ETH zürich goNEON!

E-Bike City: From a Vision to Practical Planning Tools

Catherine Elliot
Lukas Ballo

Velokonferenz Webinar

September 11, 2025

Ballo & Cardoso (2024)
ETH «E-Bike City» Project
Visualisation: Nightnurse

The E-Bike City Team

Principal investigators


Prof. Kay Axhausen


Prof. Bryan Adey


Prof. Michel Bierlaire


Prof. Francesco Corman


Prof. Stefanie Hellweg


Prof. David Kaufmann


Dr. Anastasios Kouvelas


Prof. Stephan Pfister


Prof. Martin Raubal

Researchers


Lukas Ballo


Florian Fuchs


Ayda Grisiute


Clarissa Livingston


Adrian Meister


Lucas Meyer de Freitas


Dr. Marco Miotti


Ying-Chuan Ni


Vanessa Schenker


Claudia Sinatra


Dr. Michael Wicki


Nina Wiedemann


David Zani

Coordinator


Dr. Catherine Elliot

Media relations


Iris Mickein

Webmaster


Patrick Scherer

Funding

energieschweiz

DBAUG

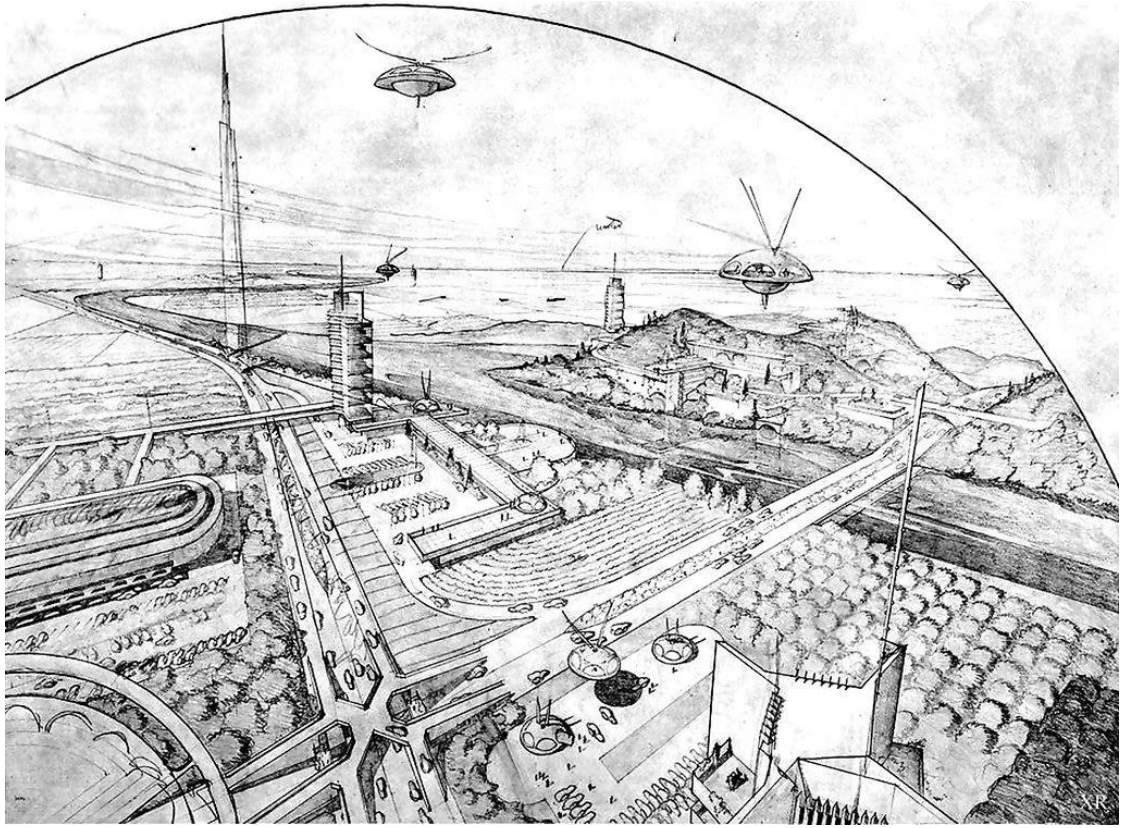
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE

Schweizerische Studienstiftung

Past Dreams

LeCorbusier, Plan Voisin (1925)



Frank Lloyd Wright, Broadacre City (1932)

Economic and Social Benefits

Car travel times 1950

Car travel times 2000

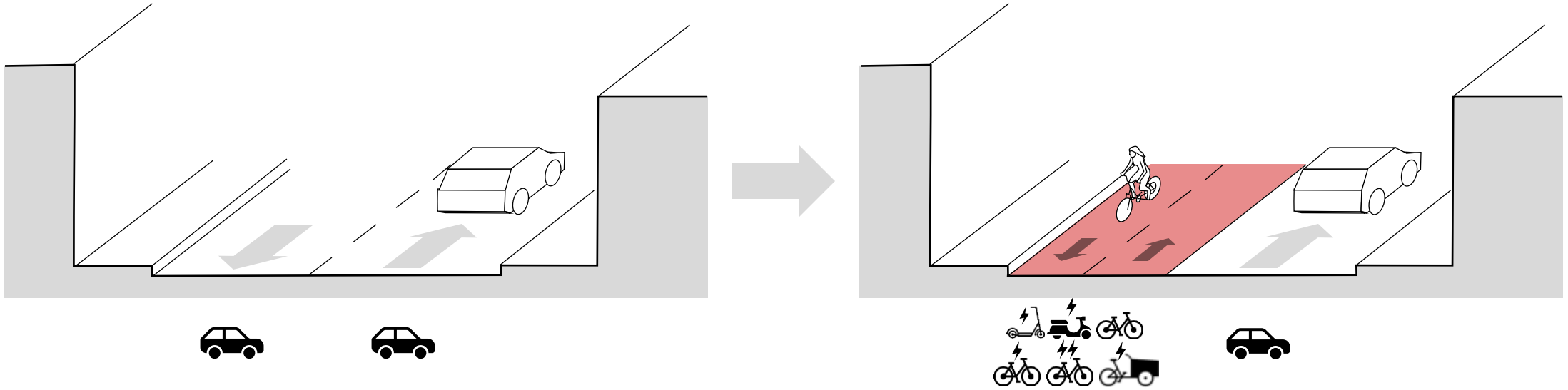
Scherer, 2004

Alternatives?

Cycling?

https://www.fosterandpartners.com/projects/skycycle
https://x.com/XHNews/status/832146910085574658/photo/2
https://www.chinadaily.com.cn/a/201905/31/WS5cf0765ea3104842260beca3.html

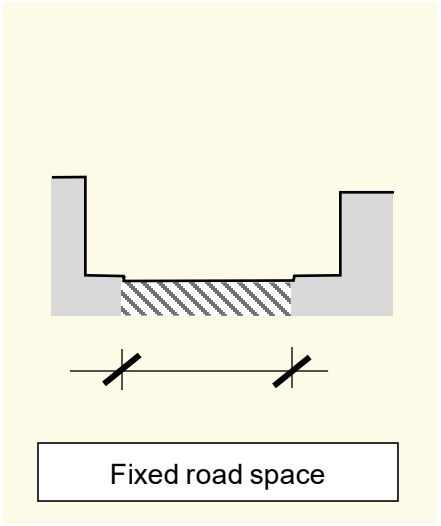
What If: An “E-Bike City”



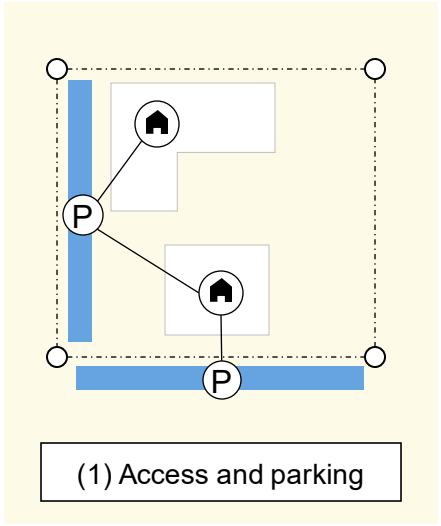
Ballo, L., L. Meyer de Freitas, A. Meister and K.W. Axhausen (2023) The E-Bike City as a radical shift toward zero-emission transport: Sustainable? Equitable? Desirable?, *Journal of Transport Geography*, **111**, 103663.

Network Design

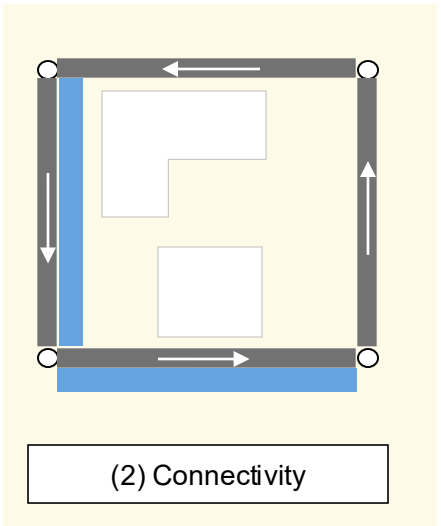
- Need to redesign the entire network within the available road space



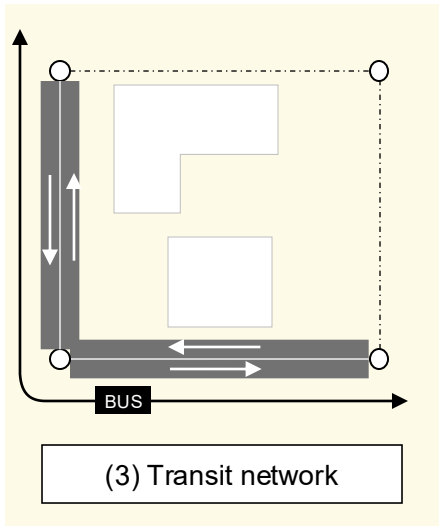
Fixed road space



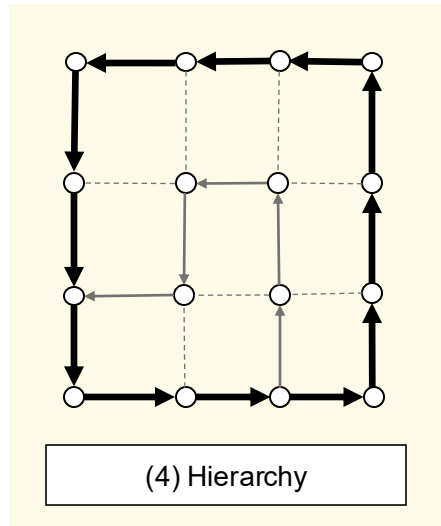
(1) Access and parking



(2) Connectivity



(3) Transit network



(4) Hierarchy

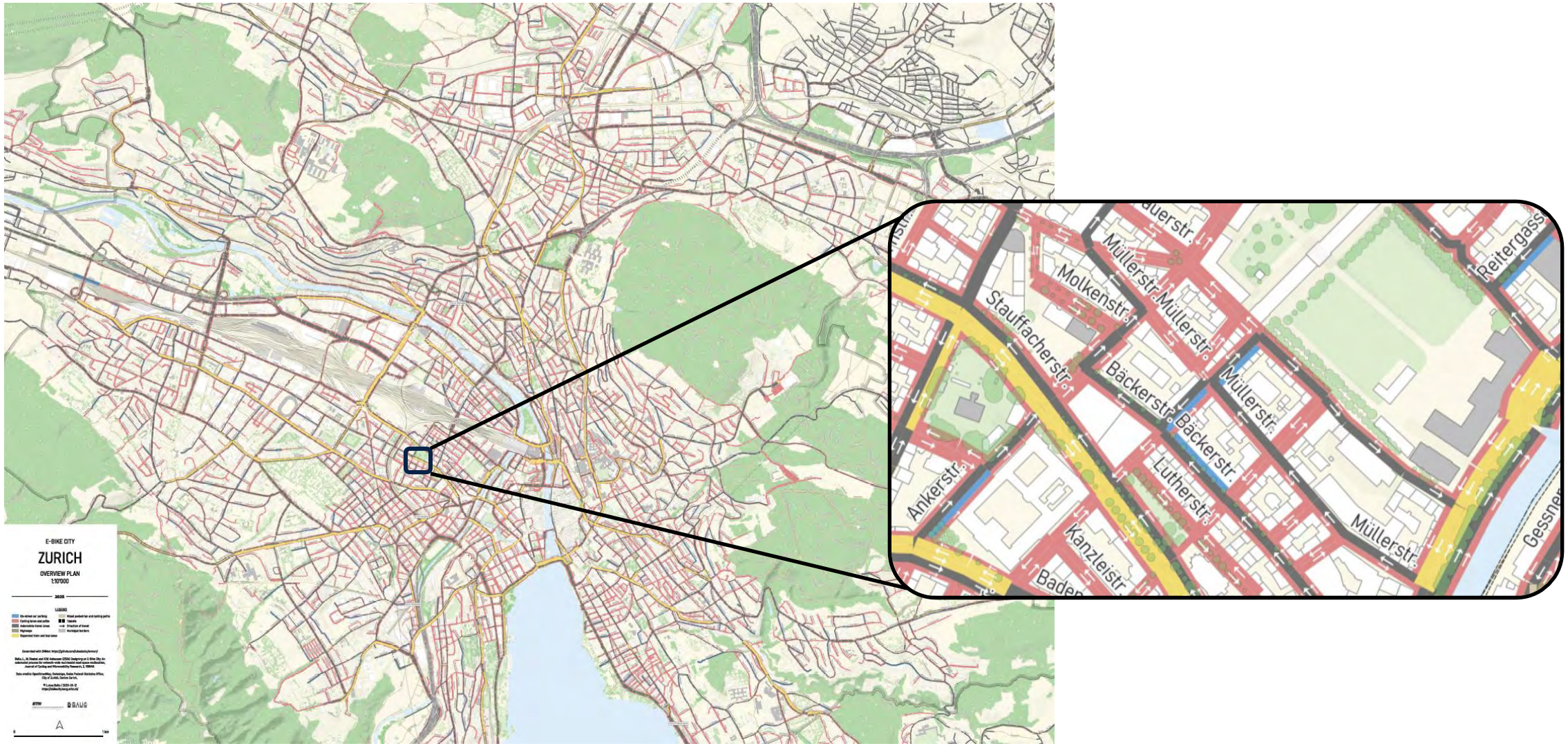
Permanent Residents

Parking Lanes

Driving Lanes

Ballo, L., M. Raubal and K.W. Axhausen (2024) Designing an E-Bike City: An automated process for network-wide multimodal road space reallocation, *Journal of Cycling and Micromobility Research*, **2**, 100048.

A Plan for the Entire City



Street Design

Mit Unterstützung von

energieschweiz

Ballo & Cardoso (2024)
Visualization: Nightnurse

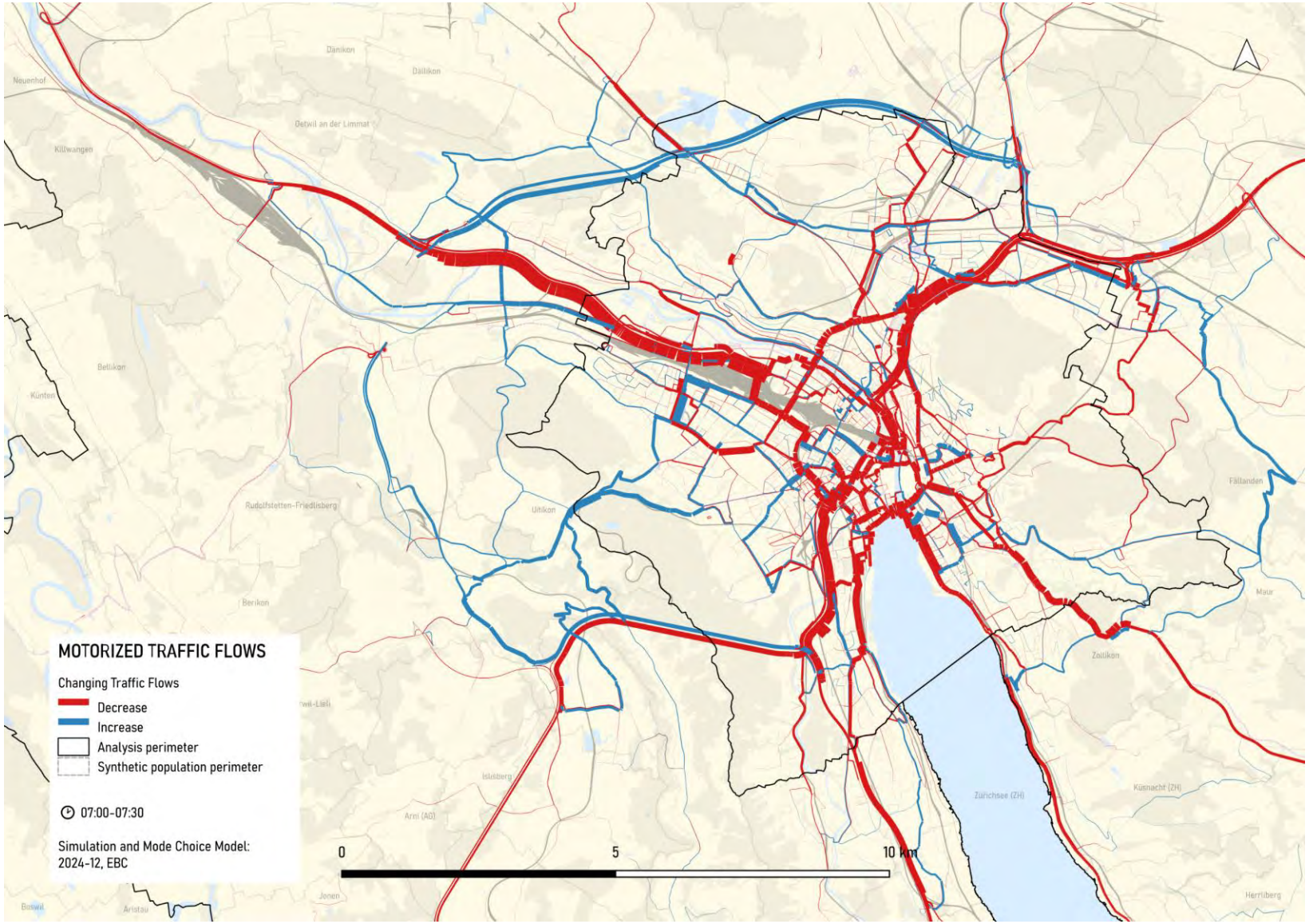
Individual Experience

Ballo & Cardoso (2024)
Visualization: Nightnurse

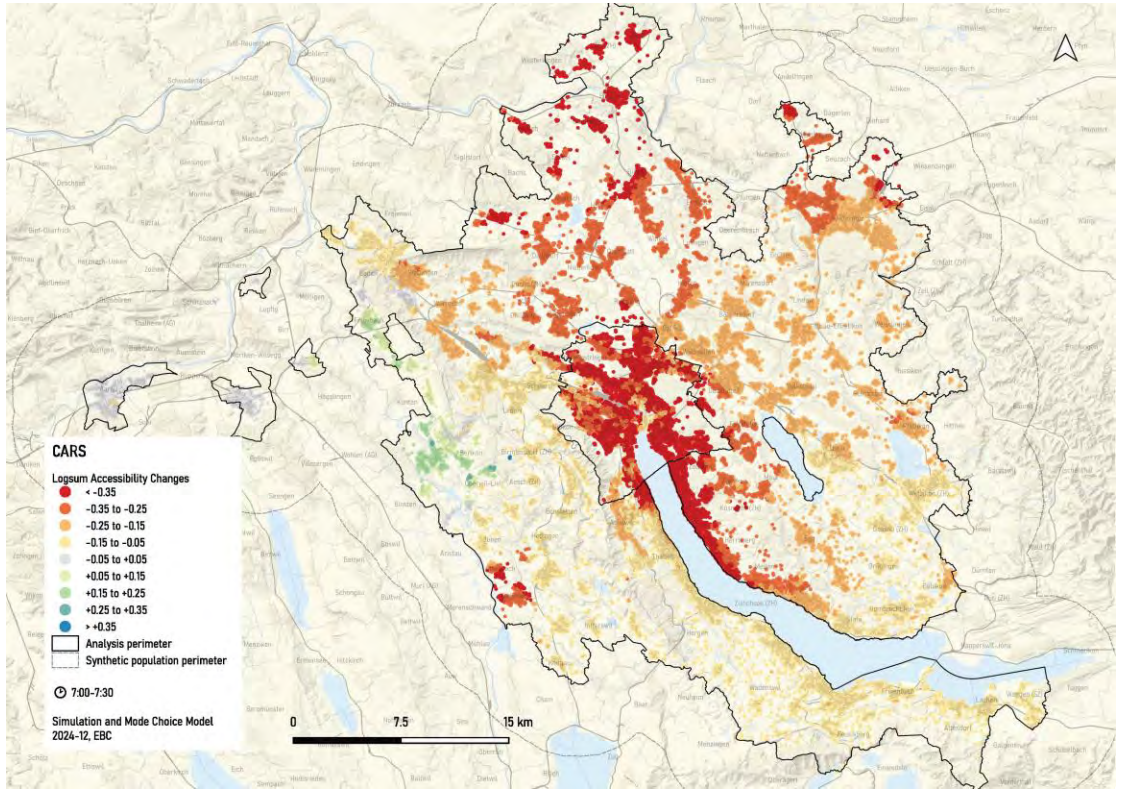
Individual Experience

Ballo & Cardoso (2024)
Visualization: Nightnurse

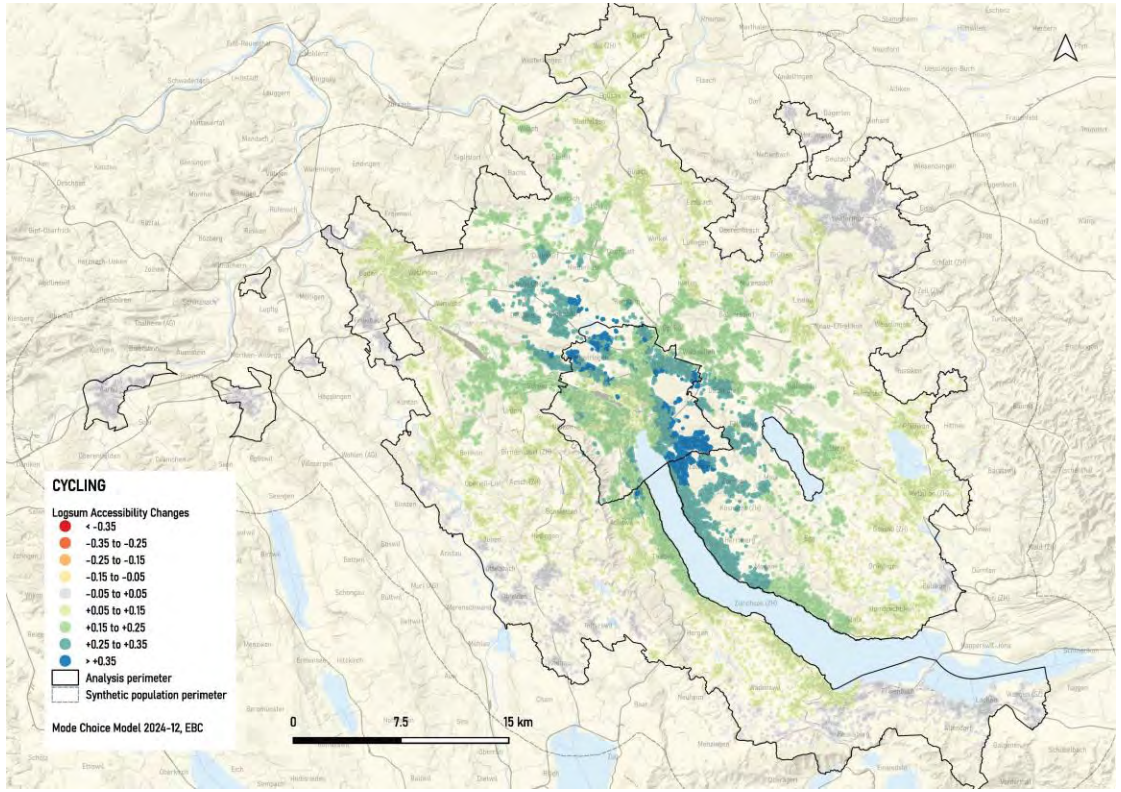
Changes to Motorized Traffic Flow



Effects on Individual Accessibility



BY CAR



BY BICYCLE

goNEON!

Revolutionizing Planning.

Schweizer Freibäder «zum Bersten voll»

▲ Das Flussbad Letten an der Limmat in Zürich war am Samstag beliebt. KEYSTONE/MICHAEL BUHOLZER sda-ats

Switzerland, 1985-2025 (40 Years):

+0%

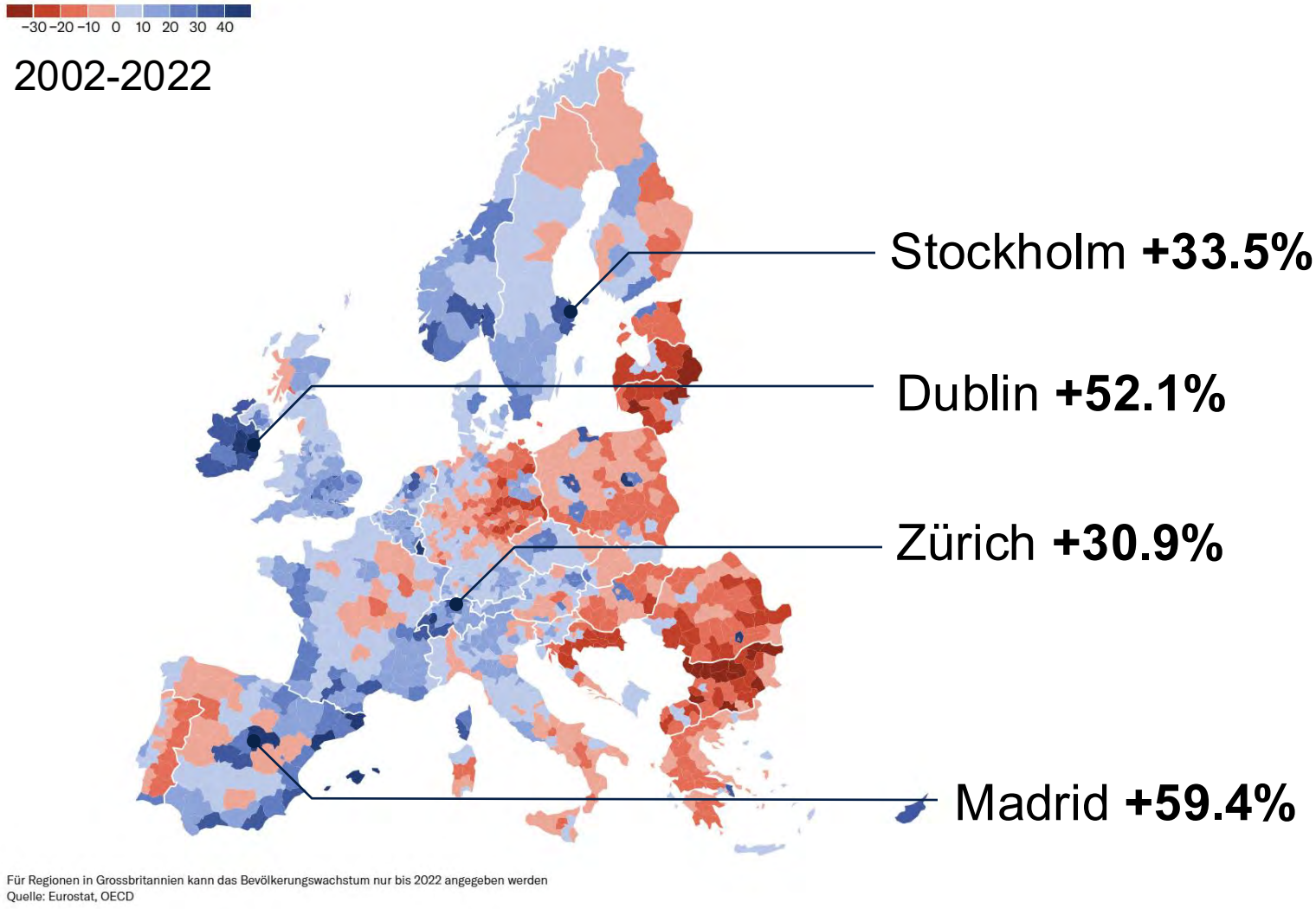
Public Lidos

+32%

Population

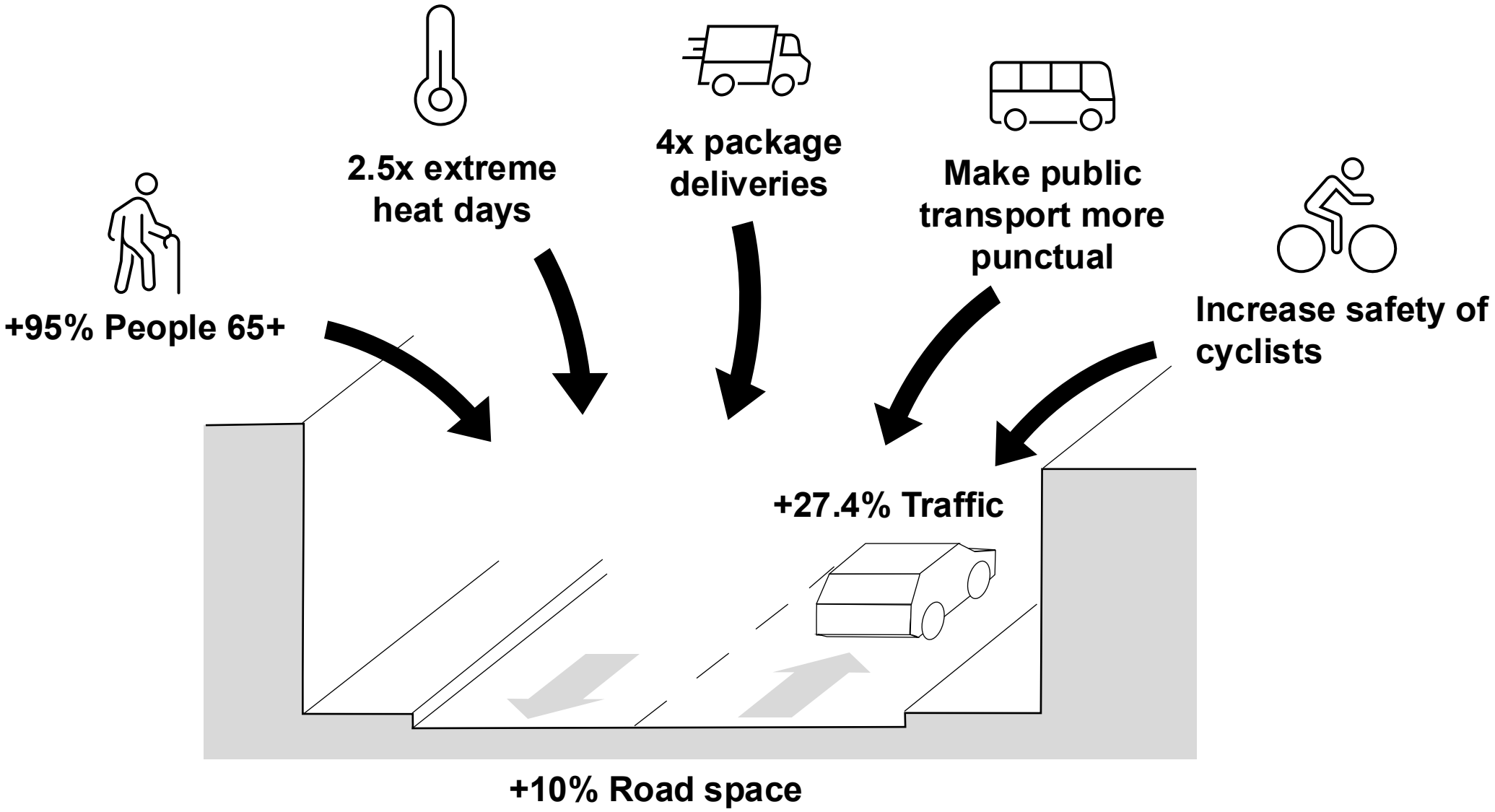
https://www.nzz.ch/schweiz/real-oder-nur-eingebildet-dem-dichtestress-auf-der-spur-ld.1892901

Rapid Population Growth in urban Centers

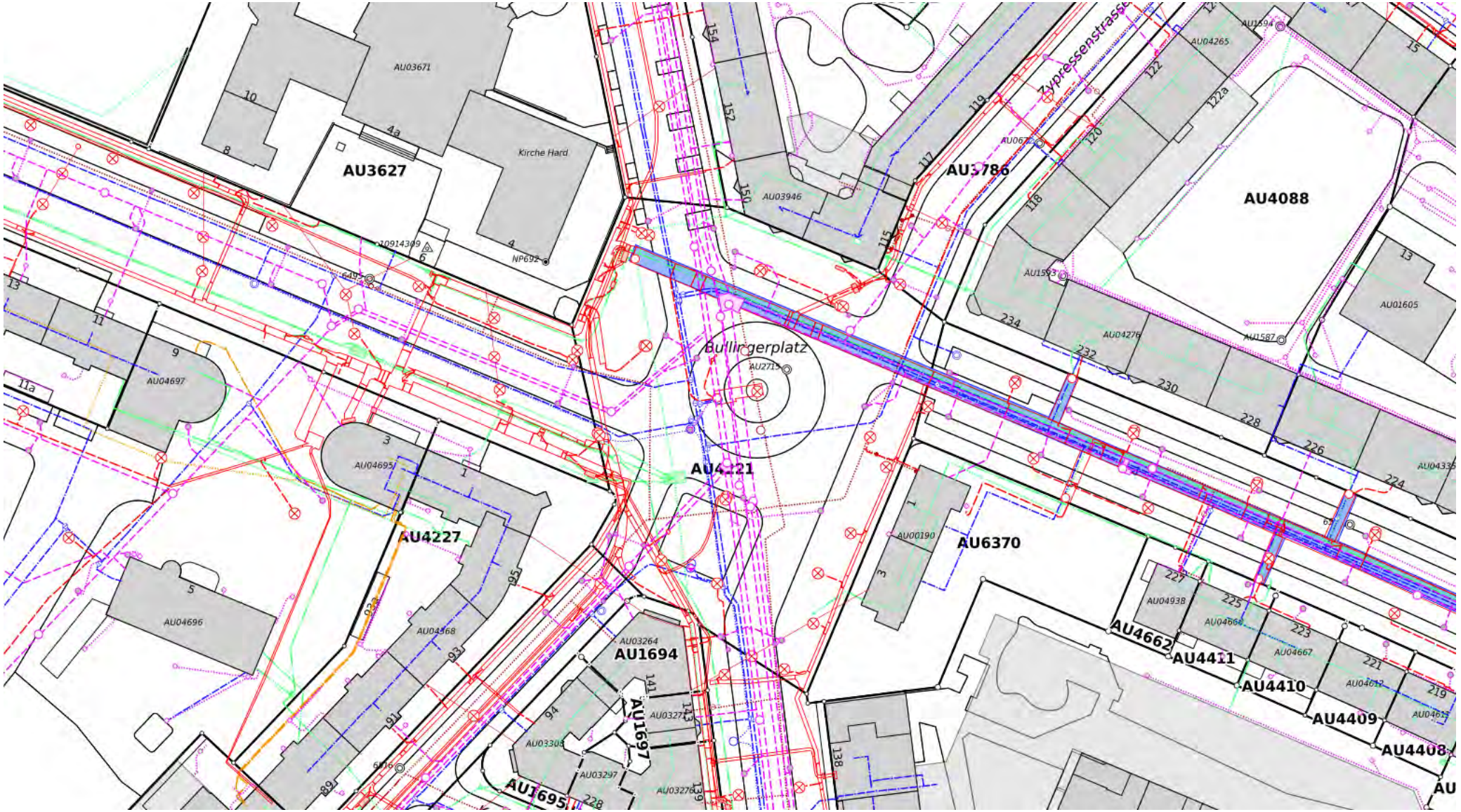


https://www.nzz.ch/pro/bevoelkerungswachstum-in-europa-so-steht-die-schweiz-im-vergleich-da-ld.1772856

Limited Street Space - Exploding Demands



+ Complexity of Underground Infrastructure

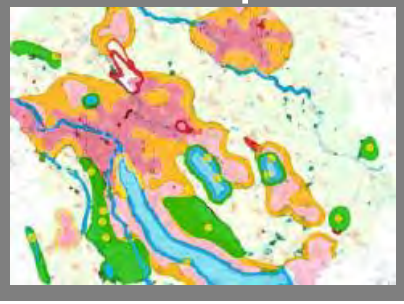


Utility cadaster Zurich (2025)

Revolutionizing Planning

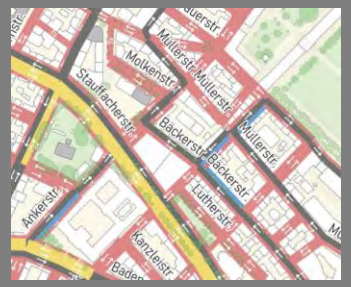
LEGACY

master plan → cencepts → projects



YEARS

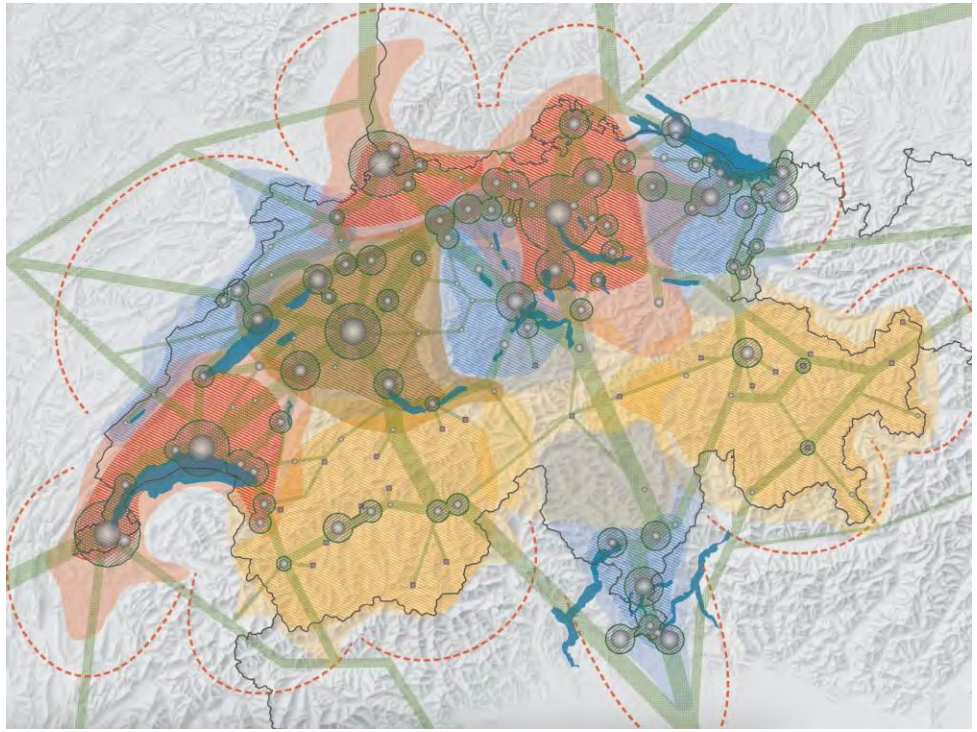
goNEON!

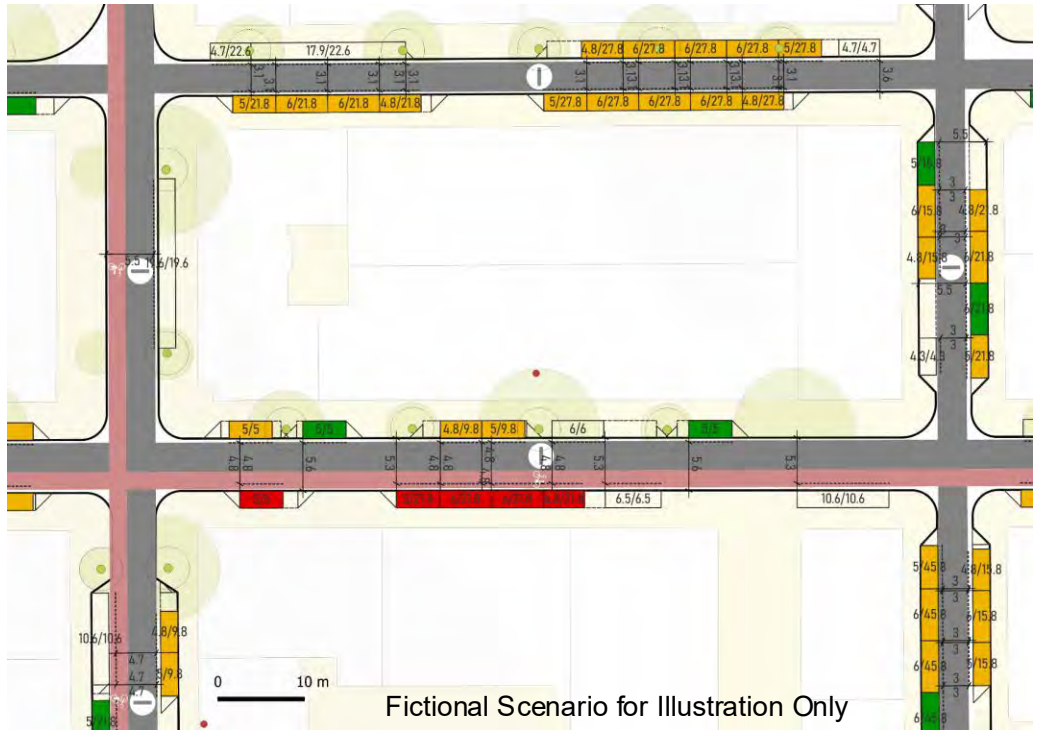


WEEKS

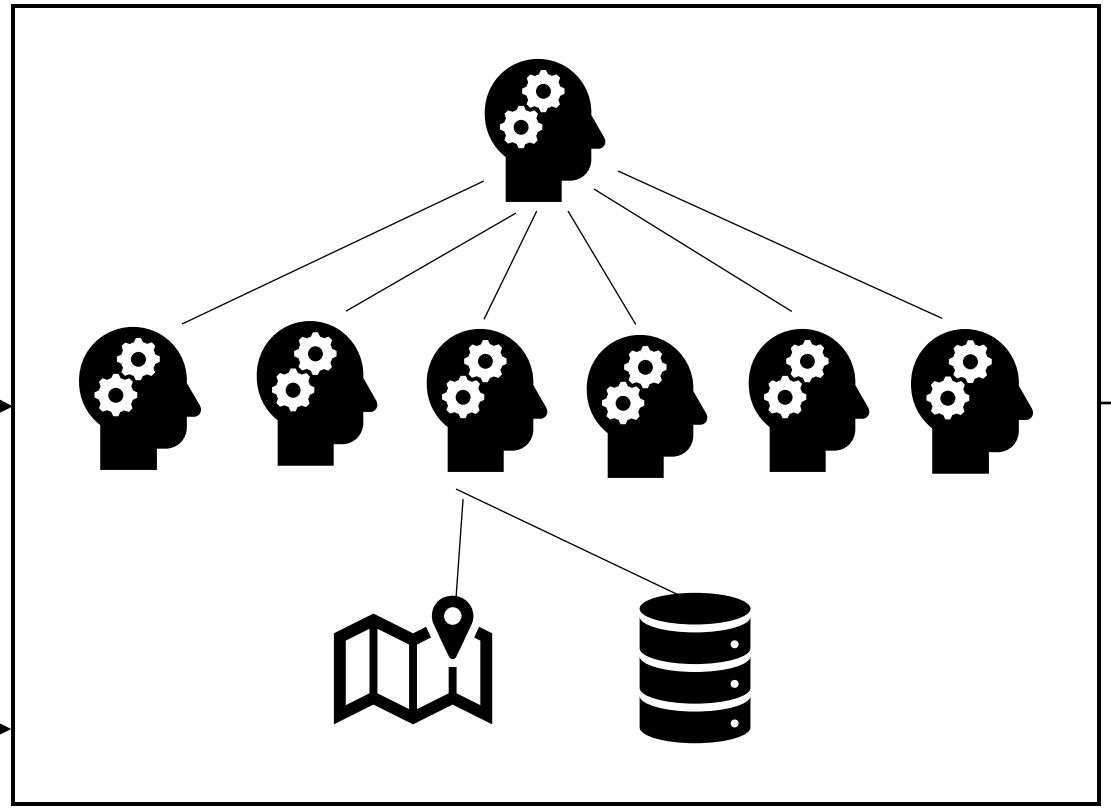
- Instant evaluation of alternatives
- Transparency and consistency
- AI-assisted design

Consistency Between Concepts and Details

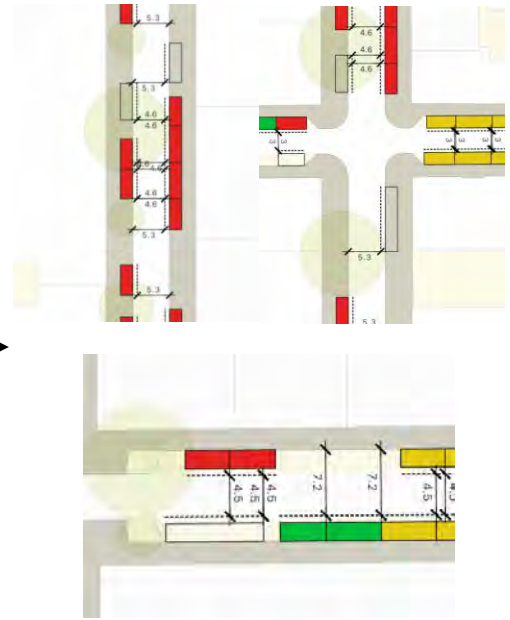




Validate all parking spaces according to the provided guidelines

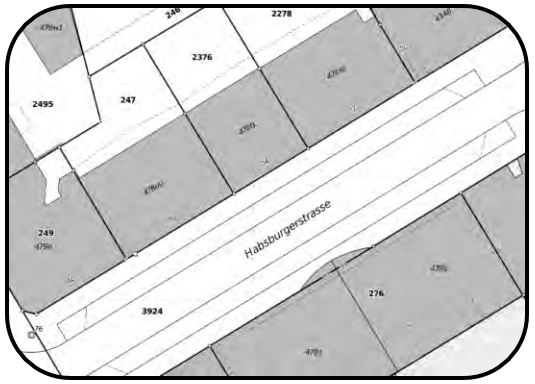


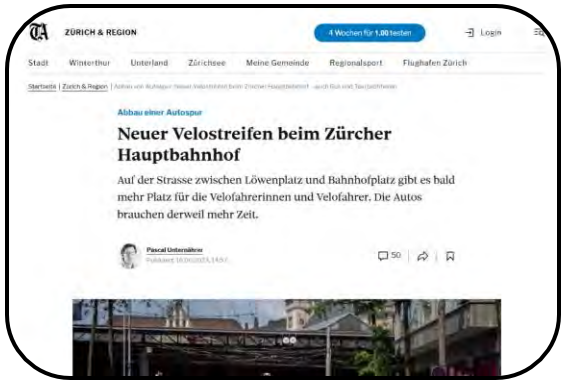
goNEON!



Fictional Scenario for Illustration Only

Data Sourcing





OPEN DATA SOURCES

CITY-SPECIFIC DATA

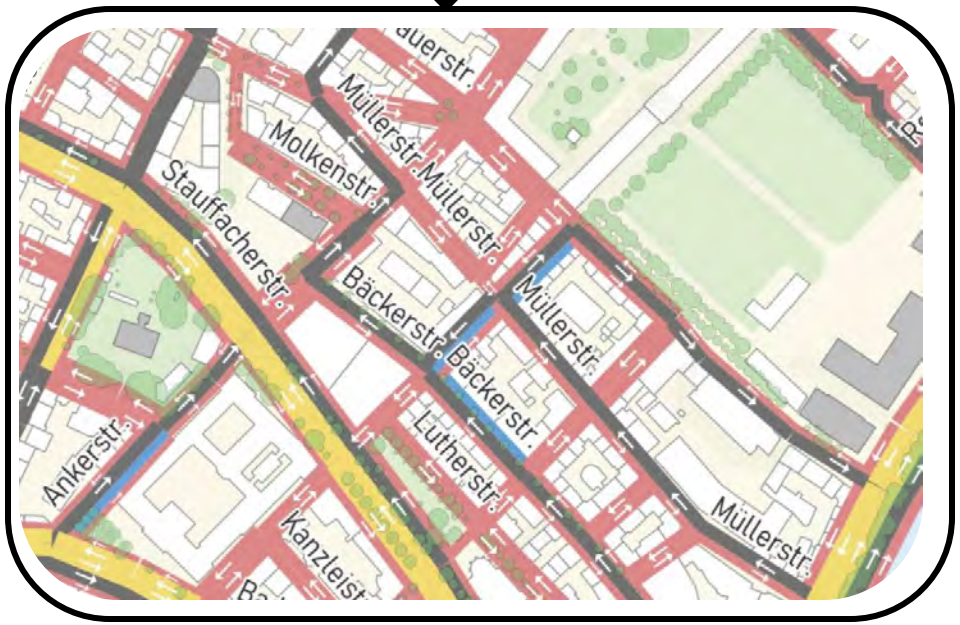
TEXT-BASED INFORMATION

IMAGE RECOGNITION

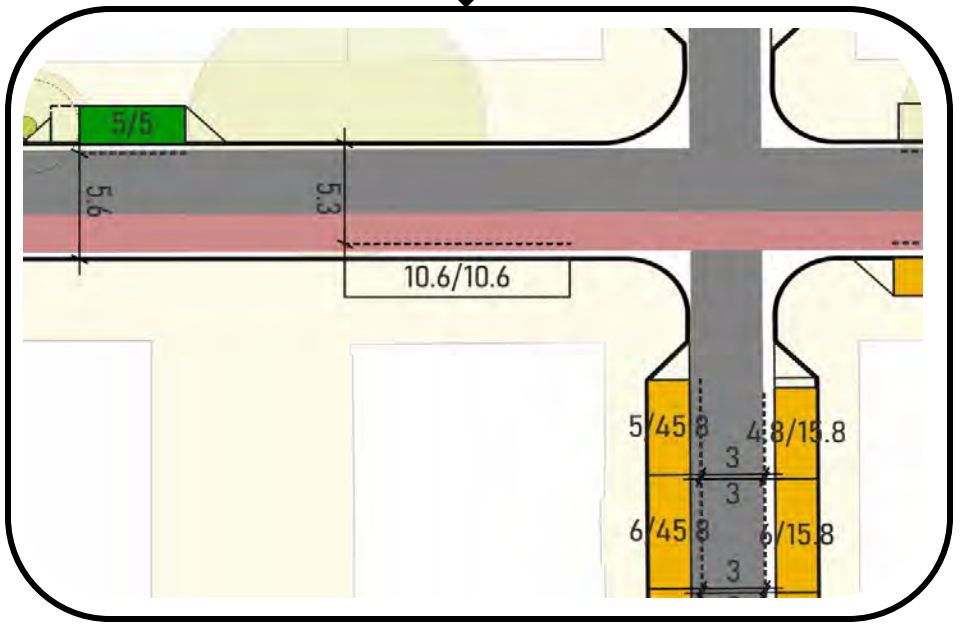
goNEON!

Use Cases

goNEON!



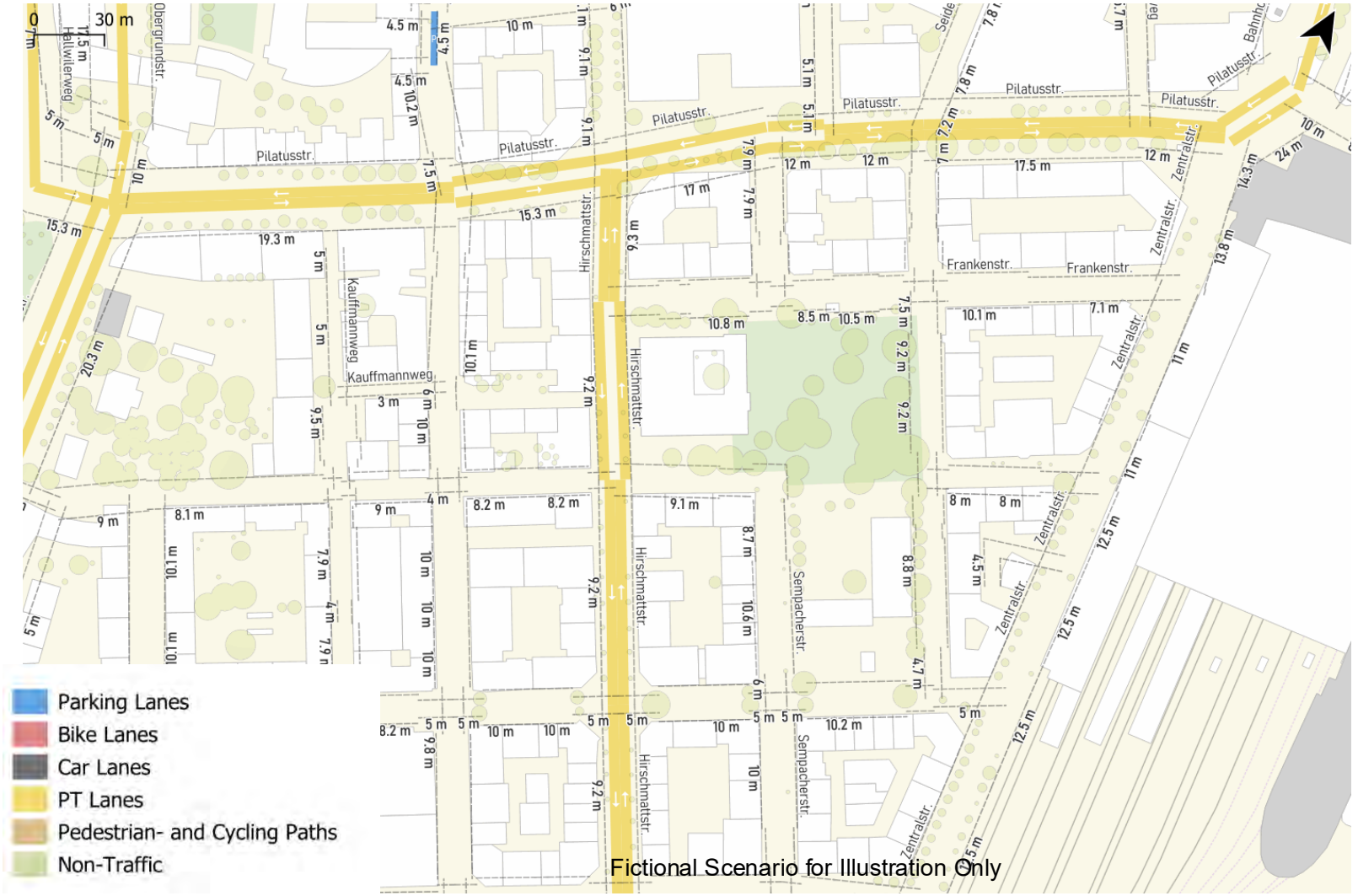
NETWORK DESIGN



PARKING AND CURB DESIGN

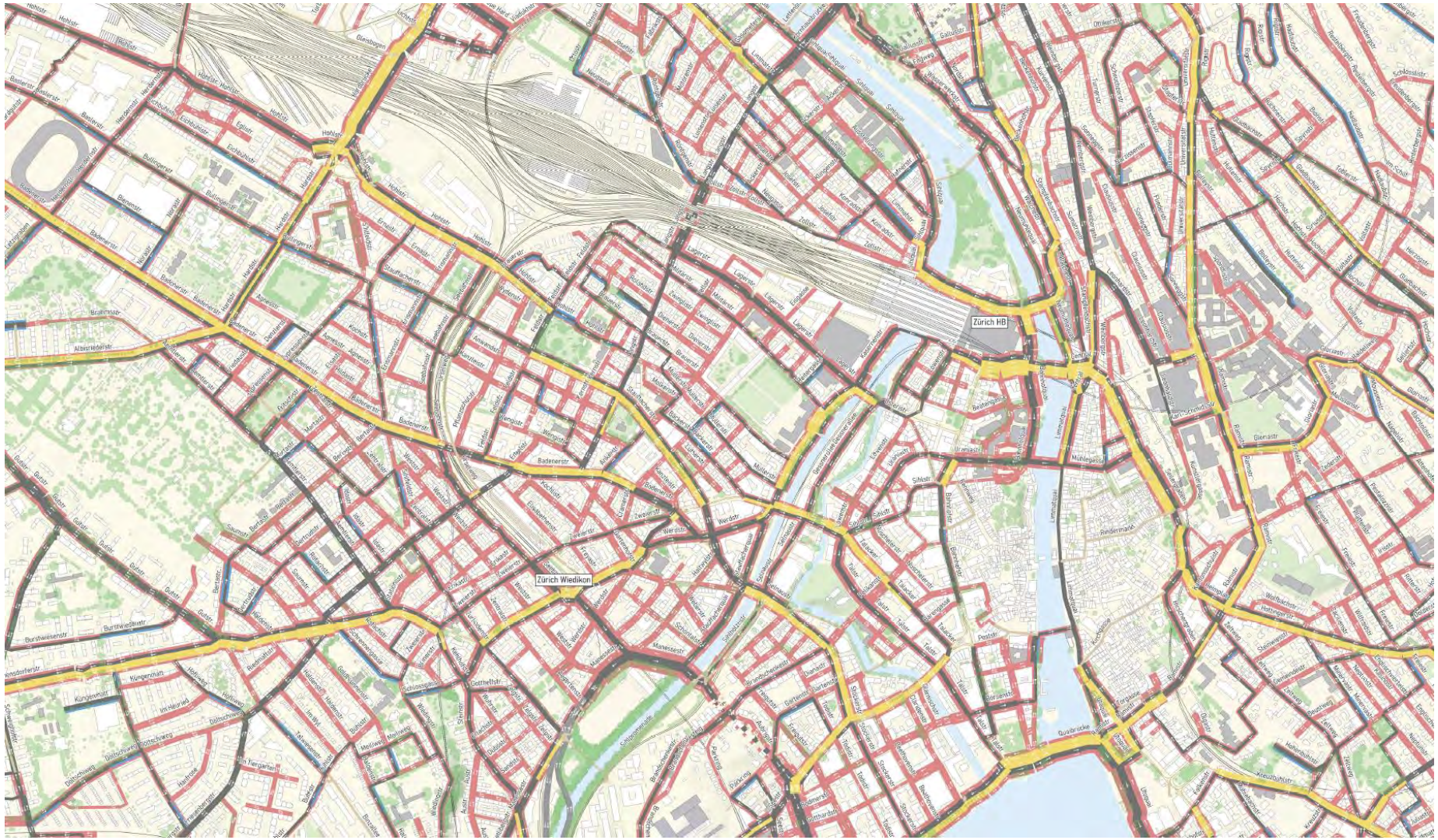
Network Design

- One-way streets
- On-street parking
- Green Spaces
- Bus lanes

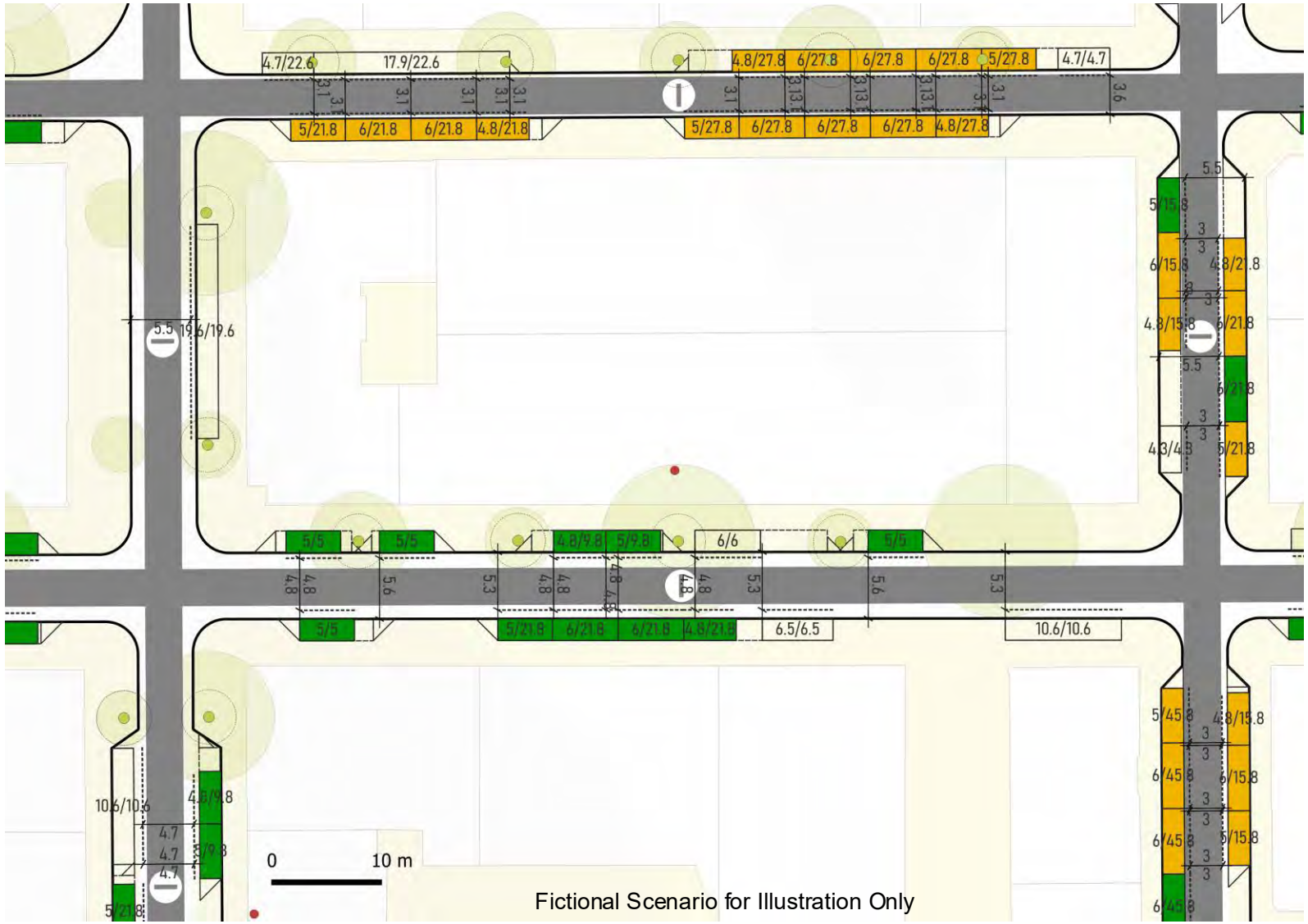


Fictional Scenario for Illustration Only

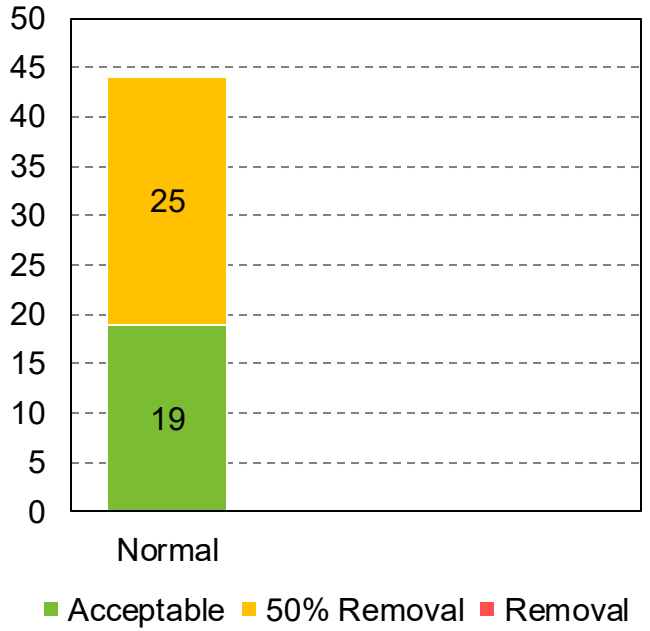
… for Entire Cities



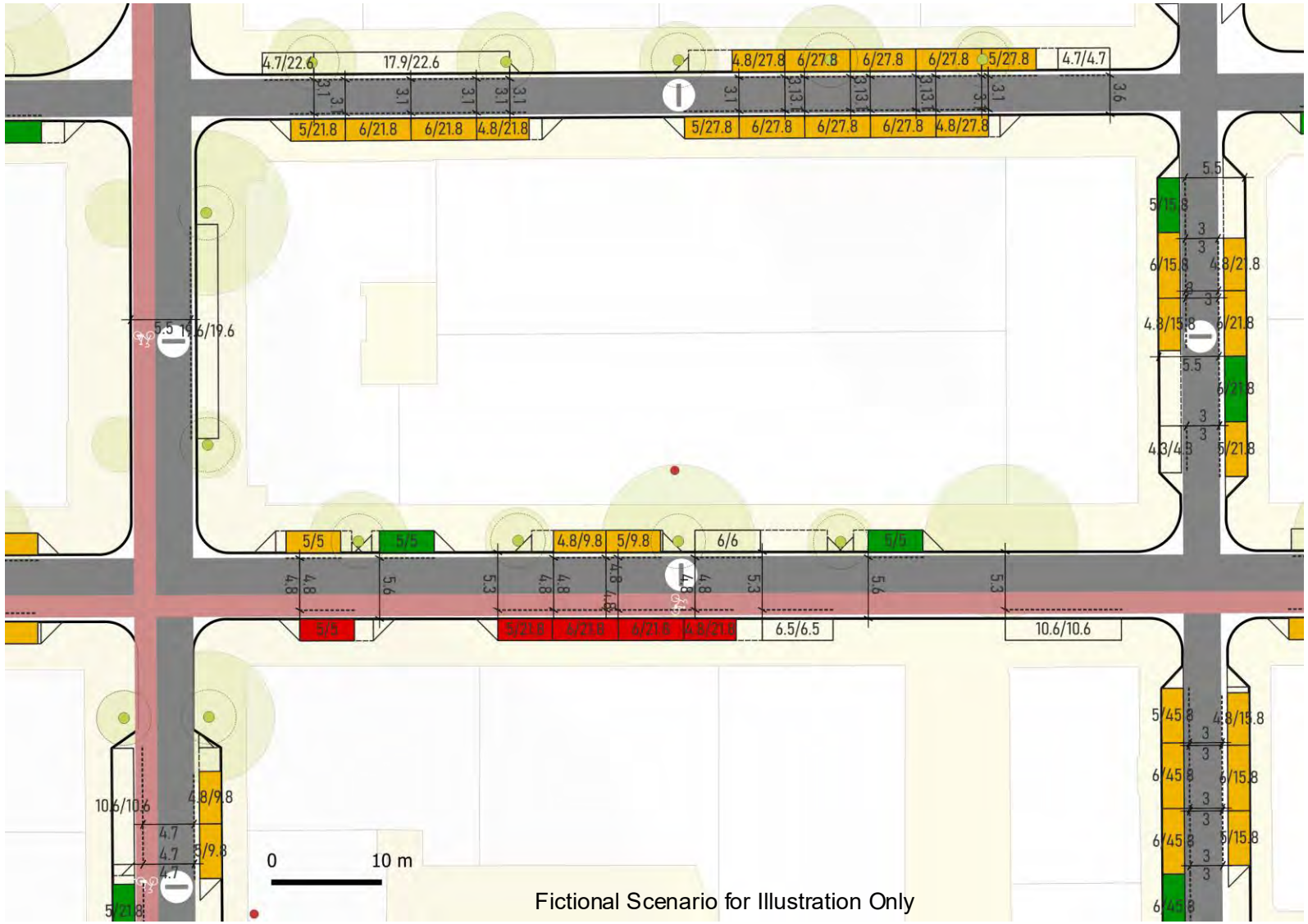
Applying Design Guidelines

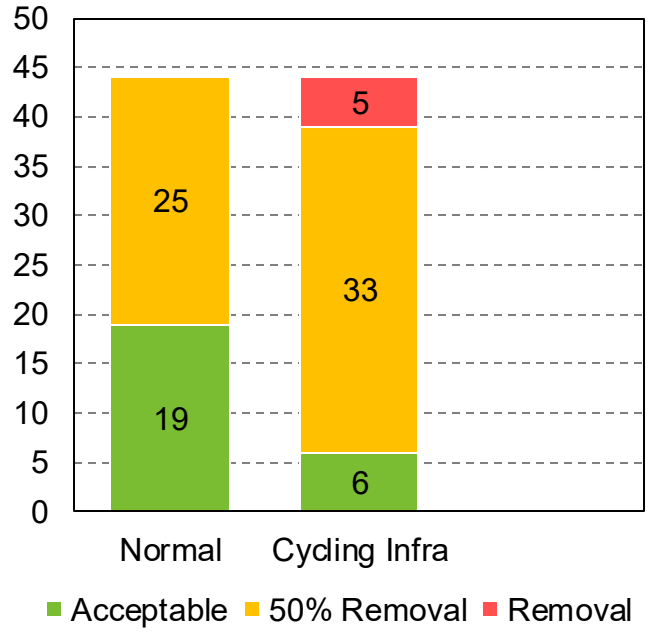


Fictional Scenario for Illustration Only

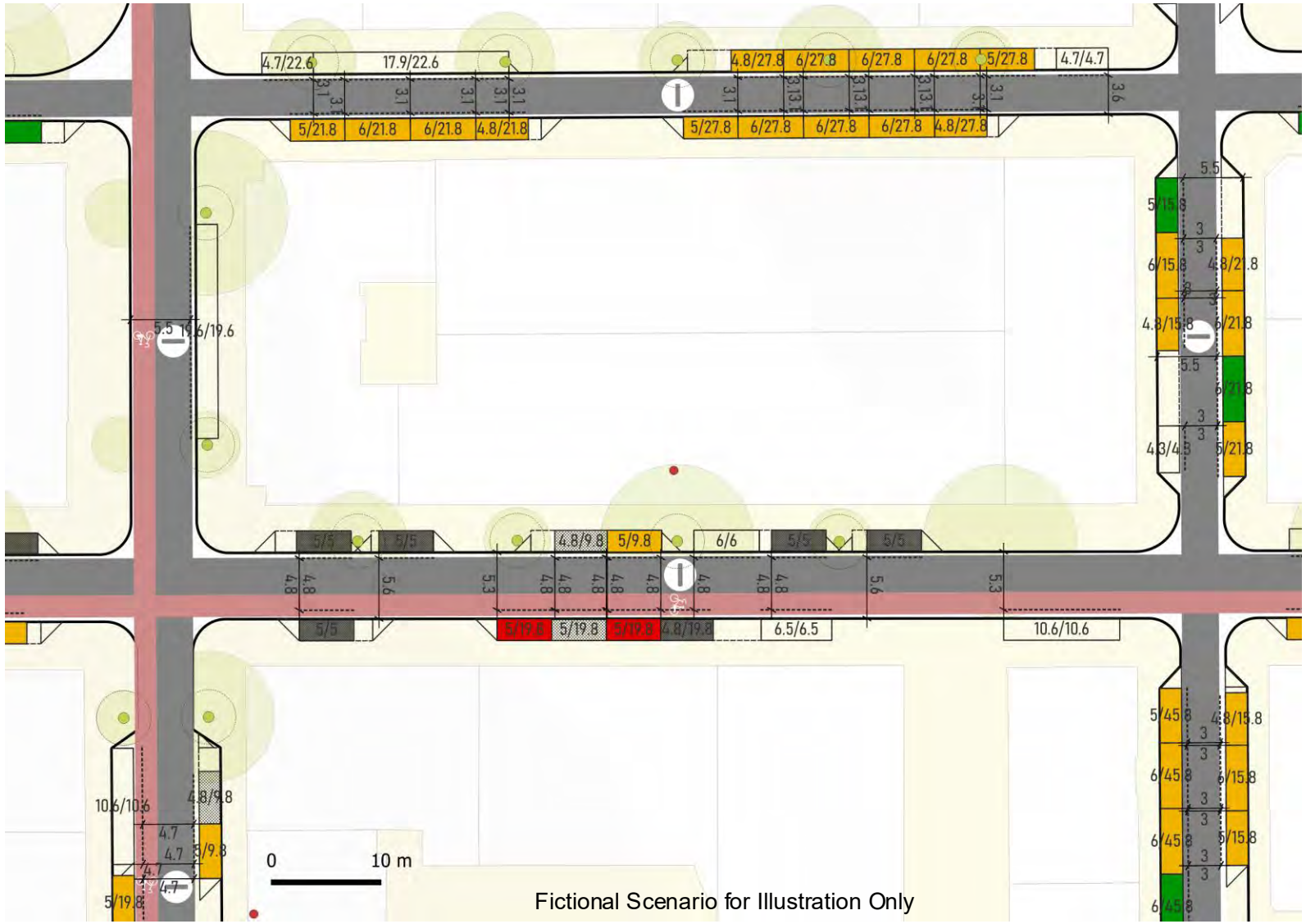


Applying Design Guidelines

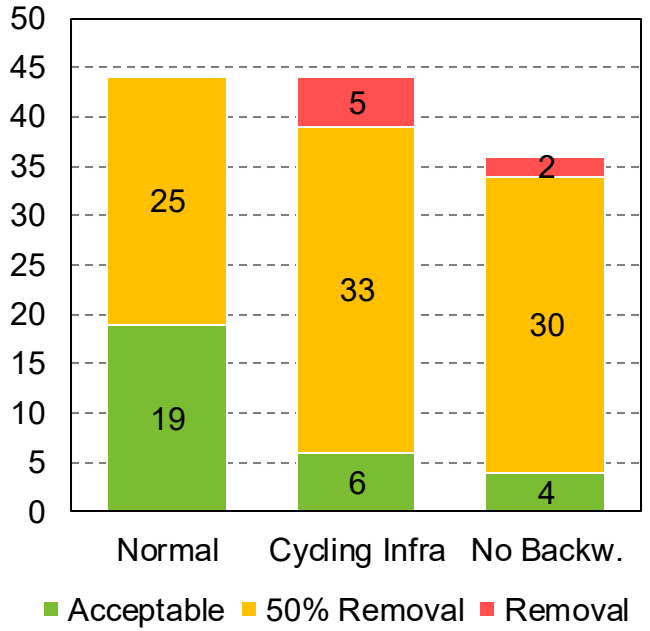




Applying Design Guidelines



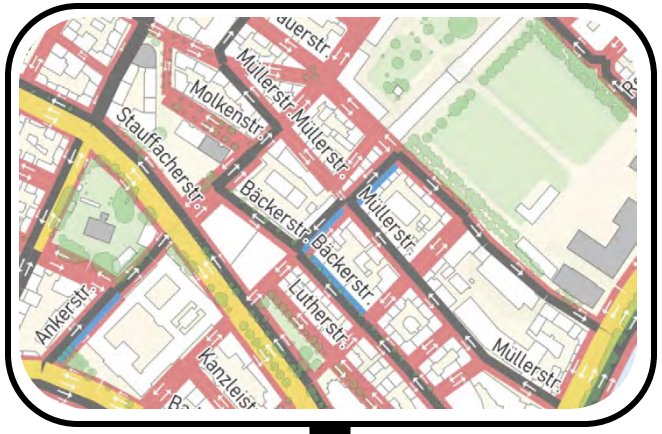
Fictional Scenario for Illustration Only



… for Entire Cities

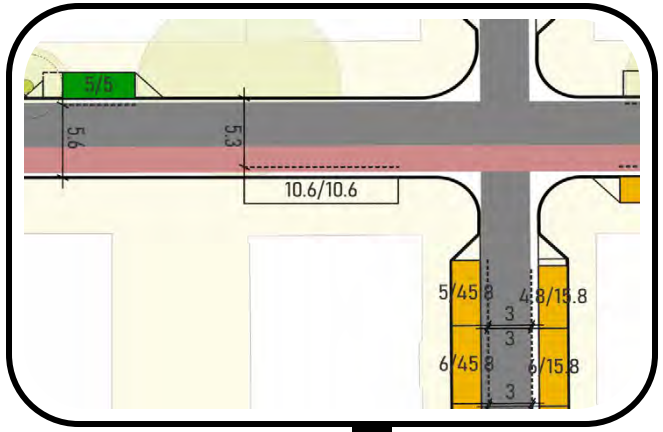
Fictional Scenario for Illustration Only

“E-BIKE CITY”



- Network design
- Simulation
- 10-12 weeks

GUIDELINES



- Network-wide impact assessment of guidelines
- 2-4 weeks

goNEON!

FURTHER TOPICS

Speed Limits, Bus Lanes, EV Charging Points, Bicycle Parking/Charging

We are *goNEON!*

Lukas Ballo | Co-Founder, CTO
PhD Transport Planning ETH MIT
Startup Experience BOND

Raphael Eder | Co-Founder, CIO
MSc Transportation ETH LSE UC San Diego
Expert in International Planning

Developers and Project Managers

Advisors & Support

Dr. **Raoul** Stöckle
Serial Entrepreneur
BOND mobility

Corinne Vogel
Serial Entrepreneur Stravox

Prof. **Kay** Axhausen
Most Cited Transport Researcher ETH

Silvia Vernaschi
Business Coach
TALENT KICK

Moritz Meenen
Founder ElectricFeel
Electric Feel

Diana Hardie
Serial Entrepreneur
Swiss Healthcare Startups

Prof. **Martin** Raubal
Expert Geographic Information Science ETH
UC SANTA BARBARA

Martin Wolfer
Business Coach
TALENT KICK

PLANOPTIMO Büro Dr. Käll ZT-GmbH · Stadt Luzern · BRIDGE · TALENT KICK · ETH zürich · Schweizerische Eidgenossenschaft Confédération suisse Confederazione Svizzera Confederaziun svizra · Innosuisse - Swiss Innovation Agency · MIE lab Mobility Information Engineering Lab at ETH Zurich · IVT Institut für Verkehrsplanung und Transportsysteme Institute for Transport Planning and Systems

goNEON!

JOIN THE MOVEMENT:

Backup

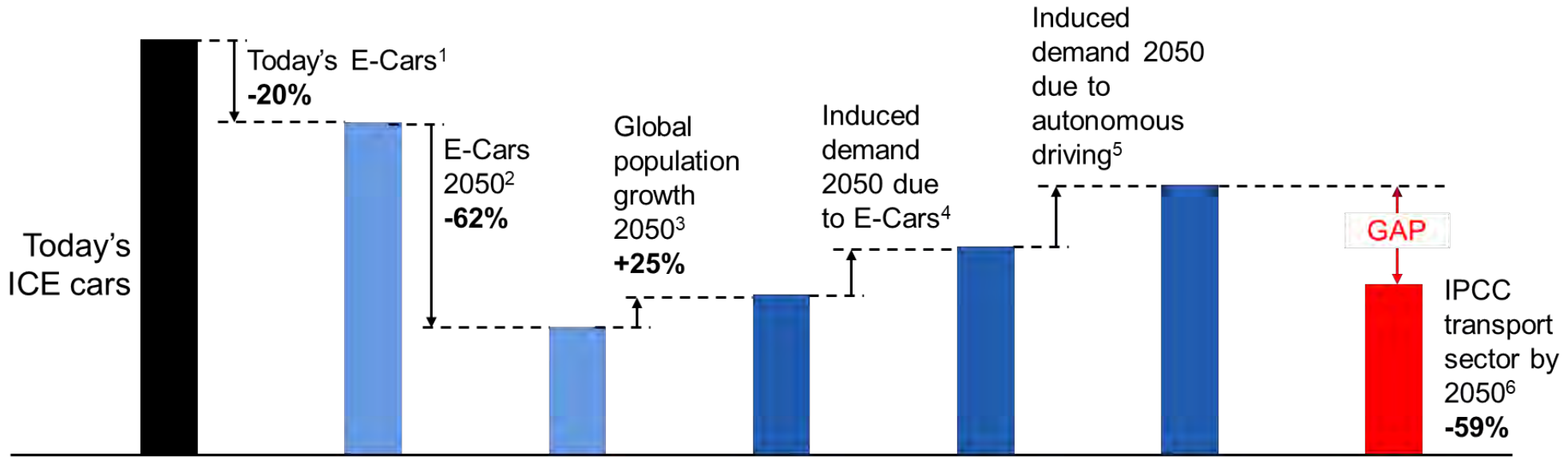
NETWORK DESIGN BASED ON NEW REGULATIONS *goNEON!*

Now reduce parking by 80% and provide 1m2 of green space per person. Make the middle section of Habsburgerstrasse where it crosses with Hirschmattstrasse into a pedestrian/cycling space. It should be about 15 meters long in each direction.

json Copy Edit

```
{
  "car_parking_supply_factor": 0.1,
  "green_space_supply_factor": 1.0,
  "motorized_traffic_in_both_directions": false,
  "constraints": [
    {
      "street_name": "Hirschmattstrasse",
      "lanes": ["T<*", "T>*"]
    },
    {
      "street_name": "Habsburgerstrasse",
      "lanes": ["X-*"],
      "intersection_with": "Hirschmattstrasse",
      "length_before": 15,
      "length_after": 15
    }
  ]
}
```

Decarbonization



[1] ITF (2020) Good to go? Assessing the environmental performance of new mobility, International Transport Forum, Corporate Partnership Board, Paris.

[2] Cox, B., C.L. Mutel, C. Bauer, A. Mendoza Beltran and D.P. van Vuuren (2018) Uncertain environmental footprint of current and future battery electric vehicles, *Environmental Science & Technology*, **52** (8) 4989–4995. – middle of the expected range

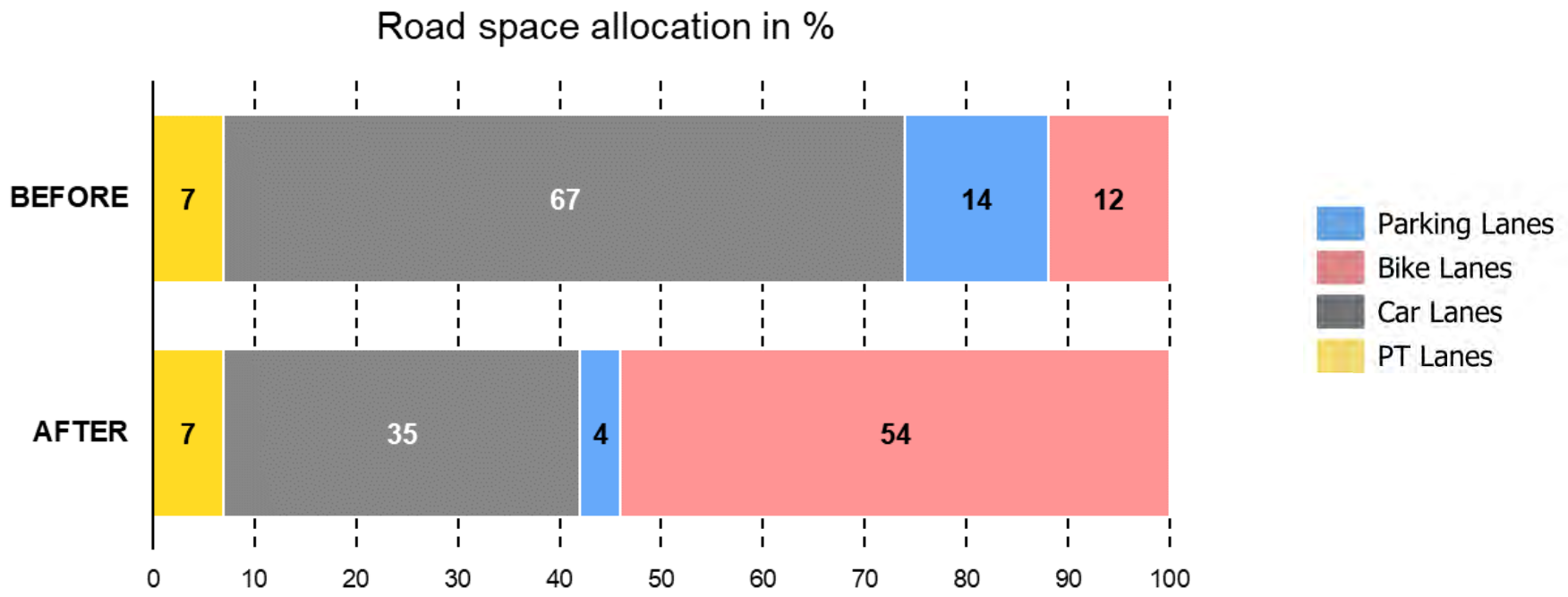
[3]UN (2019) World urbanization prospects: The 2018 revision, United Nations, Department of Economic and Social Affairs, Population Division, New York.

[4]Assumption due to growing wealth, better infrastructure and lower cost of batteries for future E-Cars: Schmidt, O., A. Hawkes, A. Gambhir and I. Staffell (2017) The future cost of electrical energy storage based on experience rates, *Nature Energy*, **2** (8) 17110.

[5]Assumption based on Bösch, P.M., F. Ciari and K.W. Axhausen (2018) Transport policy optimization with autonomous vehicles, *Transportation Research Record: Journal of the Transportation Research Board*, **2672** (8) 698–707.

[6]IPCC (2022) Climate change 2022, mitigation of climate change, summary for policymakers, Intergovernmental Panel on Climate Change, Geneva.

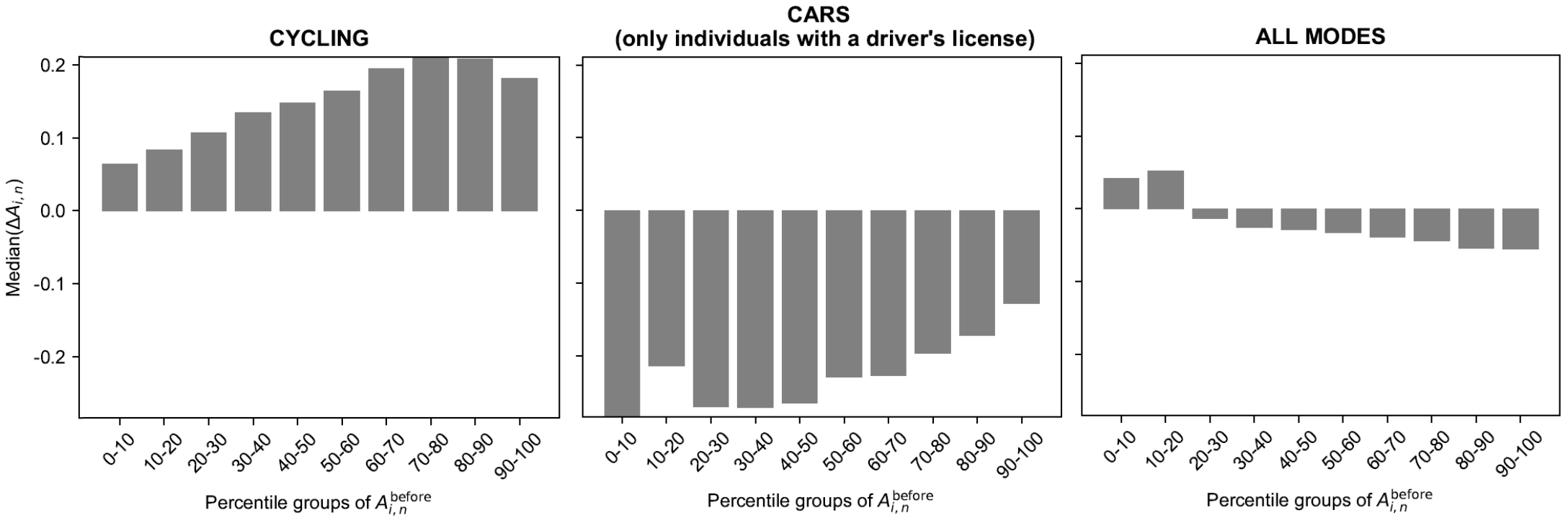
Results



Average shortest path (km):

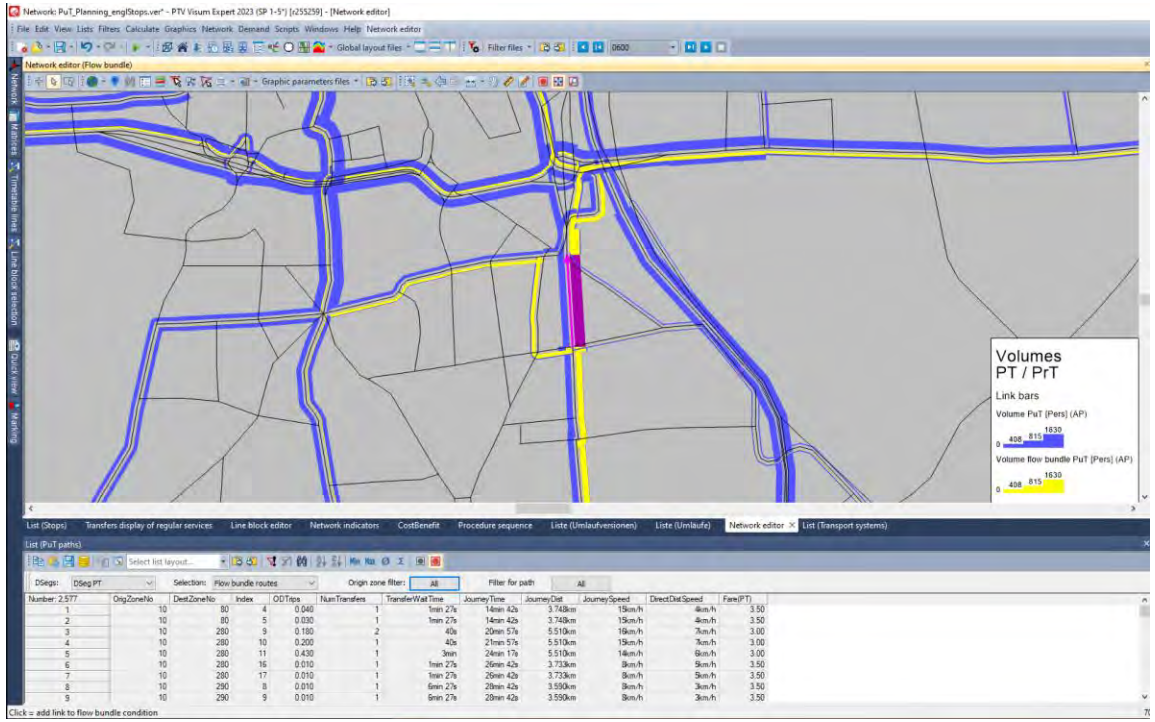
	Before	E-Bike City	Difference in detours
Motorized traffic	4.563	7.412	+35.7%
Cycling	5.391	5.334	-1.1%
Cycling (Comfort-Adjusted)	4.824	3.661	-24.1%

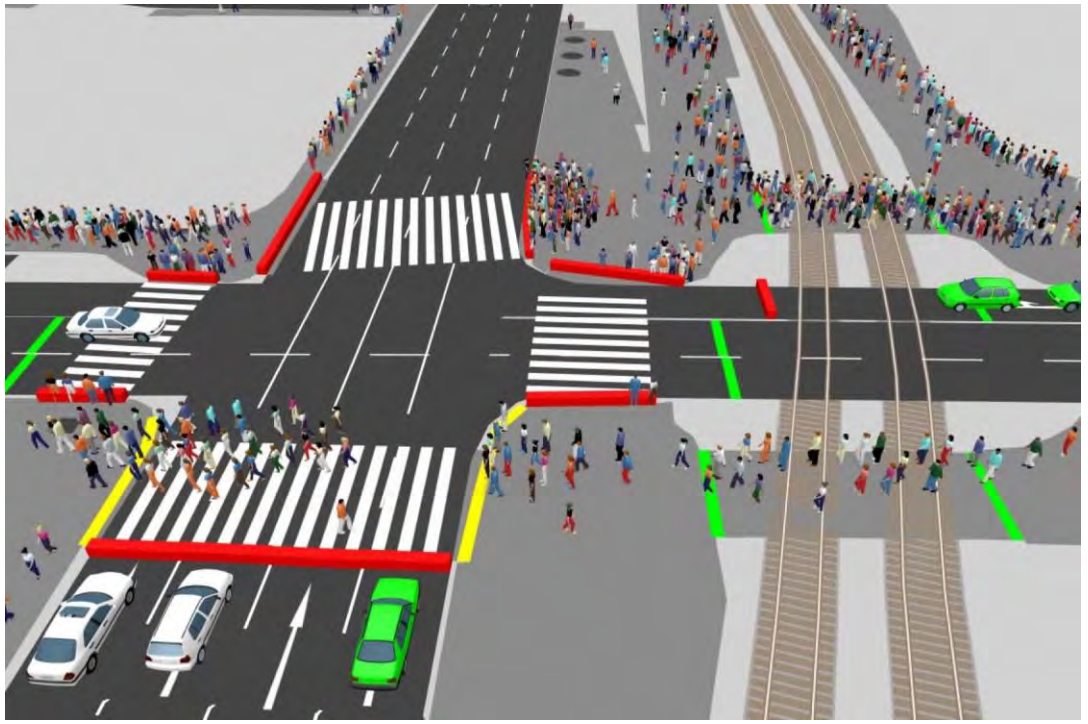
Equity Impacts



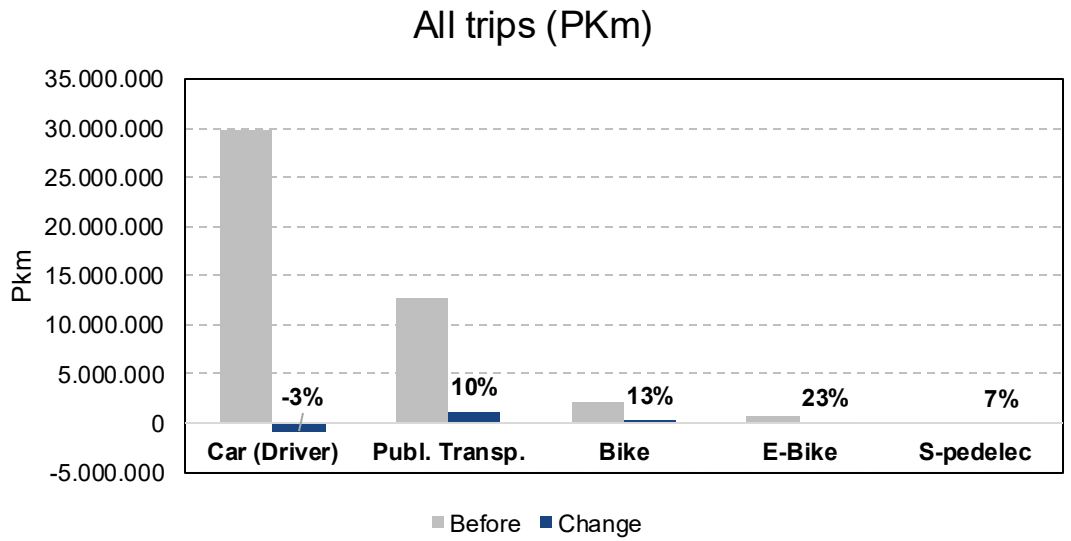
TRADITIONAL PLANNING

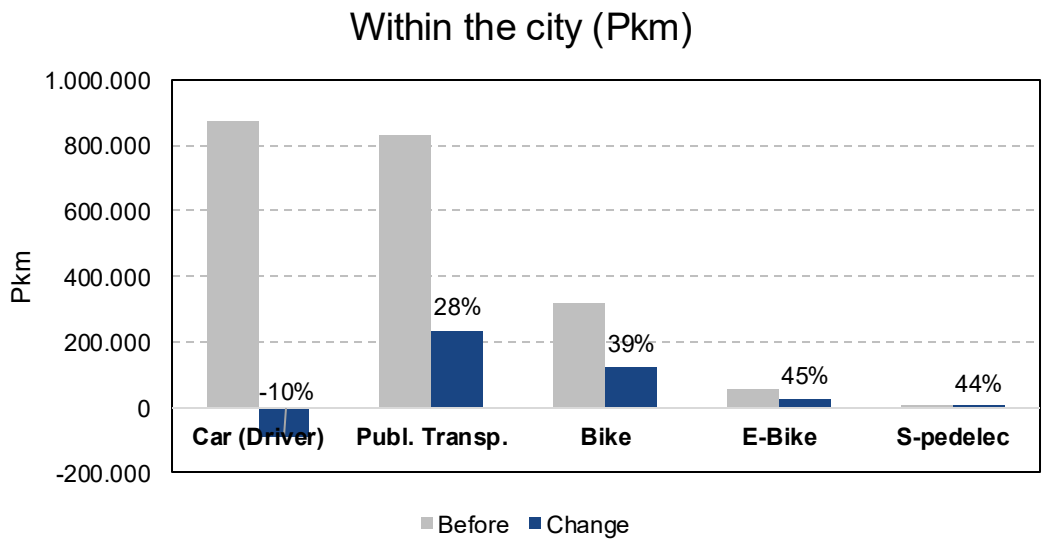
goNEON!

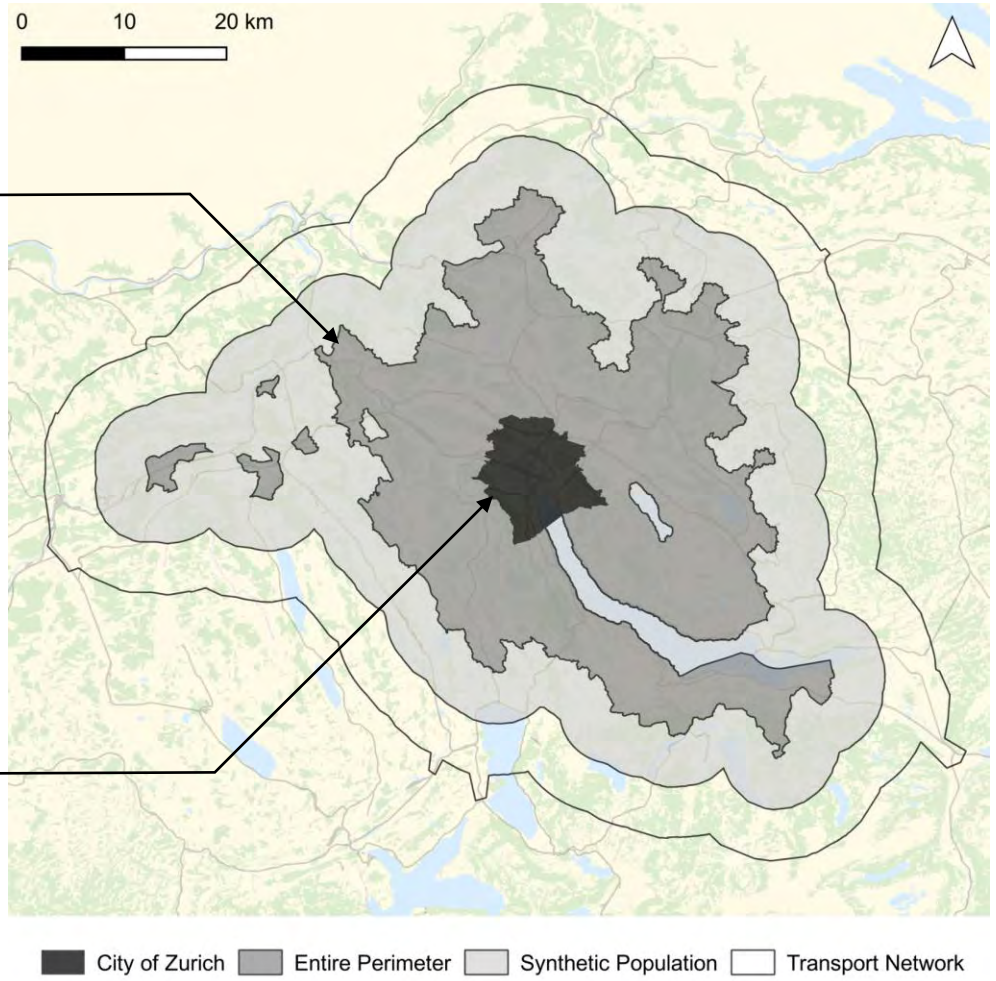




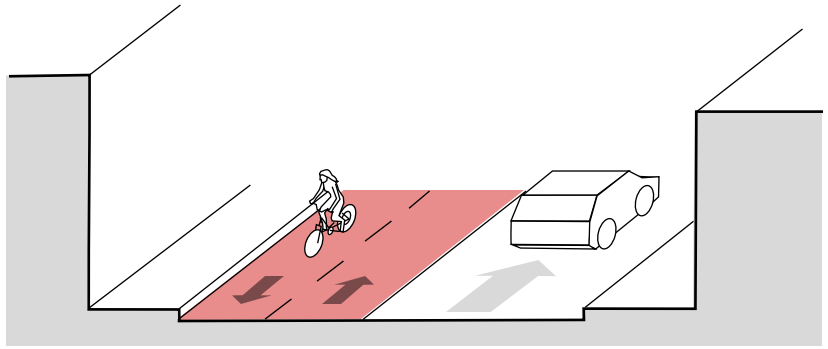
Changes in Traffic Volumes





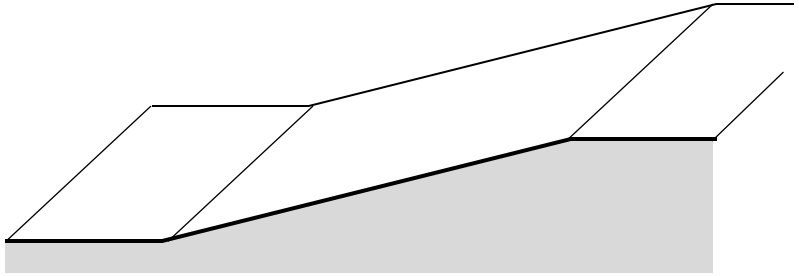


“Values of Distance”



Cycling infrastructure

-50% Distance



Slopes

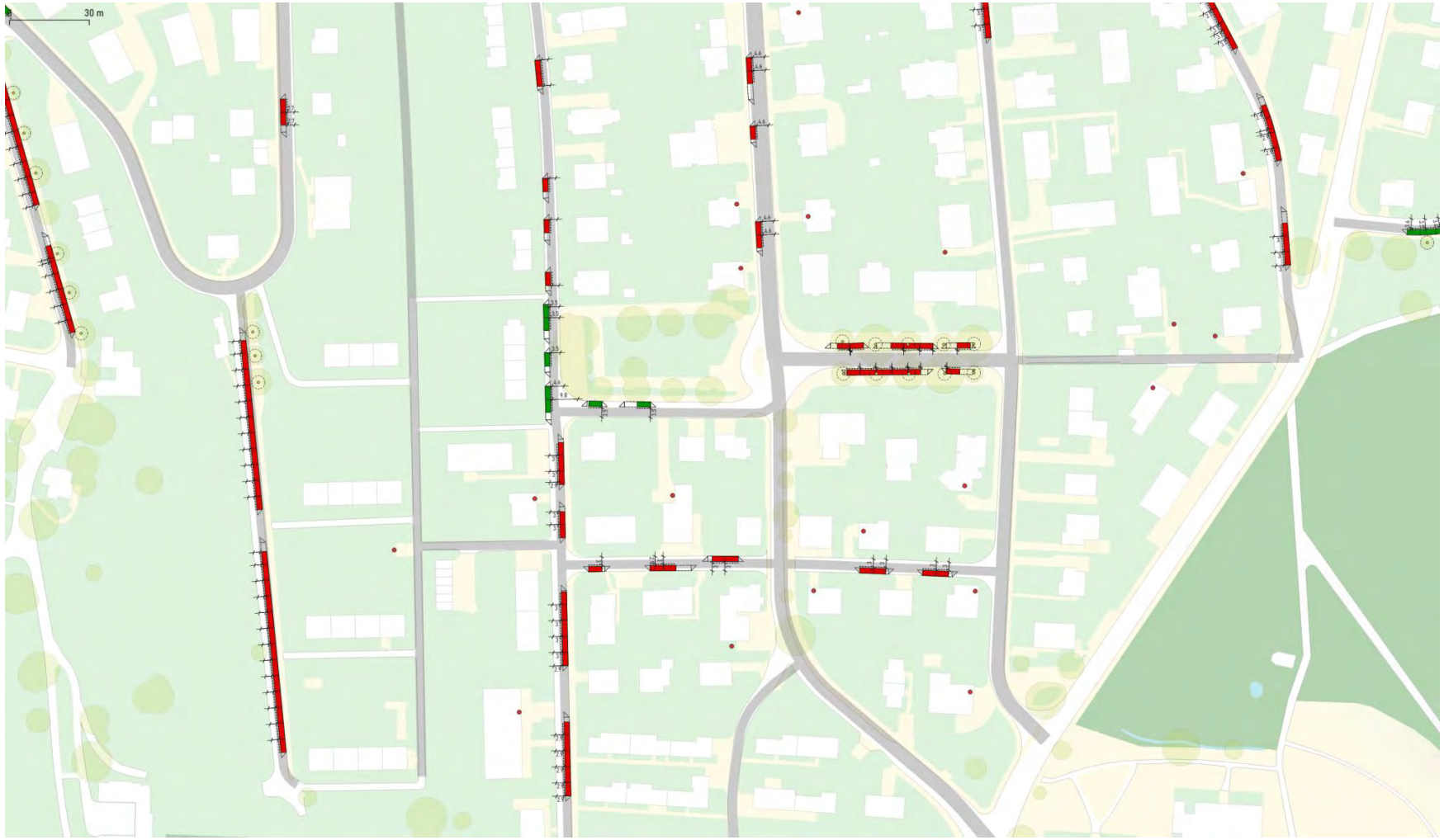
+55 to 433% Distance

+9 to 278% Distance (E-Bikes)

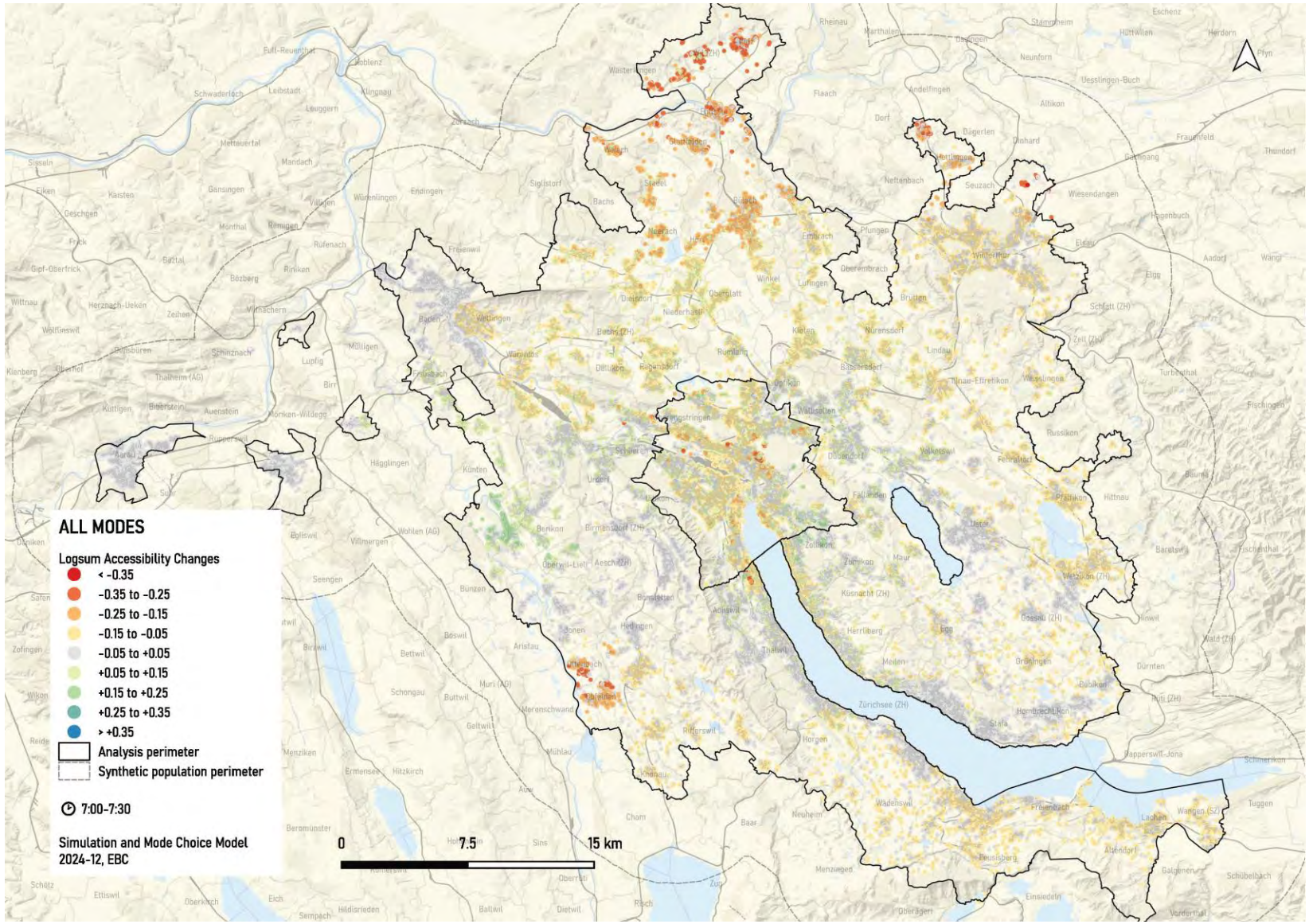
Meister, A., M. Felder, B. Schmid and K.W. Axhausen (2023) Route choice modeling for cyclists on urban networks, *Transportation Research Part A: Policy and Practice*, **173**, 103723.

WHAT-IF SCENARIOS FOR ENTIRE CITIES

goNEON!



Effects on Individuals (Accessibility, All Modes)



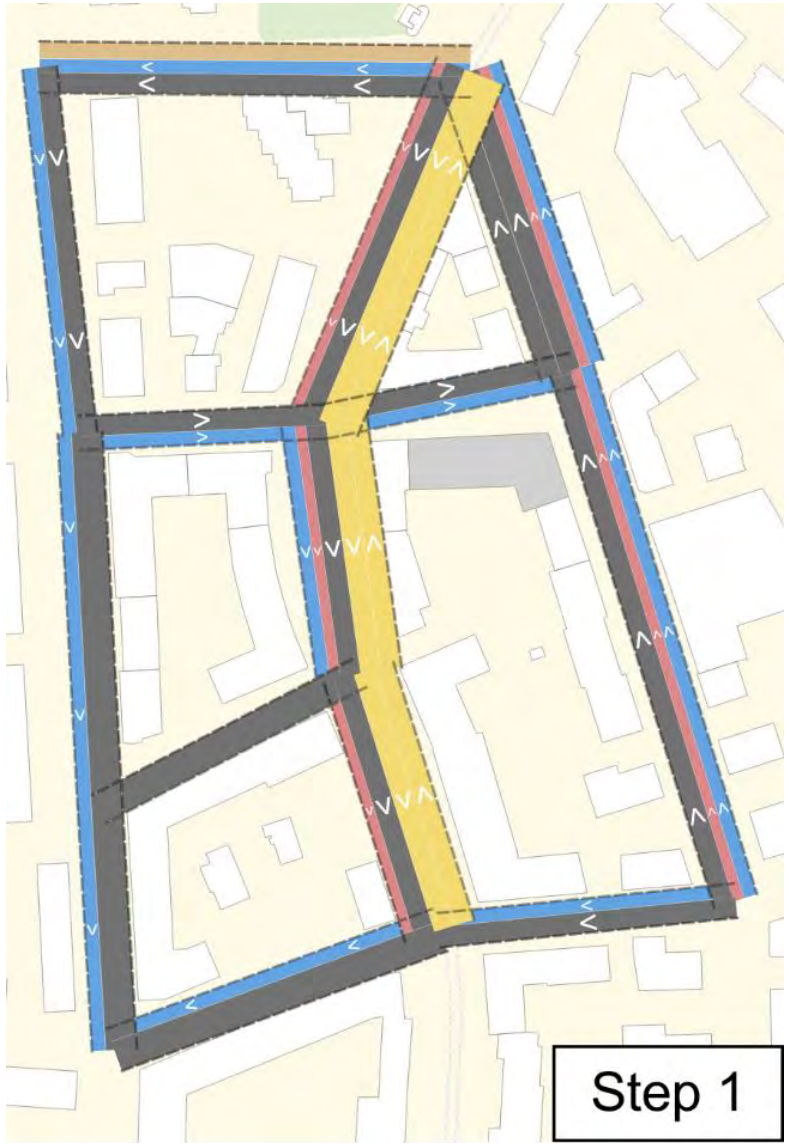
$$A_{i,n} = \ln \sum_{j} \sum_{m} e^{V_{ijmn}} * W_j$$

$A_{i,n}$	Accessibility
i	Origin i
j	Destination j
n	Person
m	Mode
$-V_{ijmn}$	Generalized travel cost
W_j	Weight of j

Starting Point: Road Space

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes
Pedestrian- and Cycling Paths
Non-Traffic

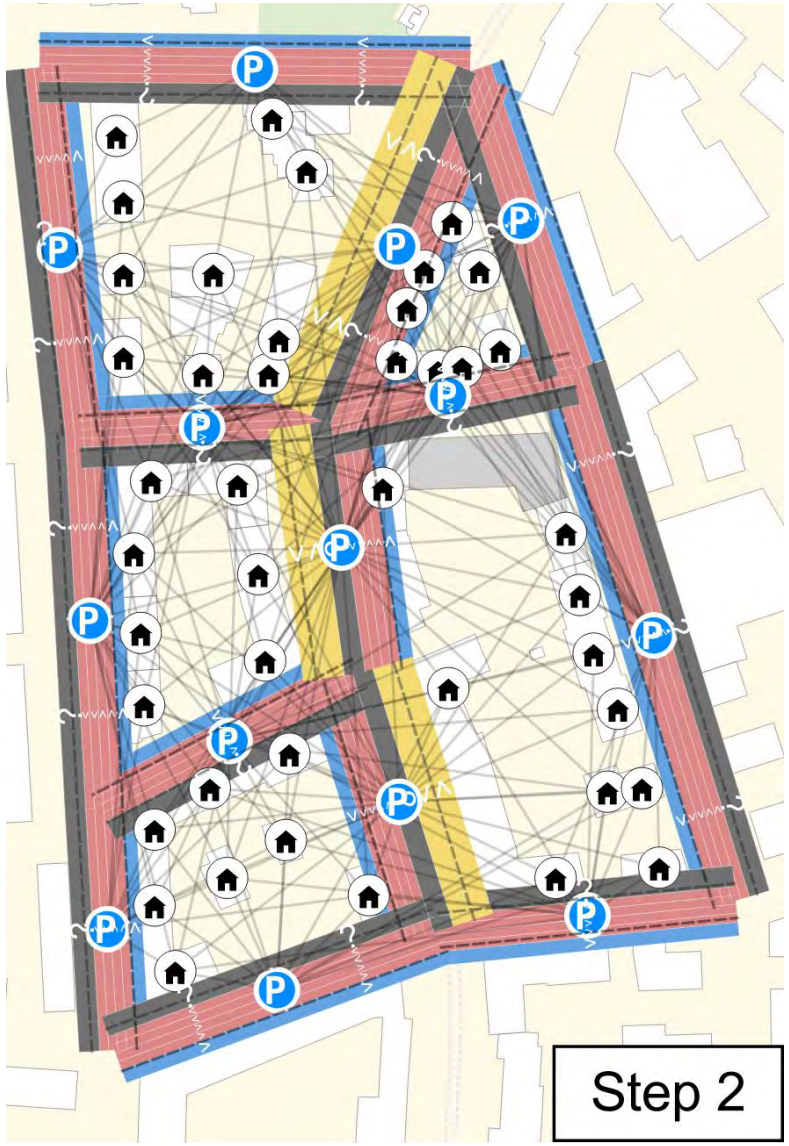
(1) Original Network



Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes

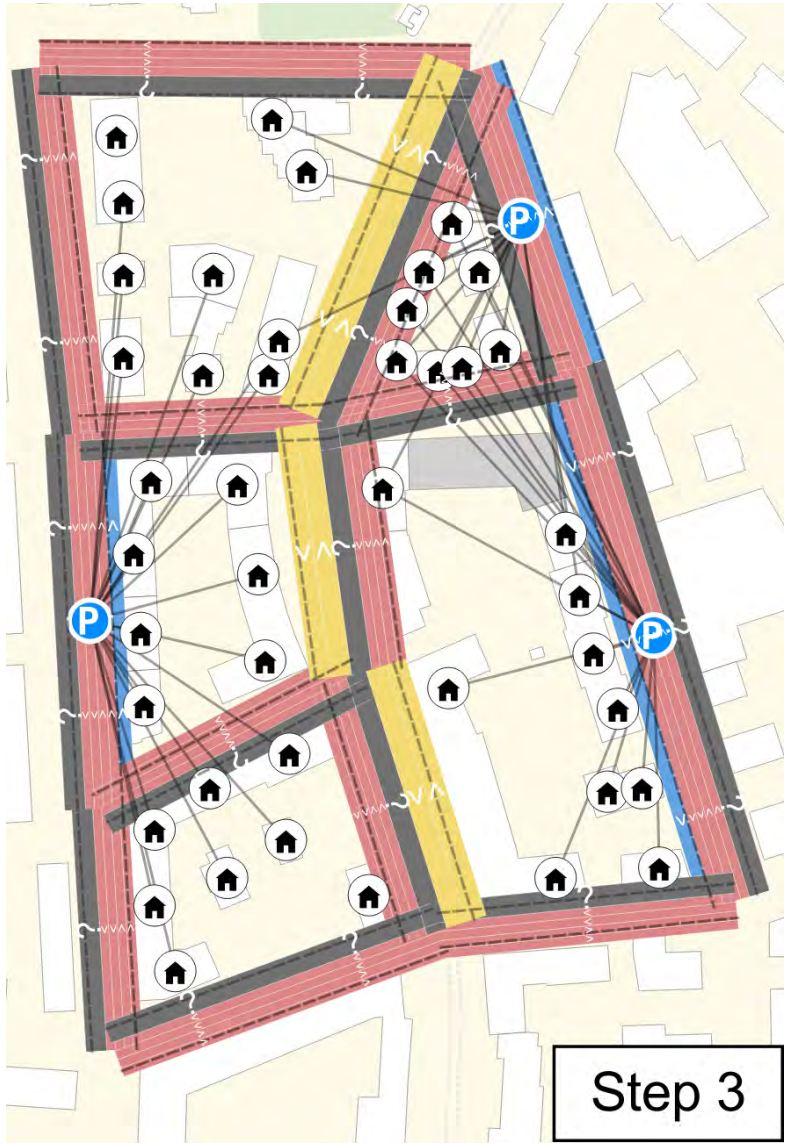
(2) Wish Lists



Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes

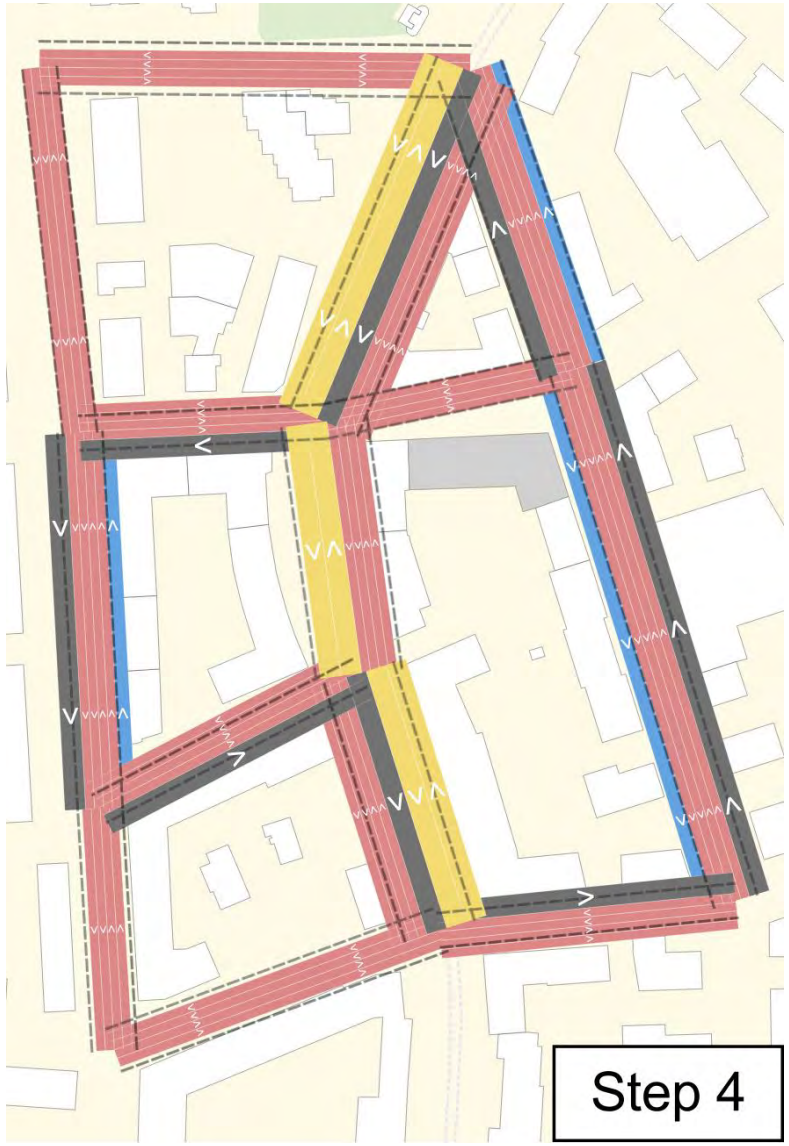
(3) Allocation of On-Street Parking



Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes

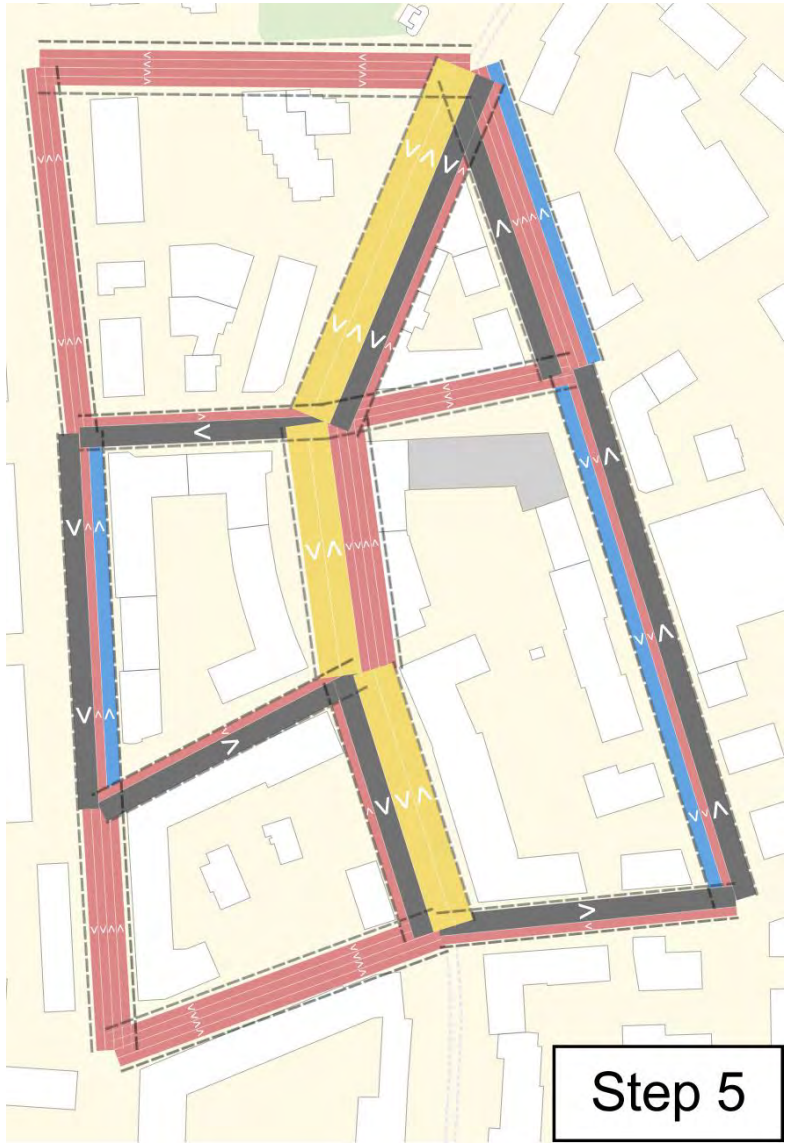
(4) Allocation of Travel Lanes



Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes

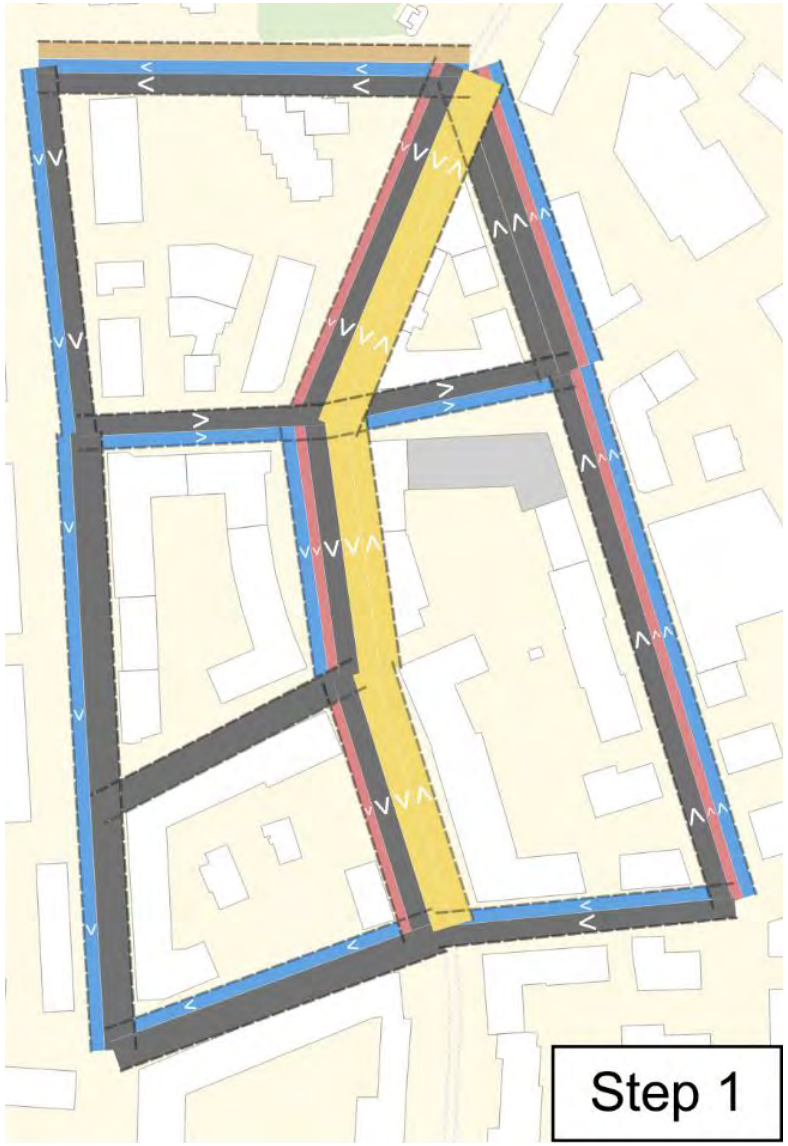
(5) Allocation of Cycling Lanes

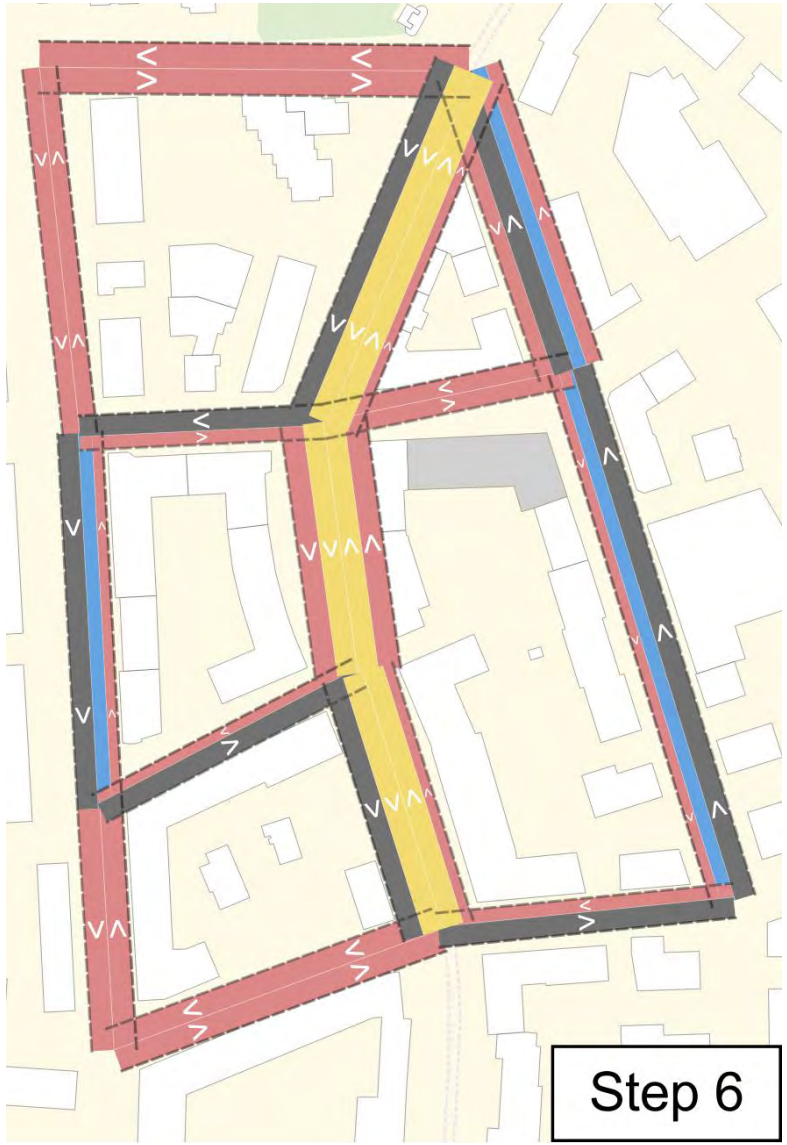


Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes

(6) Finalization





Road space widths

Parking Lanes
Bike Lanes
Car Lanes
PT Lanes