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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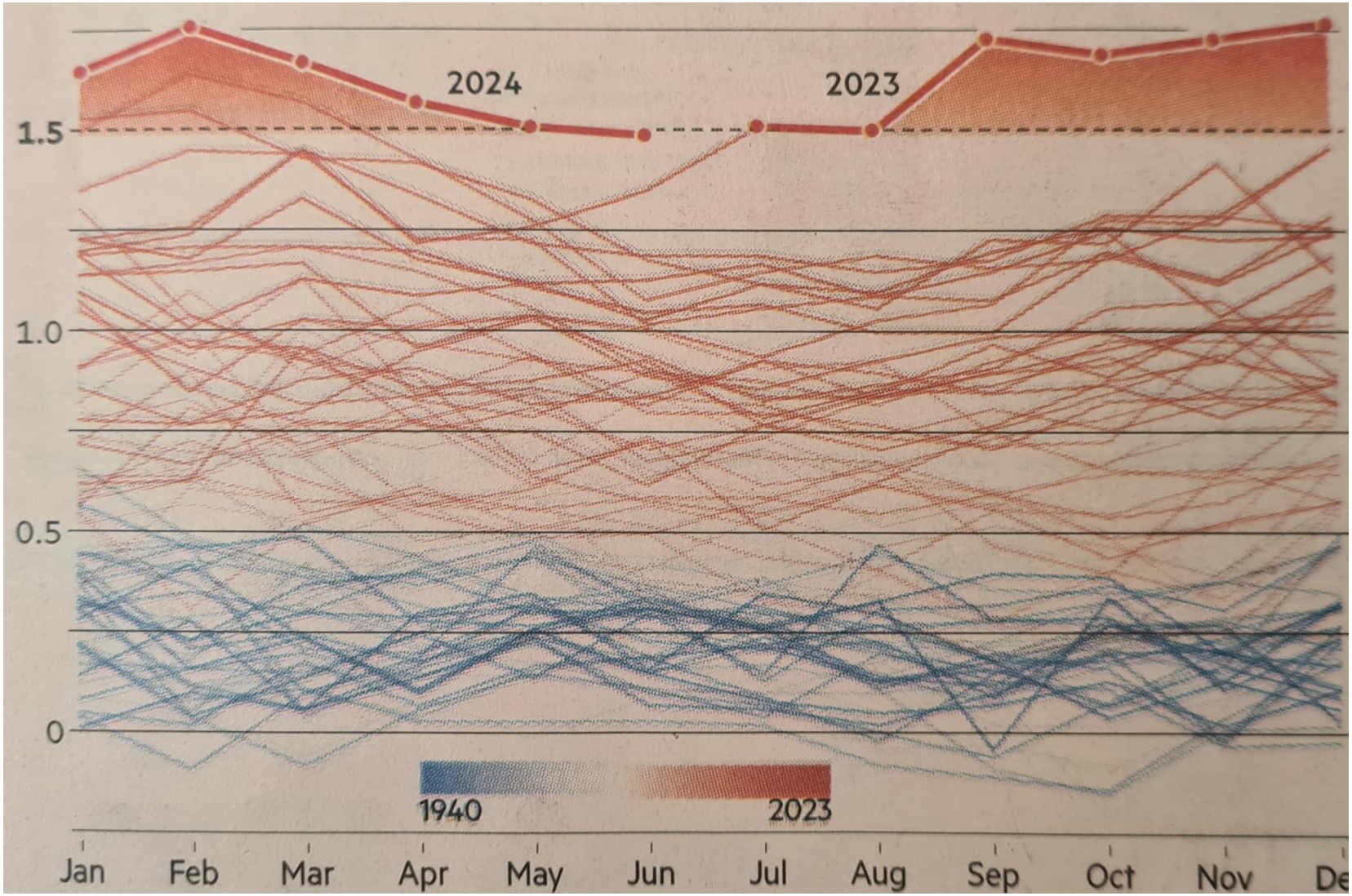


Source: Financial Times, 13.7.2024

Visions, academic visions ?

Visions, academic visions for (local) authorities ?

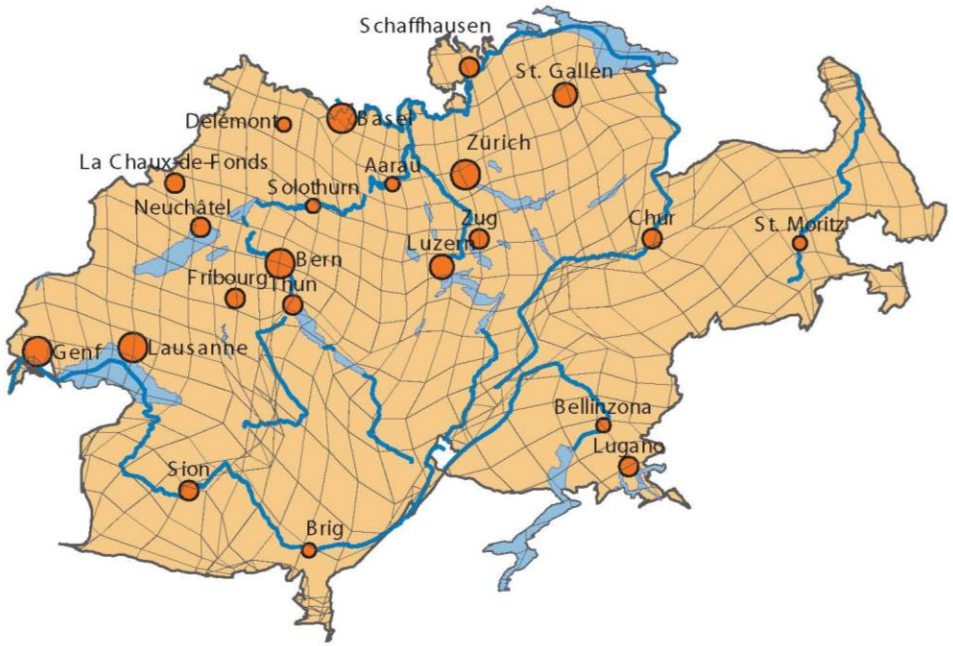
	Algorythm	Object
Idea	Developer/academic	Designer
Prototype	First coder	Workshop/engineer
Product	Software engineer	Factory/team
Transmission	Consultant	Firm
Filter	Advisor	Advisor
Decision shaper	Executive	Excutive
User/ decision maker	Sovereign	Sovereign

Dilemma of transport planning as understood today

Shrinking "road" – Switzerland (1950)

Scherer, 2004

Shrinking "road" – Switzerland (2000)



Scherer, 2004

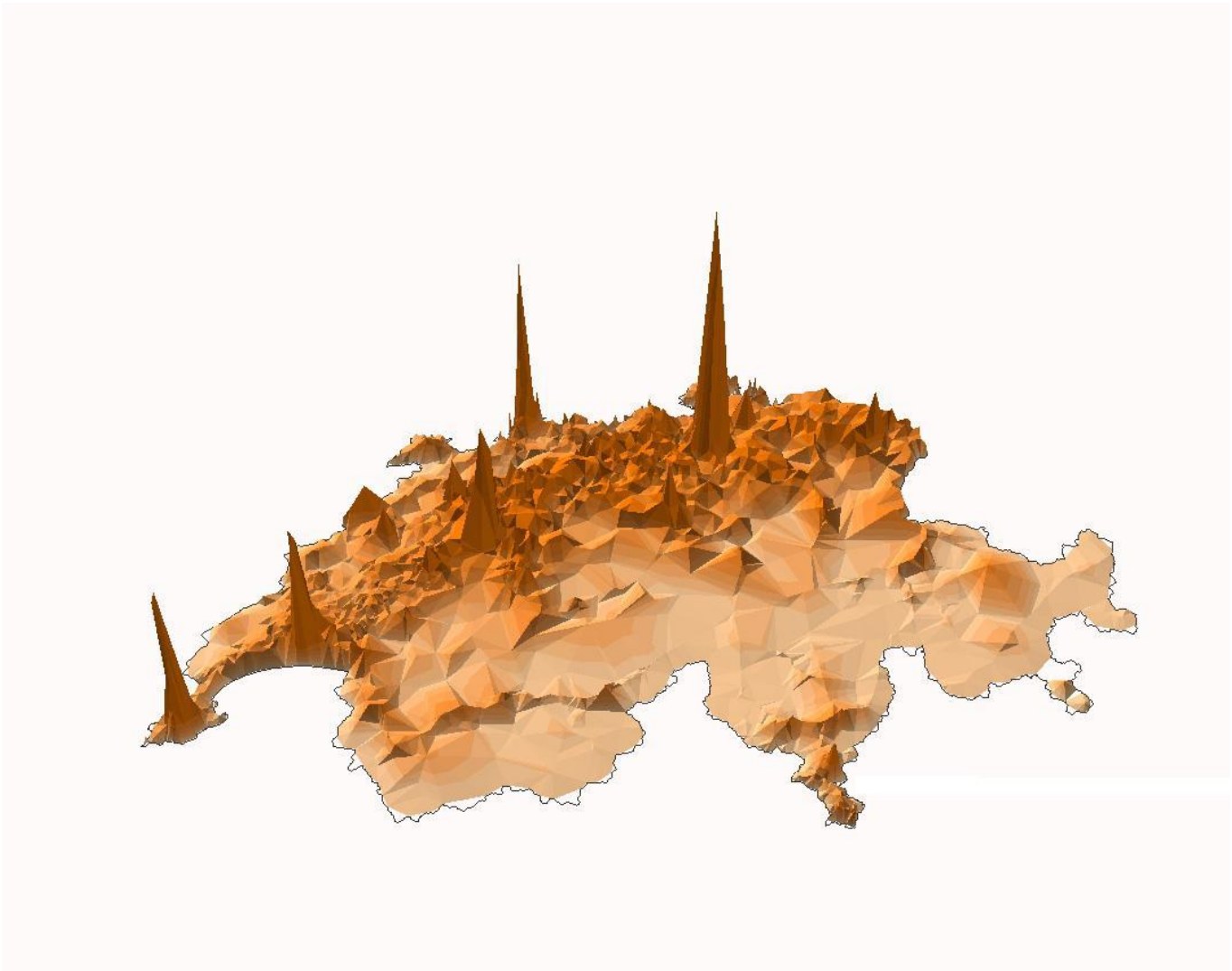
Calculation of Hansen-accessibility (log sum)

Calculation of Hansen-accessibility

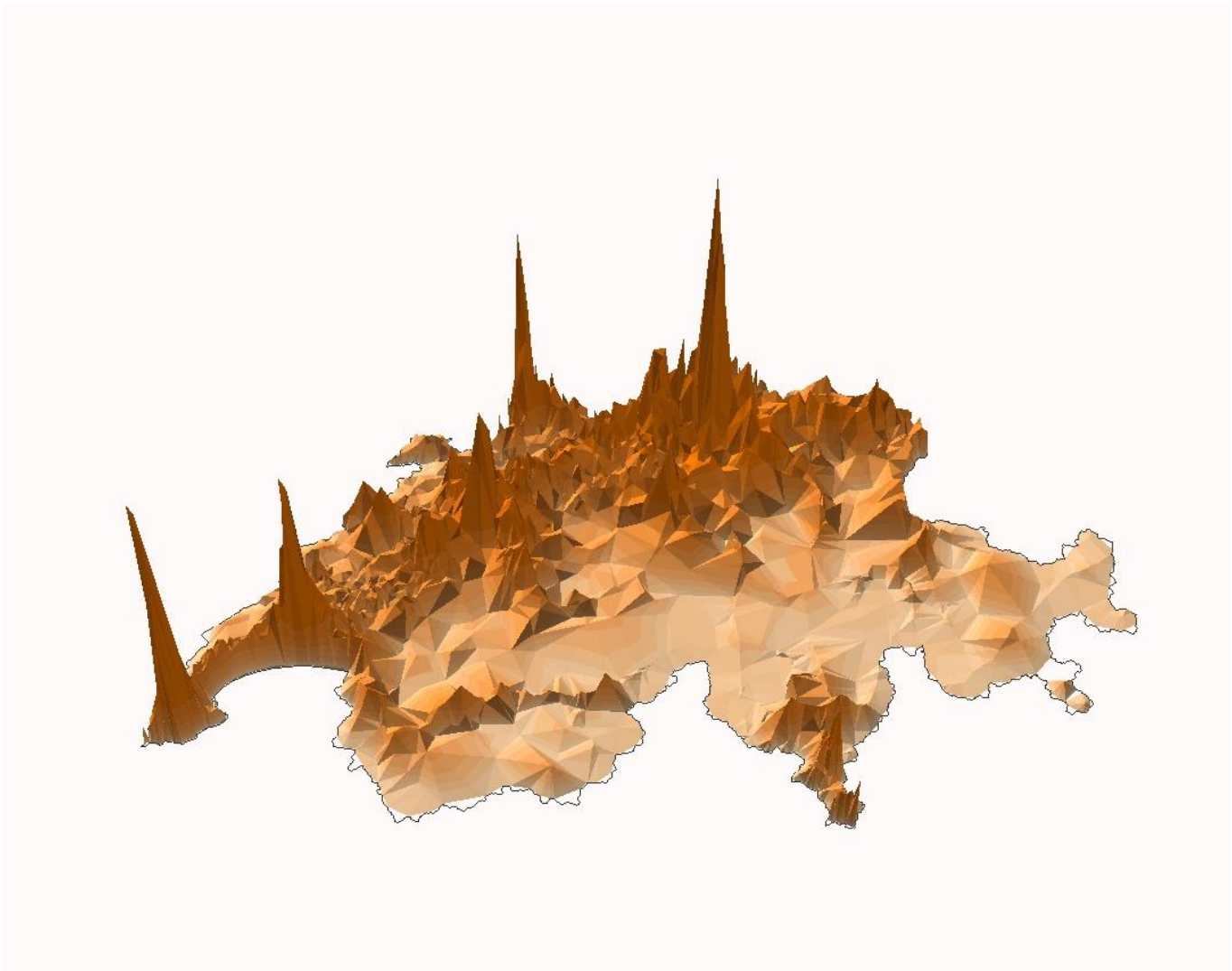
$$E_i = \sum_{k_{ij}=0}^{k_{ij} < k_{\max}} X_j \, f(k_{ij})$$

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)

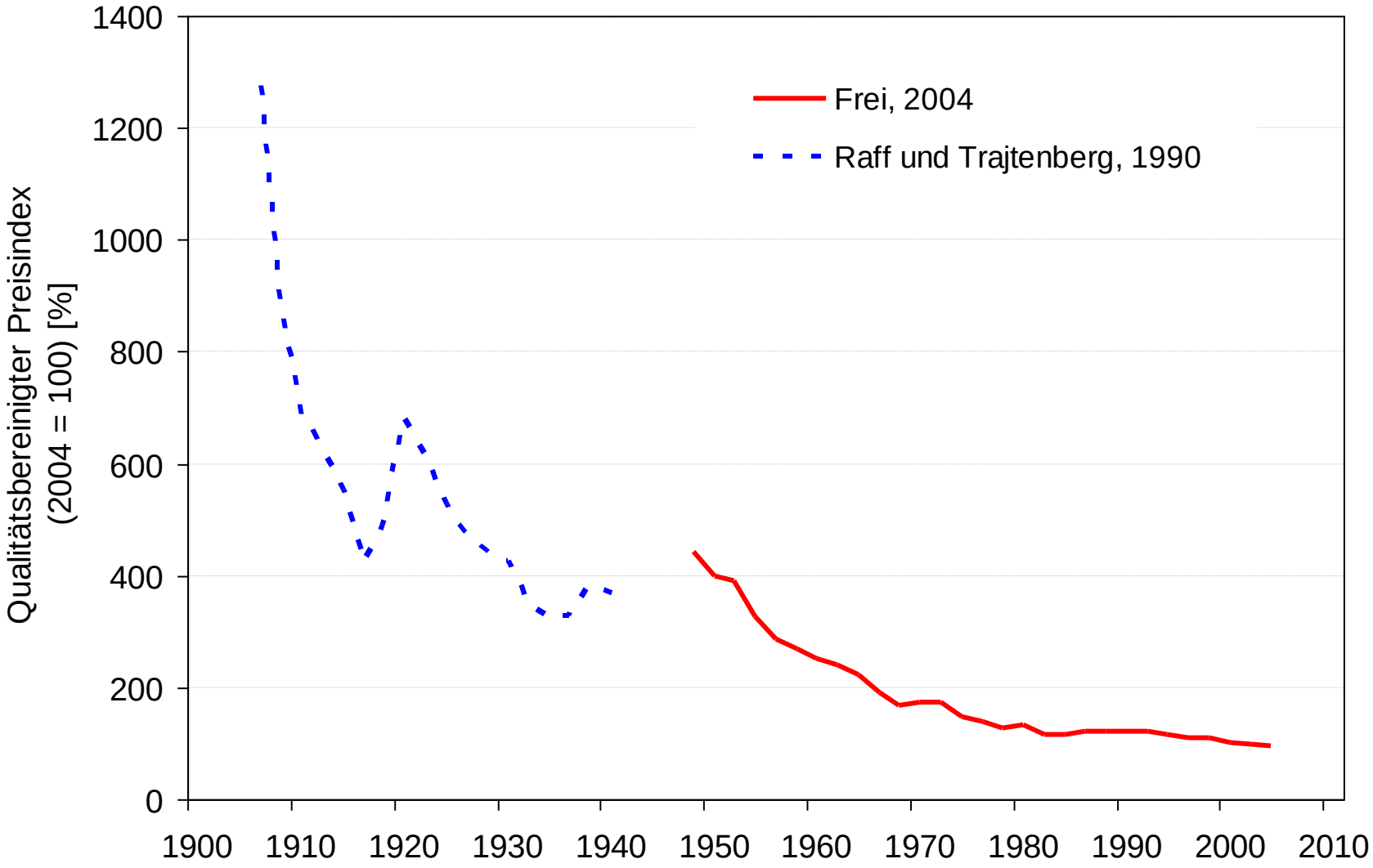


Hansen-accessibility – roads (1950)(2000)



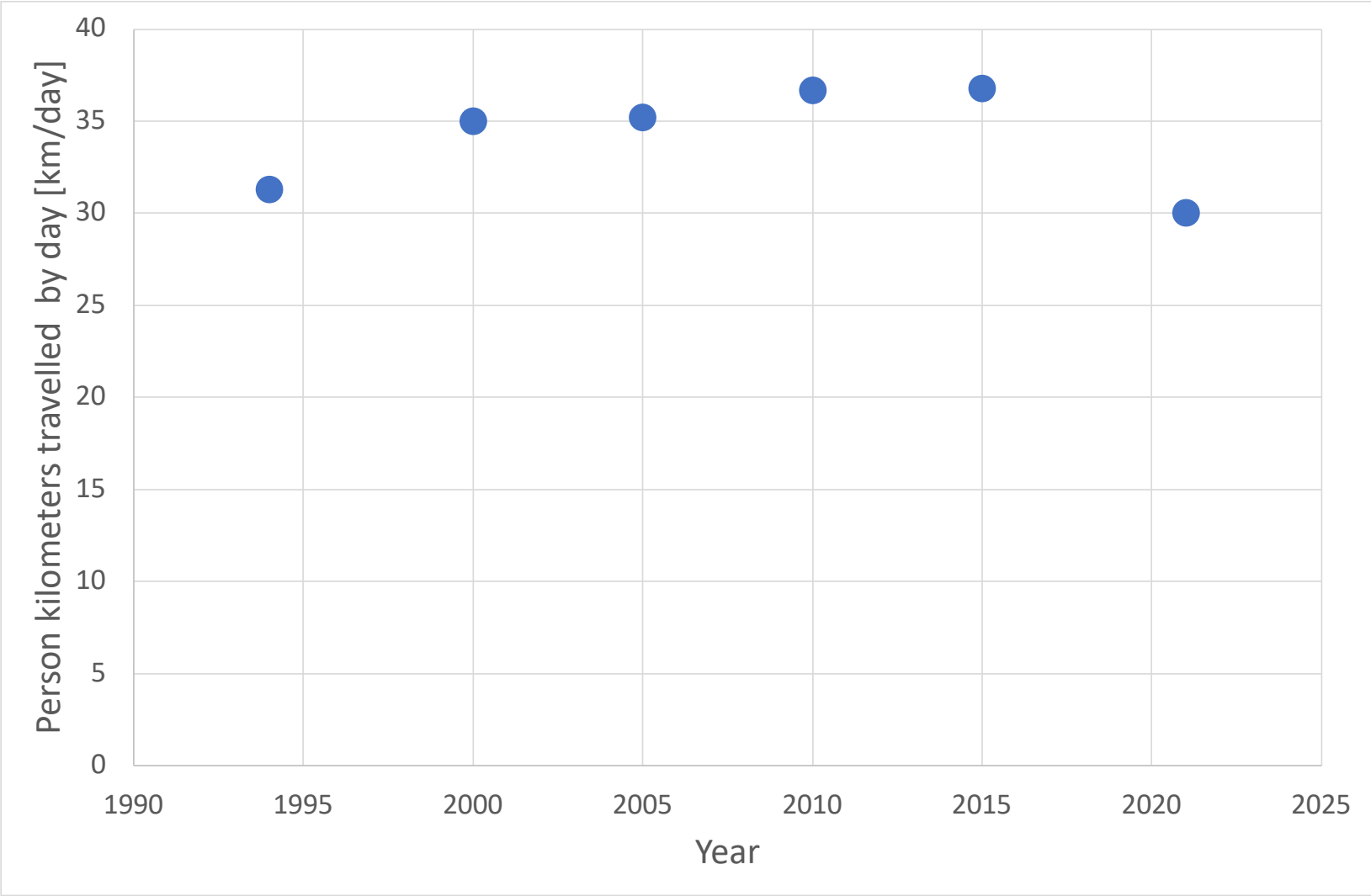
Impacts

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



Source: Frei (2005)

Switzerland: Pkm change since the MZ 1994



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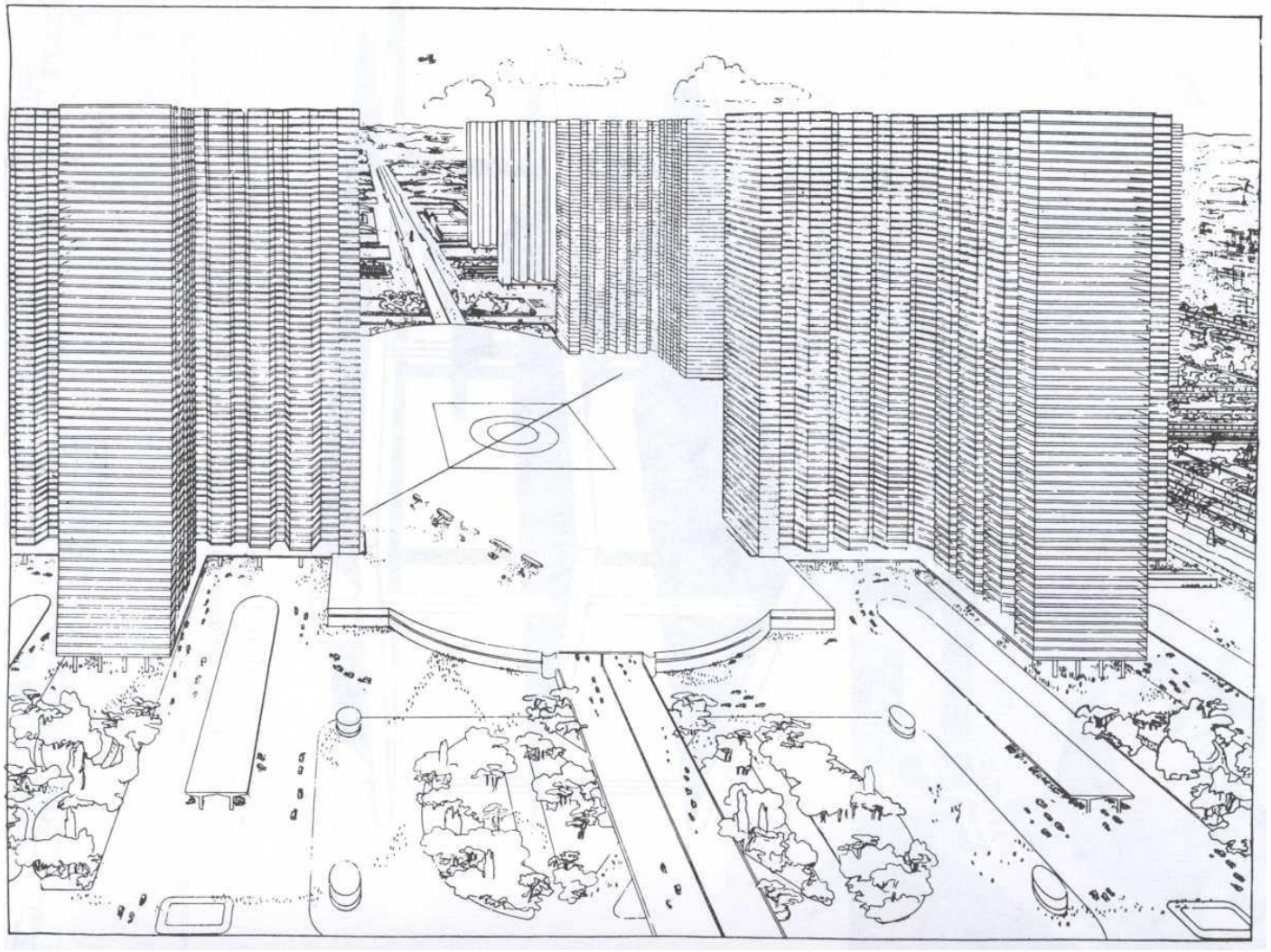
Dilemma today

- Higher accessibility improves productivity and increases social capital

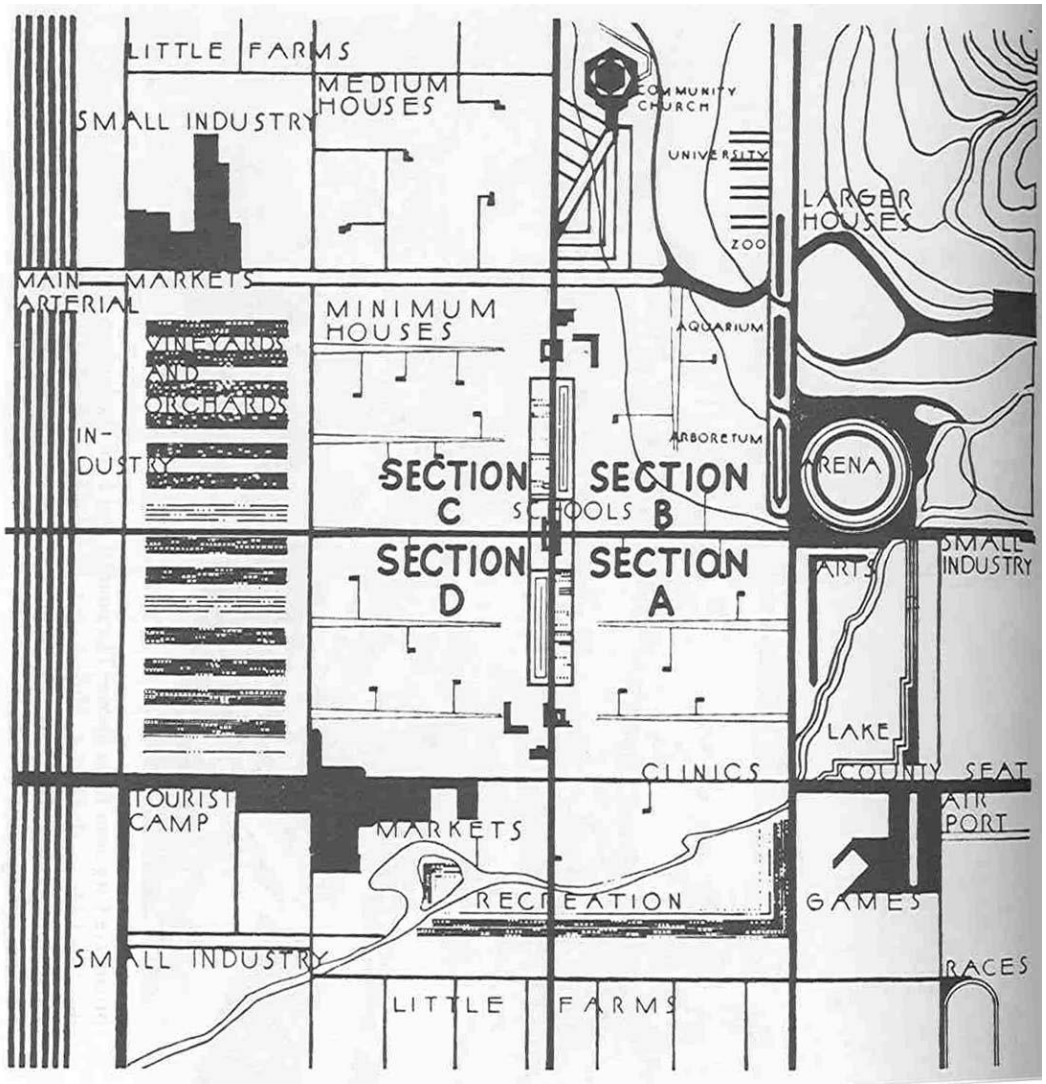
- Higher accessibility (lower generalised cost) increases
  - car ownership
  - transport demand and with it
    - GHG emissions
    - Congestion
  - encourages WFH (and lower transit use)
  - invites sprawl

What were the past visions ?

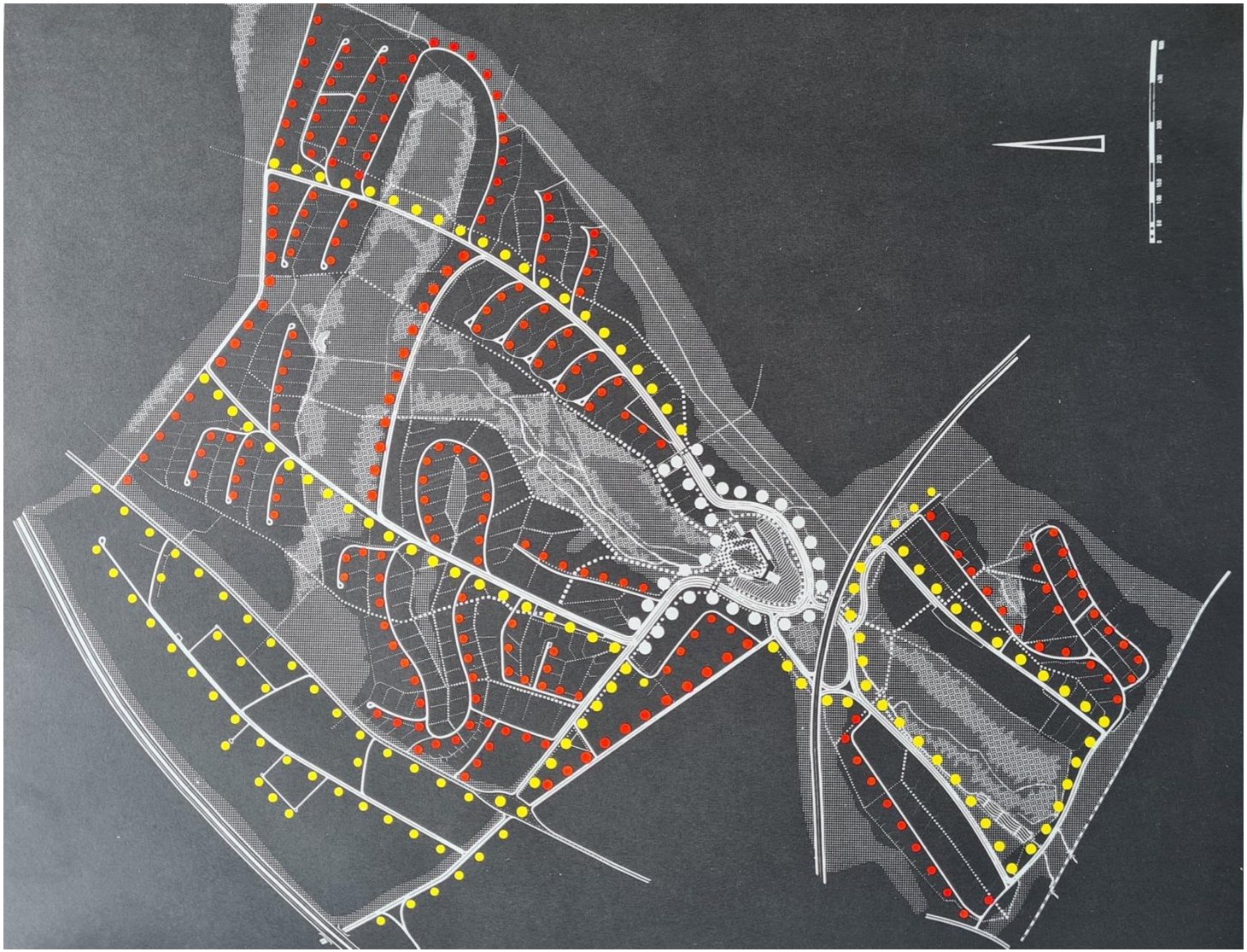
Radical dreams: Le Corbusier's City radieuse



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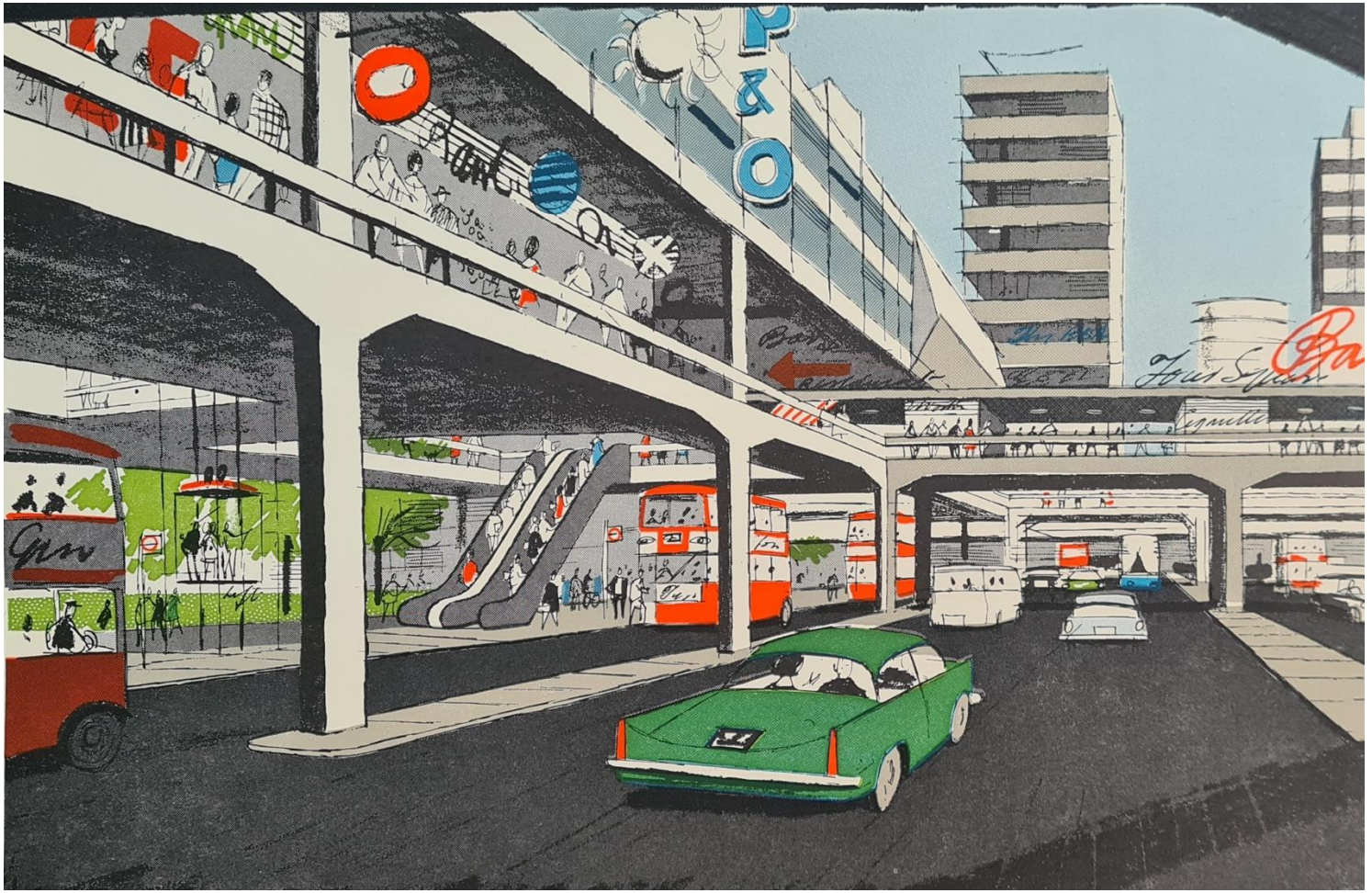
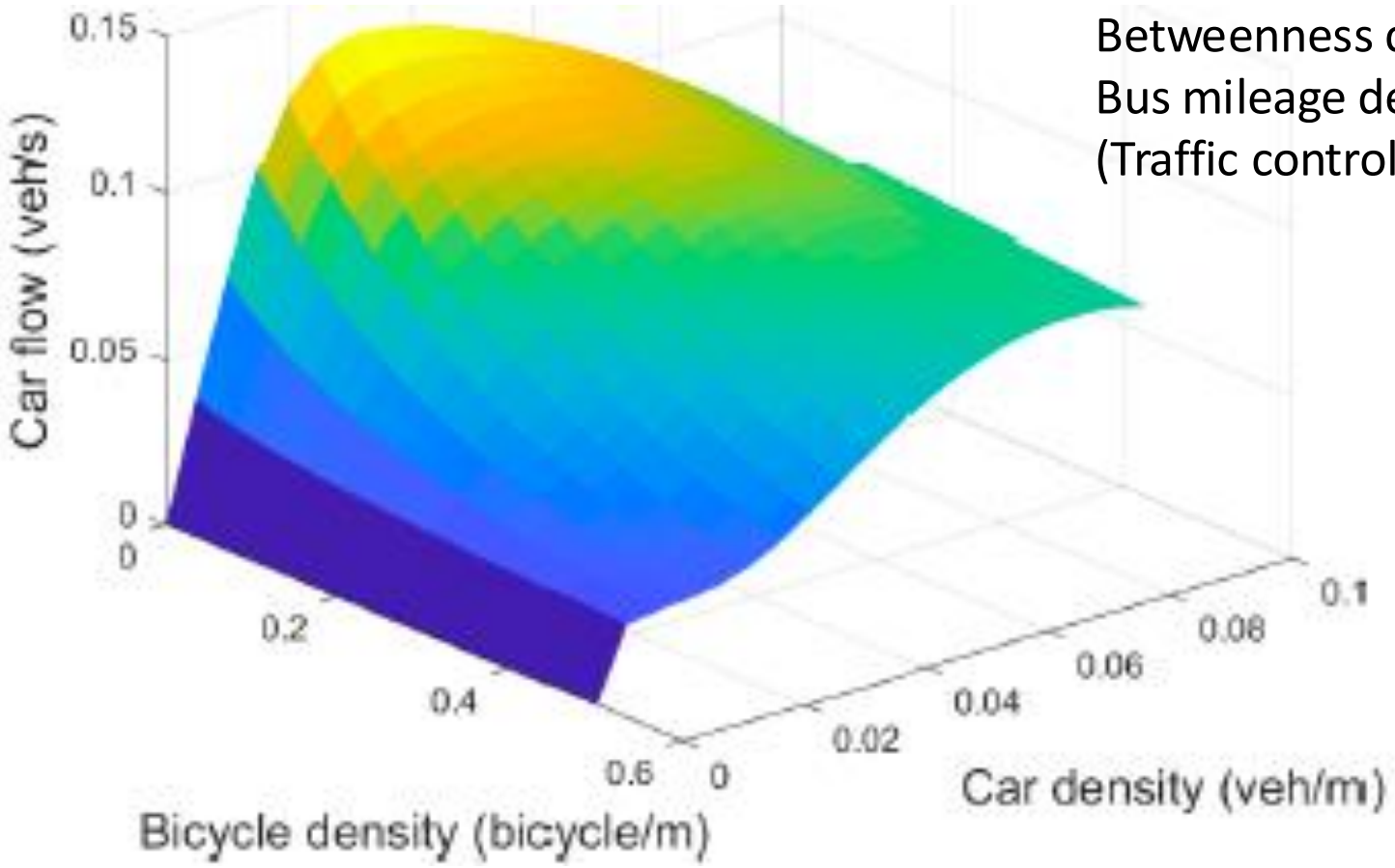
Past radical dreams: Buchanan's two-level central London



Source: Buchanan Report (1963)

Can we escape? Nearly fixed urban network capacity =

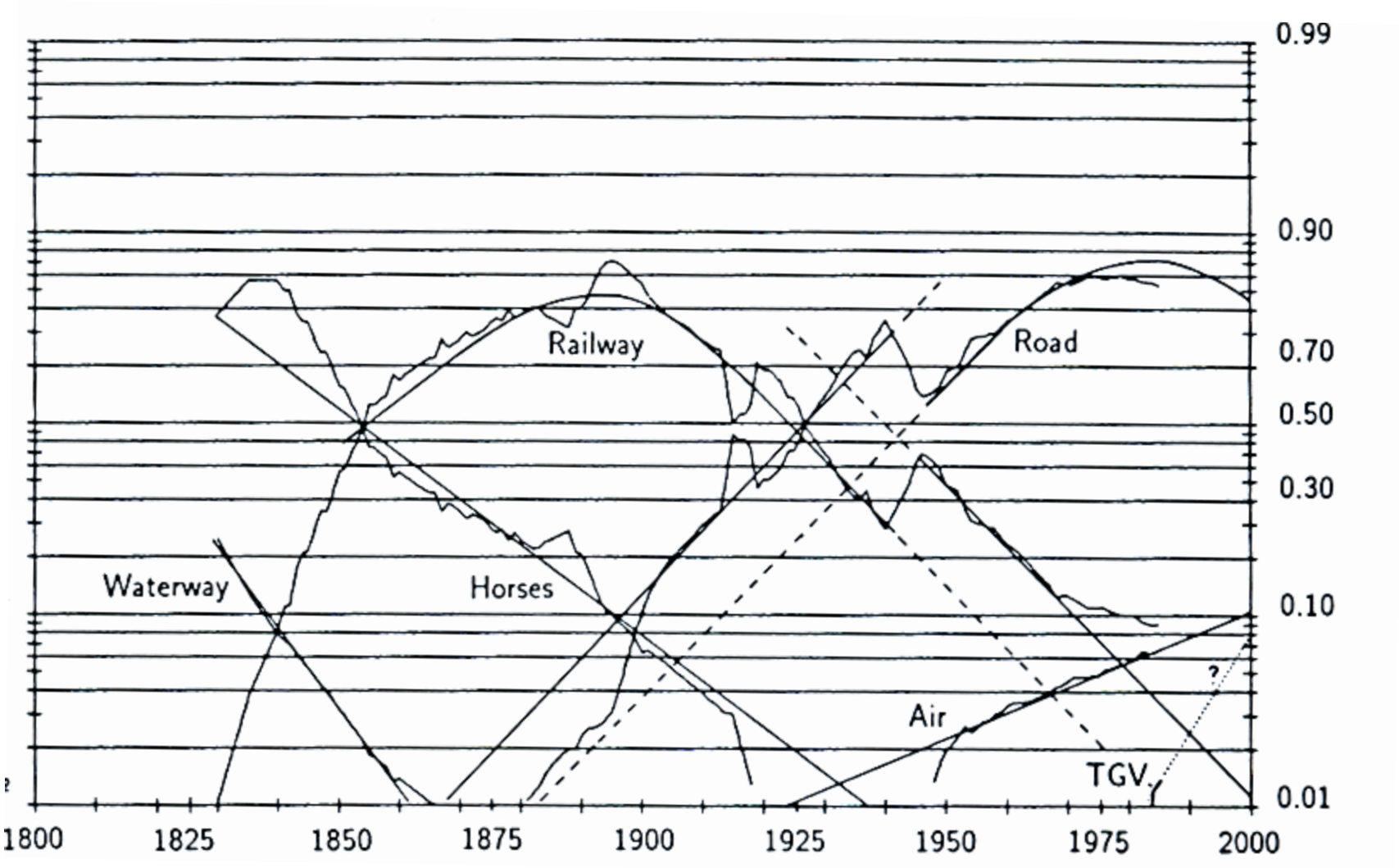
Junction density,
Lane miles density
Betweenness centrality,
Bus mileage density
(Traffic control)



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

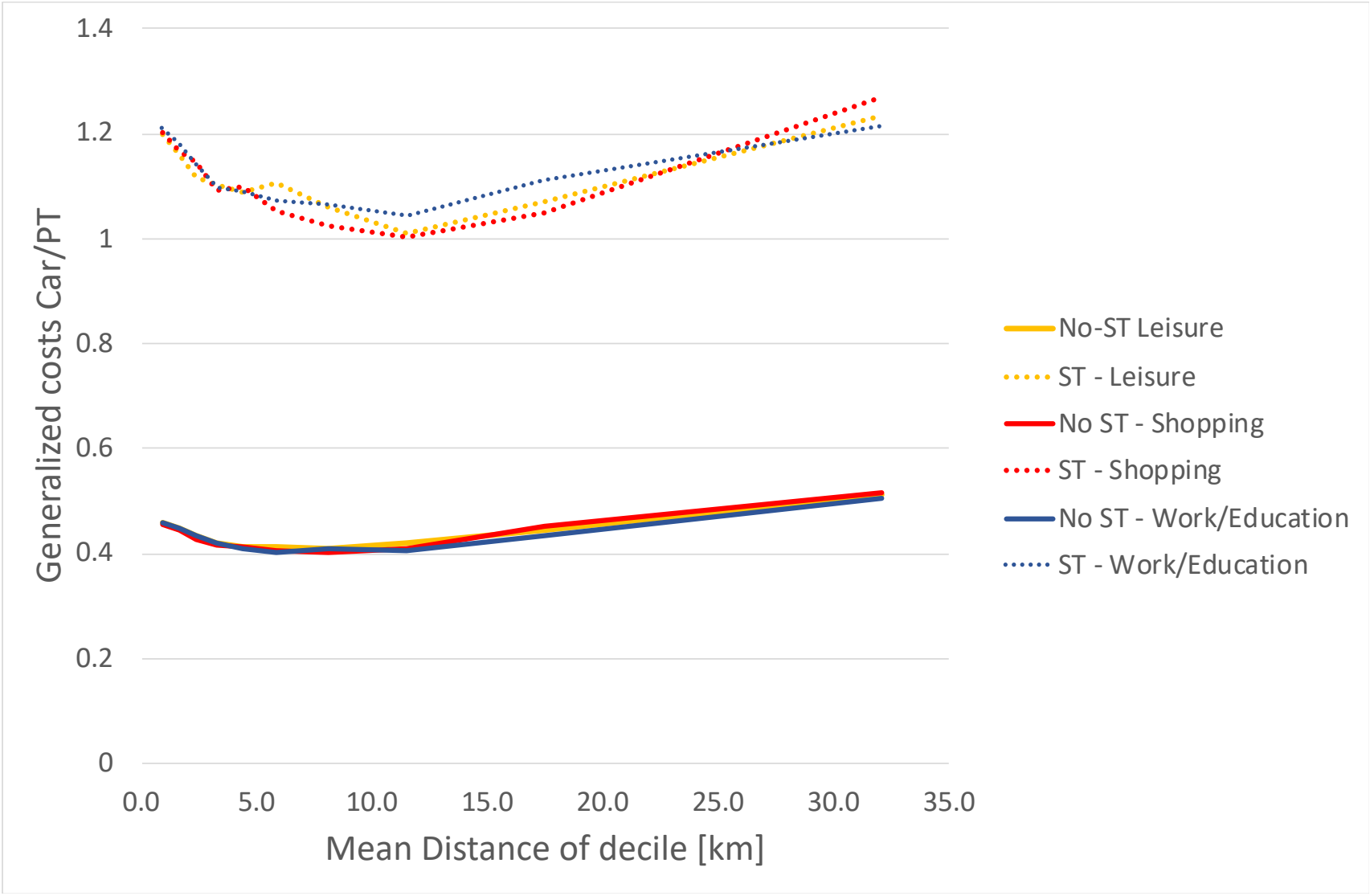
A managed/co-ordinated one: Pricing

- *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

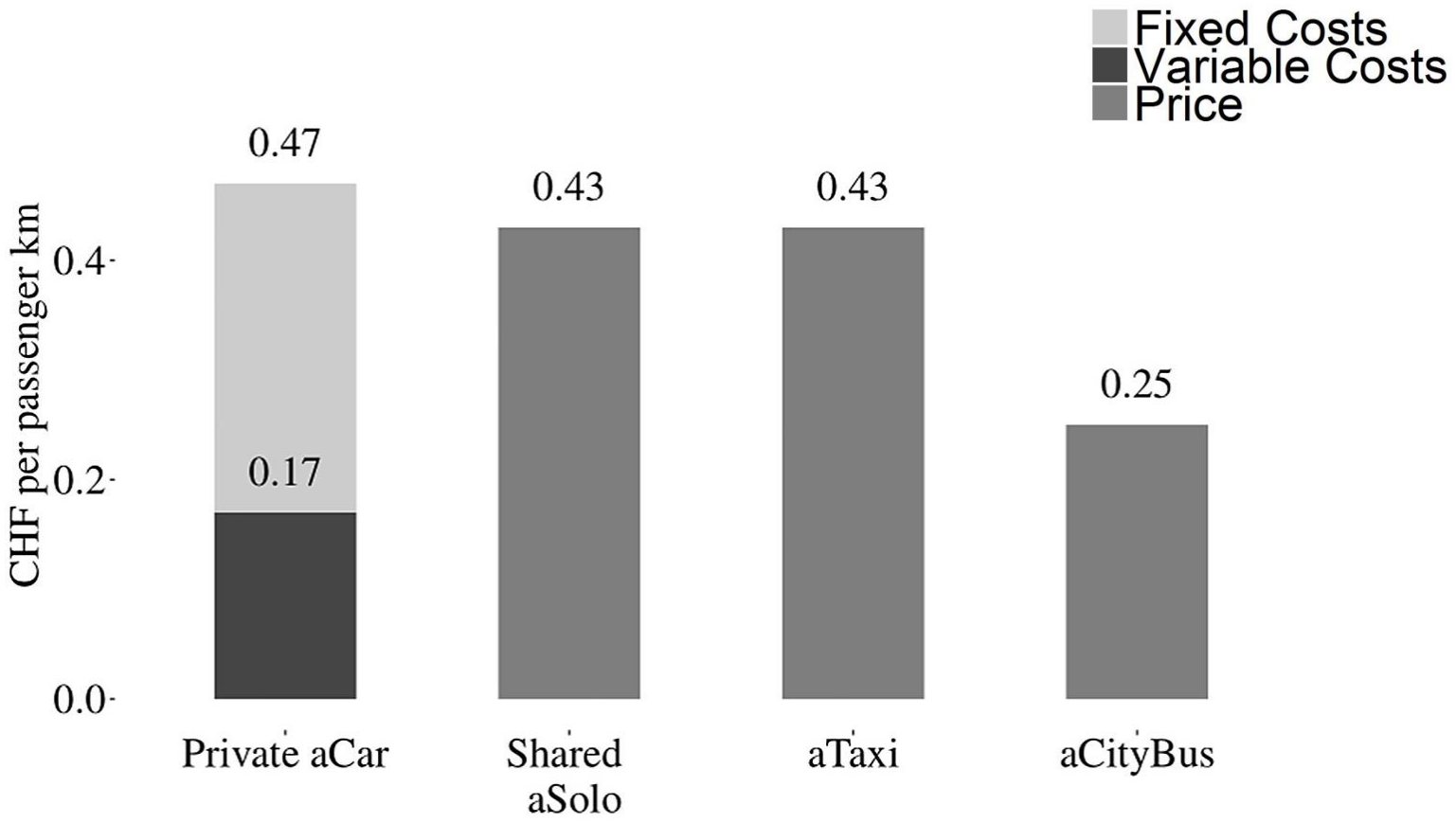
- MaaS improved shared mobility with
  - Demand responsive pricing

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



An automated one? First robust cost estimates

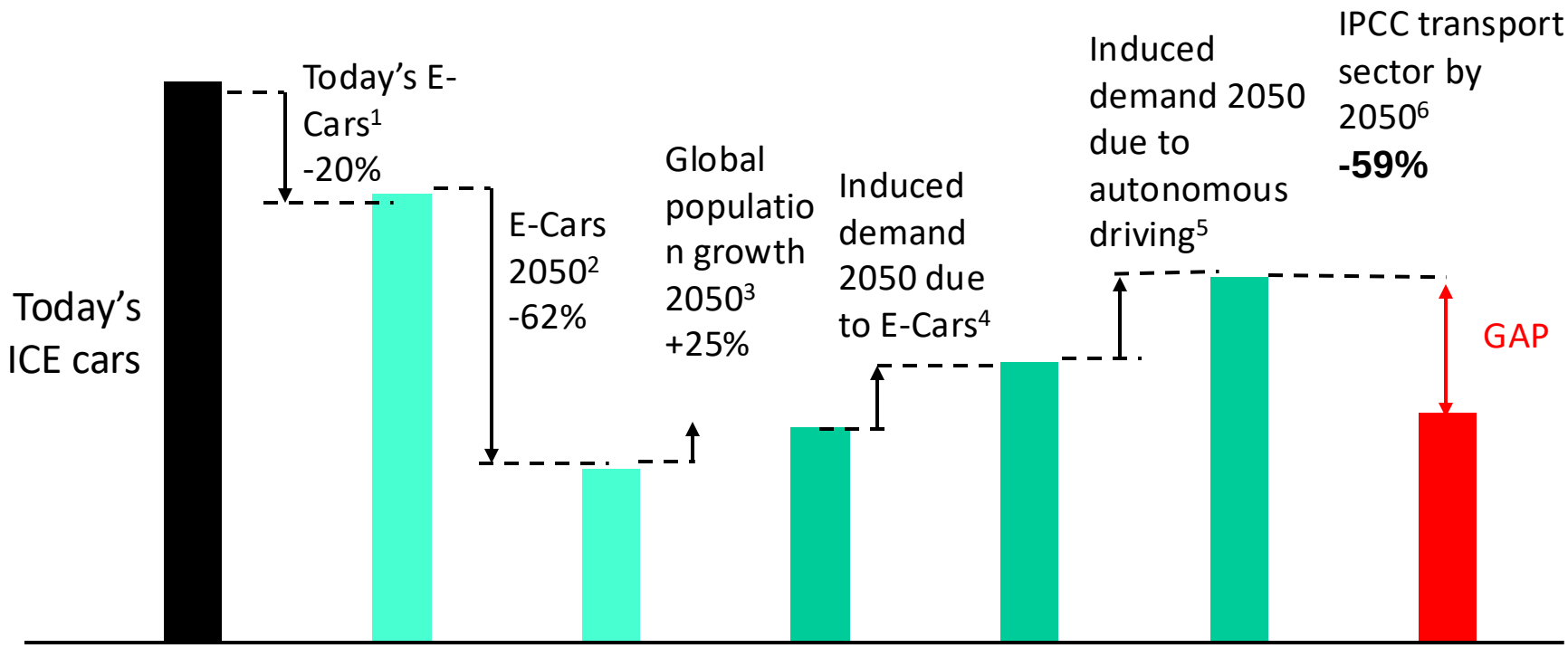
Structure of the pkm full costs for today's usage levels



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

An electrical autonomous one,

An electrical autonomous one,



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

EBikeCity: A first visualisation

Source: Nightnurse for ebikecity

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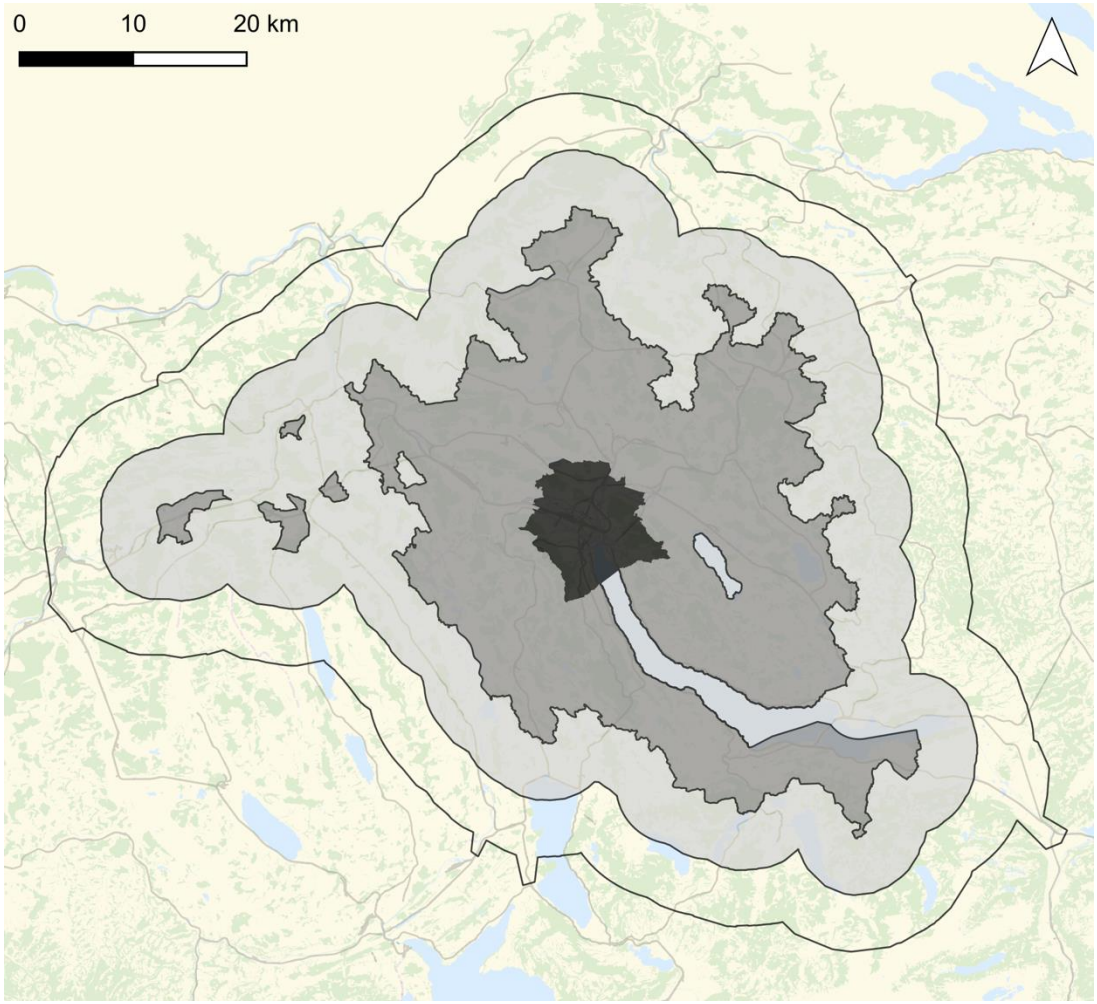
The idea of an e-bike city: A brief video

How to asses these changes?

How to asses these changes?

- 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%

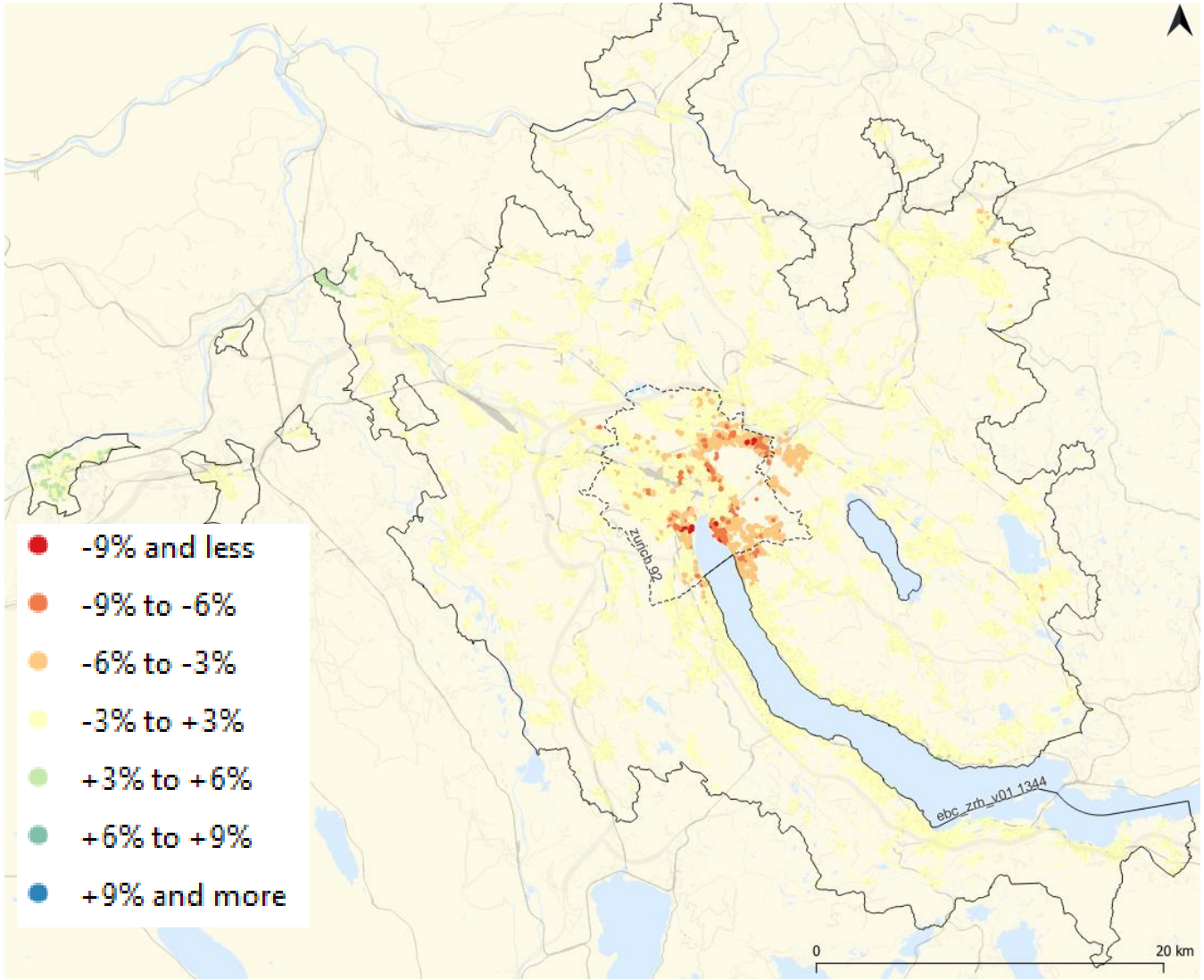
Source: Ballo and Axhausen, 2024

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

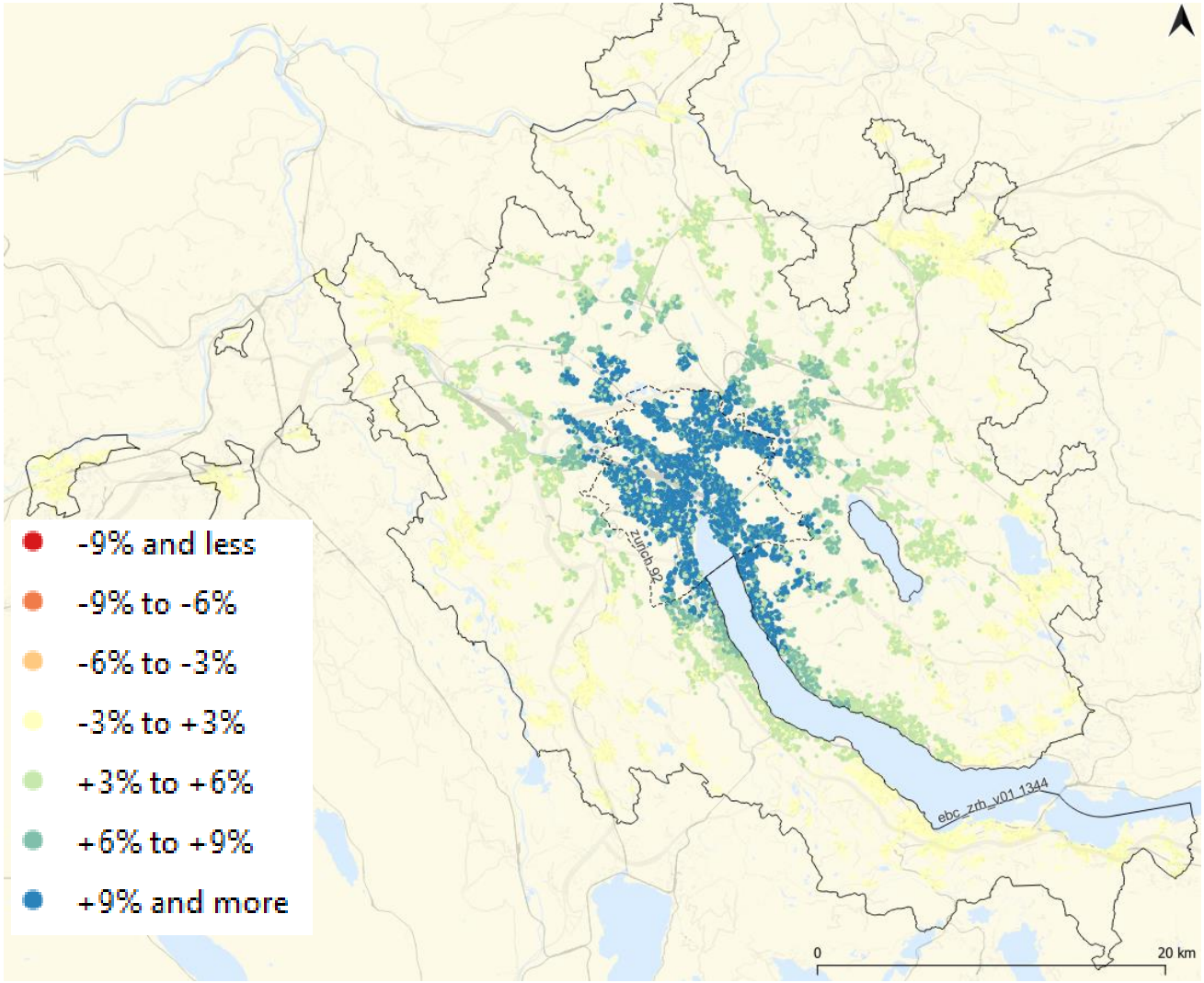
Source: Ballo and Axhausen, 2024

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.