# How to assess a mayor network change?

## The case of the E-Bike City

# Preferred citation style

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# How to assess a mayor network change: The case of the ebike city?

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# An e-bike-city ?  Daily practise today

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# Where do we go now ?

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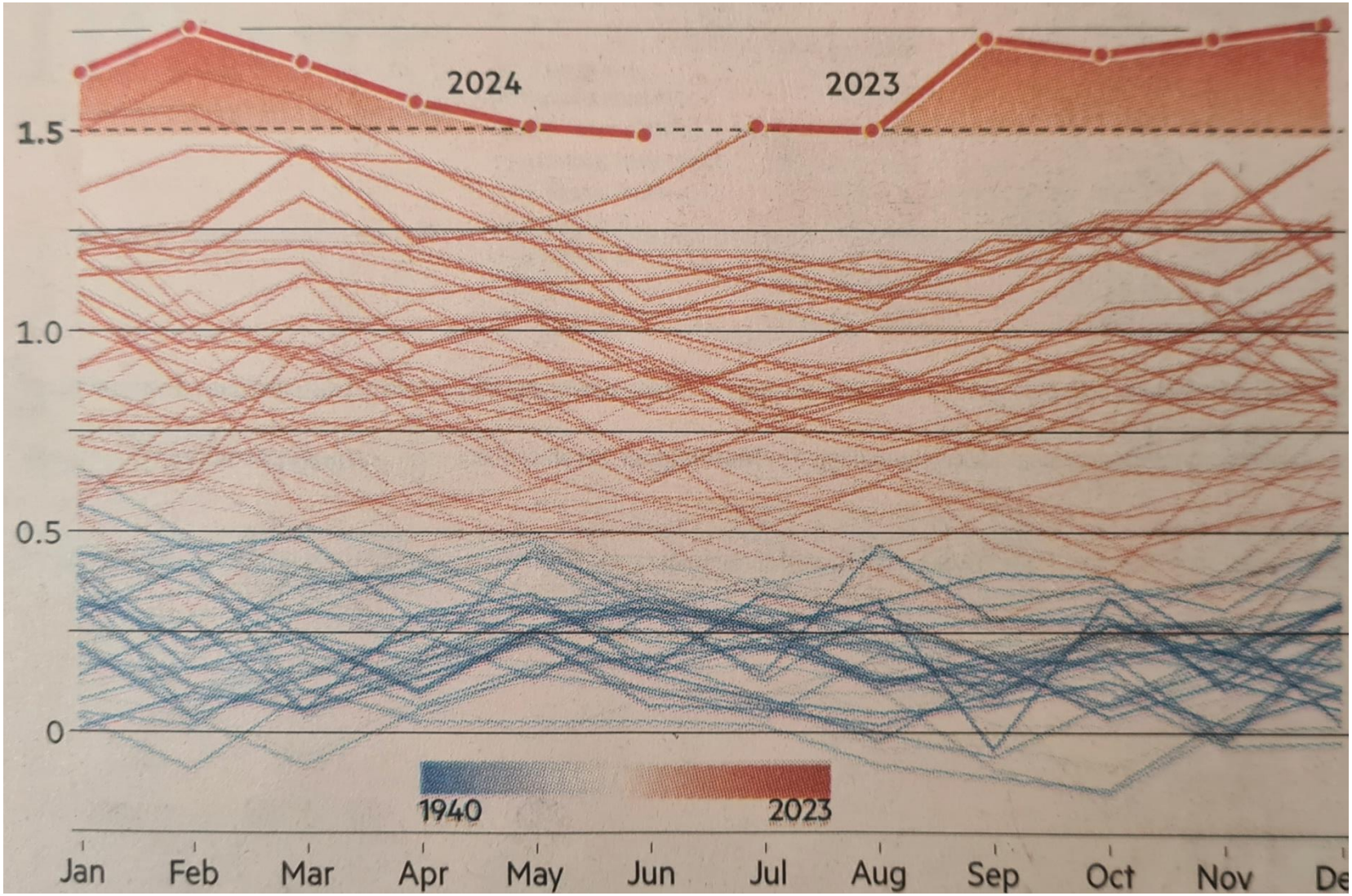



Source: Financial Times, 13.7.2024

# Visions, academic visions ?

# Visions, academic visions for (local) authorities ?

| | Algorythm | Object |
|---|---|---|
| Idea | Developer/academic | Designer |
| Prototype | First coder | Workshop/engineer |
| Product | Software engineer | Factory/team |
| Transmission | Consultant | Firm |
| Filter | Advisor | Advisor |
| Decision shaper | Executive | Excutive |
| User/ decision maker | Sovereign | Sovereign |

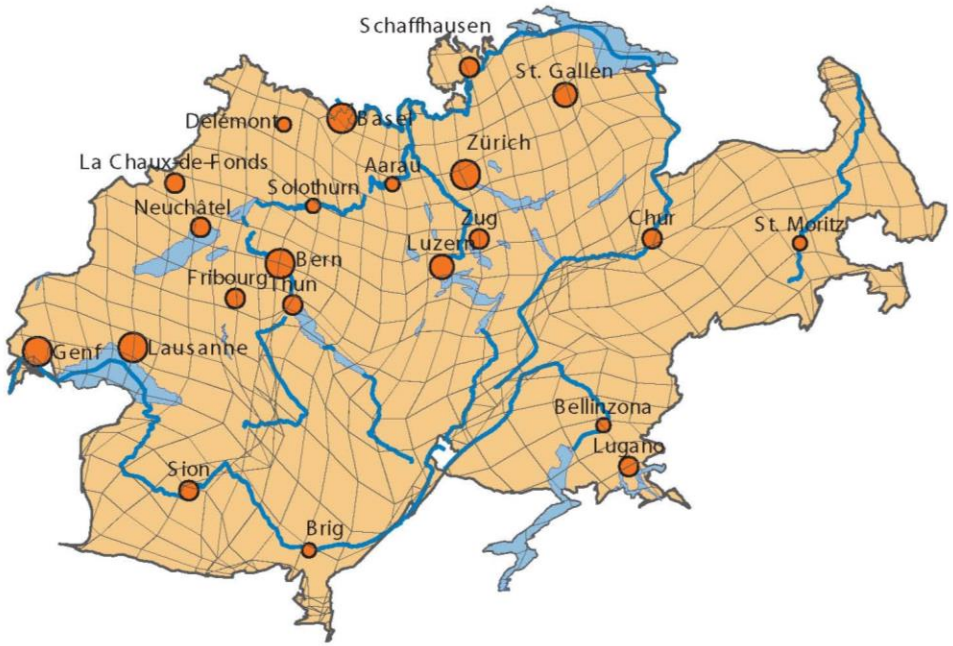
# Dilemma of transport planning as understood today

# Shrinking "road" – Switzerland (1950)




Scherer, 2004

# Shrinking "road" – Switzerland (2000)






Scherer, 2004

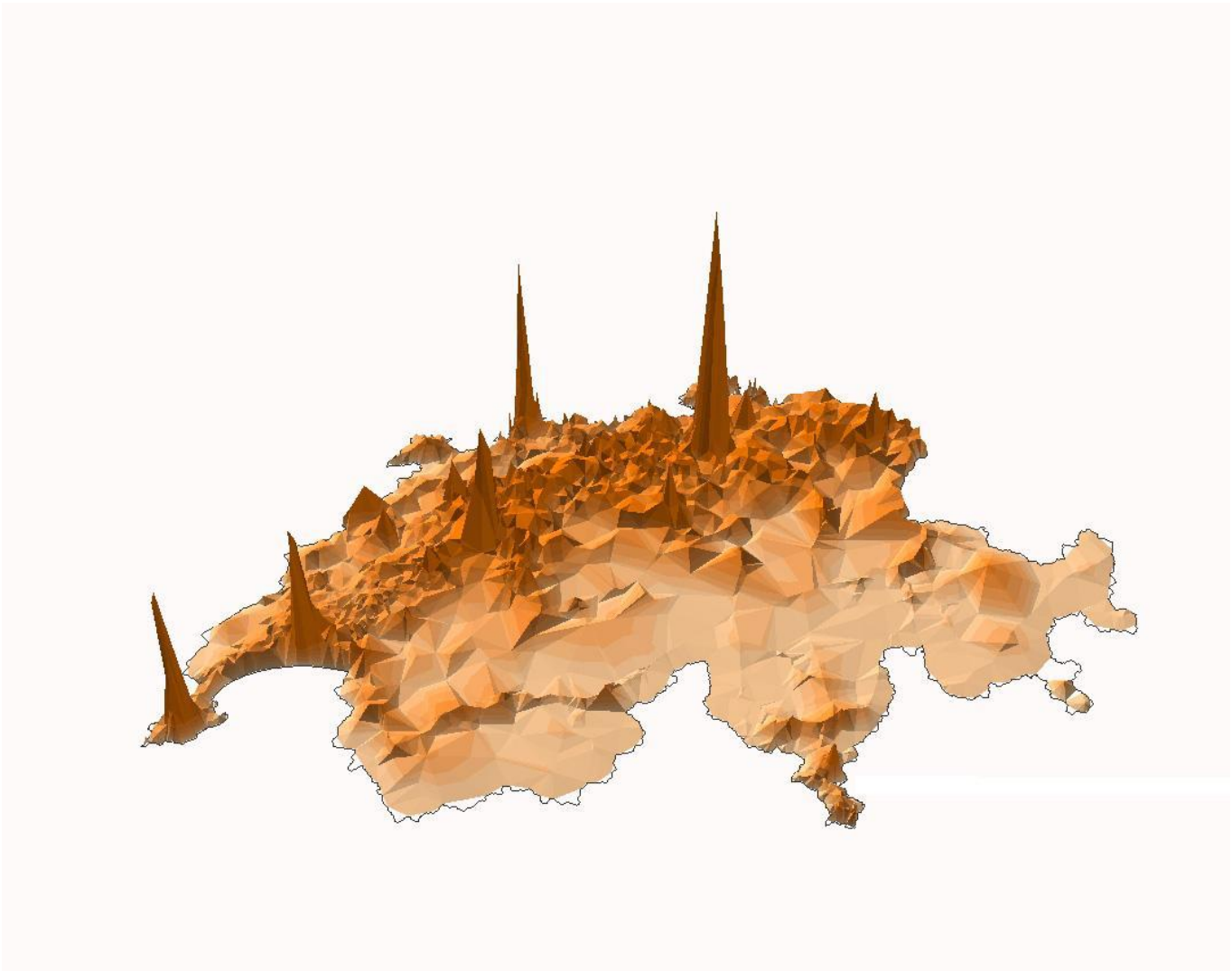
# Calculation of Hansen-accessibility (log sum)

# Calculation of Hansen-accessibility

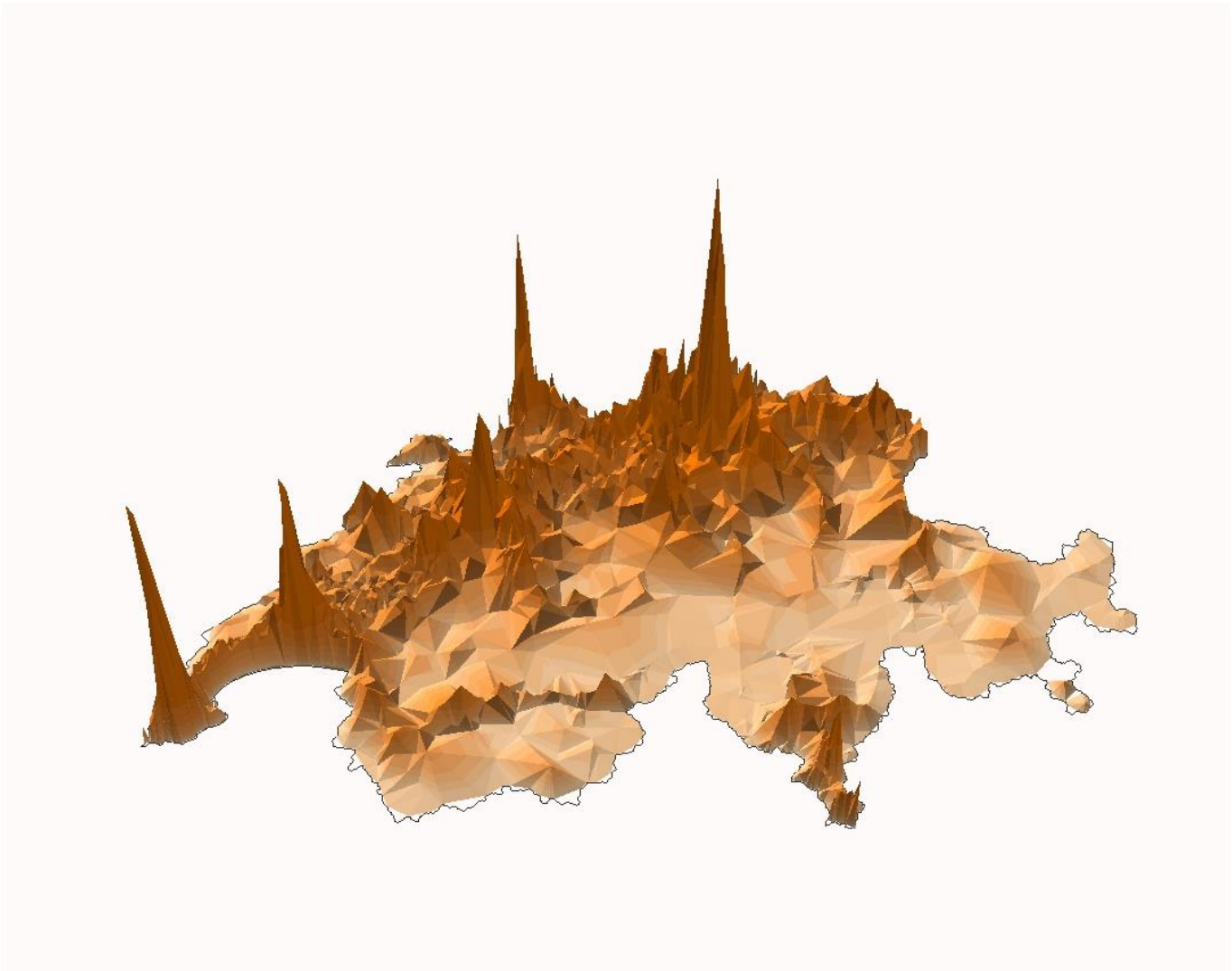
$$E_i = \sum_{k_{ij}=0}^{k_{ij} < k_{\max}} X_j \, f(k_{ij})$$

| | |
|---|---|
| $E_i$ | Erreichbarkeit von Ort i aus |
| i | Ausgangsort i |
| j | Zielort j |
| $X_j$ | Gelegenheiten am Ort j |
| k | Generalisierte Kosten des Widerstands zwischen i und j |
| f() | Gewichtungsfunktion |

# Hansen-accessibility – roads (1950)

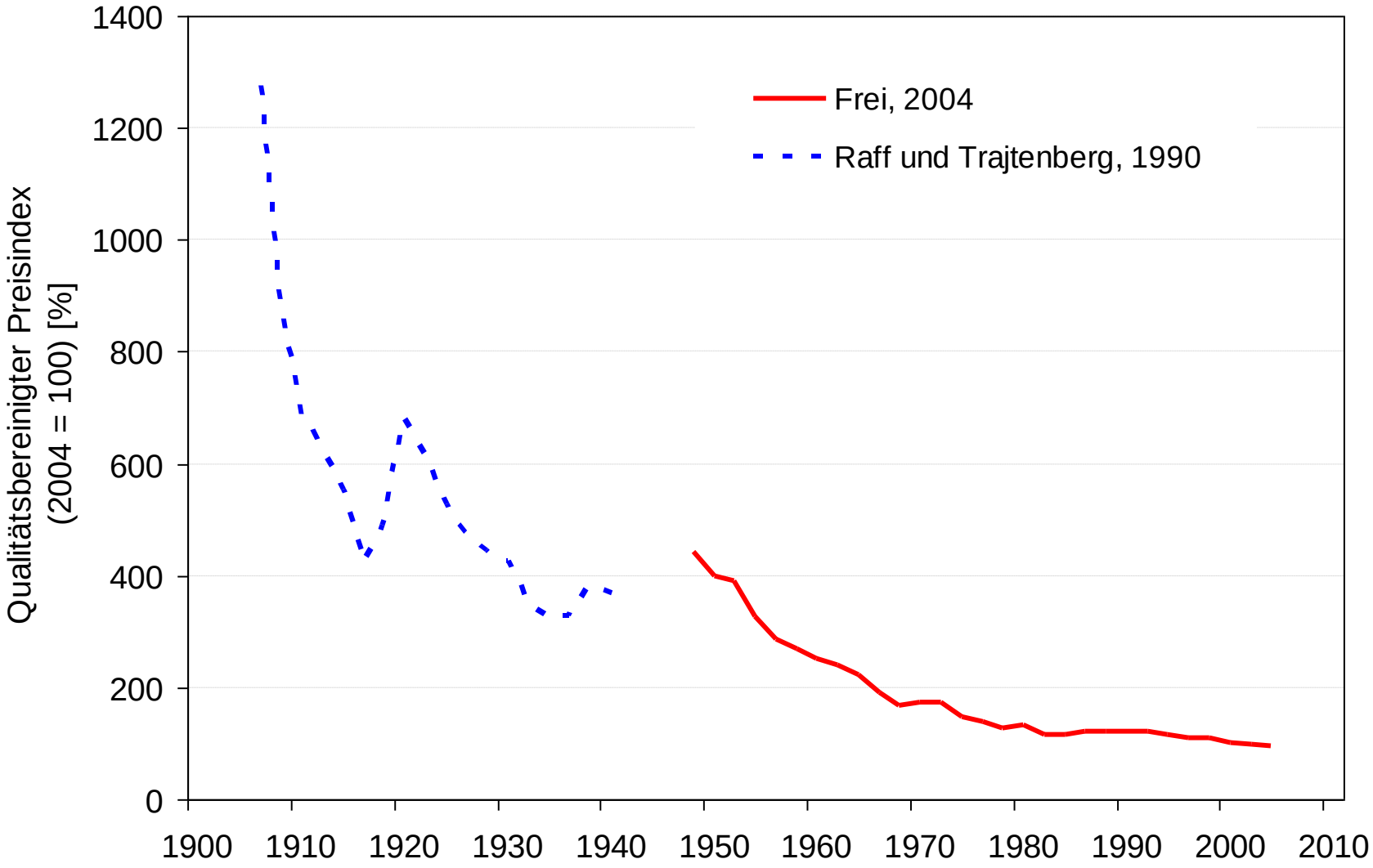


# Hansen-accessibility – roads (1950)(2000)



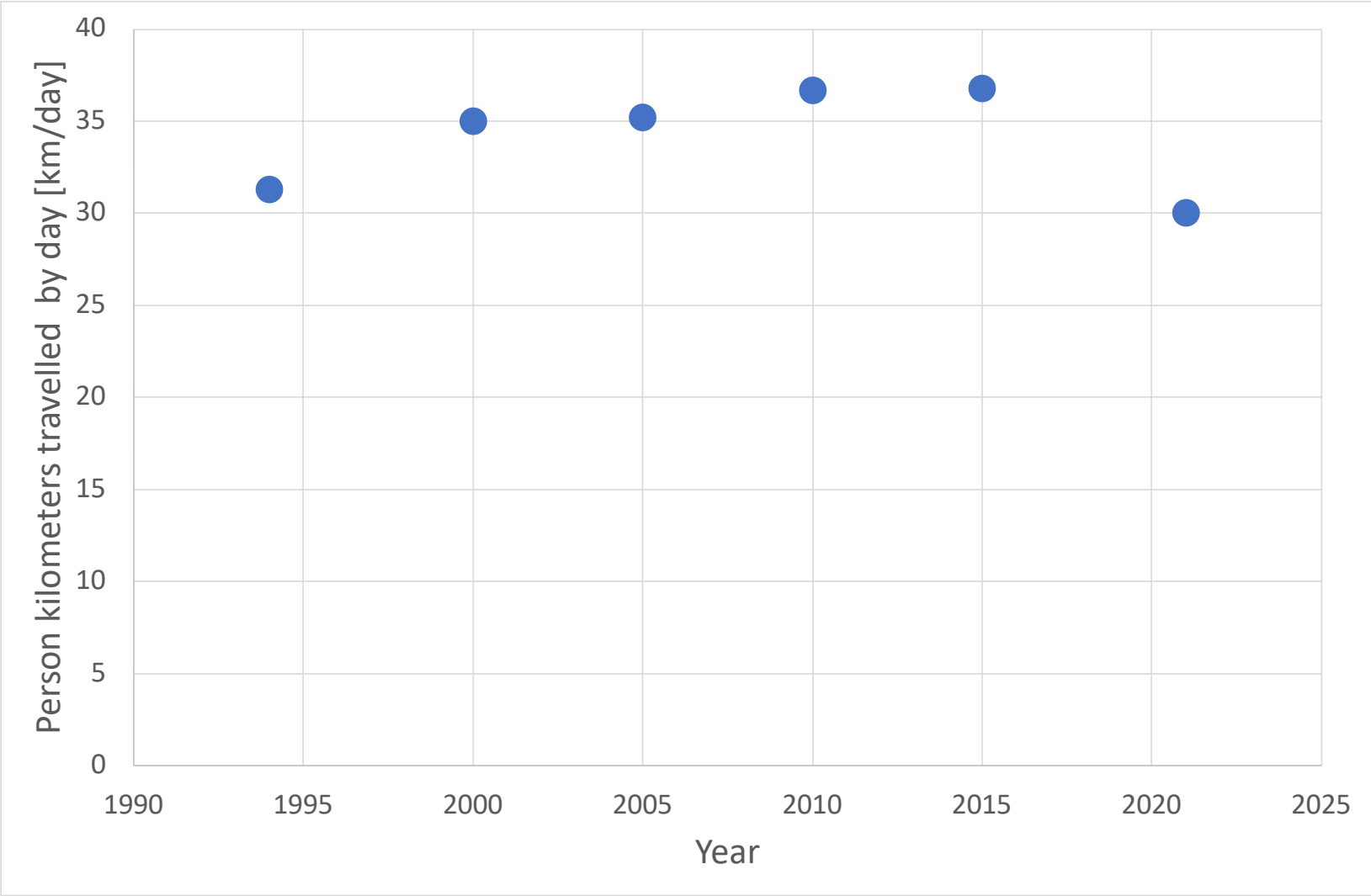
# Impacts

# CH: Quality- and inflation adjusted price of mid-class saloon




Source: Frei (2005)

# Switzerland: Pkm change since the MZ 1994

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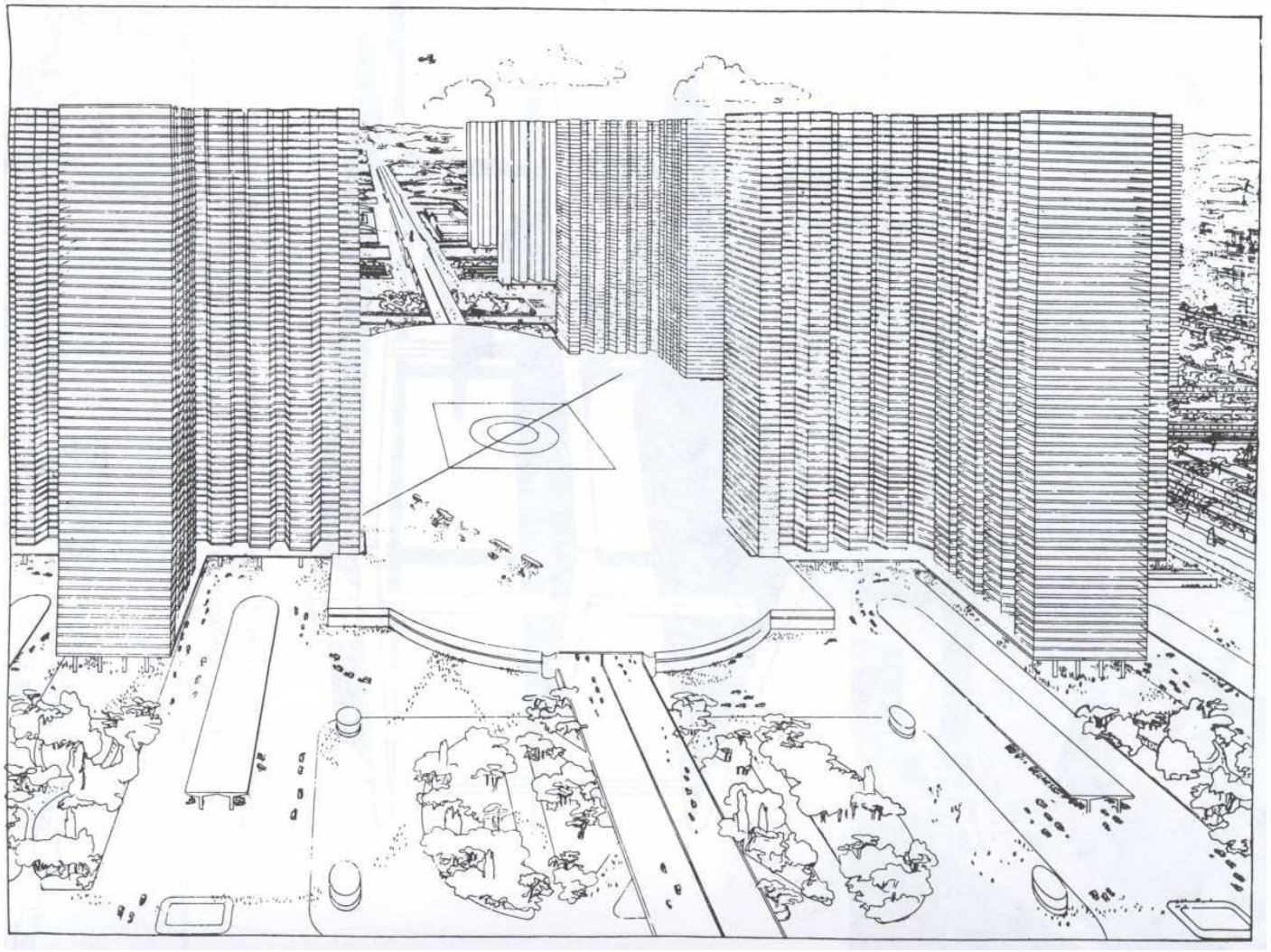
# Dilemma today

- Higher accessibility improves productivity and increases social capital

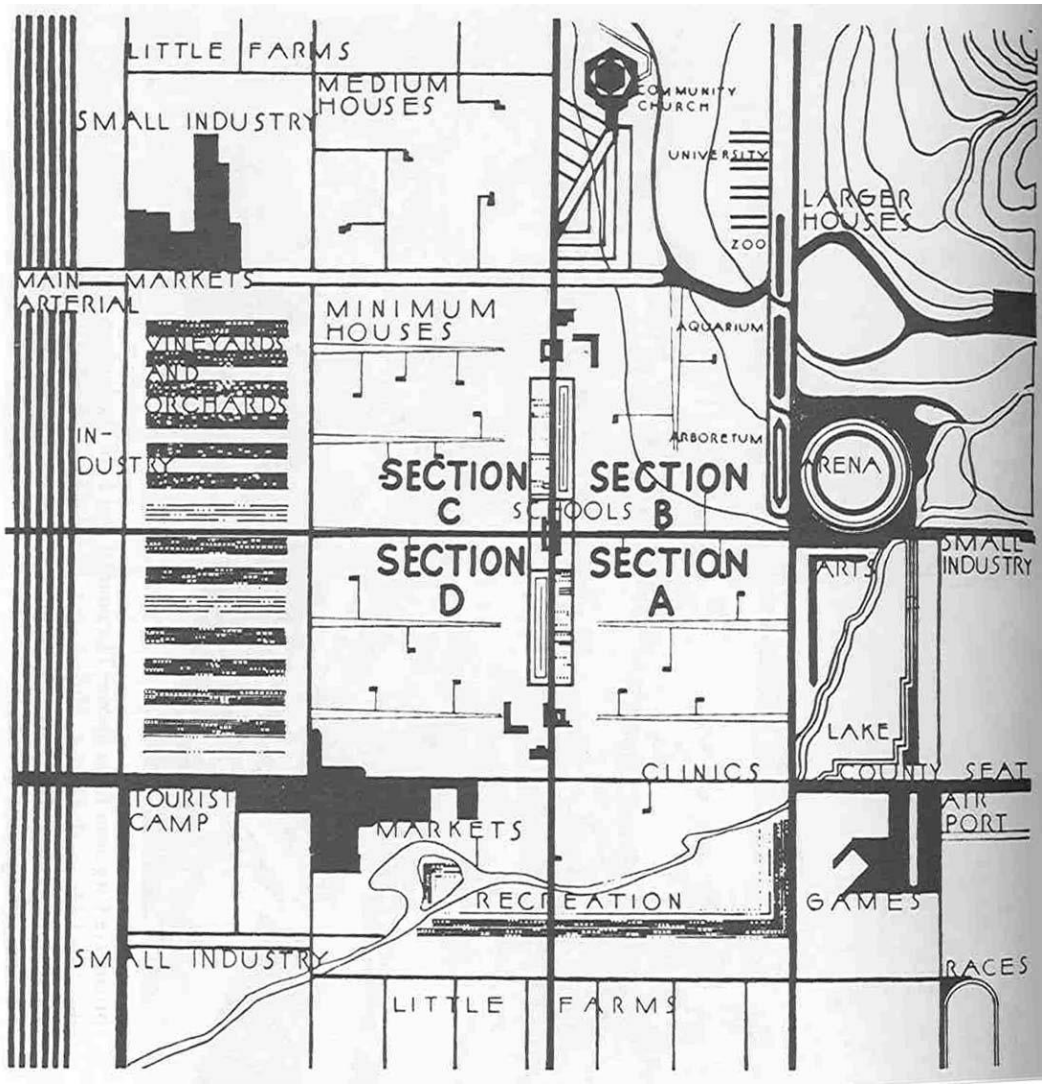
- Higher accessibility (lower generalised cost) increases
  - car ownership
  - transport demand and with it
    - GHG emissions
    - Congestion
  - encourages WFH (and lower transit use)
  - invites sprawl

# What were the past visions ?

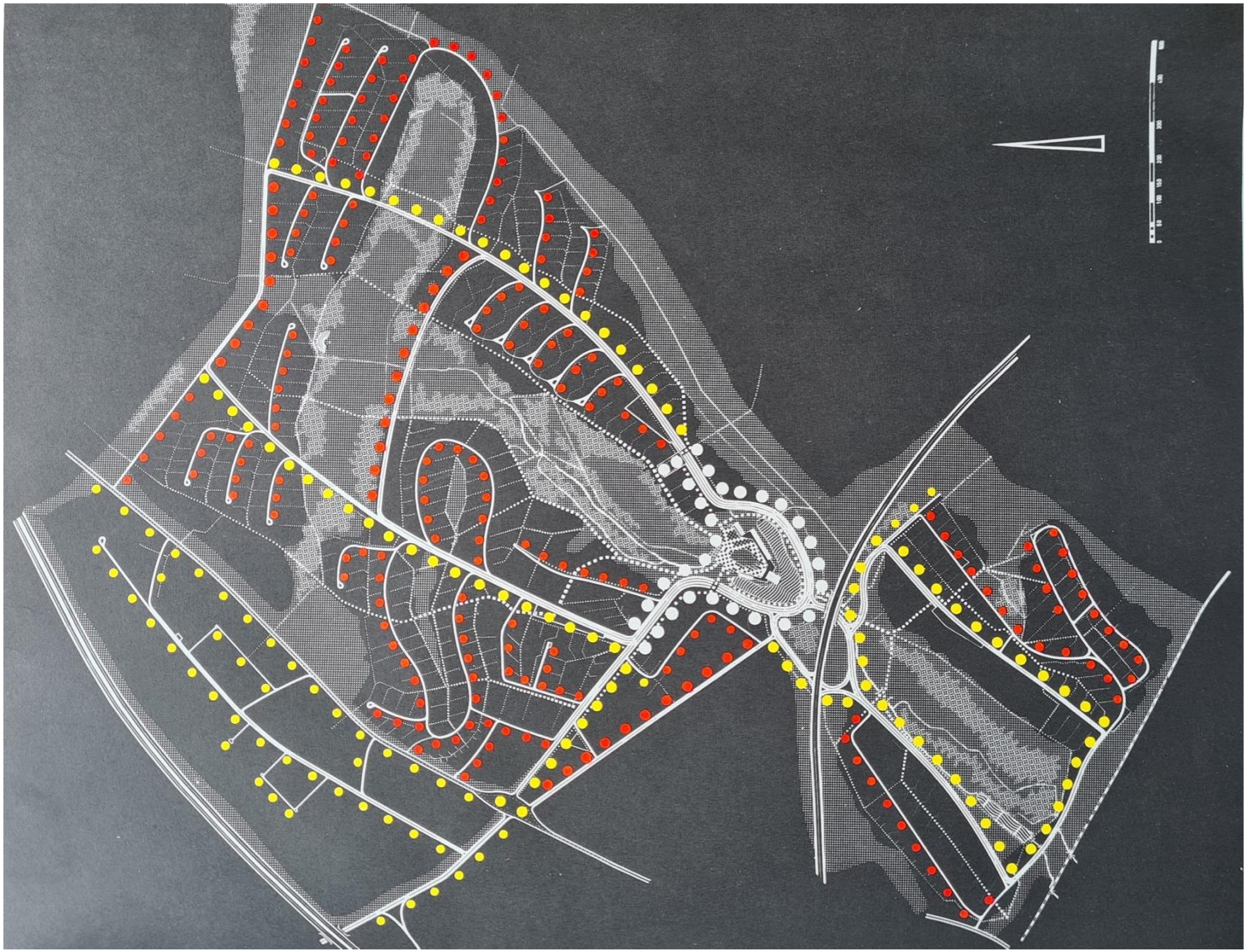
# Radical dreams: Le Corbusier's City radieuse



# Past radical dreams: Lloyd Wright's Usonia



# Past radical dreams, realised: «Autogerechte Stadt»



Source: Reichow (1963), p. 24

# Past radical dreams, realised: Motorways

Dr. Wolf Strache, Public domain, via Wikimedia Commons

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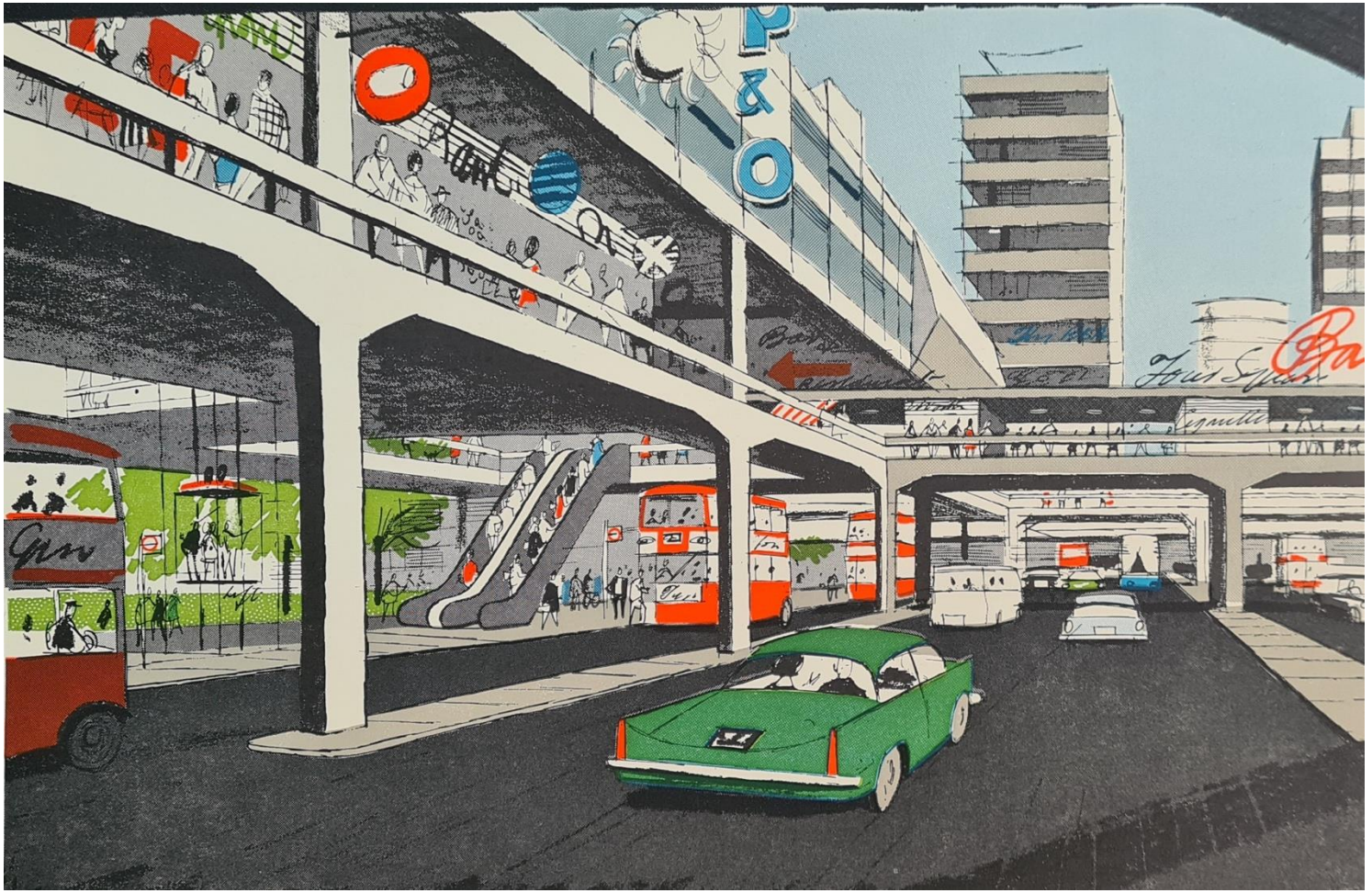
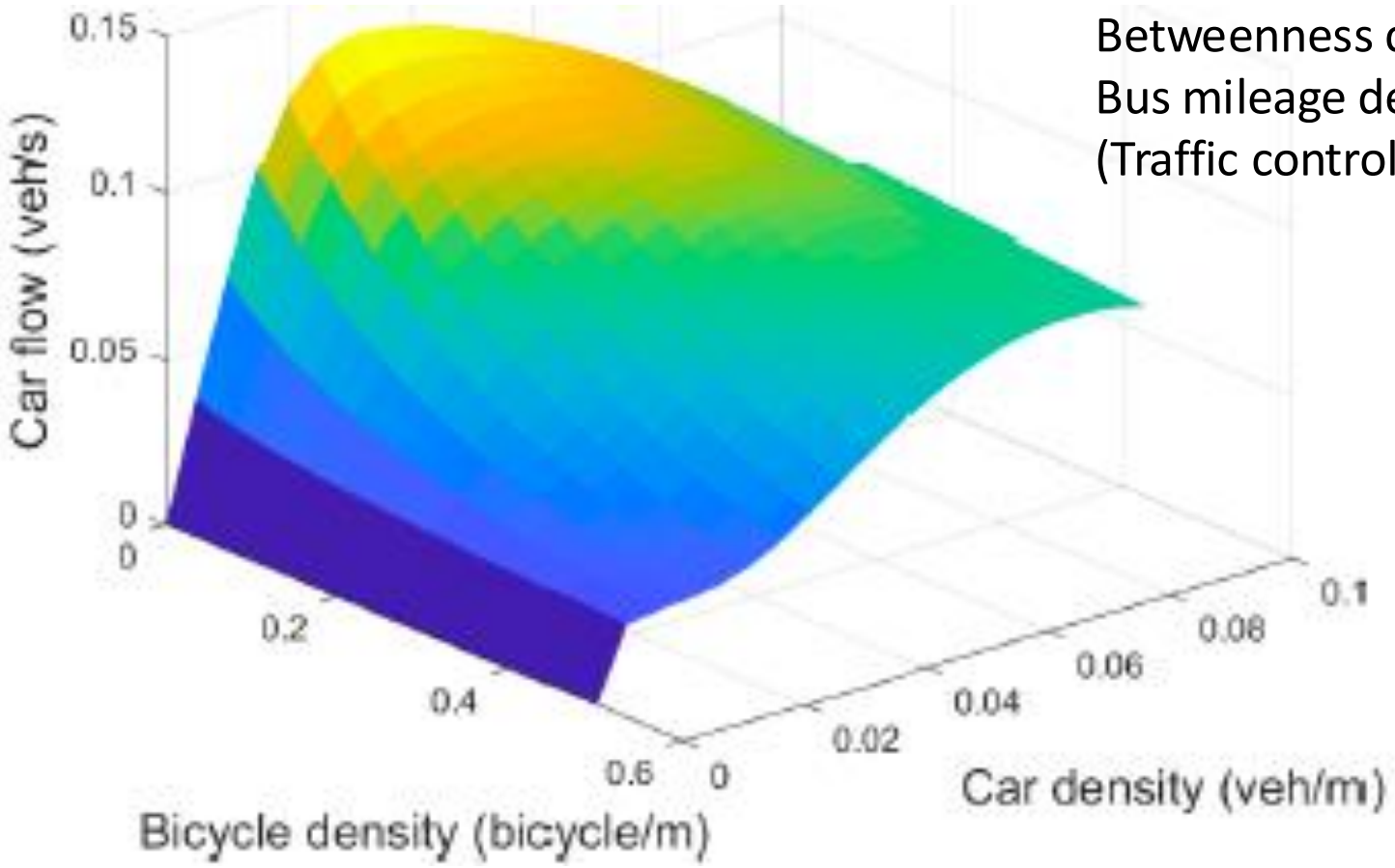
# Past radical dreams: Buchanan's two-level central London




Source: Buchanan Report (1963)

# Can we escape? Nearly fixed urban network capacity =

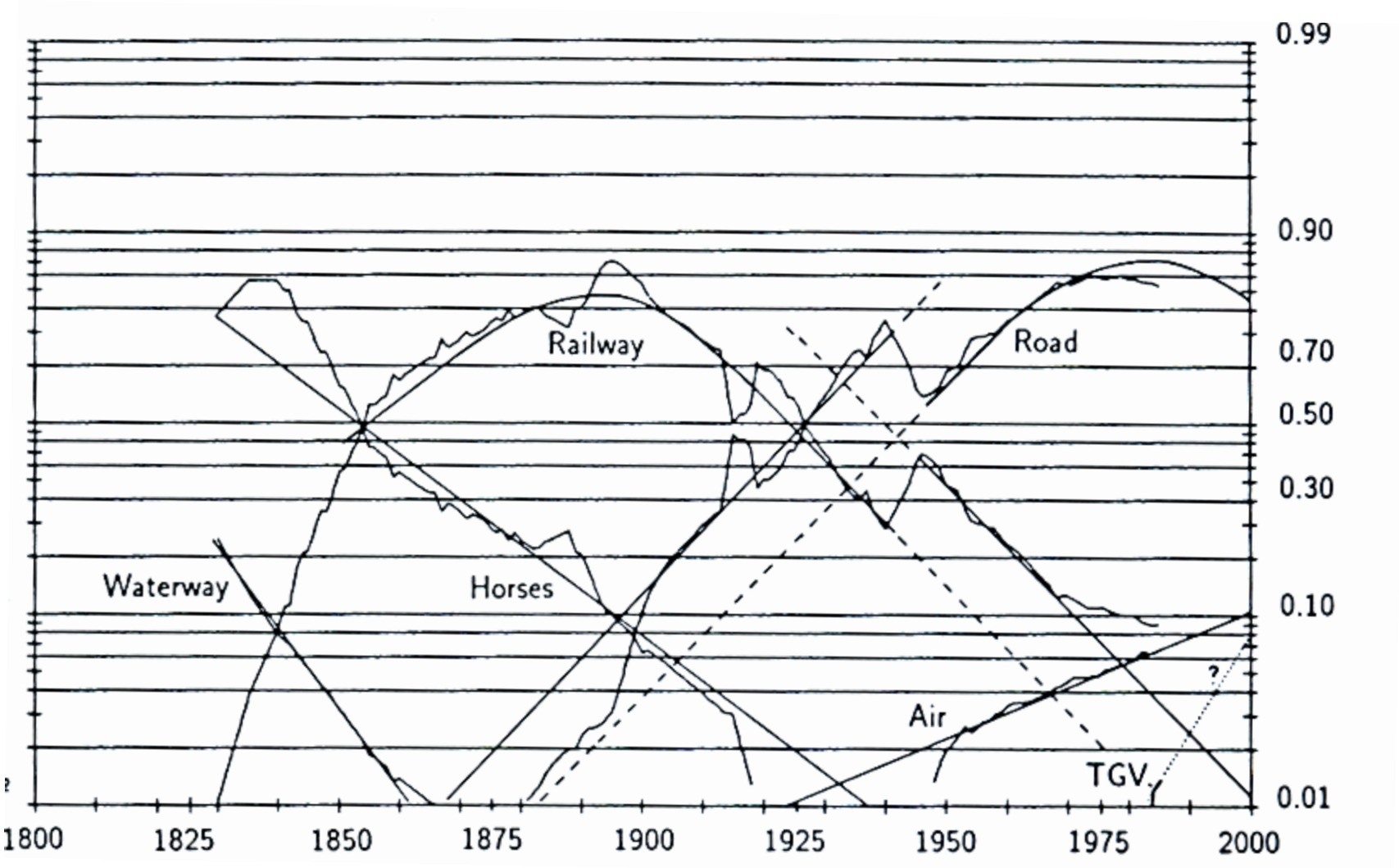
Junction density,
Lane miles density
Betweenness centrality,
Bus mileage density
(Traffic control)




Source: Loder,, Ambühl, Menendez, Axhausen, 2015

# Ways out ?

# History: Modal split in France (all distance bands)




Source: Grübler (1998) S.209

# Which visions are we discussing?

# A managed/co-ordinated one

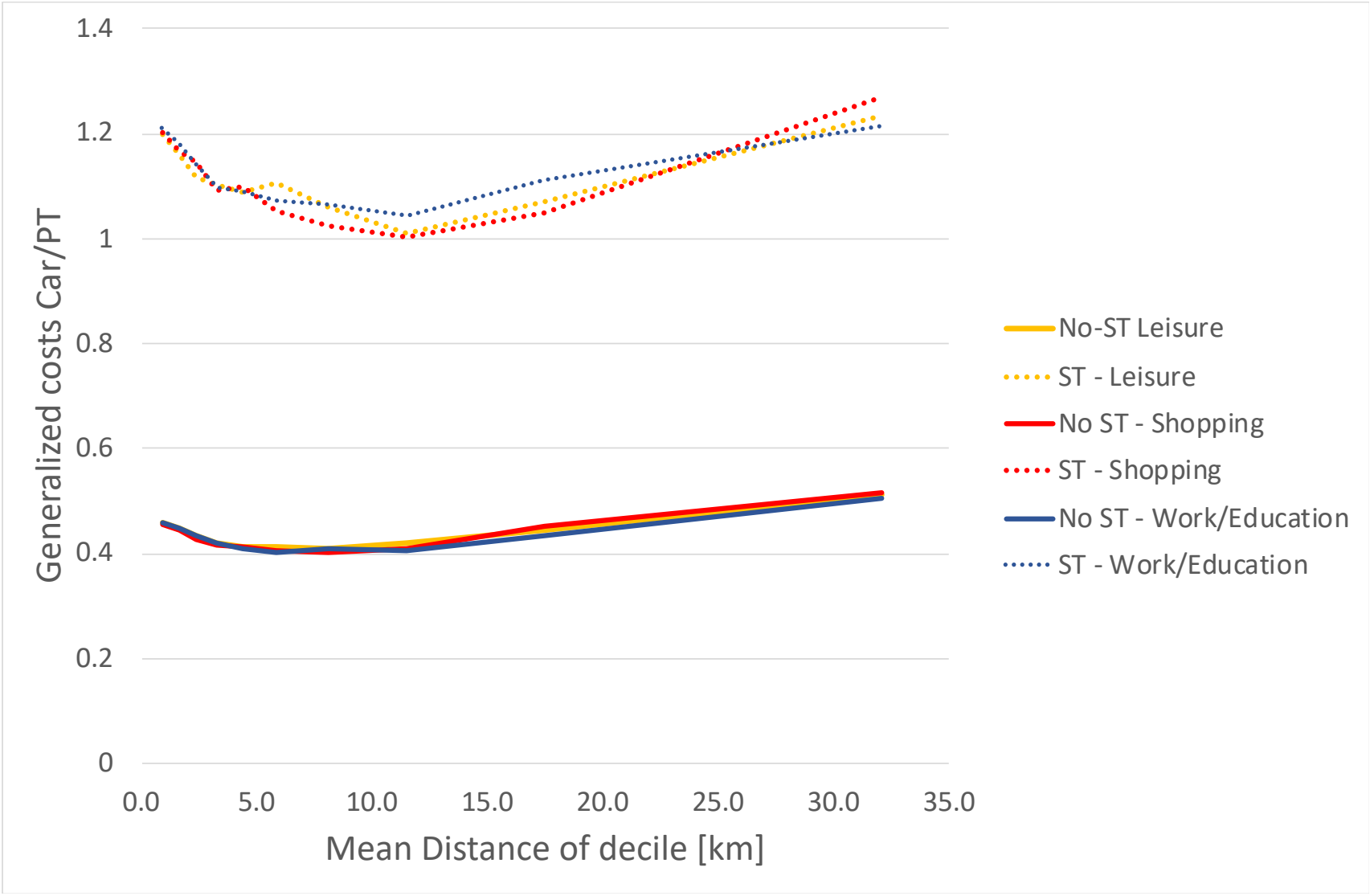
# A managed/co-ordinated one: Pricing

- *Mobility pricing*
  - Two-part tariffs for infrastructure
    - Option fee
    - Pay-as-you-go for usage
  - Congestion pricing
  - (Demand responsive) parking pricing
  - GHG ($CO_2$) pricing
  - Local emissions pricing

# A managed/co-ordinated one: Public transport

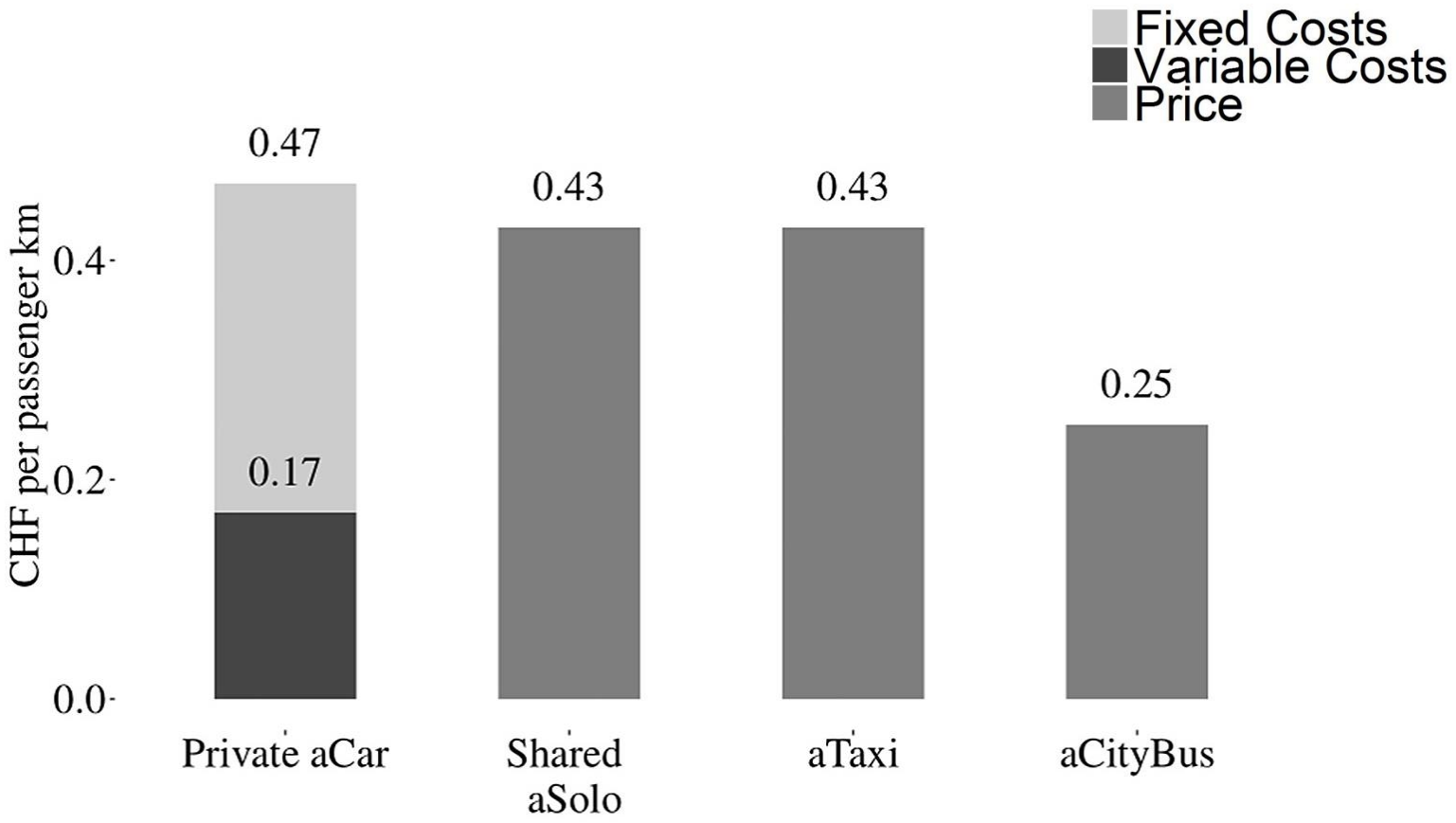
- MaaS improved shared mobility with
  - Demand responsive pricing

# A managed/co-ordinated one? Comparison of MOBIS GC



# An automated one?  First robust cost estimates

# Structure of the pkm full costs for today's usage levels




Source: Bösch, Becker, Becker and Axhausen (2017)

# An electrical autonomous one,

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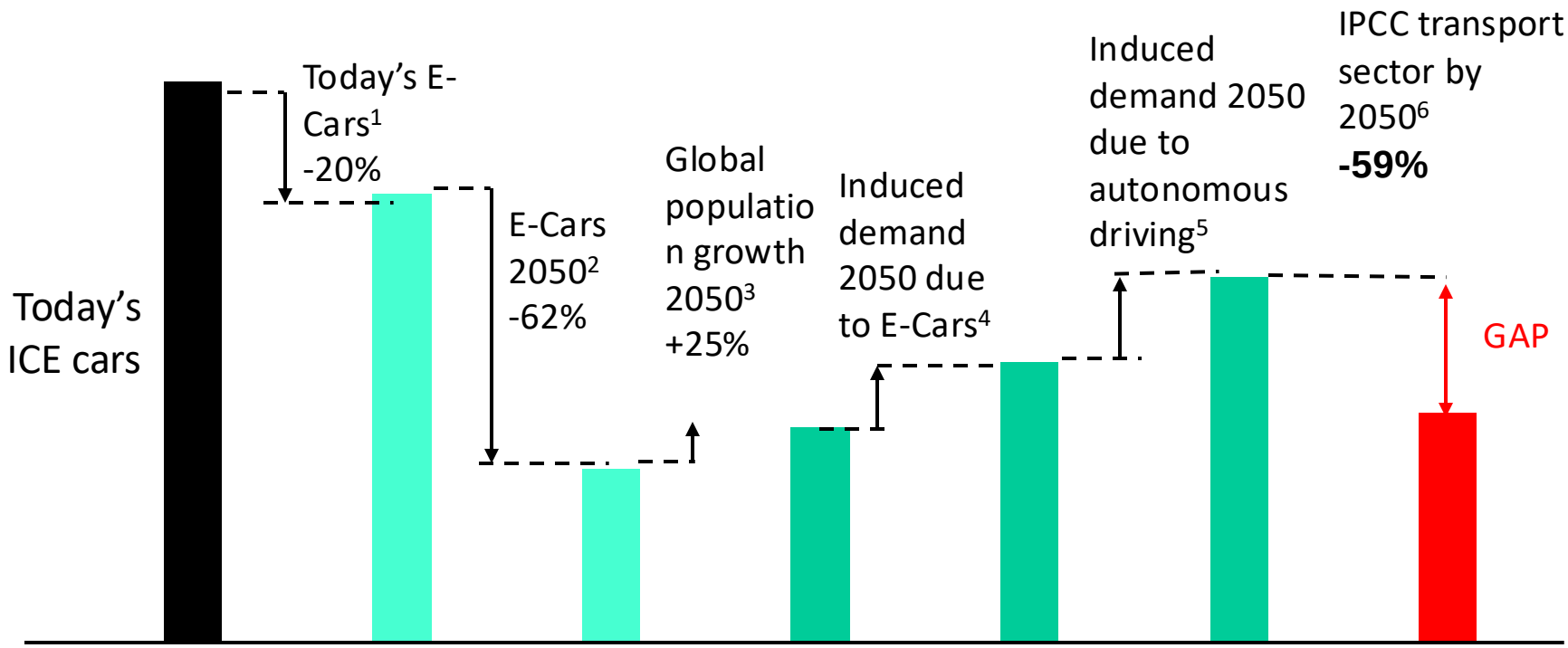


Source: Livingston (2022)

Note: These are optimistic estimates of how many CO2 emissions can be avoided through technology.

# A car free/reduced one,

# A car free/reduced one,

- a 15 min city ?
- a net-zero $CO_2$ city ?
- an e-Bike city ?

# An e-bike city?

# The idea of an e-bike city

- e-bike/transit are the core modes of the city / metro area
- 50% of road space for slow vehicles (e-bike, bike etc.)
- Integration with shared services for large demands and demand variations
- Maintaining of current accessibility levels (for all)

# EBikeCity: A first visualisation

Source: Nightnurse for ebikecity

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Source: Nightnurse for ebikecity

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# The idea of an e-bike city: A brief video

# How to asses these changes?

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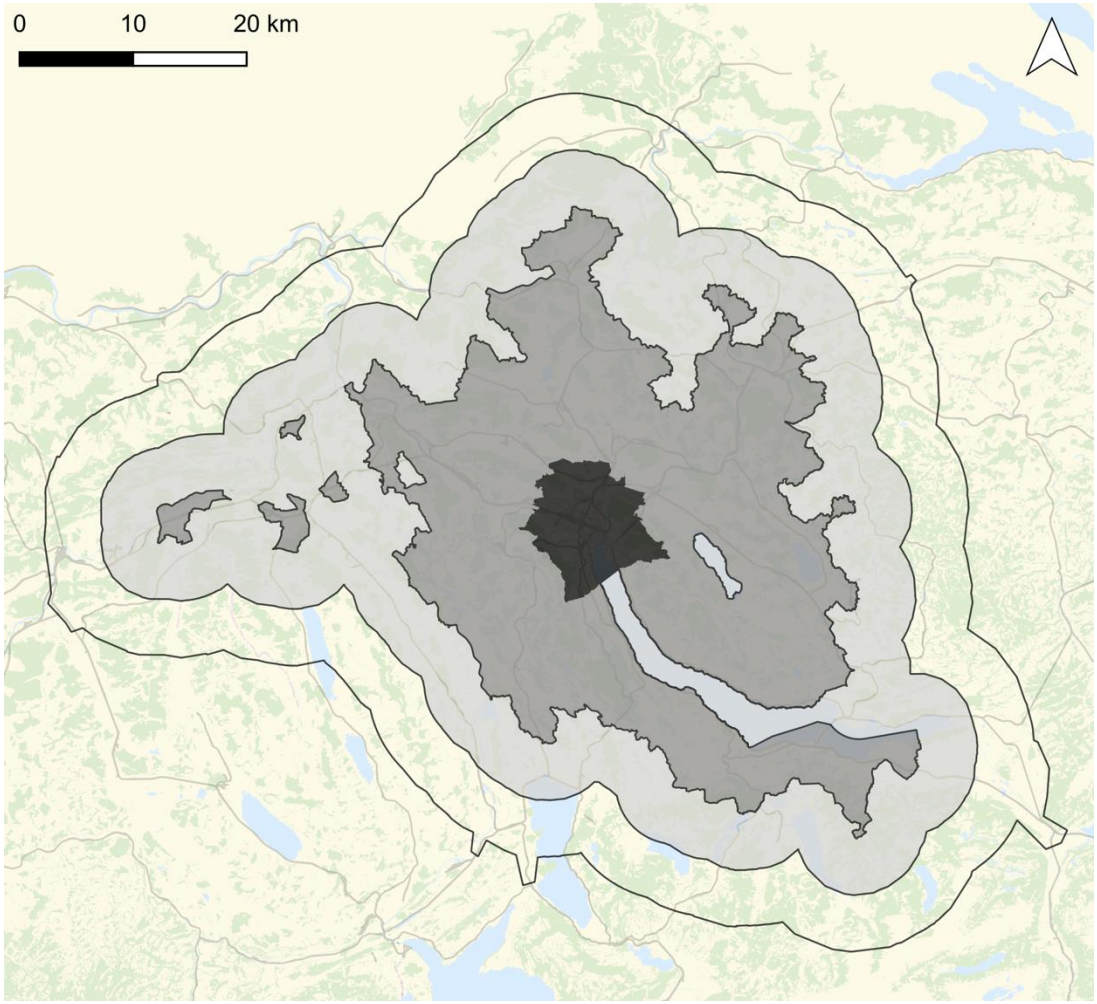
- MATSim
- Agent-based co-evolutionary equilibrium
- Open-source (Github) (linkedIn)
- Core: Mode, destination, route, on-demand services

# Study area




City of Zurich | Entire Perimeter | Synthetic Population | Transport Network

Source: Ballo and Axhausen, 2024

# Network stats after SNMan redesign

| Metric | | Today | ebikecity | Change |
|---|---|---|---|---|
| avg shortest path for cars | km | 5.463 | 7.412 | 35.7% |
| avg shortest path for bicycles | km | 5.391 | 5.334 | -1.1% |
| avg shortest path for bicycles with VoD indicators | km | 4.824 | 3.661 | -24.1% |
| avg norm. betweenness centrality for cars | - | 0.00506 | 0.01303 | 157.5% |
| avg normalized betweenness centrality for bicycles | - | 0.00367 | 0.00354 | -3.5% |
| road space general travel lanes | $km^2$ | 3.7564 | 2.0257 | -46.1% |
| road space parking | $km^2$ | 0.8040 | 0.2188 | -72.8% |
| road space dedicated public transport lanes | $km^2$ | 0.3962 | 0.3962 | 0.0% |
| road space cycling infrastructure | $km^2$ | 0.6816 | 3.1340 | 359.8% |

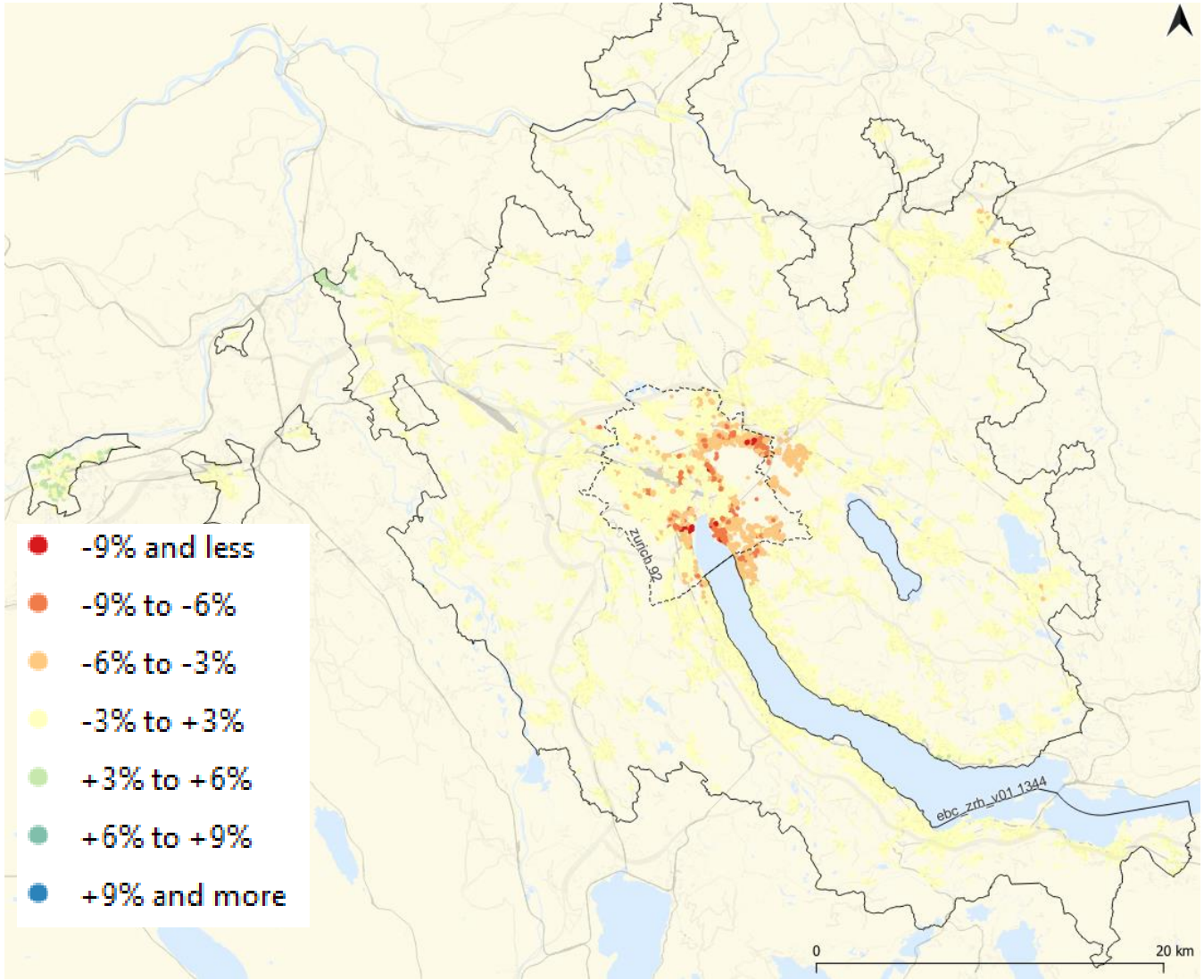
Source: Ballo and Axhausen, 2024

# Comparison with MATSim & current mode choice

| Metric | | | Before reallocation | | After reallocation | | Relative difference (%) |
|---|---|---|---|---|---|---|---|
| | | | All trips | Start/End within City of Zurich | All trips | Start/End within City of Zurich | All trips |
| Mode share (trip-based) | Car | % | 31.56 | 21.62 | 30.03 | 16.12 | -4.85 |
| | Public transport | % | 17.90 | 34.42 | 18.54 | 36.62 | +3.58 |
| | Bike | % | 9.38 | 9.95 | 10.27 | 13.34 | +9.49 |
| Mode share (pkm-based) | Car | % | 48.82 | 37.67 | 47.59 | 34.03 | -2.52 |
| | Public transport | % | 24.94 | 41.35 | 25.85 | 43.03 | +3.65 |
| | Bike | % | 4.43 | 4.96 | 4.93 | 6.70 | +11.29 |
| Person-km | Car | $x10^6$ | 37.35 | 7.62 | 37.51 | 7.40 | +0.44 |
| | Public transport | $x10^6$ | 19.08 | 8.37 | 20.37 | 9.36 | +6.78 |
| | Bike | $x10^6$ | 3.39 | 1.00 | 3.89 | 1.46 | +14.78 |

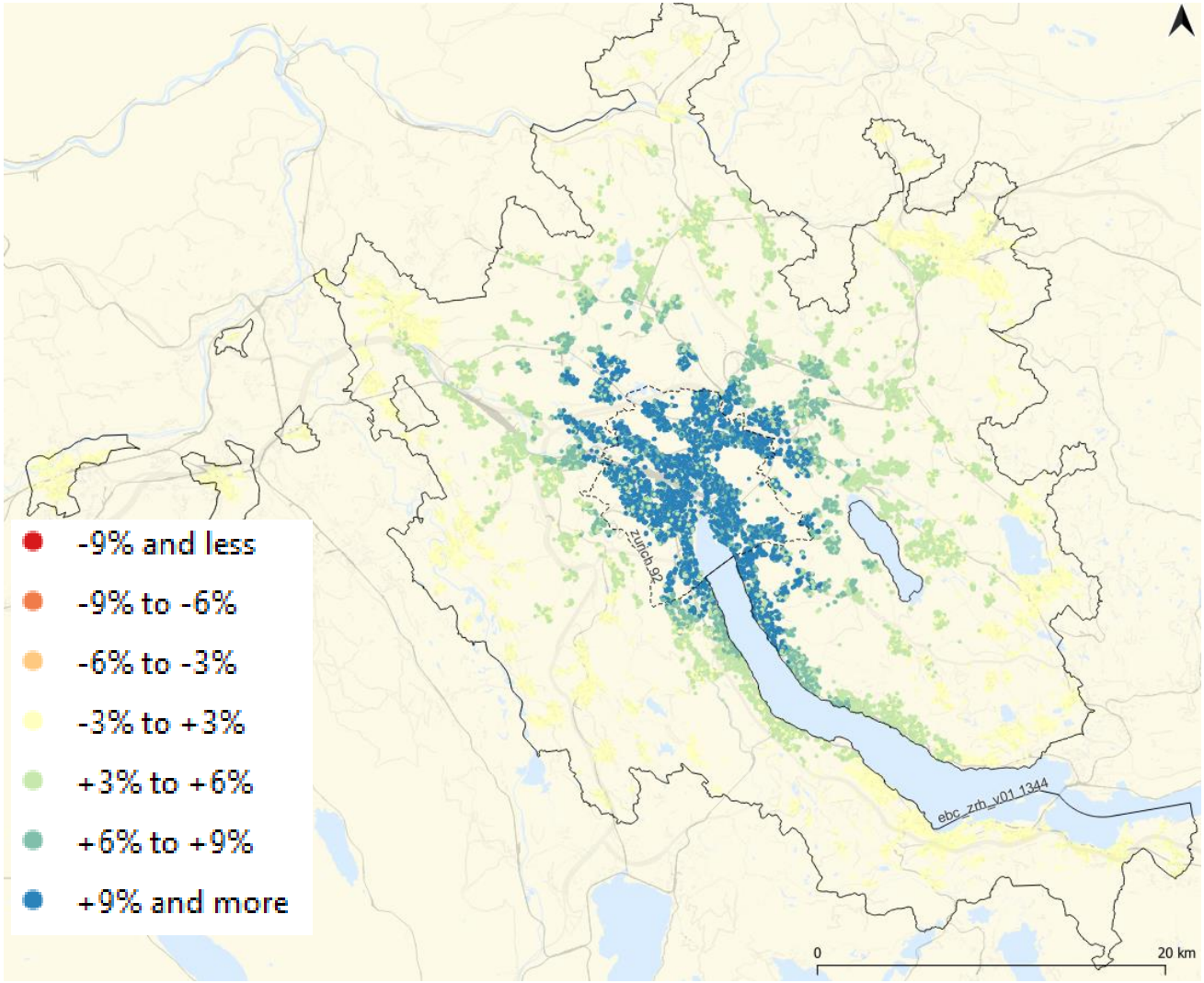
Source: Ballo and Axhausen, 2024

# Car accessibilites




Source: Ballo and Axhausen, 2024

# Bike accessibilites




Source: Ballo and Axhausen, 2024

# How to asses these changes?

- Changes in activity schedules
- Current mode choice ?
- SP mode choice ?

- How to integrate “Working from home”?
- How to integrate e-shopping ?

- Mobility impaired (who, where, how much are they impaired)

# Short term loosers & winners

- Future generations
- Current and future cyclists and micro-mobility
- Current and future pedestrians
- (Urban public transport users – fewer stops, more services & lines)
- Urban residents (and property owners)

- Mobility impaired

- (Poor) suburban in-commuters
- Urban car users
- (Urban consumers)

## Questions?

- www.ivt.ethz.ch
- ebikecity.baug.ethz.ch/
- ebis.ethz.ch/

- www.ebikecity.ch

# Selection of relevant IVT papers


- Ballo, L., L. Meyer de Freitas, A. Meister and K.W. Axhausen (2023) The E-Bike City as a radical shift towards zero-emission transport: Sustainable? Equitable? Desirable?, *Journal of Transport Geography*, **111**, 103663.
- Ballo, L., A. Sallard, L. Meyer de Freitas and K.W. Axhausen (2024) Is "small" infrastructure the next factory for accessibility? Evaluating the regional accessibility effects of a cycling-centric transport policy in Zurich, *Arbeitsberichte Verkehrs- und Raumplanung*, 1888, IVT, ETH Zurich, Zurich.
- Heinonen, S., A. Meister, L. Meyer de Freitas, L. Schwab, J. Roth, T. Götschi, B. Hintermann and K.W. Axhausen (2023) The e-biking in Switzerland (EBIS) study: Methods and dataset, paper presented at the *102nd Annual Meeting of the Transportation Research Board (TRB 2023*), Washington, D.C., January 2023.
- Meyer de Freitas, L. and K.W. Axhausen (2023) Evaluating willingness-to-pay for cycling infrastructure in Switzerland, paper presented at the 7th Annual Meeting of the Cycling Research Board (CRBAM), Wuppertal, October 2023.
- Meyer de Freitas, L. and K.W. Axhausen (2024) The influence of individual physical capabilities for cycling adoption: Understanding its influence and mode-shift potentials, *Transportation Research Part A: Policy and Practice*, **185**, 104105.