

Will autonomous vehicles contribute to the advent of low-carbon lifestyles?

A three scenario-analysis

THOMAS LE GALLIC, PARIS (FRANCE)

CIREC - INTERNATIONAL RESEARCH CENTER ON ENVIRONMENT AND DEVELOPMENT

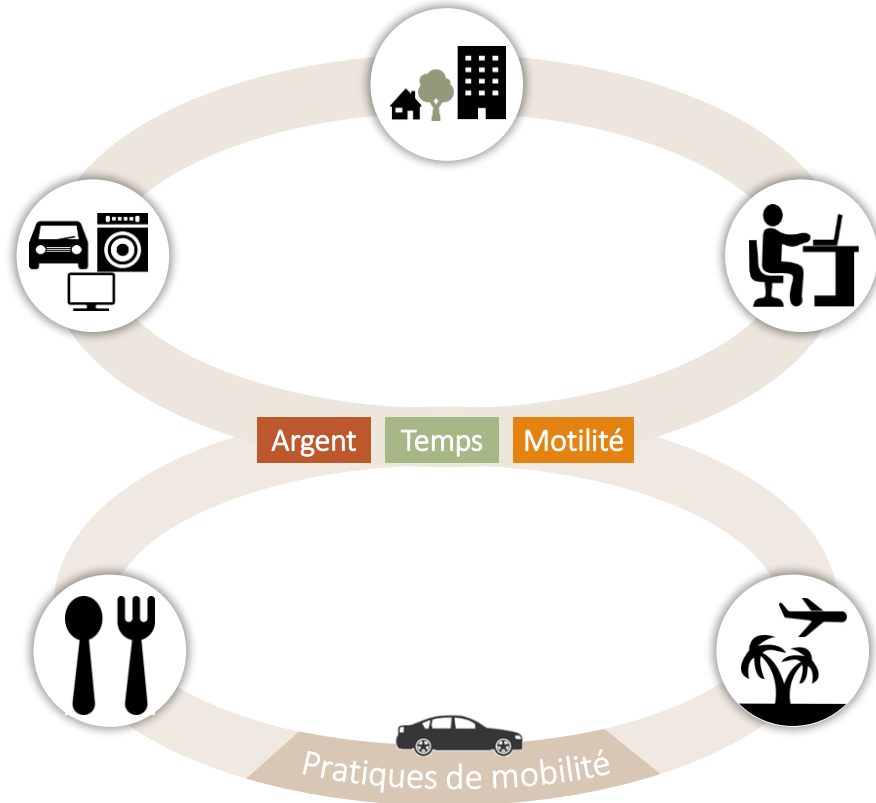
LVMT – LABORATORY “CITY, MOBILITY, TRANSPORT”



Introduction

Autonomous vehicles ...

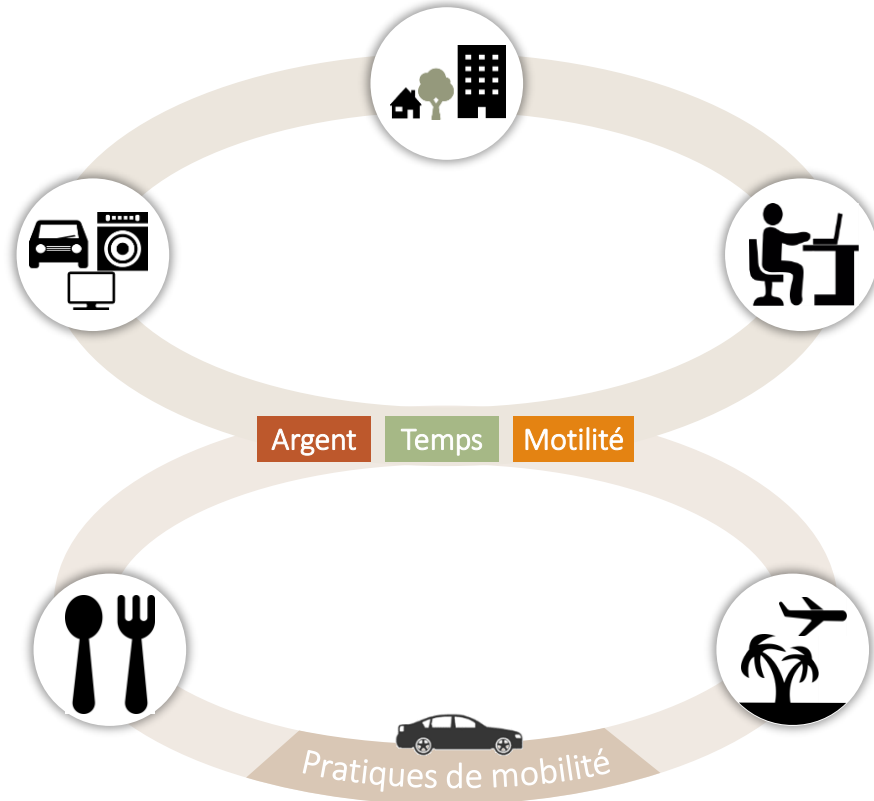
"... are about to change the way we live"



Introduction

Autonomous vehicles ...

"... are about to change the way we live"



"... could greatly reduce GHG emissions"

Greenblatt Saxena, 2015

nature
climate change

LETTERS

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Autonomous taxis could greatly reduce greenhouse-gas emissions of US light-duty vehicles

Jeffery B. Greenblatt* and Samveg Saxena

Autonomous vehicles (AVs) are conveyances to move passengers or freight without human intervention. AVs are potentially disruptive both technologically and socially¹⁻³, with claimed benefits including increased safety, road utilization, driver productivity and energy savings¹⁻⁶. Here we estimate 2014 and 2030 greenhouse-gas (GHG) emissions and costs of autonomous taxis (ATs), a class of fully autonomous^{7,8} shared AVs likely to gain rapid early market share, through three synergistic effects: (1) future decreases in electricity GHG emissions intensity, (2) smaller vehicle sizes resulting

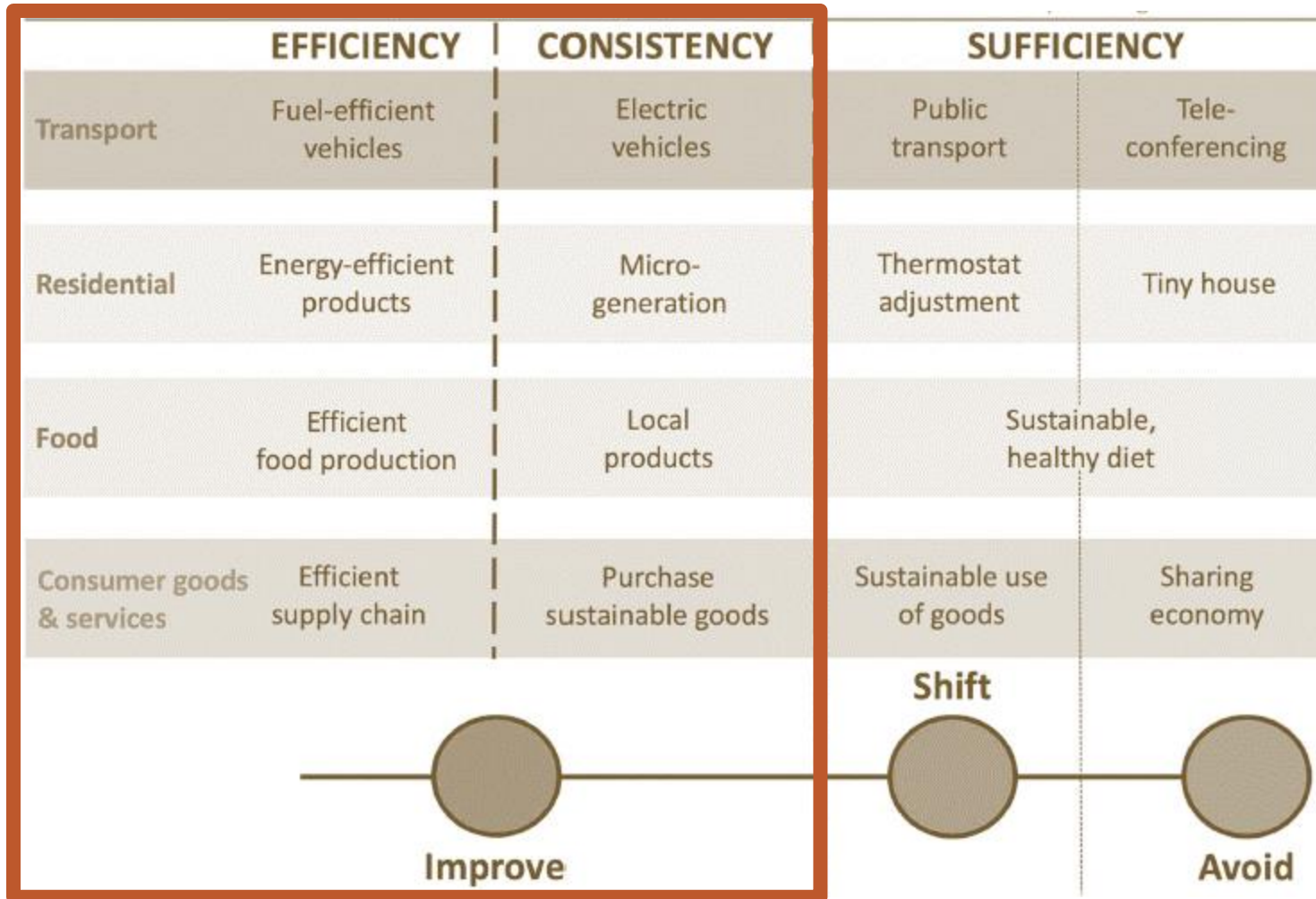
per mile. Passenger car and light truck fuel efficiencies were combined using fleet mix ratios projected for 2014 and 2030 (ref. 11). As shown in Fig. 1 (see Supplementary Table 2 for additional data), there is a 52% decrease in GHG emissions in moving from 2014 internal combustion engine vehicles (ICEVs) to 2030 ICEVs, a further 29% decrease in moving to hybrid-electric vehicles (HEVs), and (depending on hydrogen production assumptions) a 6% increase to 32% decrease in moving to hydrogen fuel-cell vehicles (HFCVs). Although HFCVs and battery-electric vehicles (BEVs) can have similar GHG emissions

... will enable low-carbon lifestyles?

State of the art: a mainly technological perspective

Current studies

(e.g. Brown et al., 2014; Fagnant and Kockelman, 2014; Wadud, 2017; Wang et al., 2018)

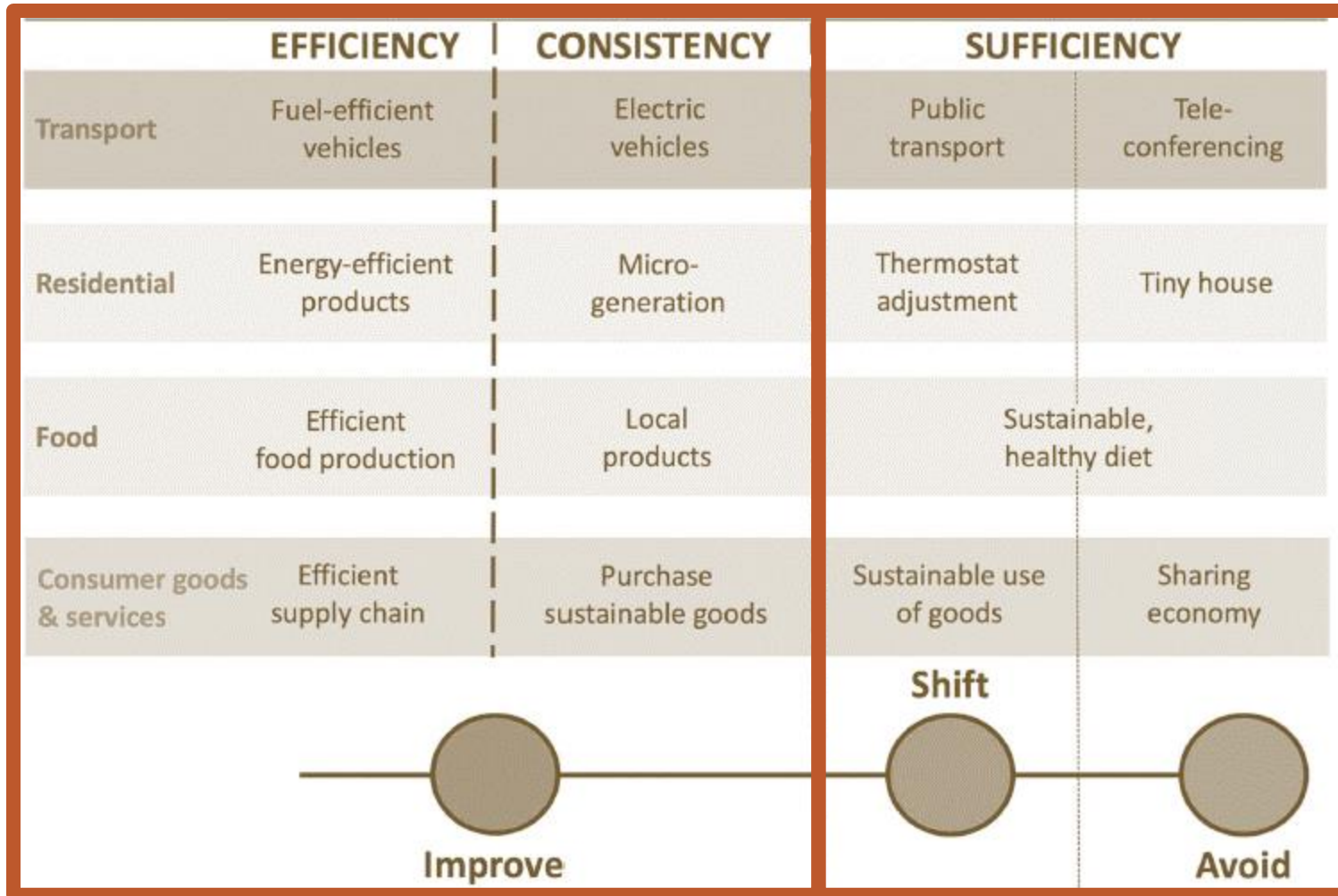


Source: van den Berg et al, 2019; in part based on Samadi et al, 2017 and Creutzig et al., 2018

State of the art: a mainly technological perspective

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What about lifestyle change factors ?

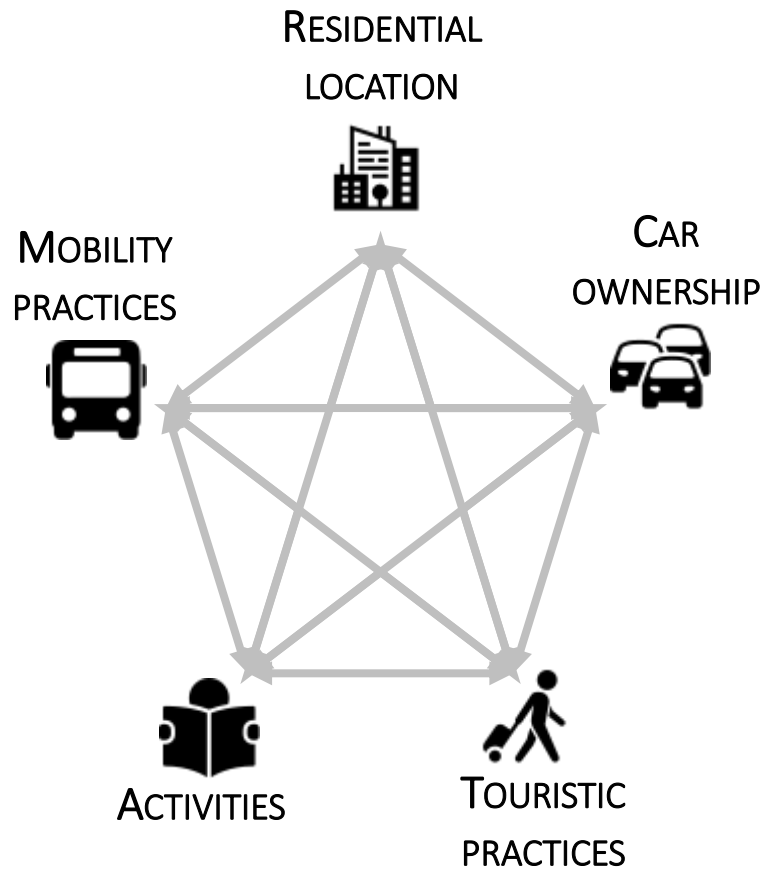
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FRAMEWORK AND METHODS

The 'lifestyle' frameworks

Five components of lifestyles

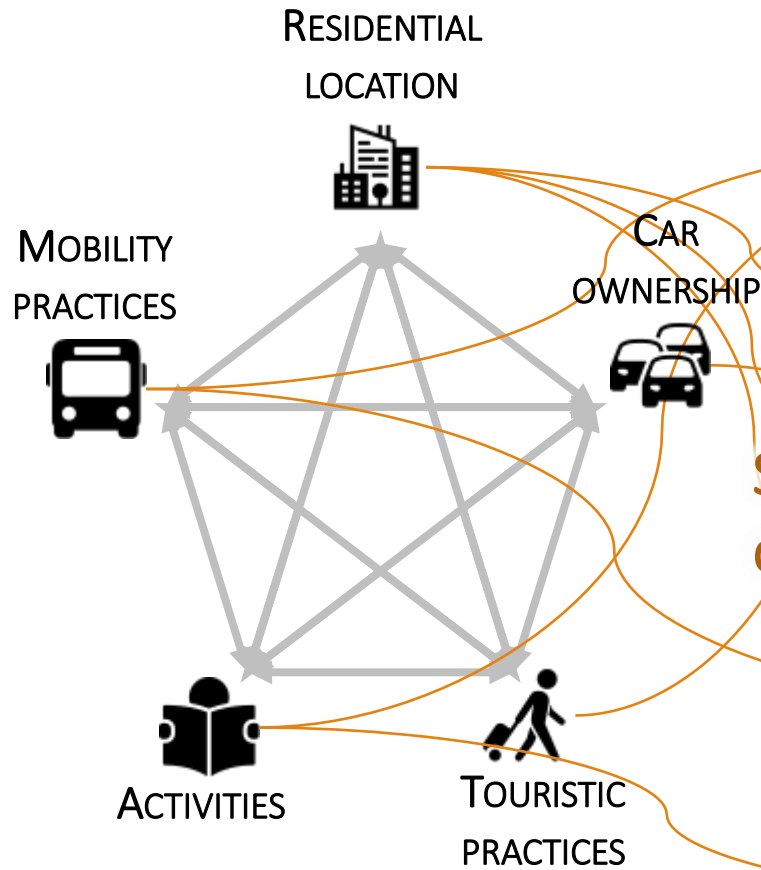
LIFESTYLE COMPONENTS



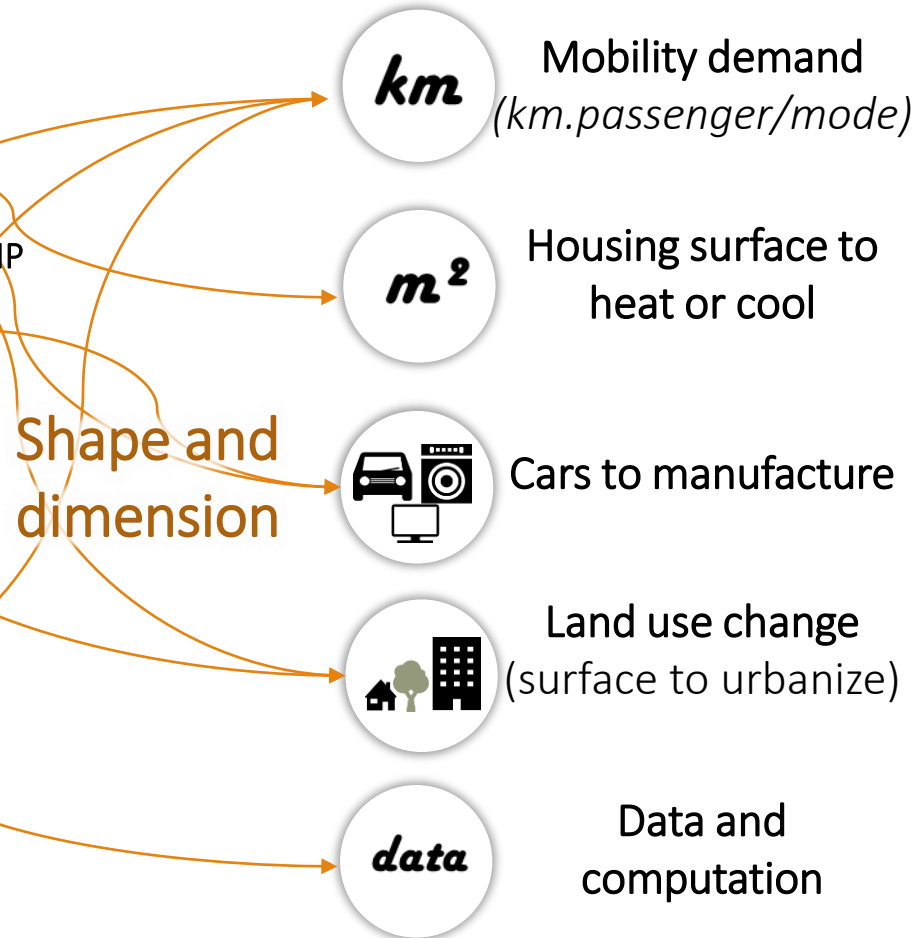
The 'lifestyle' frameworks

Five components of lifestyles

LIFESTYLE COMPONENTS



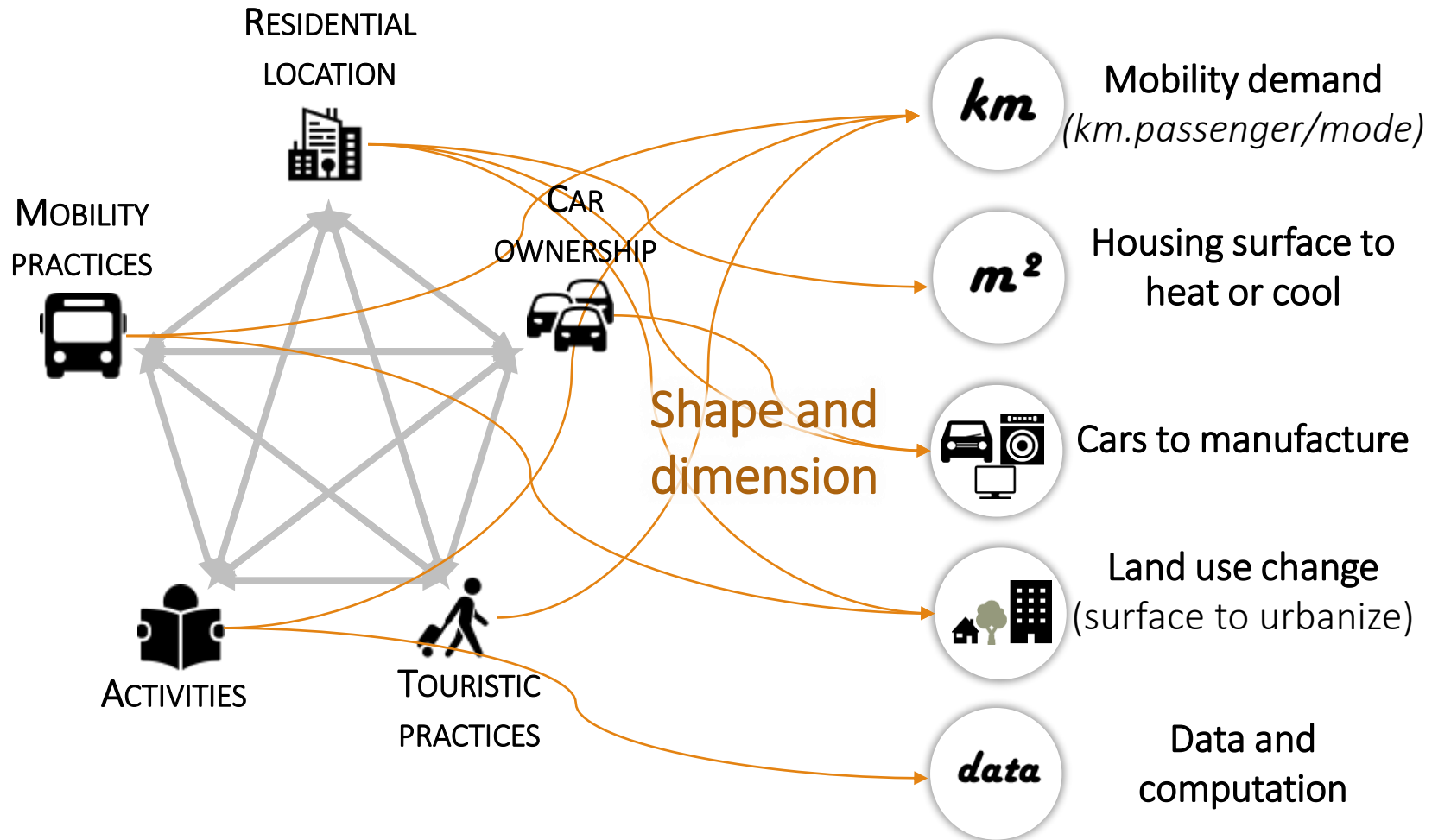
"ACTIVITY LEVEL" INDICATORS



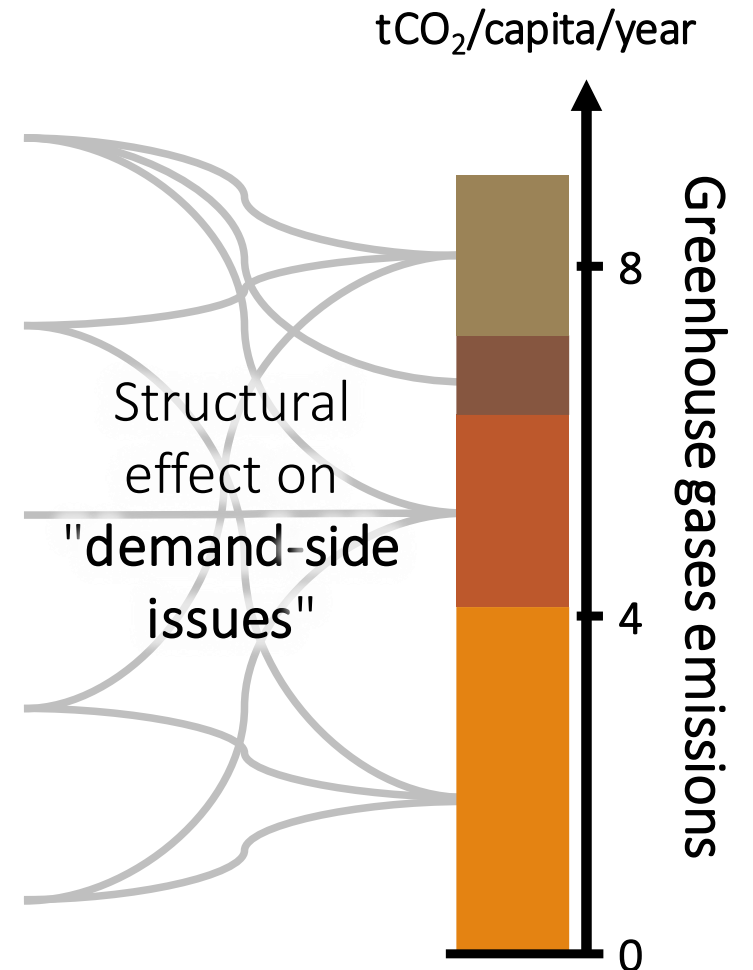
The 'lifestyle' frameworks

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LIFESTYLE COMPONENTS

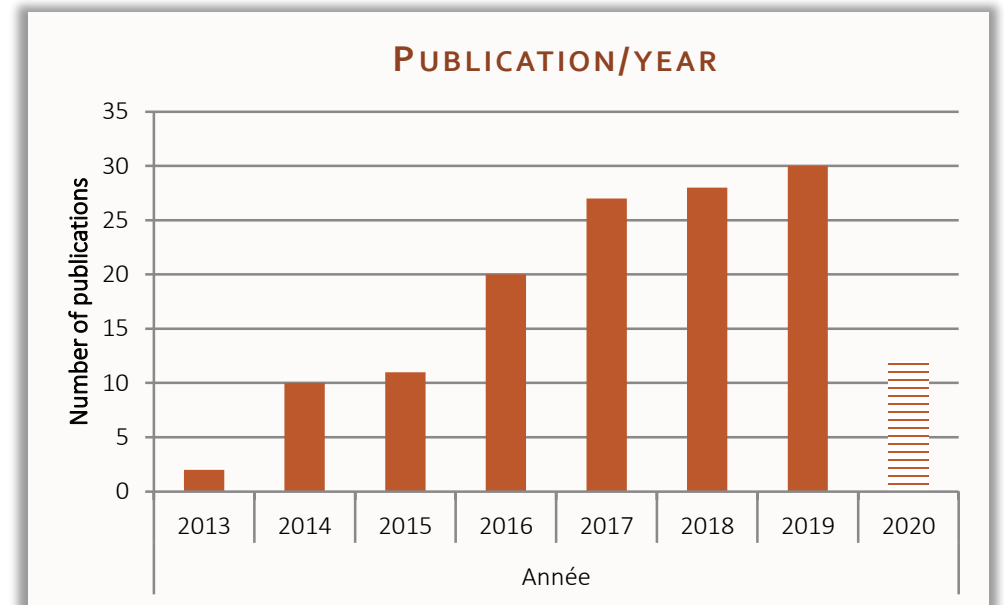
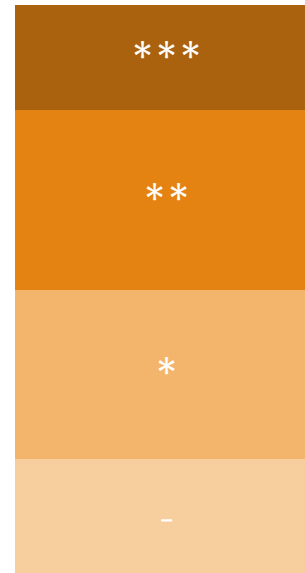


"ACTIVITY LEVEL" INDICATORS



Corpus

~240
publications



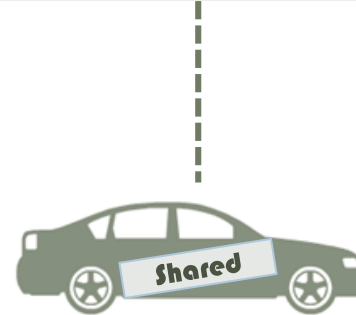
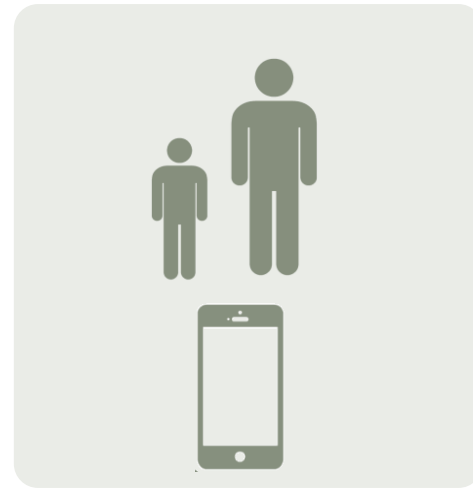
RESULTS

Three 'families' of scenarios

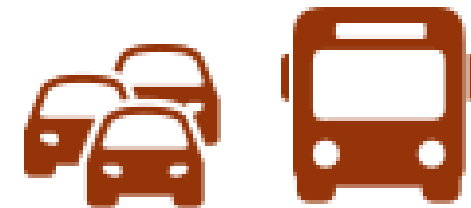
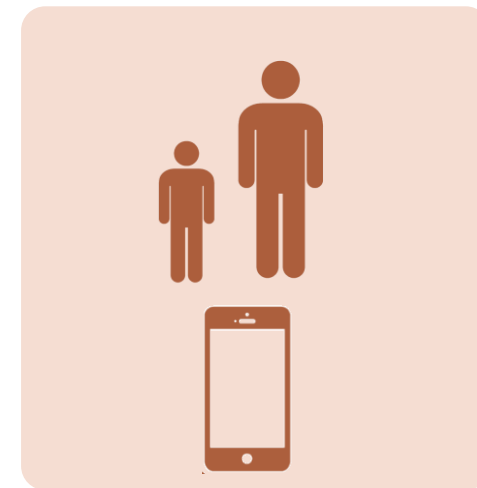
Type A



Type B



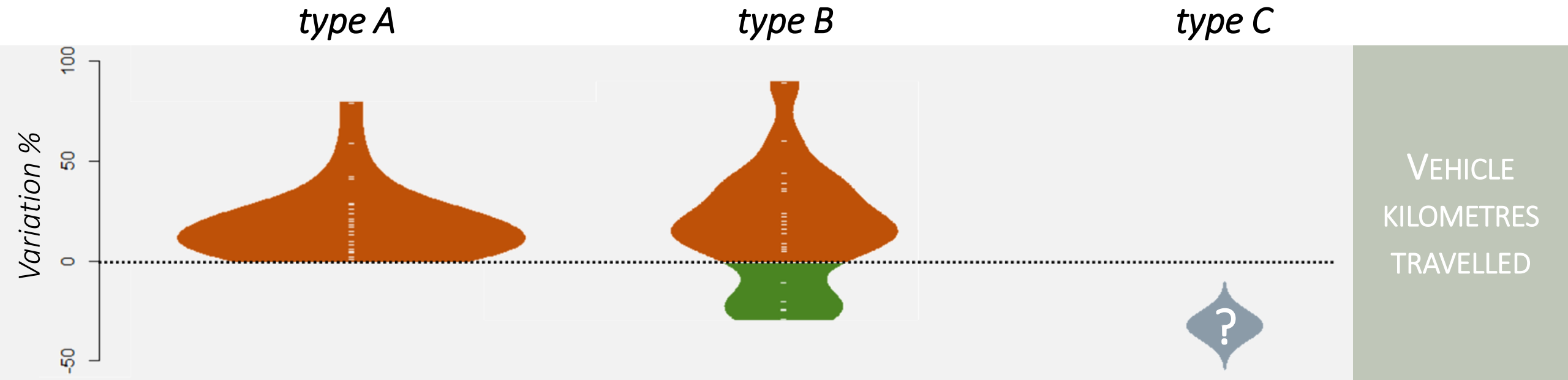
Type C



New uses for the space previously occupied by the car



Changes in mobility patterns



Direct and indirect implications

of autonomous vehicles on the land-use transportation system

FIRST ORDER IMPLICATIONS

Milakis & al, 2017

Travel time

Travel comfort

Value of time

Travel cost (€)

Road capacity

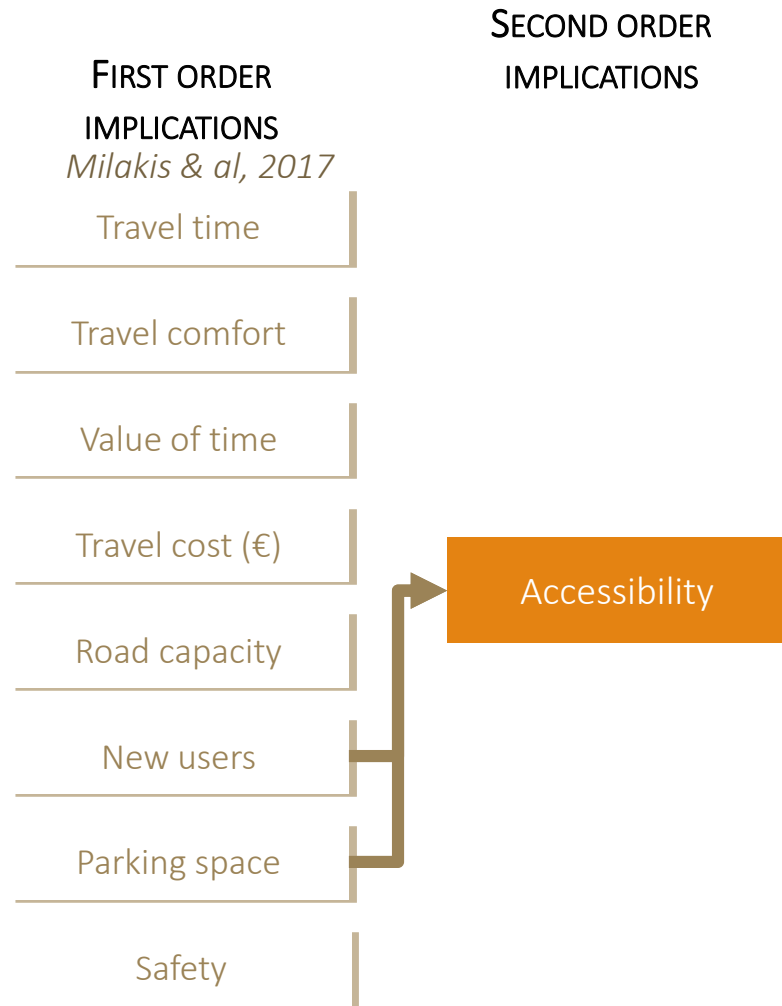
New users

Parking space

Safety

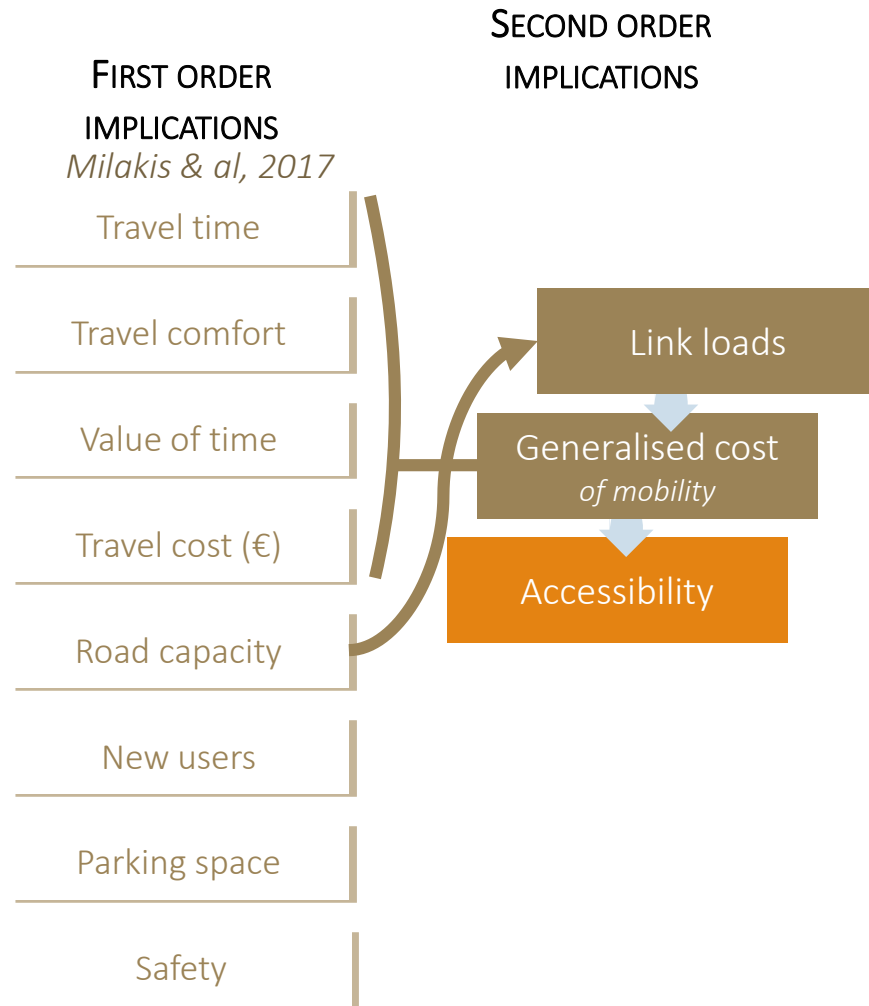
Direct and indirect implications

of autonomous vehicles on the land-use transportation system



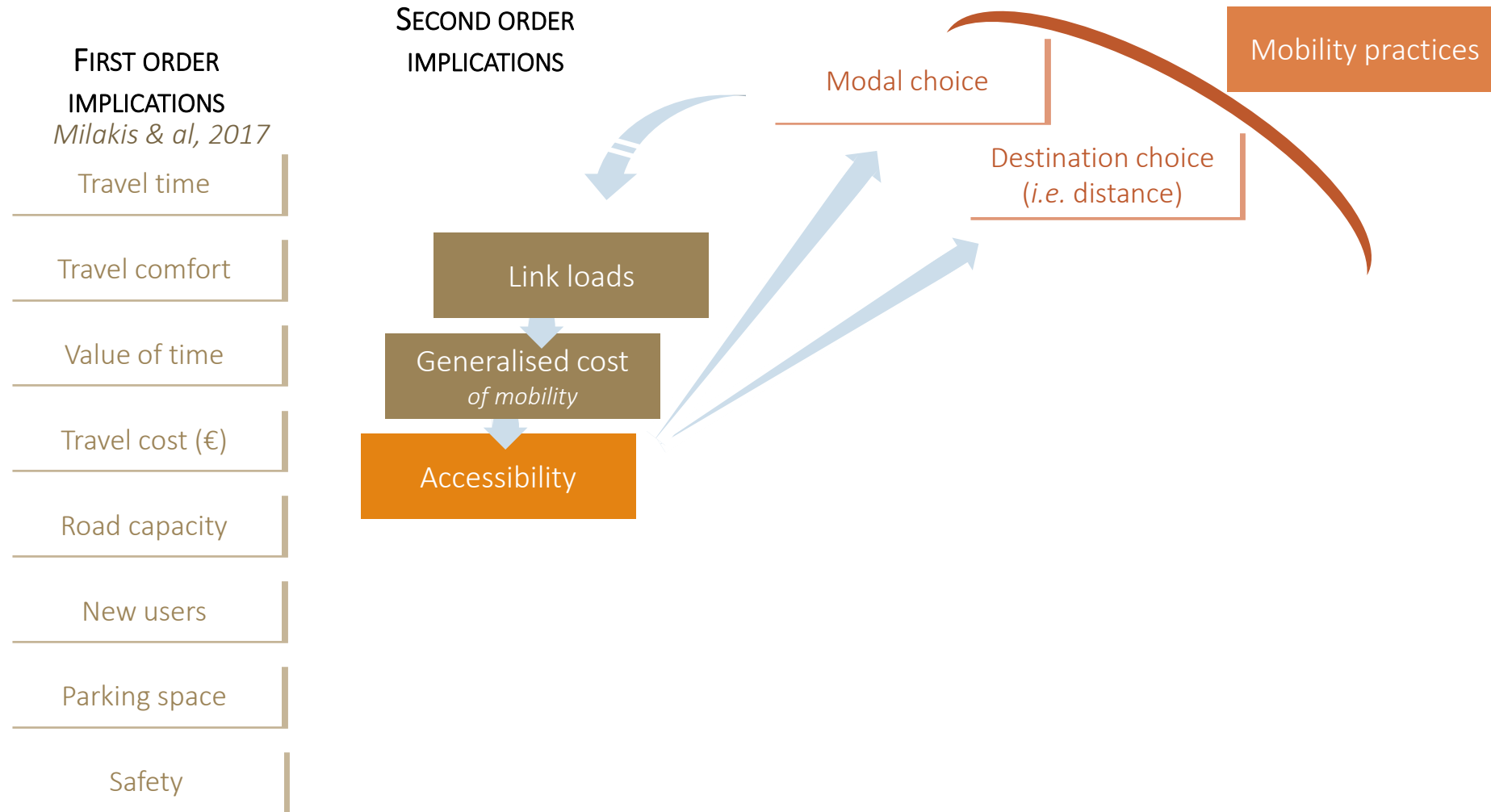
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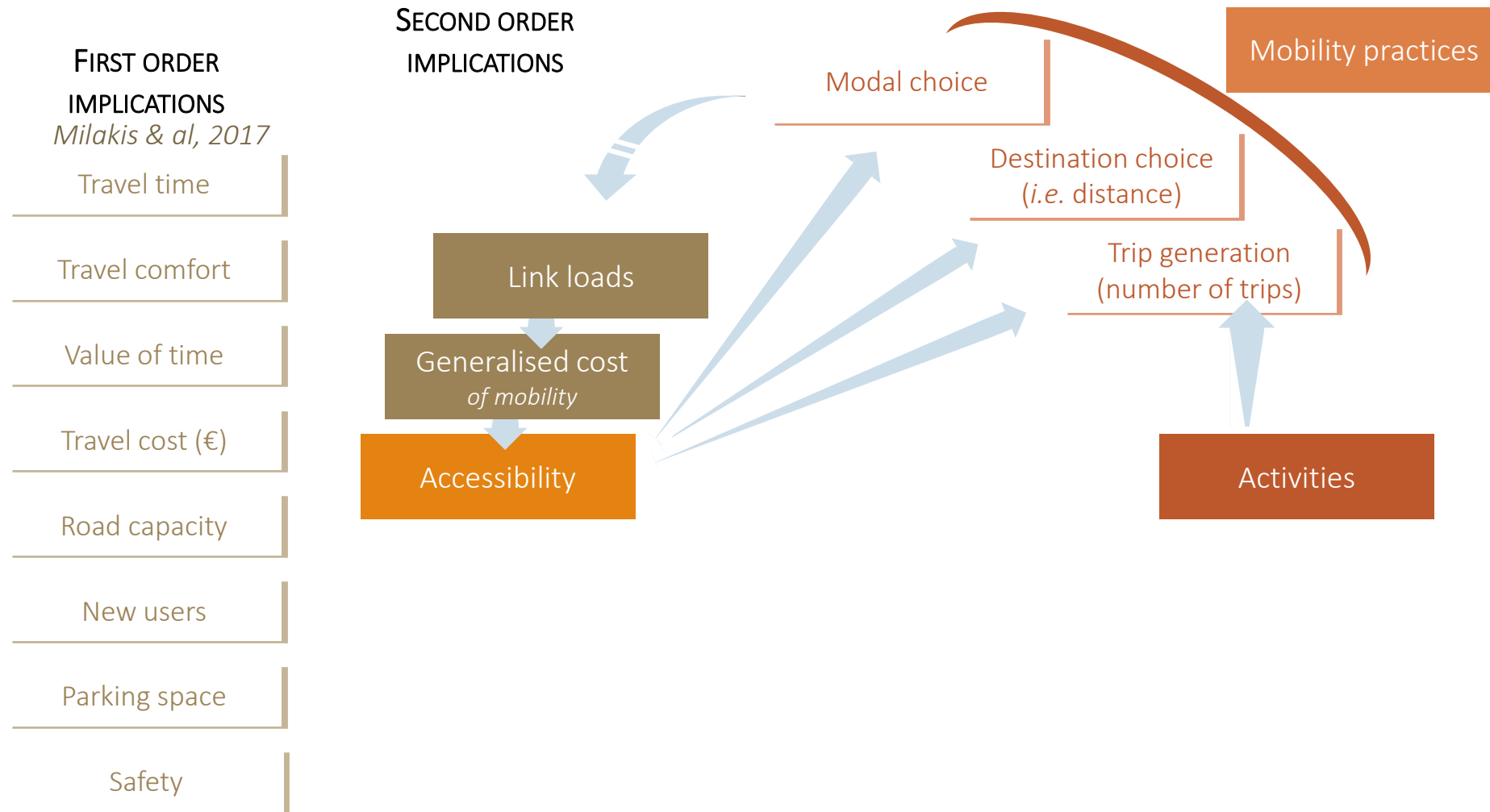
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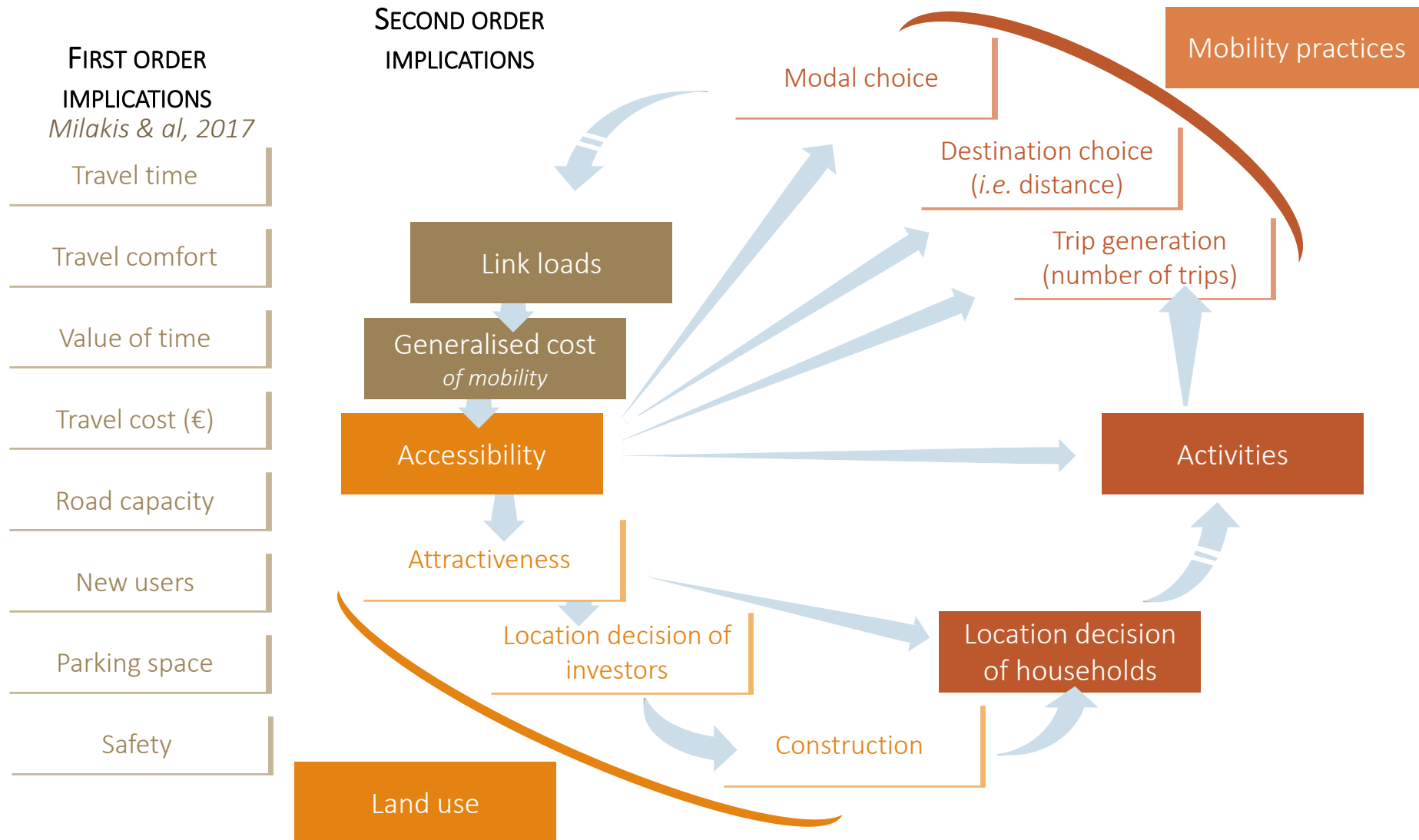
Direct and indirect implications

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Direct and indirect implications

of autonomous vehicles on the land-use transportation system



km

m²

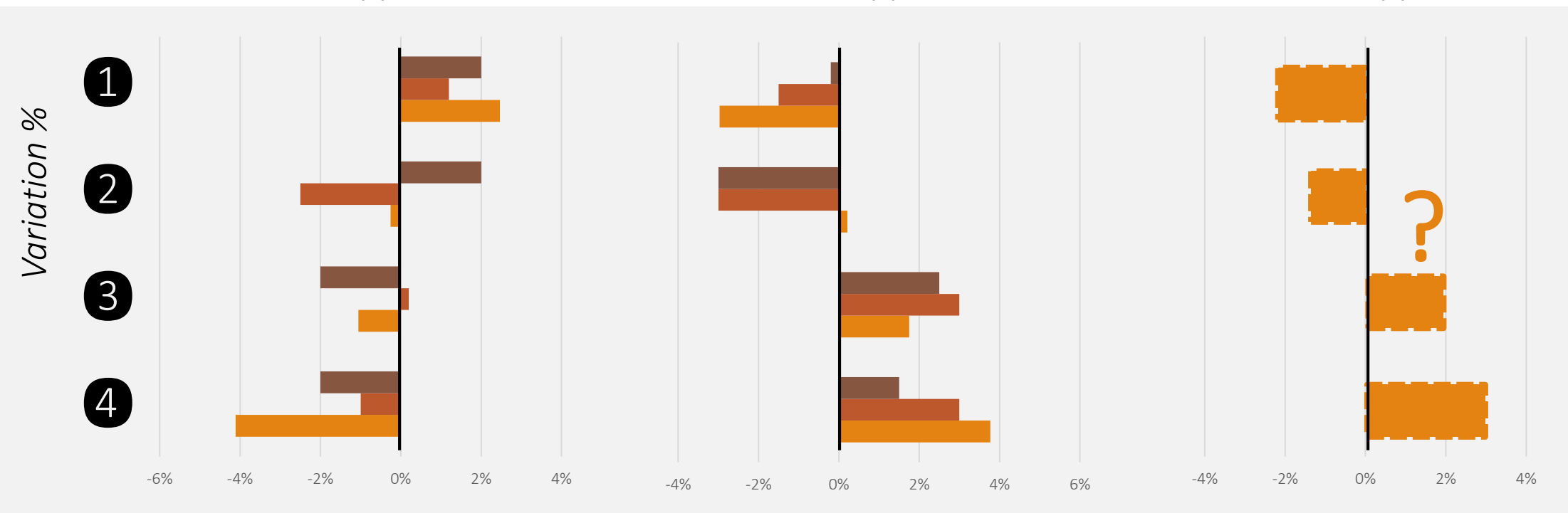


Changes in household location

type A

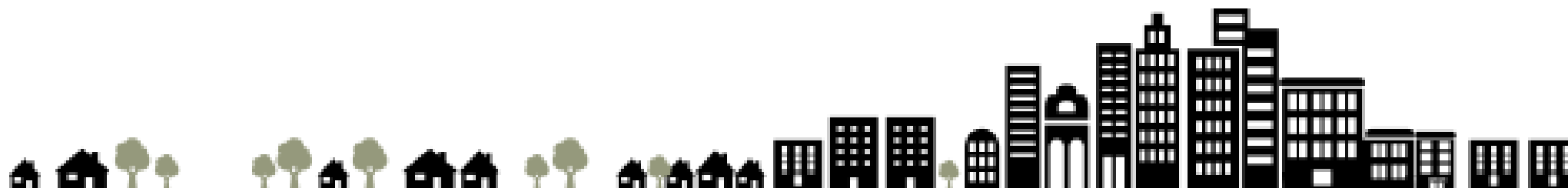
type B

type C



HOUSEHOLD LOCATION

Source: from Gelauff et al, 2017 ; Thakur et al, 2016 ; Kim et al, 2015 ; Zhang et al, 2018



1

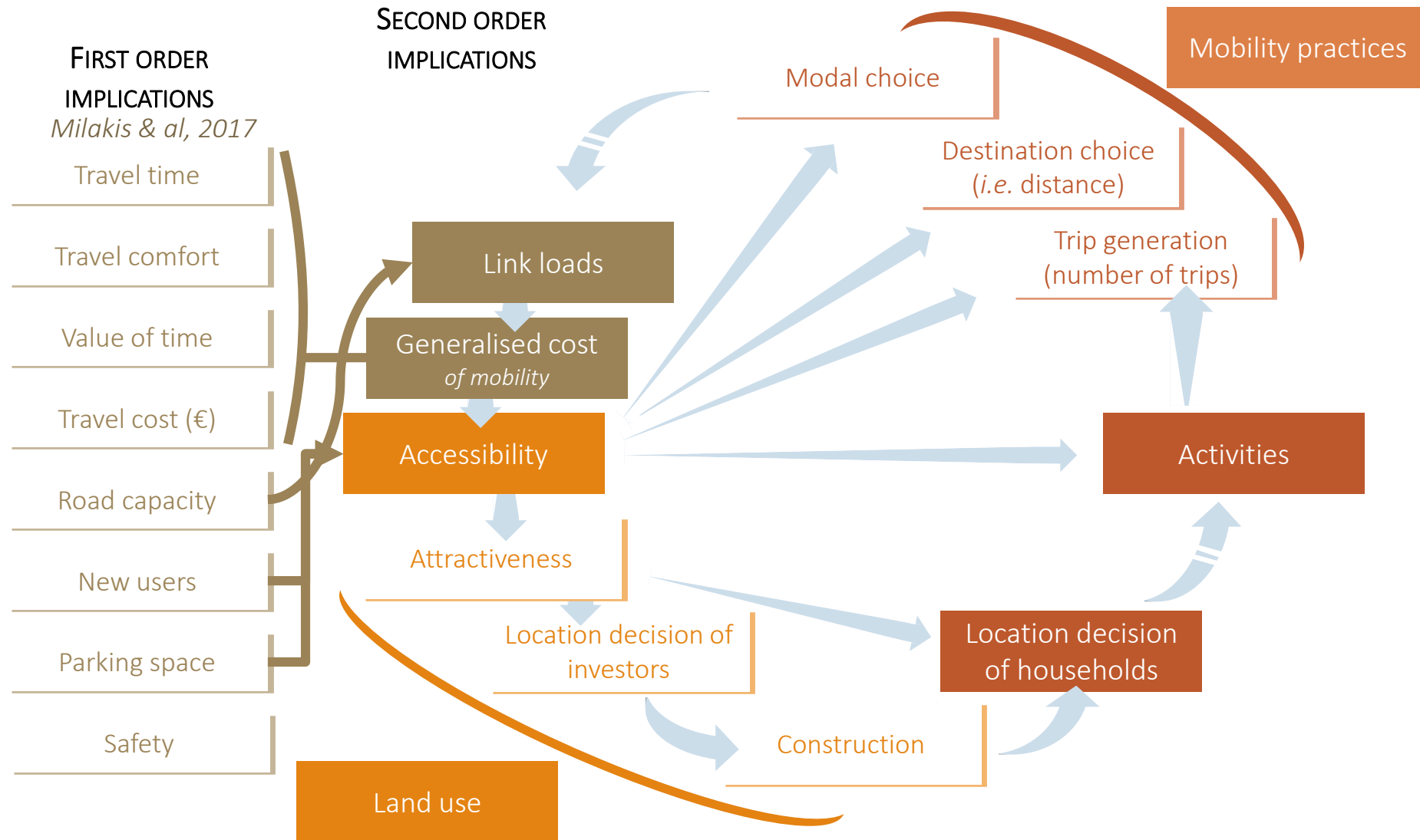
2

3

4

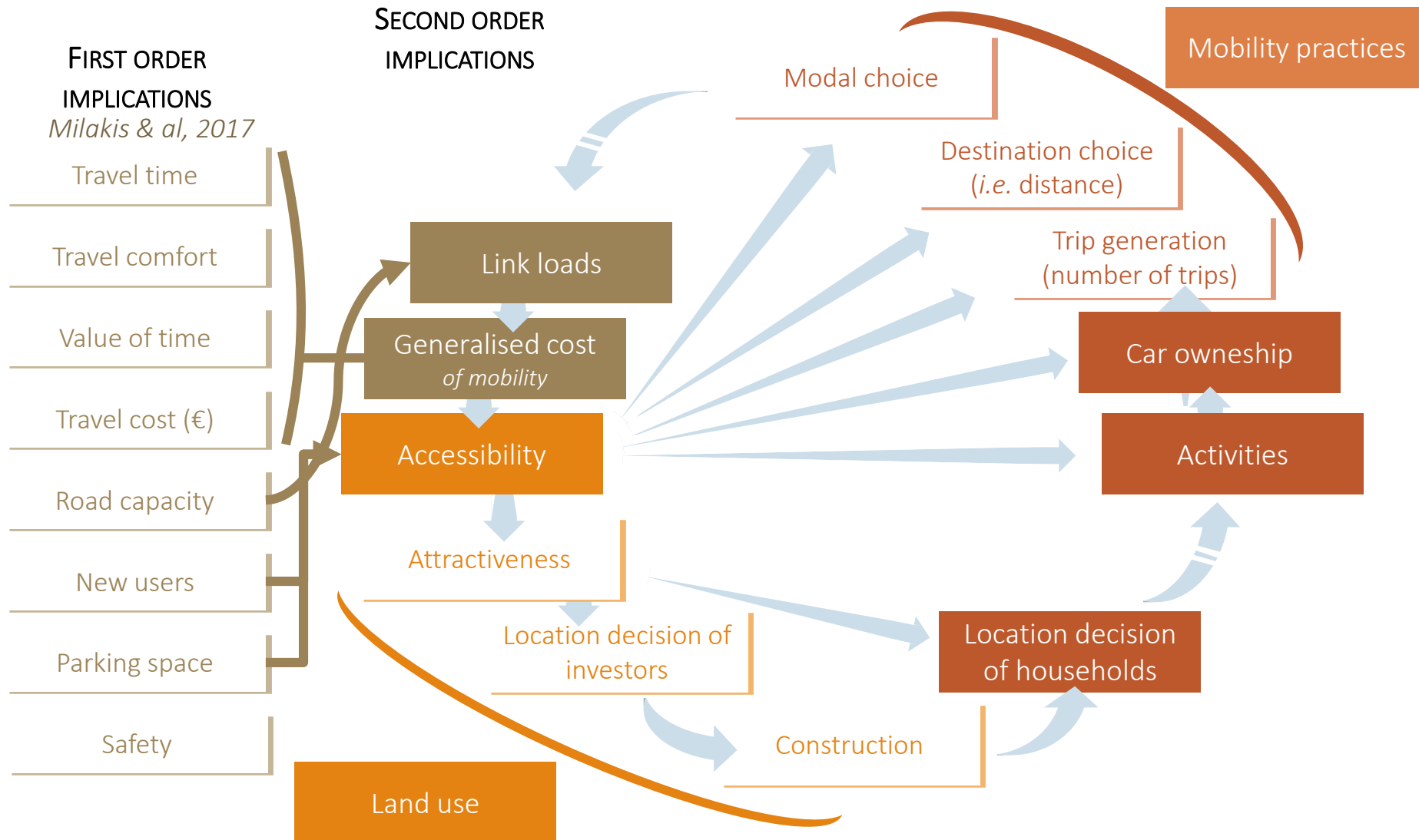
Direct and indirect implications

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Direct and indirect implications

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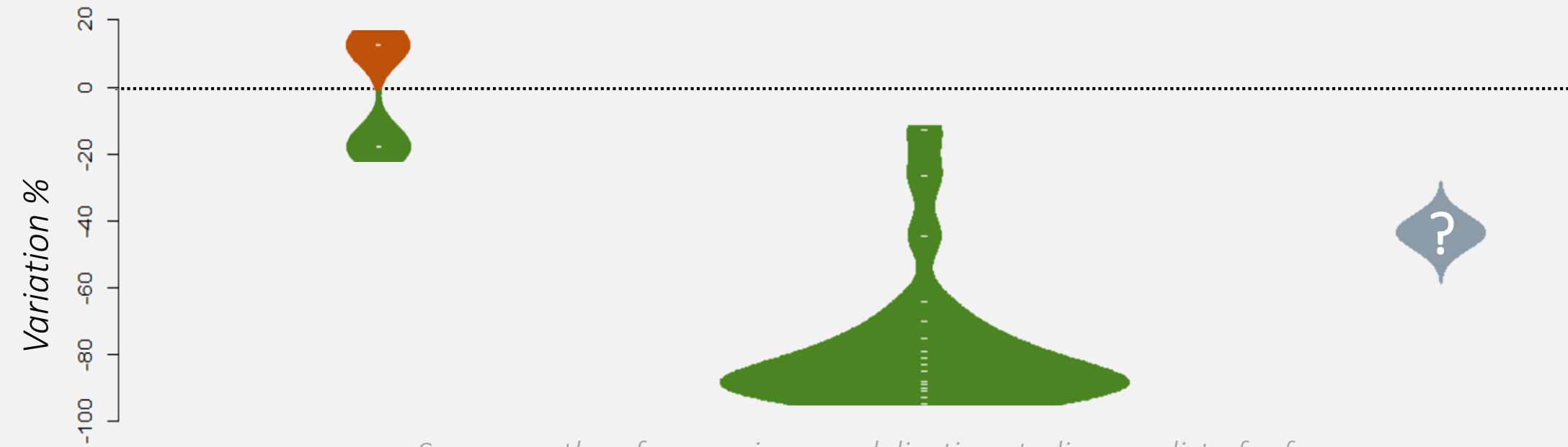


Changes in total fleet size

type A

type B







type C



TOTAL FLEET
SIZE

Source: author, from various modelisation studies, see list of references

Overview of the effects on activity level indicators

	<i>Indicator type</i>	Type A	Type B	Type C	Quantification effort
Mobility demand	 <i>passenger.km</i>	+ ~+0 to +30%	+/- ~-20 to +35%	-	***
Equipment demand	 <i>nb of cars/capita</i>	-15 to -15%	+/- -60 to -90%	-	***
Surface area of housing	 <i>m²/capita</i>	+ ~ +5 to +15%	-	-	*
Built-up land area	 <i>km² built-up</i>	+	-	-	0
Long-distance mobility demand	 <i>passenger.km</i>	?	?	?	*
Data and computation	 <i>Mb</i>	+	+	+	0
Quantification effort		***	**	0	

Conclusion, discussion and limits

Three scenarios which are not equiprobable

- *Scenarios B and C are more uncertain **technologically** and **economically***
- *In terms of **public policies**: B and C need more intervention and regulation (e.g. Cohen and Cavoli, 2019; Papa and Ferreira, 2018)*
- *A is more probable with regard to **social attractiveness** (e.g. Nielsen and Haustein, 2018; Pakusch et al., 2018; Zmud and Sener, 2017)*

Three scenarios which are not exclusive

- *Different scenarios in different type of areas (e.g. density) as in Glus et al. (2017)*
- *One after the other?*

Limits: considering technology-lifestyles interactions

Thank you!

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