ETH zürich

IVT Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems

Environmental implications of shared micro-mobility services

Dr. Daniel J. Reck | 8 September 2022

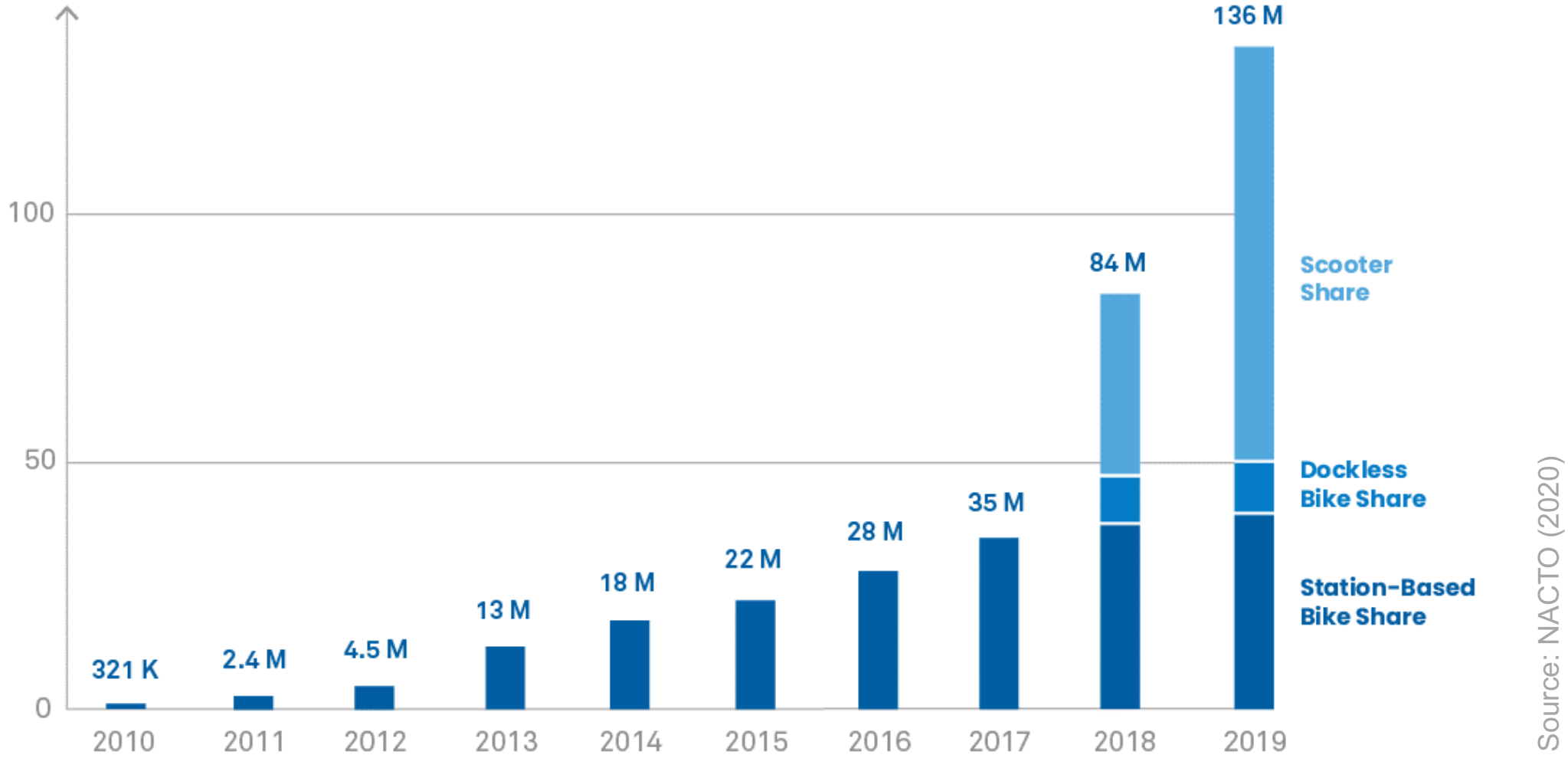
Several new mobility services were recently introduced to cities

https://www.voanews.com/economy-business/e-scooters-put-swedish-startup-road-positive-cashflow

https://seattletransitblog.com/2020/05/14/with-ubers-investment-lime-is-getting-back-into-the-local-bike-share-game/

https://www.aa.com.tr/en/americas/us-envoy-concerned-by-ubers-departure-from-colombia/1725652

Dockless shared micro-mobility services have seen particularly fast roll-outs



… and have challenged city administrations in many places

Forbes

Sep 10, 2019, 07:36am EDT | 2,255 views

E-Scooter Havoc Across French Cities. Is A Crackdown Needed?

Alex Ledsom Senior Contributor

Travel

I write about travel, culture, food & drink.

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https://www.forbes.com/sites/alexledsom/2019/09/10/e-scooter-havoc-across-french-cities-is-a-crackdown-needed/?sh=3d244de83038

The Atlantic

The Bike-Share Oversupply in China: Huge Piles of Abandoned and Broken Bicycles

ALAN TAYLOR | MARCH 22, 2018 | 30 PHOTOS | IN FOCUS

https://www.theatlantic.com/photo/2018/03/bike-share-oversupply-in-china-huge-piles-of-abandoned-and-broken-bicycles/556268/

Effective planning and regulation is hindered by knowledge gaps

Use of shared micro-mobility

- How does the use of different shared micro-mobility services differ across space and time?
- How do users choose between different shared micro-mobility services?

Users of shared micro-mobility

- How do user groups differ between shared micro-mobility services?
- Are there any equity concerns?

Interactions with other modes

- How do shared micro-mobility services affect the use of other transport modes?
- Which do they substitute?
- What are their environmental implications?

Data and methods

How can emerging data sources be used to advance our understanding of shared micro-mobility travel behavior?

Adapted from: Transportation Research Part D: Transport Environment - Call for Papers for Special Issue: Understanding and planning shared micro-mobility (15 Feb 2020)

Overview of contributions on shared micro-mobility

All papers available open access online

Use of shared micro-mobility

Reck, D.J., H. Haitao, S. Guidon and K.W. Axhausen (2021) Explaining shared micro-mobility usage, competition and mode choice by modelling empirical data from Zurich, Switzerland, *Transportation Research Part C: Emerging Technologies*, **124**: 102947.

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Environmental impacts of shared micro-mobility services

(Peer-reviewed) literature on shared micro-mobility

	≤ 2013	2014-2015	2016-2017	2018-2019	2020-2021
Shared bikes	9	4	5	6	10
Shared e-bikes			1	3	3
Shared e-scooters				4	16

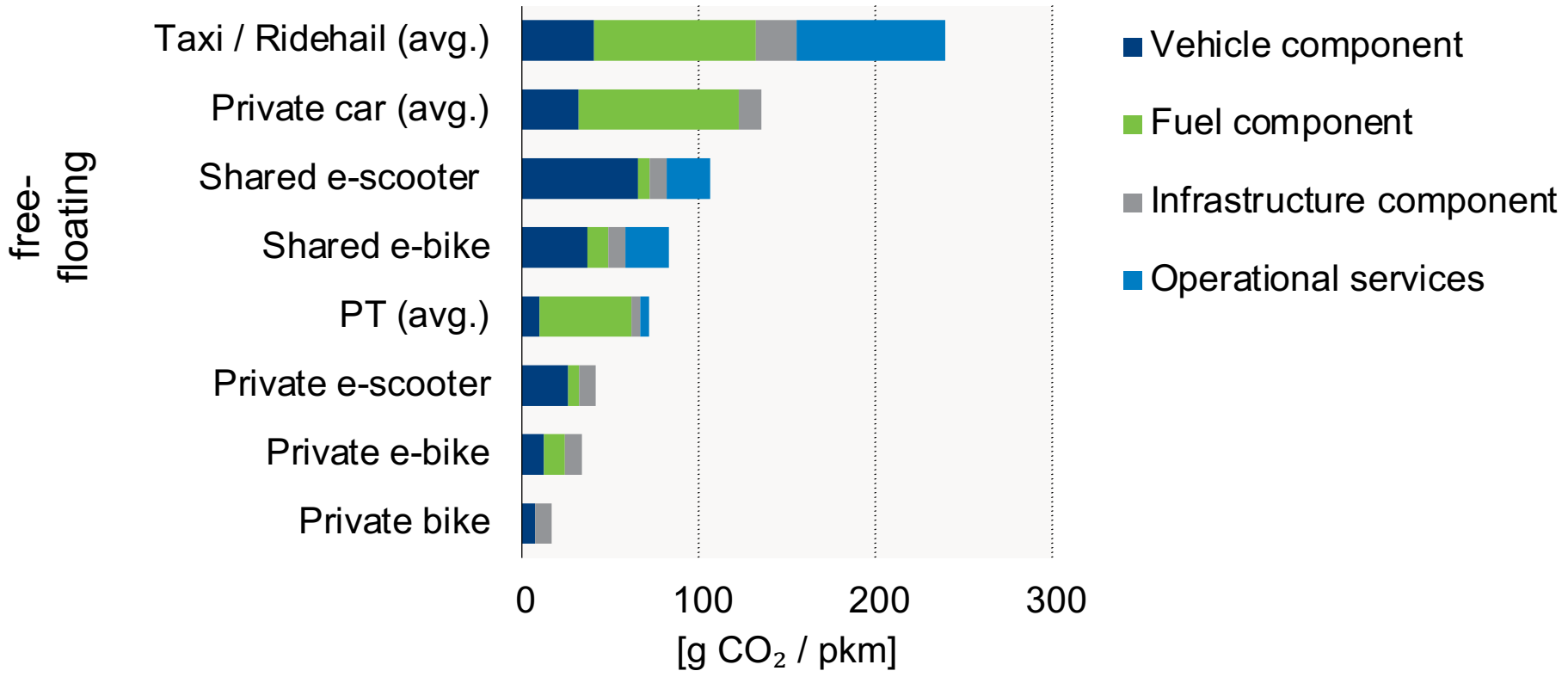
e.g., Fishman et al., 2013; Fishman, 2016; Ricci, 2015; Teixeira et al., 2021

e.g., Campbell et al., 2016; Guidon et al., 2019; He et al., 2019

e.g., Caspi et al., 2020; Noland, 2021; Wang et al., 2021

Life cycle assessments (LCA) analyse the CO_2 emissions of shared micro-mobility services

- ITF (2020), de Bortoli and Christoforou (2020), Hollingsworth et al. (2019)



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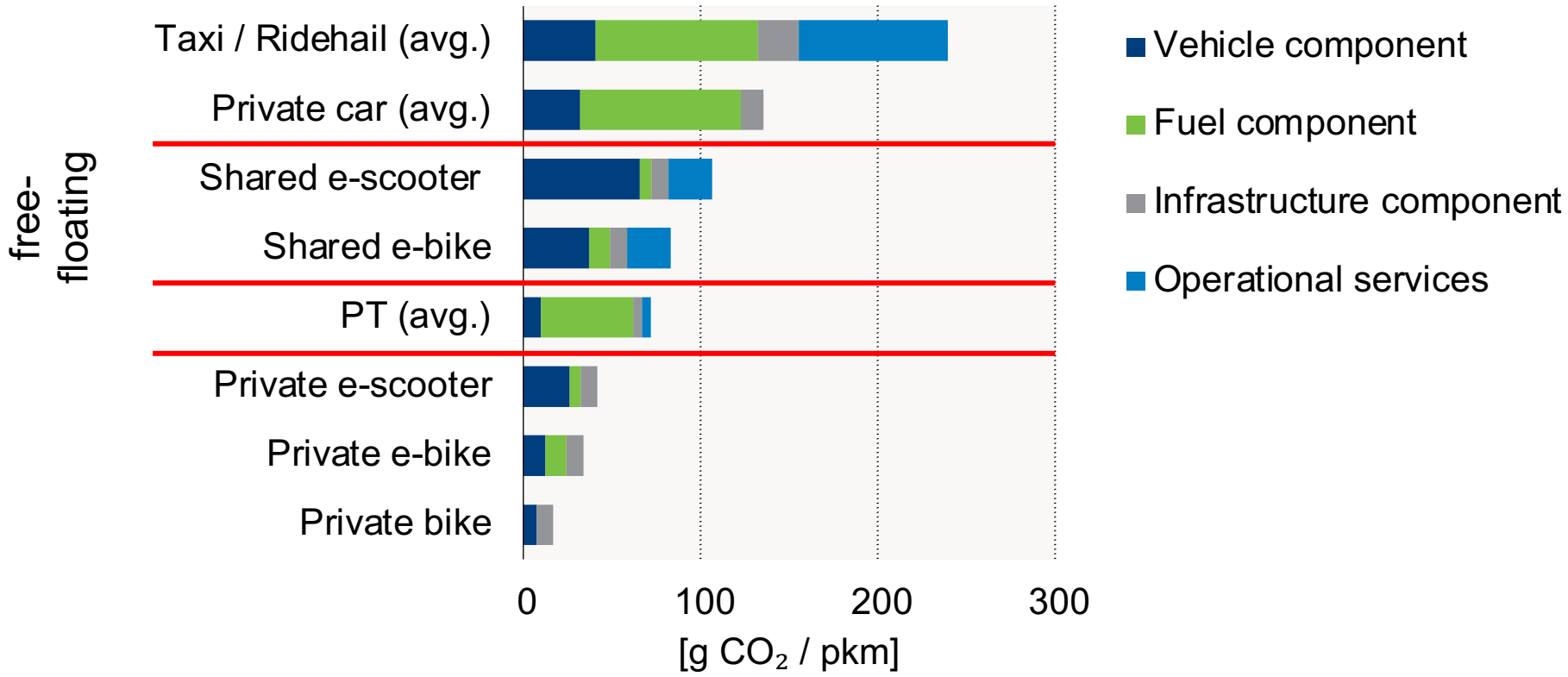

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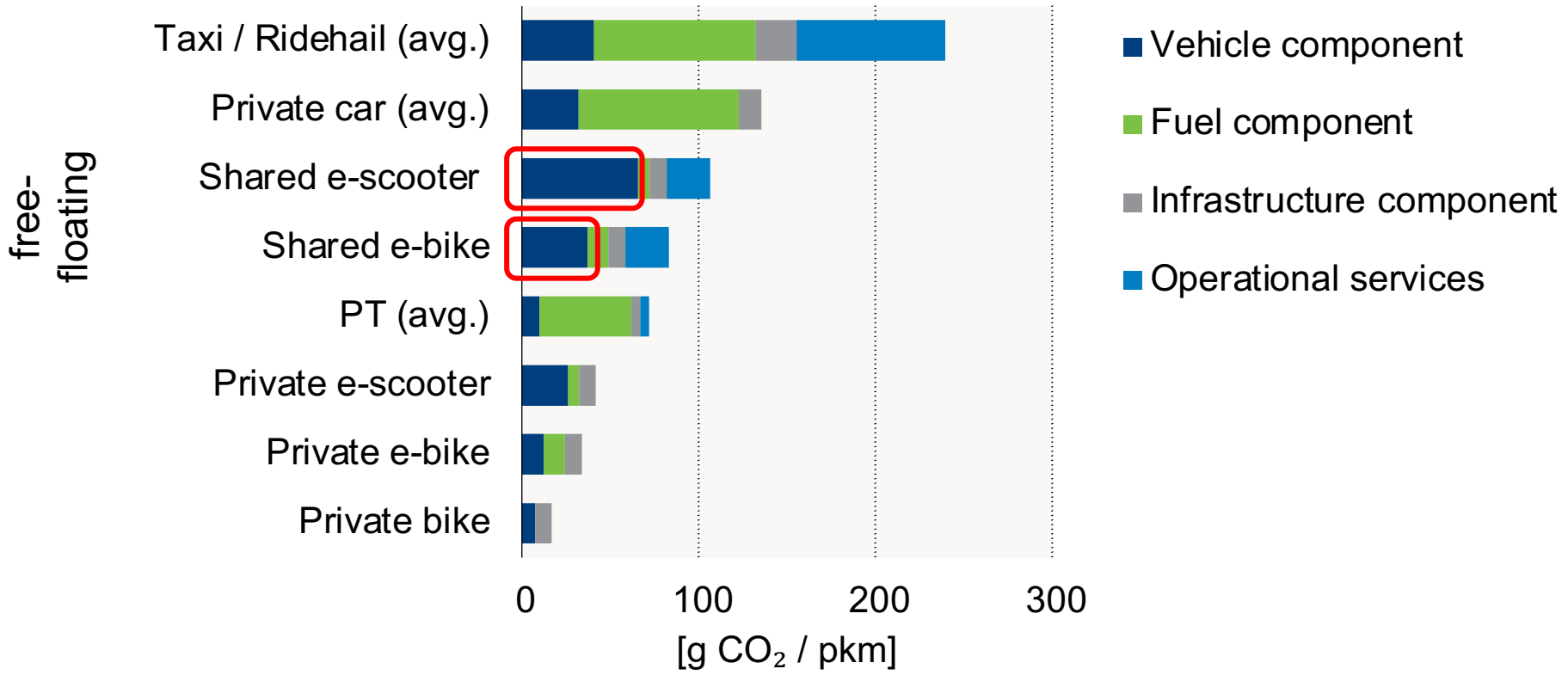

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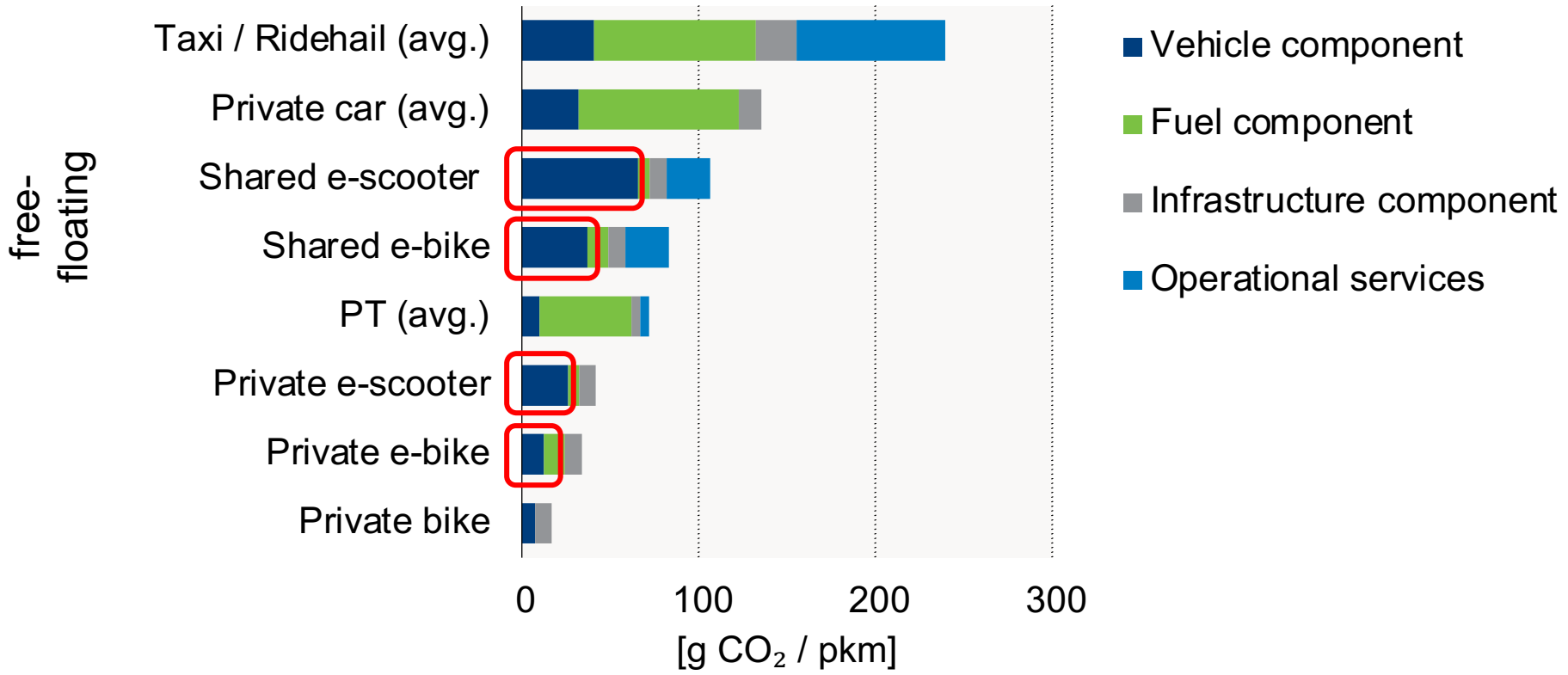

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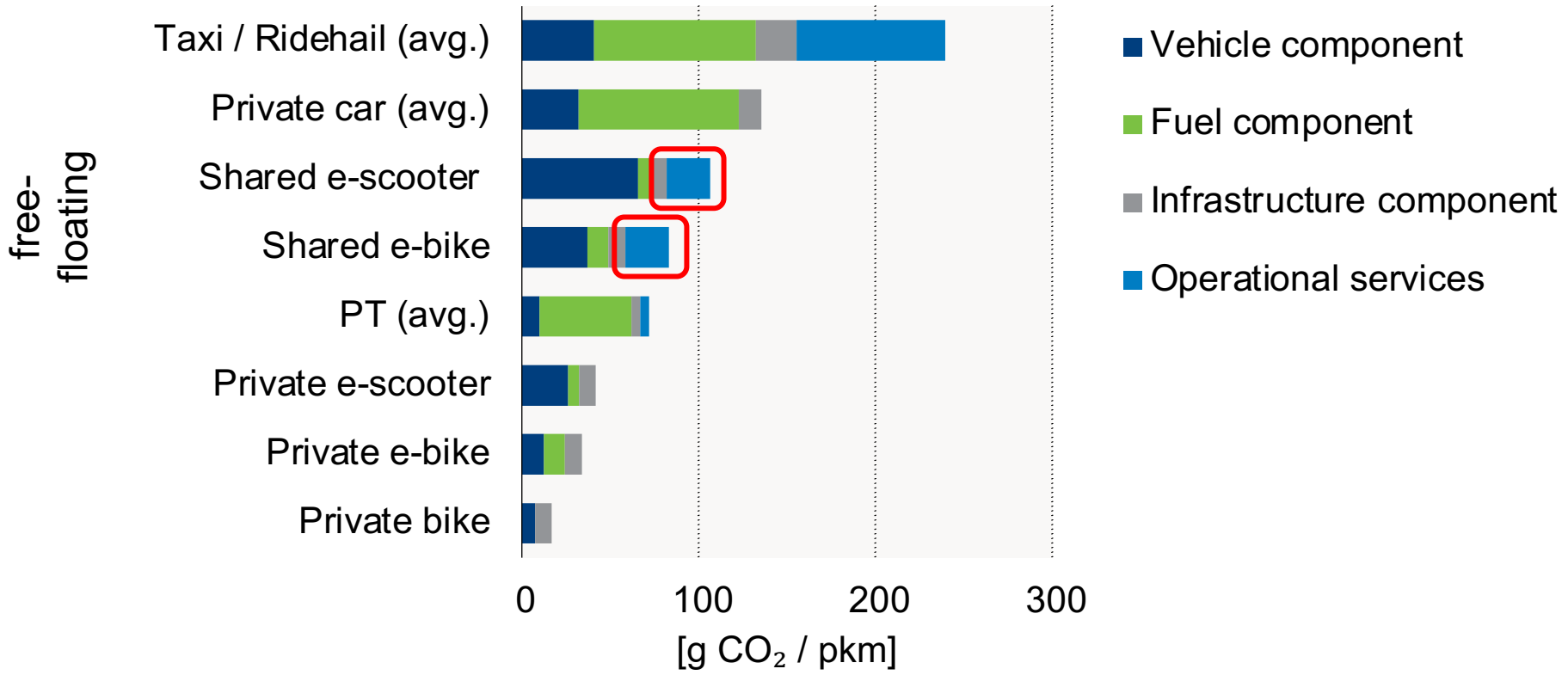

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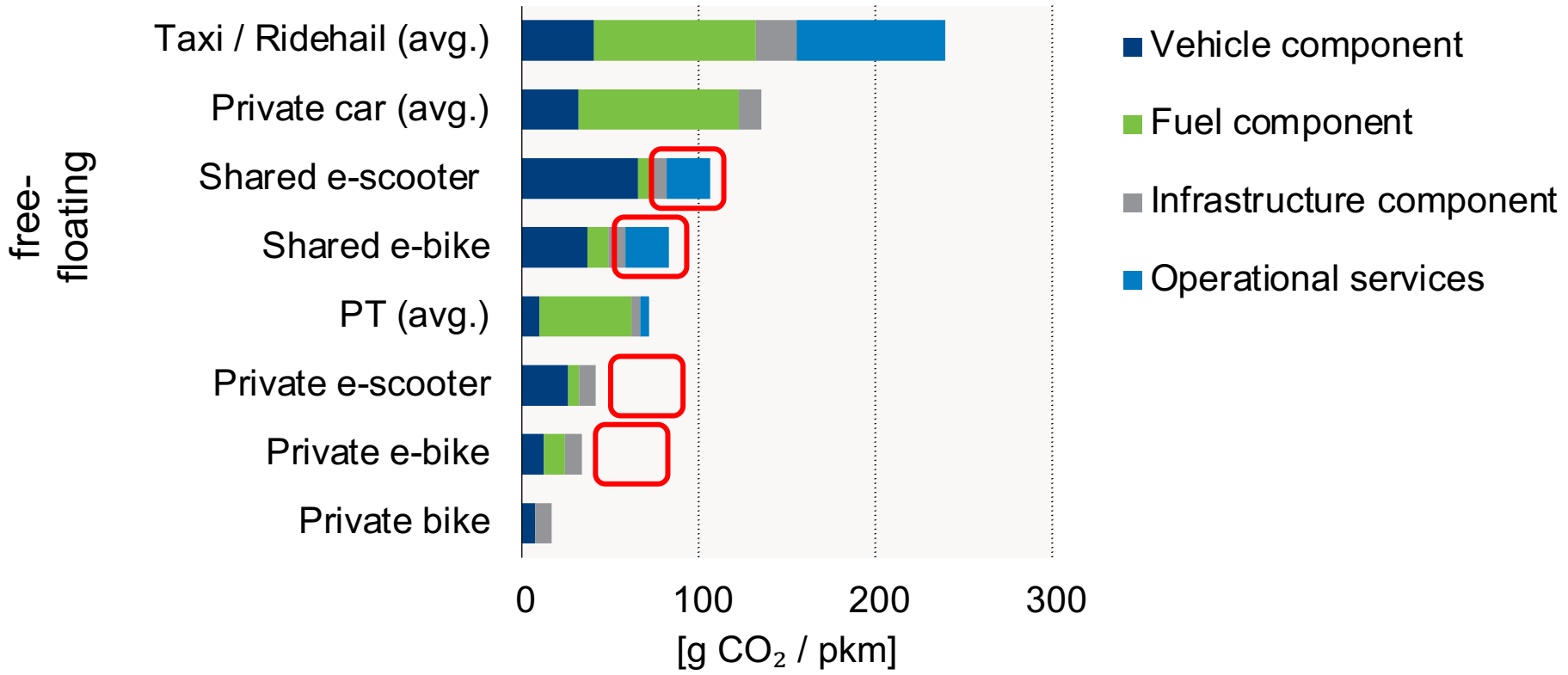

Source: ITF (2020)

Life cycle assessments: summary

ITF (2020), de Bortoli and Christoforou (2020), Hollingsworth et al. (2019)

1. Shared micro-mobility services are **more sustainable** (in terms of CO2 / pkm) than private cars
2. Shared micro-mobility services are **less sustainable** (…) than public transport
3. Shared micro-mobility services are **less sustainable** (…) than private micro-mobility vehicles

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However, life cycle assessments only provide part of the answer.

How sustainable are shared micro-mobility services really?

- Consider two scenarios of replaced modes

  A. Shared e-scooter
  - replaces trips otherwise walked (40%)
  - replaces trips otherwise conducted with PT (60%)
  - induces 10% new trips

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- **We need substitution patterns to evaluate how sustainable a new transport mode is.**
- **Which substitution patterns do we observe in reality?**

Two approaches to elicit substitution rates and derive net CO_2 emissions

Survey-based approach (well established)

- Did you conduct a trip with an [e-scooter, e-bike, …] in the past 7 days?
- If yes, would you have made this trip if this vehicle had not been available?
- If yes, which alternative transport mode would you have chosen?

Choice model based approach (new)

- Estimate mode choice model
- Set availabilities of mode of interest to 0
- Estimate alternative choices

Two approaches to elicit substitution rates and derive net CO_2 emissions

Survey-based approach (well established)

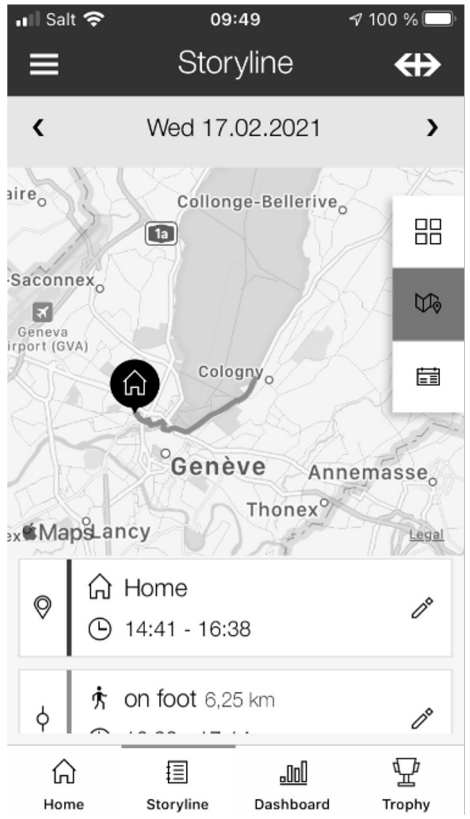
+ Easy & cheap to conduct (1 survey is enough)
− Survey responses often biased (recall bias, social desirability bias)
− Responses valid only for last trip
− Metric: trips. But replaced distance is more important to calculate environmental impact

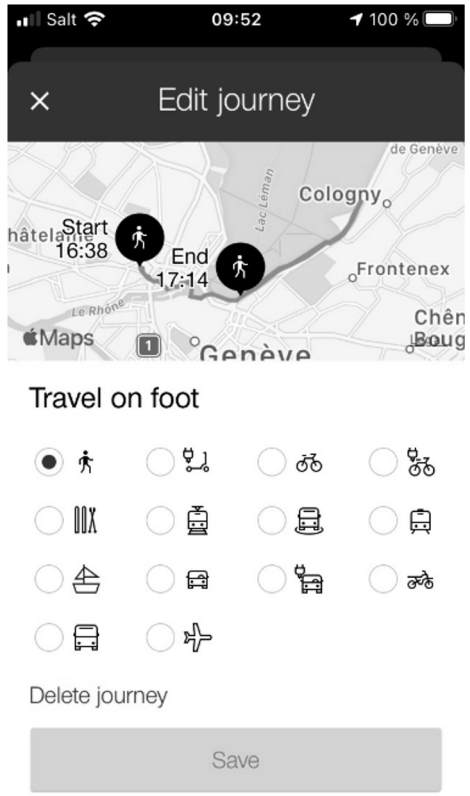
Choice model based approach (new)

− Difficult & expensive to conduct (GPS tracks + booking data)
+ No behavioral biases (revealed preferences)
+ Responses valid for all trips as they are based on preferences
+ Different metrics possible, incl. precise replaced distances

Study design

- Study design
  - 06/2020: 1st survey
  - 07-09/2020: 3 months GPS smartphone tracking
  - 10/2020: 2nd survey
- Recruitment
  - 10 000 invitations sent by cantonal statistical office
  - 90 CHF incentive
  - 540 participants completed entire study
  - 65 716 observed trips
- Additional data sources
  - Booking data
  - Vehicle availability
  - Weather data





Substitution rates

Substituted mode	Substitution rates (km-level) by micro-mobility mode			
	E-Bike (personal)	E-Bike (shared)	E-Scooter (personal)	E-Scooter (shared)
Walk	9%	9%	19%	25%
PT	29%	43%	27%	38%
Car	48%	15%	25%	15%
Bike	14%	29%	27%	13%
E-Bike (personal)		5%	1%	2%
E-Bike (shared)	0%		0%	5%
E-Scooter (personal)	1%	0%		1%
E-Scooter (shared)	0%	0%	0%	

Calculating micro-mobility net emissions

Substituted mode	Gross emissions [g CO_2 / pkm]	Substitution rates (km-level) by micro-mobility mode			
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Emissions of substituted modes		88	58	58	55

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Net emissions [g CO_2 / pkm]		**-54**	**25**	**-16**	**51**

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Conclusions and implications

- Dockless shared e-bikes and e-scooters emit more CO_2 than the transport modes they replace
  - Shorter lifetime & production emissions
  - Operations
  - Substitution patterns
- Immediate implications
  - ‘Sharing is caring’ for the environment
  - Work with operators to decrease CO_2 emissions (e.g., durability, integration, incentives, availability)
  - Improve bike infrastructure
- Personal e-bikes and e-scooters emit less CO_2 than the transport modes they replace

Thank you for your attention.

Questions?