

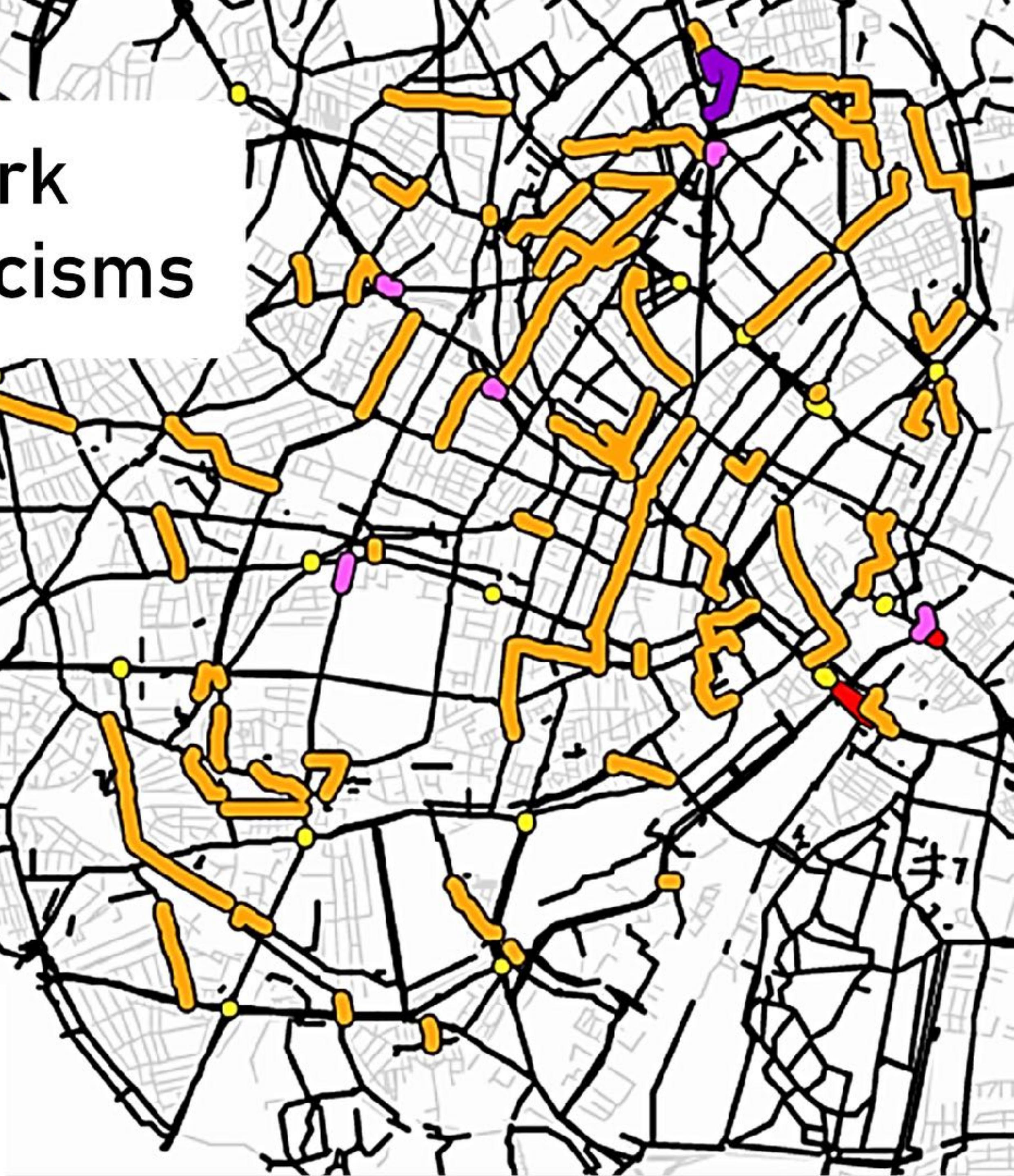
# Data-informed bicycle network planning: processes and criticisms

## BROWN BAG SEMINAR SERIES WITH

Ane Rahbek Vierø,  
Anastassia Vybornova,  
Michael Szell

NERDS (NEtwoRks, Data and Society),  
IT University of Copenhagen

22 Sept. 2022 3.00PM BST



Hi, we are NERDS!

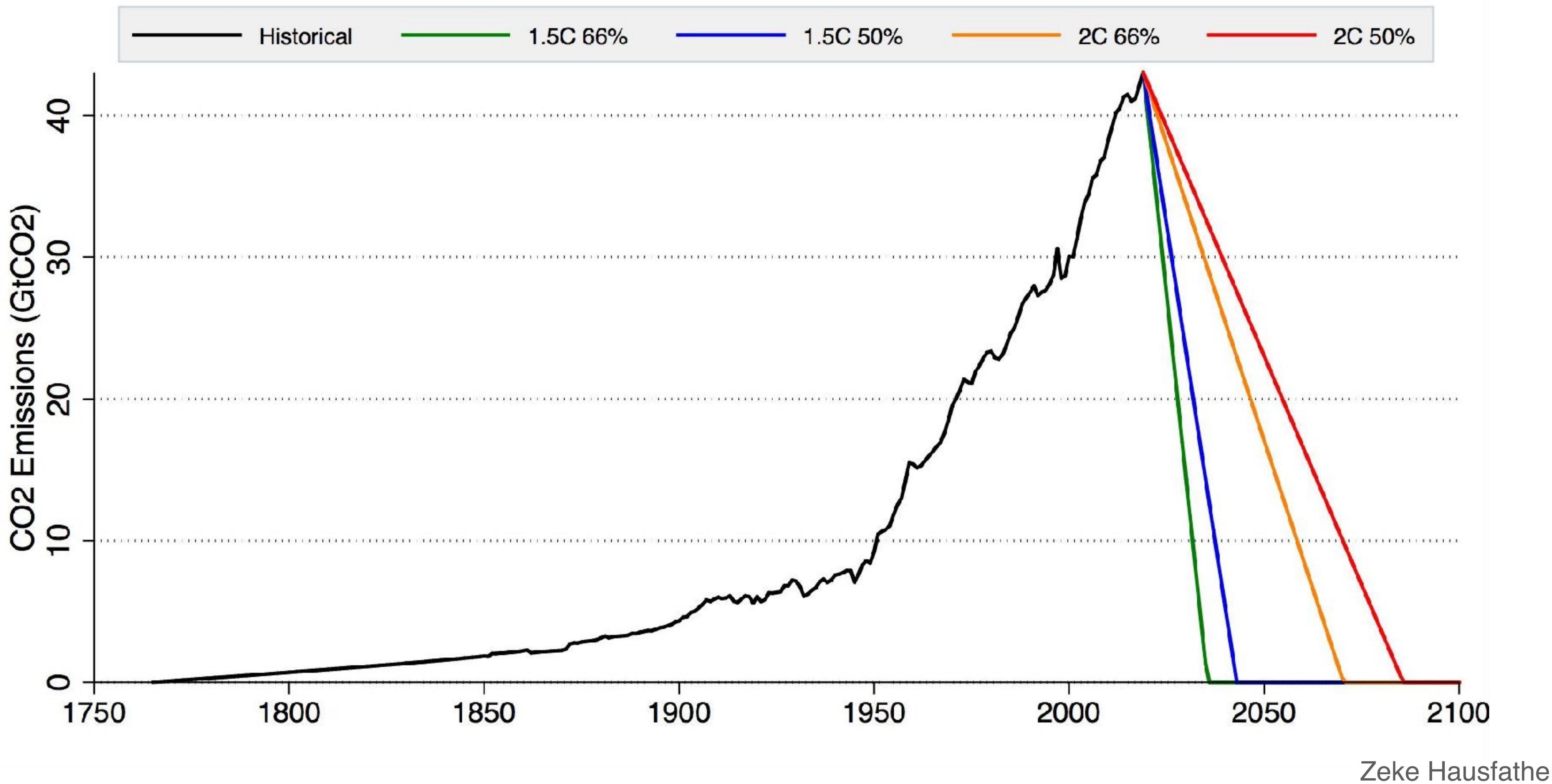
# NEtwoRks, Data, and Society



IT UNIVERSITY OF COPENHAGEN

[nerds.itu.dk](http://nerds.itu.dk) @nerdsitu

## Simplified Emissions Pathways for Climate Targets

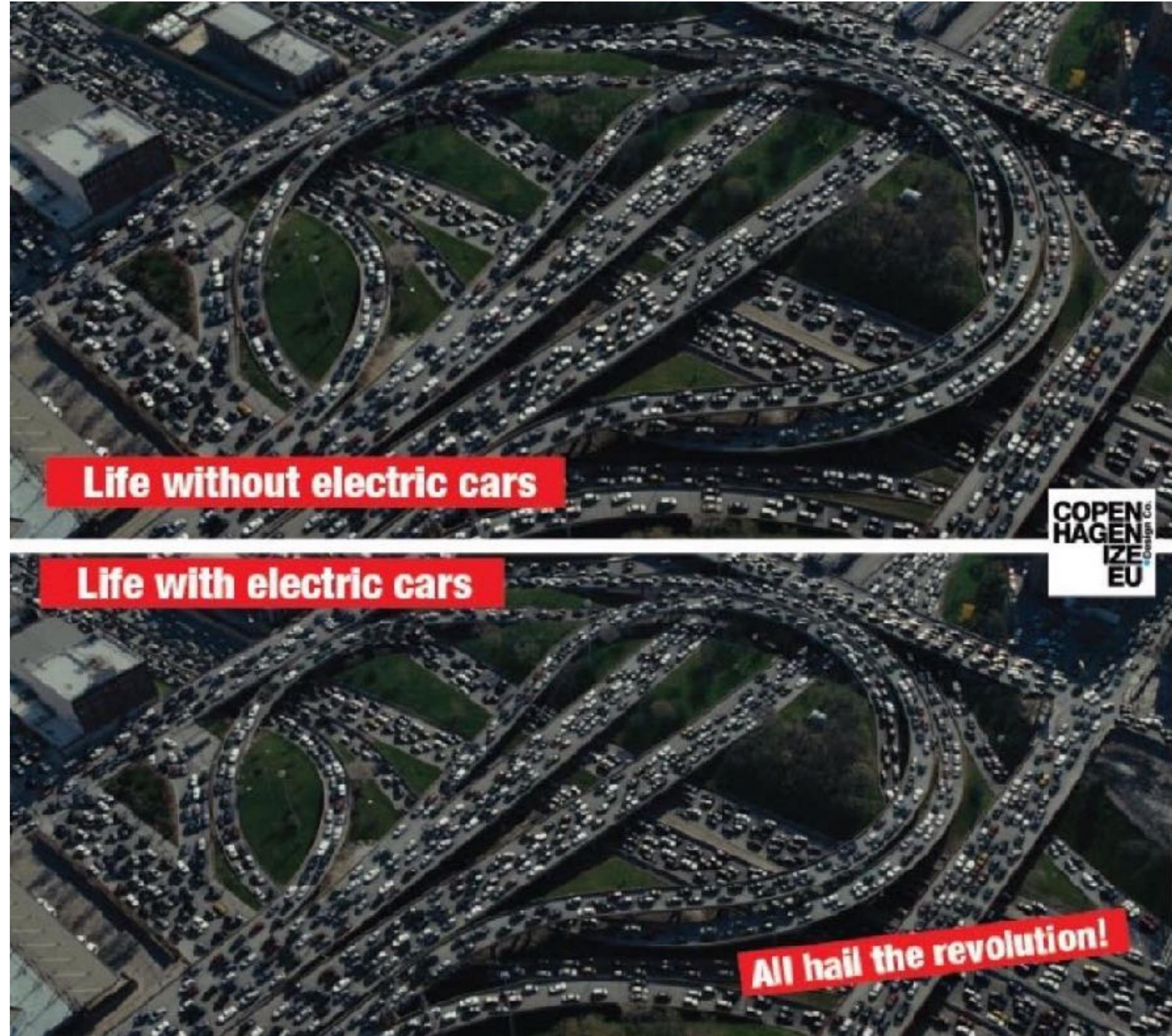
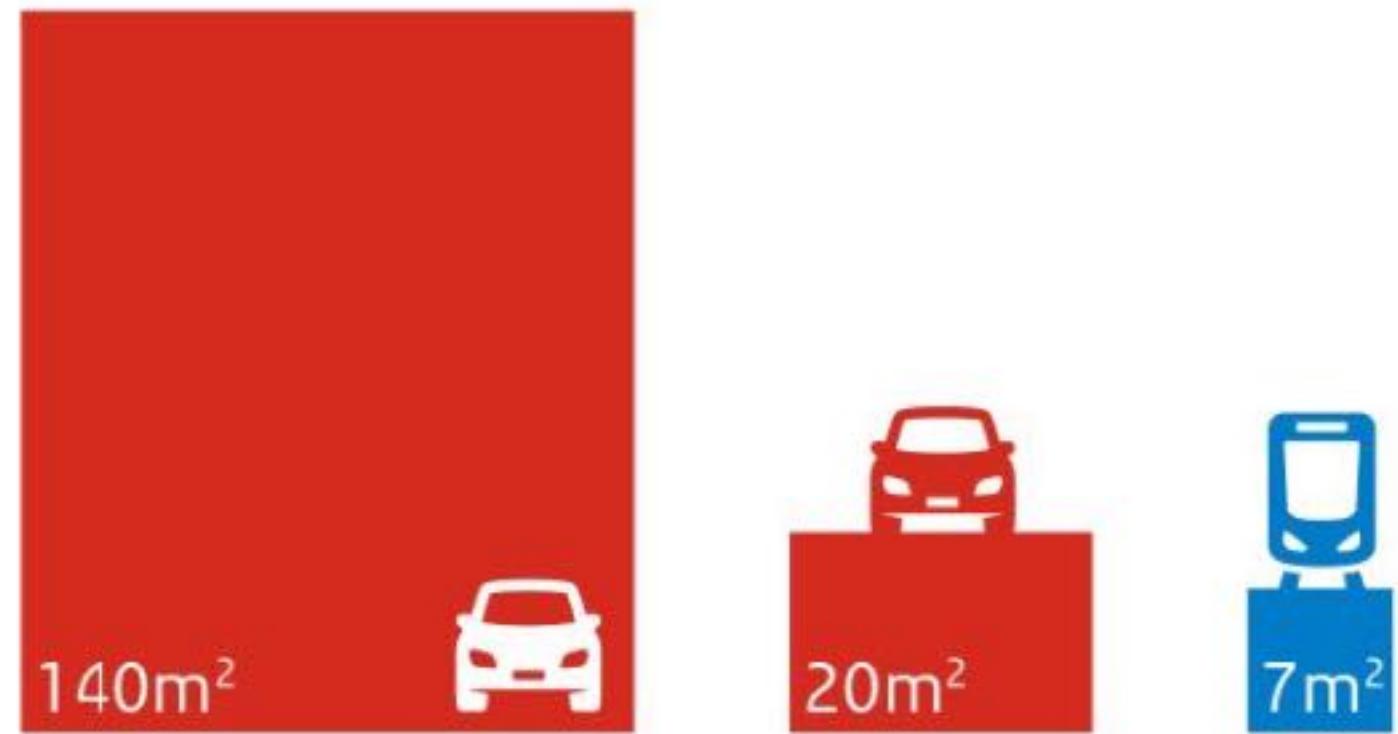


# The E-car is hailed as the Golden Goose but it is not



Brand et al, Trans Res D 93 (2021)  
Henderson: EVs are not the answer, Amer Assoc Geo 110, 6 (2020)

# E-cars are not THE solution: Cars take too much space



# Most mobility space is for cars



Modal Share for Copenhageners Commuting to Work/Education



Allocation of Transport Space in Copenhagen



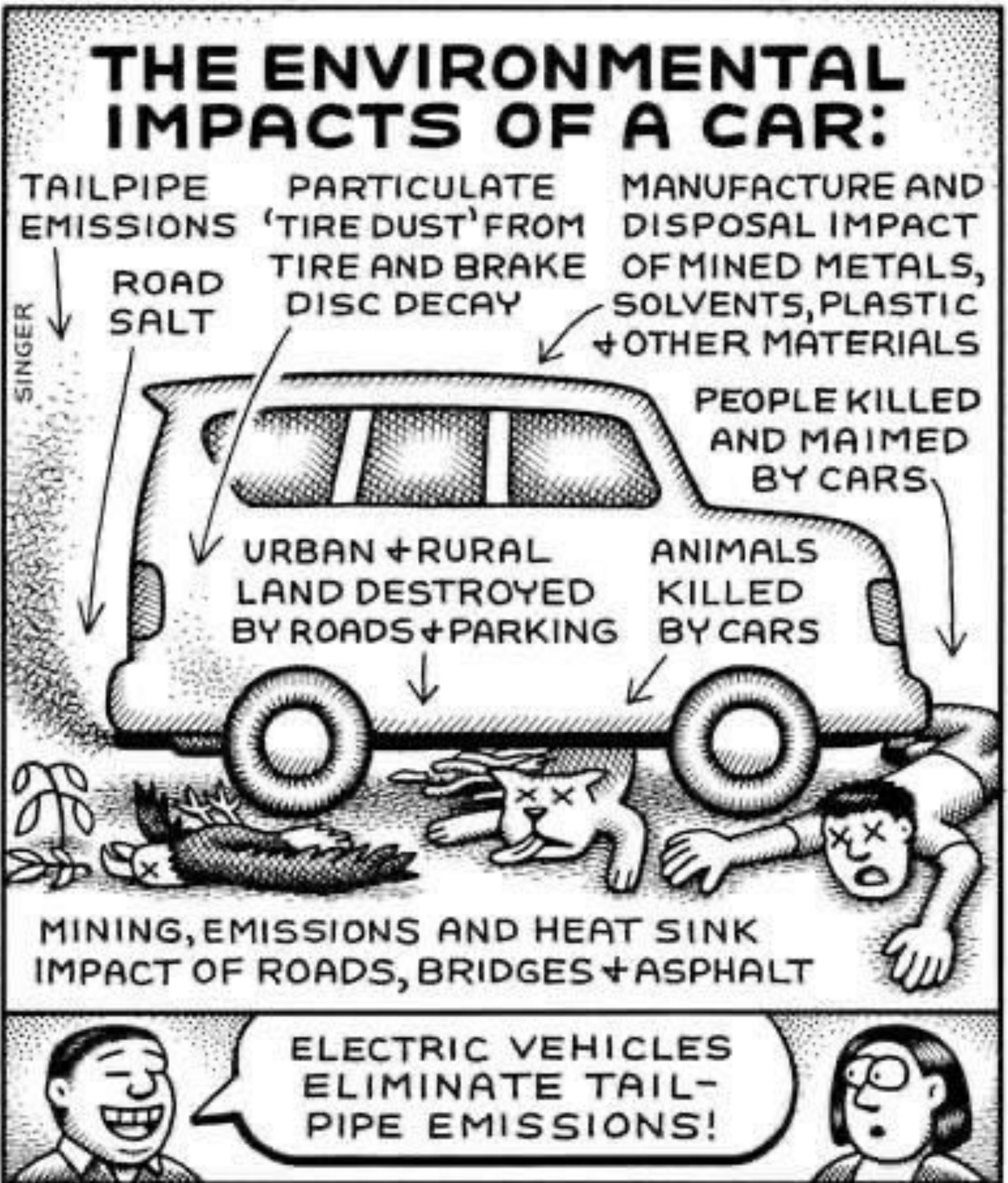


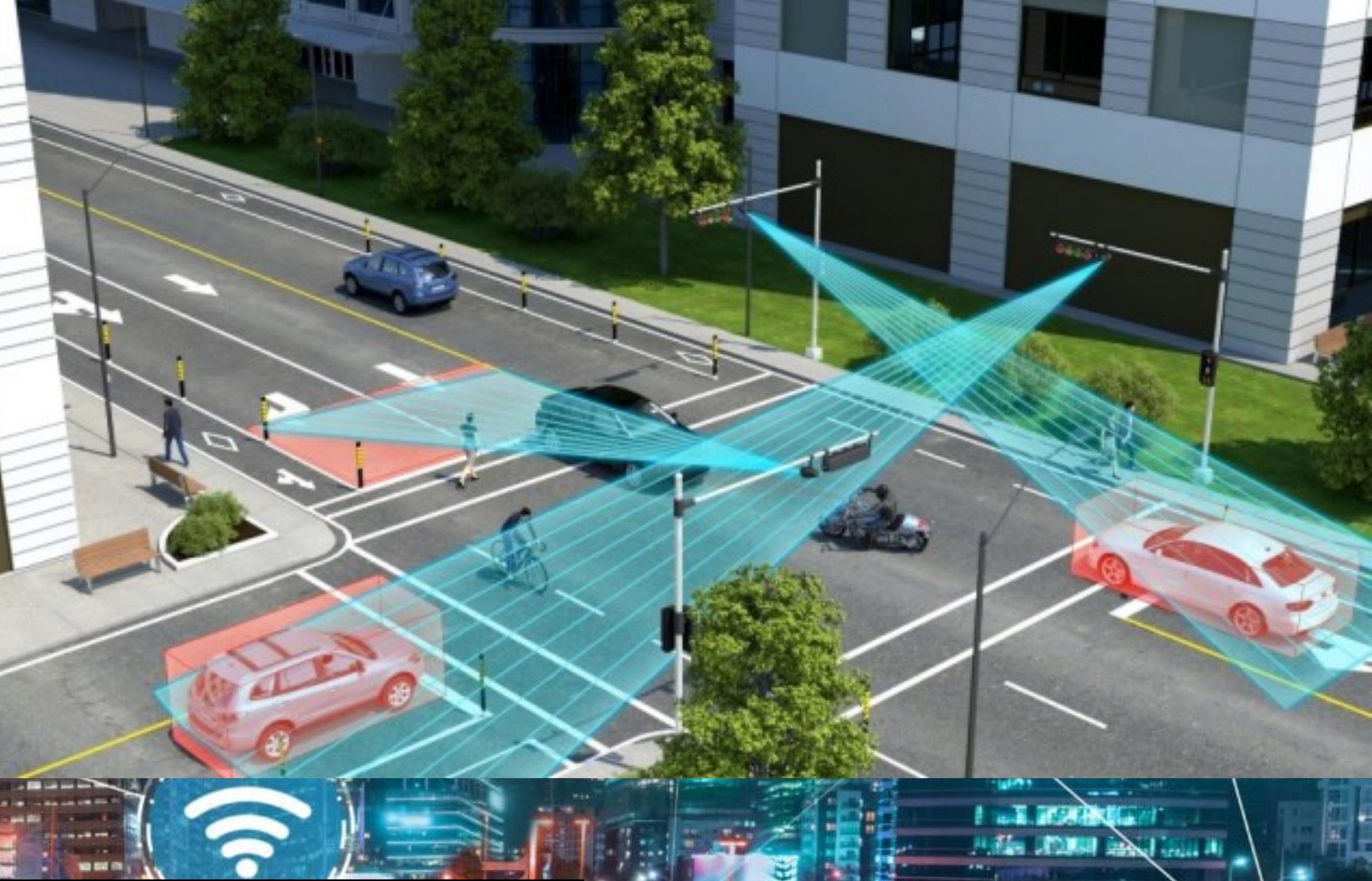
1.350.000



M.L. Anderson, M. Auffhammer, *Rev Econ Stud* 81, 2 (2014)  
<https://www.vrt.be/vrtnws/nl/2022/08/25/elektrische-auto-s-test/>





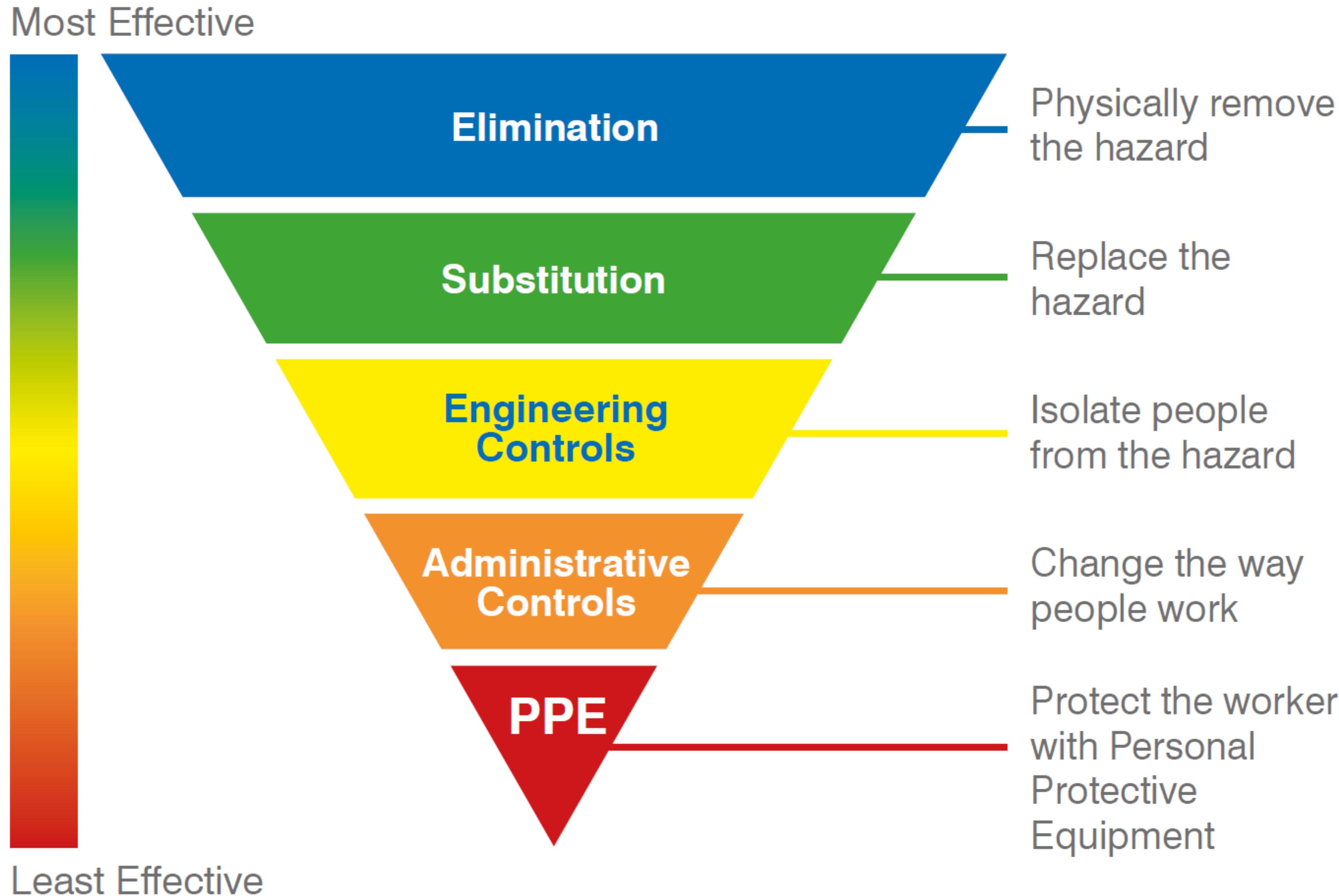


Tech alone won't save us





# Hierarchy of controls



# Cycling is a time-tested solution that delivers on 11 SDGs



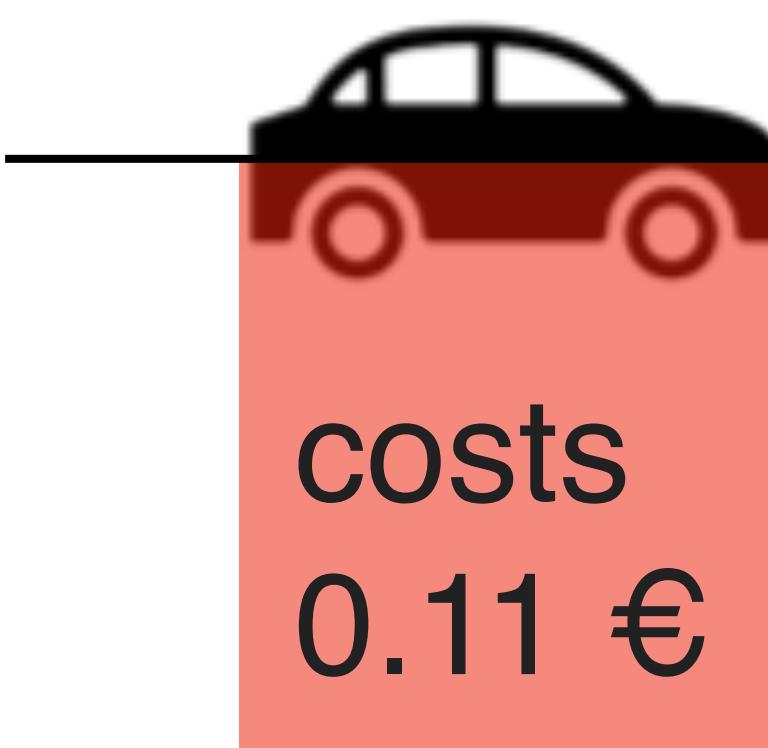
## CYCLING DELIVERS ON THE GLOBAL GOALS

Shifting towards a better economy, society, and planet for all

<https://unric.org/en/sustainable-development-goals-cycling/>

More active travel is also an *economic* "no-brainer"

Cost-benefit  
analysis in  
EU shows: 1 km travelled by



brings  
0.18 €



brings  
0.37 €

More active travel is crucial to  
make cities better.

How to build bicycle infrastructure?

# How to build bicycle infrastructure?



We have great  
planning guides.



NACTO



Urban  
Bikeway  
Design  
Guide

April 2011 Edition

# How to build bicycle infrastructure?



We have great planning guides.



NACTO



Urban  
Bikeway  
Design  
Guide

April 2011 Edition



Mostly about intersection or street design.

We don't know much from a systemic birds-eye perspective!



# We focus on network data

We use

Structural network data

OpenStreetMap 

We don't use  
(so much)

Empirical flow data

OD-matrices,  
GPS data, ...

# We focus on network data

We use

Structural network data

OpenStreetMap ❤️

We don't use  
(so much)

Empirical flow data

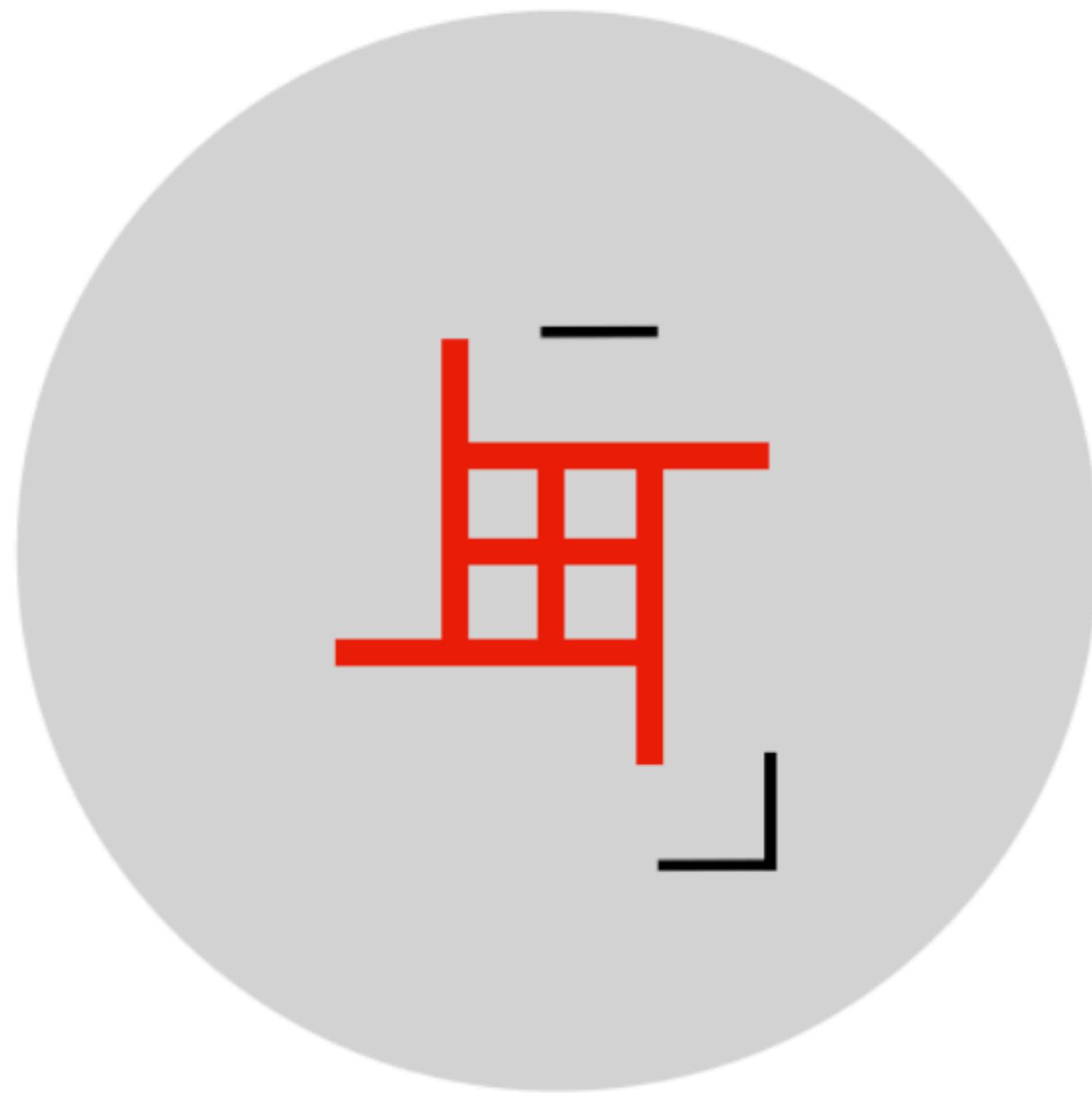
OD-matrices,  
GPS data, ...

We care FIRST about the  
systemic structure of cities.

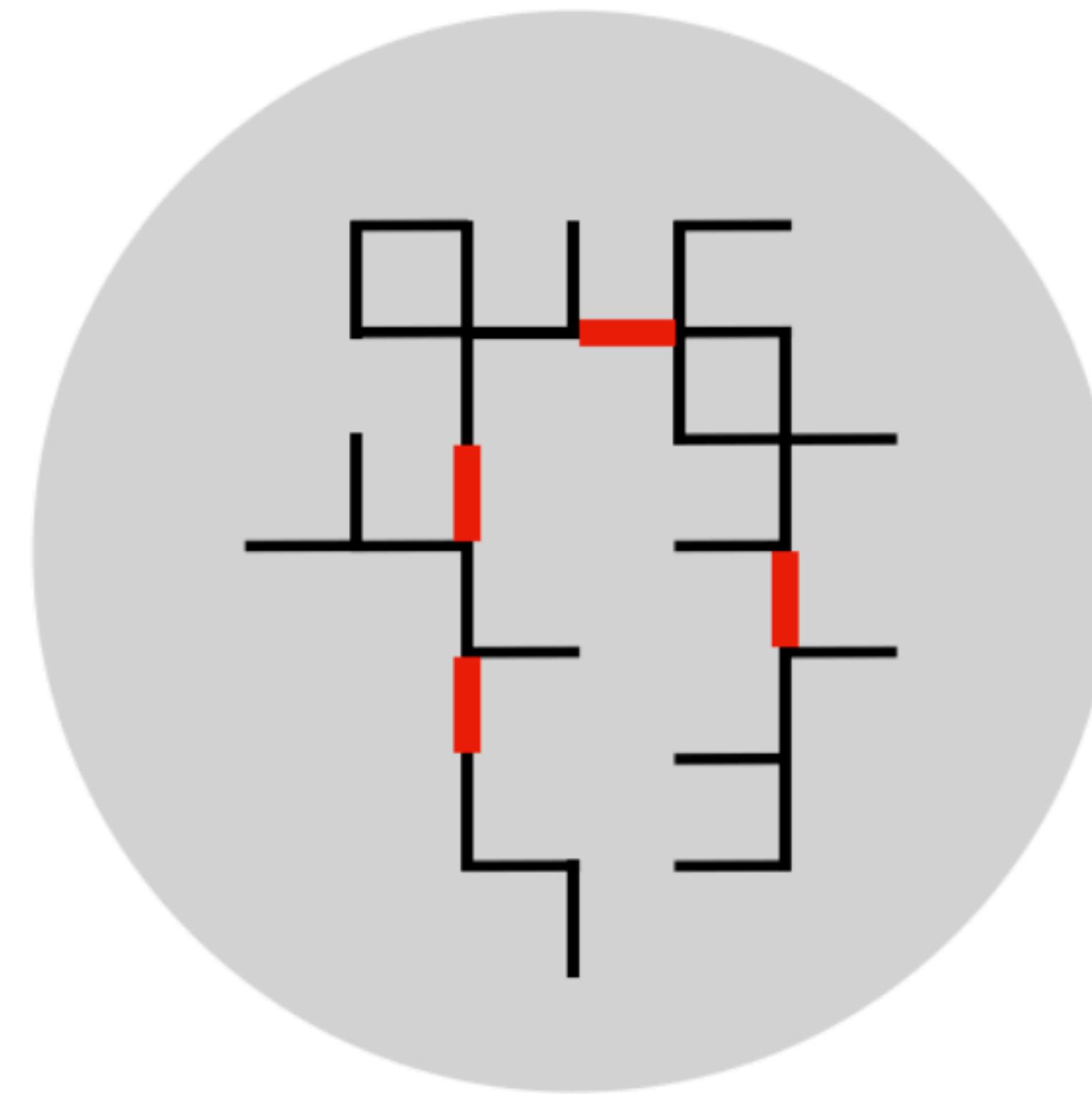
We care about ACCESSIBILITY FOR ALL,  
less about predicting from past flows.



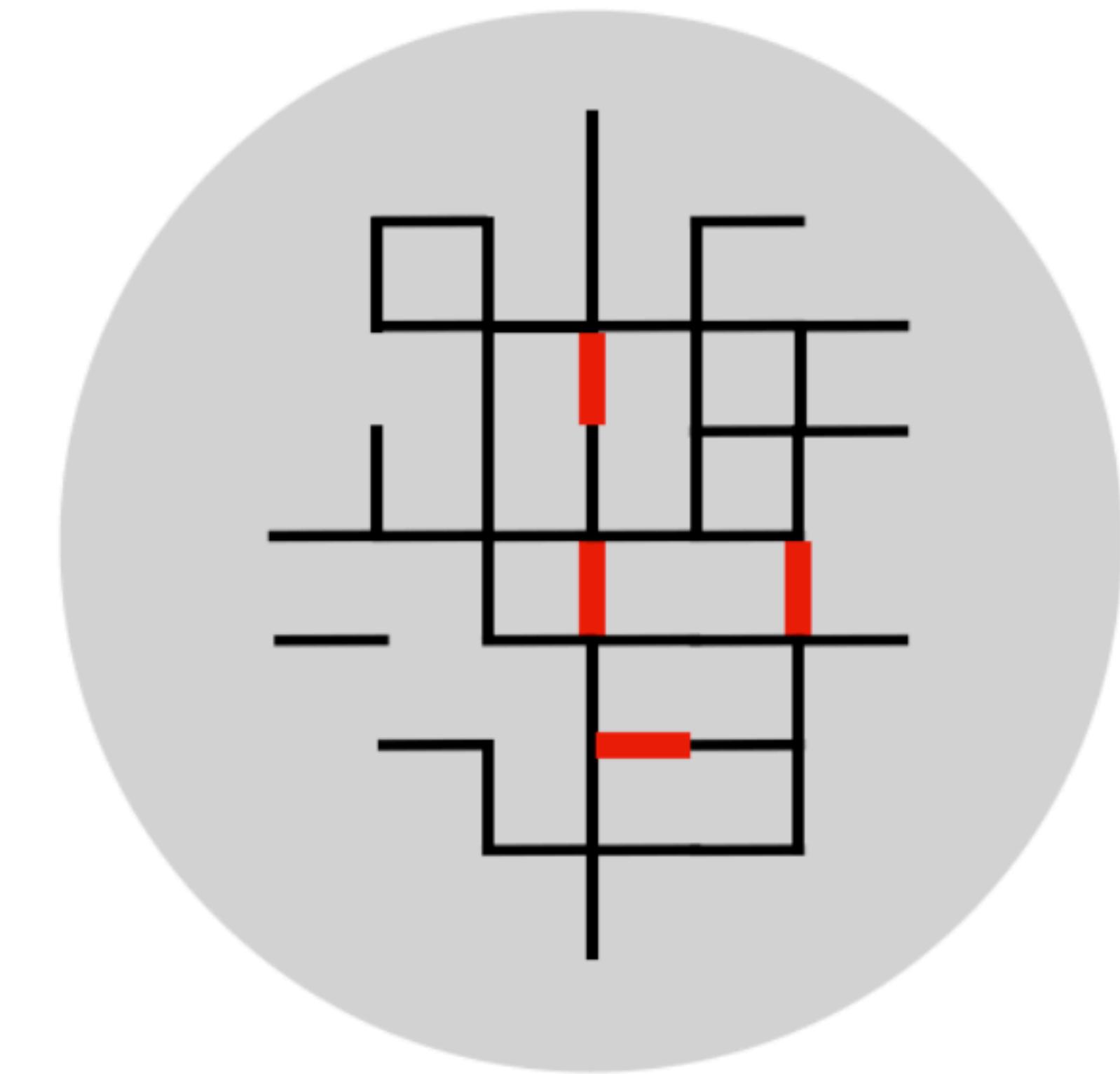
# How to build bicycle infrastructure? Finished research:



**Grow from scratch**  
GrowBike.Net



**Connect components**  
LinkBike.Net



**Find missing links**  
FixBike.Net

How to build bicycle infrastructure? Ongoing research:

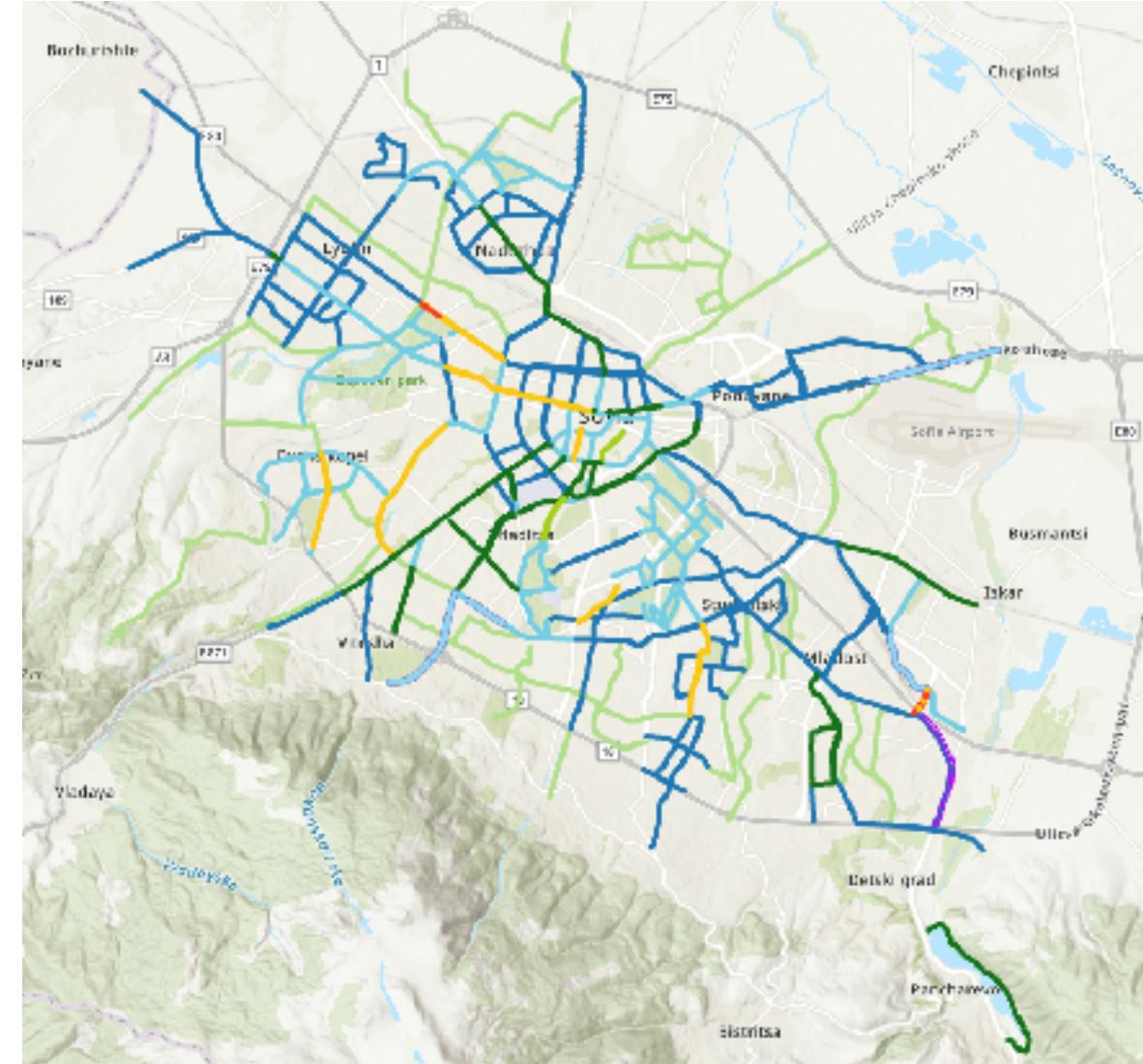
... in the city: Bicycle Network Development Plans

... in the countryside: The Cycle Node Network Planner

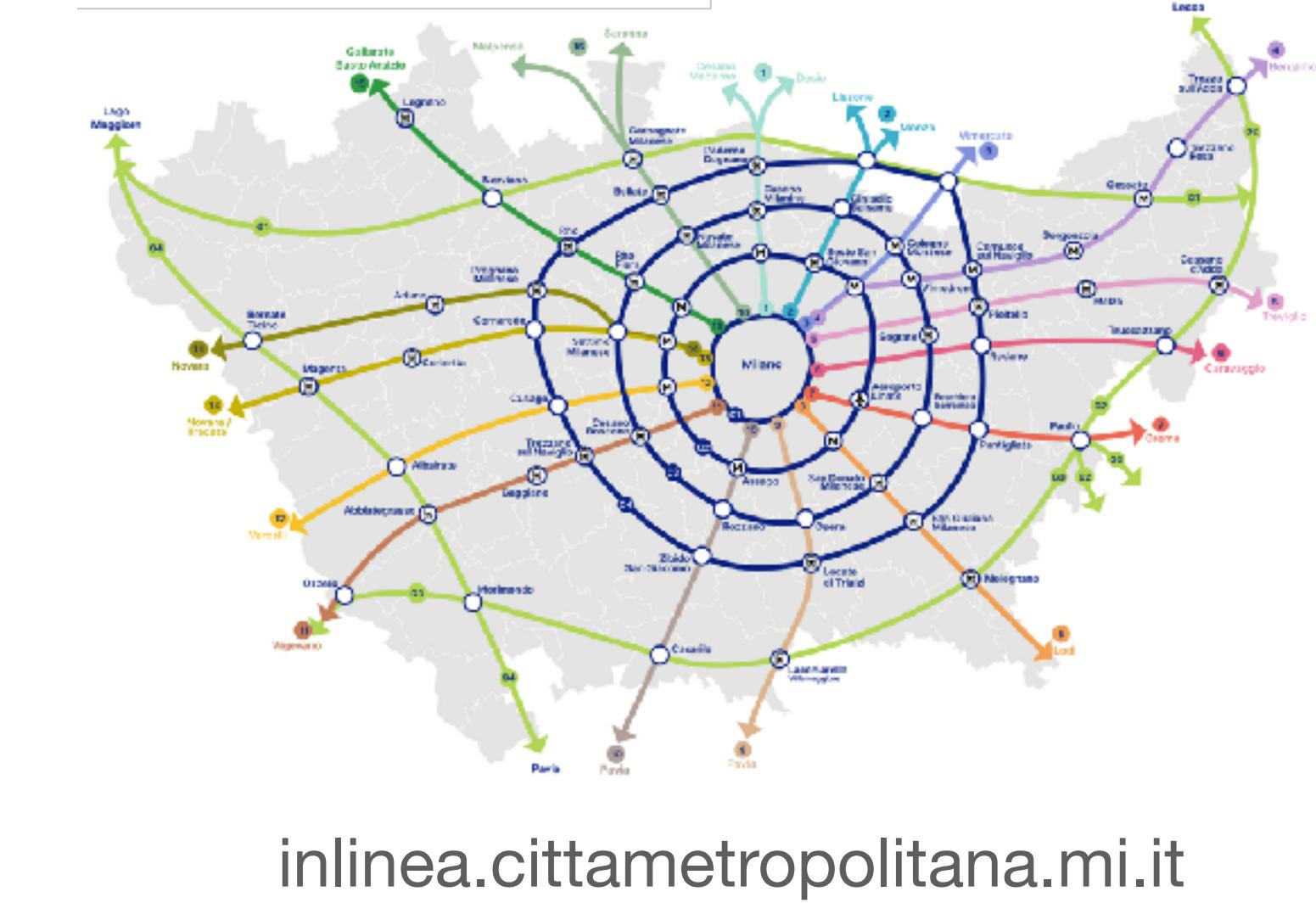
# Many cities have ambitious bicycle network development plans...



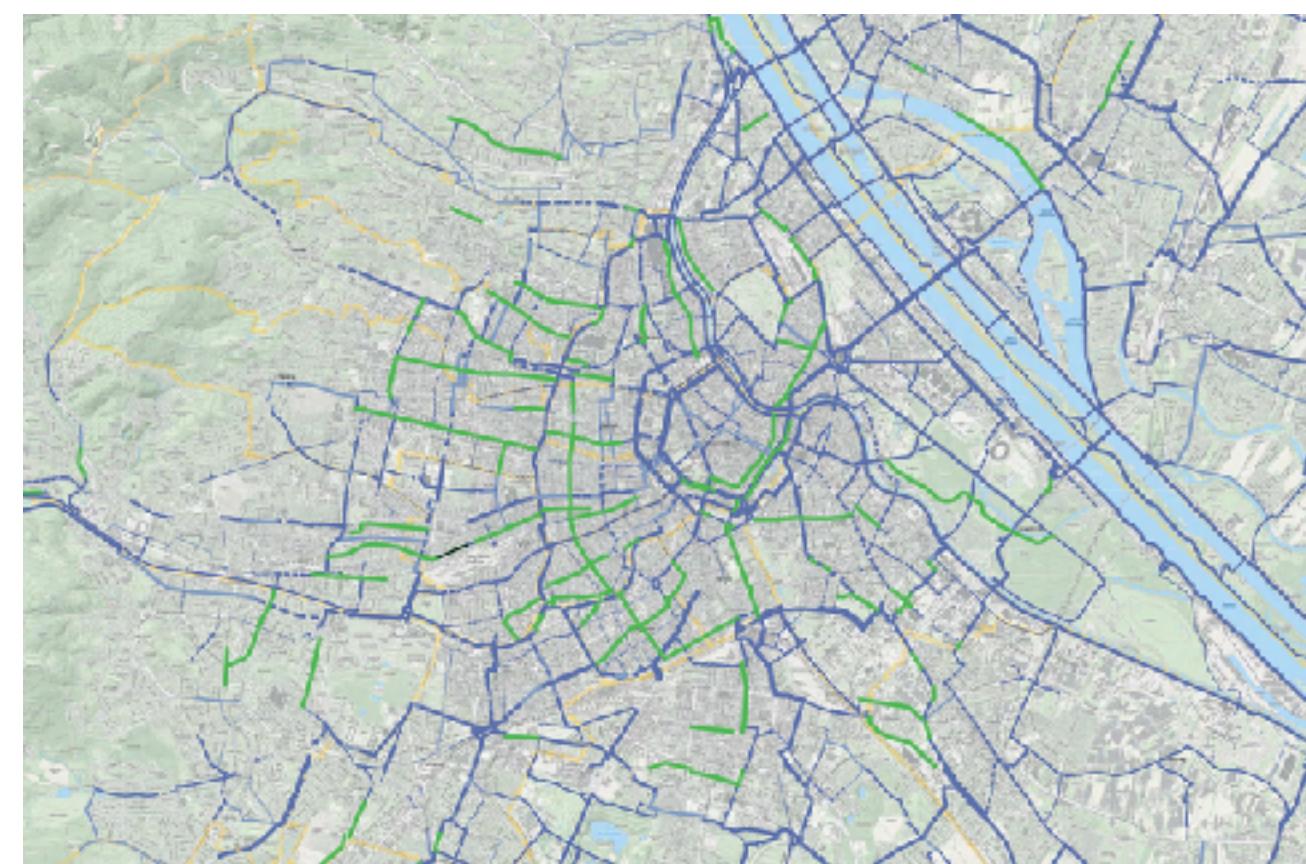
morgenpost.de



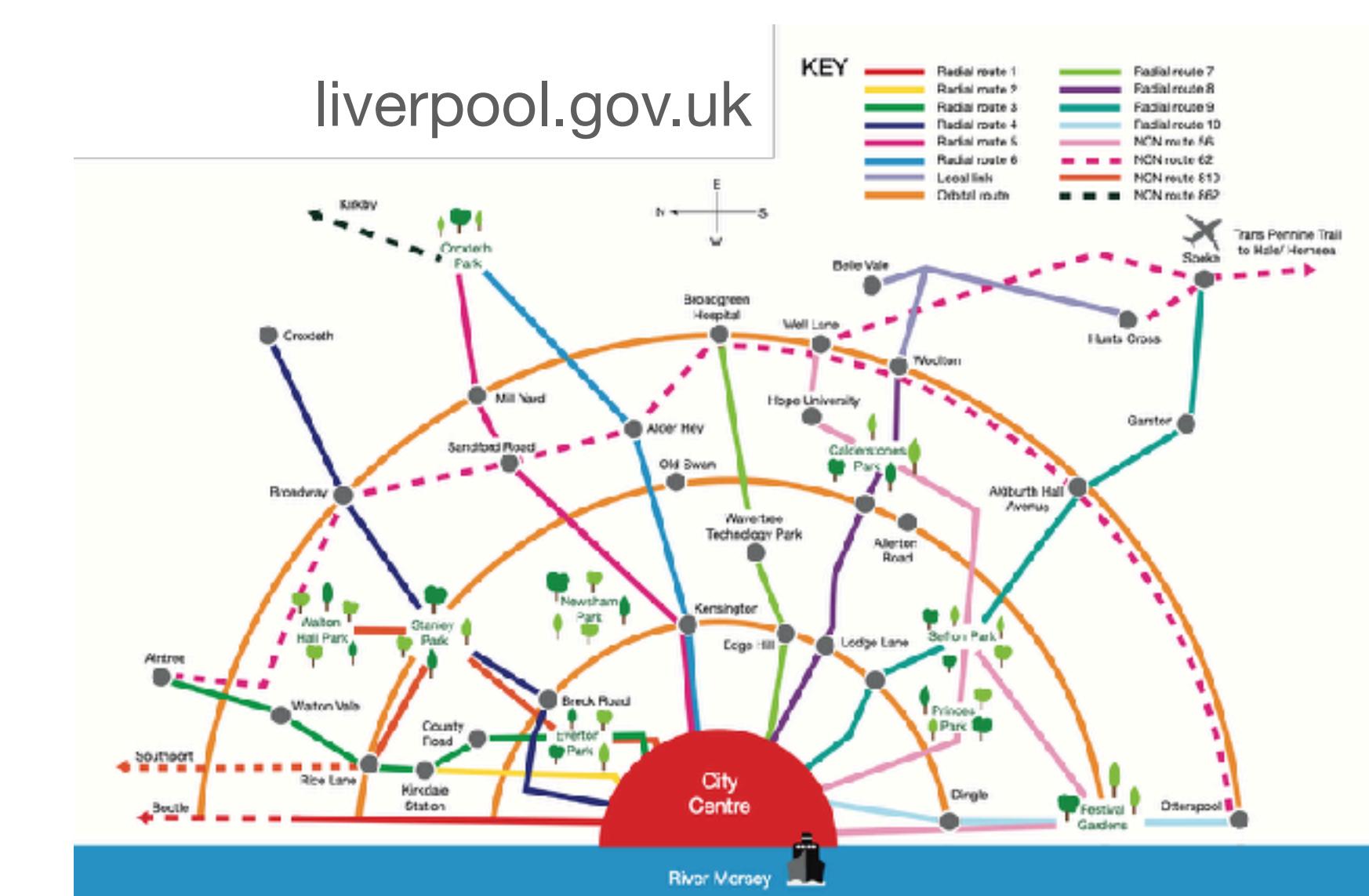
gis.sofiaplan.bg



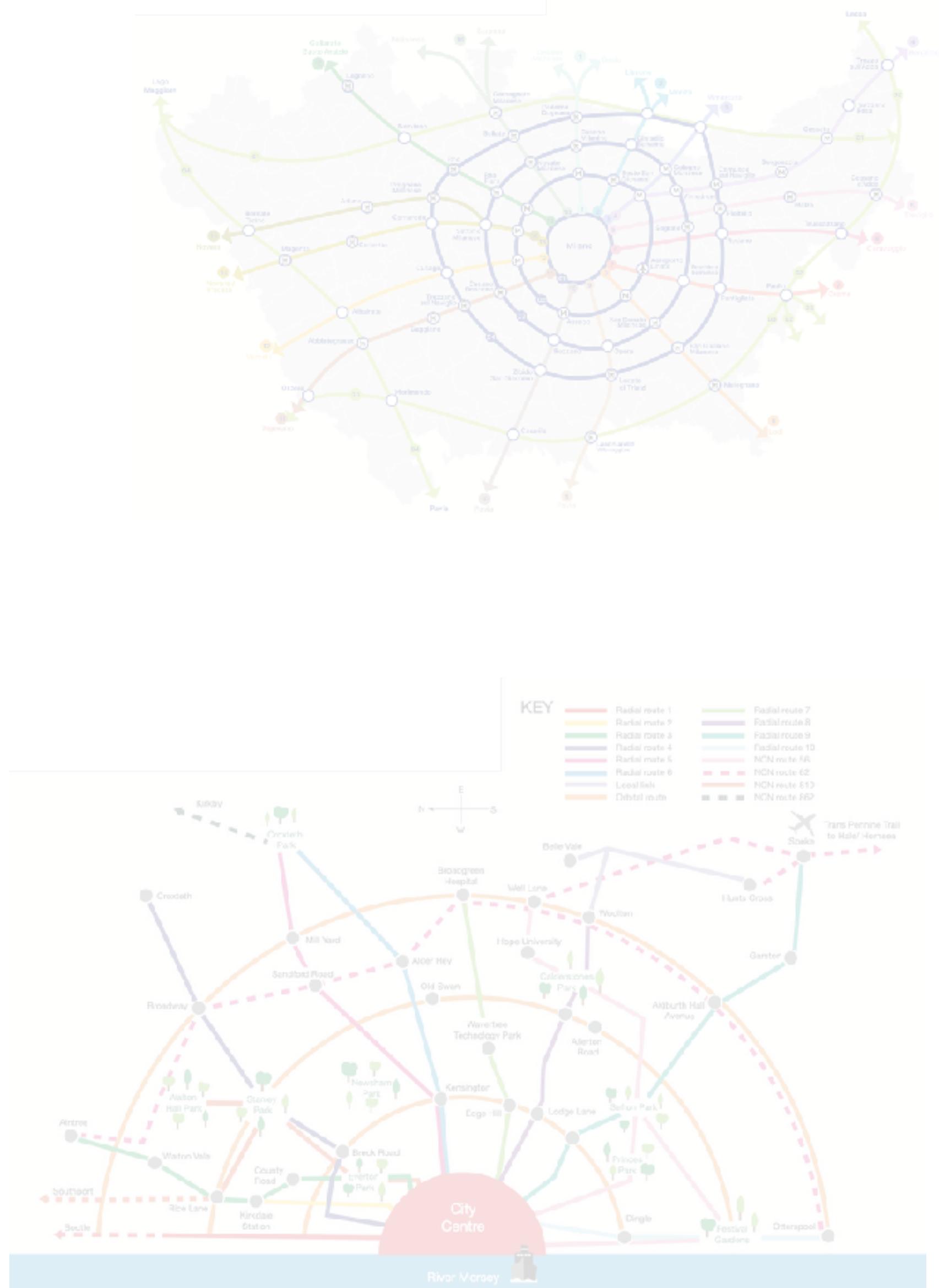
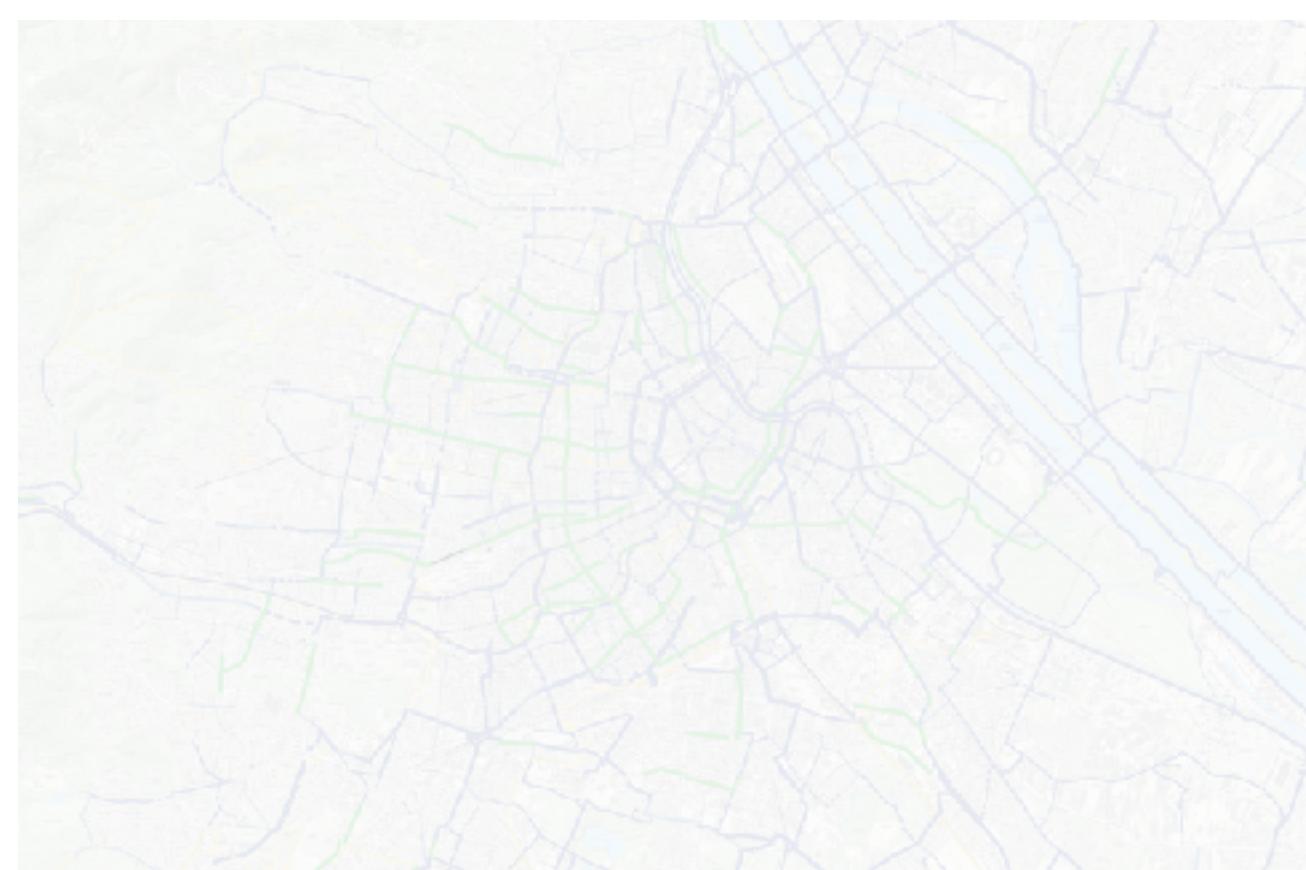
inlinea.cittametropolitana.mi.it



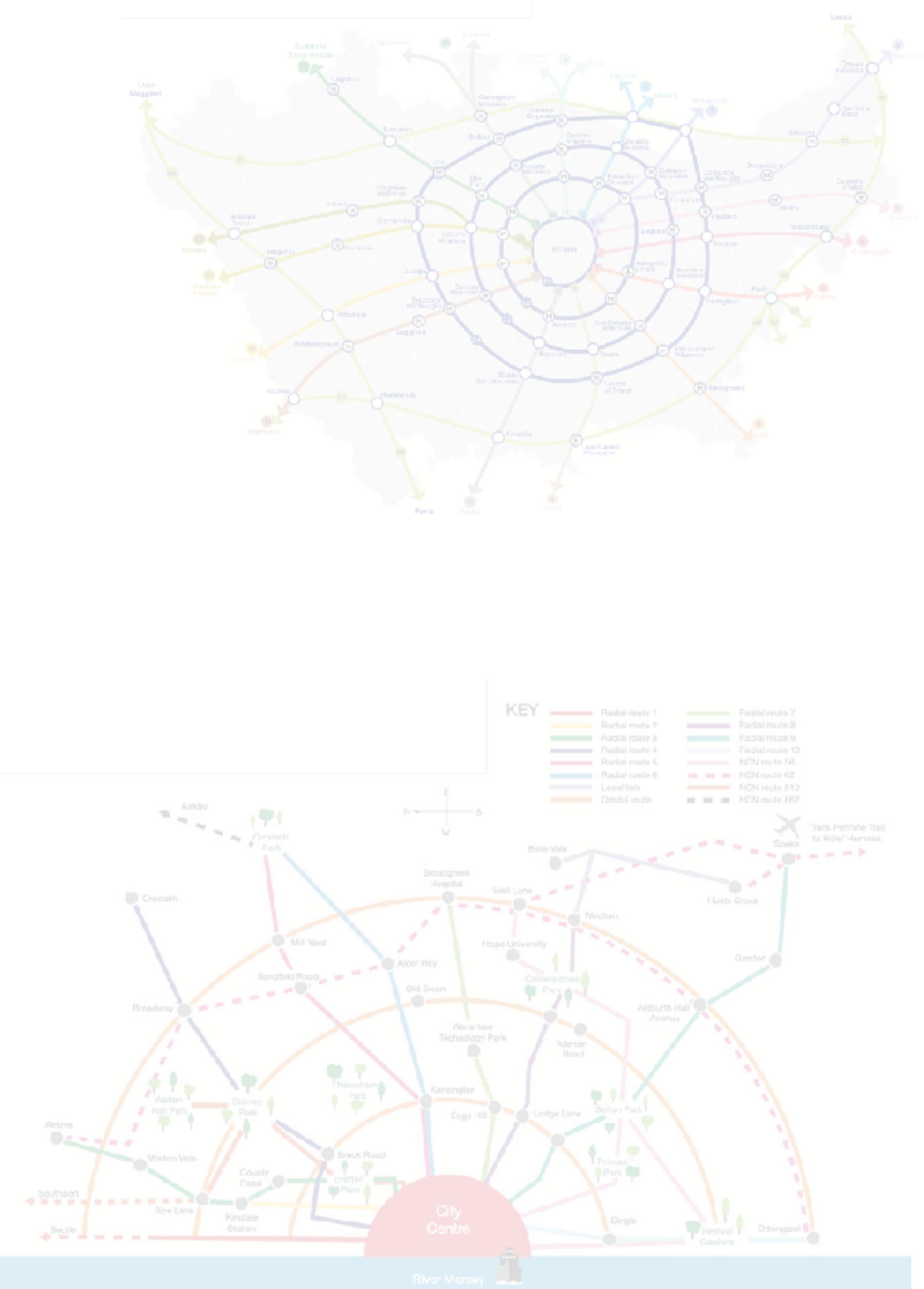
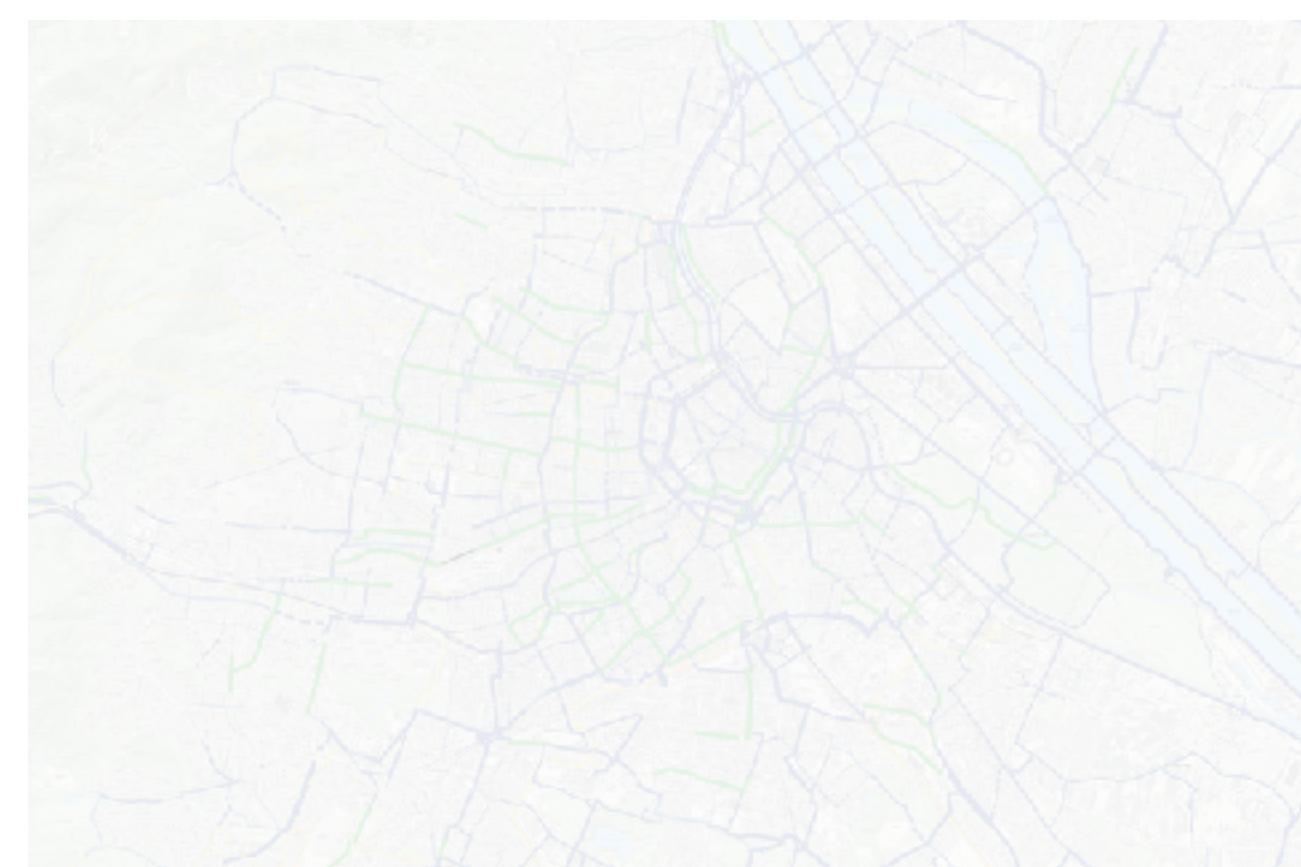
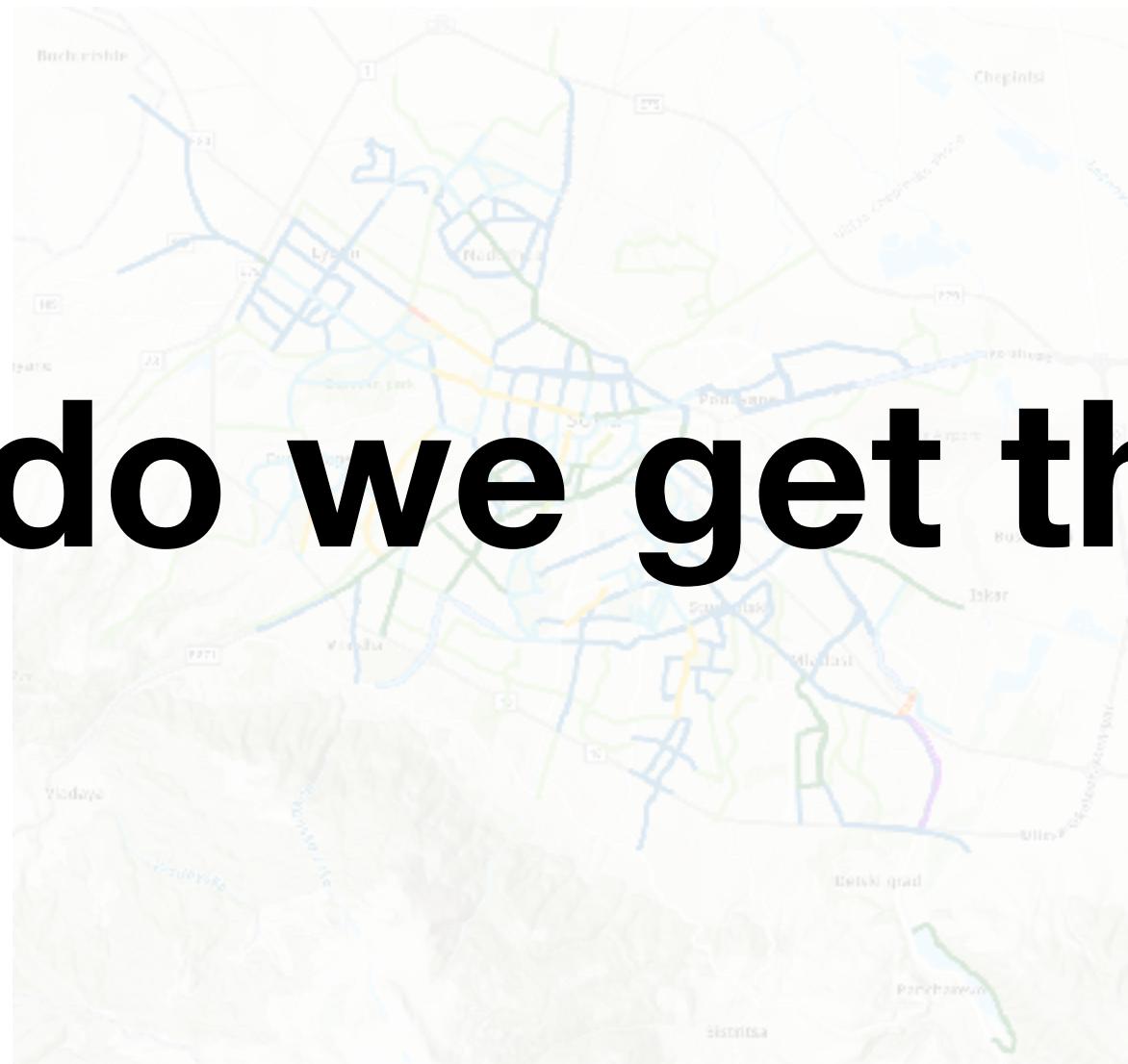
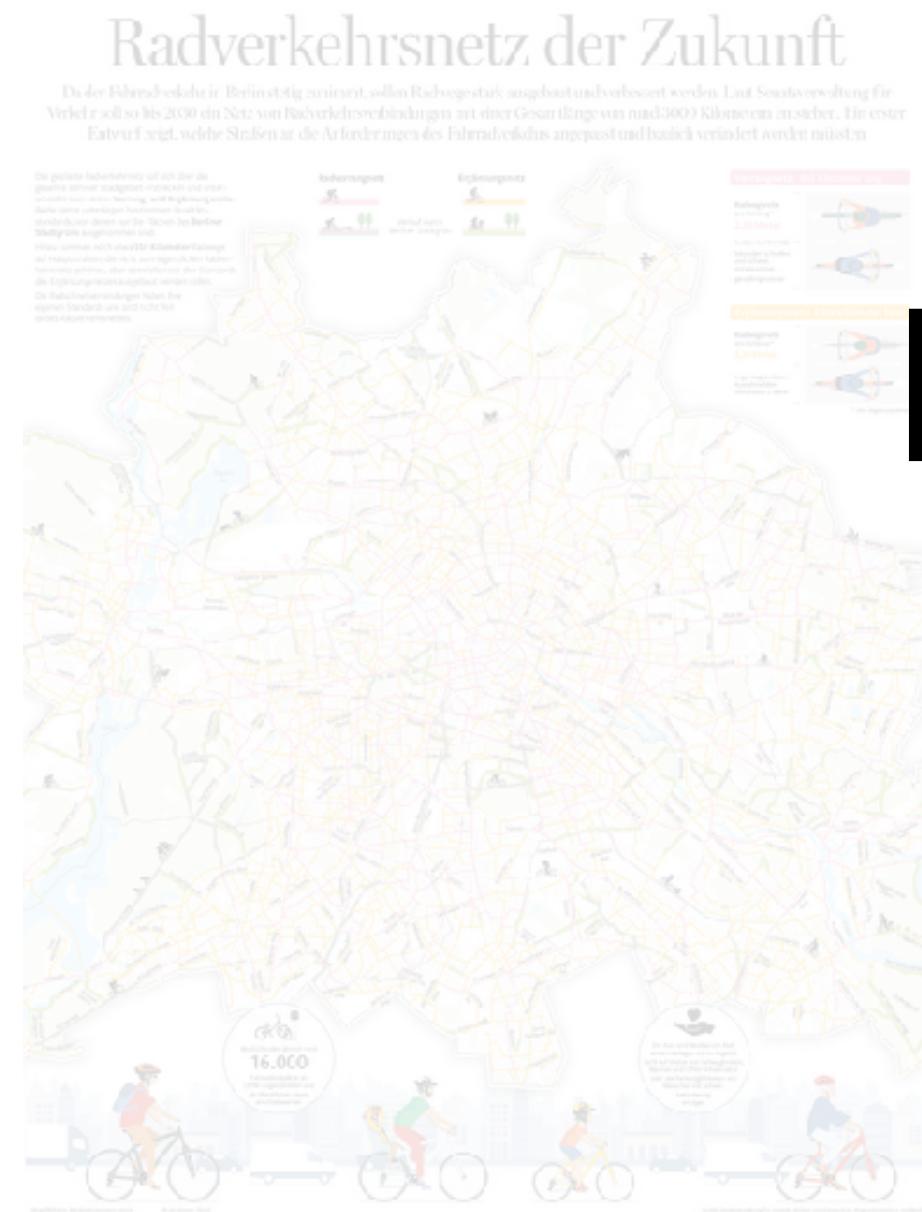
wien.gv.at



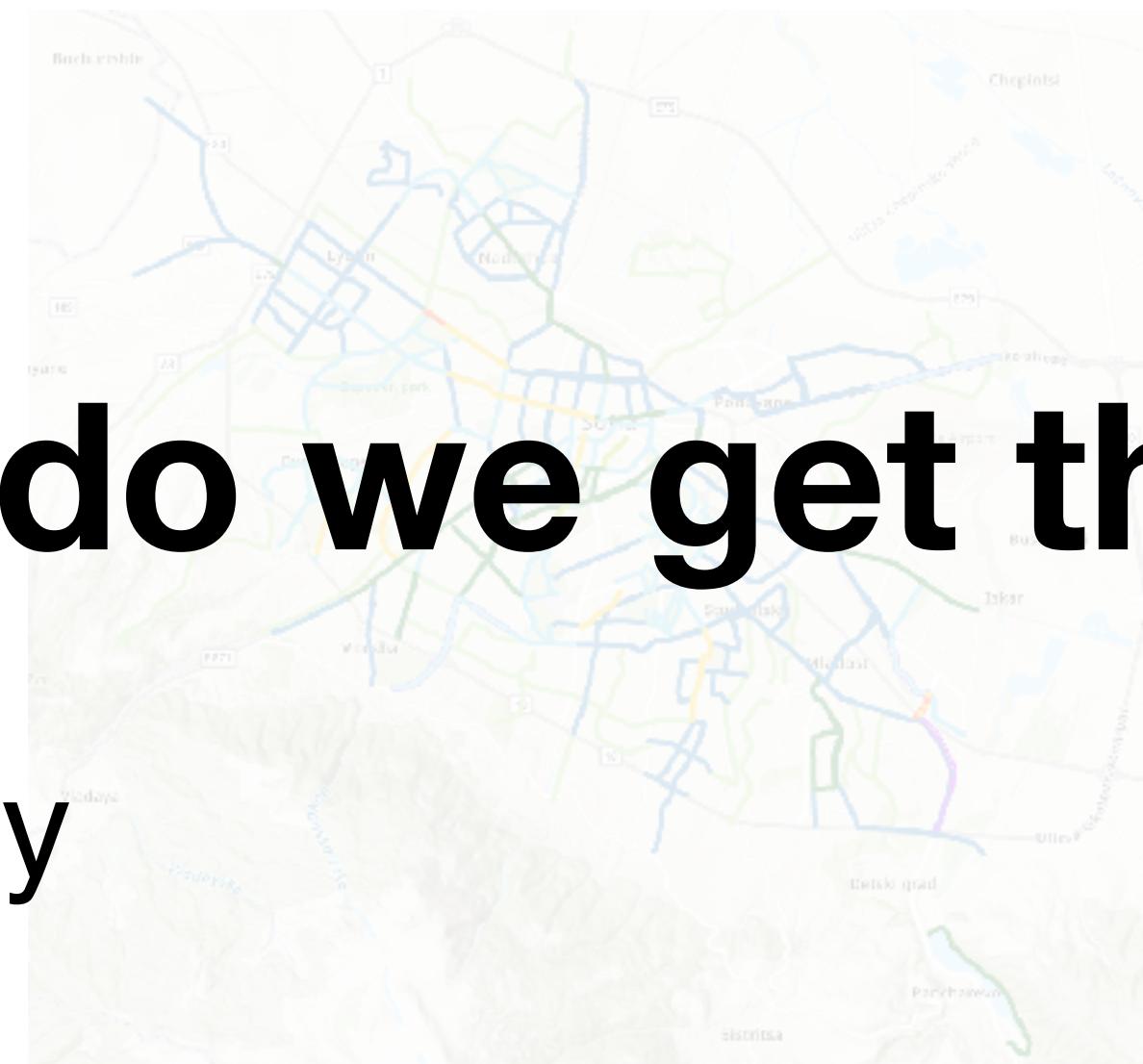
# ...but construction order sometimes lacks strategy



# ...but construction order sometimes lacks strategy

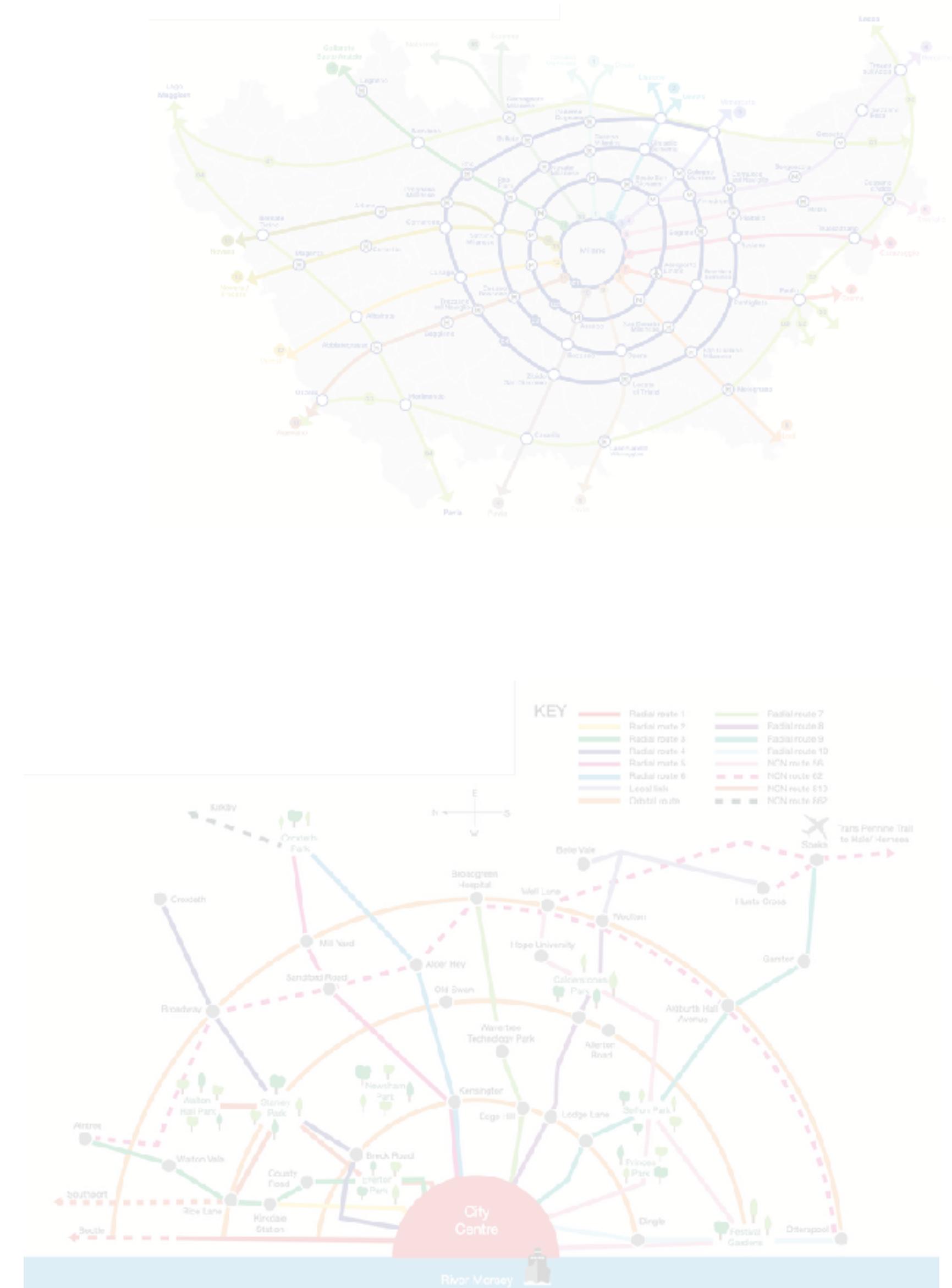
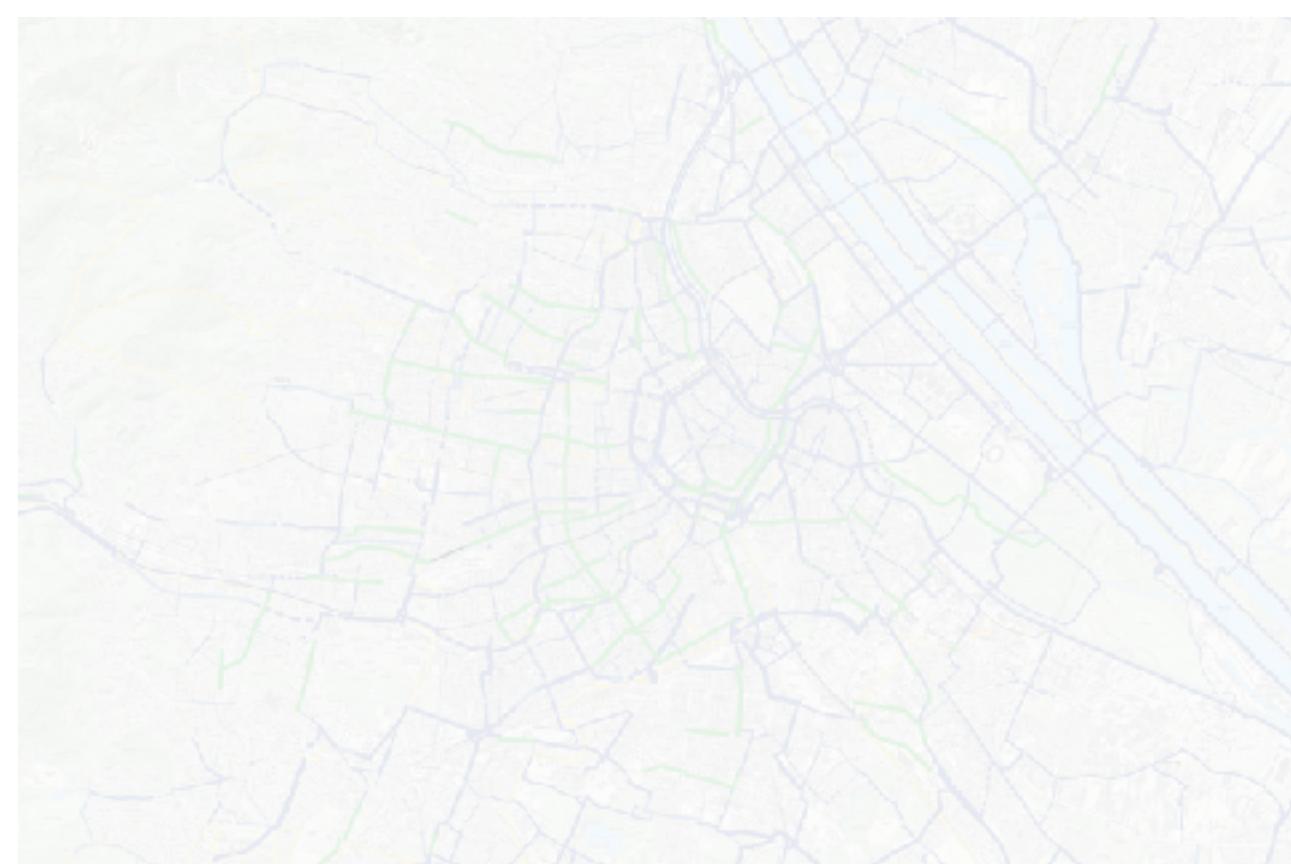


# ...but construction order sometimes lacks strategy



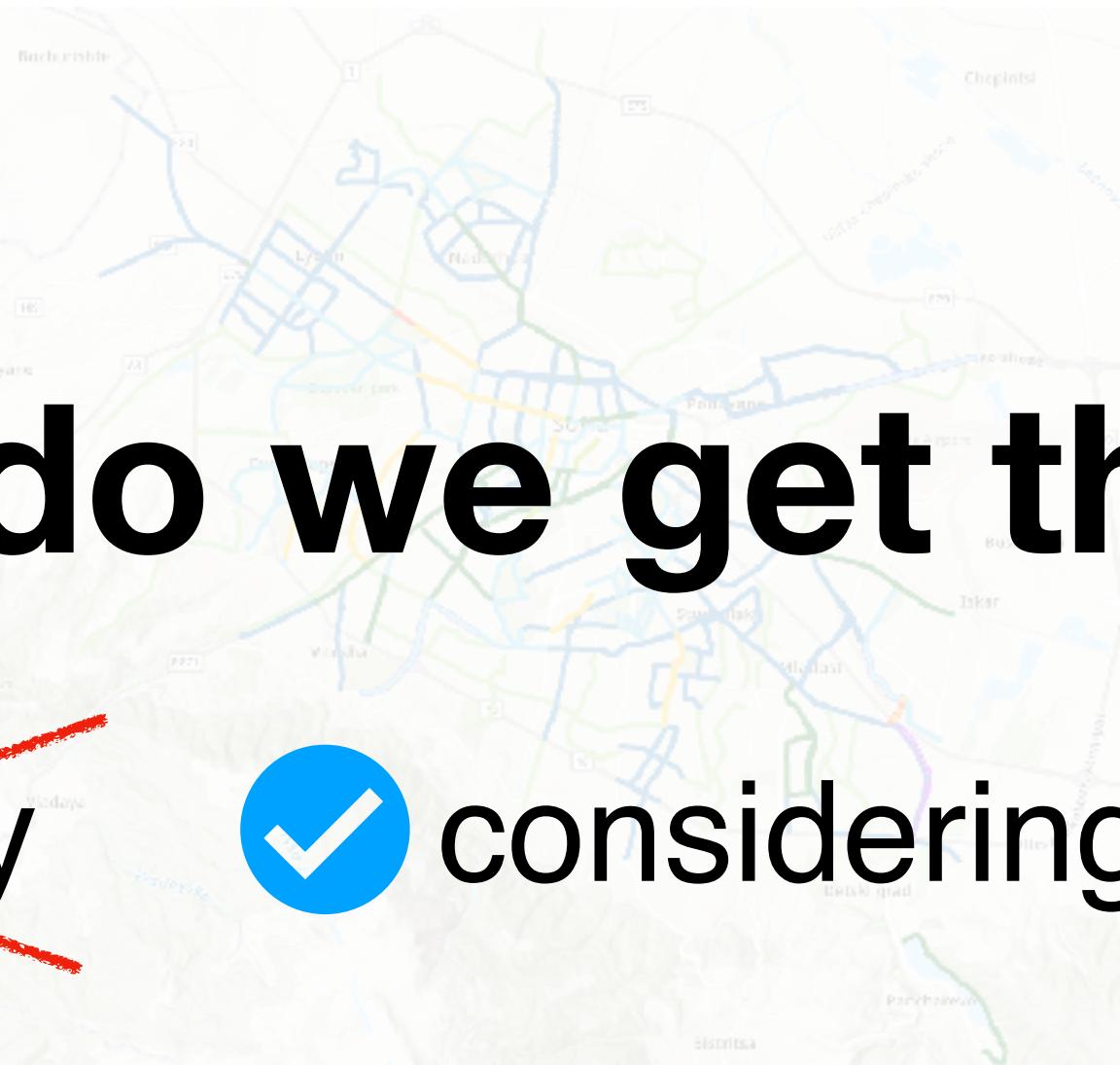
# How do we get there?

randomly



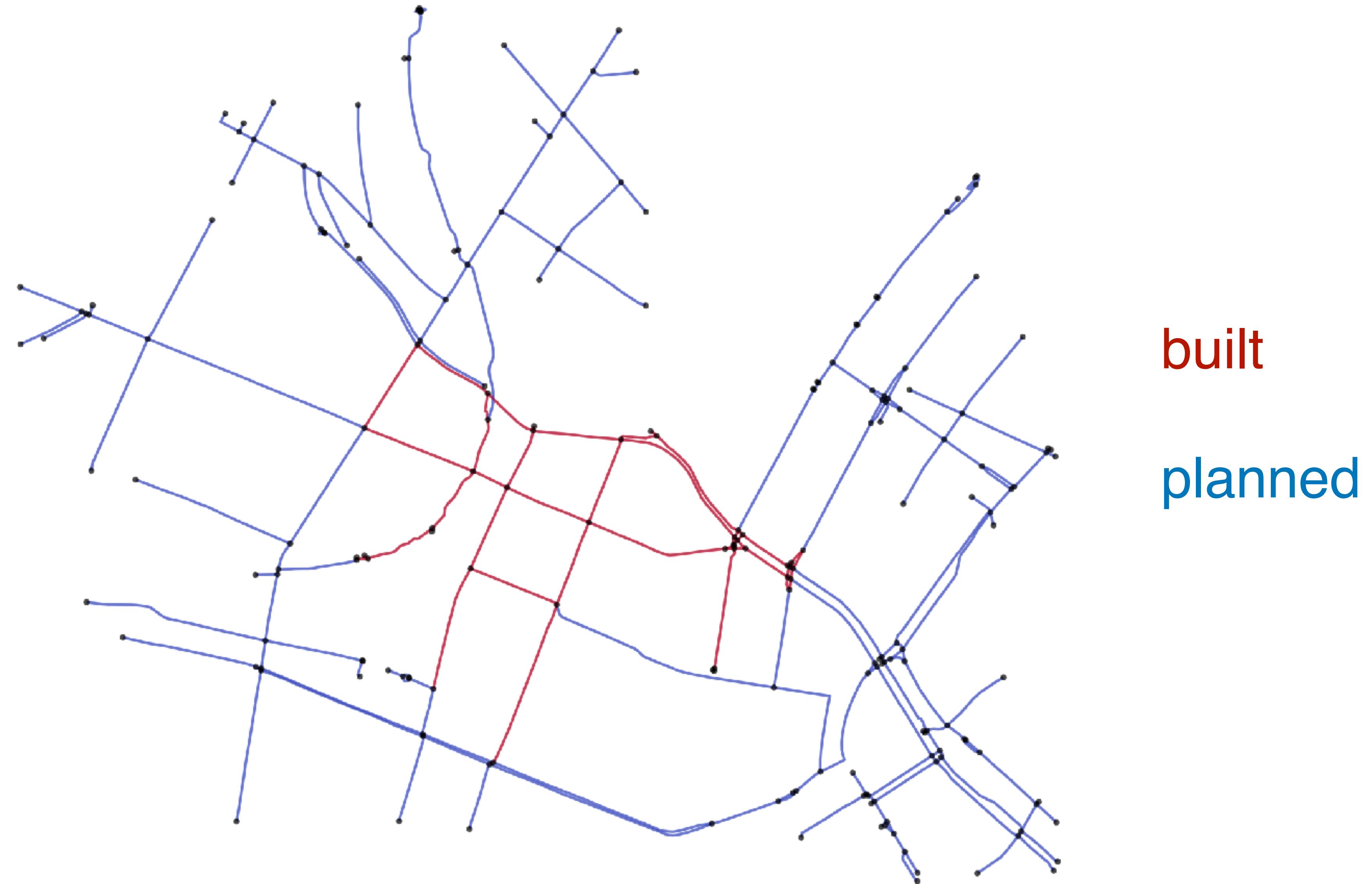
...but construction order sometimes lacks strategy

~~randomly~~



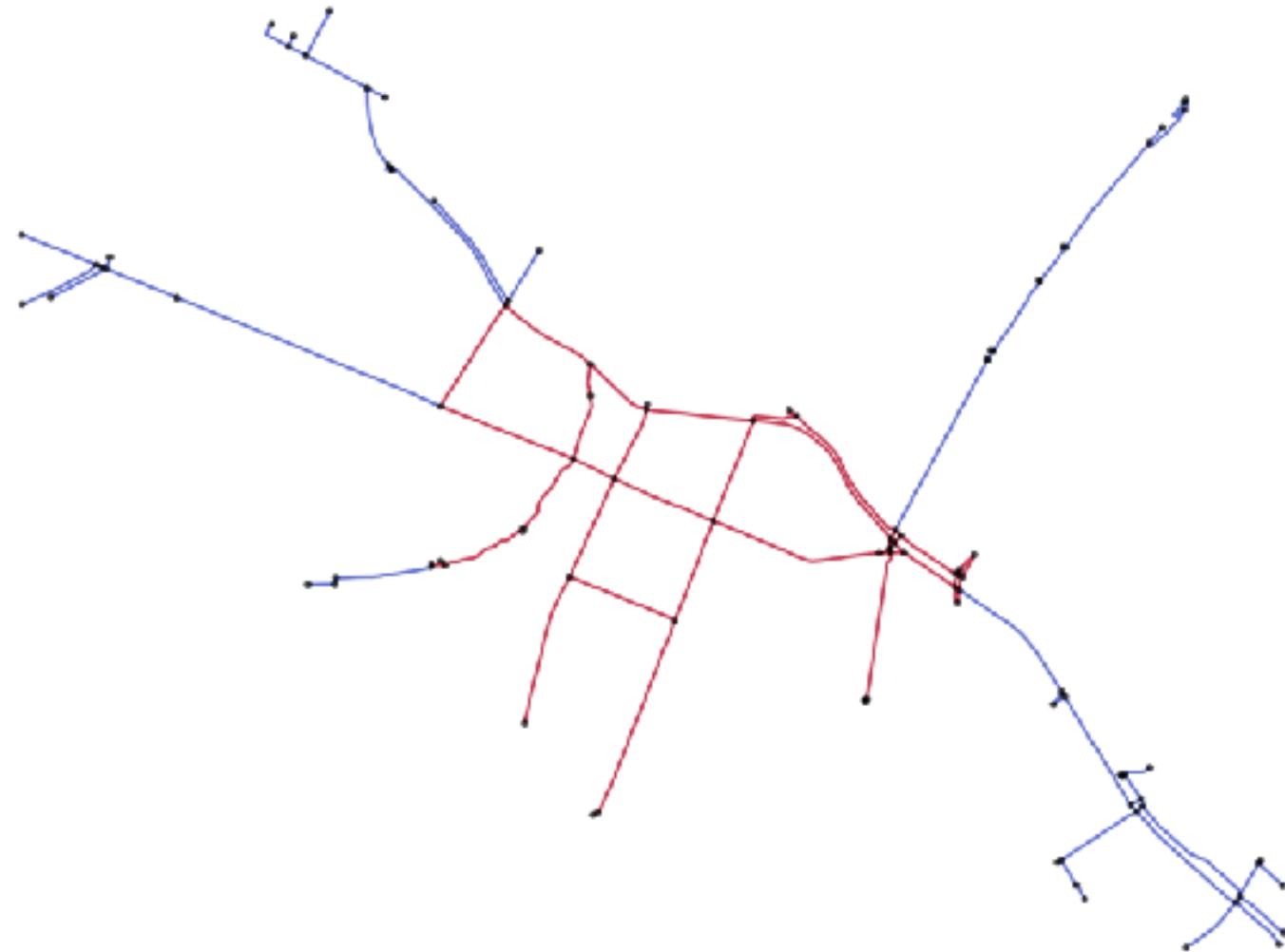
considering the network structure

# We can optimise for directness or coverage

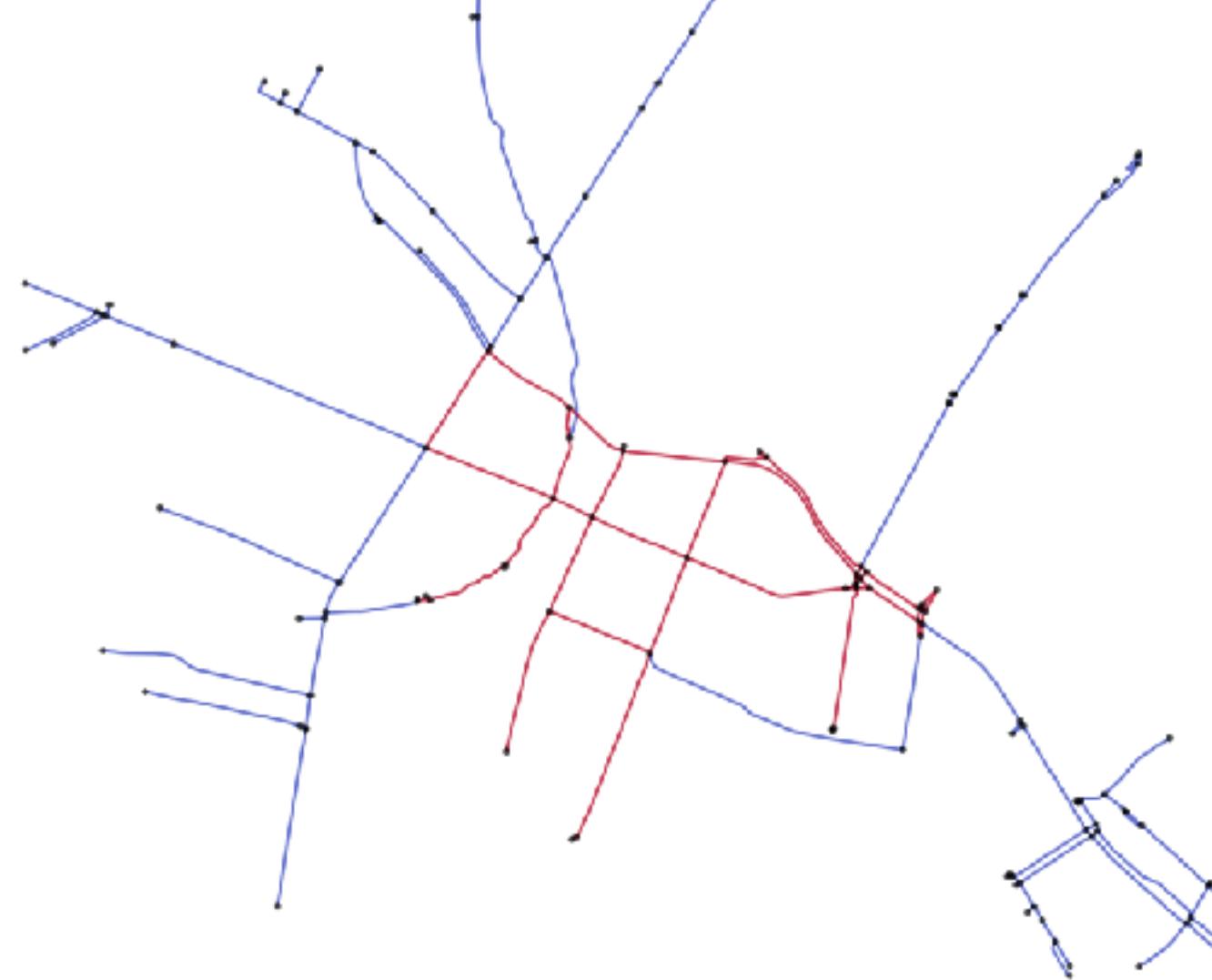


We can optimise for directness or coverage

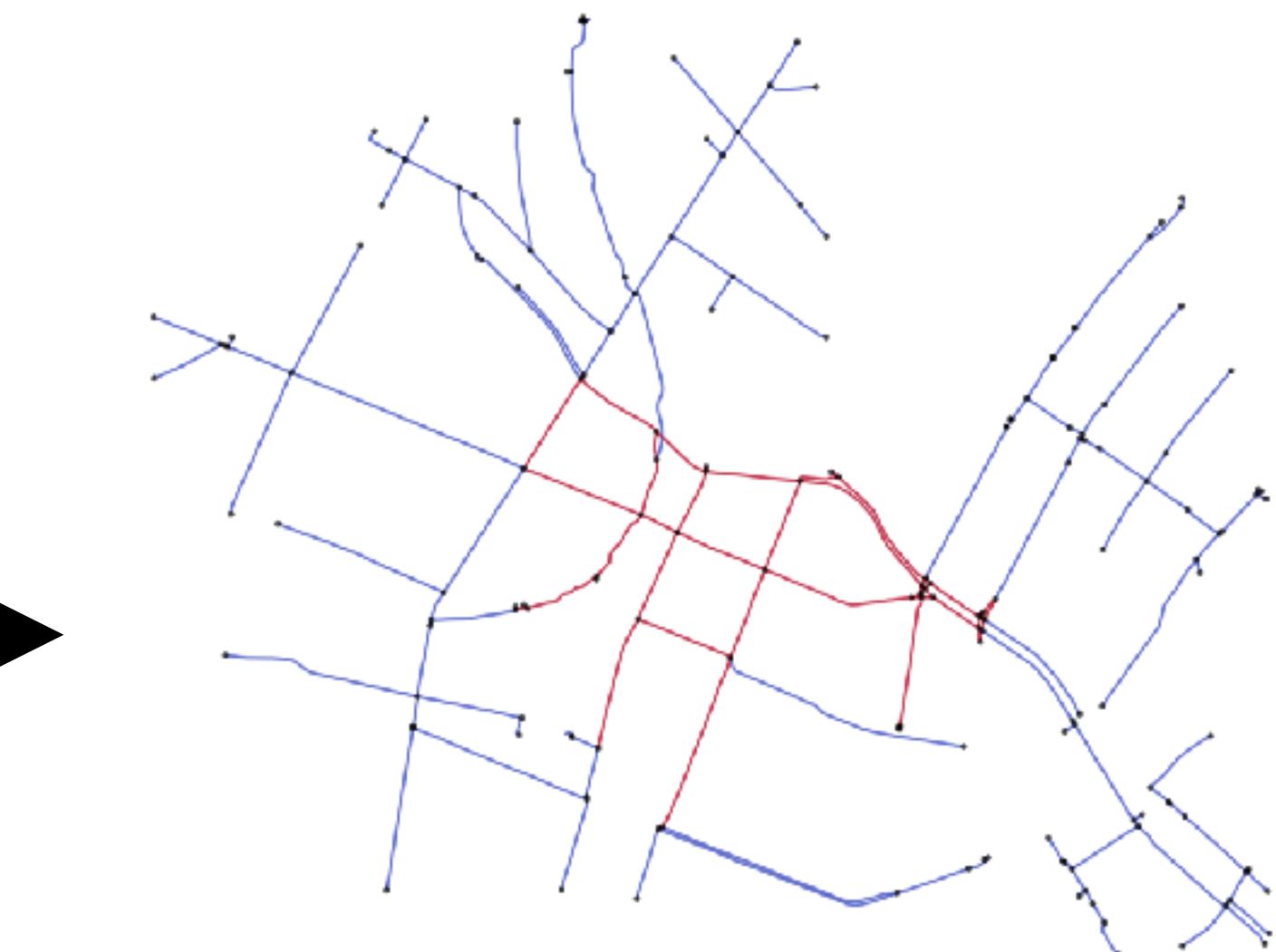
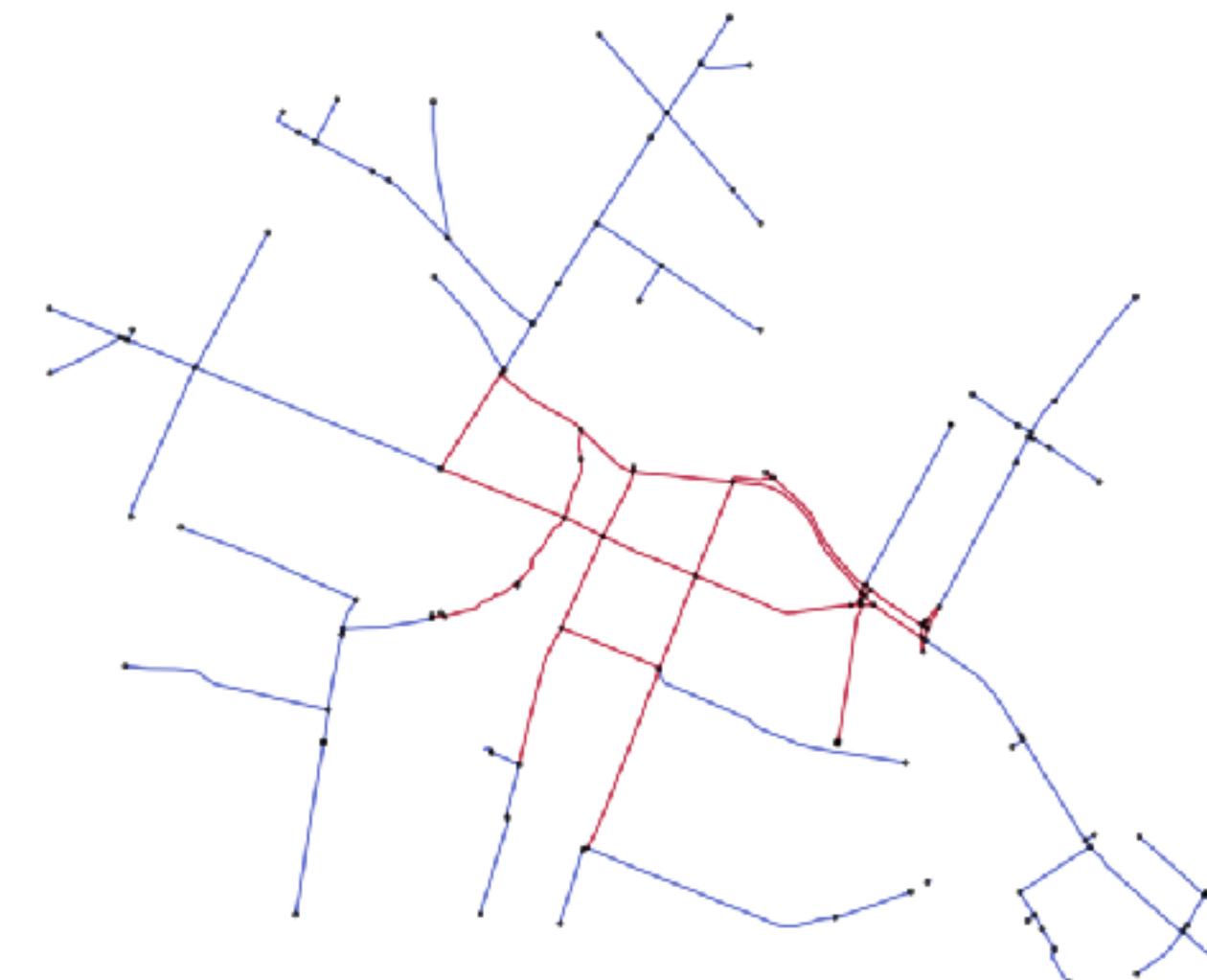
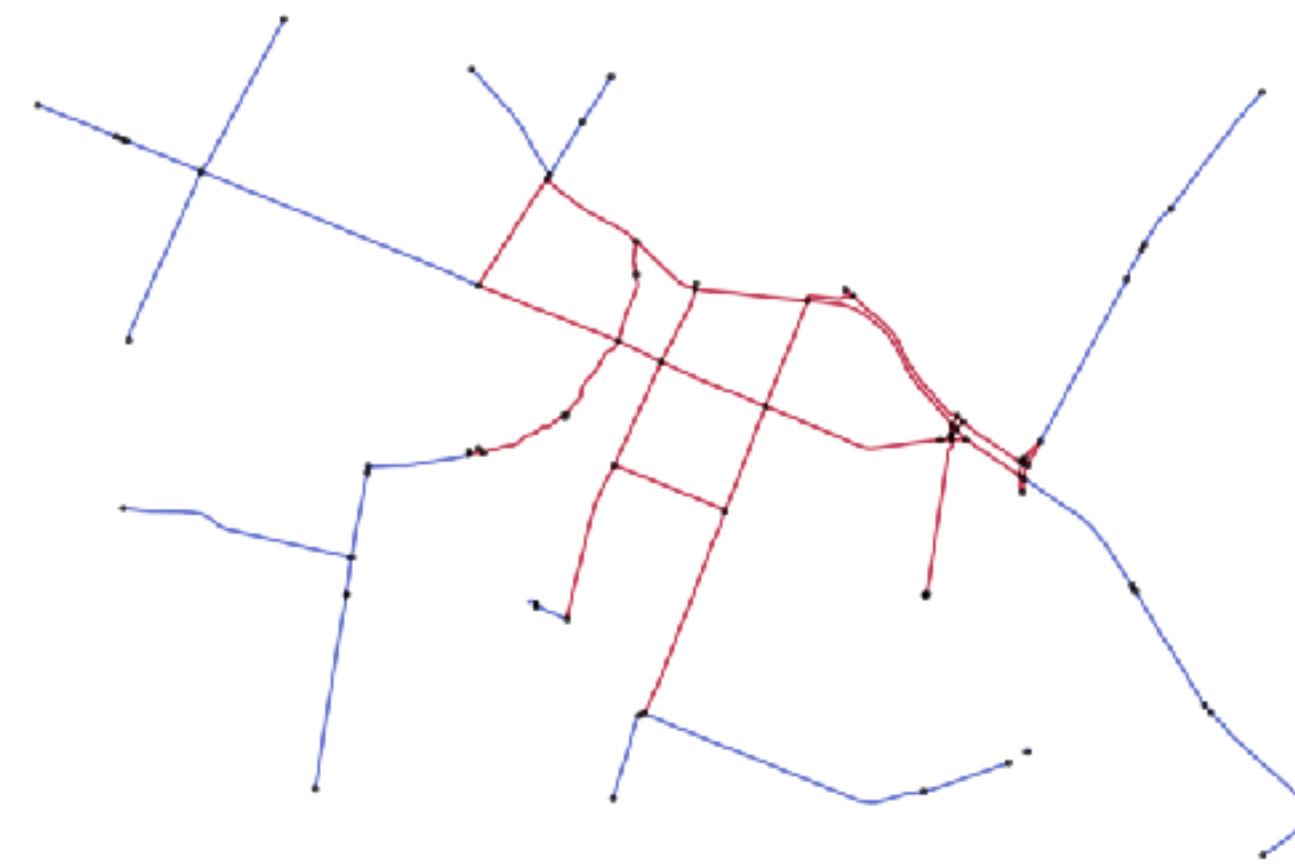
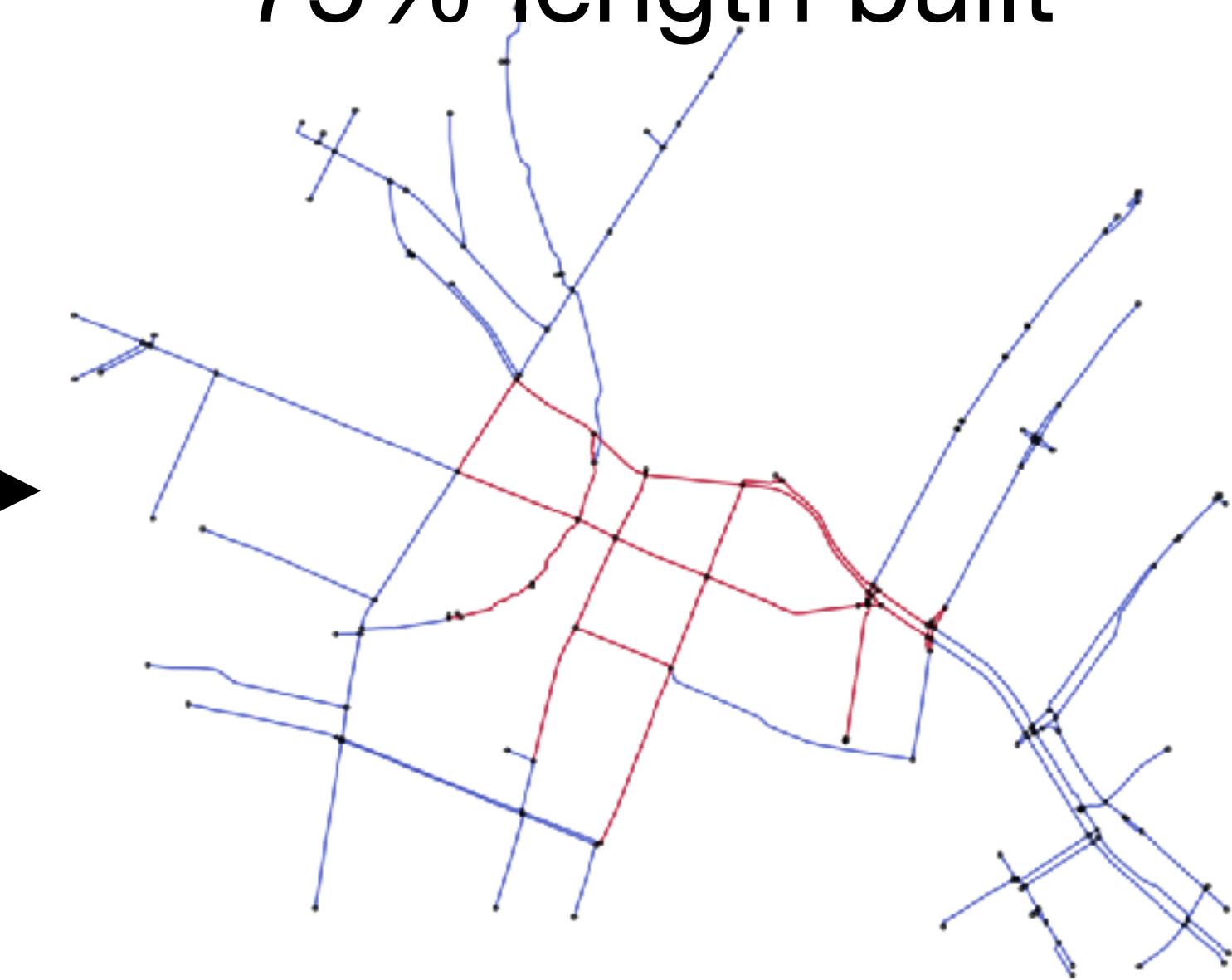
25% length built



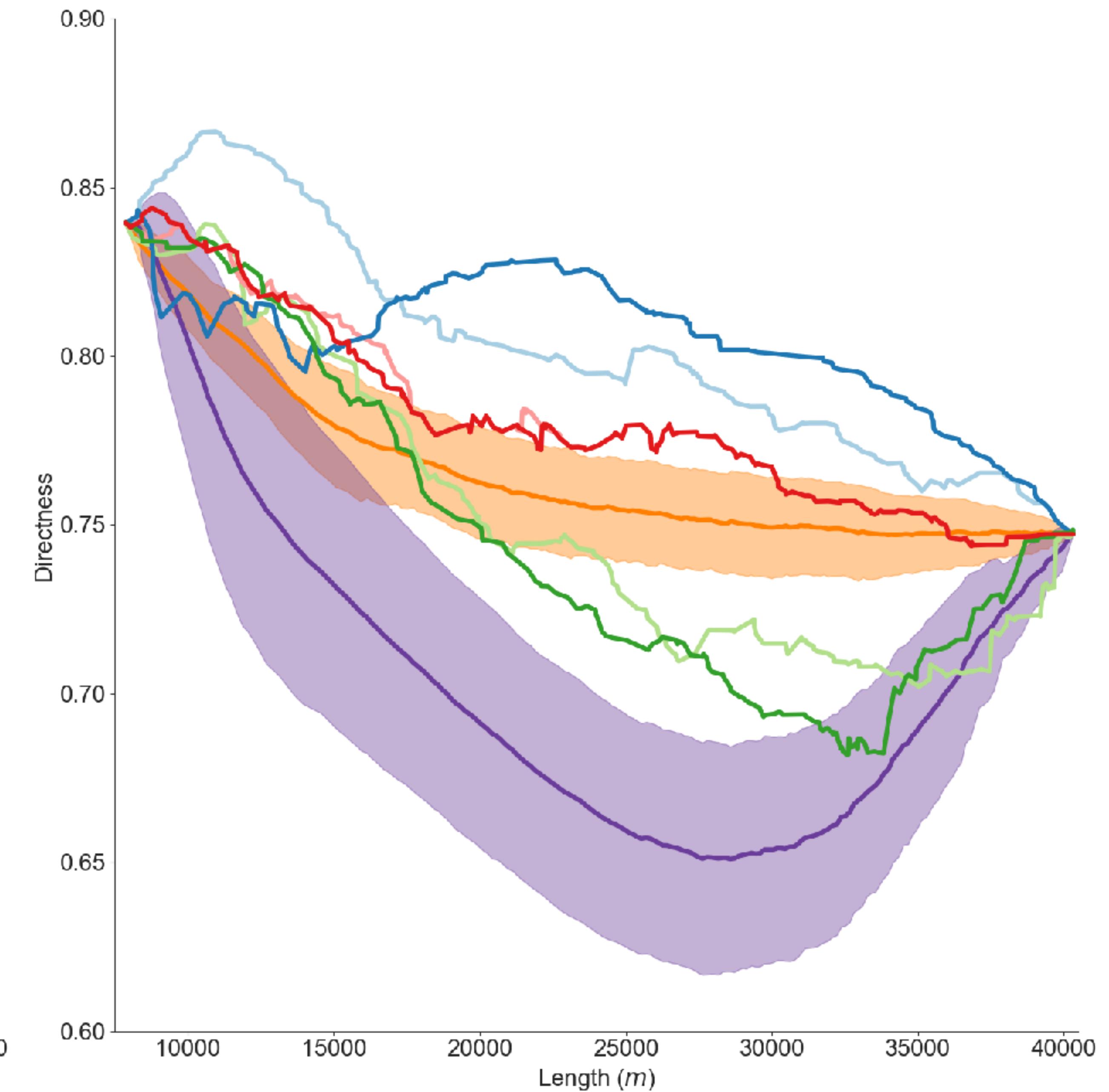
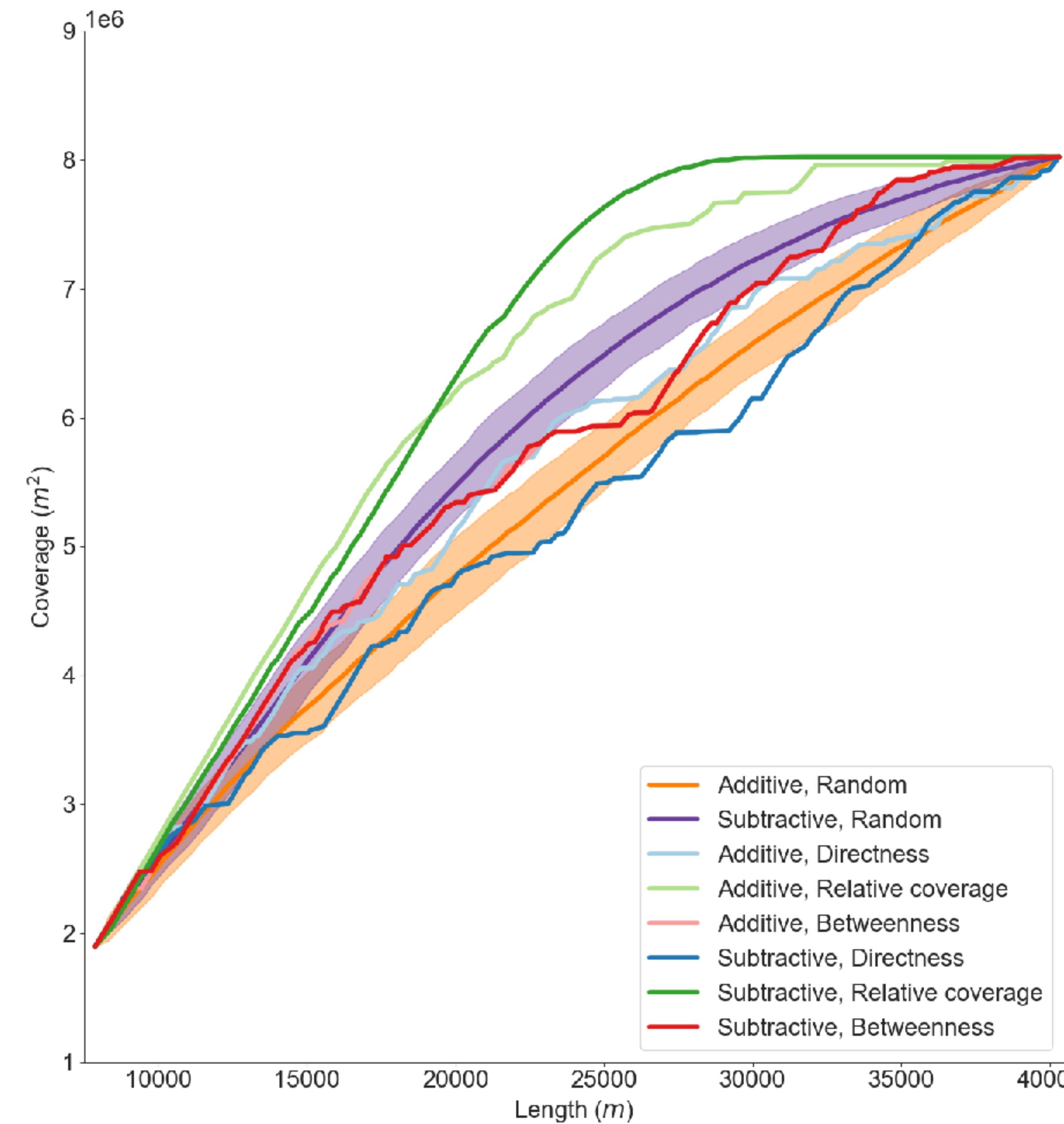
50% length built



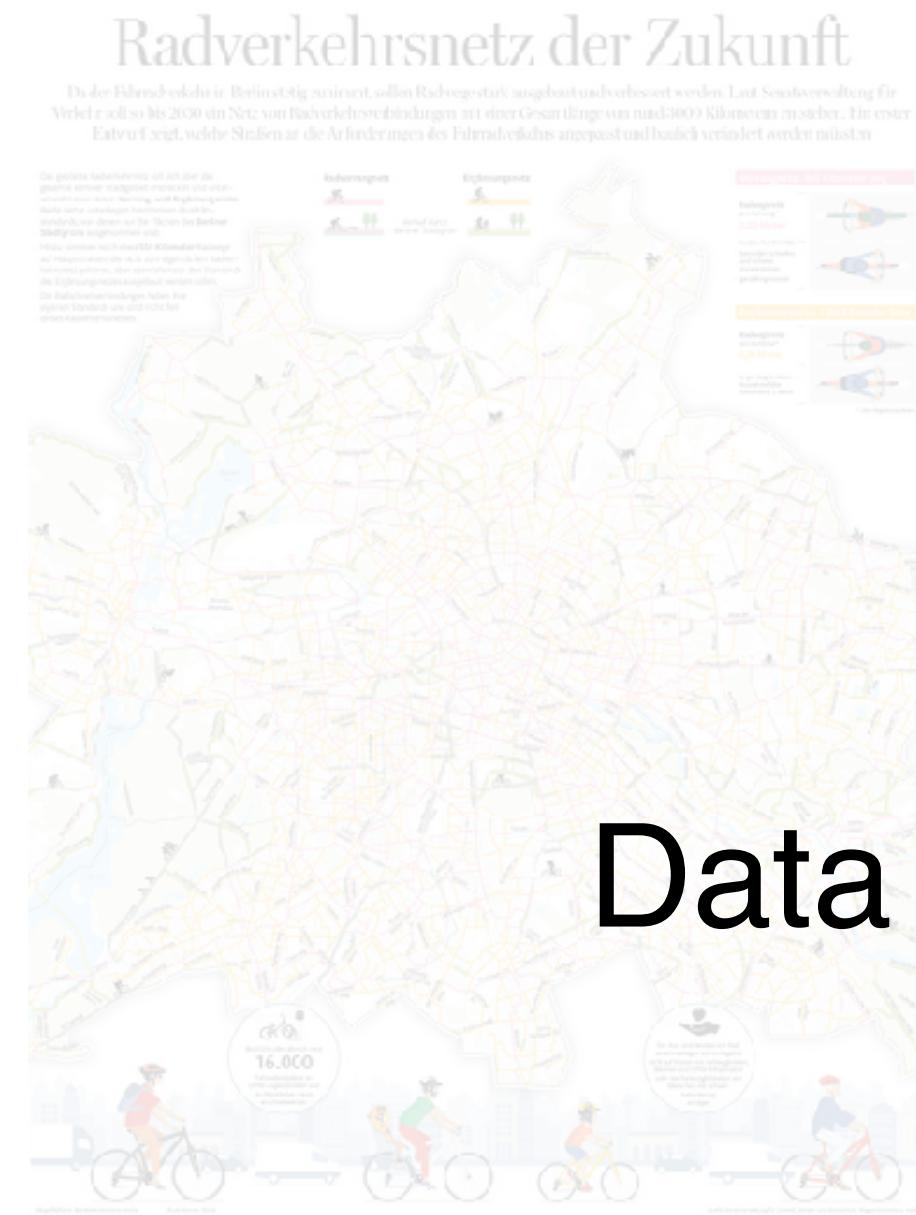
75% length built



# We can optimise for directness or coverage



...but there are many challenges on the way there



# Data

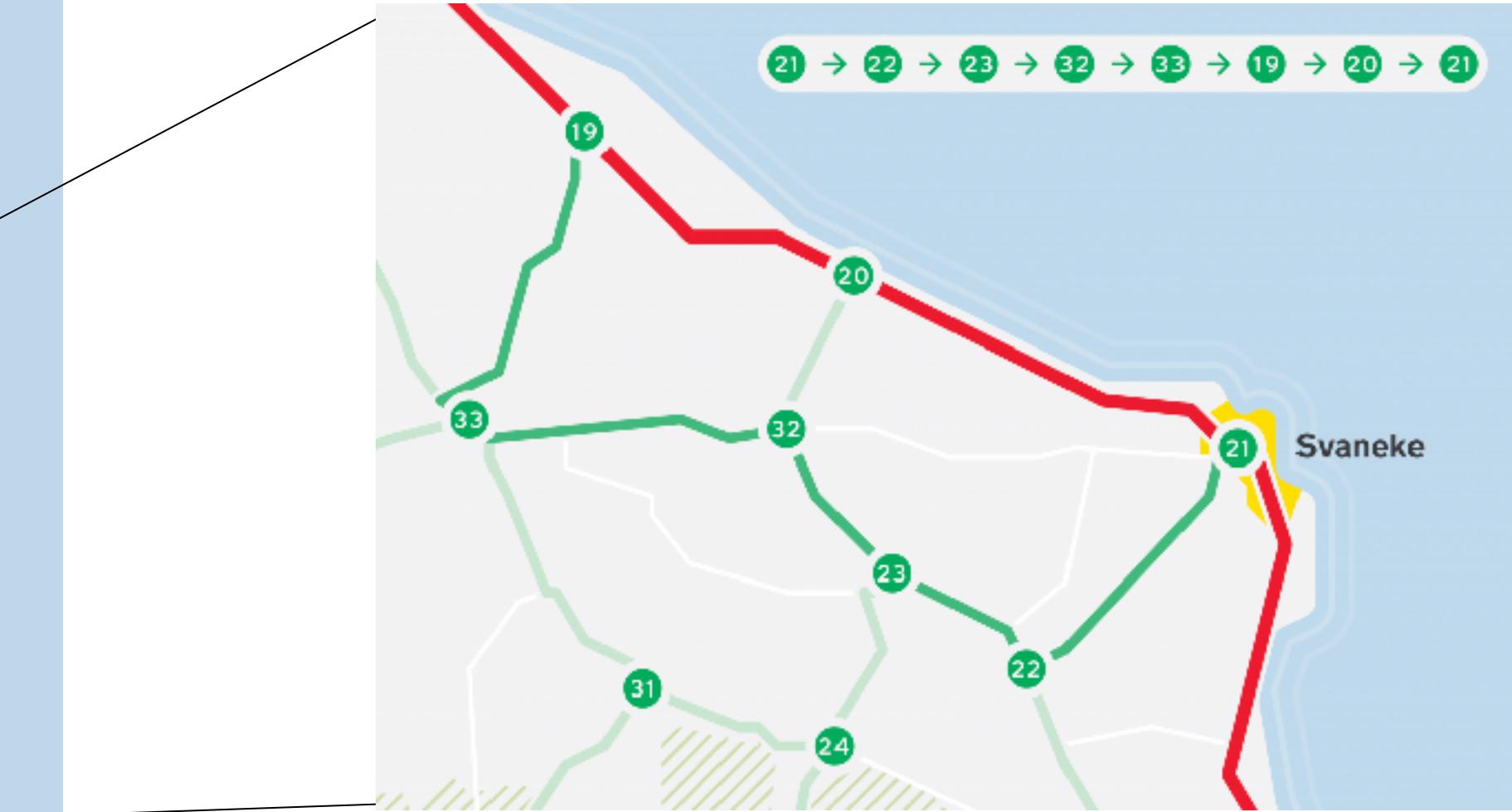
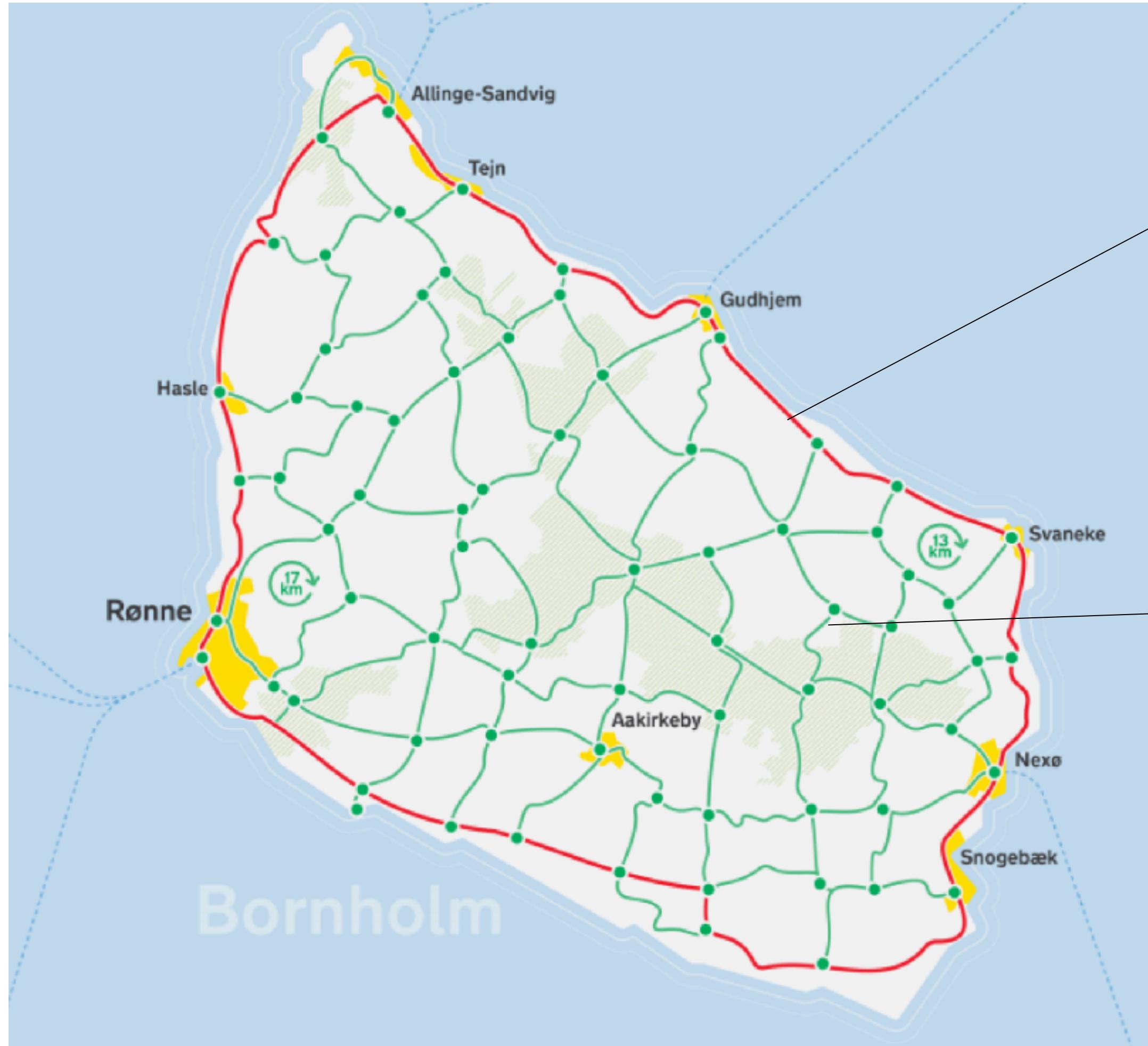


# Hand-drawn “networks”

# Cycle Node Networks: great in practice...



# Cycle Node Networks: great in practice...



...and (yet) uncharted in theory

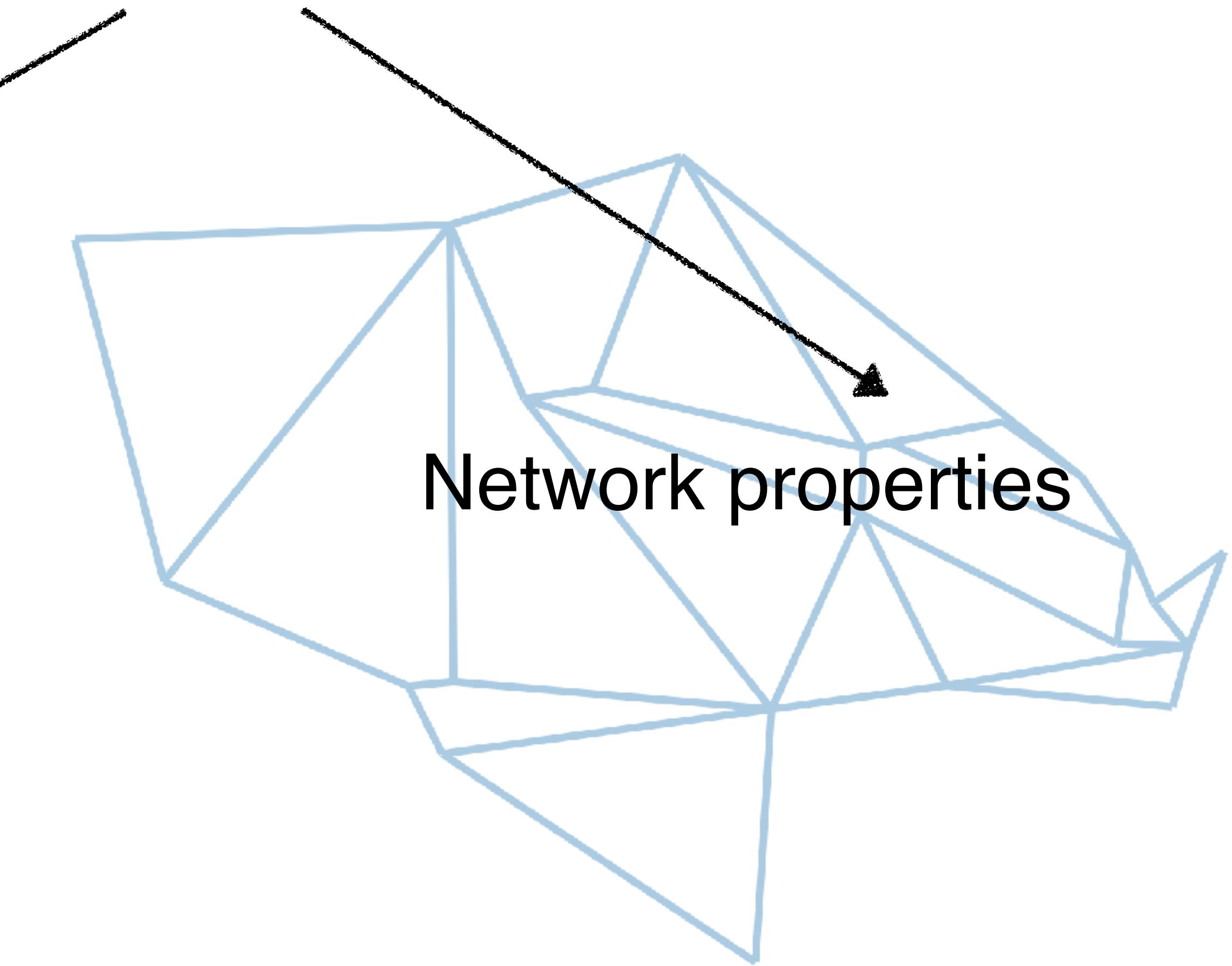


How to plan a cycle node network?

...and (yet) uncharted in theory



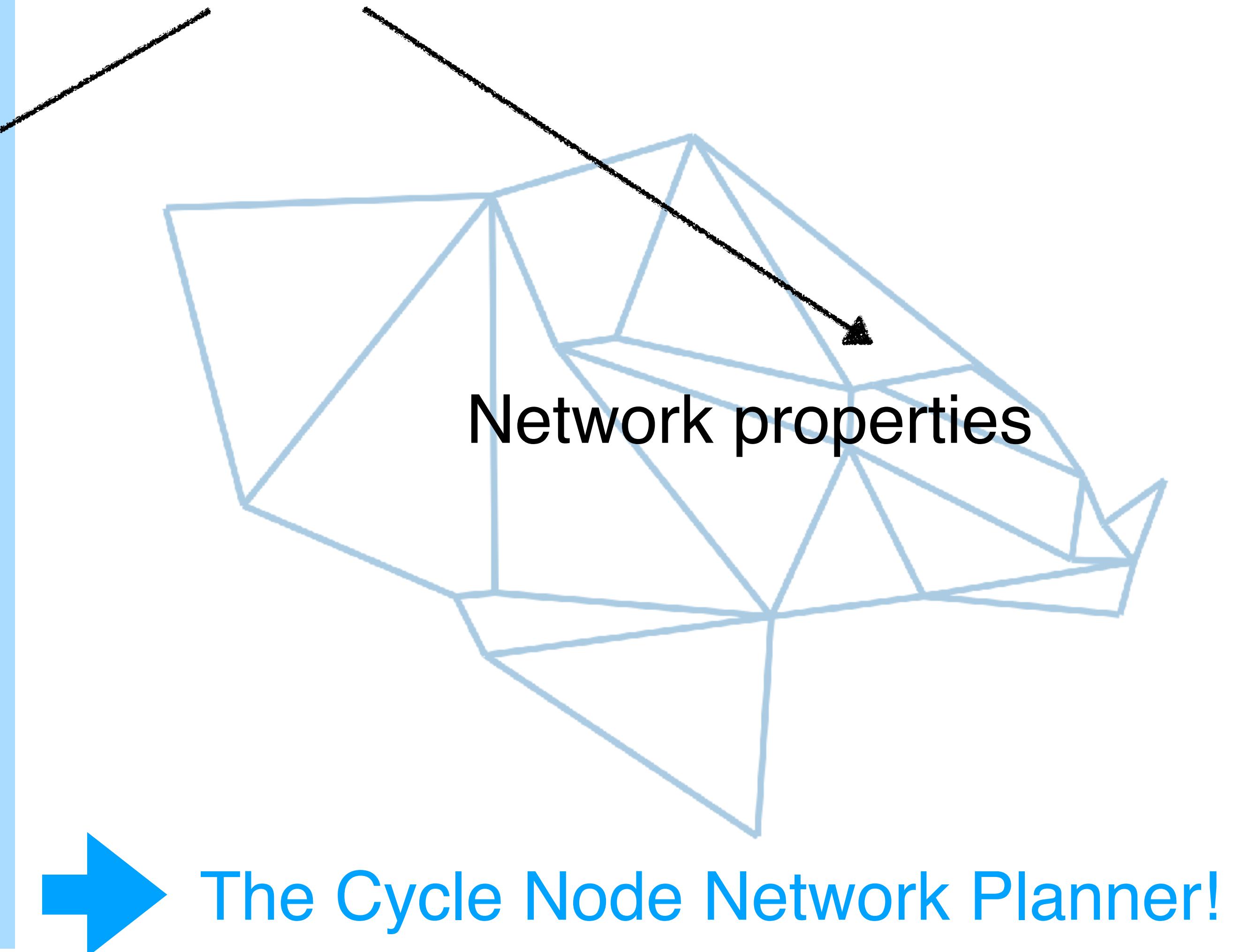
How to plan a cycle node network?



...and (yet) uncharted in theory



How to plan a cycle node network?



# Cycling Data Quality

A reproducible workflow for assessing data quality for cycling network analysis

Cycling is marginalised - in urban landscapes *and* in data collection

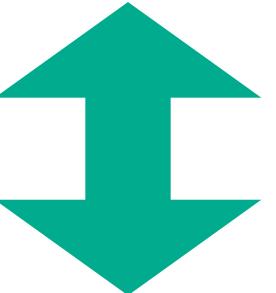
Data reflects priorities

# Cycling Data Quality

A reproducible workflow for assessing data quality for cycling network analysis

Cycling is marginalised - in urban landscapes *and* in data collection

Data reflects priorities



Data influences priorities and decisions

# A reproducible workflow for assessing quality of cycling infrastructure data



README.md

## Reproducible Quality Assessment of OSM Data for Cycling Research

This repository contains a reproducible workflow for assessing the quality of OSM data on cycling infrastructure.

A fair amount of research projects on OSM and other forms of volunteered geographic information (VGI) have already been conducted - but few focus explicitly on cycling infrastructure, although we know that paths and tracks for cyclists and pedestrians often are among the latter features to be mapped, and once they do, are more

# Spatial data quality

## ISO 19115

- Completeness
- Consistency
- Positional accuracy
- Temporal accuracy
- Thematic accuracy



Senaratne et al. 2017

# Spatial data quality

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Senaratne et al. 2017

# Spatial data quality

## ISO 19115

- Completeness
- Consistency
- Positional accuracy
- Temporal accuracy
- Thematic accuracy



## 'Fitness for Purpose'

Is the data good enough for my use case?

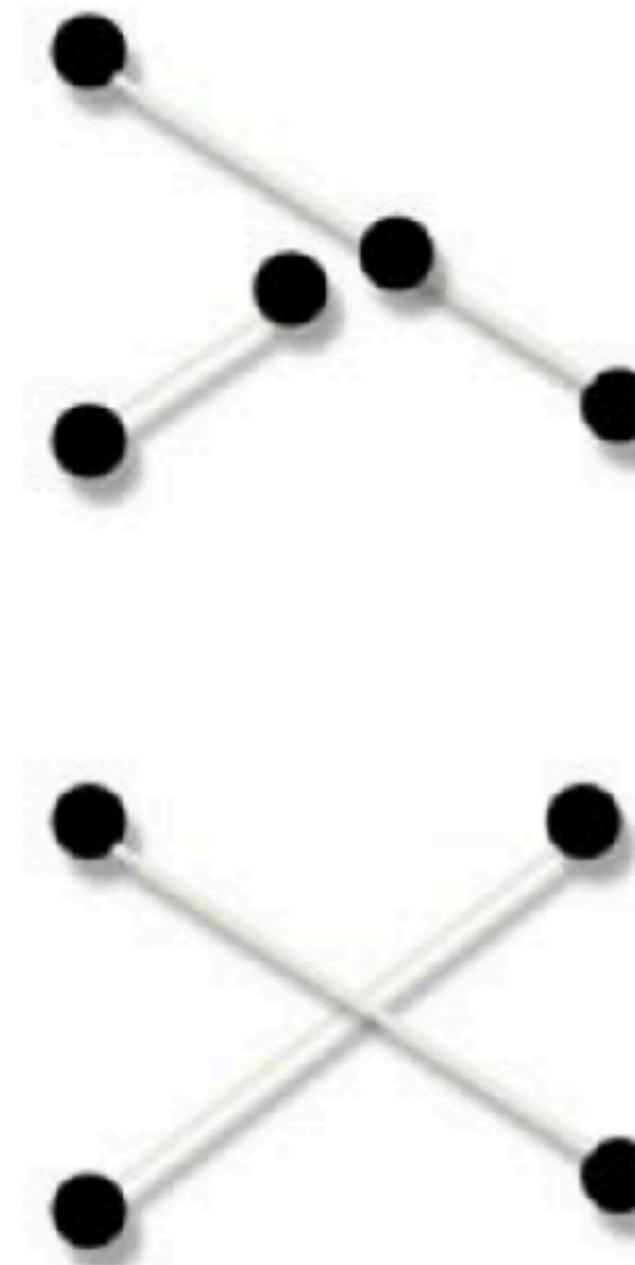


Senaratne et al. 2017

Barron et al. 2014

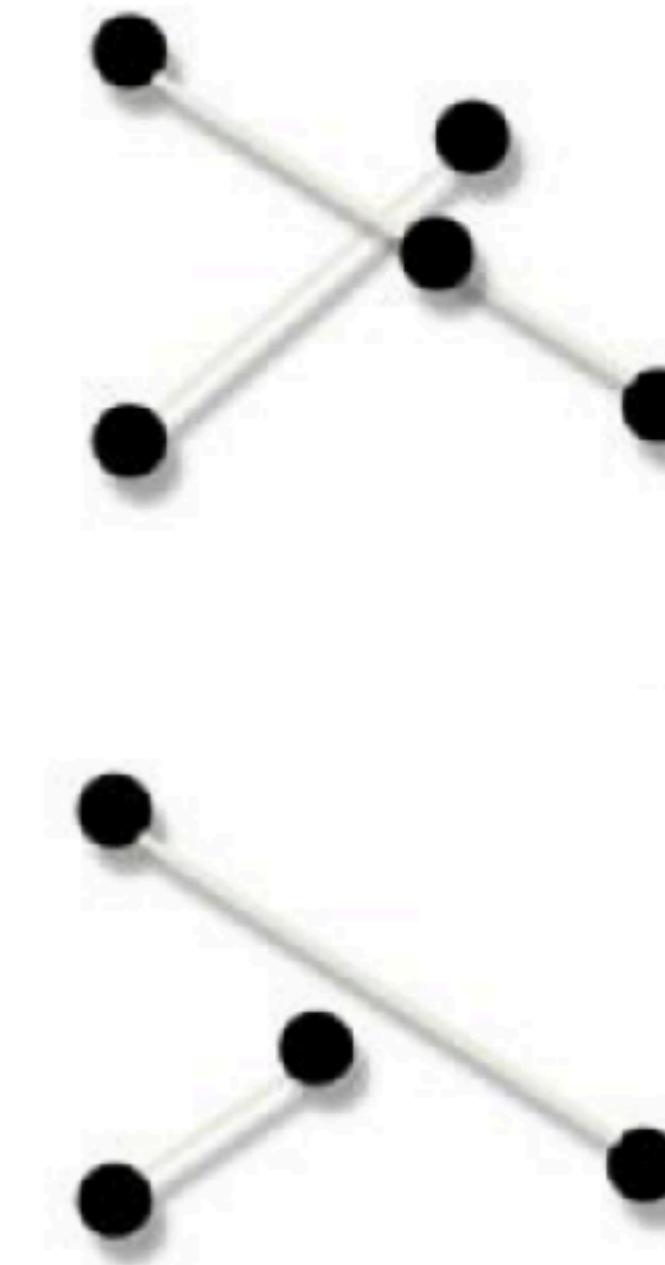
# We care more about topology than accuracy

TOPOLOGY

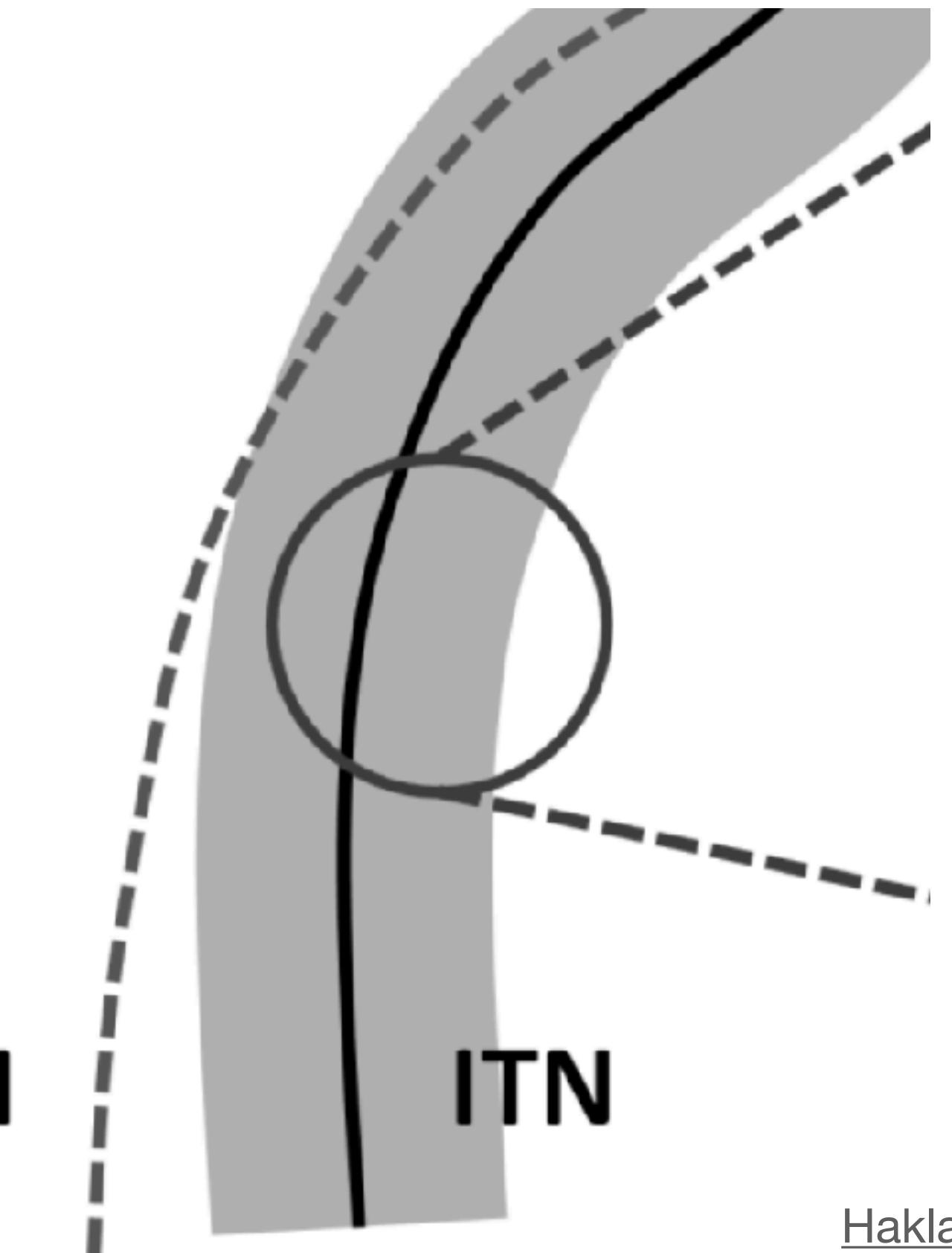


[Neis et al. 2012](#)

ACCURACY



OSM



[Haklay et al. 2010](#)

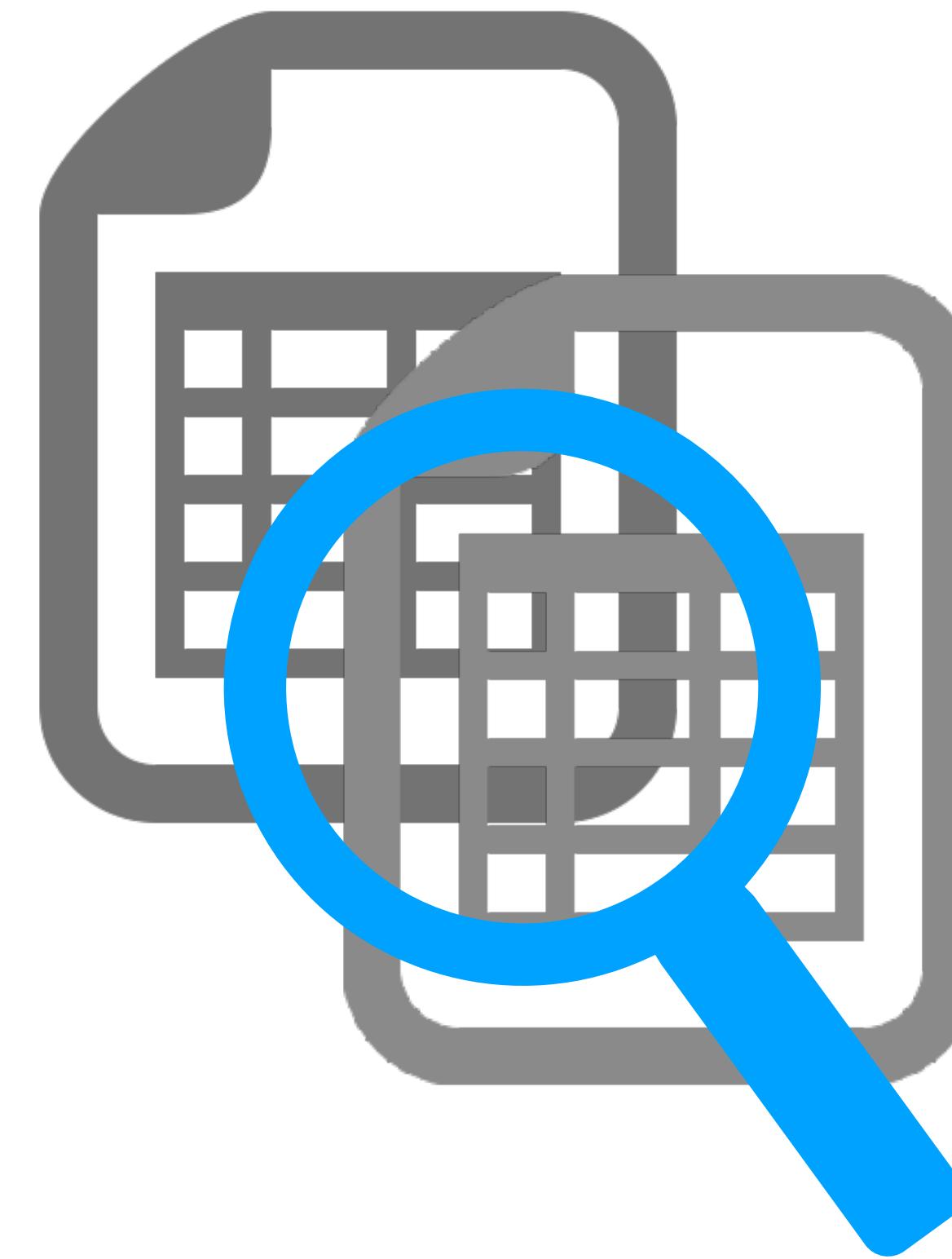
See also [Hochmair et al. 2015](#), [Barron et al. 2014](#)

# You can analyse one data set or compare two

**INTRINSIC**



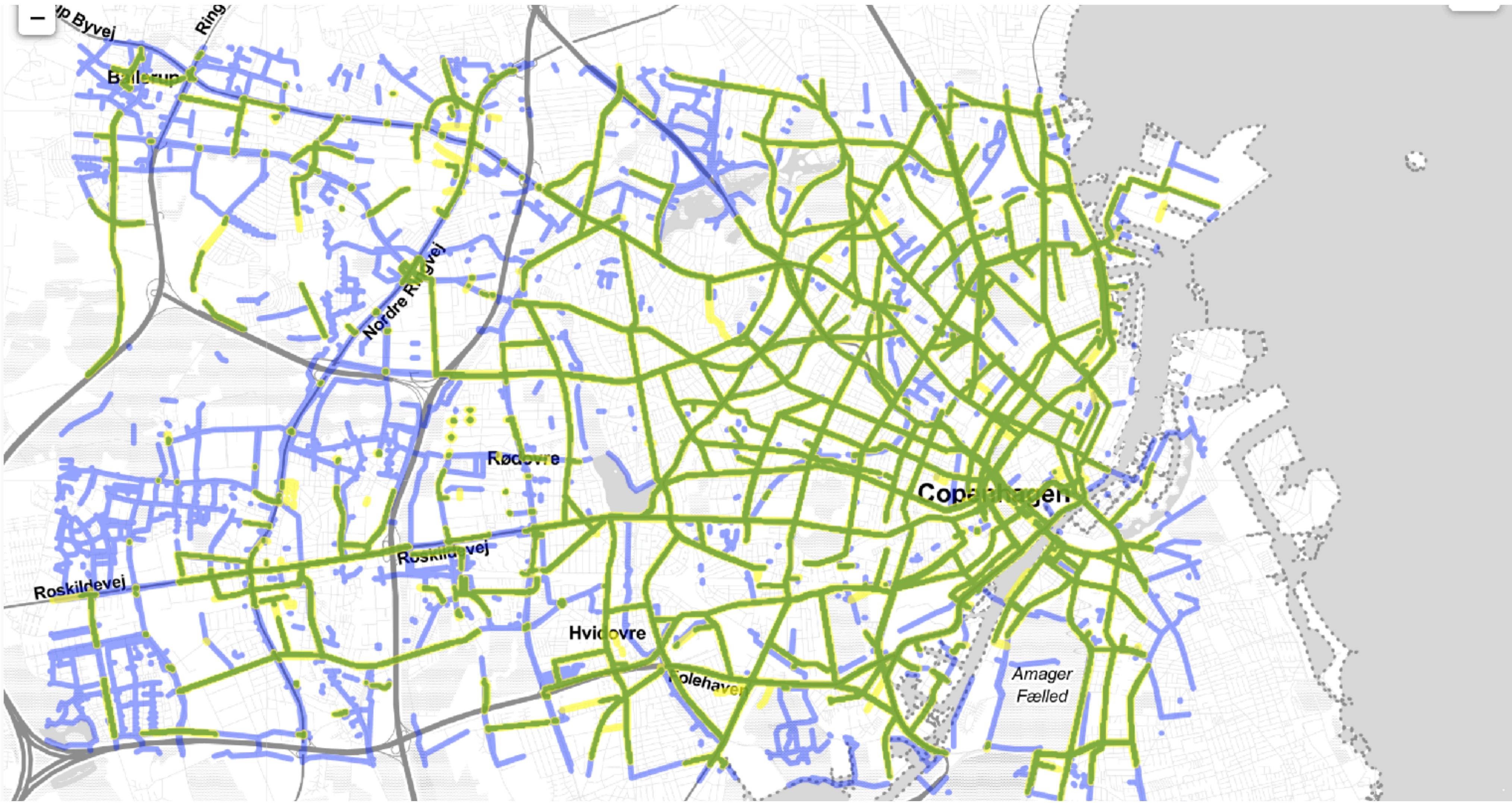
**EXTRINSIC**



# OSM tags are added inconsistently

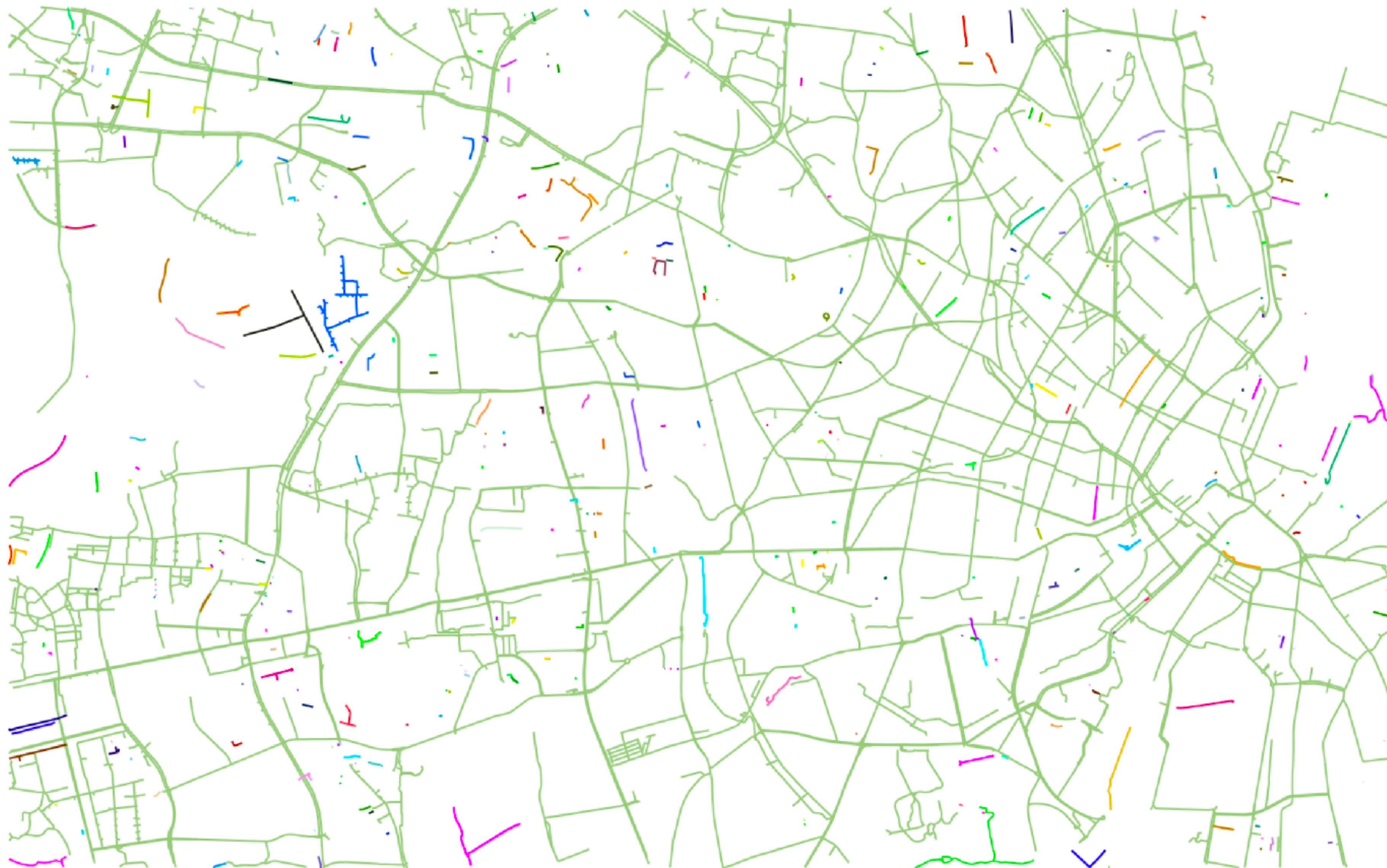


# Datasets might not include the same features

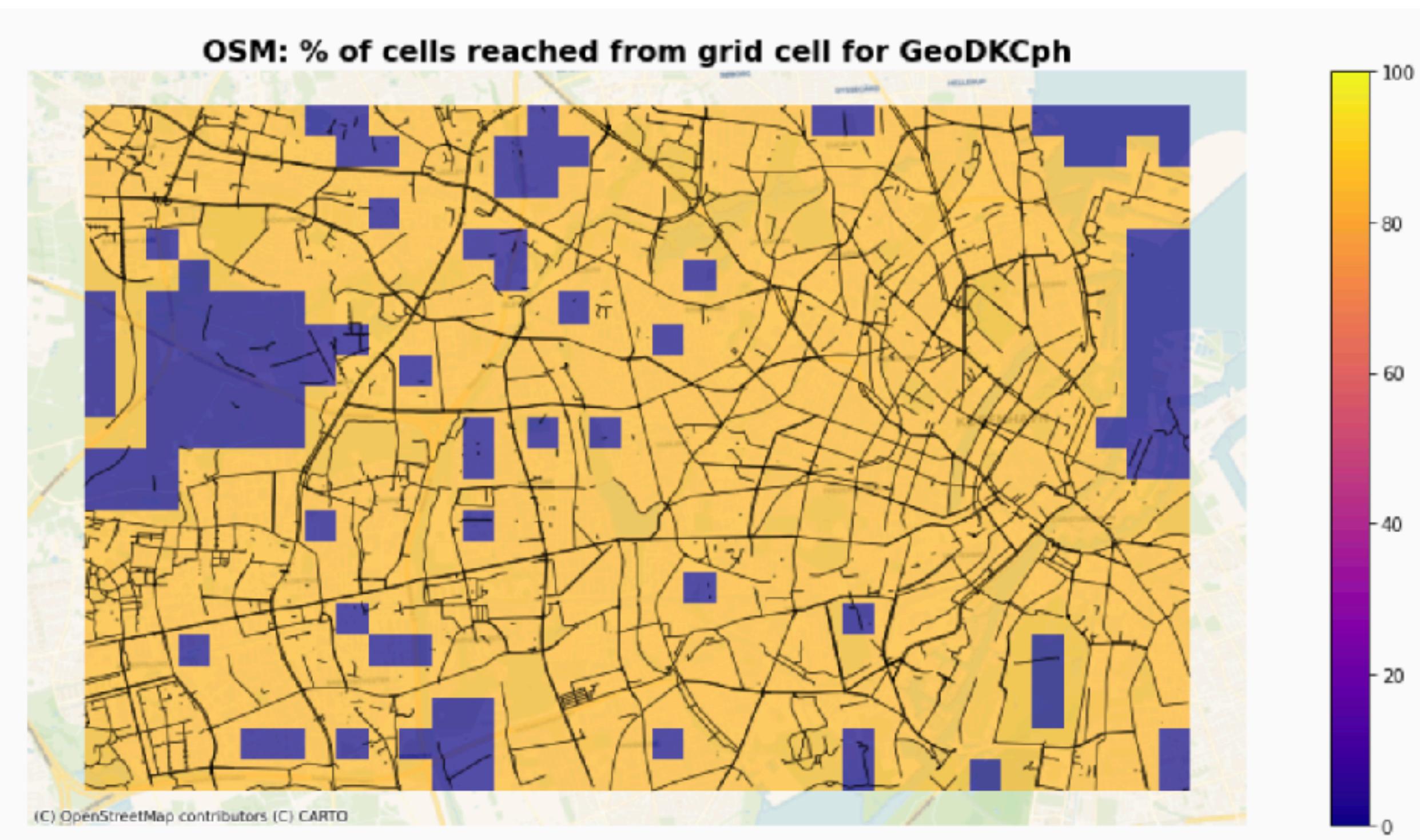


Green: Matched data, Purple: Unmatched OSM data, Yellow: Unmatched reference data

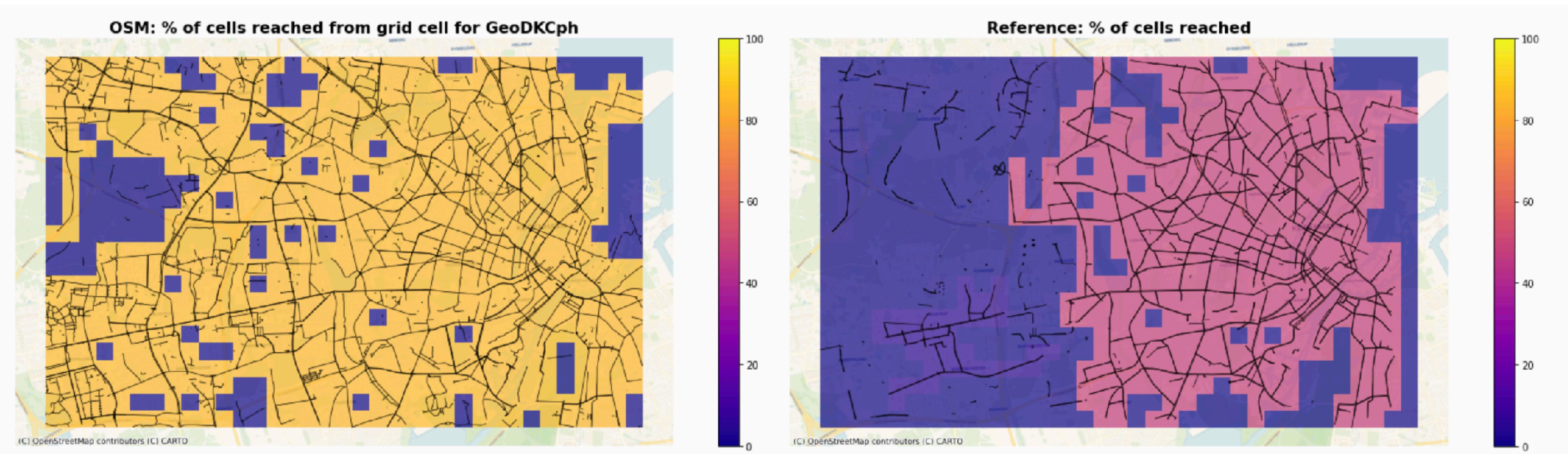
# Networks are often not connected



# Errors and omissions have real effects



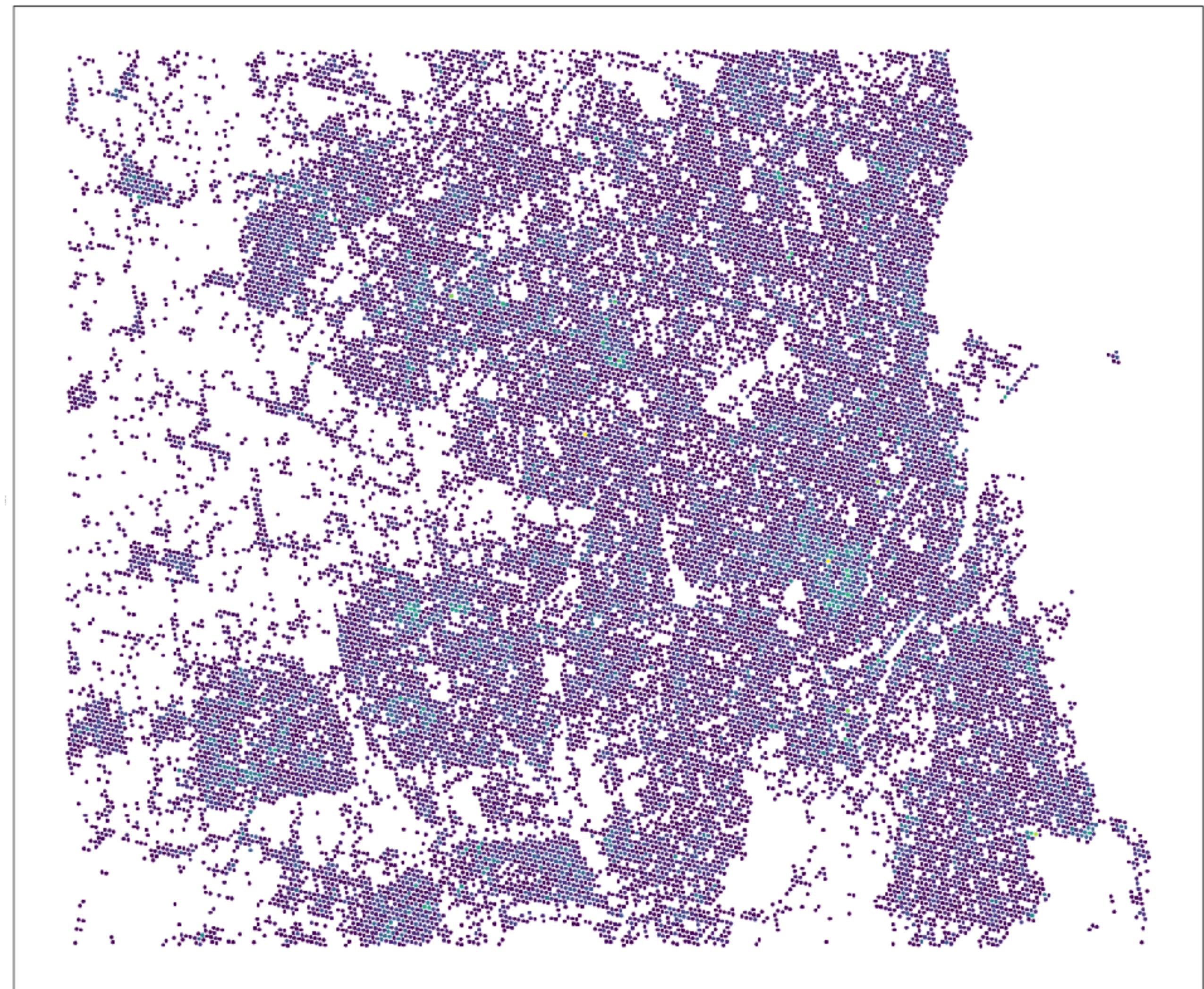
# Errors and omissions have real effects



# Concluding remarks

## ...and unsolved challenges

- Quality data not a given!
- No ground truth
- No agreement on how to map/  
classify  
→ difficult to compare areas



What are possible problems of just focusing on building bike networks?

# What are possible problems of just focusing on building bike networks?

- First priority should be walking
- Consider public transport and multimodality
- Consider people who cannot or do not want to bike
- ...

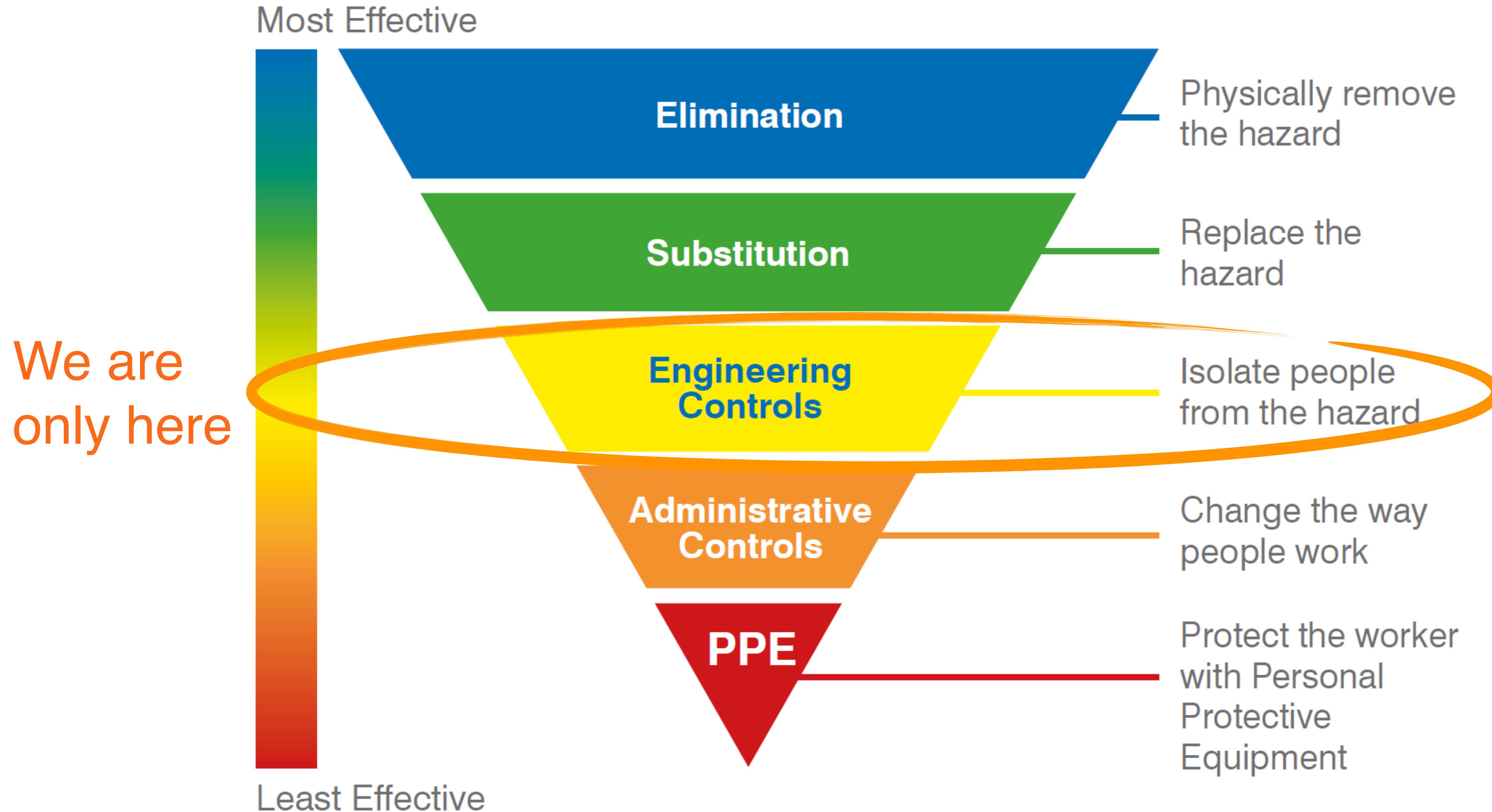


Nice

# Separated infrastructure could lock in the "Flow city"



# Hierarchy of controls

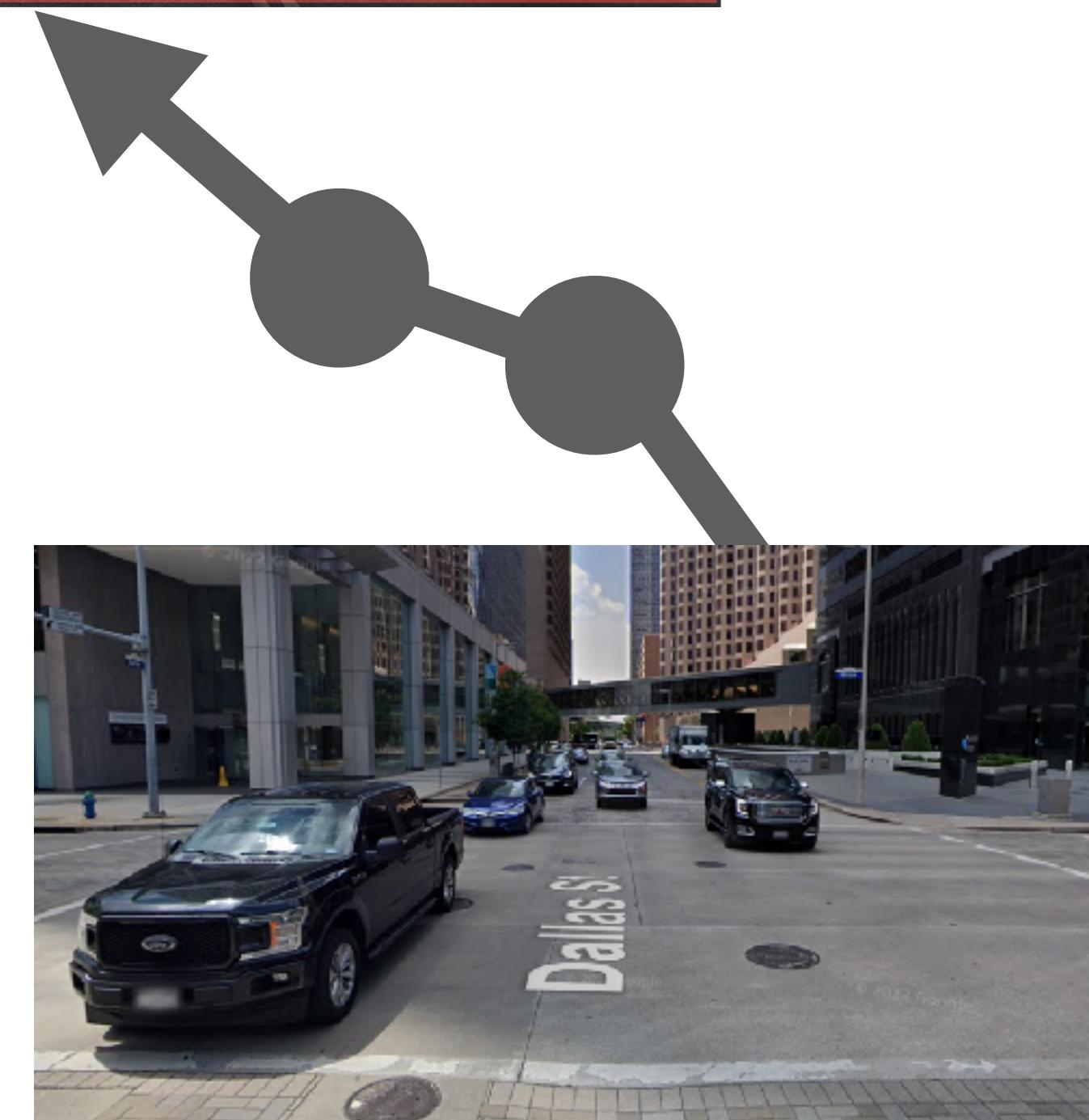


# Separated infrastructure could lock in the "Flow city"

Flow city Copenhagen



Livable city Goal



Car city Houston

# Separated infrastructure could lock in the "Flow city"

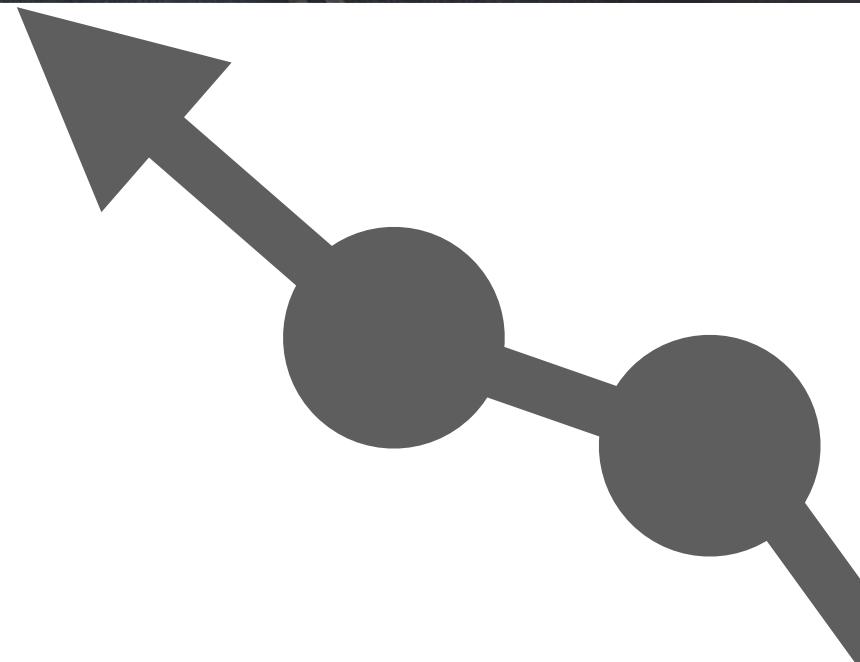
Flow city Copenhagen



Livable city Goal



Path dependence

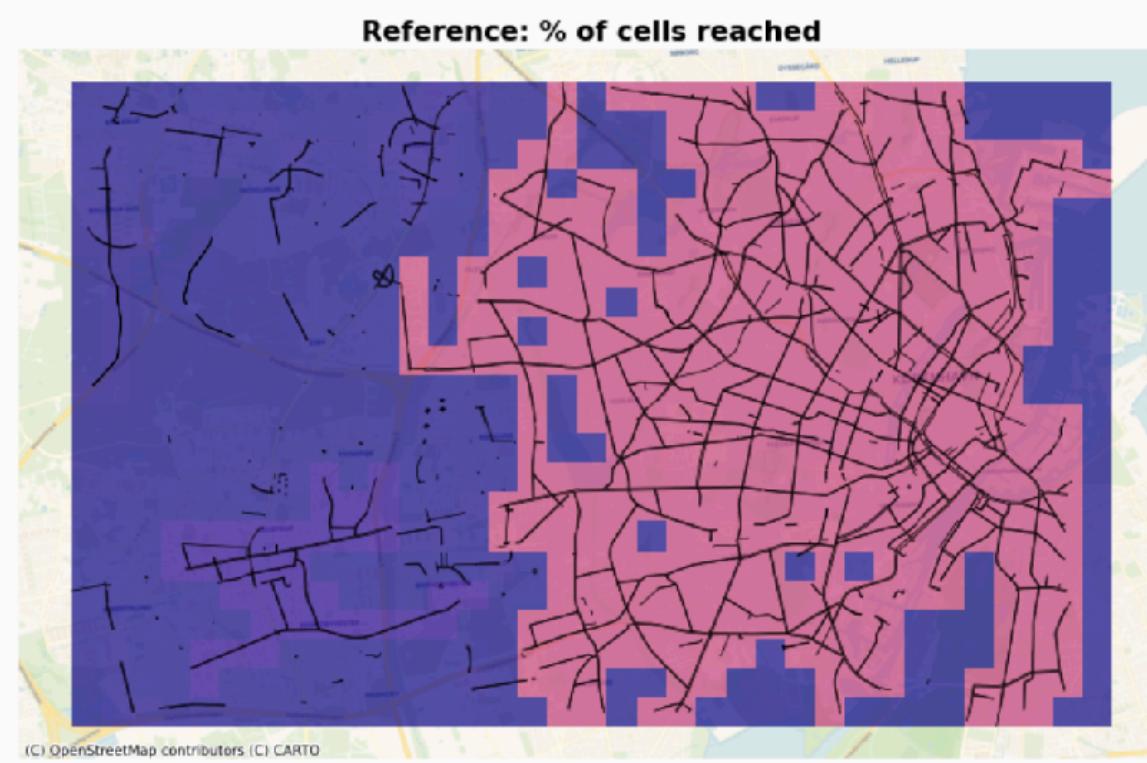


Car city Houston



# We develop tools for planning the best cycling networks

# We must always scrutinise if/how this advances society



anev@itu.dk @\_ane\_rv

anvy@itu.dk @AnaVybor

misz@itu.dk @mszll



nerds.itu.dk @nerdsitu