Autonomous Driving – Transport, Accessibility & Land Use

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future.lab

STRUCTURE

(1) Introduction / Initial situation: Transport, Accessibility & Land Use – Interaction

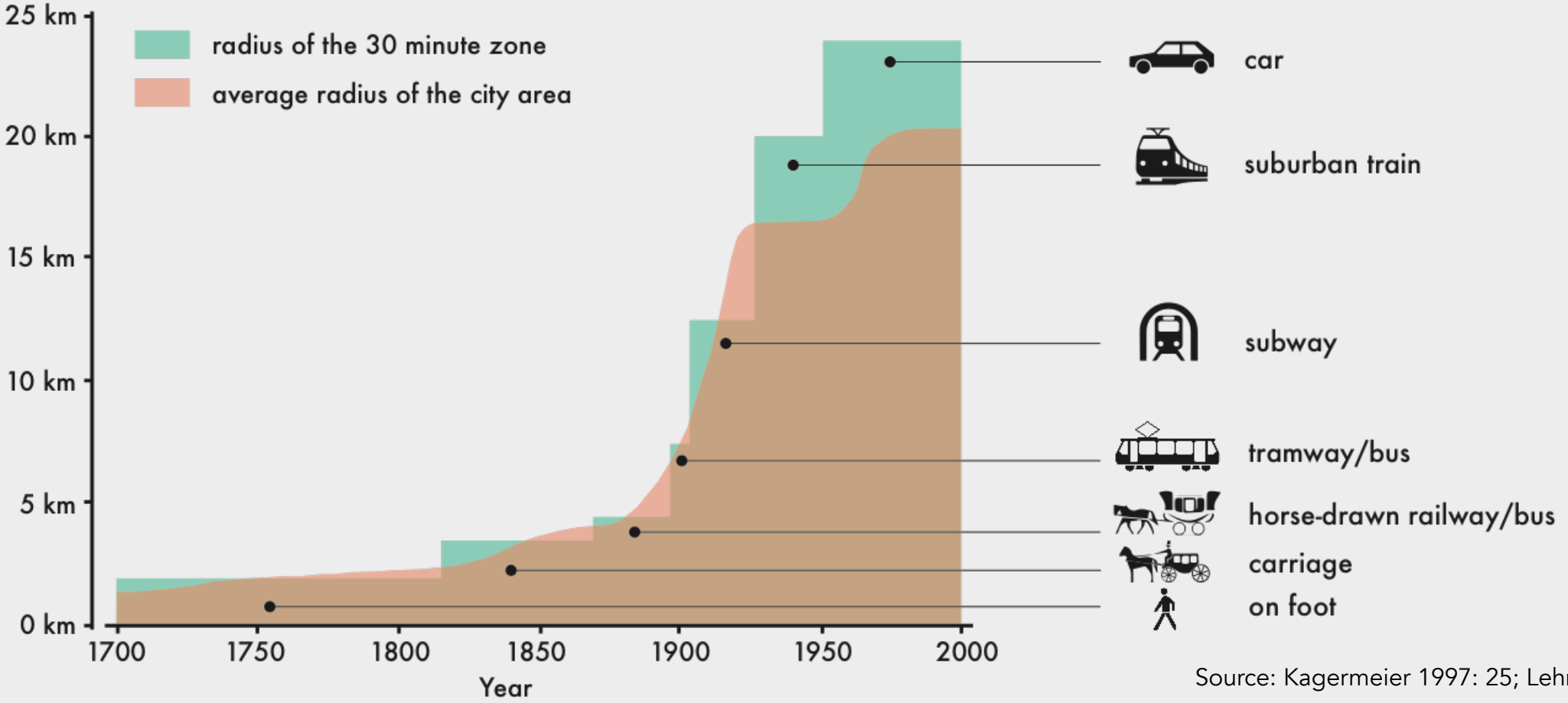
(2) Problem definition: Autonomous Driving within the Interaction of Land Use and Transport

(3) Transport and Spatial Impacts

(1) Introduction / Initial situation:
Transport, Accessibility & Land Use – Interaction

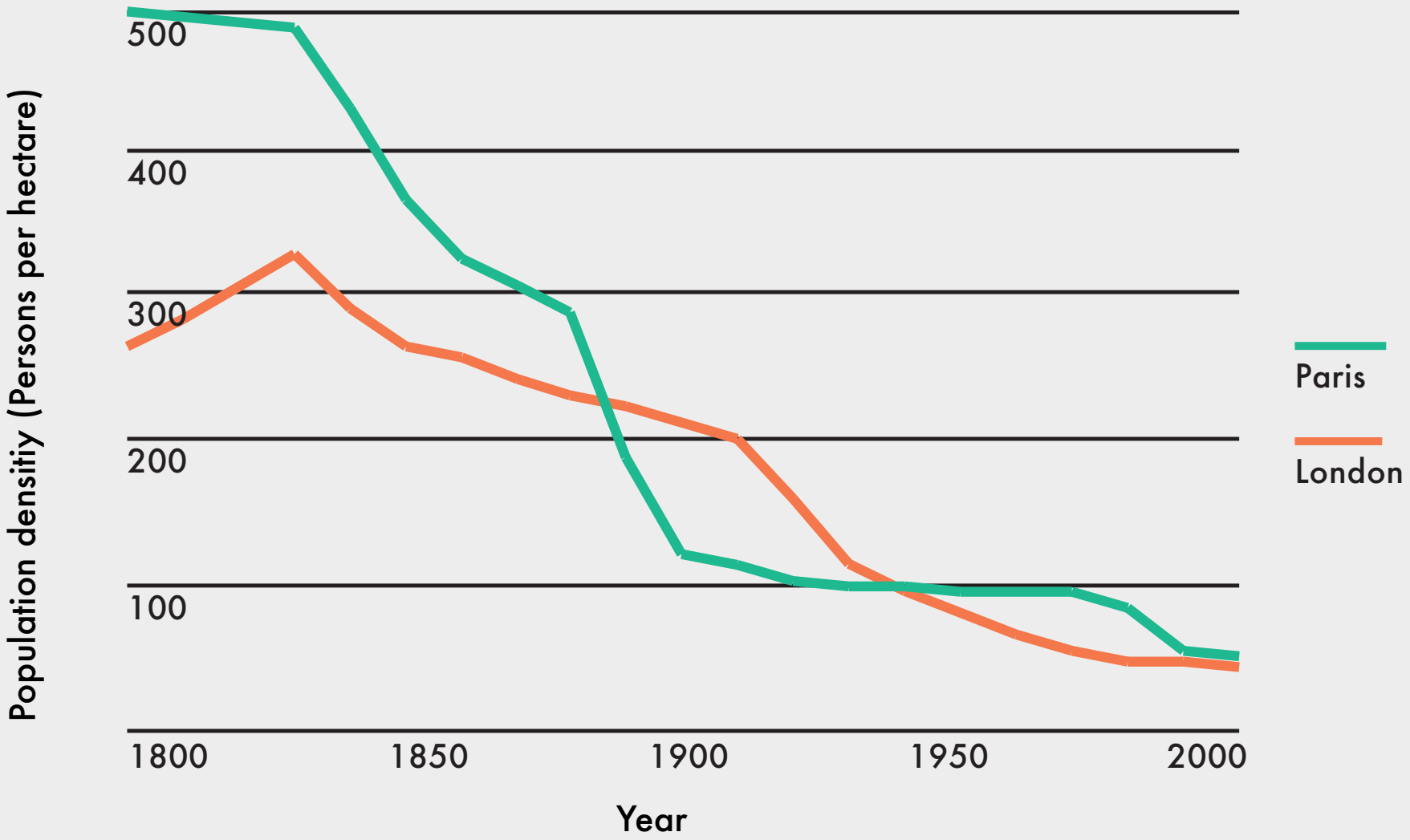
Introduction / Initial situation I

- Urban and settlement development closely linked to transport and the development of new technological innovations in mobility ever since



Source: Kagermeier 1997: 25; Lehner 1964: 22f

Introduction / Initial situation II



Source: Bloomberg Philanthropies 2017: 74; Shiomo Angel et al. 2012

Interaction of Land Use and Transport

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

Accessibility is influenced by Land Use and…
.... density, mixture, location, attractiveness, etc.

…. by the transport supply.
…..time, costs, comfort etc.

Interaction of Land Use and Transport

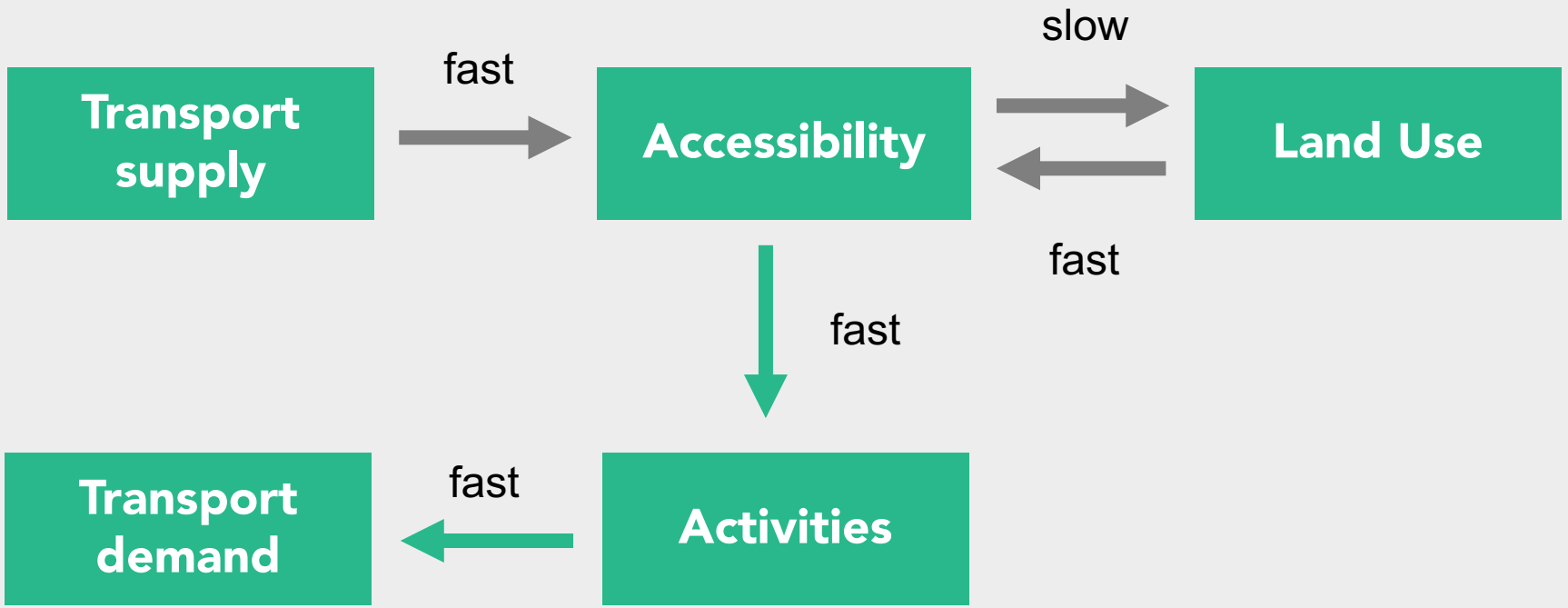
long-term decisions (location choice, purchase of a vehicle etc.)

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

… Accessibilty affects Land Use

„Those who love the countryside could not get away from it. At least not with the bus.“

Interaction of Land Use and Transport

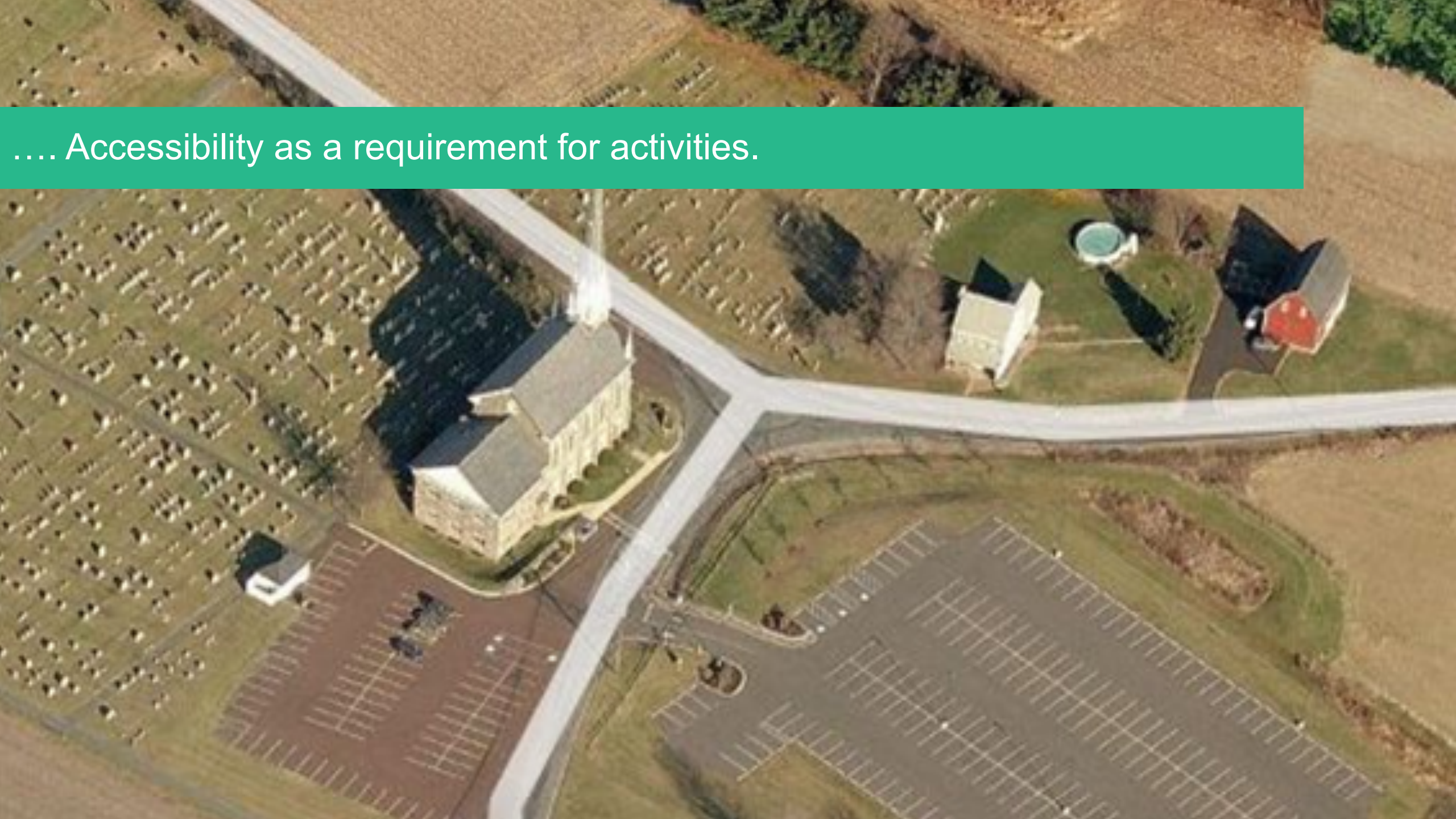


long-term decisions (location choice, purchase of a vehicle etc.)

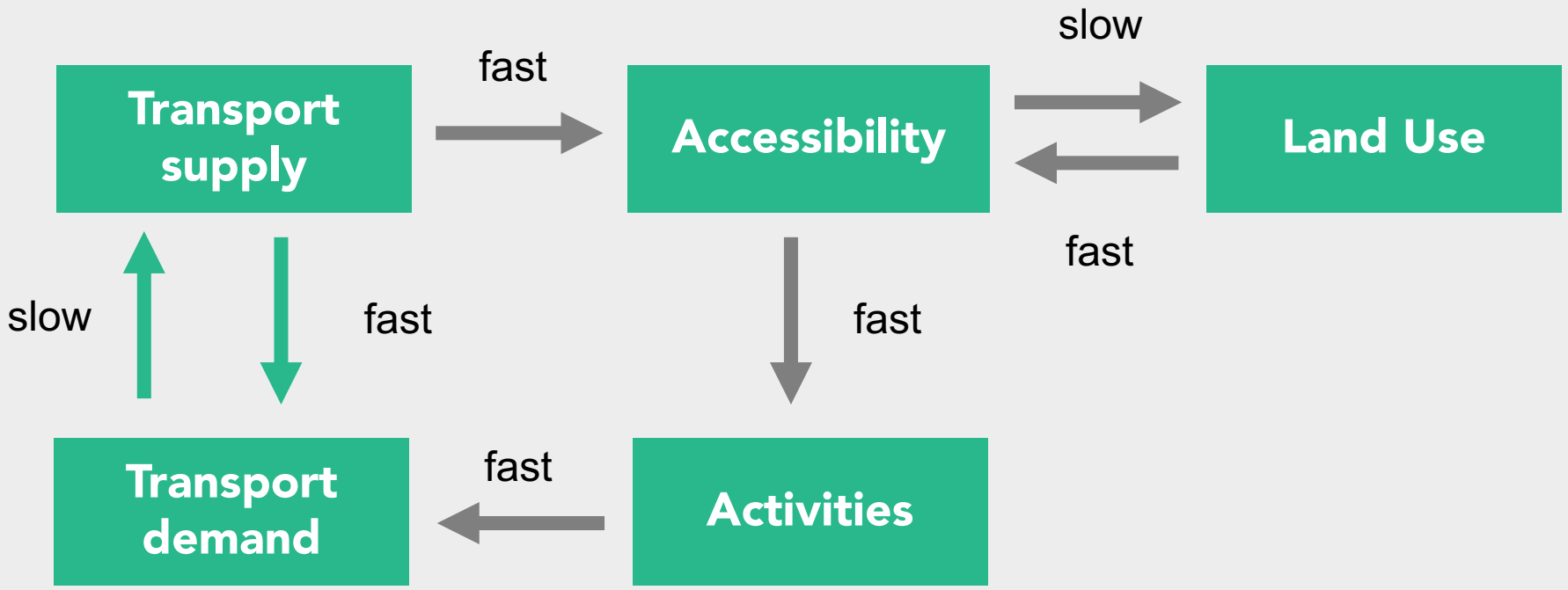
everyday behaviour (activities, means of transport, distances etc.)

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

…. Accessibility as a requirement for activities.



Interaction of Land Use and Transport



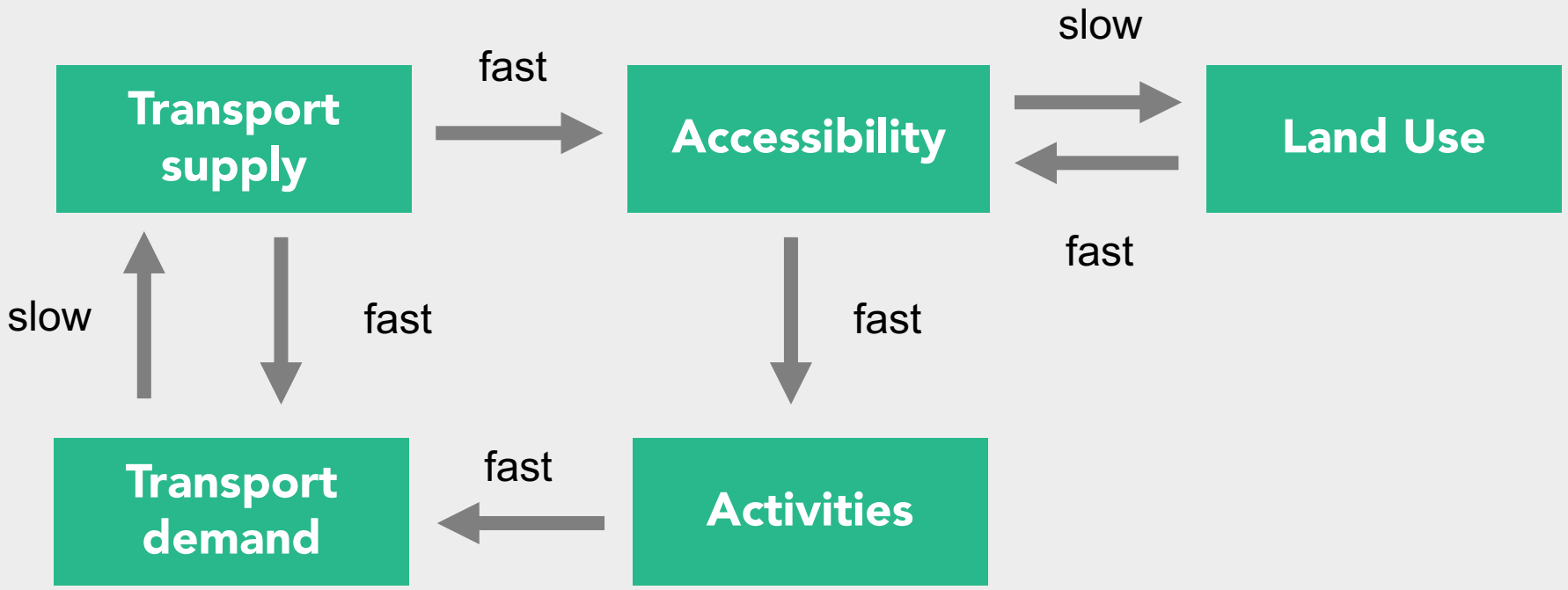
long-term decisions (location choice, purchase of a vehicle etc.)

everyday behaviour (activities, means of transport, distances etc.)

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

…. Transport demand and transport supply are interdependent.

Interaction of Land Use and Transport



long-term decisions (location choice, purchase of a vehicle etc.)

everyday behaviour (activities, means of transport, distances etc.)

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

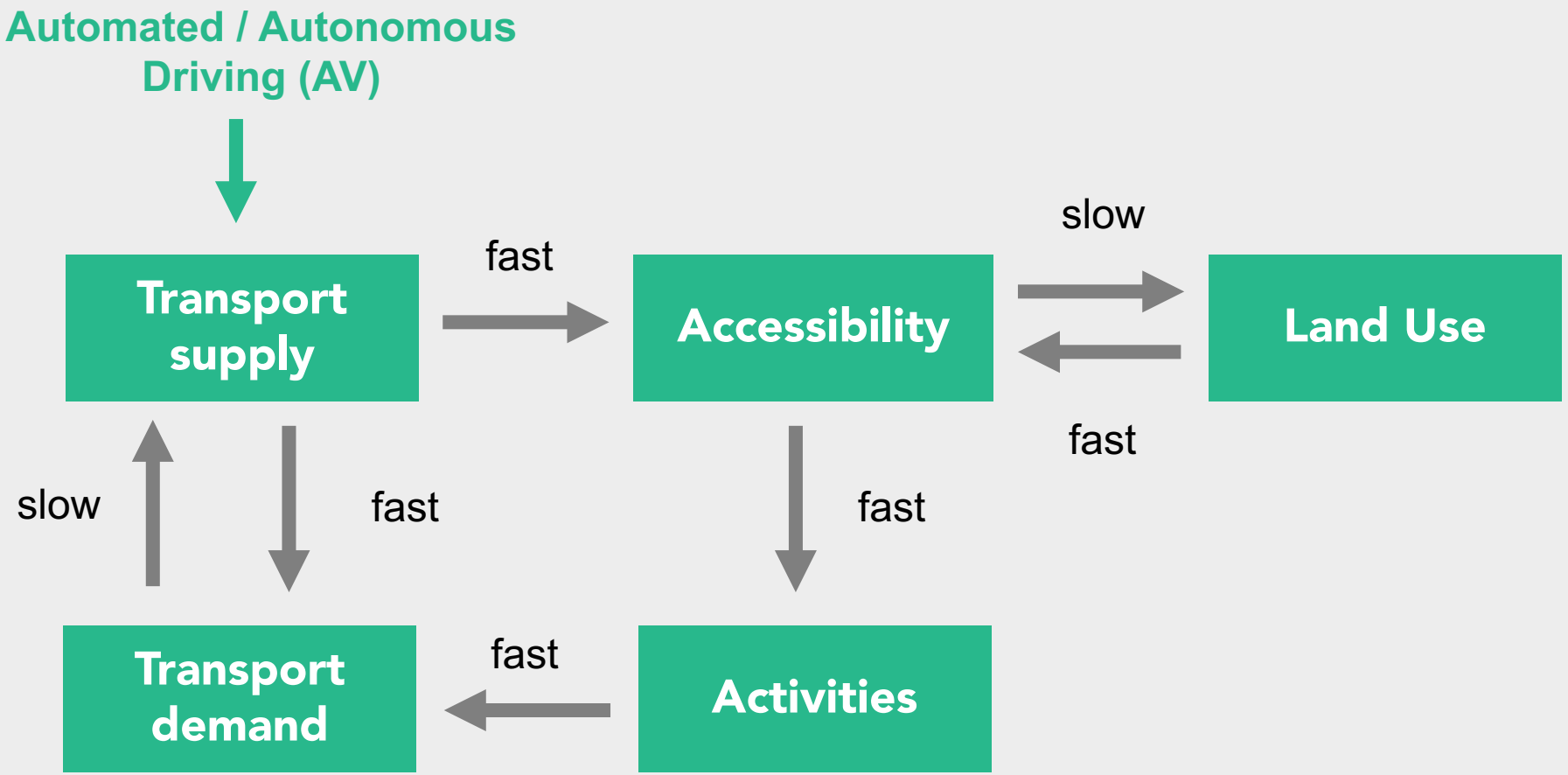
(2) Problem definition:
Autonomous Driving within the Interaction of Land Use and Transport

Problem definition

- Automated / autonomous Driving (AV) as a new technological innovation in mobility

- Different transport supply with changes in Transport demand (Alessandrini 2015: 148; Friedrich & Hartl 2016: 7, European Commission 2016: 1)

Autonomous Driving within the Interaction of Land Use and Transport

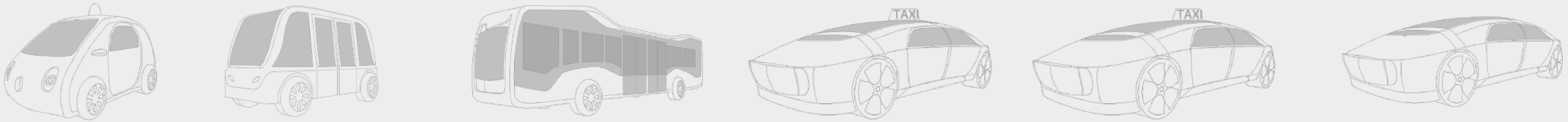


long-term decisions (location choice, purchase of a vehicle etc.)

everyday behaviour (activities, means of transport, distances etc.)

Source: Wulfhorst 2003: 16; Wegener & Fürst 1999: 5f

Changes of the Transport Supply

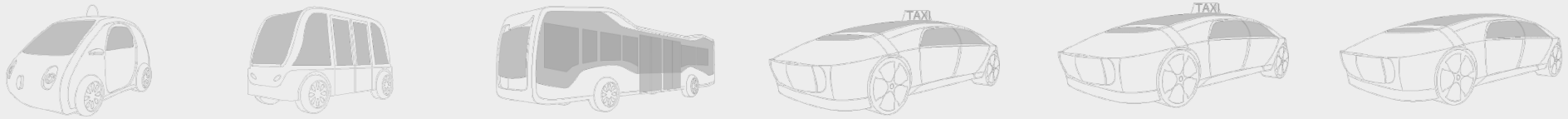


Pod Car | **Autonomous Shuttle** | **Autonomous Bus** | **Autonomous Taxi** | **Autonomous Shared Taxi** | **Private Autonomous Vehicle**

- Regarding:
  - Comfort
  - Time (e.g. driving time, time for accessing and egressing the vehicle)
  - Reliability
  - Costs / operating costs €
  - Safety

dependent on the different Use Cases AV

Examples



	Pod Car	Autonomous Shuttle	Autonomous Bus	Autonomous Taxi	Autonomous Shared Taxi	Private Autonomous Vehicle
reduction of the time for accessing and egressing the vehicle[1]	+	–	–	++	+	++
increase in comfort due to permitting other activities during driving[2]	o	o	–	+	o	++
...						

– low relevance o medium relevance + medium to high relevance ++ high relevance

[1](Heinrichs 2015: 229)
[2](Friedrich & Hartl 2016: 7)

Impacts within the Interaction of Land Use and Transport I

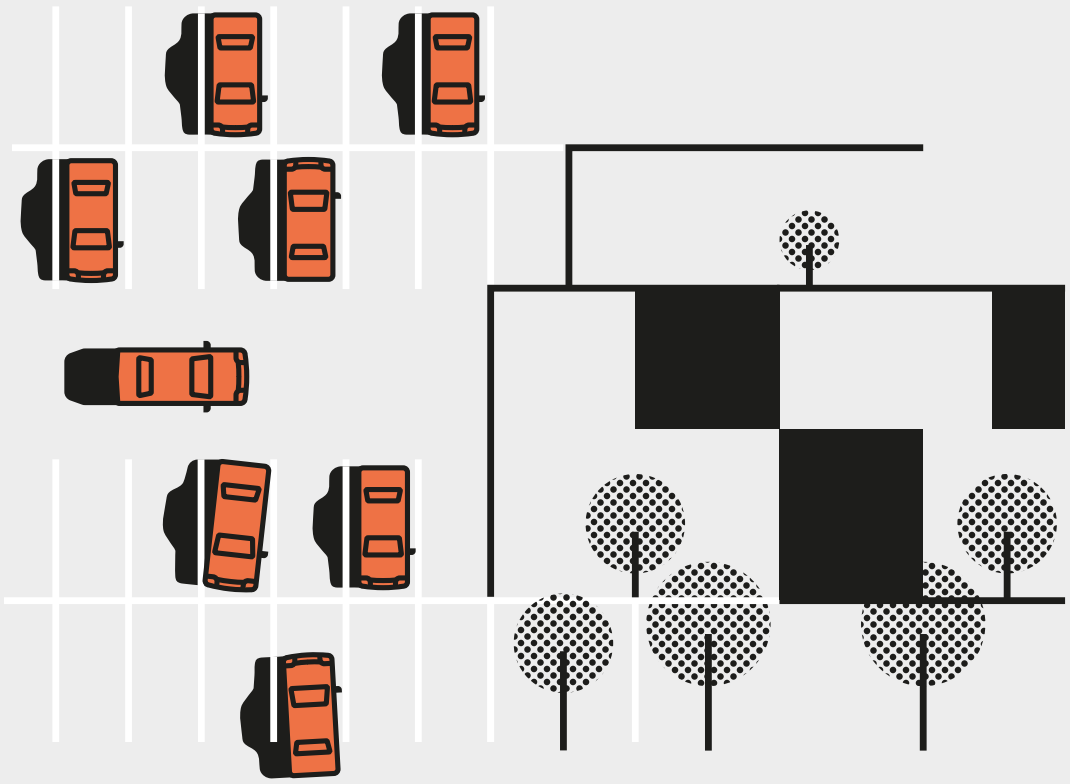
- Change of Accessibility and Transport demand:
  - Fast: impacts on everday mobility: activities, number of journeys, length of journeys, choice of means of transport (and decision of purchasing a vehicle)
  - Slow: possible impacts on the location choice of households, firms and public institutions and hence the settlement structure

Impacts within the Interaction of Land Use and Transport II

- Moreover influence of:
  - Individual characteristics and needs of persons, households and firms like e.g. household formation, generation of property etc.
  - Area attractiveness and Land availability / supply of dwellings
  - Politics (e.g. Mobility politics, Spatial politics)
  - Accompanying technological developments (Bertolini 2012: 20)

Impacts within the Interaction of Land Use and Transport III

- Simultaneously, impacts of a potential conversion of parking spaces due to AV on the availability of land and the construction activity of investors and therefore the supply (and prices) of dwellings (Moreno 2017: 5)



Source: Bloomberg Philanthropies 2017: 29

(3) Transport and Spatial Impacts

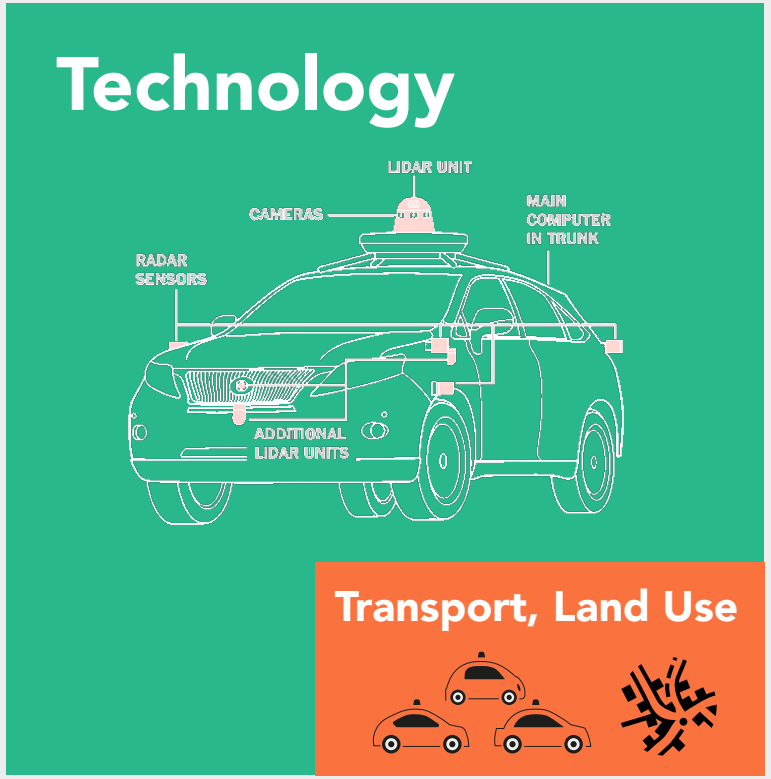
Transport and Spatial Impacts - Research

- Current international discourse on AV focusses mainly on the field of technology

- Transport and spatial impacts are hardly part of studies (Gertz & Dörnemann 2016: 6; Milakis et al. 2017: 40)

- Existing investigations by simulations on the basis of different scenarios or assumptions regarding the composition of the transport supply (Truong et al. 2017: 2

Research on AV



Transport Impacts

(several...)

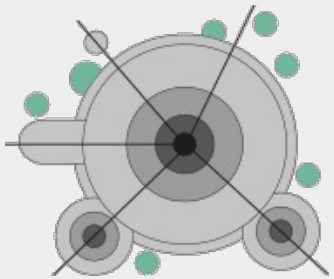
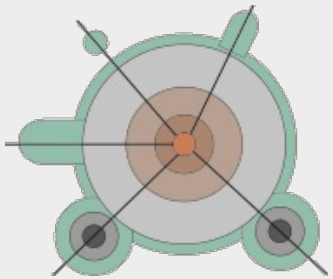
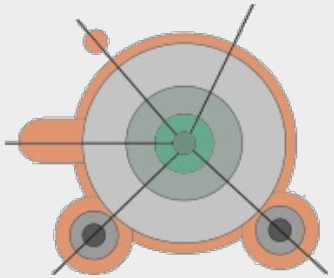
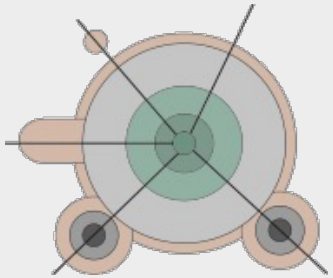
Settlement structure/type	rather monocentric, compact		rather disperse	
Share of Ridesharing	low	high	low	high
Vehicle miles/kilometers travelled	-11% - +44%	-36% - +6%	+11% - + 60%	-
Number of vehicles to process the current transport demand	-83% - -66%	-95% - -90%	-	-85%
Increase in road capacity	low	high	low	high
Vehicles miles/kilometers travelled	-	-	-	+2% - +4%
Reduction of the value of time	low	high	low	high
Vehicles miles/kilometers travelled	-	-	-	+13%

→ thereby also reduction of needed parking spaces

ITF 2015; Friedrich & Hartl 2016; Fagnant & Kockelmann 2014; Spieser et al. 2014; Bischoff & Maciejewski 2016; Gucwa 2014; Burns et al. 2013; Childress et al. 2015; Zhang et al. 2015; Boesch et al. 2016; Hörl et al. 2016; Rigole 2014; Llorca 2017

Spatial Impacts

(few, not transferable...)

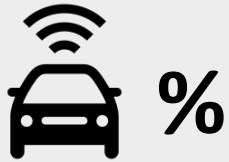
	Seoul, KOR	Melbourne, AUS		
Share of Ridesharing	low	low	high	high
Reduction of the value of time	-	high	-	high
Spatial / Settlement development / (spatial) Population development	 ↑ considerable dispersed settlement development	 ↑ High increase in areas far away from the city centre ↓ High decrease in areas near to the city centre	 ↑ High increase in areas near to the city centre ↓ High decrease in areas far away from the city centre	 ↑ Increase in areas near to the city centre ↓ Decrease in areas far away from the city centre

Kim et al. 2015; Thakur et al. 2016

Transport and Spatial Impacts

- Impacts dependent on:
  - Share of ridesharing and maximum waiting time of users 

  - Changes in the value of time 

  - Increase in road capacity 
  - Penetration rate of AV 

  - Settlement structure 

Transport and Spatial Impacts - Conclusion

- Transport impacts: first investigations in the US, Europe and Asia
- Spatial impacts: only few studies, so far only in South Korea and Australia
- Modelling of possible spatial impacts / impacts on the settlement structure in the context of European cities not conducted so far
- Different results make clear, that impacts are also dependent on the existing spatial / settlement structure

Discussion

- Which use cases for autonomous driving could complement or replace the existing transport supply in different spatial structures?

- How or in what form and for whom does the accessibility change through different use cases? Where do the impacts set in?

- Are changes in settlement structures expected to occur in the long-term, or have other factors a much larger impact? In which form are these conceivable?