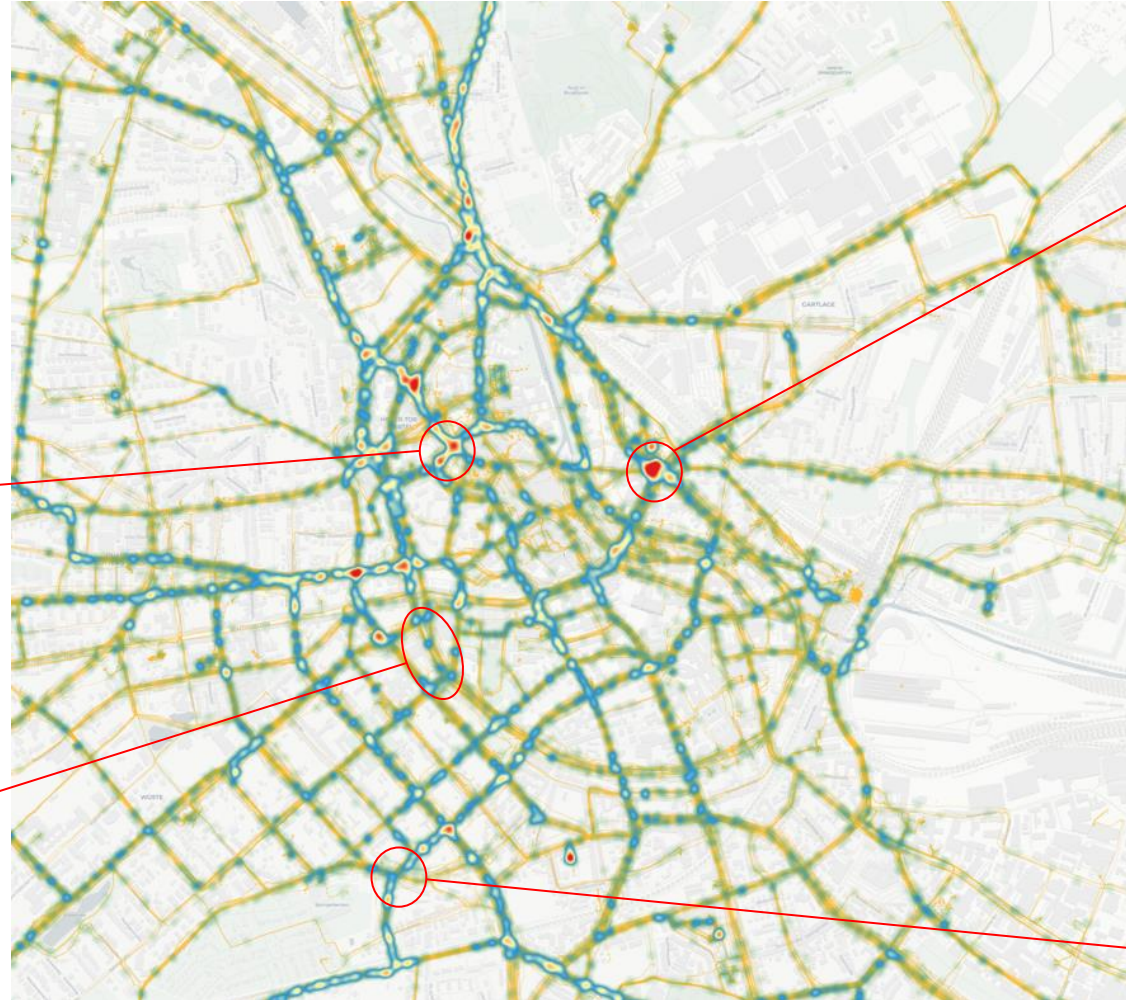
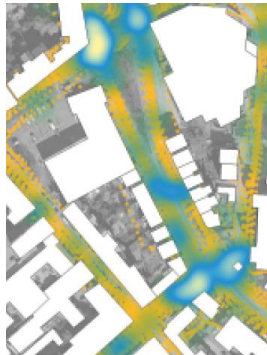
Potential for conflict due to interactions



Infrastructure

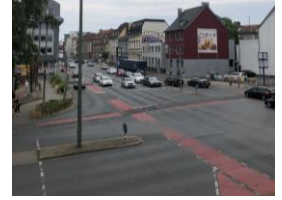


Obviously deficient infrastructure without a hotspot

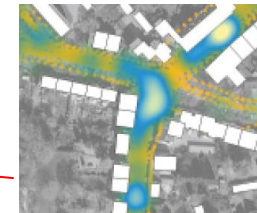


Infrastructure

Obviously inadequate infrastructure



Anger



Potential for conflict due to interactions

Monitoring

Validation of modifications- before and after comparison?

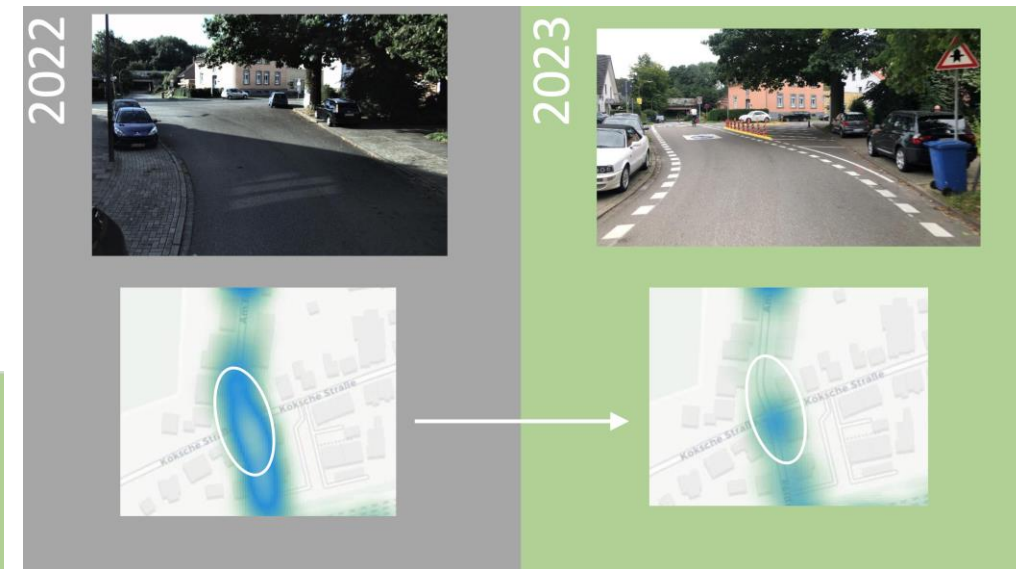
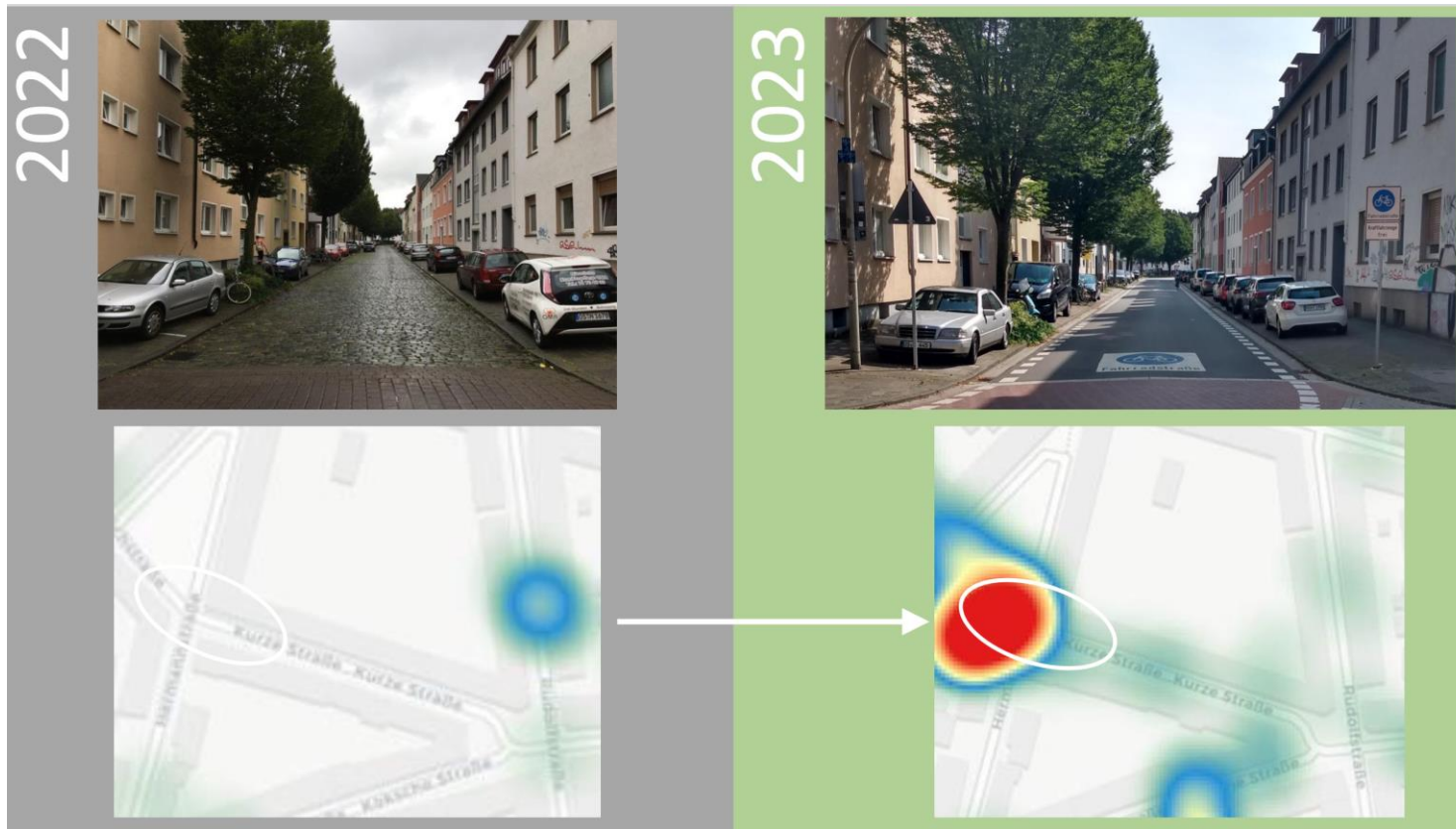


Figure: Am Freibad/Koksche Straße junction before and after the remodelling

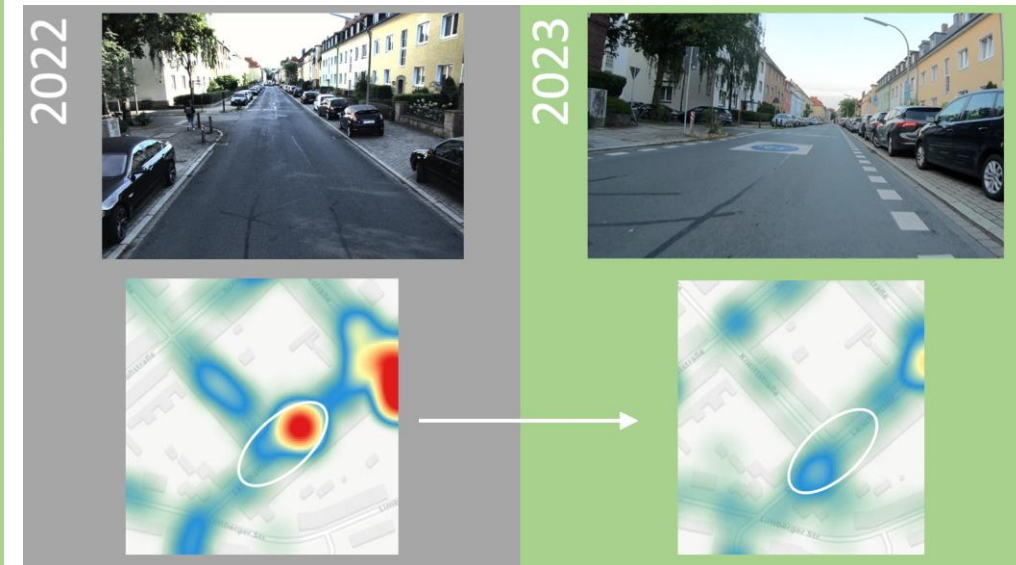


Figure: Laischaftsstraße/Kiwittstraße junction before and after conversion to a cycle lane



Routing-Demonstrator - Exploitation

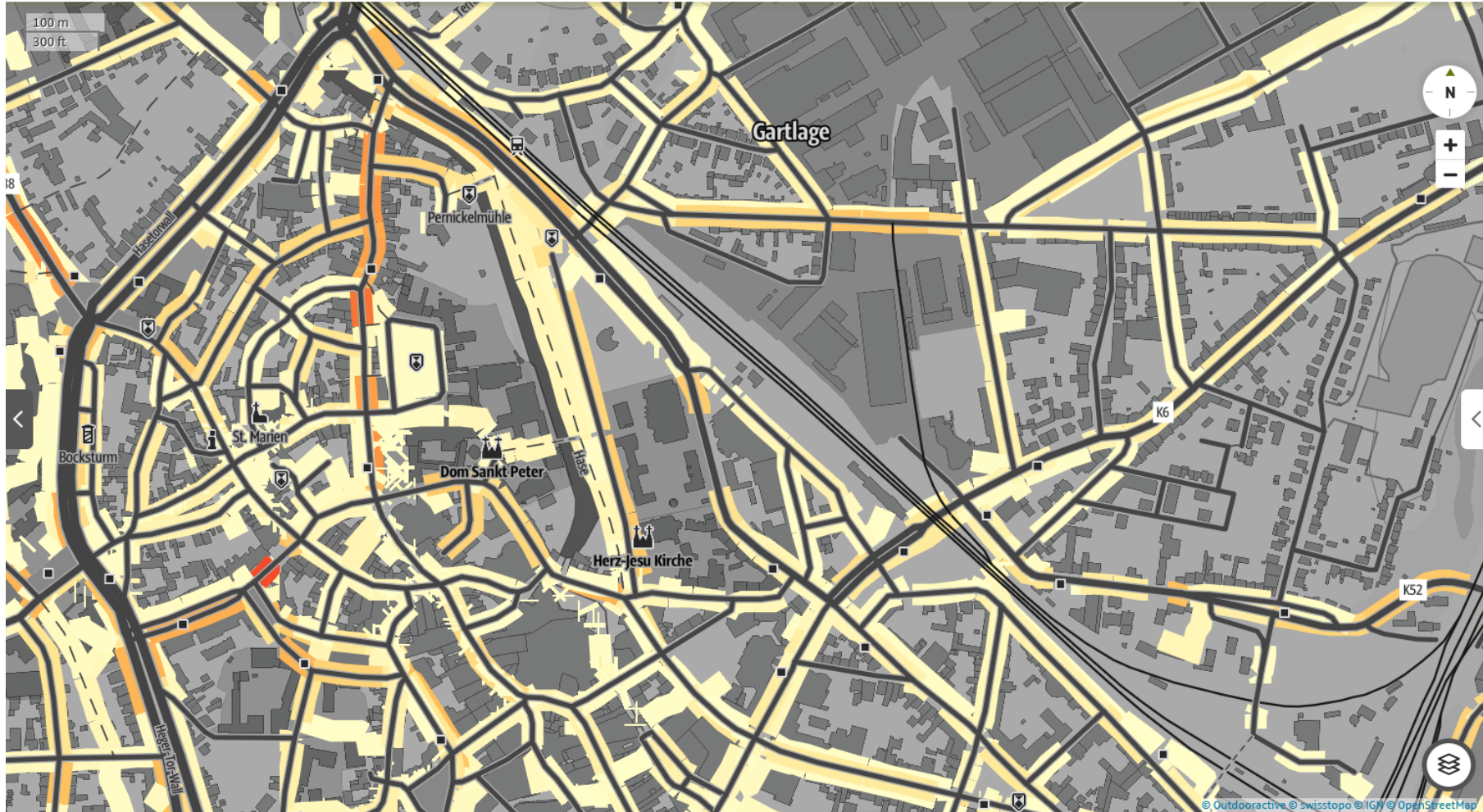
Cycling Network Infrastructure

„Dumb network“



Cycling Network Infrastructure

„Smart network“



Cycling Path Network Infrastructure

Analysis of geodata quality

Data Quality Restrictions

- Weather influences (e.g. snow, rain, pollen)
- Traffic influences

Attribution OpenStreetMap

- DE:Key:smoothness
- Proposal:Key:is sidepath



Image Source: Pixabay



Image Source: Pixabay, User: Kasman



Image Source: Pixabay, User: Hans

Processing Test Data for Planning and Navigation

Data aggregation

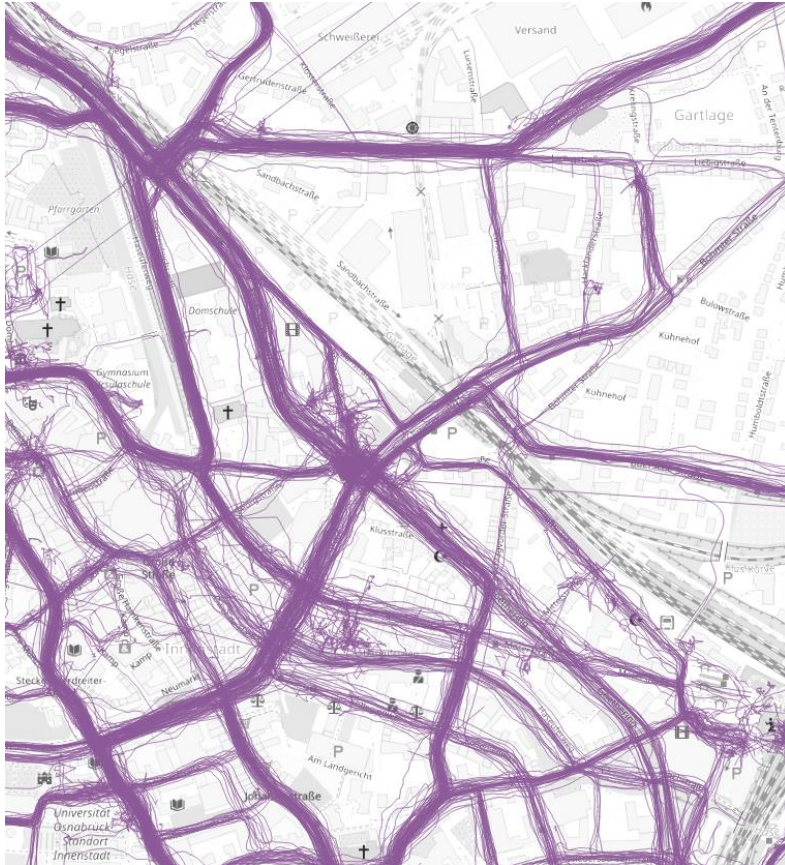


Figure: Test rides in the centre of Osnabrück

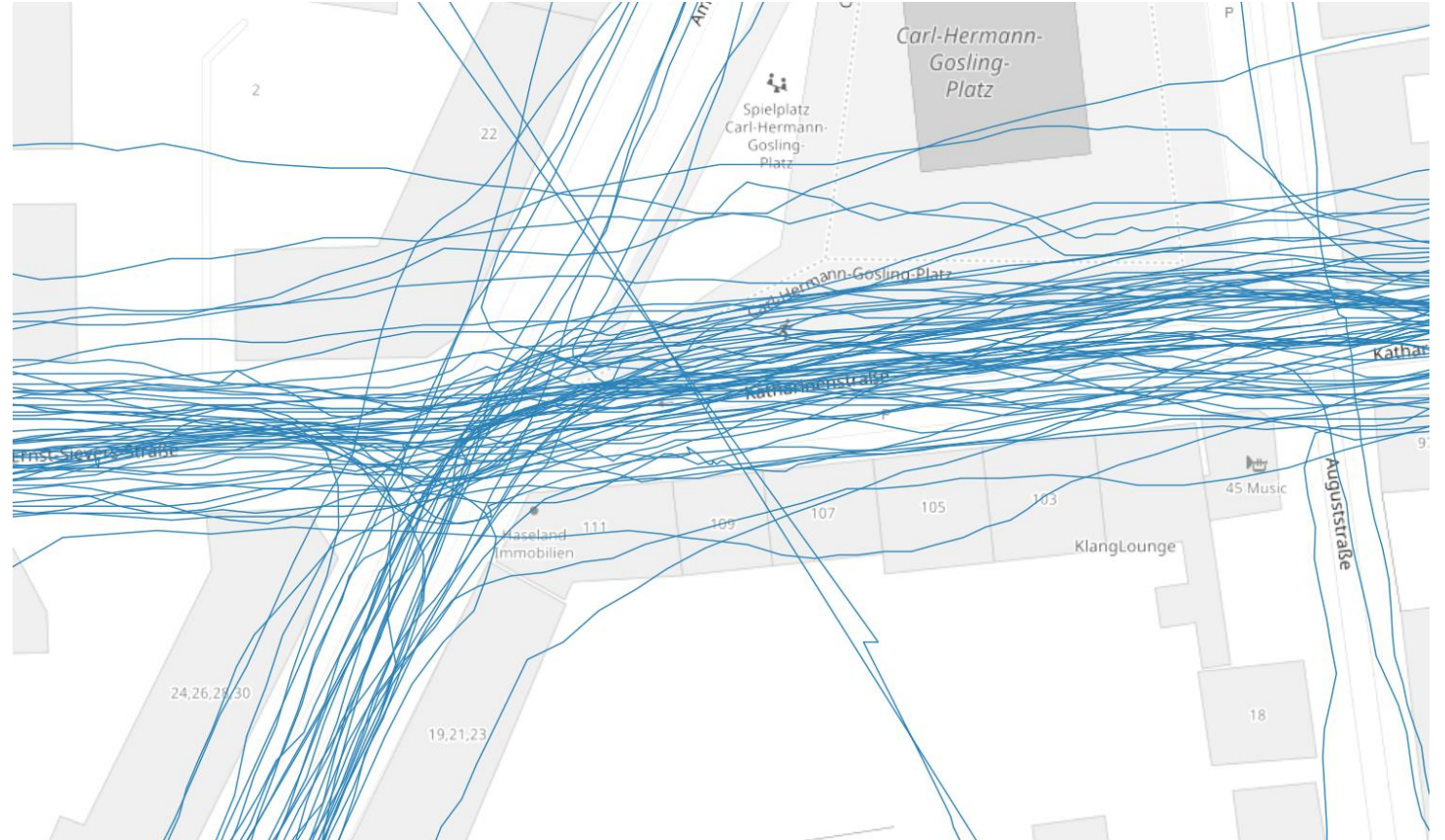


Figure: Scattering of tracked route coordinates at a single intersection

From Test Rides to Navigation Data

Relevance of the direction of travel and turning directions

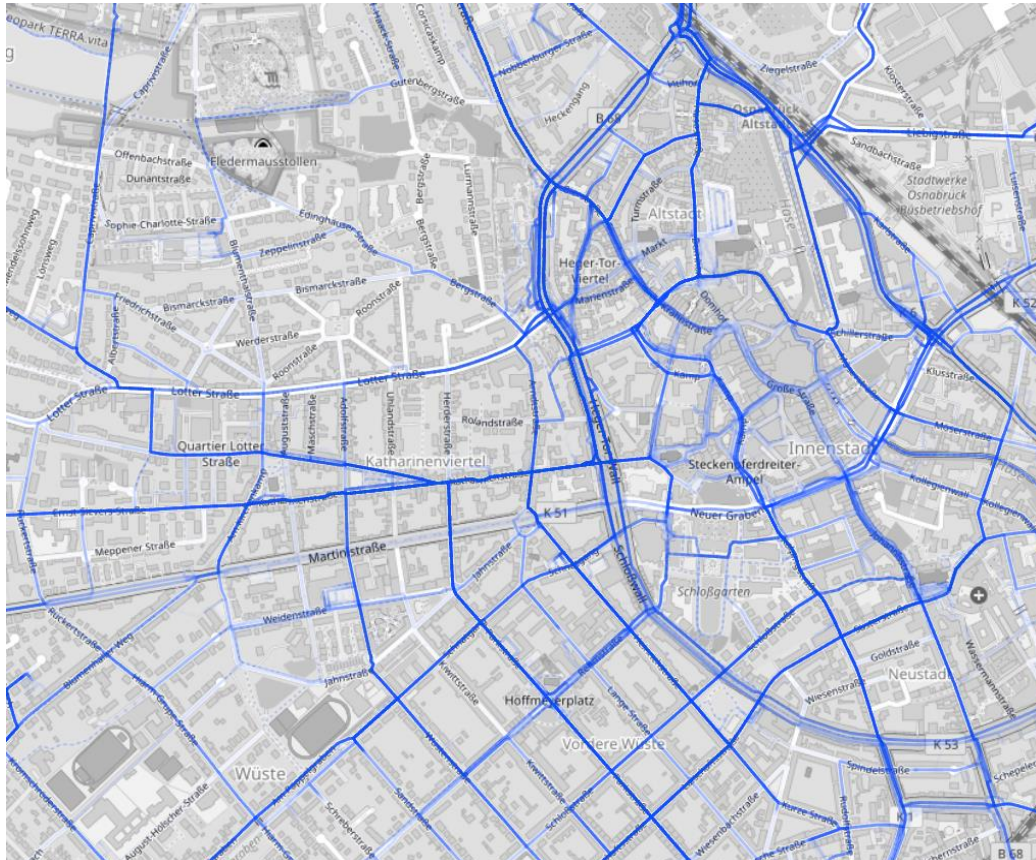


Figure: Coverage of test rides in the centre of Osnabrück (Saturation of the blue tone visualises number of rides)

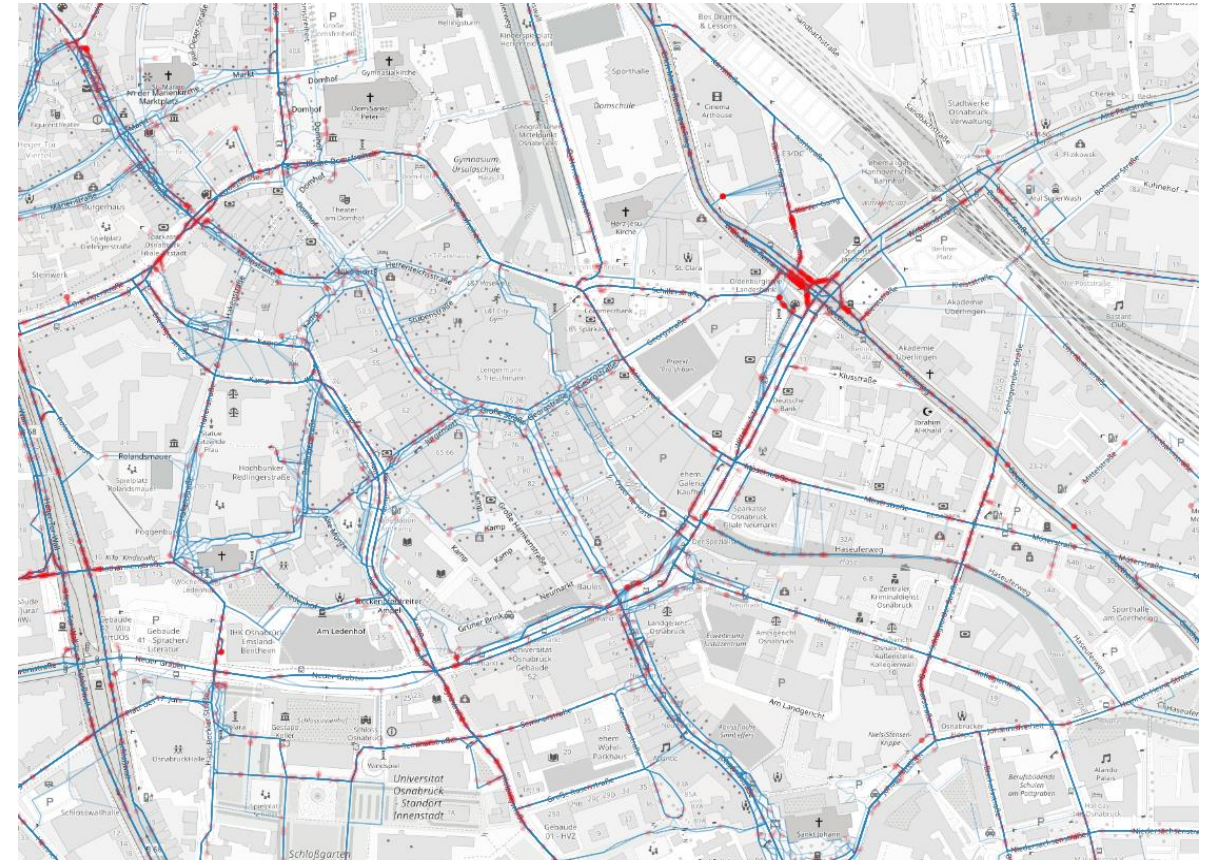
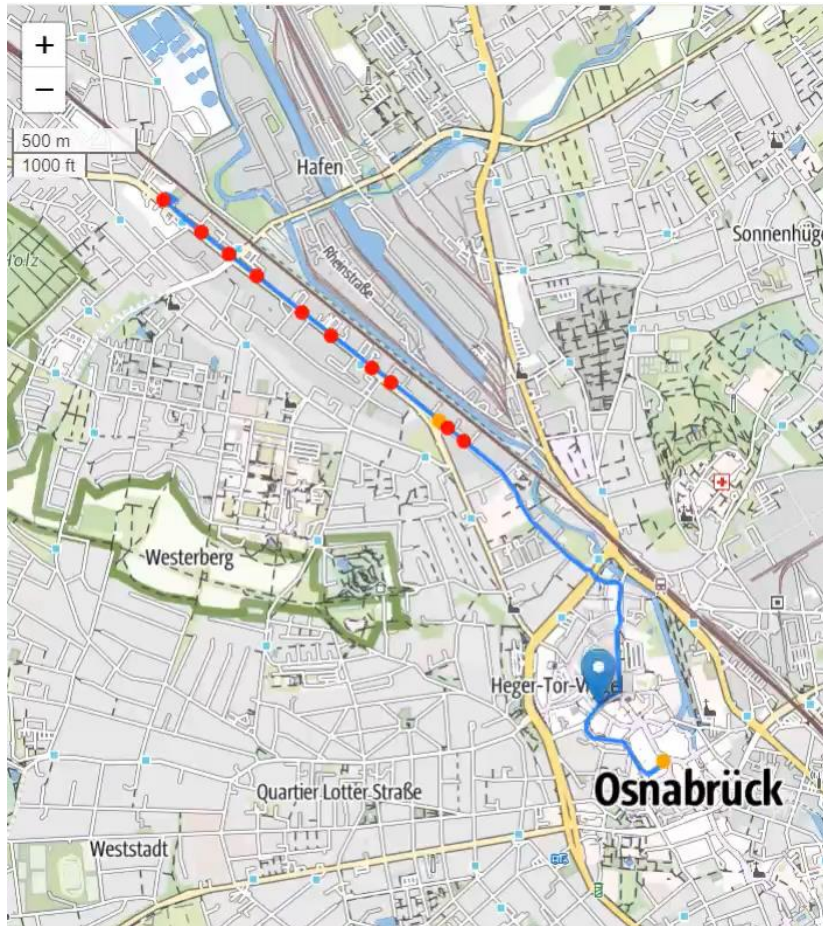


Figure: Coverage of test rides (blue) and visualisation of hotspots (red)

Weighting of Stress Hotspots in Route Planning

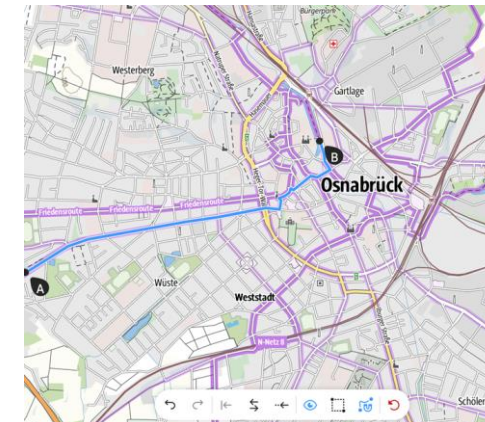
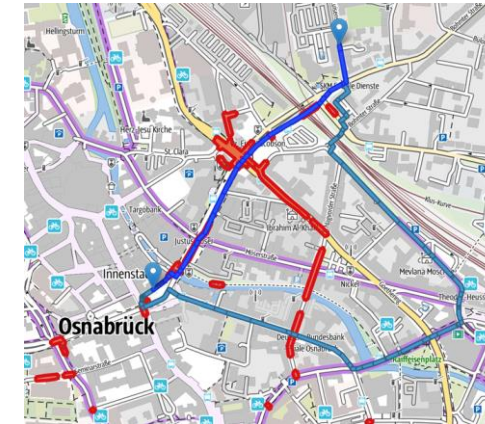
Data analysis of test rides



speed	18 km/h
v	[#####]
orange	moment of stress; speed < 2.0 km/h
red	moment of stress; speed >= 2.0 km/h

play next track

- [LB_1a](#) [8 drivers; 178 runs]
- [LB_1b](#) [4 drivers; 81 runs]
- [OS_1a](#) [17 drivers; 658 runs]
- [OS_1b](#) [16 drivers; 712 runs]
 - [ESSEM_10_Julius](#) [36 runs]
 - [ESSEM_11_Karla](#) [105 runs]
 - [ESSEM_12_Ludwig](#) [37 runs]
 - [2023-01-24T0730](#) [548 points]
 - [2023-01-24T1048](#) [296 points]
 - [2023-01-24T1240](#) [296 points]
 - [2023-02-10T1248](#) [357 points]
 - [2023-02-13T0731](#) [394 points]
 - [2023-02-13T0907](#) [186 points]
 - [2023-02-13T1245](#) [991 points]
 - [2023-02-14T1534](#) [481 points]
 - [2023-02-15T0747](#) [386 points]
 - [2023-02-21T1727](#) [344 points]
 - [2023-02-21T1753](#) [833 points]
 - [2023-02-21T2003](#) [2209 points]
 - [2023-02-21T2040](#) [499 points]
 - [2023-02-23T1448](#) [3848 points]
 - [2023-02-23T1628](#) [244 points]
 - [2023-02-23T1702](#) [285 points]
 - [2023-02-23T1738](#) [72 points]
 - [2023-02-25T0837](#) [1310 points]
 - [2023-02-25T1156](#) [582 points]
 - [2023-02-25T1211](#) [946 points]
 - [2023-02-25T1428](#) [5 points]

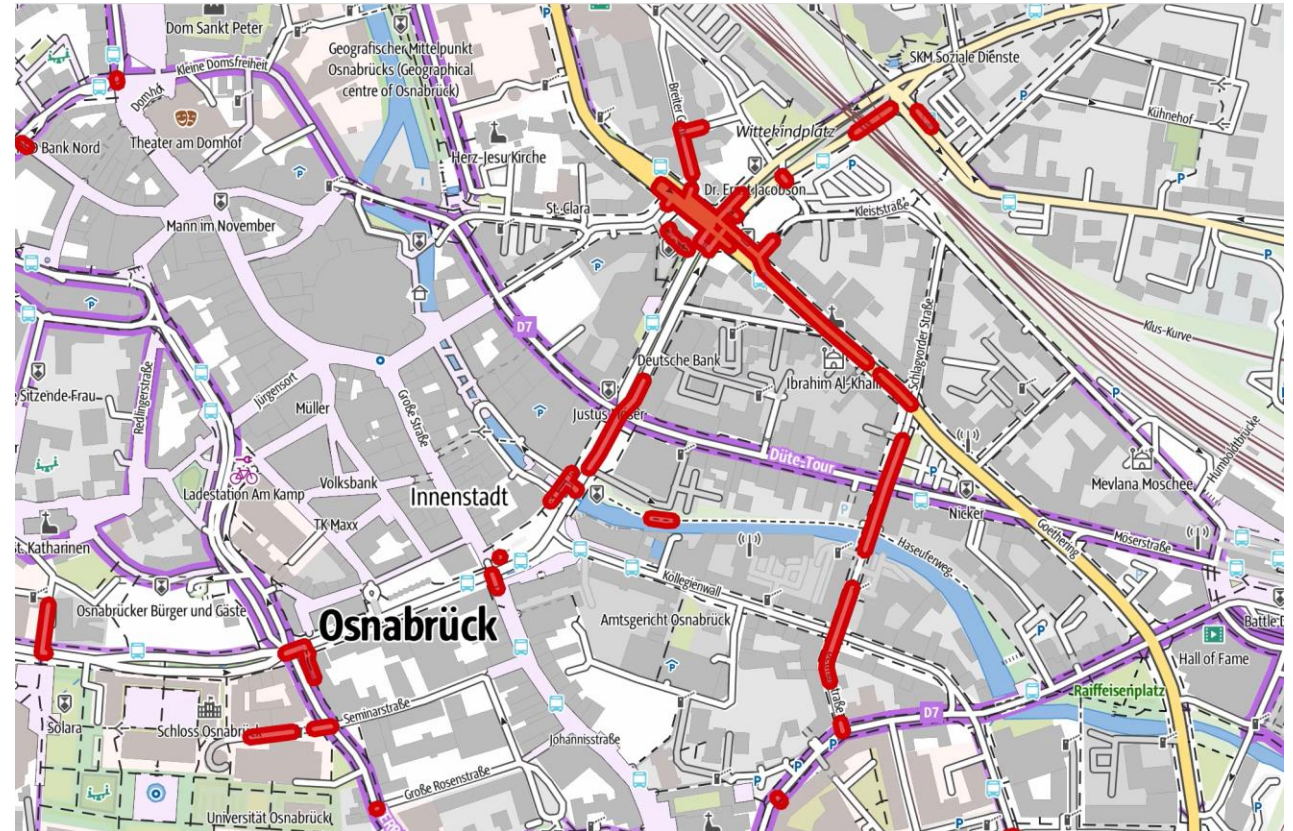


Demonstrator – Route Planning

Route calculation and alternatives to avoid stress

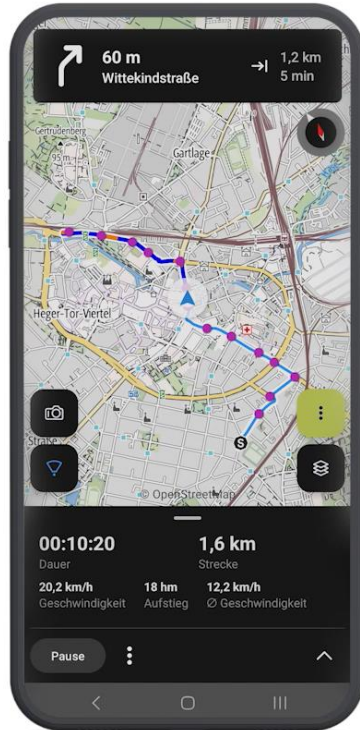
Options and Results

- Display of alternative routes and bypassing of stress hotspots
- Output of stress hotspots on any routes



Demonstrator - Navigation

Test ride navigation

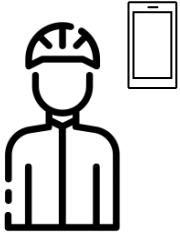


Emotion Sensing for (E-)Bicycle Safety and Mobility Comfort

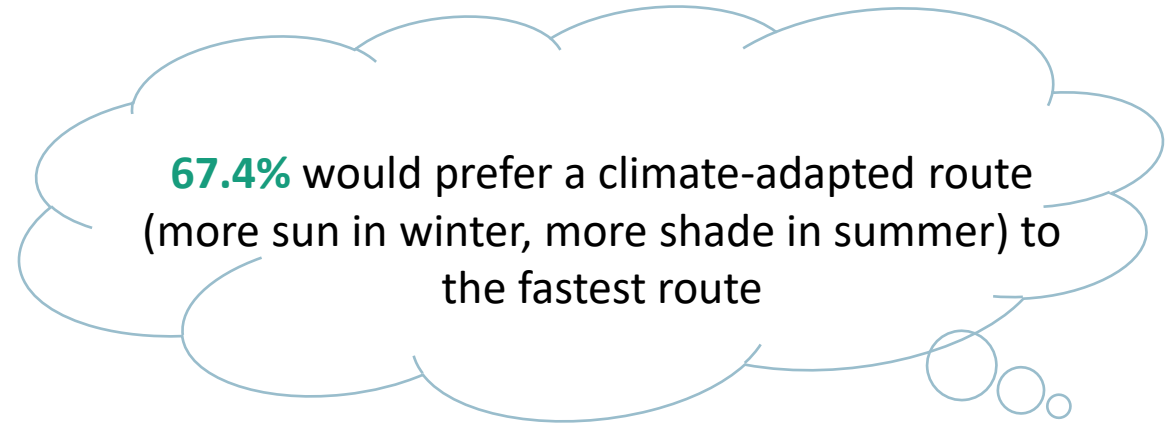


Test Market Validation

Some results



84,8% already use digital applications when cycling....



Would you take a **diversion** on your route if the alternative route was ...

... **safer?** **94,3%** for recreational cycling
77,8% for cycling to work

... **more enjoyable?** **97,1%** for recreational cycling
77,8% for cycling to work

The **3 most important factors** to enjoy a cycling route



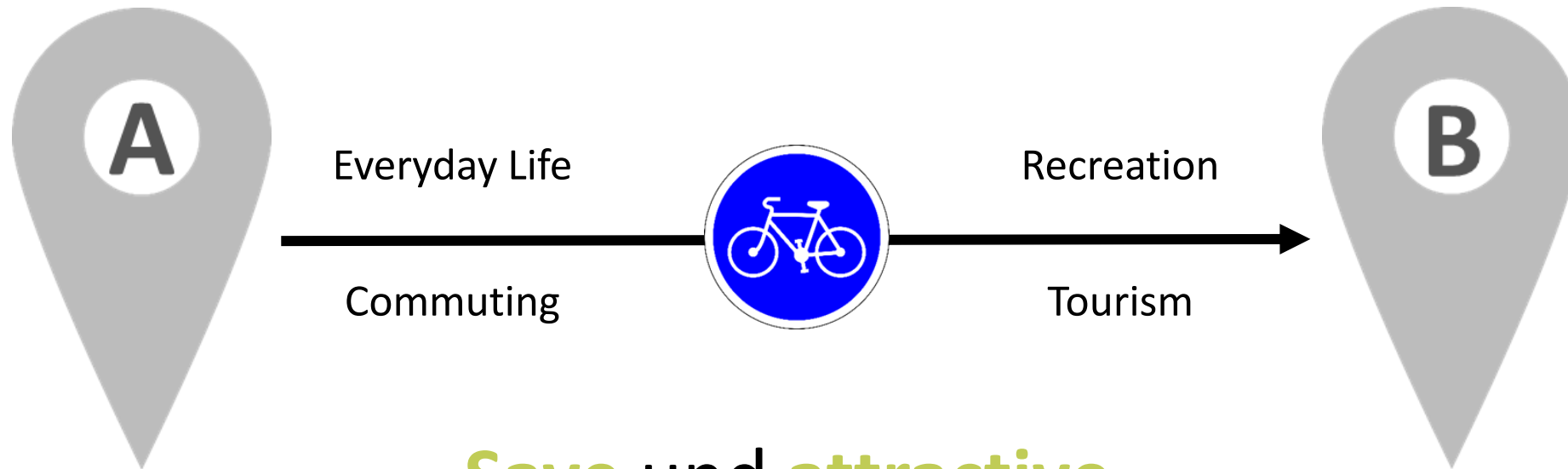
89,1% Scenic beauty
84,8% Low traffic volume
73,9% Good conditions of cycling paths



Business Perspective & Outlook

Insights for Exploitation

Safety Comfort Zone and Joy of Experience



Save und attractive
cycle routes and navigation

Business Exploitation Perspectives

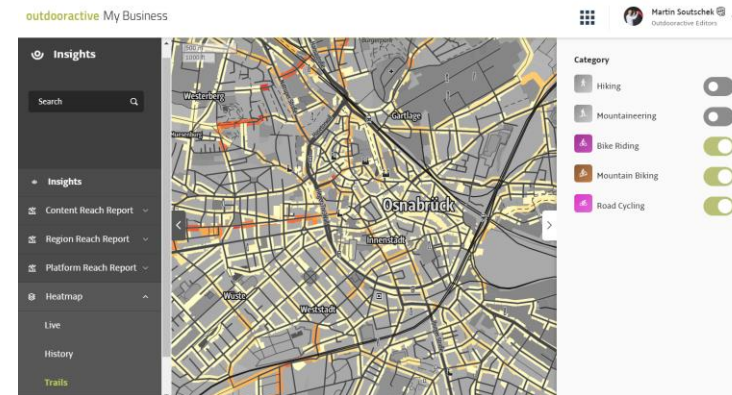
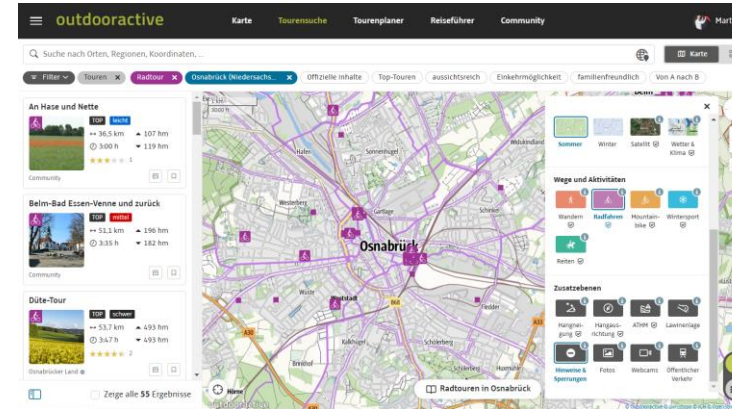
Added values for different target groups

End Consumers (B2C)

- “Better” routes
- Integration of warnings
- Increased acceptance for cycling and habit change

Business Partners (B2B)

- Tourism destinations, cities, municipalities
- Trail managers
- Infrastructure planning, maintenance



Outlook: Emotion Sensing Data as Part of a Digital Data Infrastructure for Bicycle Mobility

Relevance for everyday life and on vacation



Image source: Pixabay, User:Surprising_Media // User: michaelbuch60

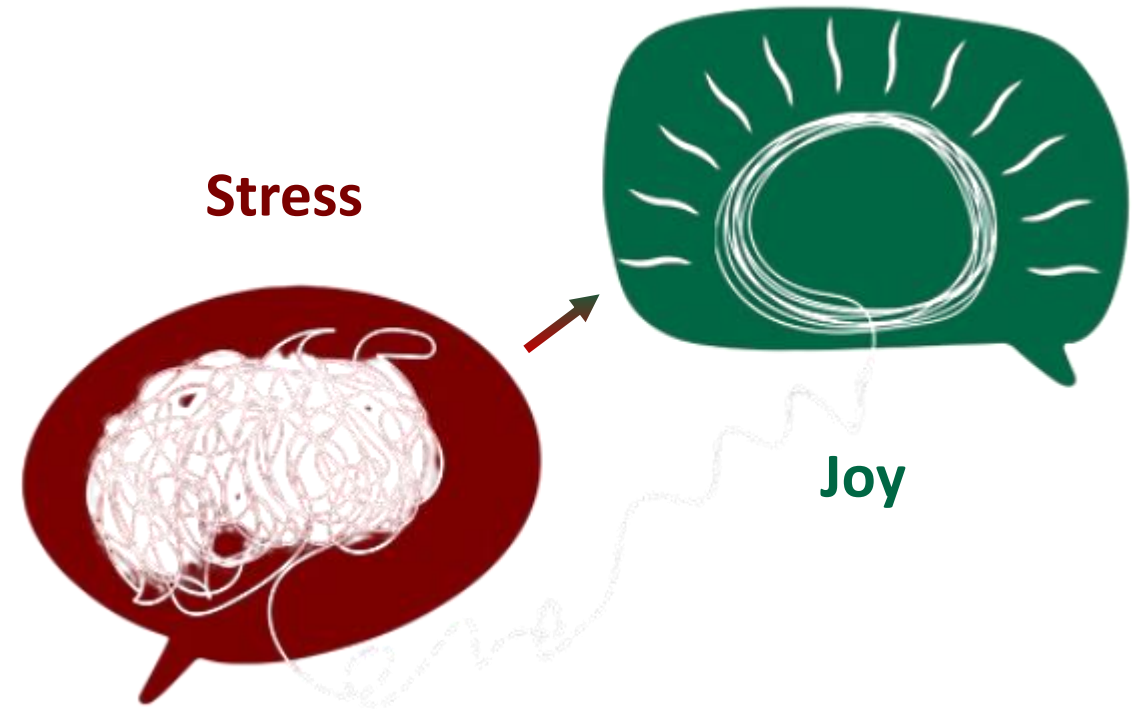


Image source: Pixabay, User: RosZieHans

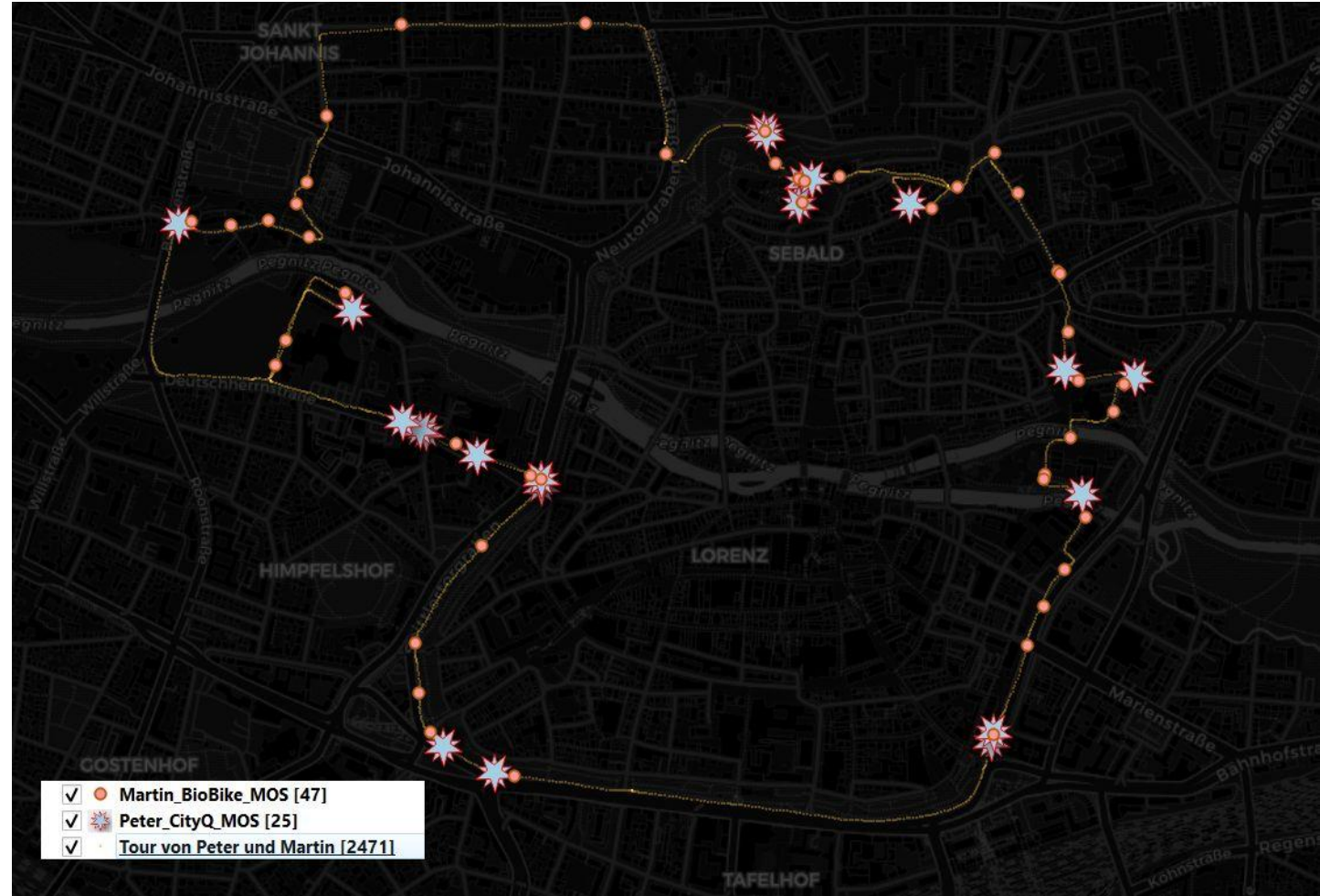
Three Wheels Ahead – Comfort Zone Improvement?

Innovations – Weather protected cycling: Hopper Mobility



Four Wheels Ahead - Comfort Zone Improvement?

Innovations – Weather protected cycling: CityQ



Inclusive Bicycle Mobility Potential – The Data Perspective

Special Purpose Bikes: Van Raam



Image source: [Mattes, Wikimedia Commons \(Creative Commons Attribution-Share Alike 3.0 Unported\)](#) (Image cropped)



Image source: [Erik Wannee, Creative Commons Attribution-Share Alike 4.0 International](#) (Image cropped)



Emotion Sensing for (e-)bicycle safety and mobility comfort



Thank you for your attention and your interest!
We look forward to your questions.



Discussion & Questions

Workshop series

DRIVEN by DATA

The mFUND Workshops Series about Mobility in Europe

Will be continued in August.

Dates and topics will be announced on LinkedIn and on the Daten+ Website:

daten.plus/driven-by-data-workshops

Have a great summer and see you in August!

Federal Ministry for Digital and State Modernisation (BMDS)

24.06.2025



www.linkedin.com/groups/12778505

