The Science of Growing Urban Bicycle Networks
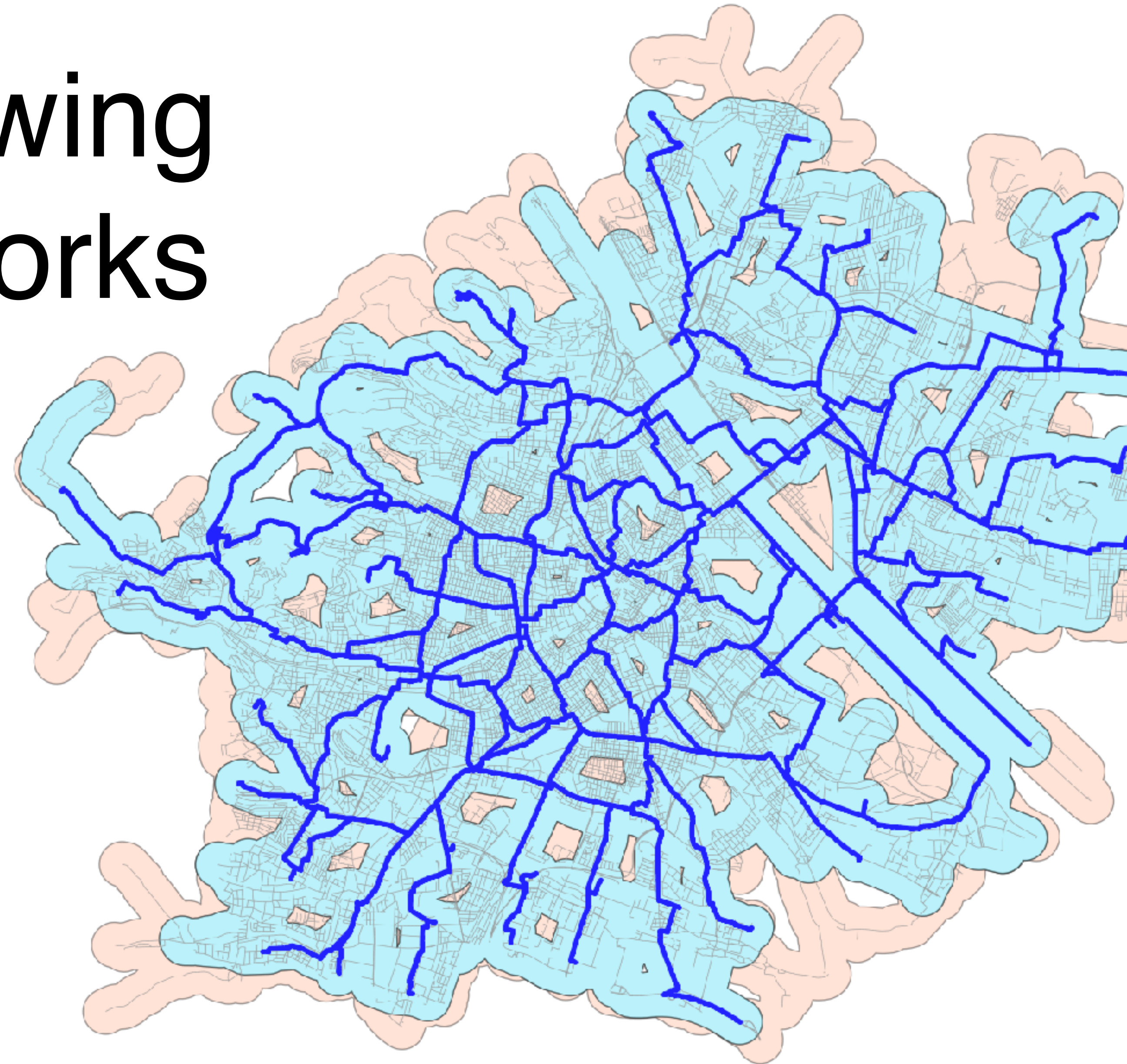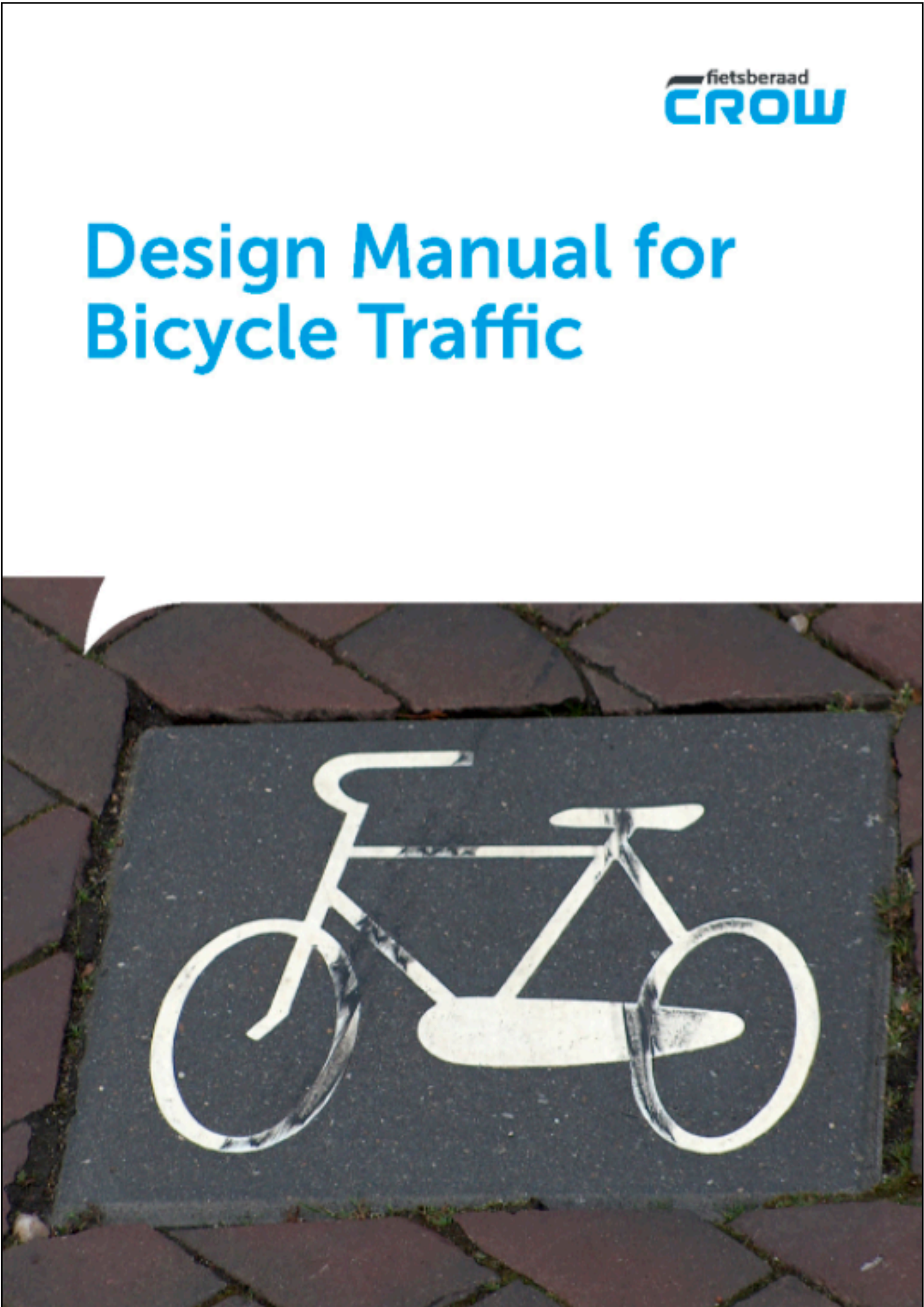
Michael Szell

NERDS (NEtwoRks, Data, and Society)
nerds.itu.dk
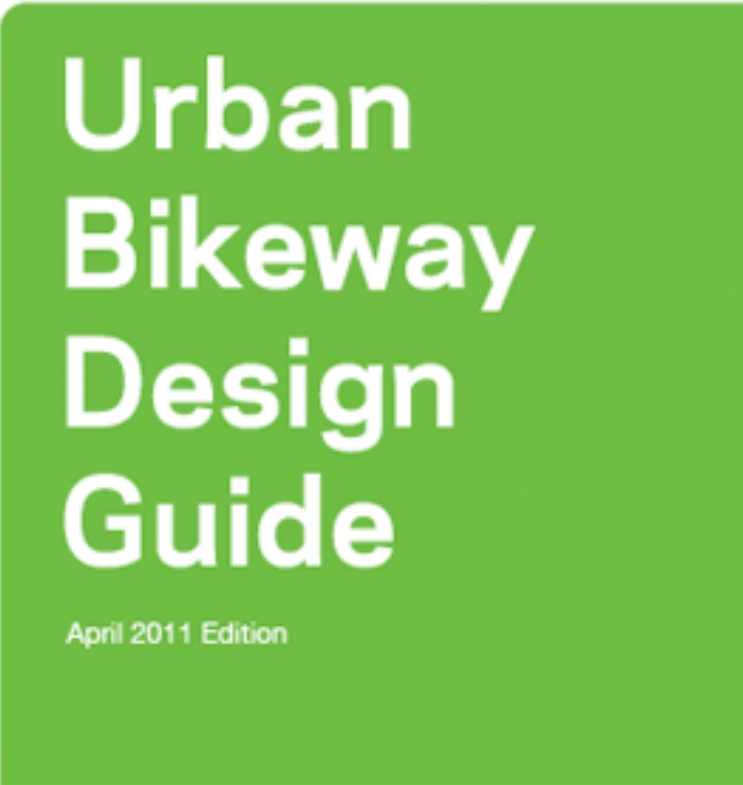
IT UNIVERSITY OF COPENHAGEN

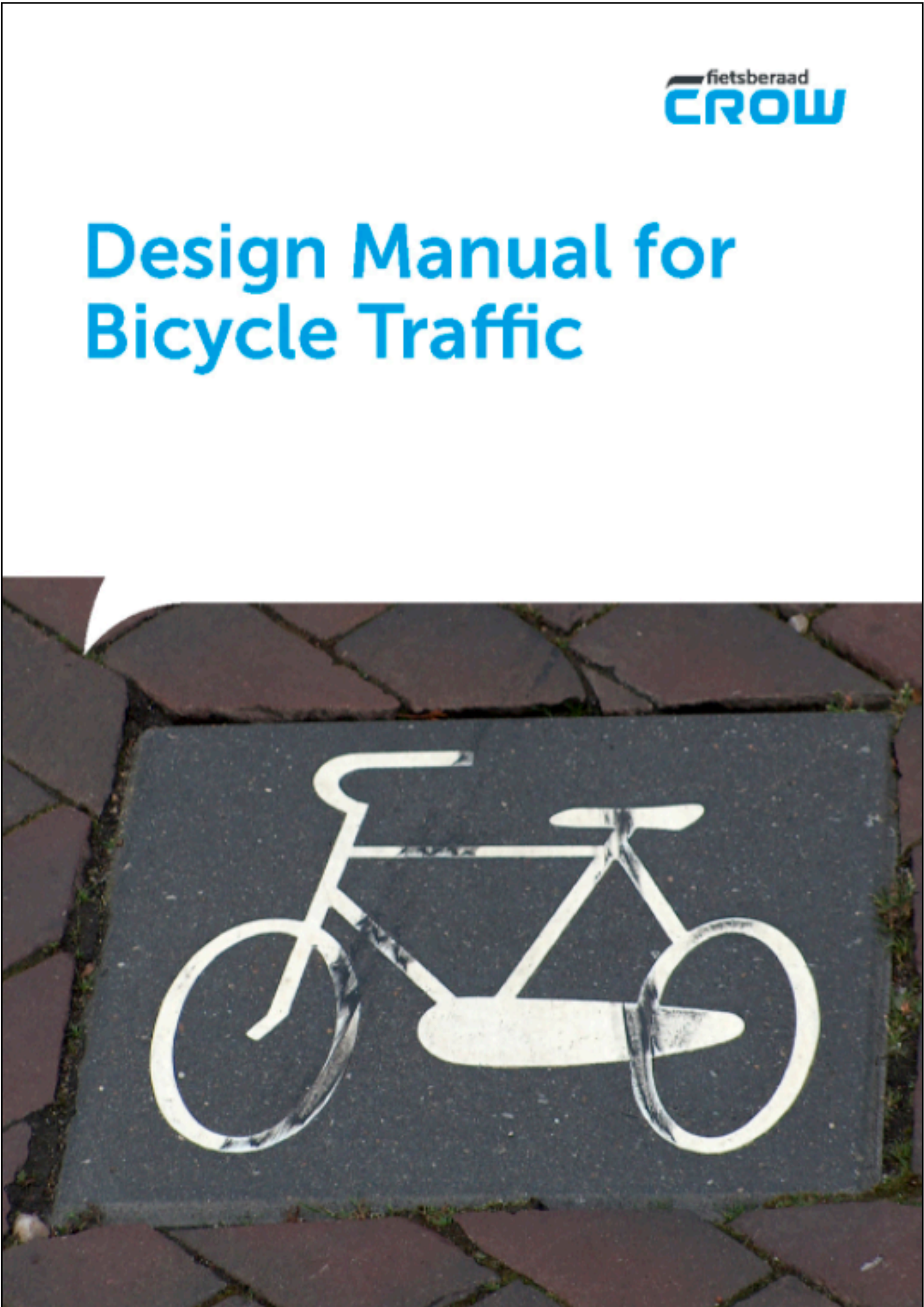Vienna, April 14, 2023

Design Manual for Bicycle Traffic

We have great planning guides.
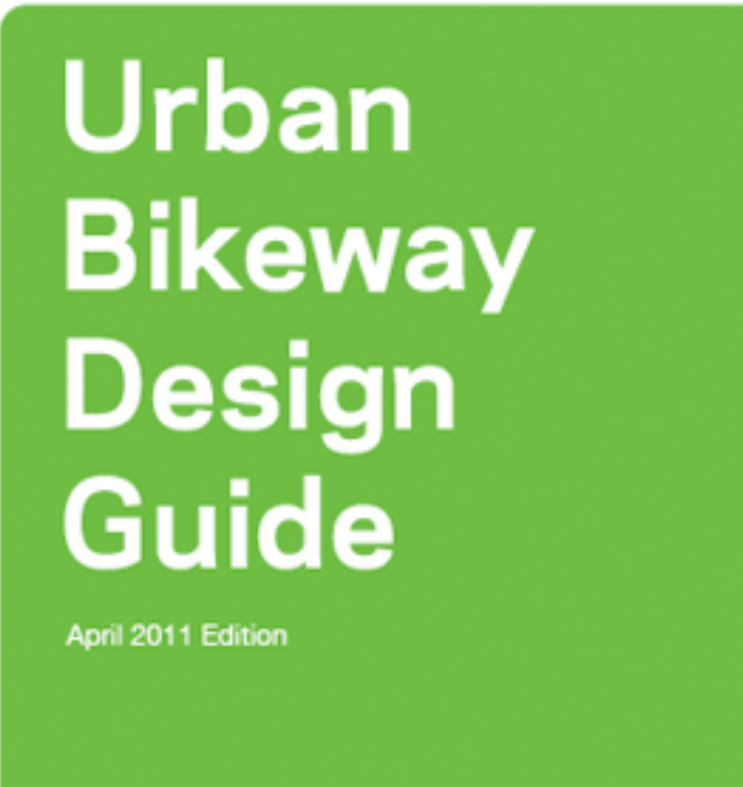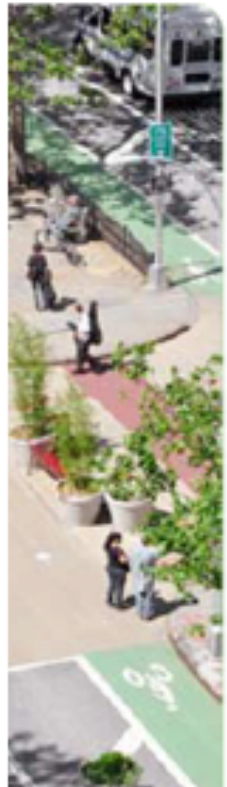
NACTO

Urban Bikeway Design Guide

April 2011 Edition

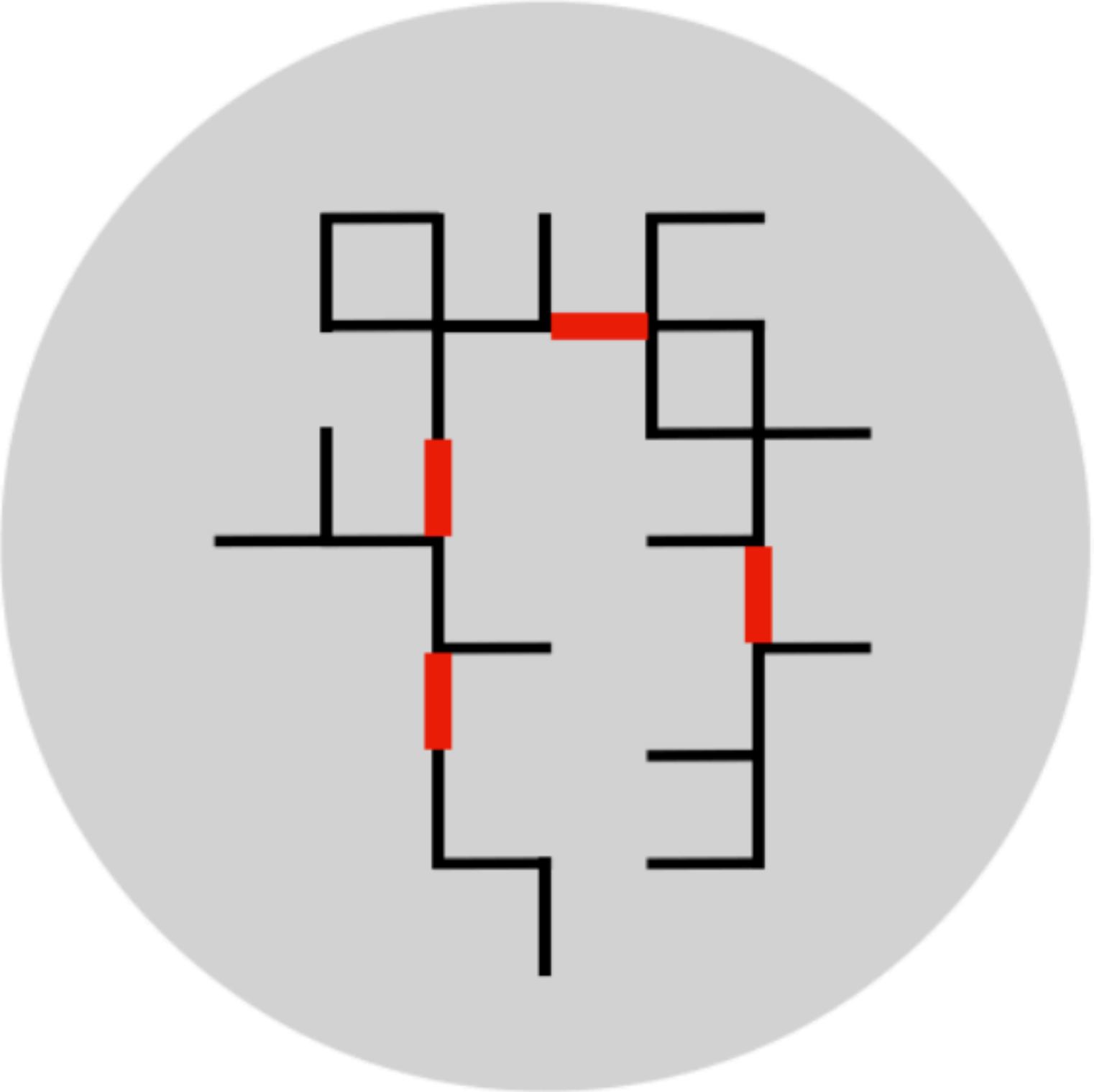# How to build bicycle infrastructure?

We have great planning guides.

Mostly about intersection or street design.

We don't know much from a systemic birds-eye perspective!
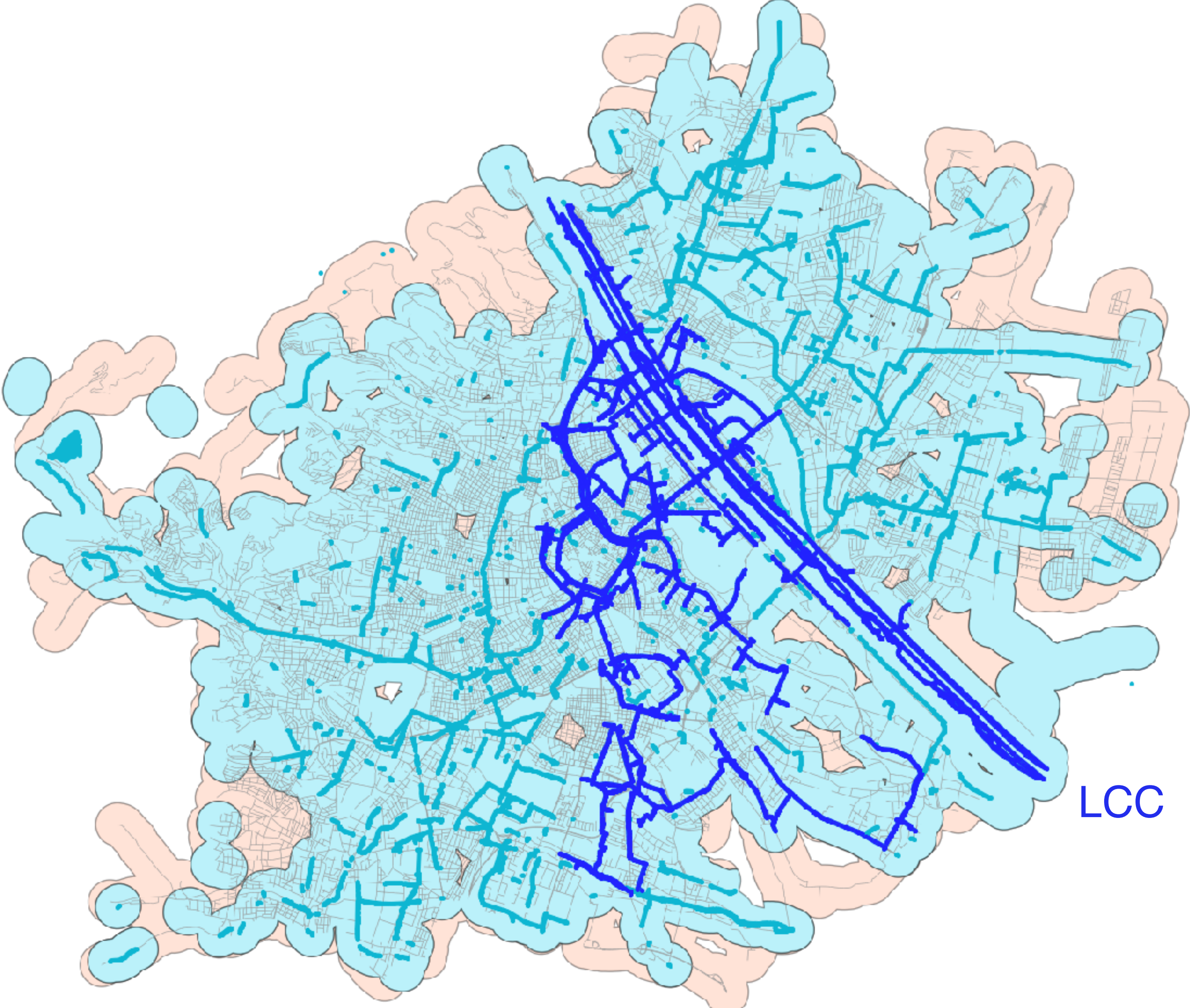
Different cities need different strategies

Some cities
Developed but
disconnected
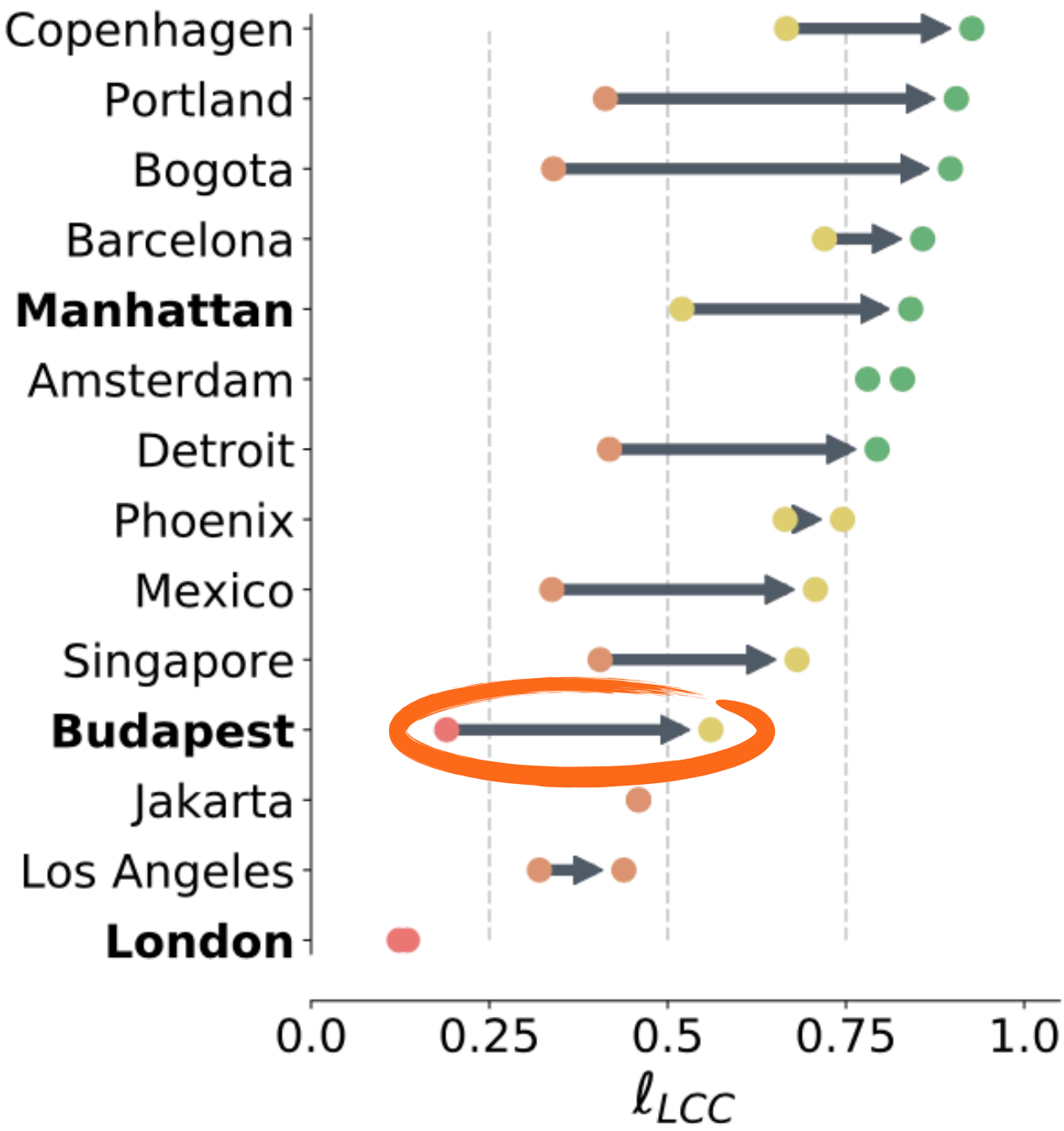
Connect components
LinkBike.Net

Every network has a Largest Connected Component (LCC)
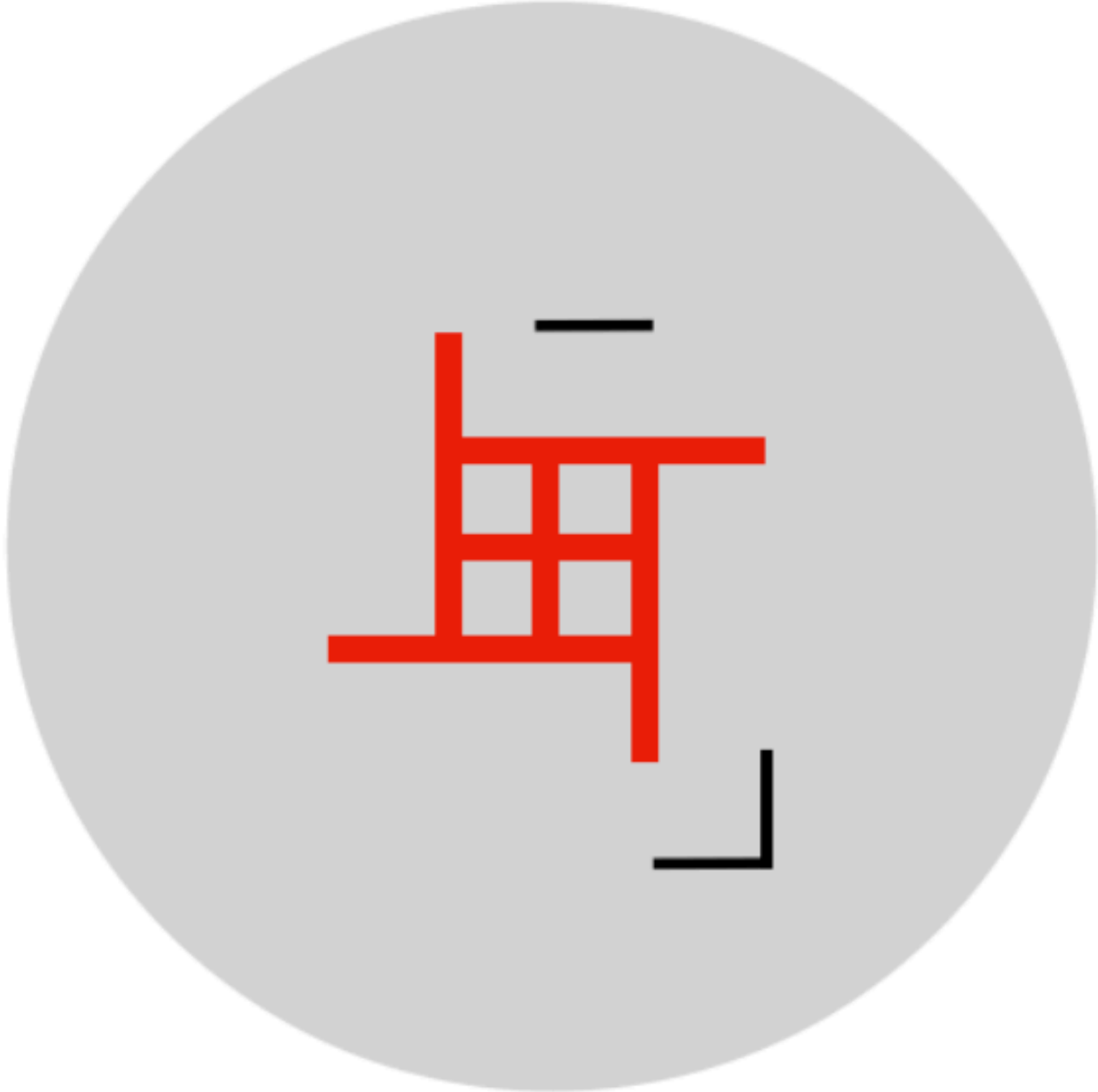

LCC

Effective connectivity improvements are possible

Small but focused investments connect the bicycle network effectively

(a) 5 km investment

Natera Oroczo et al, R Soc Open Sci 7 (2020)

Most cities
Not developed

Grow from scratch

GrowBike.Net

Let's grow networks
from scratch

to understand fundamental
structural limitations

Connectedness & Resilience

Minimum spanning tree

Investor's optimum

Connectedness & Resilience

Minimum spanning tree

Investor's optimum

Fully connected

Traveler's optimum

Inspired by CROW, we want a cohesive network

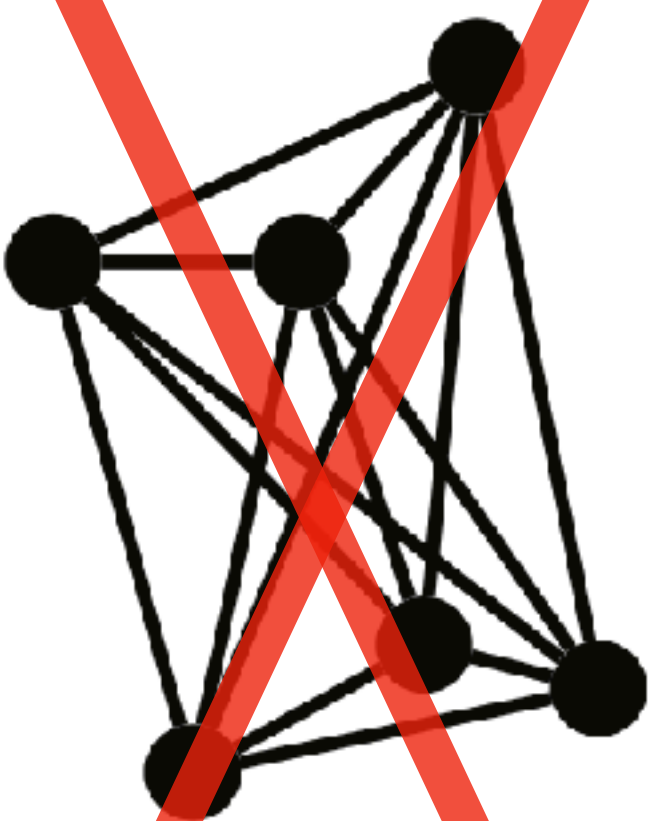Connectedness & Resilience

Szell et al., Sci Rep 12, 6765 (2022)
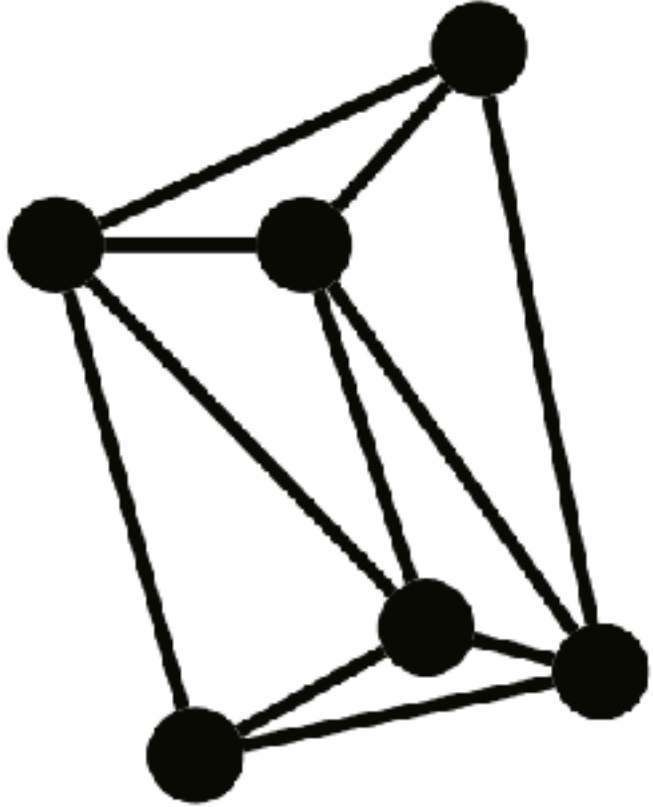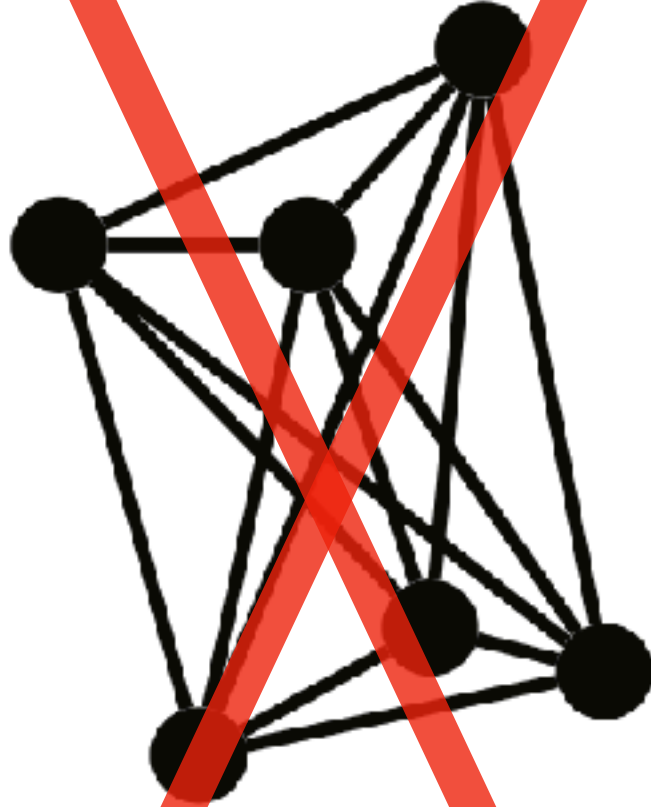
Inspired by CROW, we want a cohesive network

Connectedness & Resilience   **& Coverage**
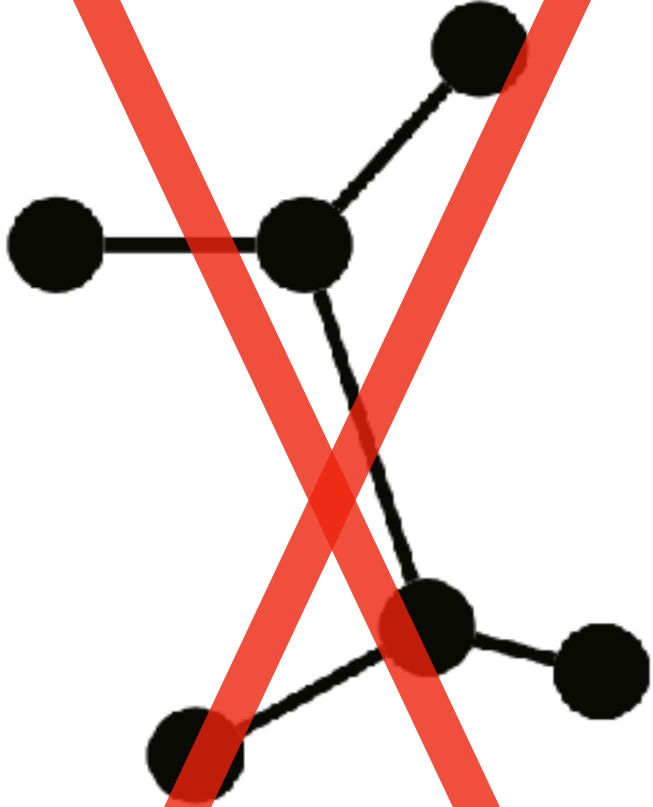
Minimum spanning tree — Investor's optimum

Triangulation — Cohesive planar network
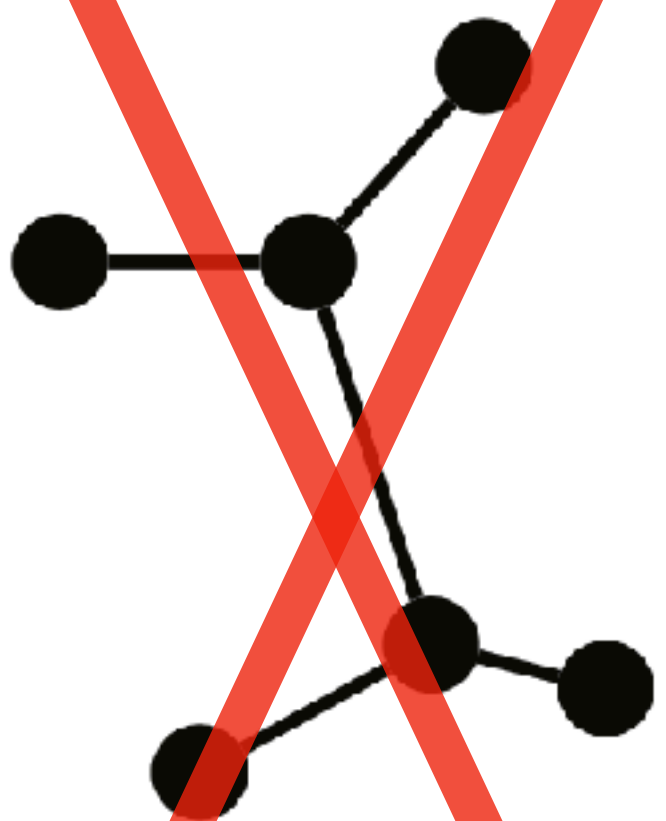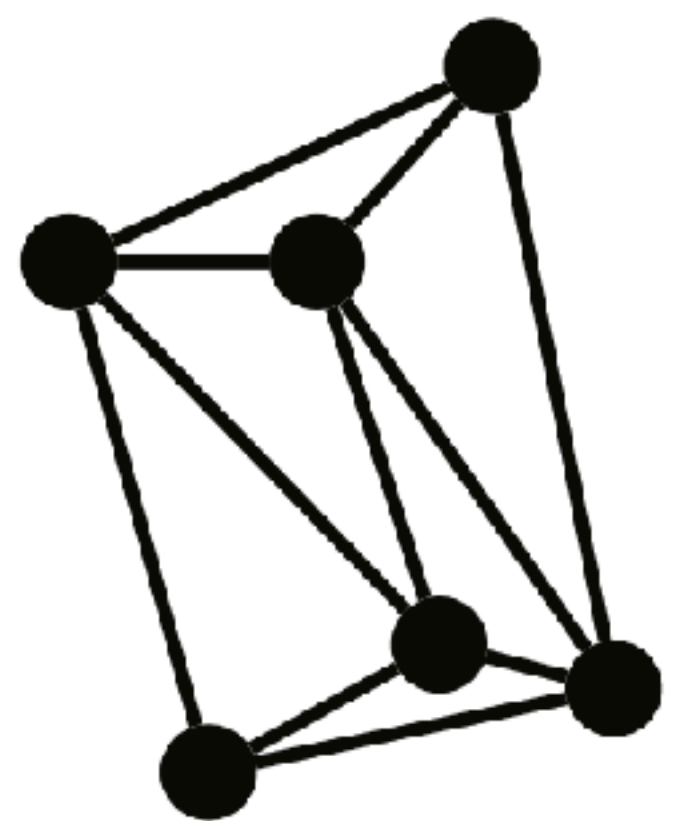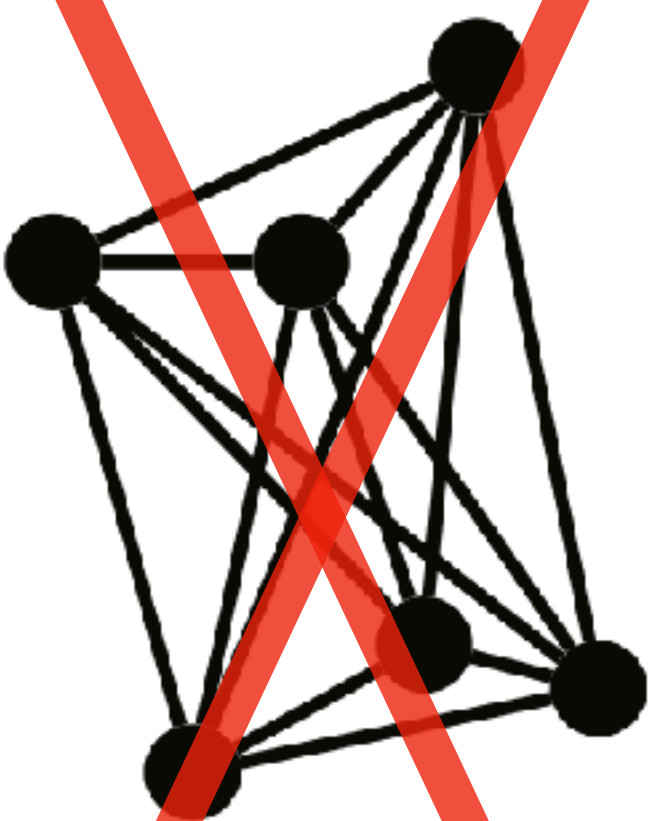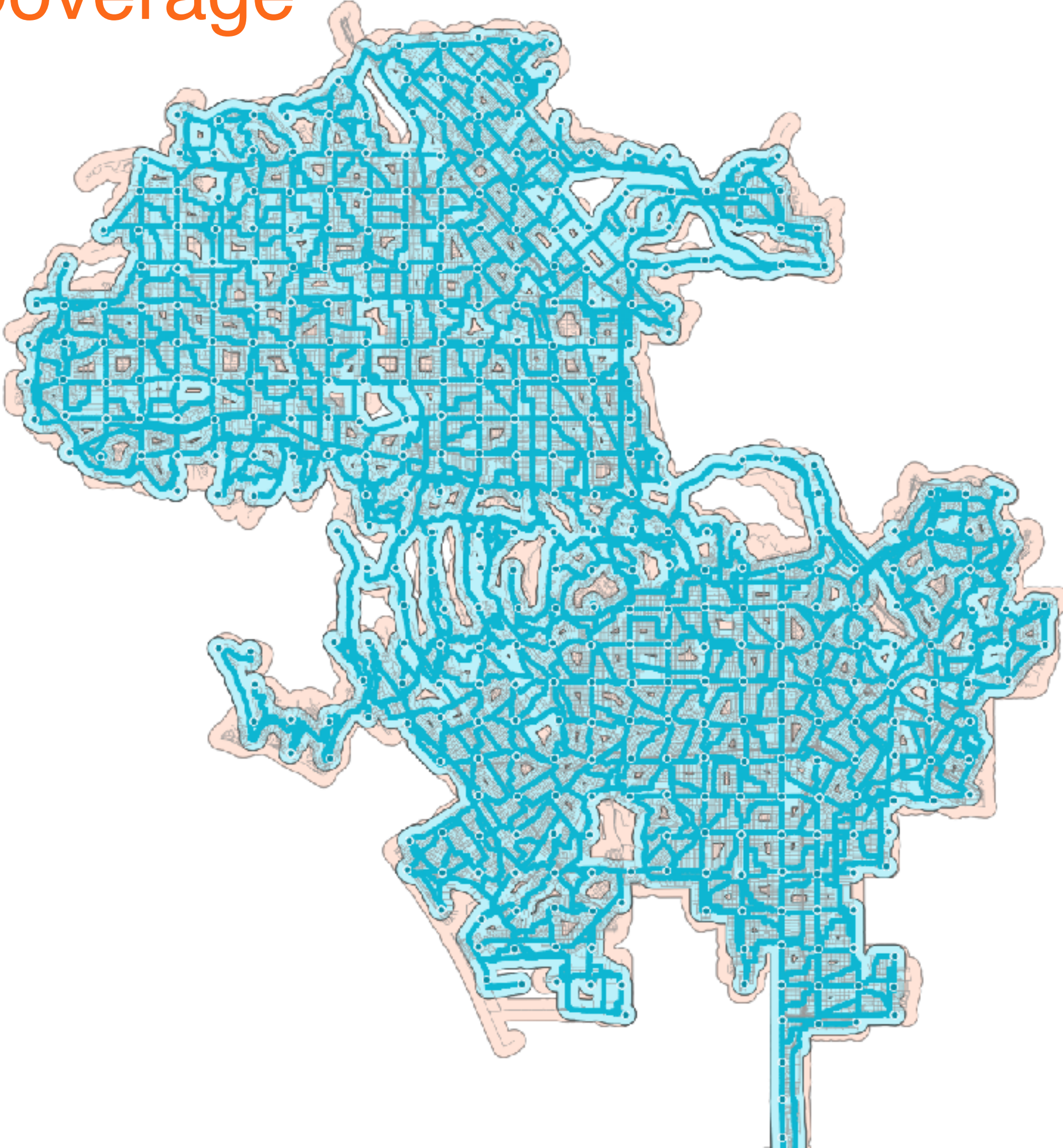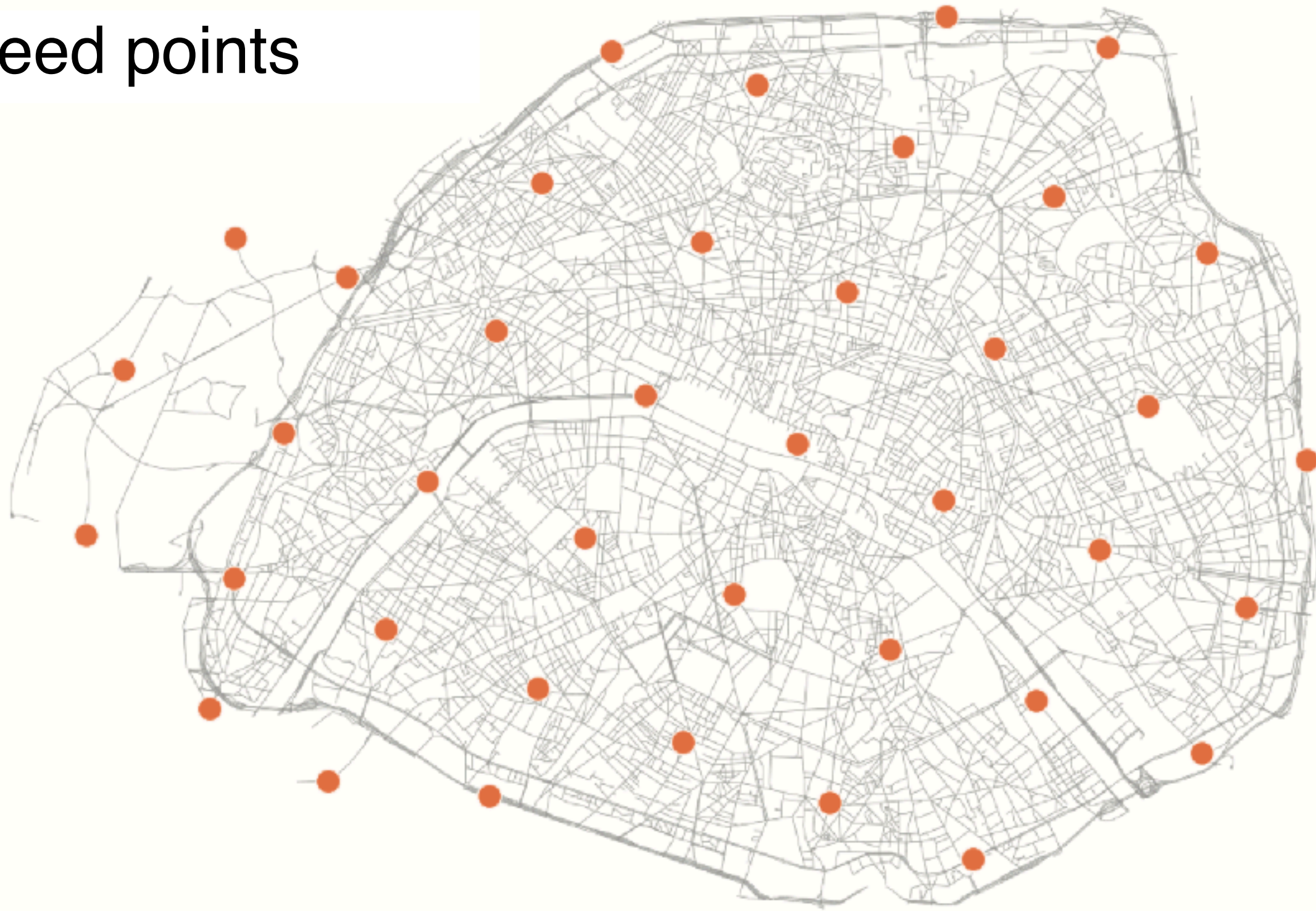
Fully connected — Traveler's optimum

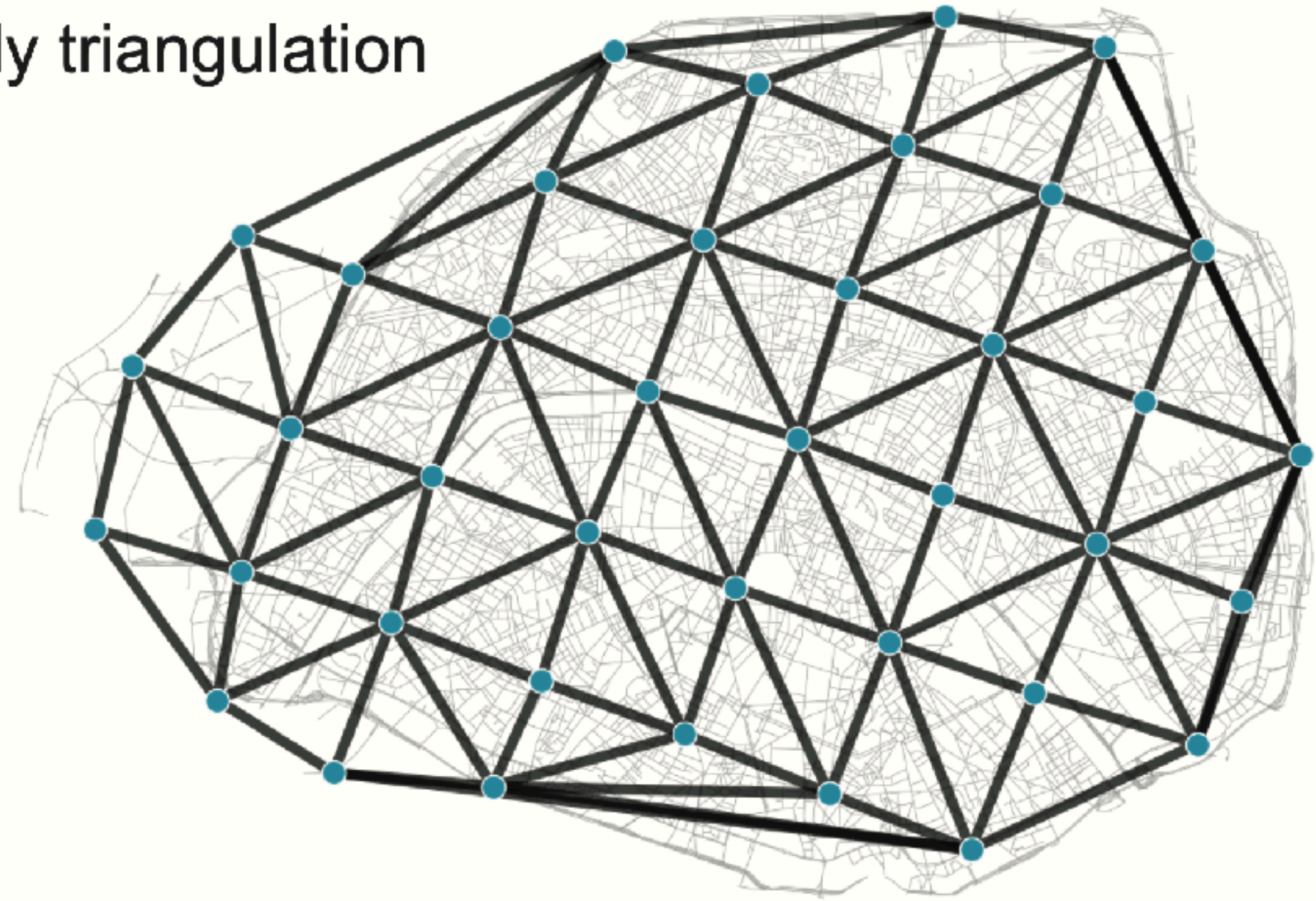Economic   Resilient

We build a greedy triangulation between points of interest

1) Seed points
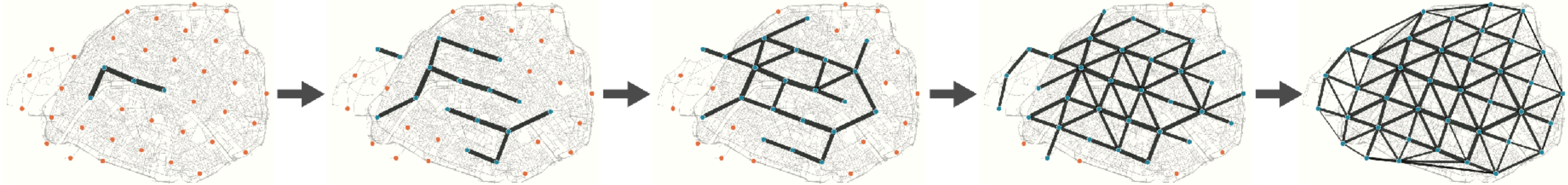
2) Greedy triangulation

We build a greedy triangulation between points of interest
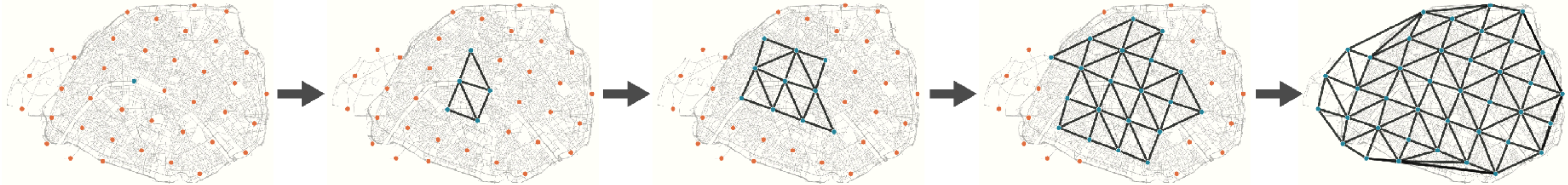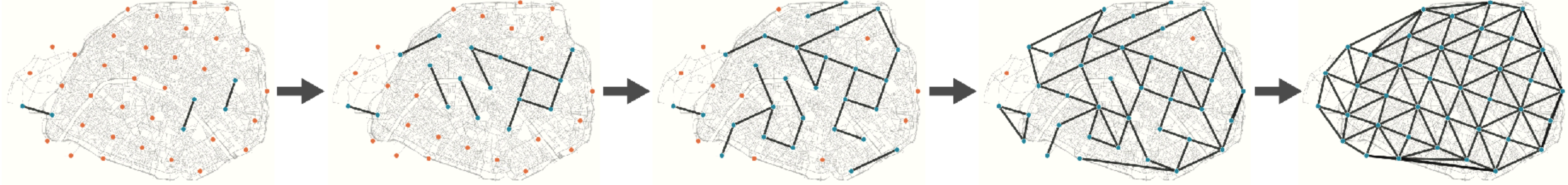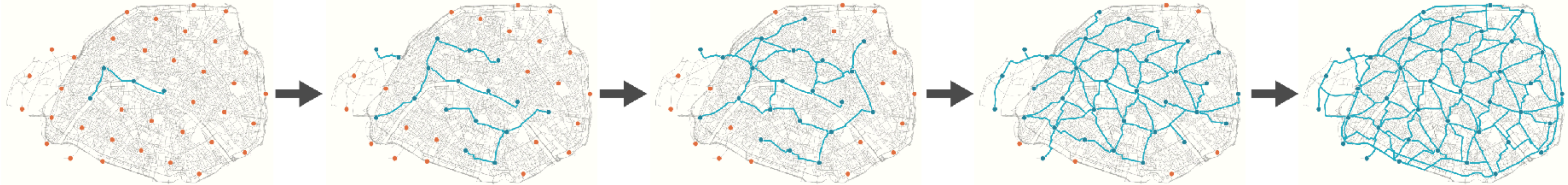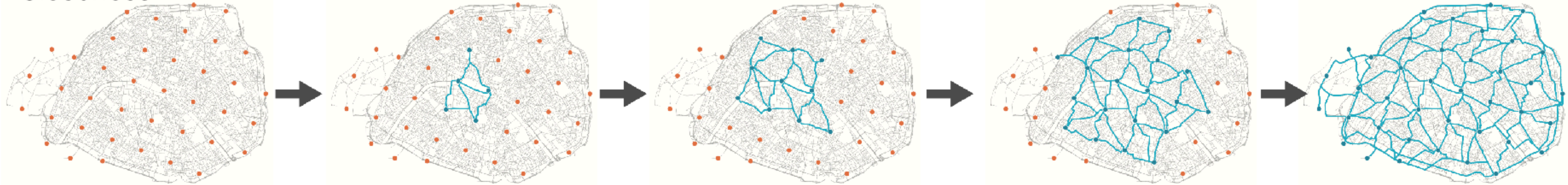
3) Order by growth strategy

We build a greedy triangulation between points of interest

4) Route on street network

Betweenness

Closeness

Random

We explore 62 cities
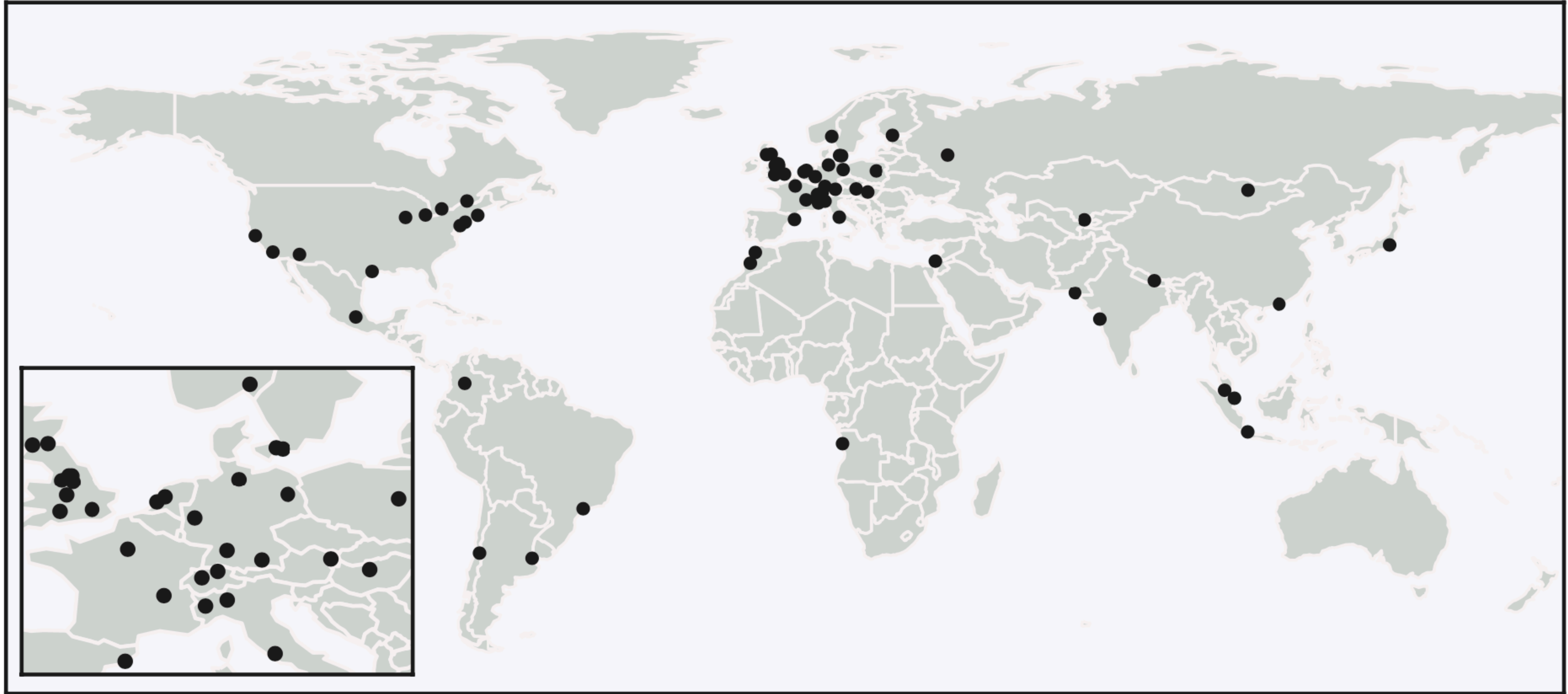
The pieces need to connect and to form cycles
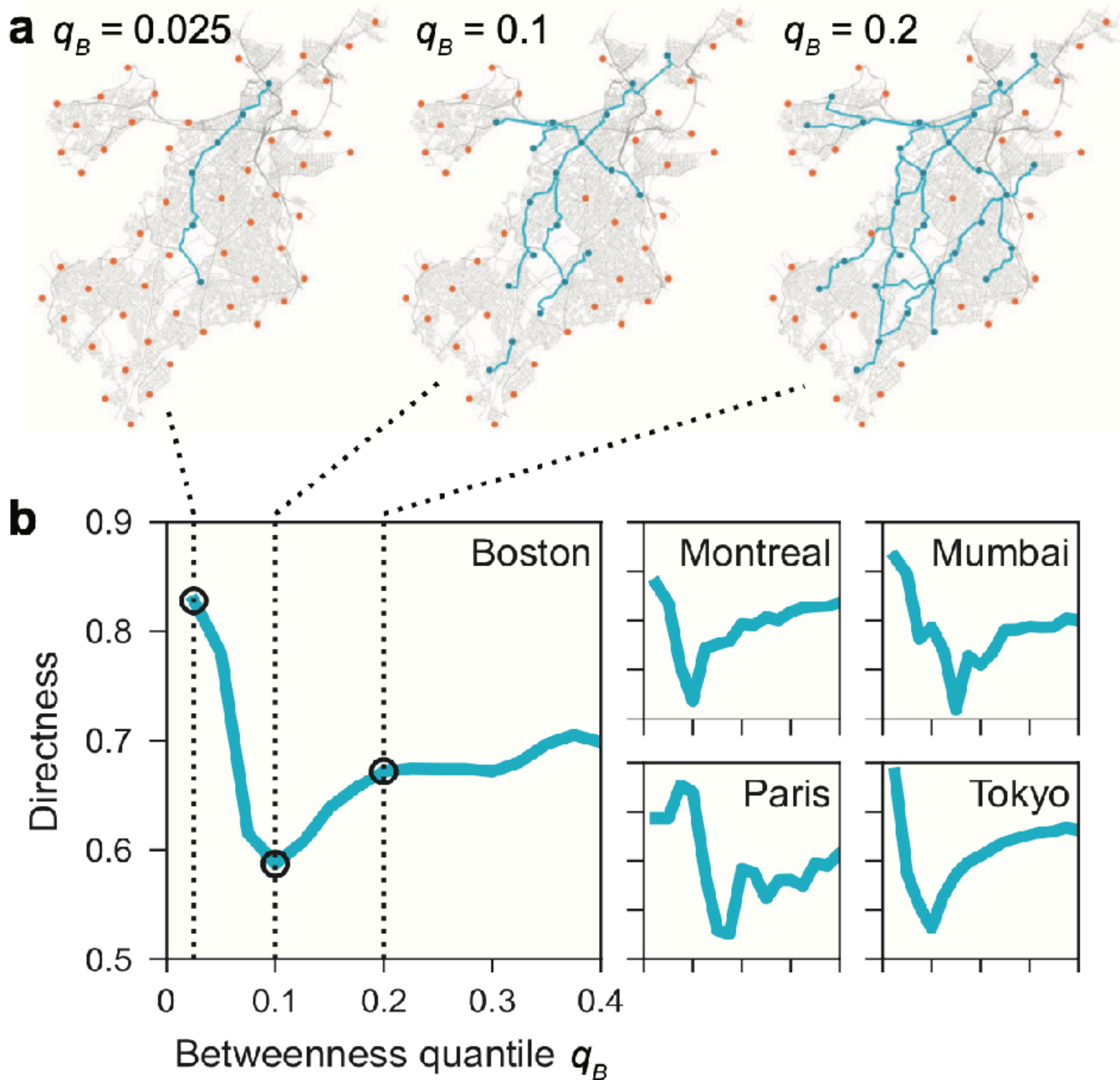
Policy implication 1: Invest persistently!

Brent Toderian ✓ @BrentToderian · Jul 30

My real advice for ambitious municipal elected leaders on building a safe, connected network of REAL (not painted lines or sharrows) bike infrastructure — direct your staff to do ALL of the work that you're currently planning to build over the next 5-10 years, ALL IN ONE YEAR.

https://twitter.com/BrentToderian/status/1420907319982915587?s=20

At same length, we could do much better
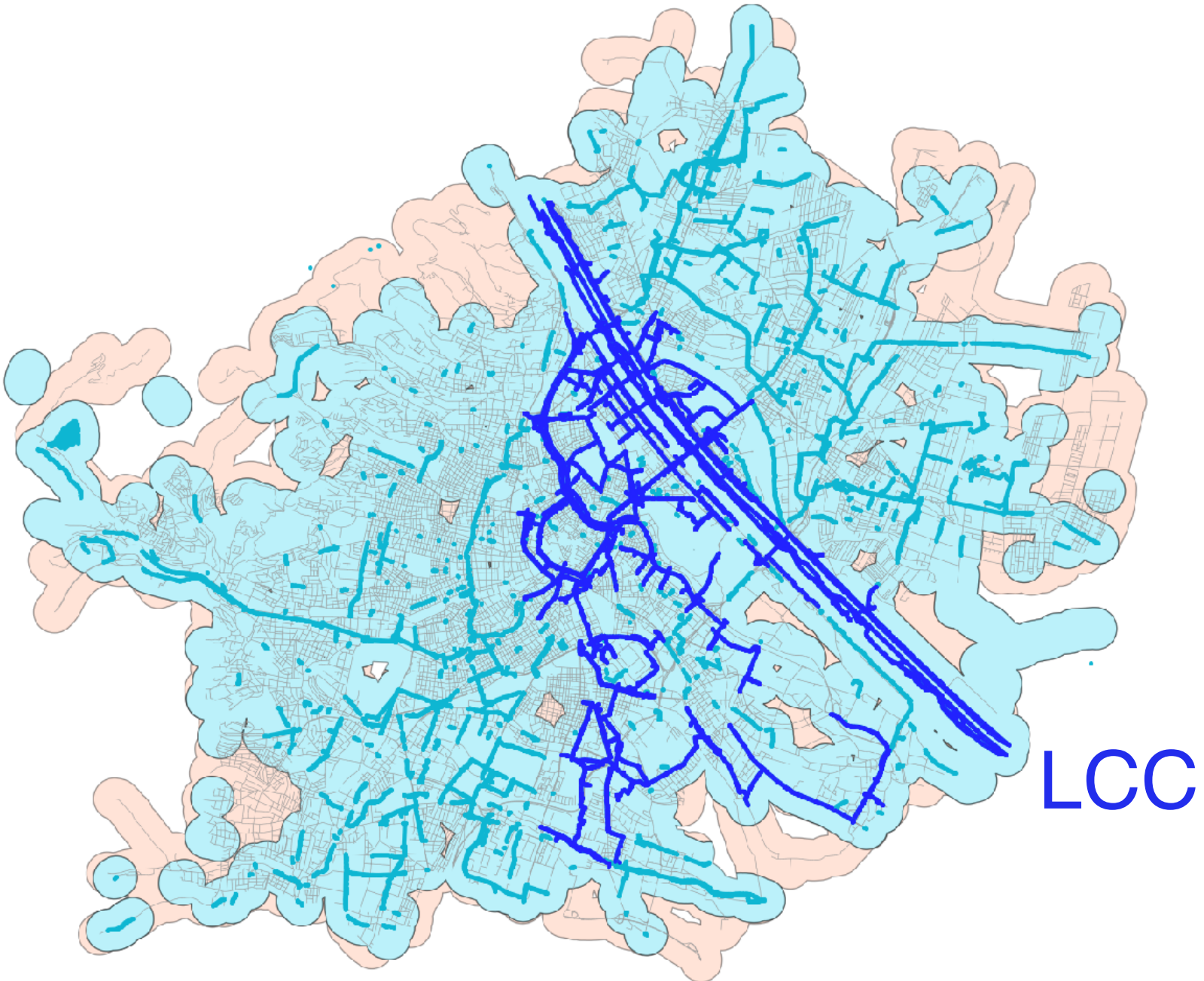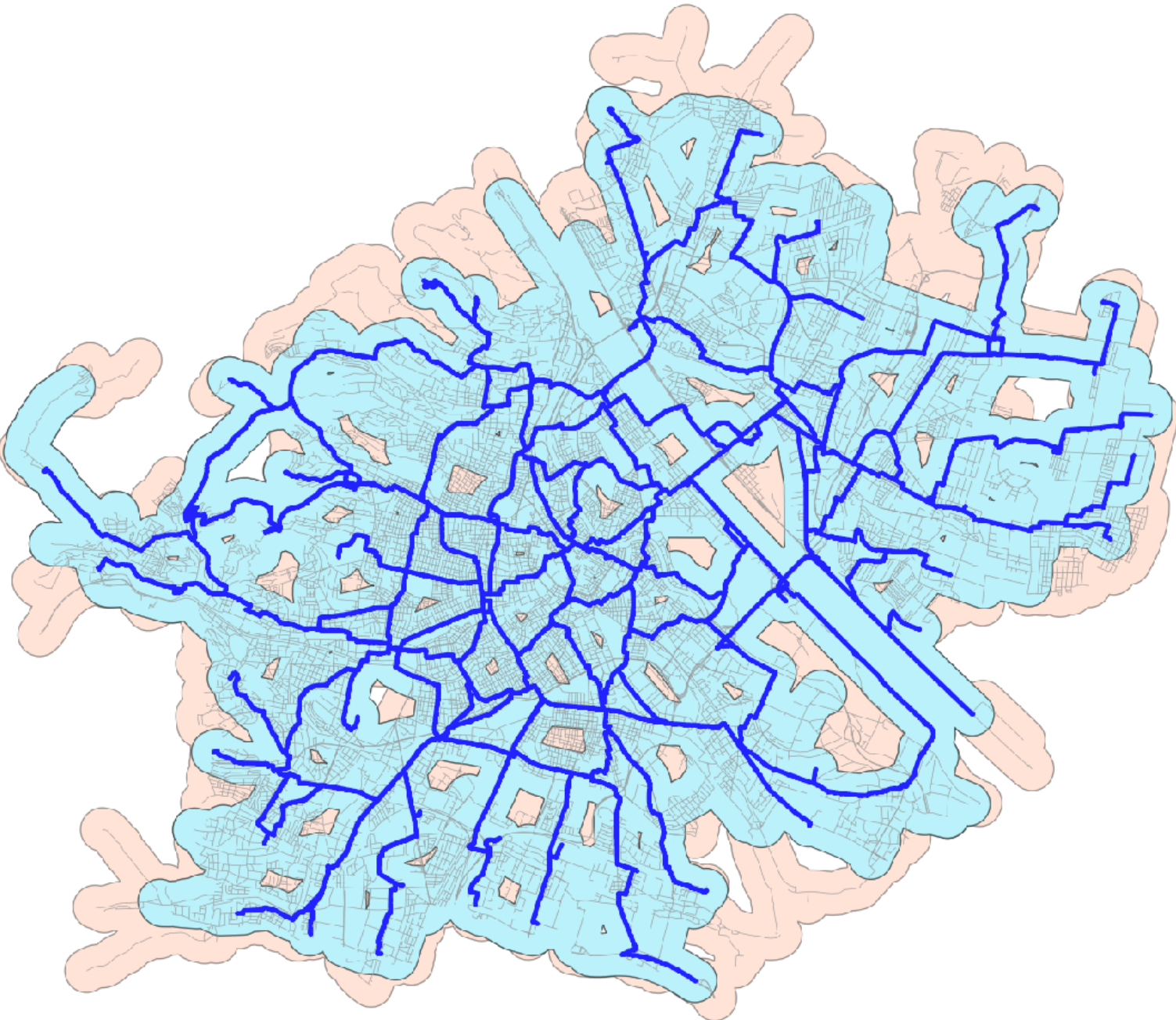
LCC

Real Vienna

Synthetic Vienna

Avoid "random-like", piecewise growth

LCC
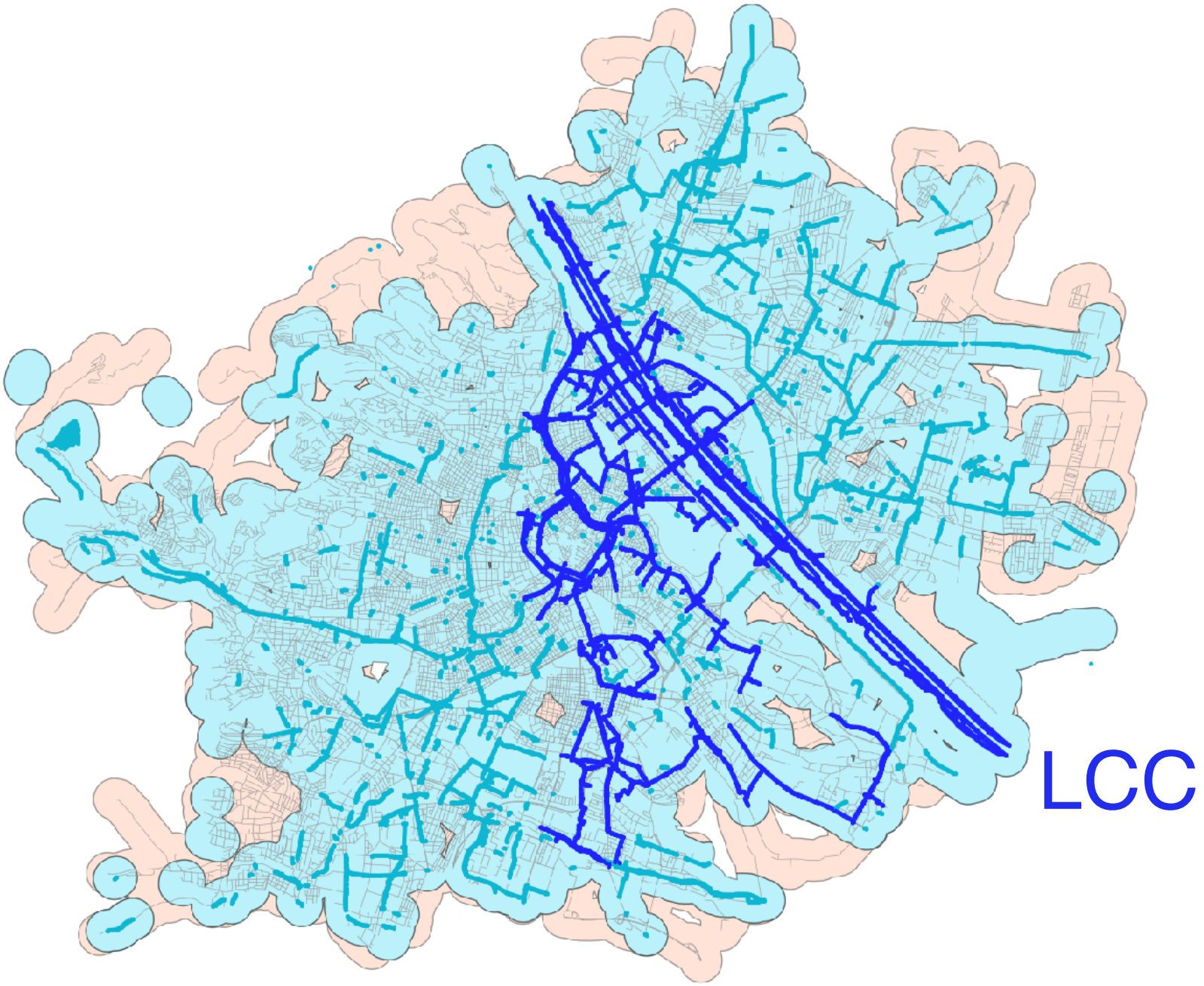
Real Vienna   Synthetic Vienna

Avoid "random-like", piecewise growth
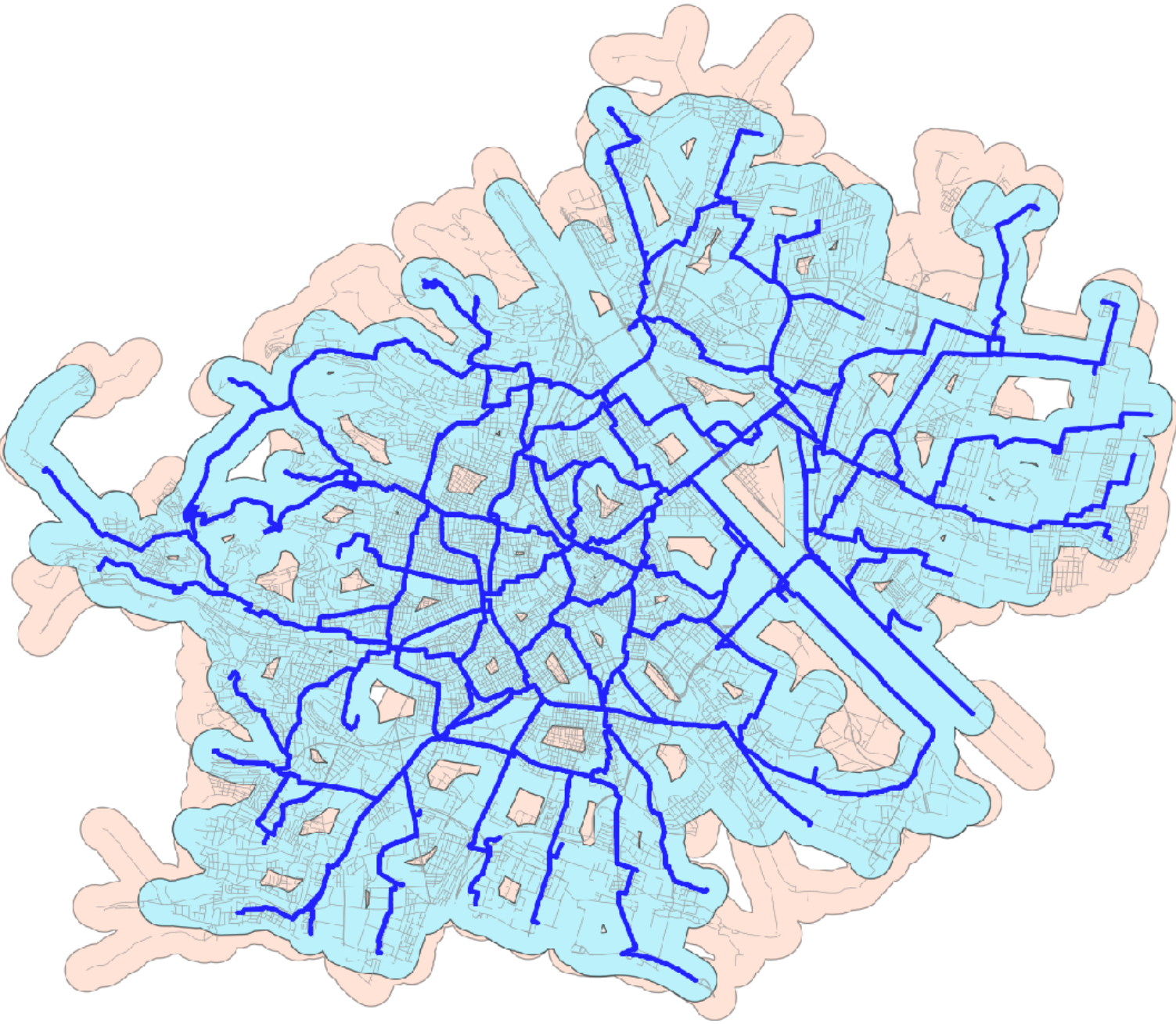
Random growth needs 3x the investments than a global strategy
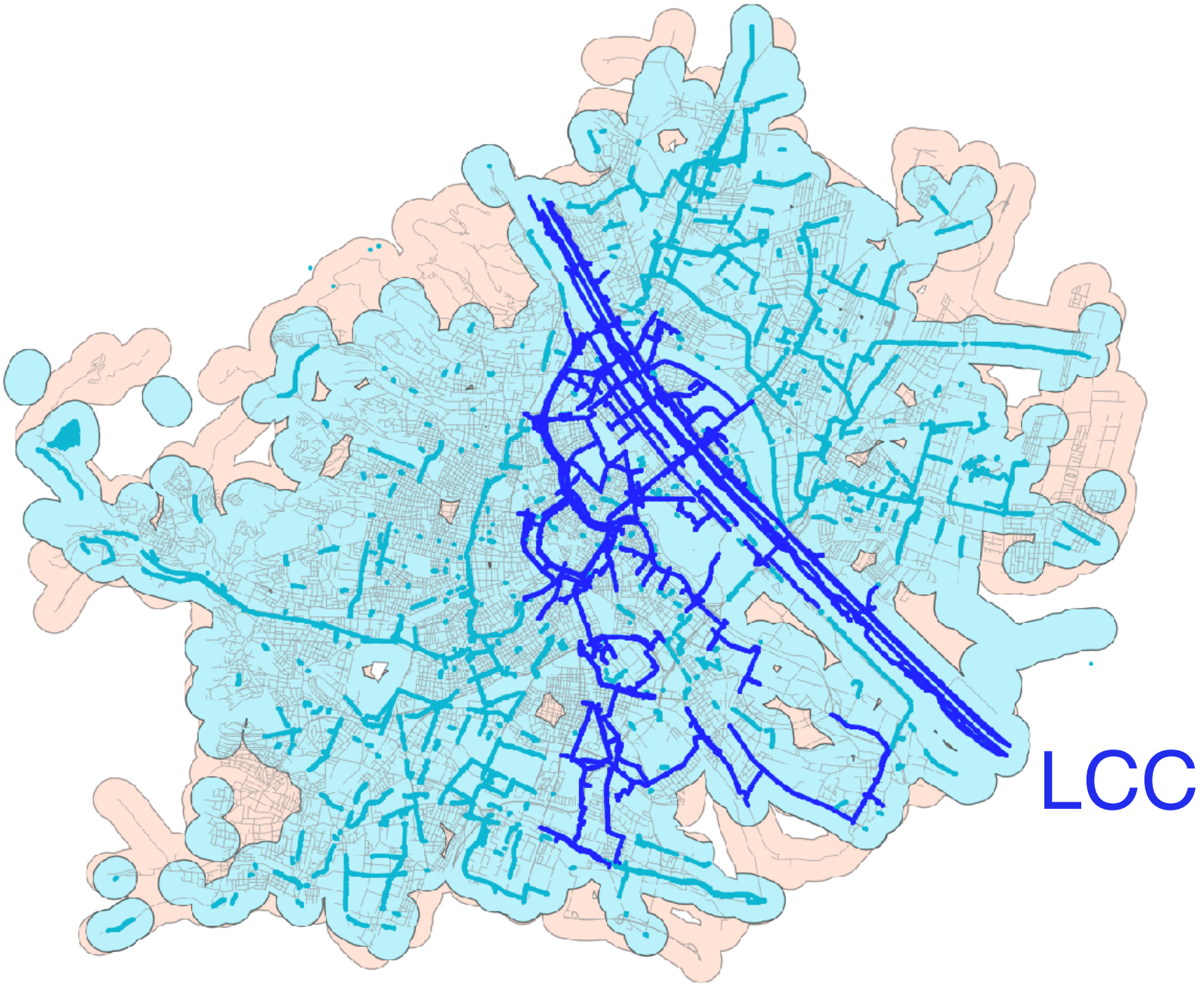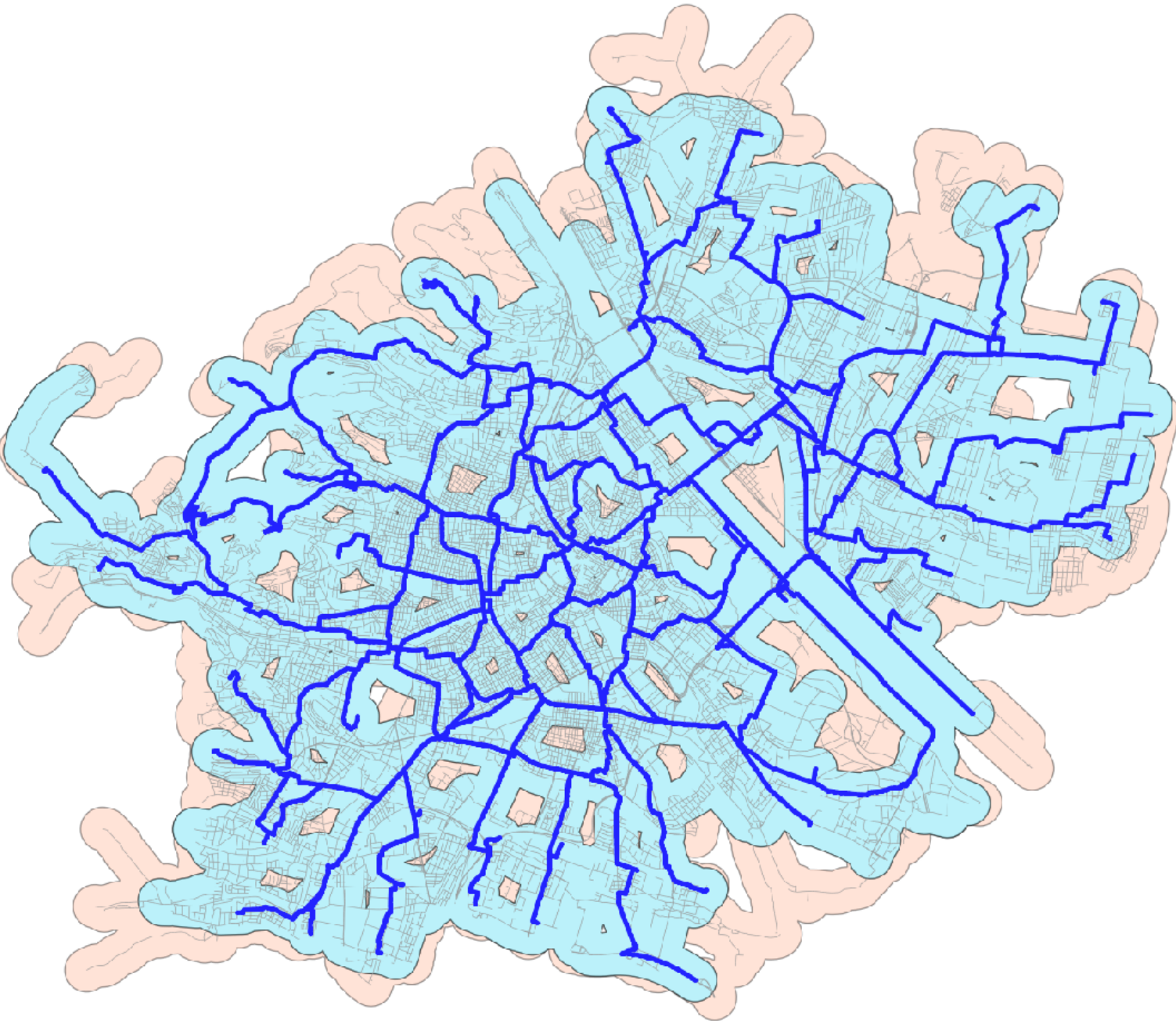
LCC

Real Vienna

Synthetic Vienna

Avoid "random-like", piecewise growth

We've built many bike paths but nobody is using them, so why build more?

LCC
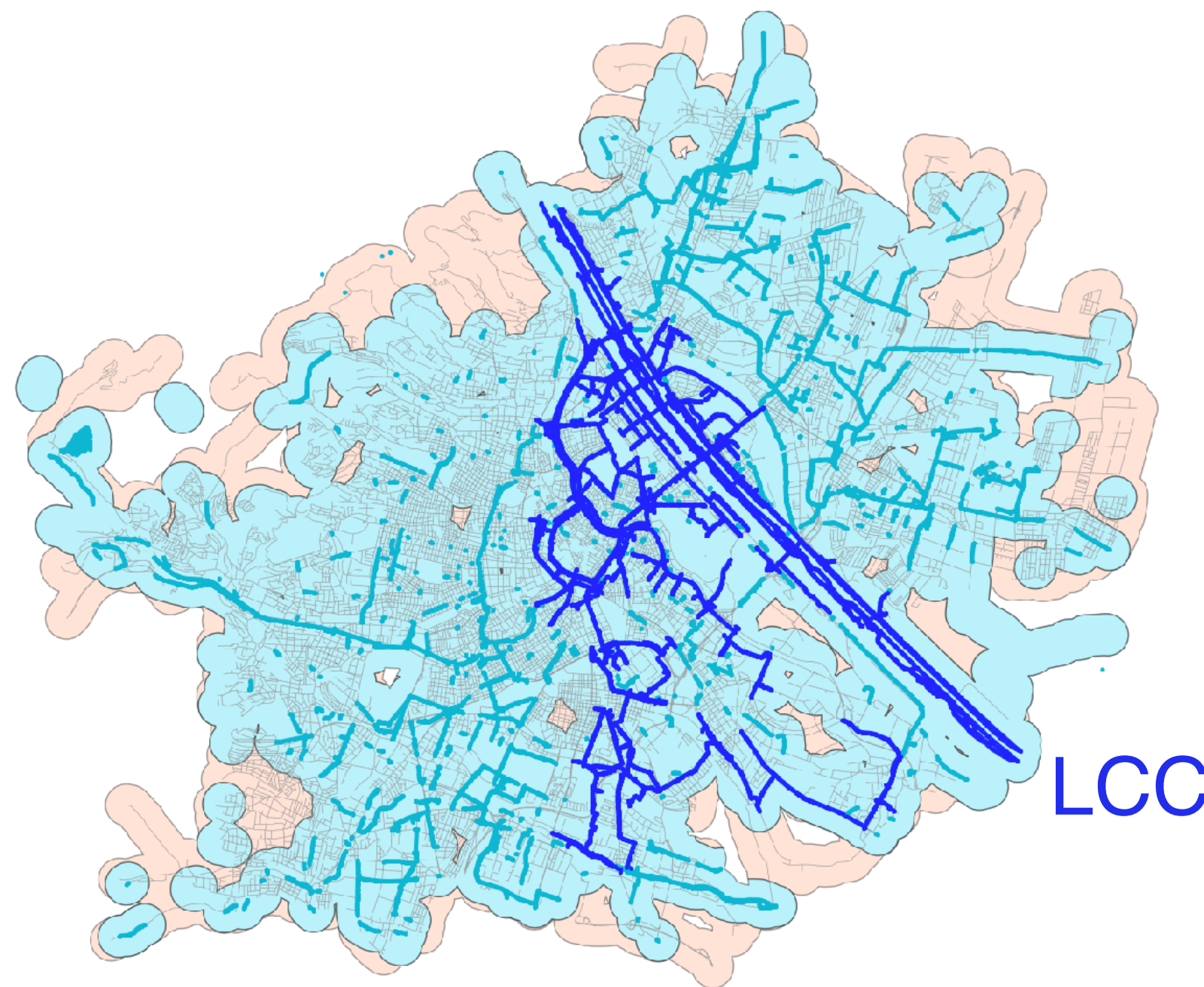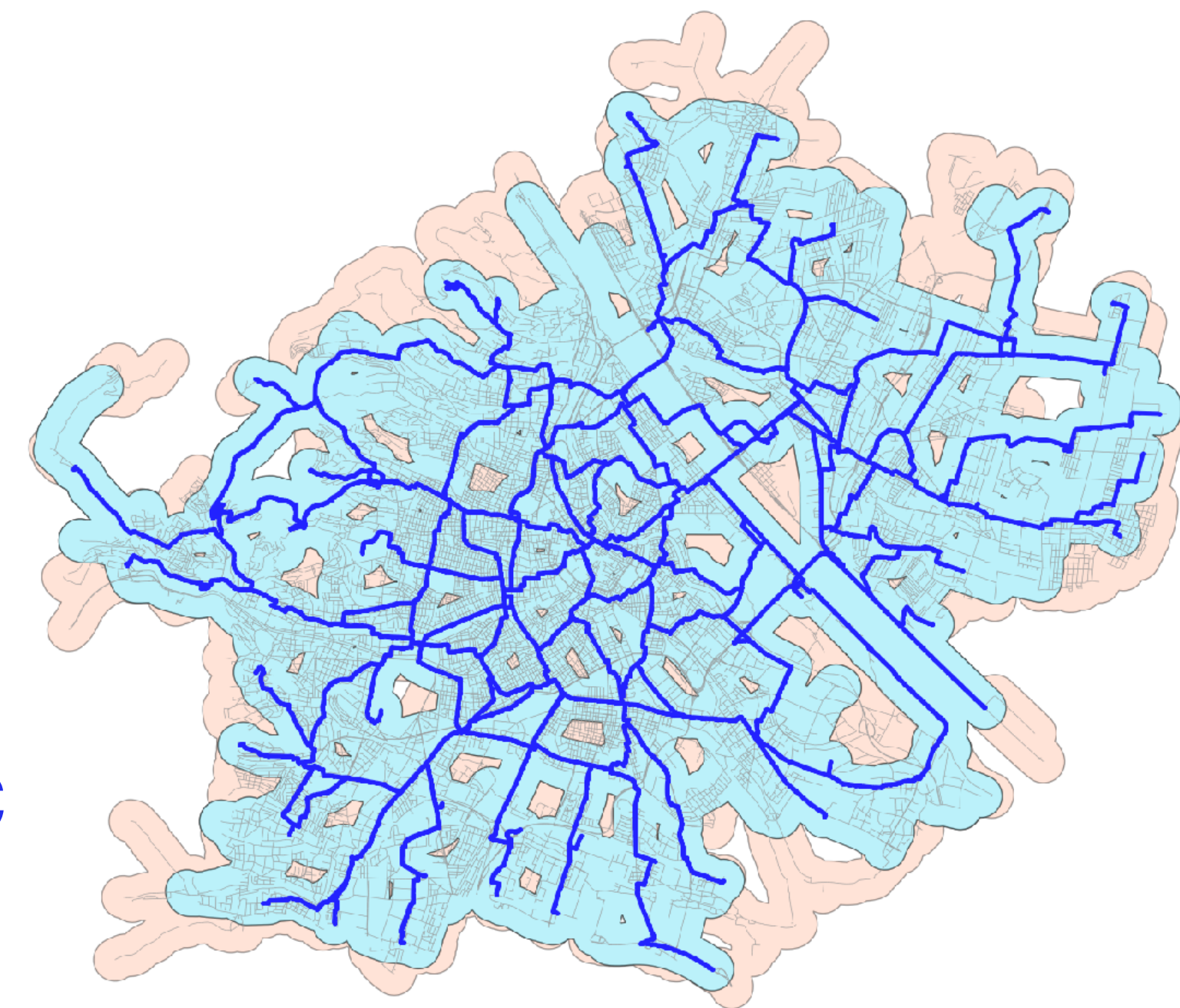
Real Vienna

Synthetic Vienna

Würden wir unsere U-Bahnen bauen wie Radwege?
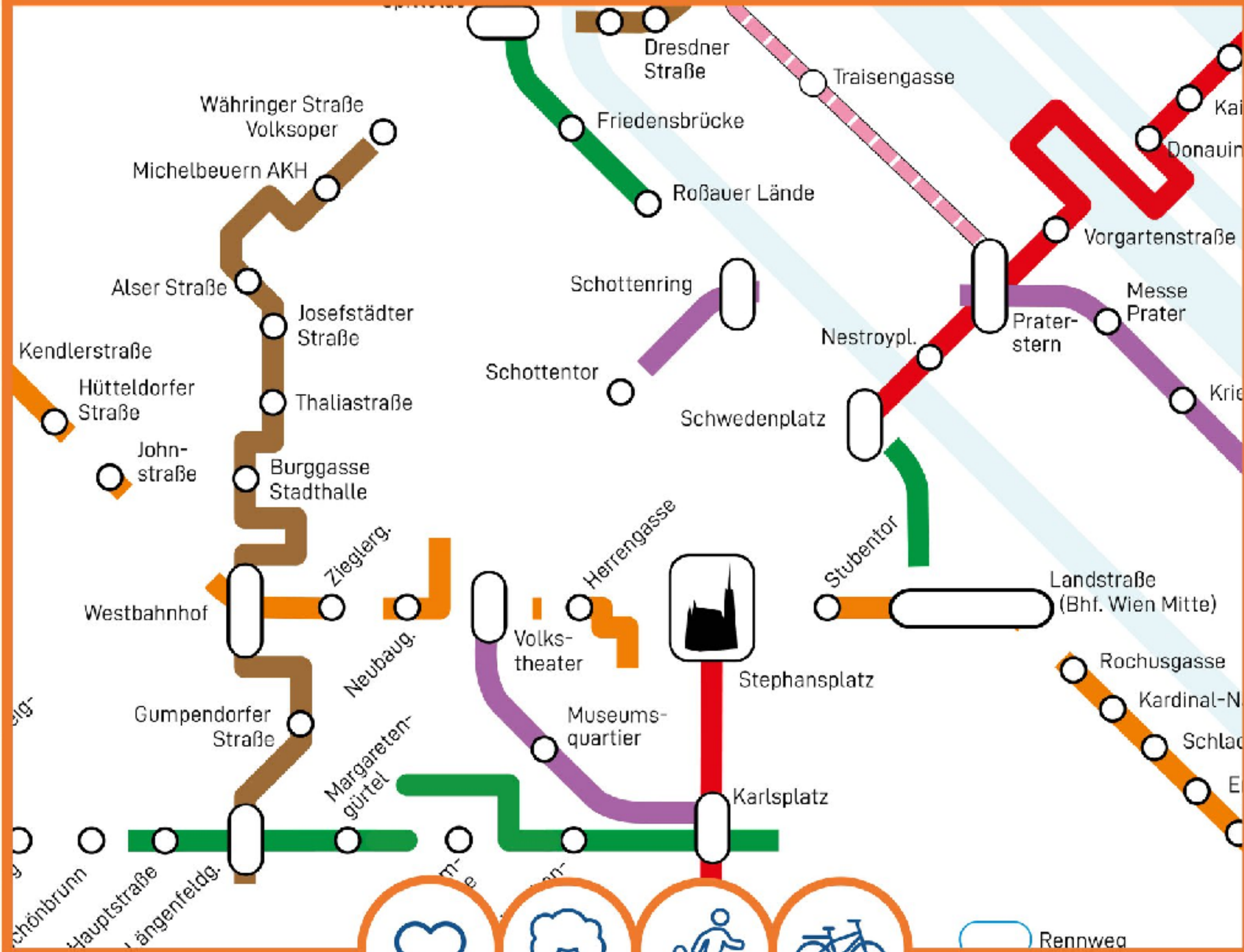
#PlatzFürWien
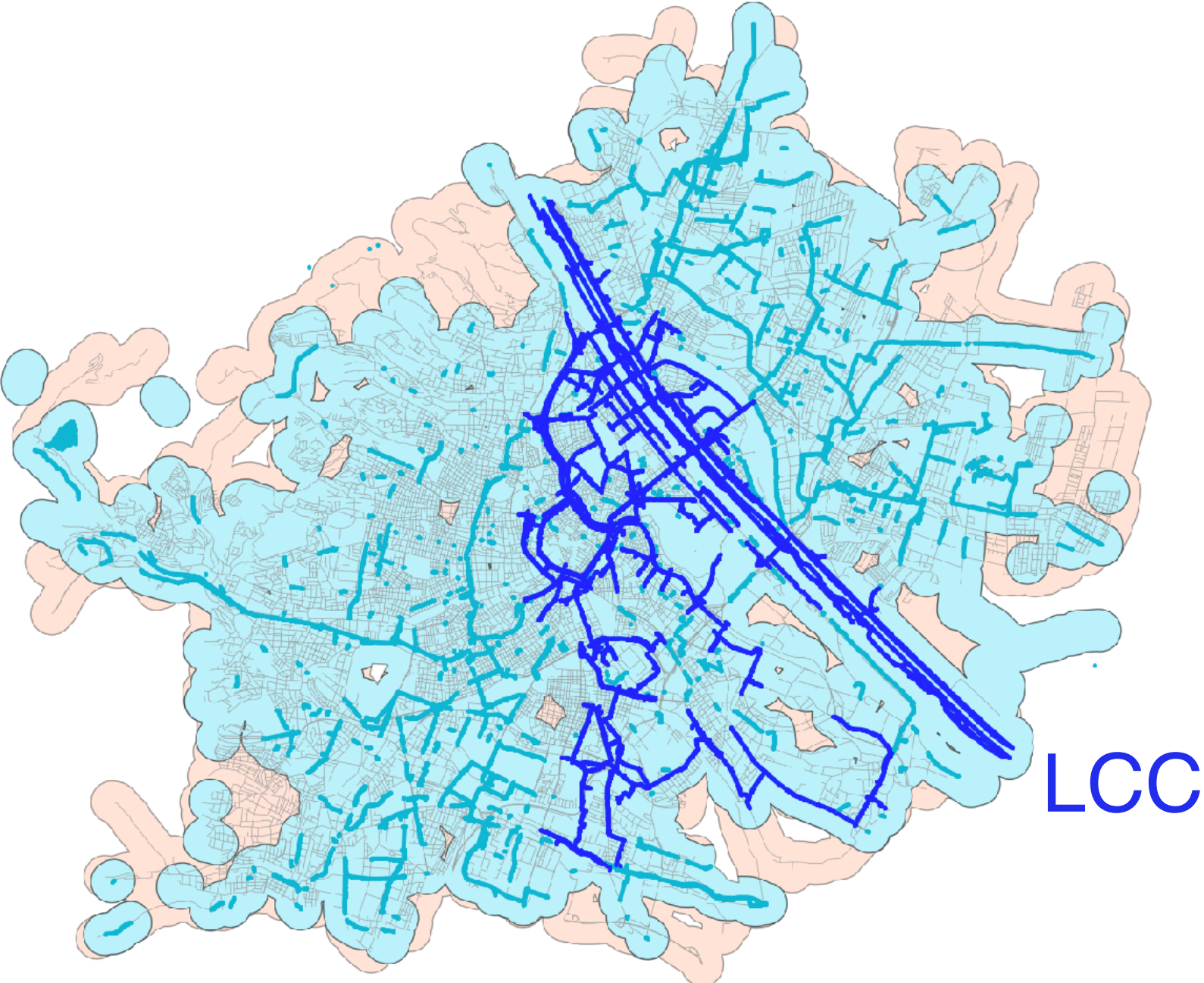
Quelle: Wiener Linien / eigene Bearbeitung

LCC

Real Vienna
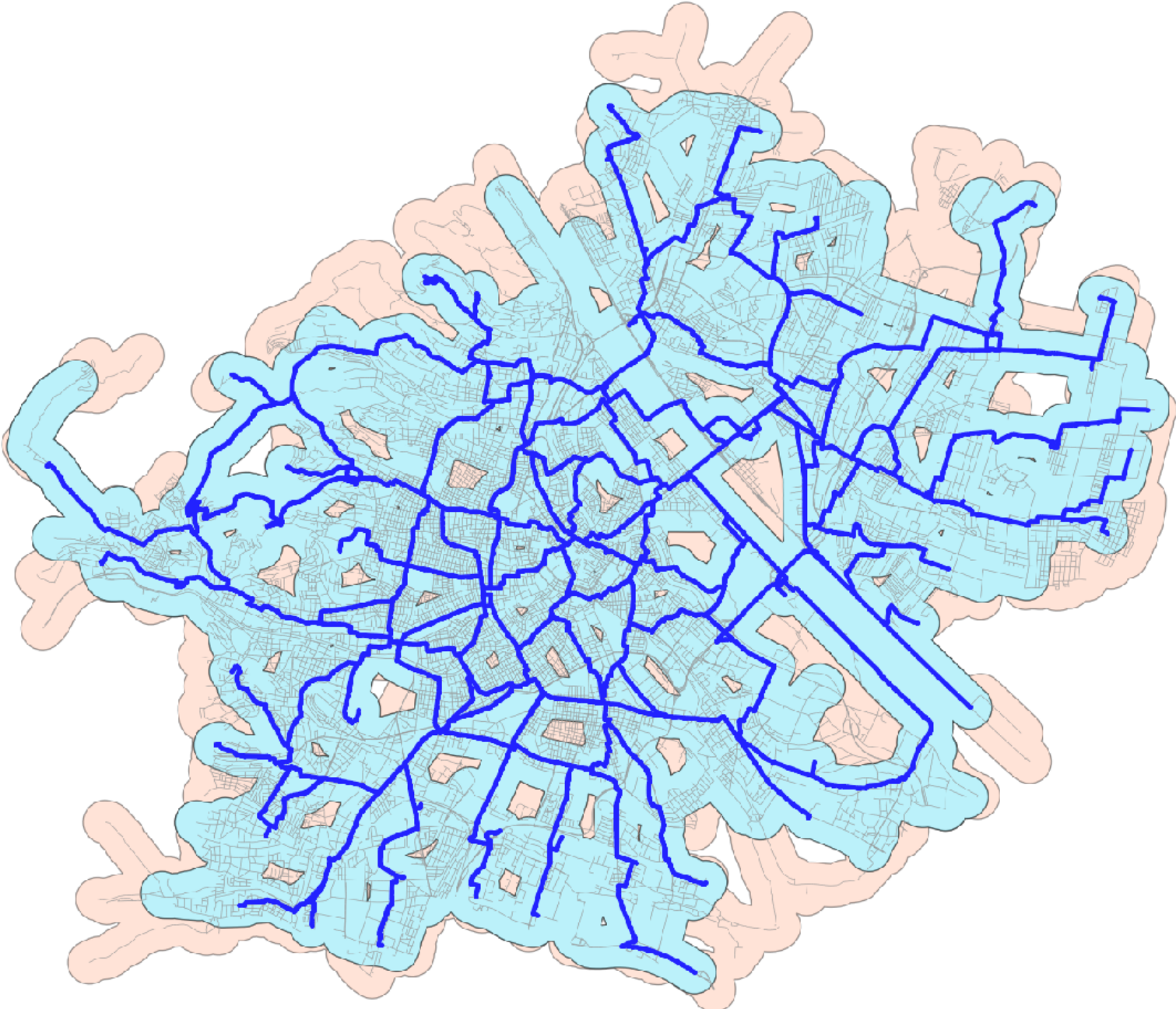
Synthetic Vienna

Nope: See Seville
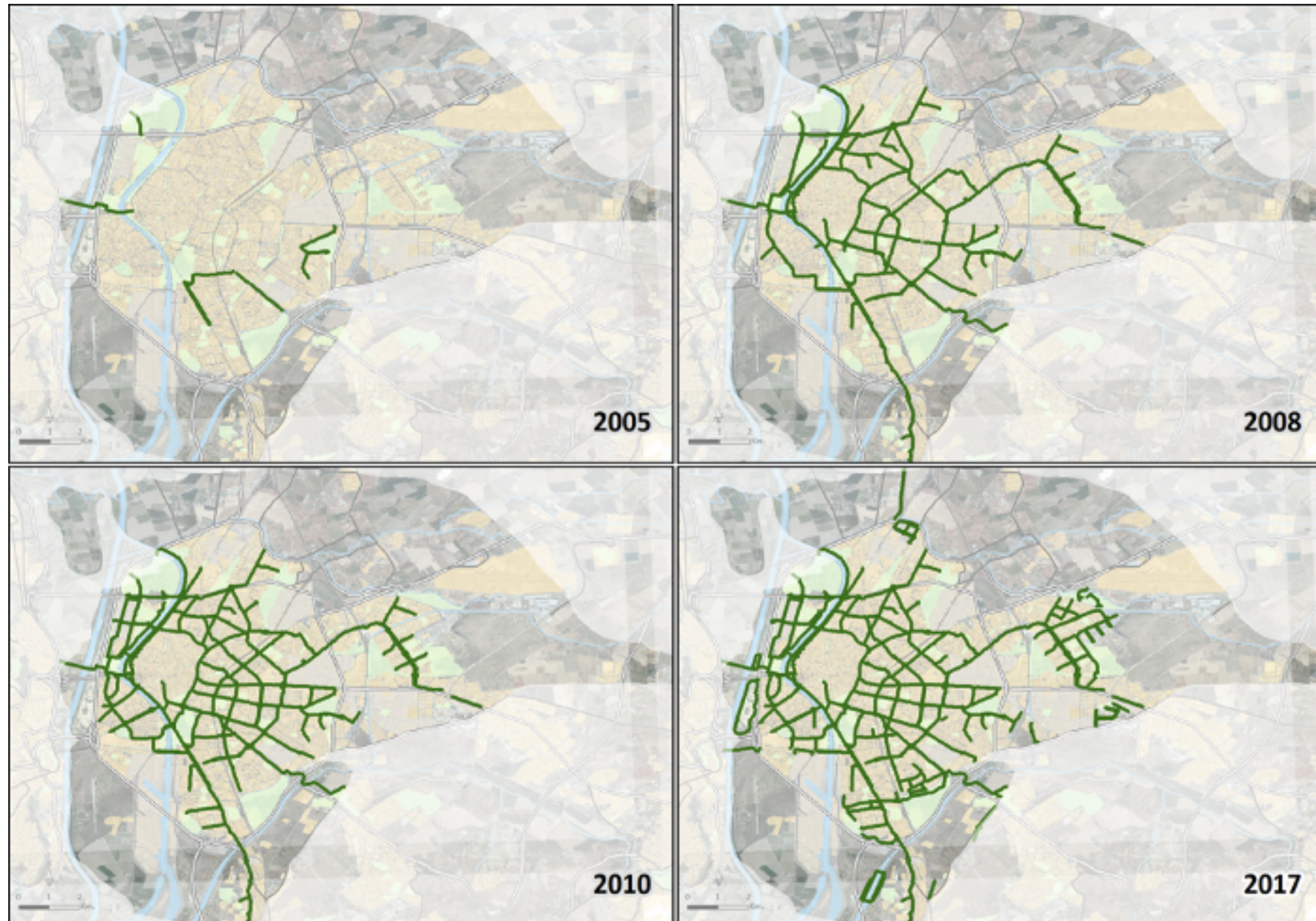
Also: Paris, Oslo, ...
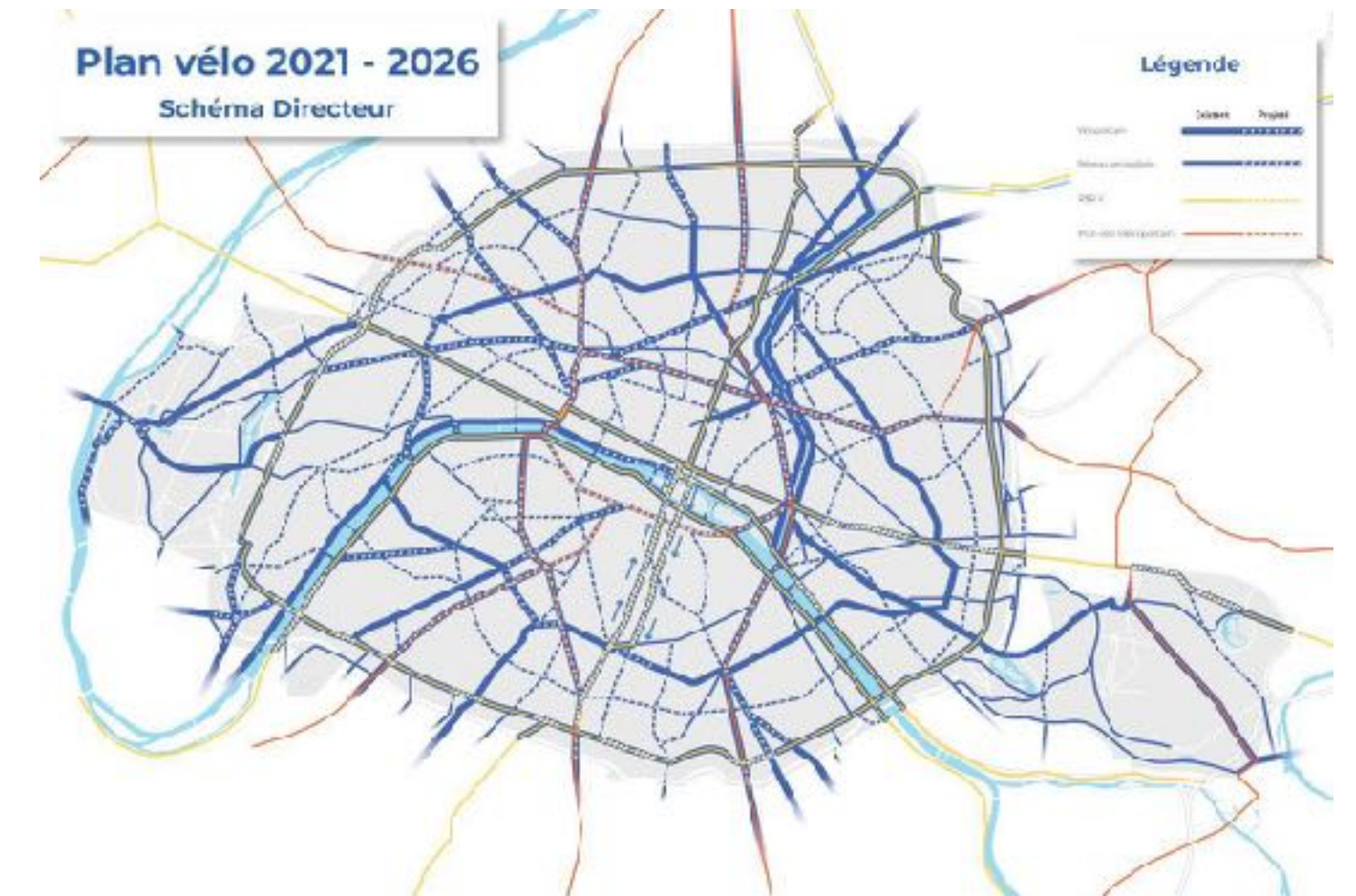
There is no excuse

Explore your city at GrowBike.Net

1) Invest early, build fast
2) Plan for the whole city

Building sustainable cities is a political, not a technical question

Tom Flood

PUT IN PROTECTED MOBILITY LANES?

Pros	Cons
Reduces fatalities	A driver might get mad
Reduces injuries	
More people biking	
Less pollution	
Economic boost	
Less congestion	
Healthier population	
Kids biking/rolling to school	
Safer sidewalks	
Helps address the climate emergency	
Increase active transportation	
More inclusive spaces	

Tom Flood

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1. Car industry
2. Roads & parking
3. Land use for cars
4. Neglect public transport
5. Car culture

Mattioli et al, Energy Research & Social Science 66 (2020): 101486

ROYAL SOCIETY OPEN SCIENCE

royalsocietypublishing.org/journal/rsos

Research

Data-driven strategies for optimal bicycle network growth

Luis Guillermo Natera Orozco[1], Federico Battiston[1], Gerardo Iñiguez[1,2,3] and Michael Szell[4,5,6]
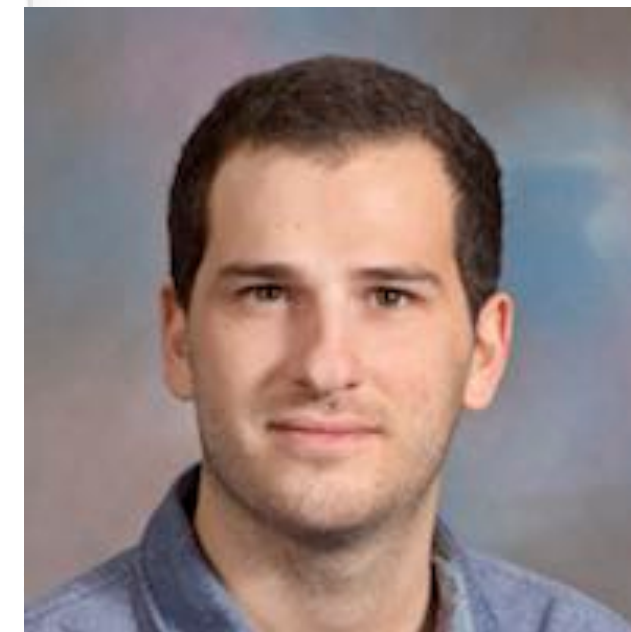
Cite this article: Natera Orozco LG, Battiston F,
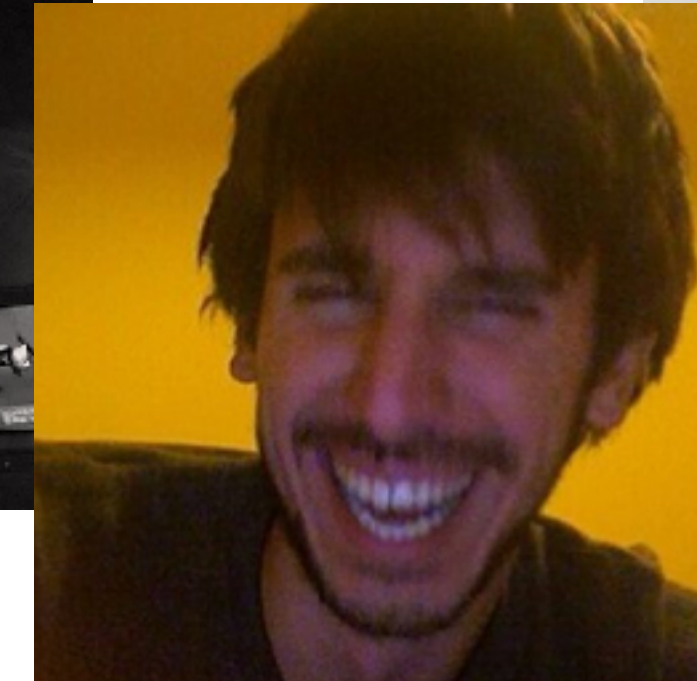
www.nature.com/scientificreports

scientific reports

OPEN Growing urban bicycle networks

Michael Szell[1,2,3], Sayat Mimar[4], Tyler Perlman[4], Gourab Ghoshal[4] & Roberta Sinatra[1,2,3,5]

growbike.net

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