Master Urban Engineering and Habitat

(2022 – 2023)

Course Smart City

Ch7: Smart mobility

Professor Isam SHAHROUR

Smart Mobility

Outline

- **What is urban mobility ?**
- **What are the challenges of urban mobility?**
- **What is the smart mobility ?**

Smart Mobility

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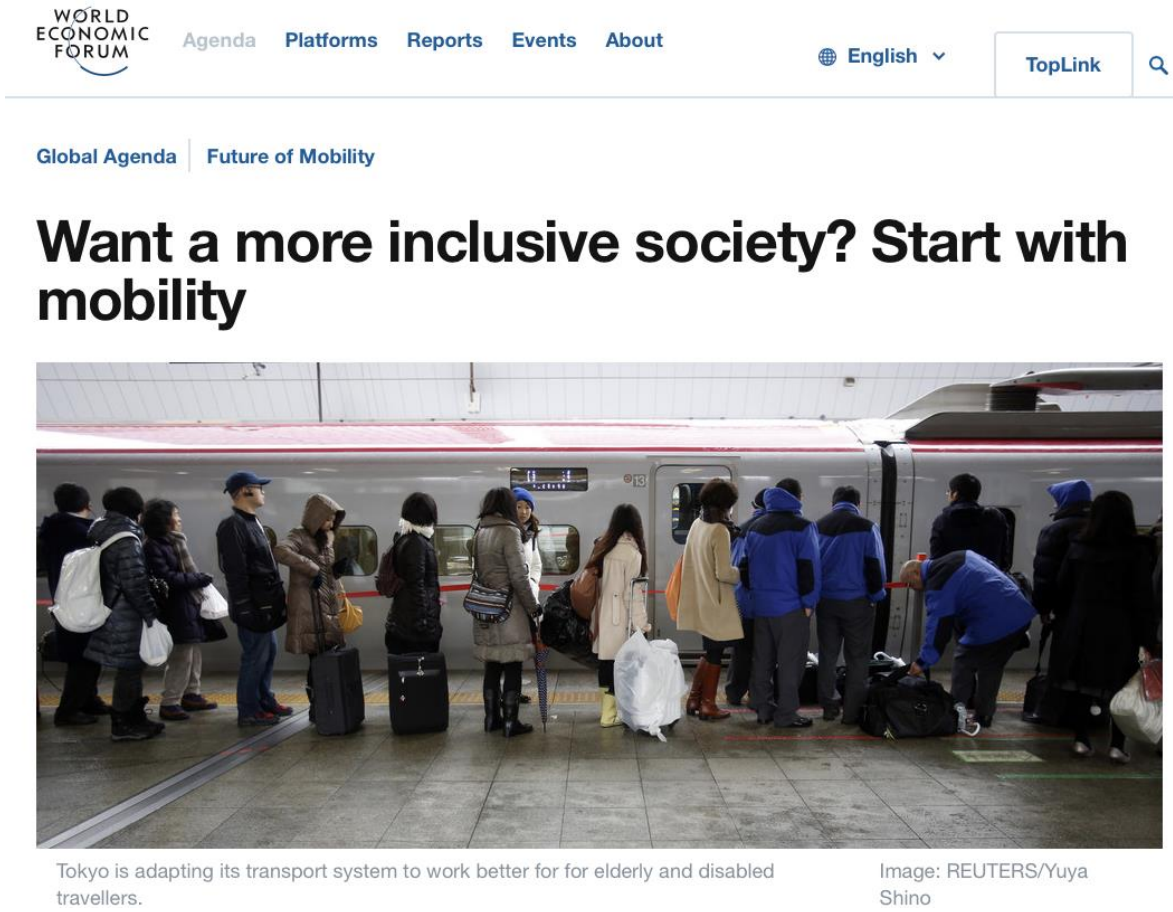
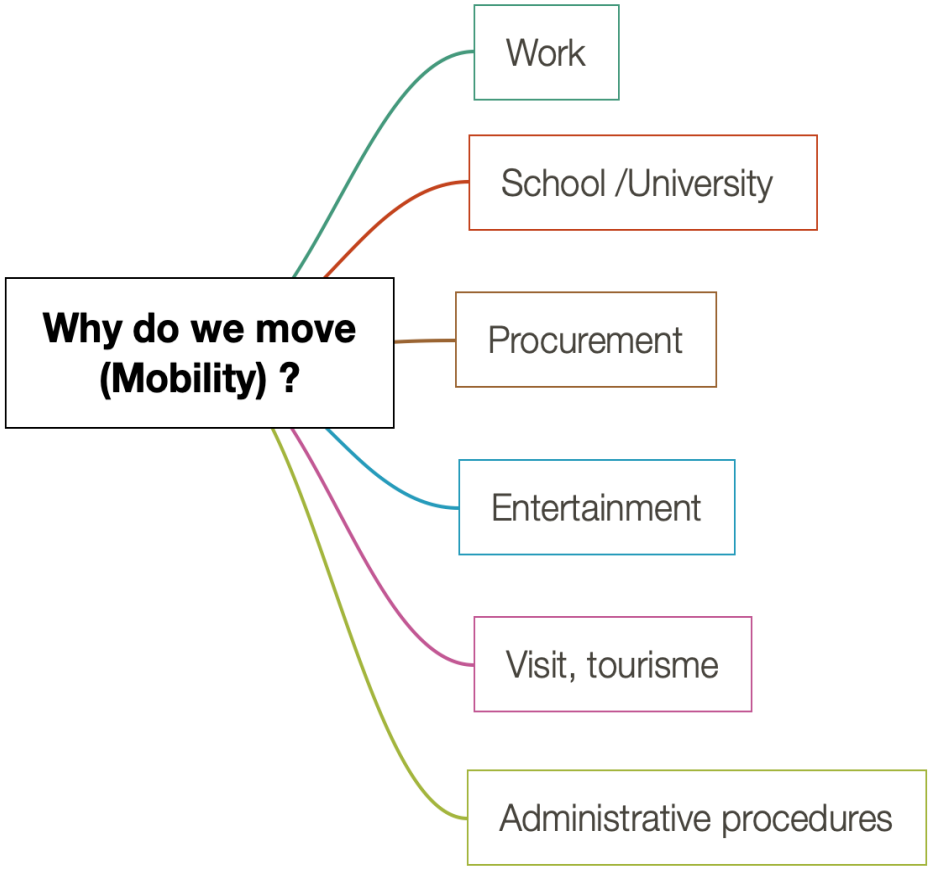
Mobility is a core human right

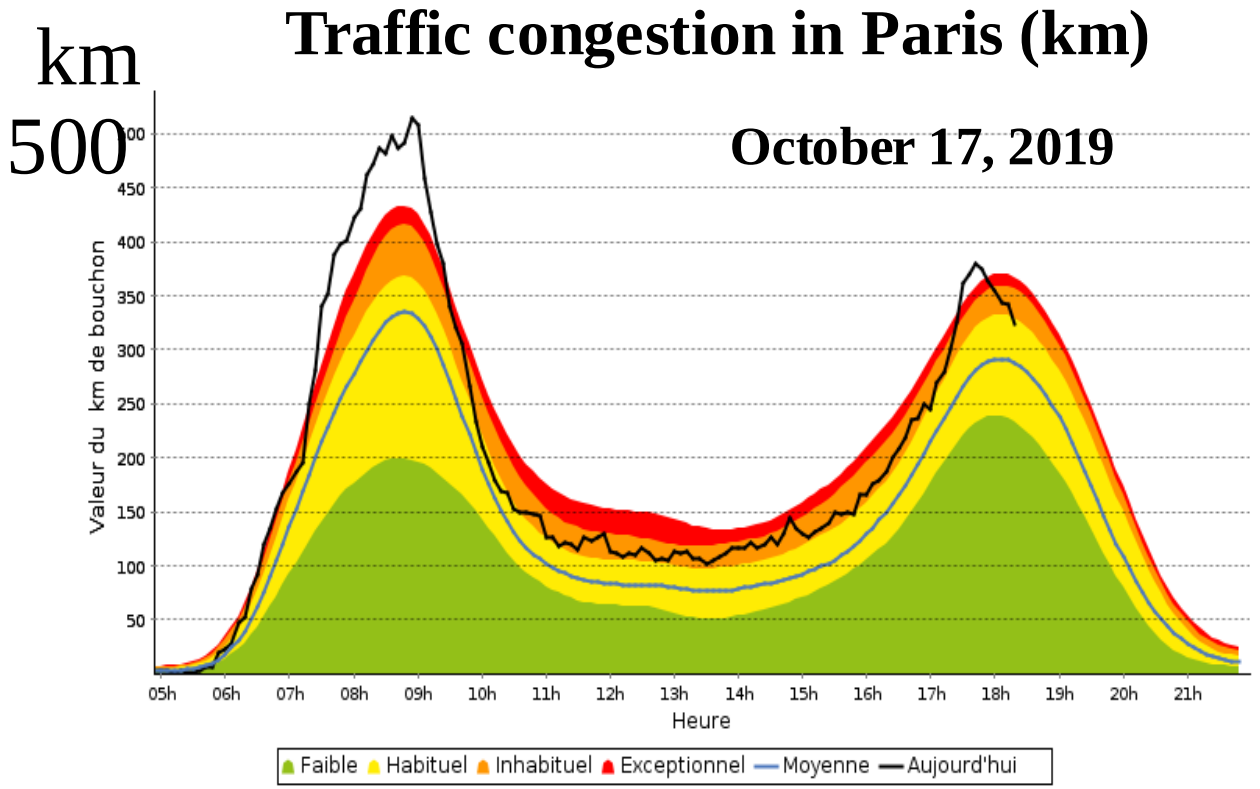
Mobility is a core human right *(UN Universal Declaration of Human Rights)*



What is urban mobility ?

Ability to move people and things in urban area

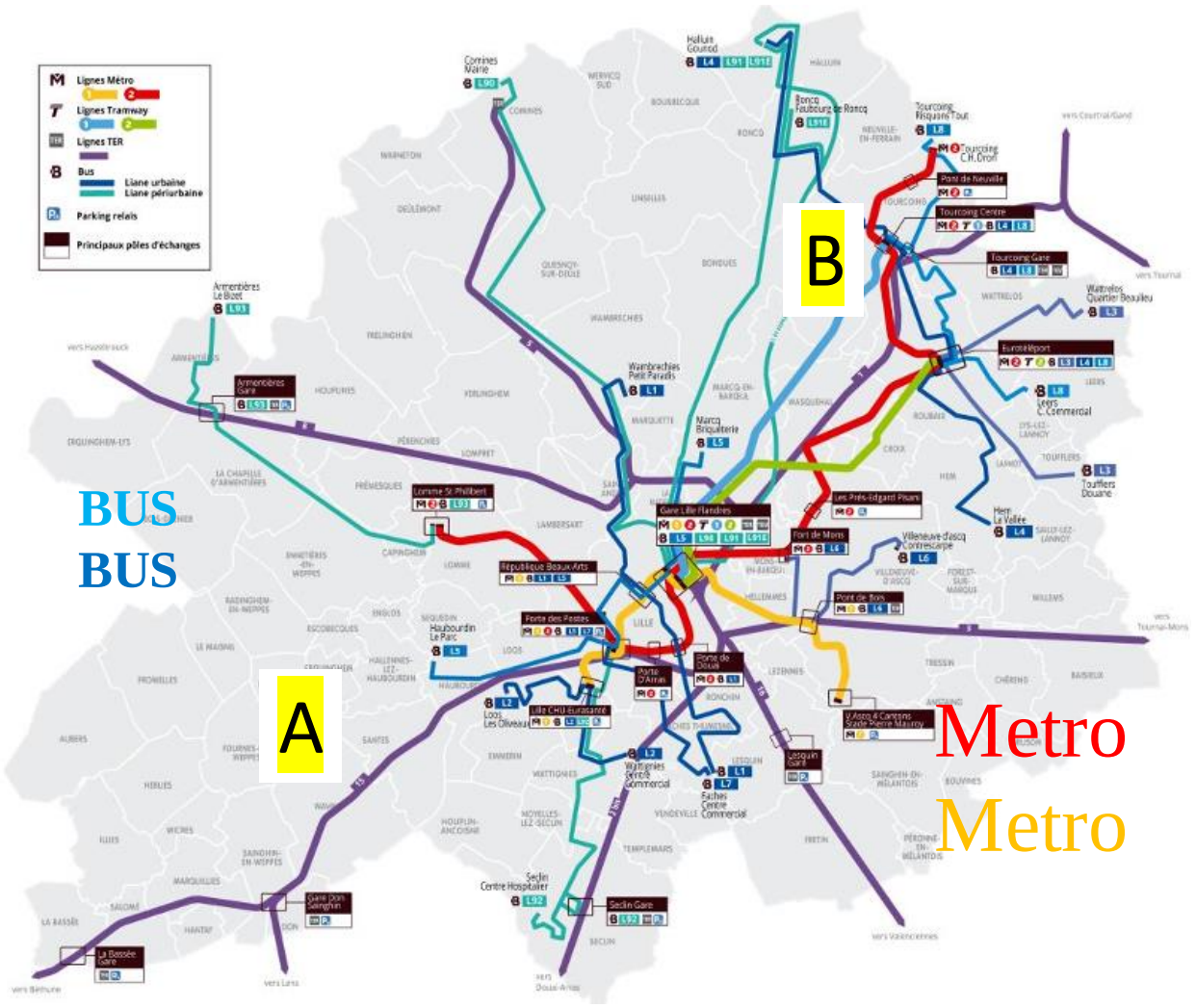




Mobility in urban area

To move from A to B, I use:

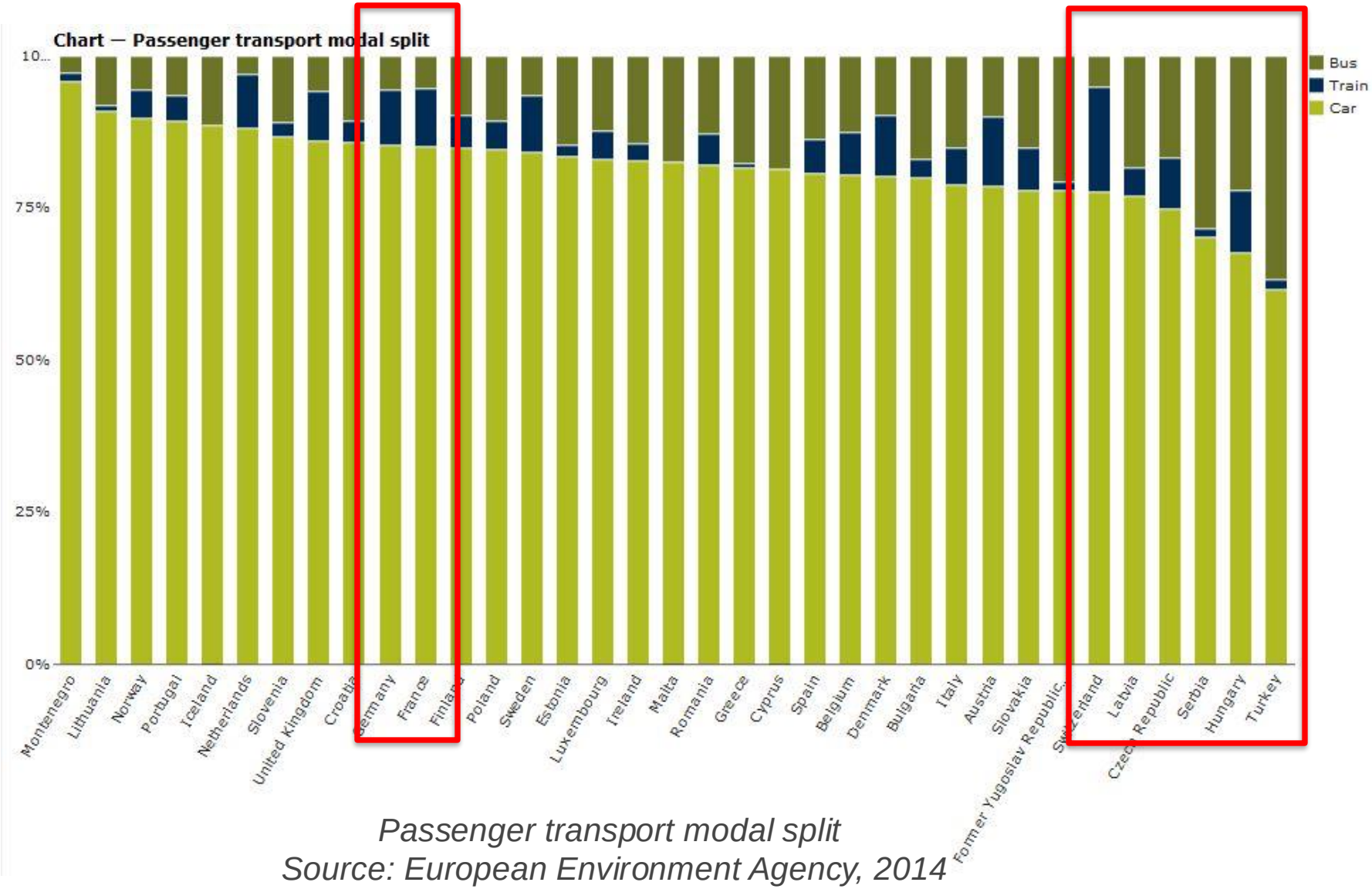
- Vehicle
- Walking, TER, BUS or Tramway, walking
- Personal vehicle, parking, metro, BUS, Walking,…
- …..



Transport modes in Europe

Bus

Car



Passenger transport modal split
Source: European Environment Agency, 2014

Traveler mobility performance system

Value	Description
Travel time	Reducing travel time (includes service and vehicle speed)
Travel price	Reducing price, fair price
Physical comfort	Enhancing the comfort of the body
Sensorial comfort	Enhancing the comfort of the senses
Cognitive comfort	Improving psychological comfort (ease of use, travelers interactions, information)
Temporal availability	Increasing frequency of the travel mean and make it available out of peak hours
Spatial availability	Improving access to underserved regions
Safety/security	Reducing the risk of injuries (caused either by material of people)
Improvement of travel activities	Enhancing travel activities

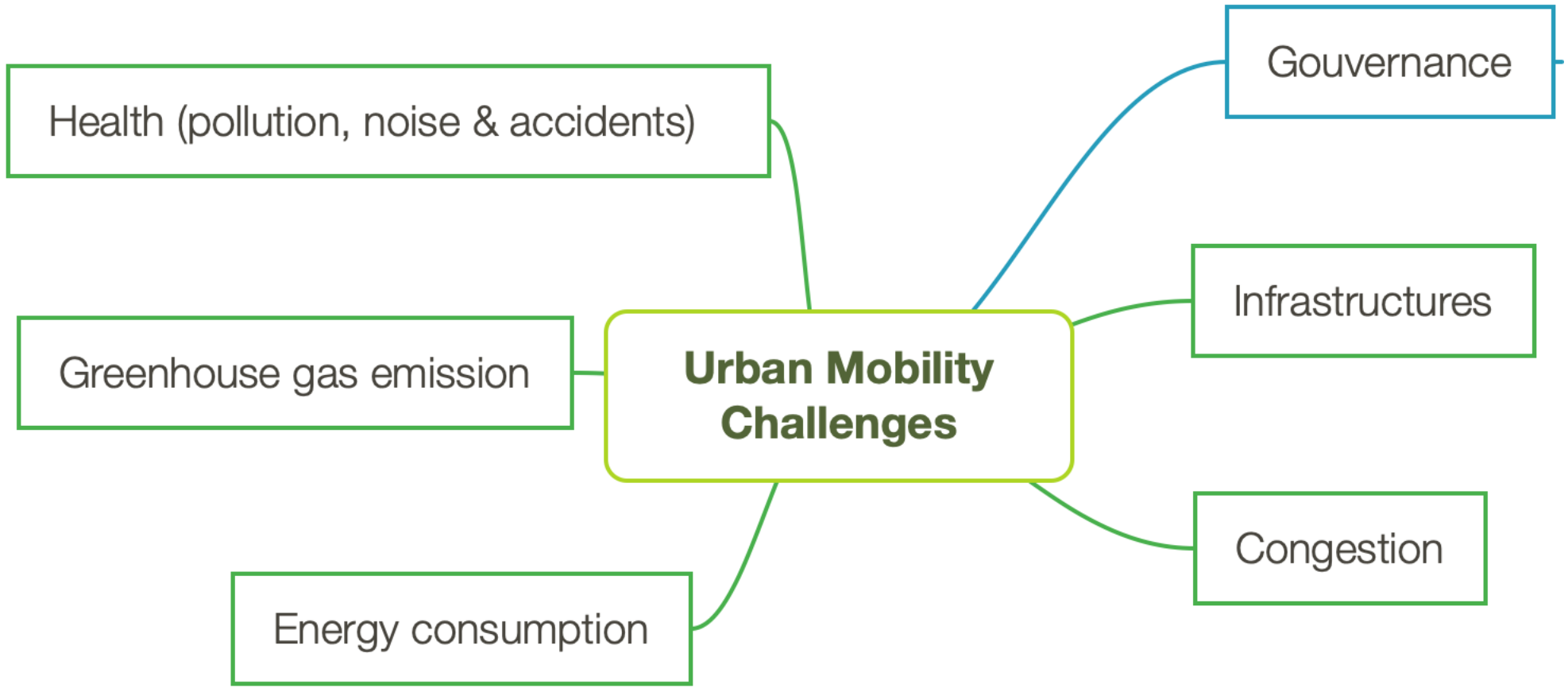
Smart Mobility

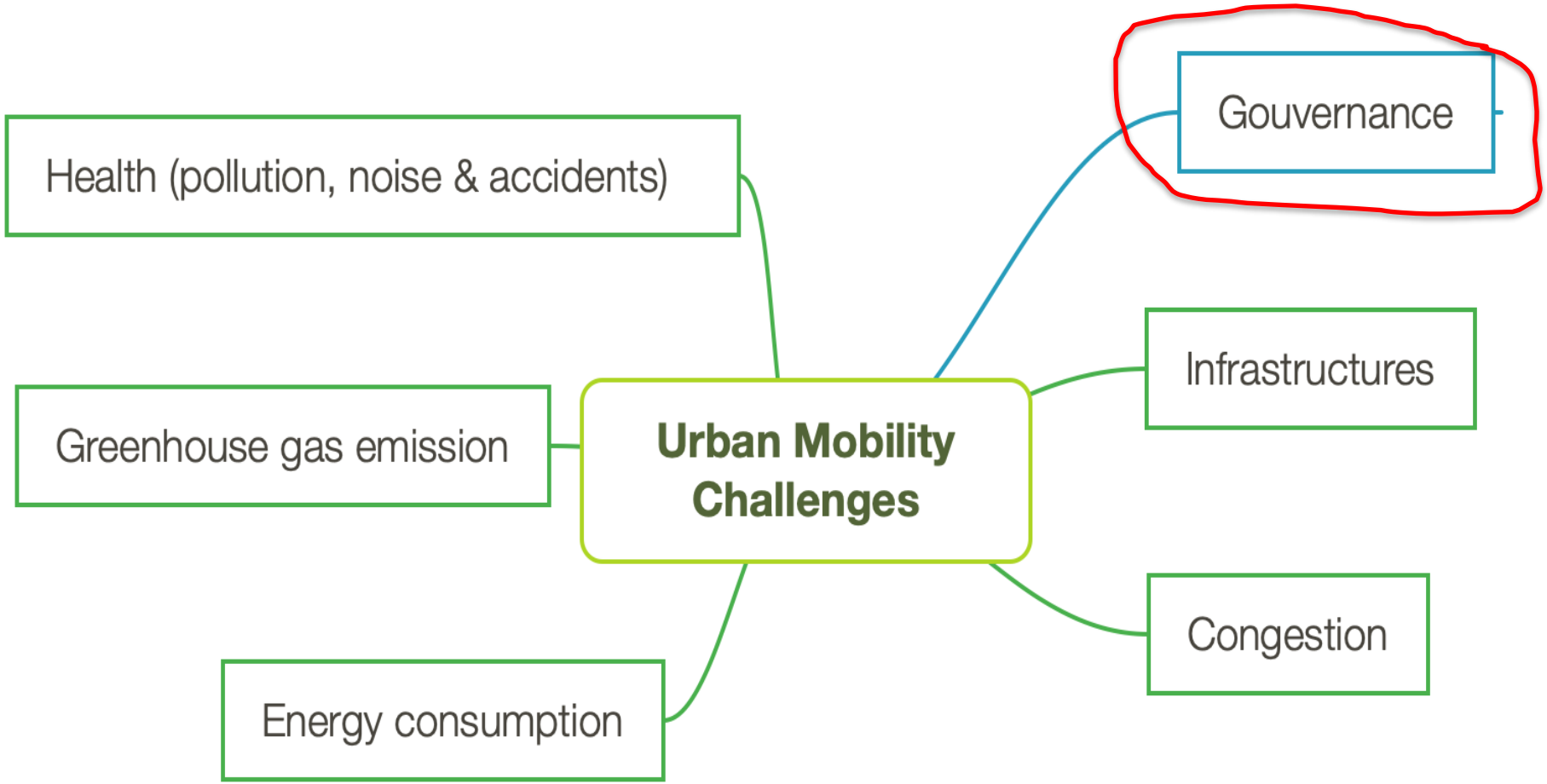
Outline

- What is urban mobility ?
- **What are the challenges of urban mobility?**
- What is the smart mobility ?

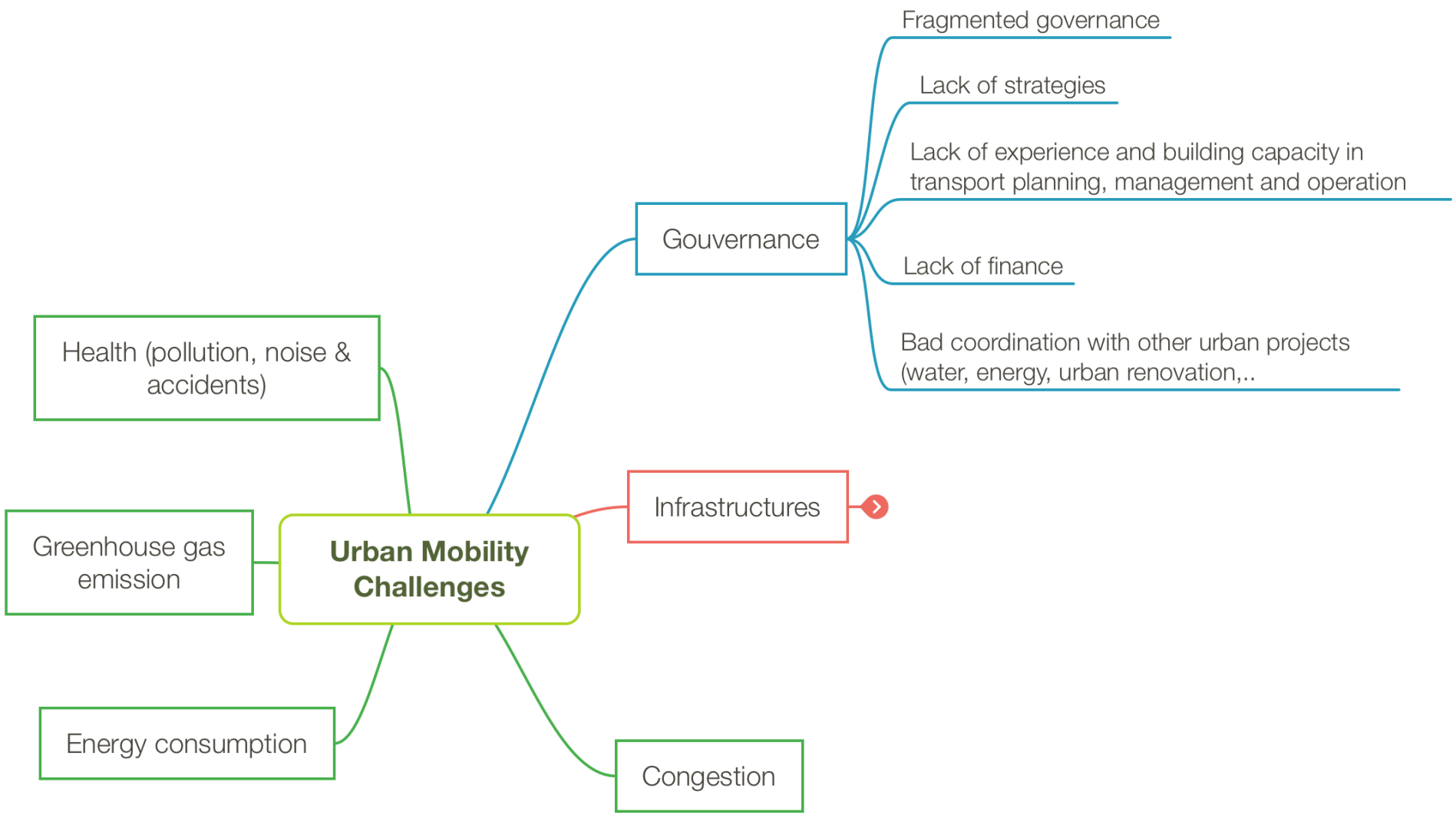
Challenges of urban mobility

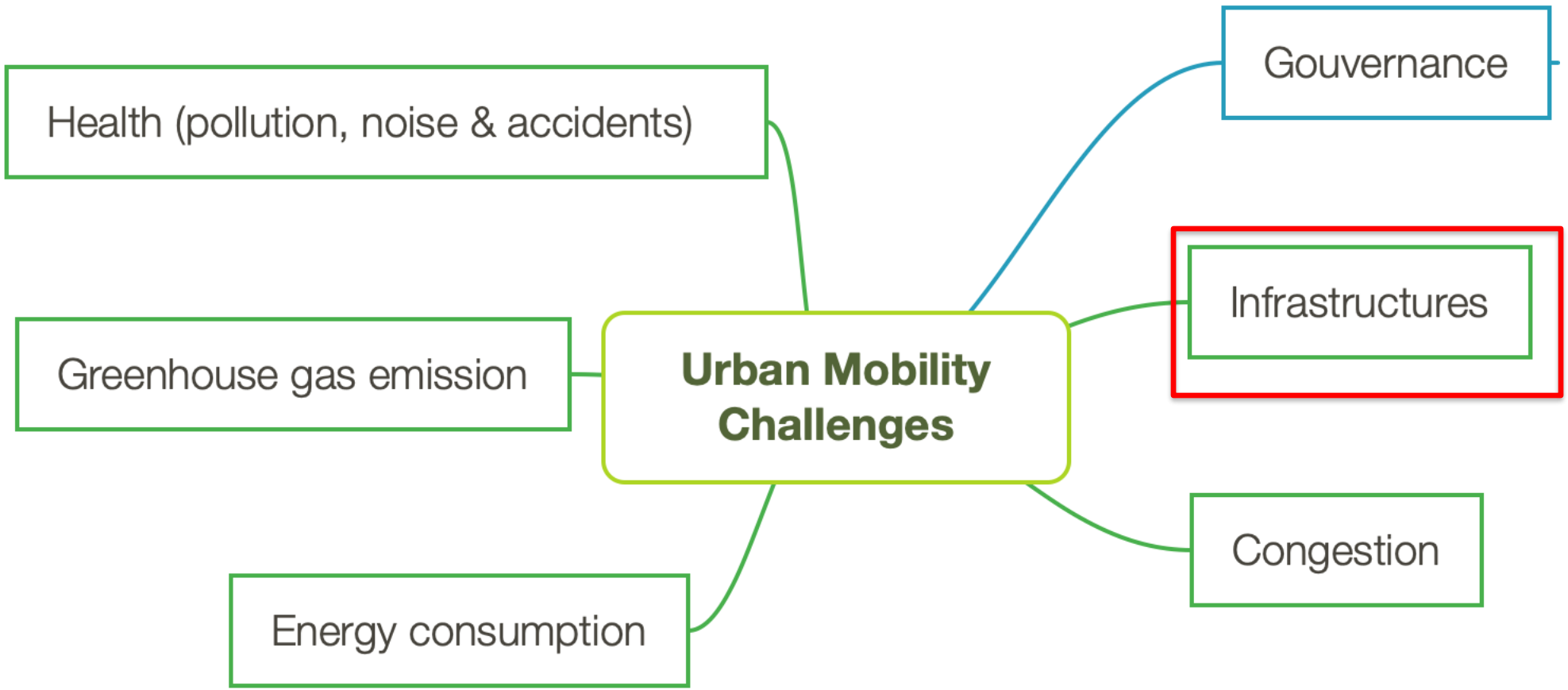
In urban area, mobility is a must: Consequently, it concerns large communities and things with tough consequences and questions on the quality of life, economic and social activity, and expenses


Health (pollution, noise & accidents)
Greenhouse gas emission
Energy consumption
Urban Mobility Challenges
Gouvernance
Infrastructures
Congestion



Decision-taking and strategies


Urban Mobility Challenges
Gouvernance
Fragmented governance
Lack of strategies
Lack of experience and building capacity in transport planning, management and operation
Lack of finance
Bad coordination with other urban projects (water, energy, urban renovation,..
Infrastructures
Congestion
Energy consumption
Greenhouse gas emission
Health (pollution, noise & accidents)


Health (pollution, noise & accidents)
Greenhouse gas emission
Energy consumption
Urban Mobility Challenges
Gouvernance
Infrastructures
Congestion

Key figures of transport in France

- Roads : 1,1 million km
- Highway : 11 000 km
- Railway : 28 000 km
- Metro: 2 000 km
- Waterway : 9 000 km

ÉVOLUTION DES RÉSEAUX

En kilomètres

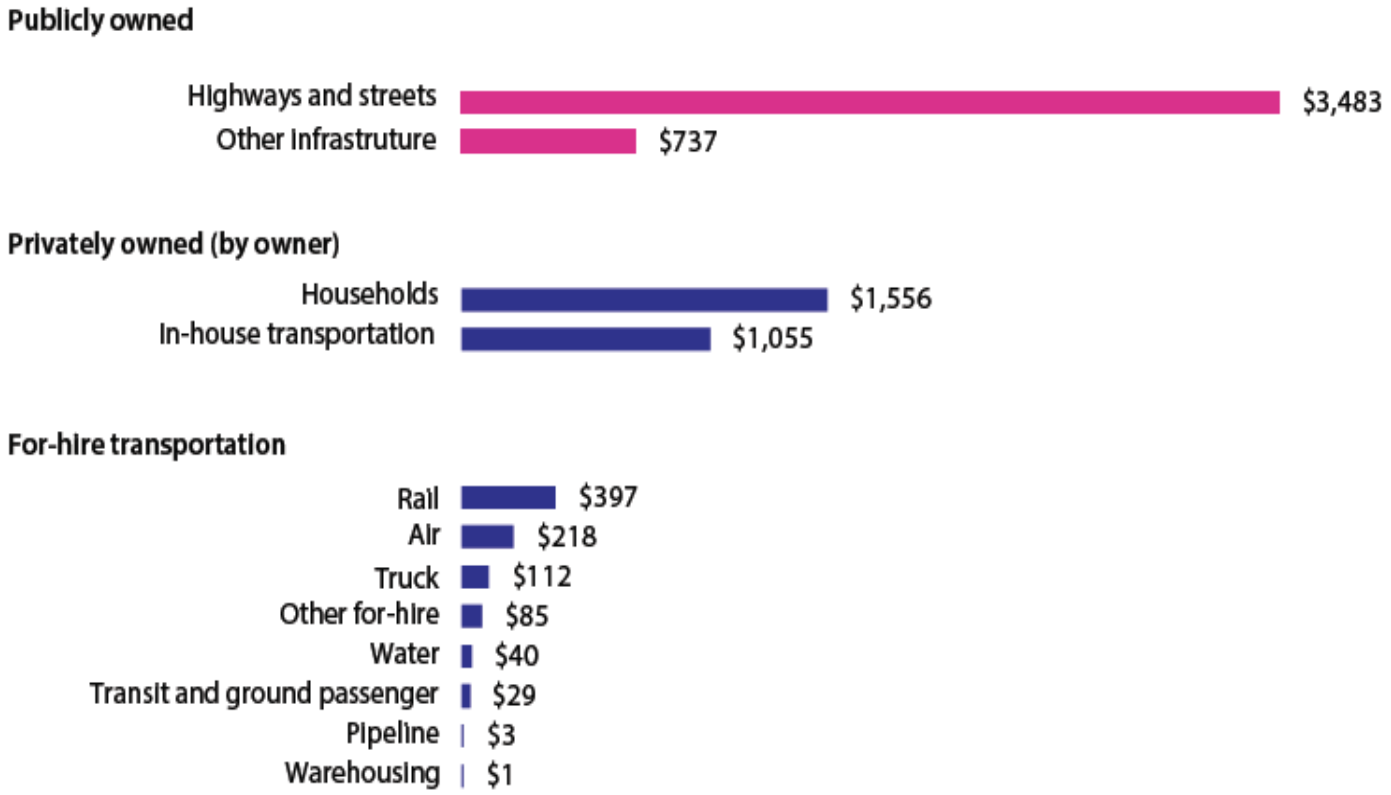
	1996	2001	2006	2011	2016
Routes hors DOM[1]	963 451	997 082	1 014 025	1 050 468	1 092 913
Routes France entière	-	-	-	-	1 103 366
Voies ferrées exploitées par la SNCF	31 852	31 385	30 883	30 404	28 364
dont trains d'Île-de-France	*nd*	*nd*	*nd*	*nd*	*1 484*
Métro, RER, tramways	917	1 032	1 212	1 552	1 659
Métro, RER et tramways Île-de-France[2]	736	763	859	963	914
Métro et tramways en province[3]	181	269	353	589	745
Véloroutes et voies vertes	nd	nd	nd	6 900	13 700

https://www.jobtransport.com/actualites/transport/les-chiffres-du-transport-2019-emploi-economie-developpement-pour-tout-savoir-cest-ici/

Transport Infrastructures (US)

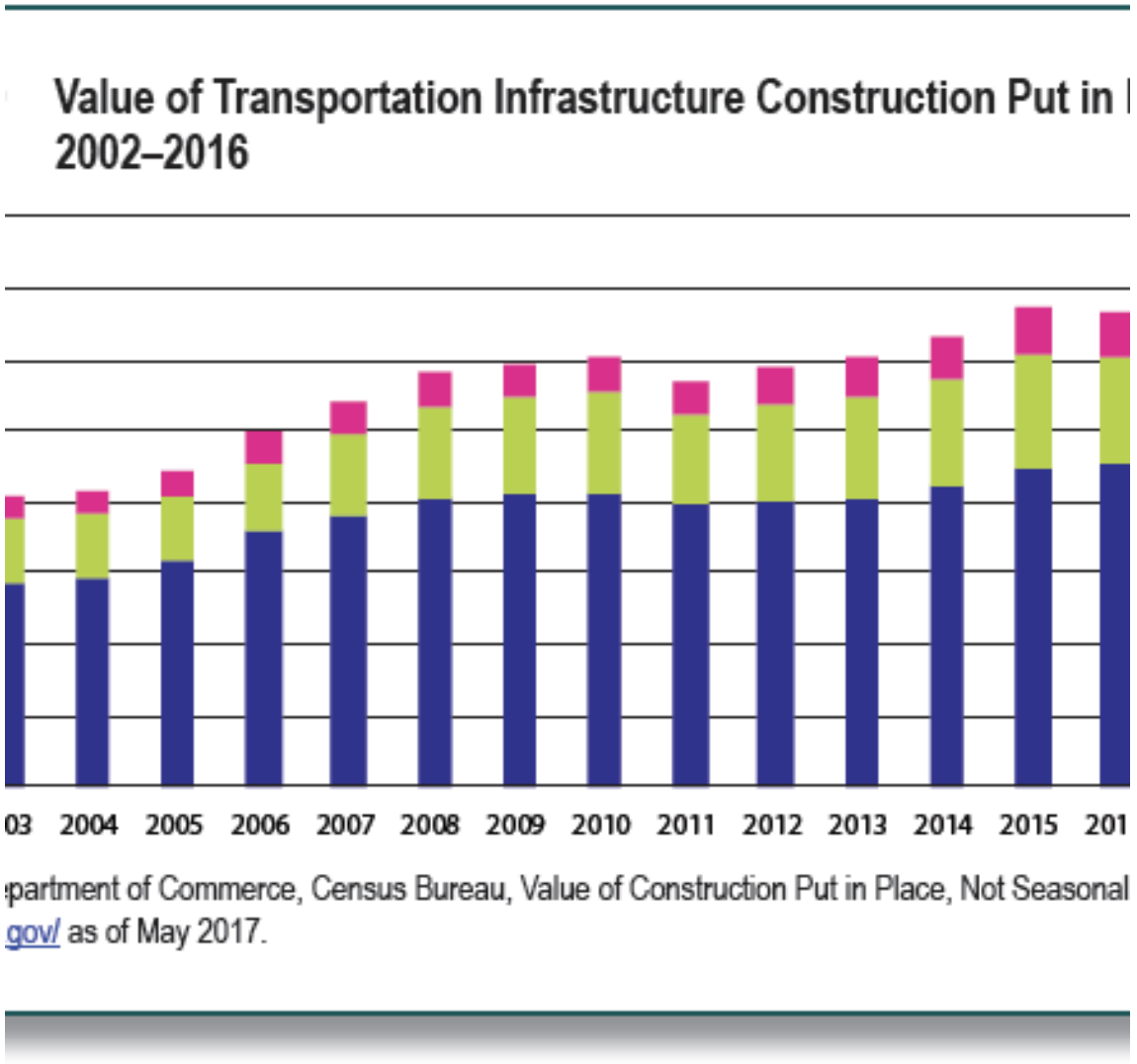
2016: Transportation assets were valued at about $7.7 trillion

FIGURE 1-1 Net Value of Transportation Capital Stock: 2016
(billions of dollars)

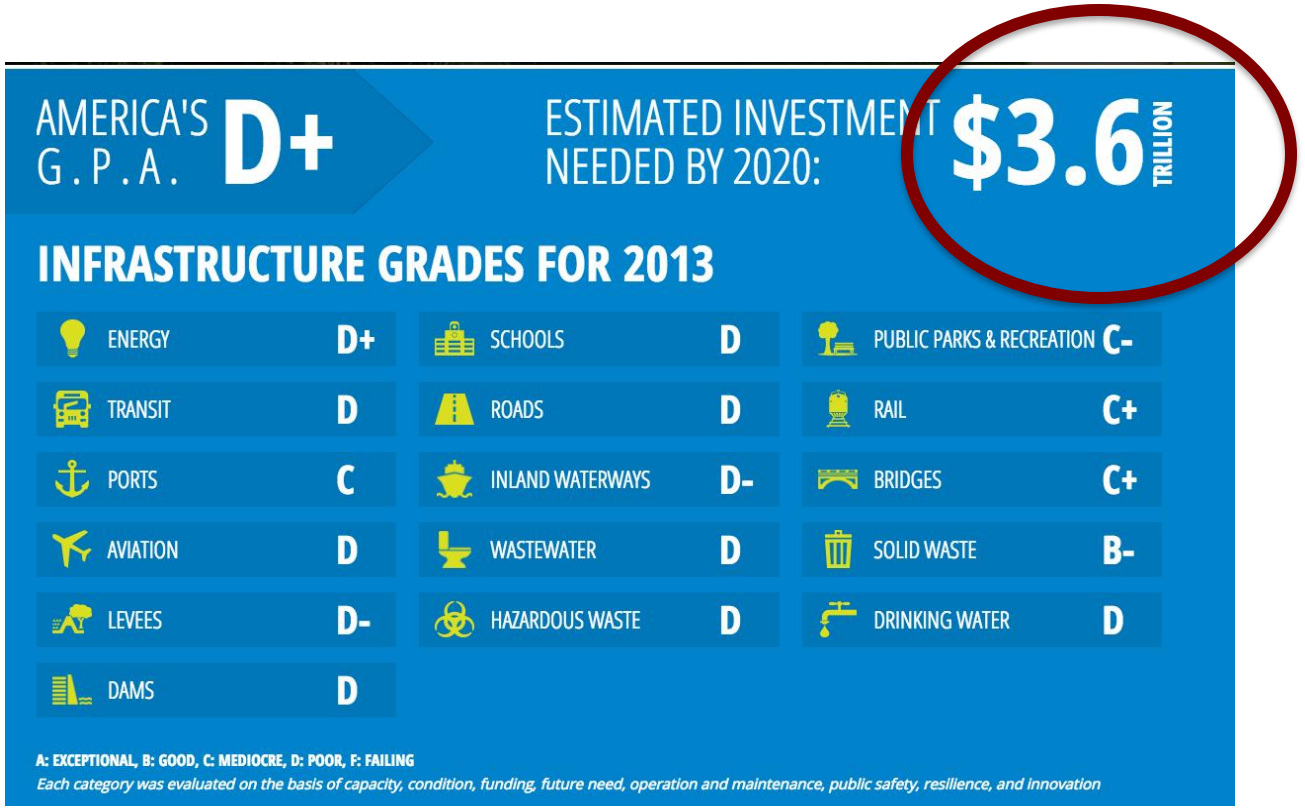


Transport Infrastructures (US)

- In 2016 private and public spent $133 billion on transportation construction (91% public sector)

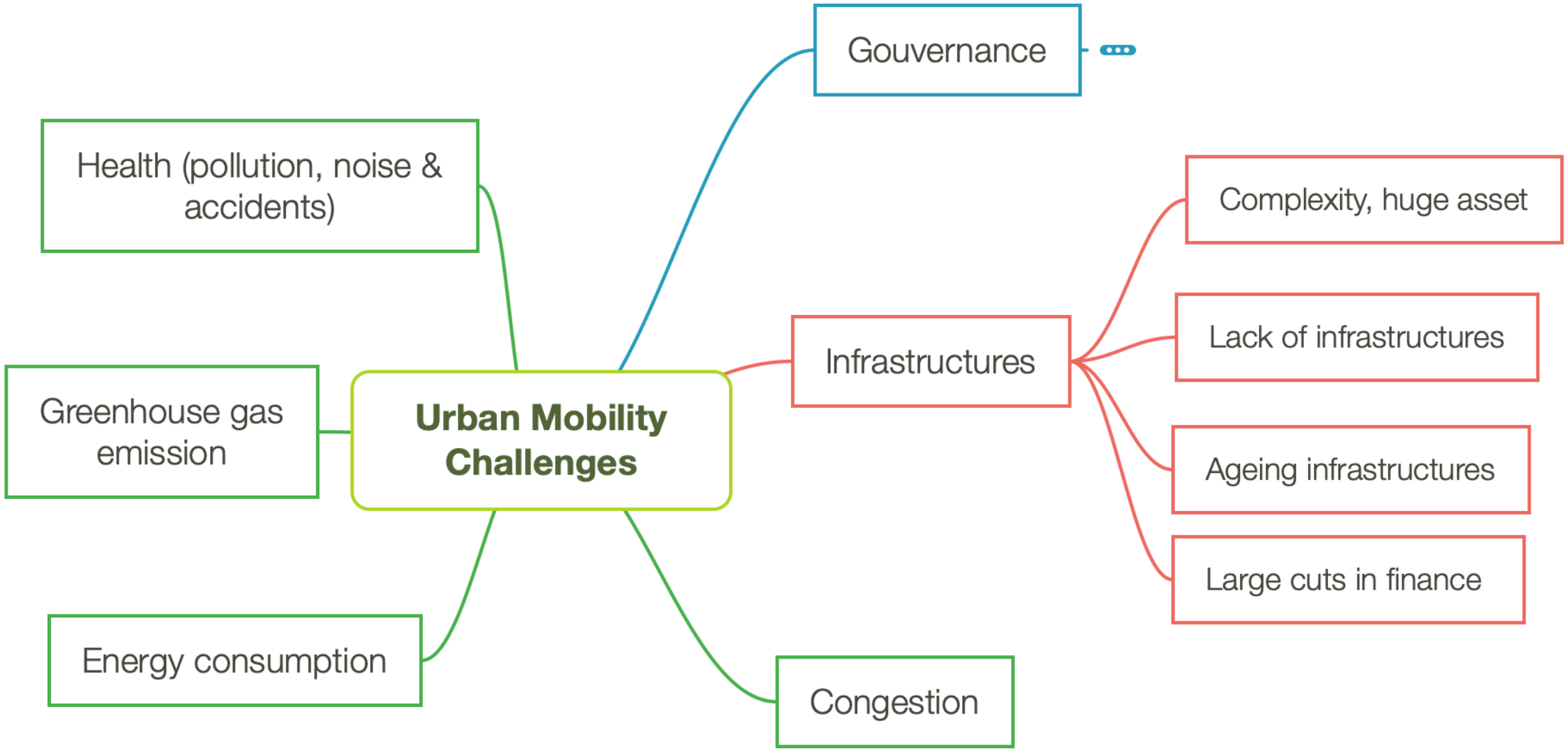


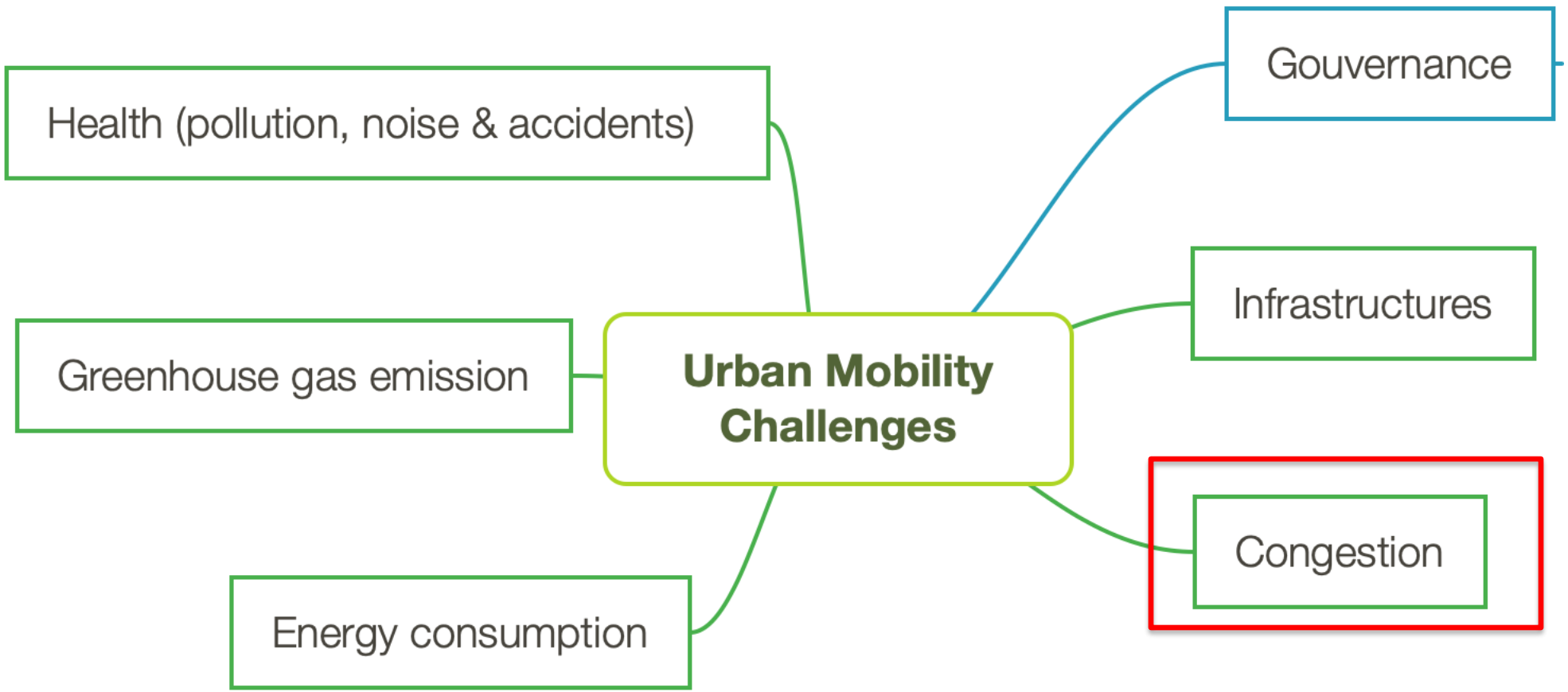
Aging infrastructure in developed countries (US, ASCE, 2013)



Dramatic transport conditions

Transport Infrastructures


Urban Mobility Challenges
Health (pollution, noise & accidents)
Greenhouse gas emission
Energy consumption
Gouvernance
Infrastructures
Complexity, huge asset
Lack of infrastructures
Ageing infrastructures
Large cuts in finance
Congestion


Health (pollution, noise & accidents)
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Gouvernance
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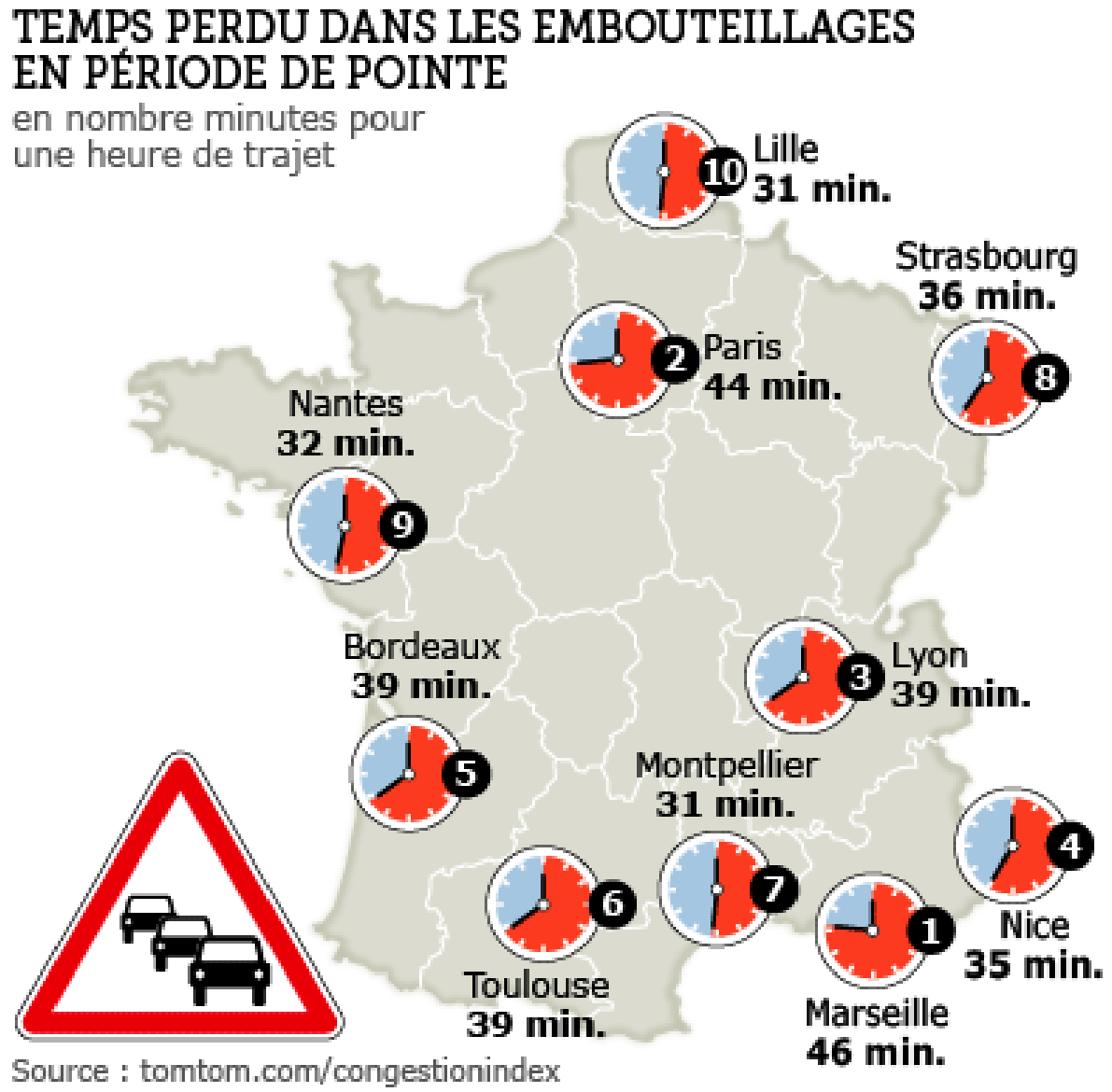
Transport challenges:

Urban Congestion

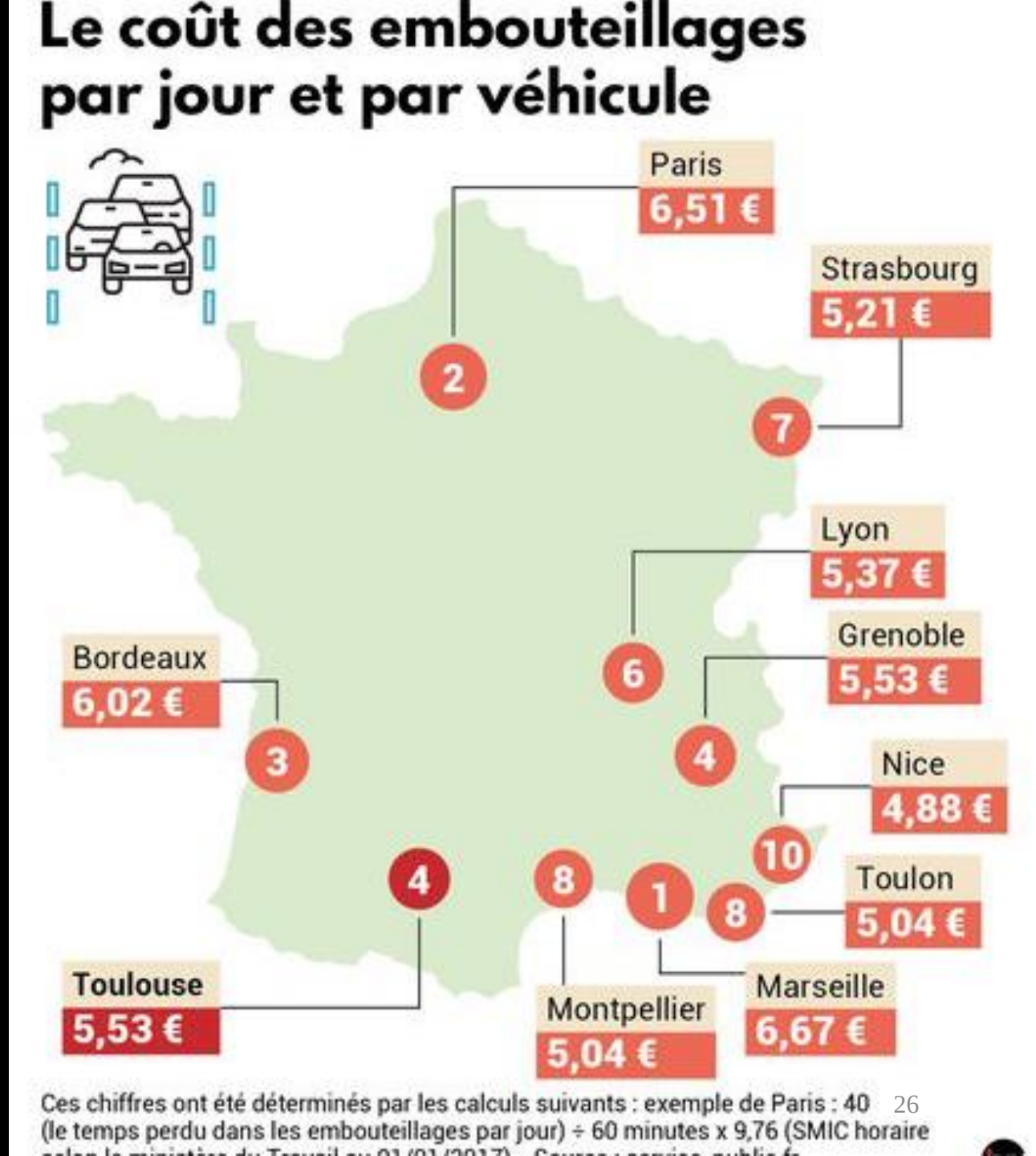
Traffic congestion causes:

- Huge time and economic lost
- Stress, anxiety and health deterioration
- Energy consumption
- Air pollution
- Greenhouse gas emission
- Insecurity,…

Urban Congestion – waste of time



Urban Congestion – economic cost



PRESS RELEASES

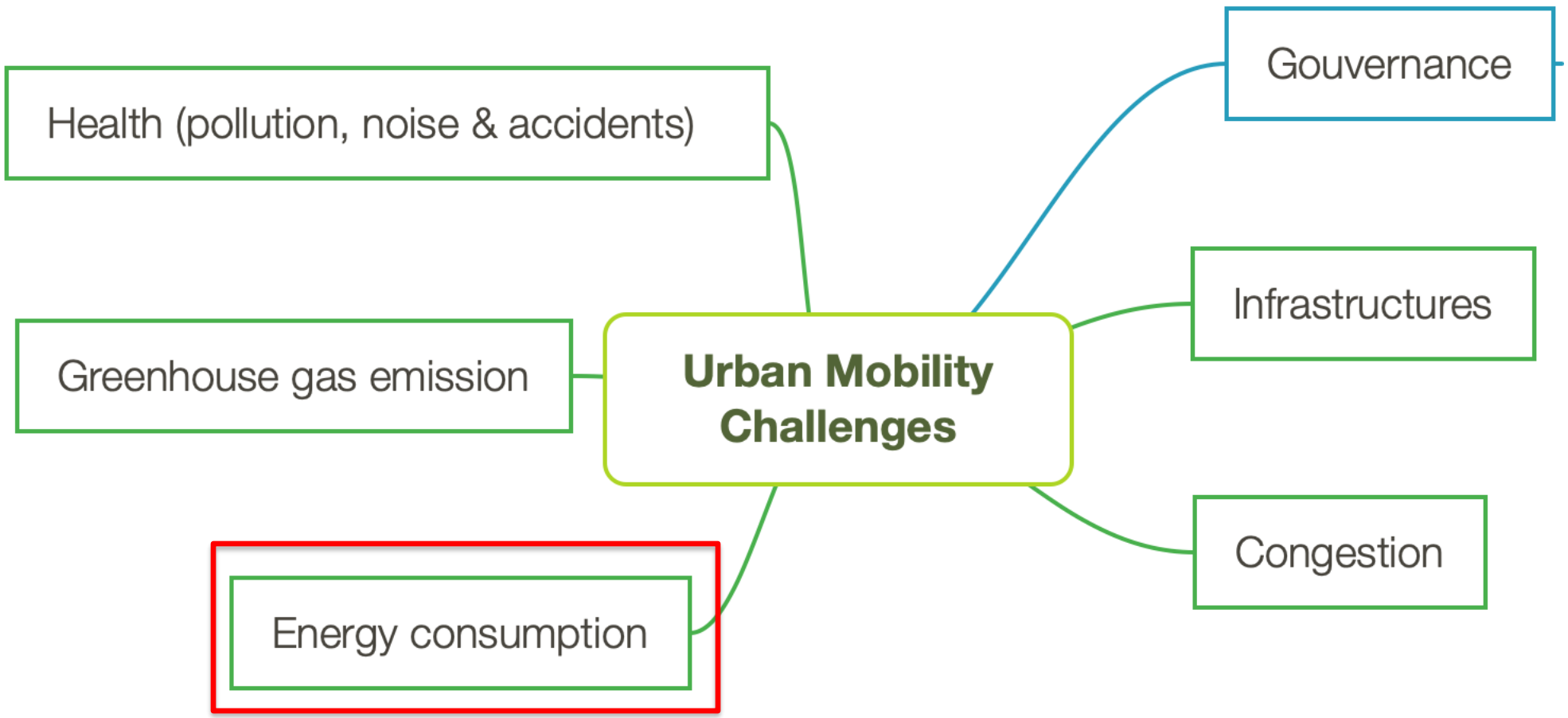
Traffic Congestion Cost UK Motorists More Than £30 Billion in 2016

AUTOS

Traffic Jams Cost Americans $124 Billion in 2013

Brad Tuttle, Turner Cowles
Oct 15, 2014

Traffic congestion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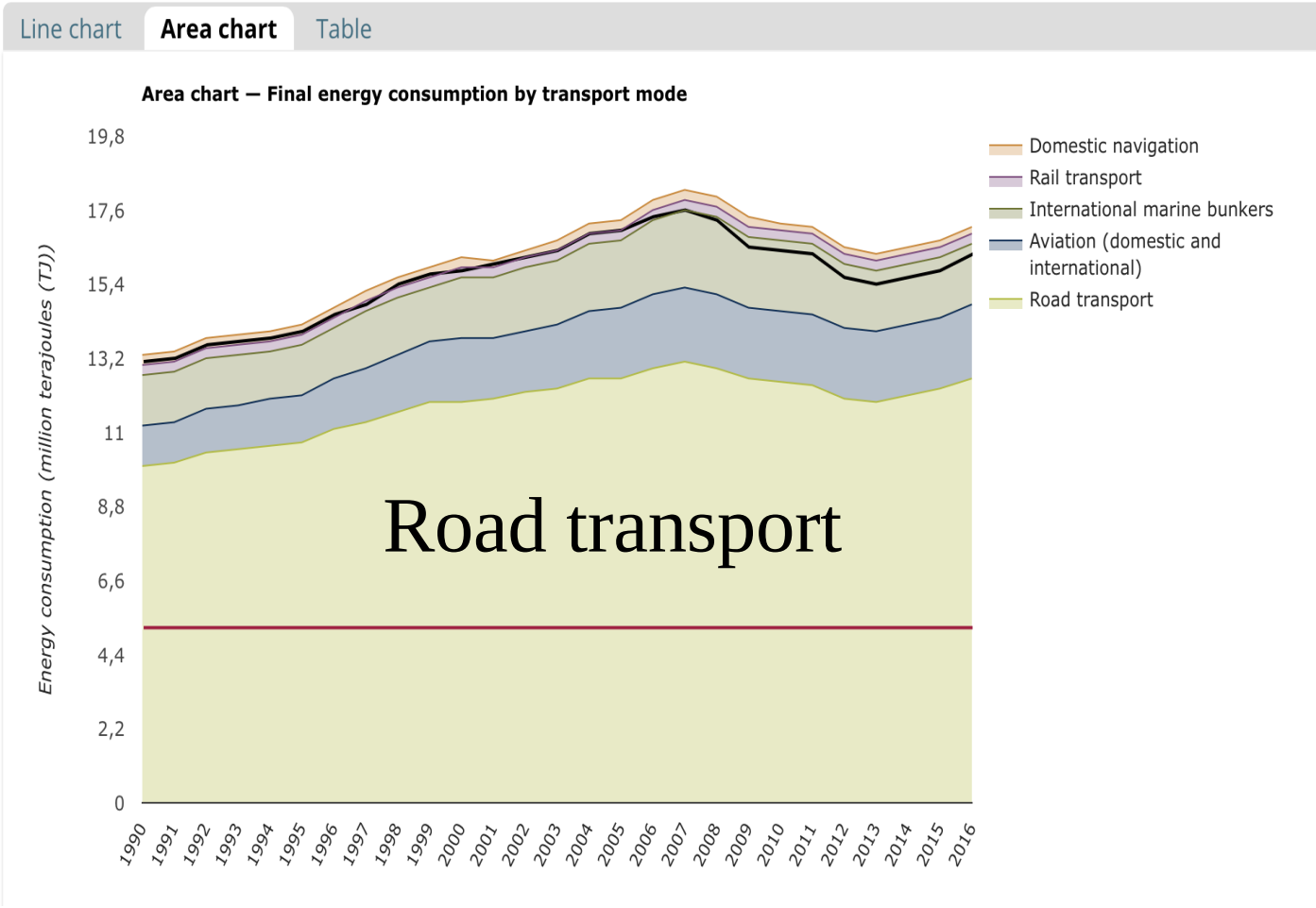
Energy consumption (Europe)

Road transport accounts for 74 % of the energy consumption in the transport (2016).

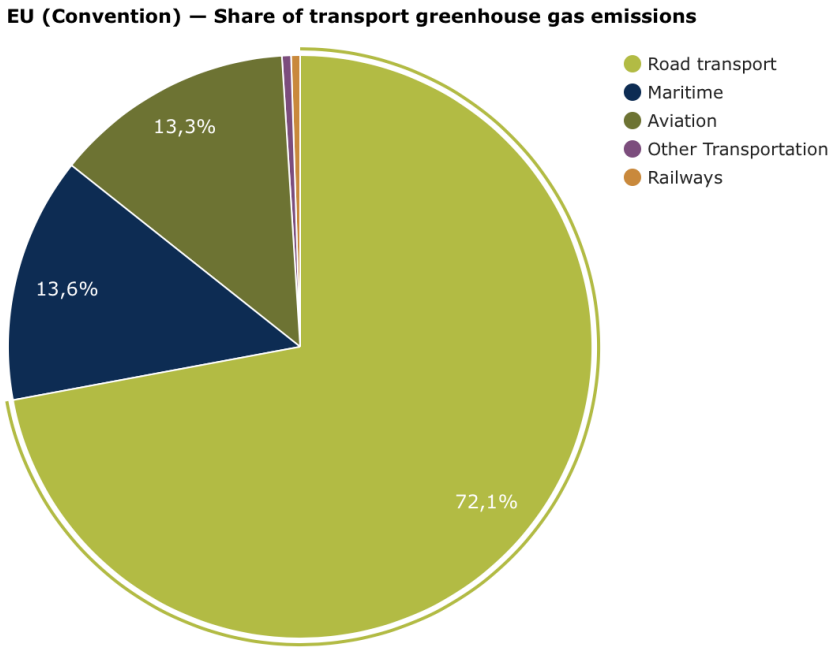
Fig. 1: Final energy consumption by transport mode

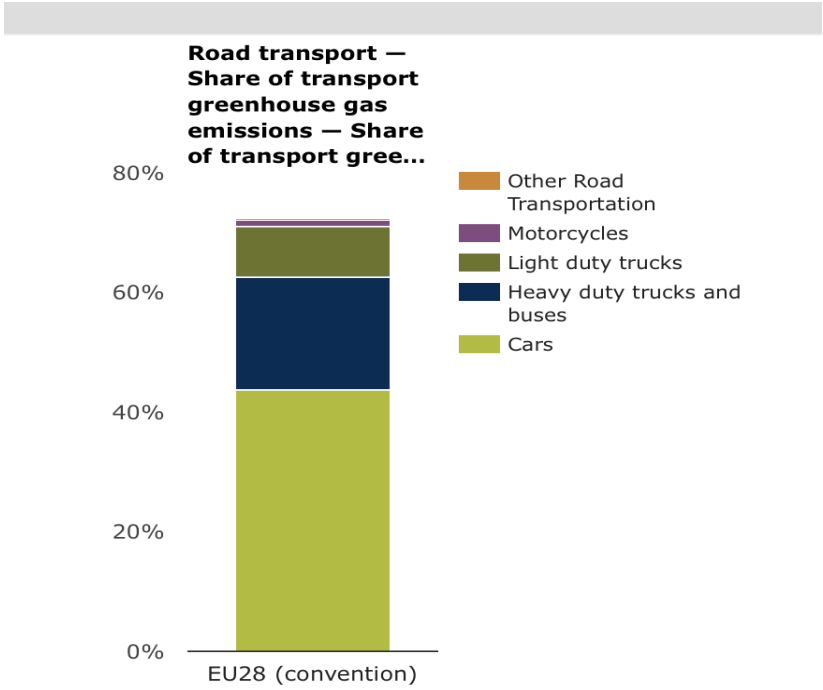


Greenhouse Gas emissions (GHGE) (Europe)

In 2016, the transport sector contributed to 27 % of the GHGE.

- Road transport accounted for 72% of the GHGE
- Cars for 40 %
- Heavy trucks for 20%

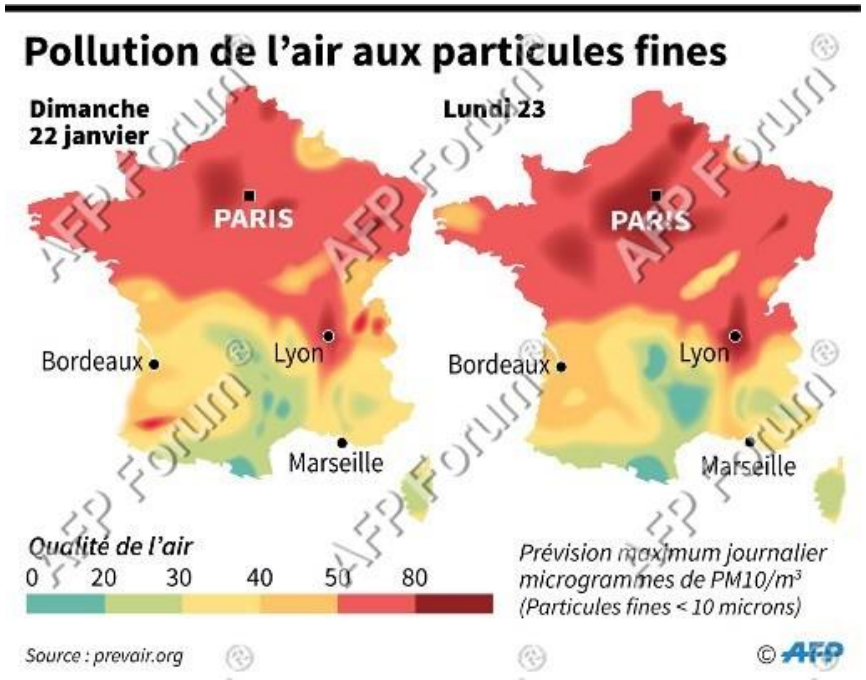




Air pollution

- **World: 7 million deaths (WHO)**
- Europe : 790 000 deaths
- France : 48 000 deaths

Air pollution: restriction on vehicle circulation (France)

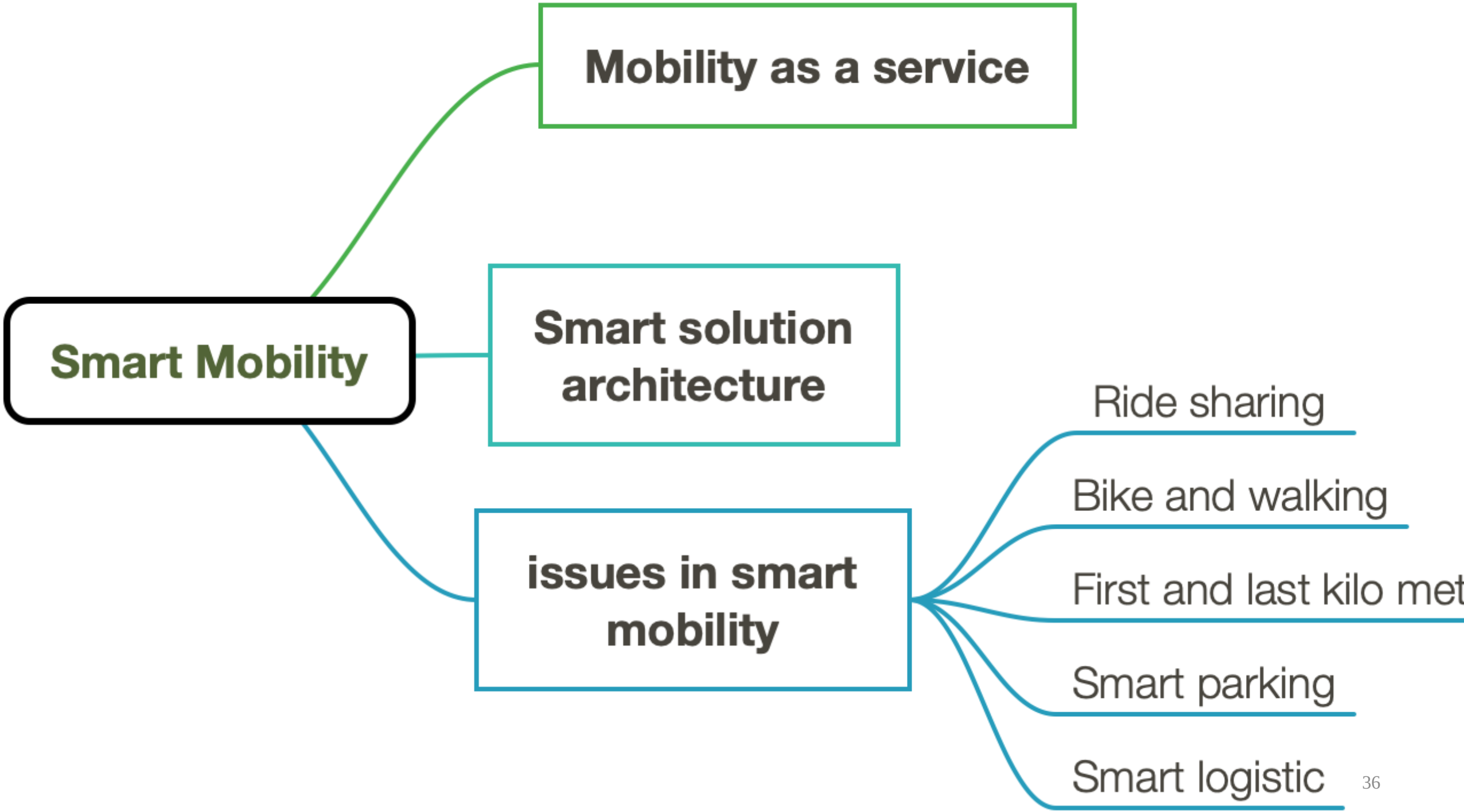


Air pollution kills

Smart Urban Mobility

Outline

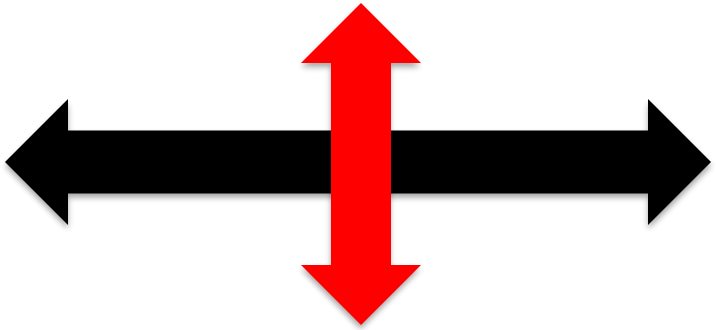
- Introduction to Mobility
- What are the mobility challenges
- **Smart Mobility**


Mobility as a service
Smart Mobility
Smart solution architecture
issues in smart mobility
Ride sharing
Bike and walking
First and last kilo met
Smart parking
Smart logistic

Mobility as a service

Environment
- Weather,
- Congestion
- Pollution

Mobility demand



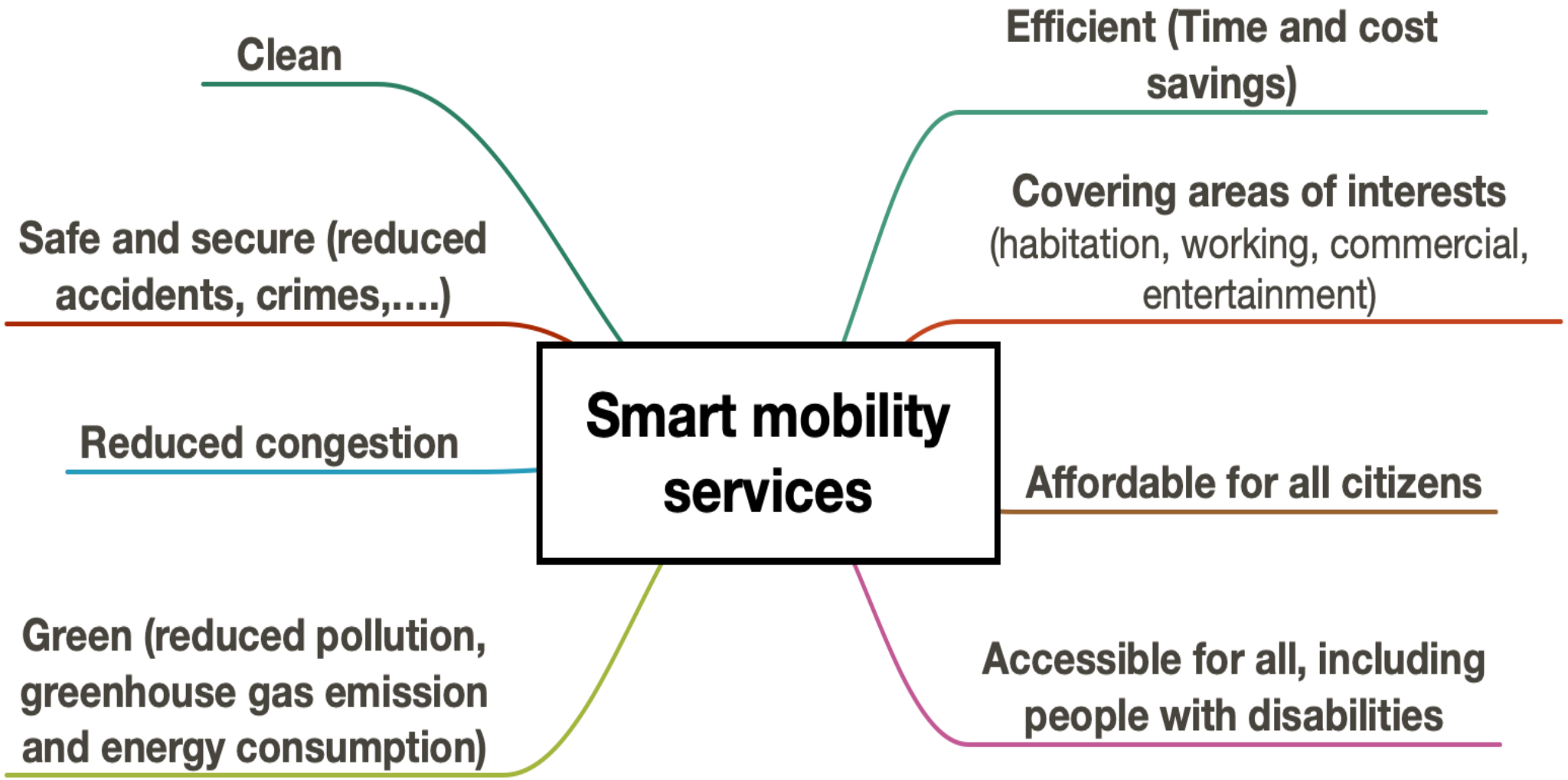
Mobility offer

- Work
- Schools
- Entertainment
- Tourism
- Shopping
- Administration
- Fright

Socio-economic
- Availability
- Time
- Cost /Income
- Quality, Security
- Social (age, disabilities,….)

- Vehicles (private, sharing,.)
- Buses
- Metros
- Tramway
- Train
- Waterway
- Bike, Walking
- **Combination**

Quality of mobility service



Architecture of the Smart mobility system

Mobility demand
(users)

Mobility services
Vehicle, Bus, Metro, Tramway, Bike, Walking

Infrastructures

Mobility operators
Publics, privates, users

Other data:
Weather, pollution, GHGE, Congestion, accidents, emergency

Data

Platform

Information system

Architecture of the Smart mobility system

Mobility demand
(users)

Mobility services
Vehicle, Bus, Metro, Tramway, Bike, Walking

Infrastructures

Mobility operators
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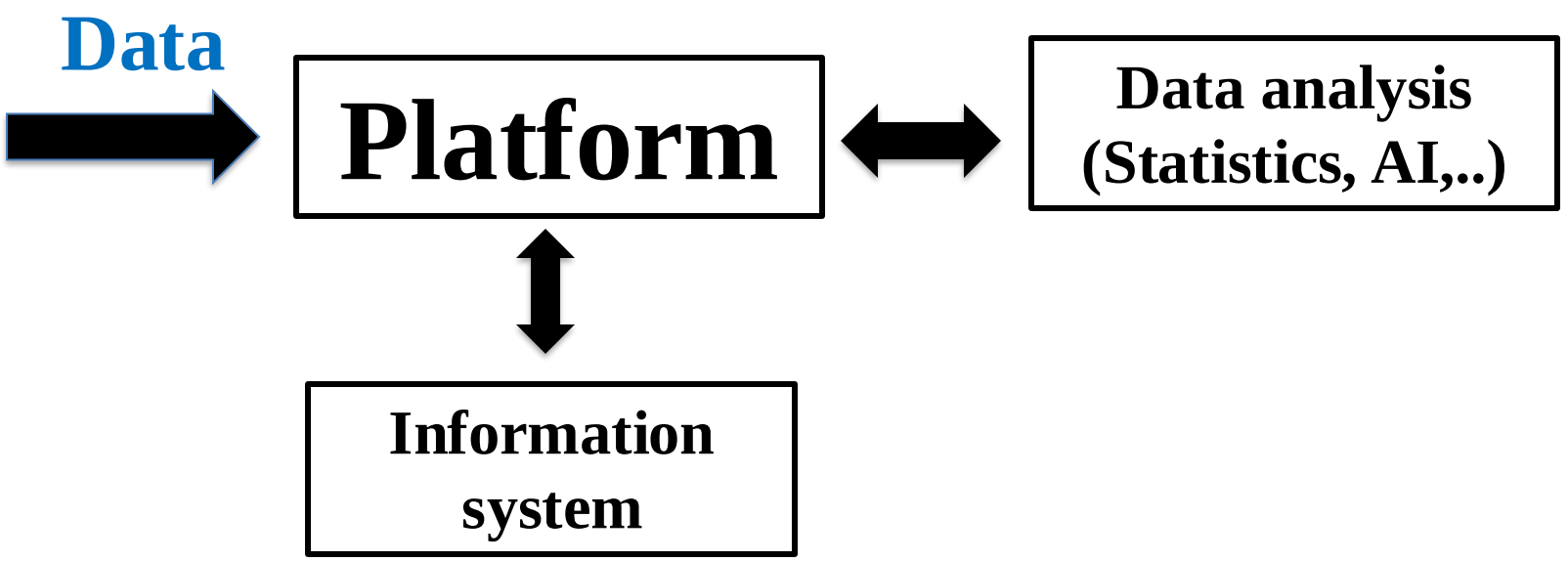
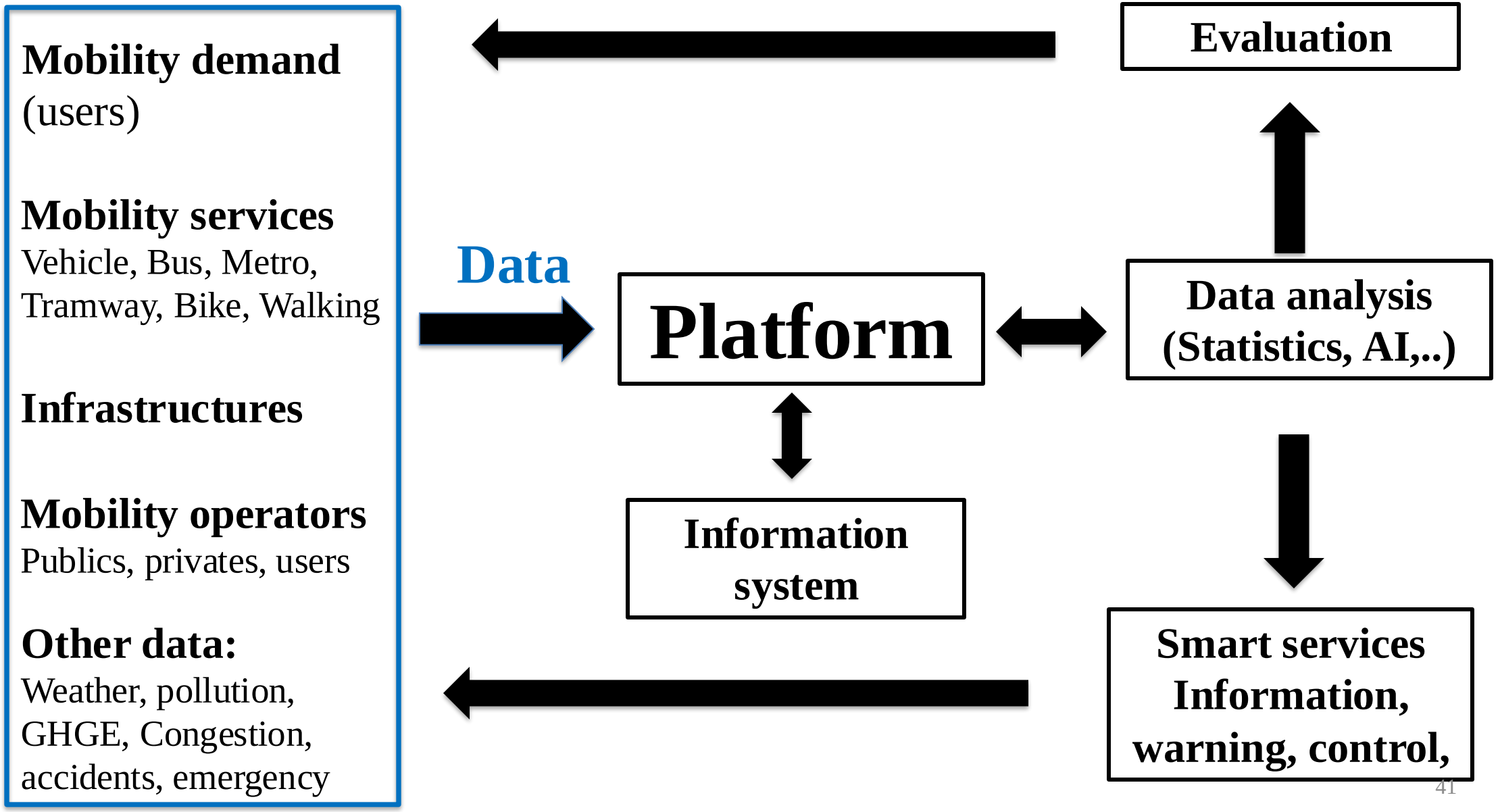
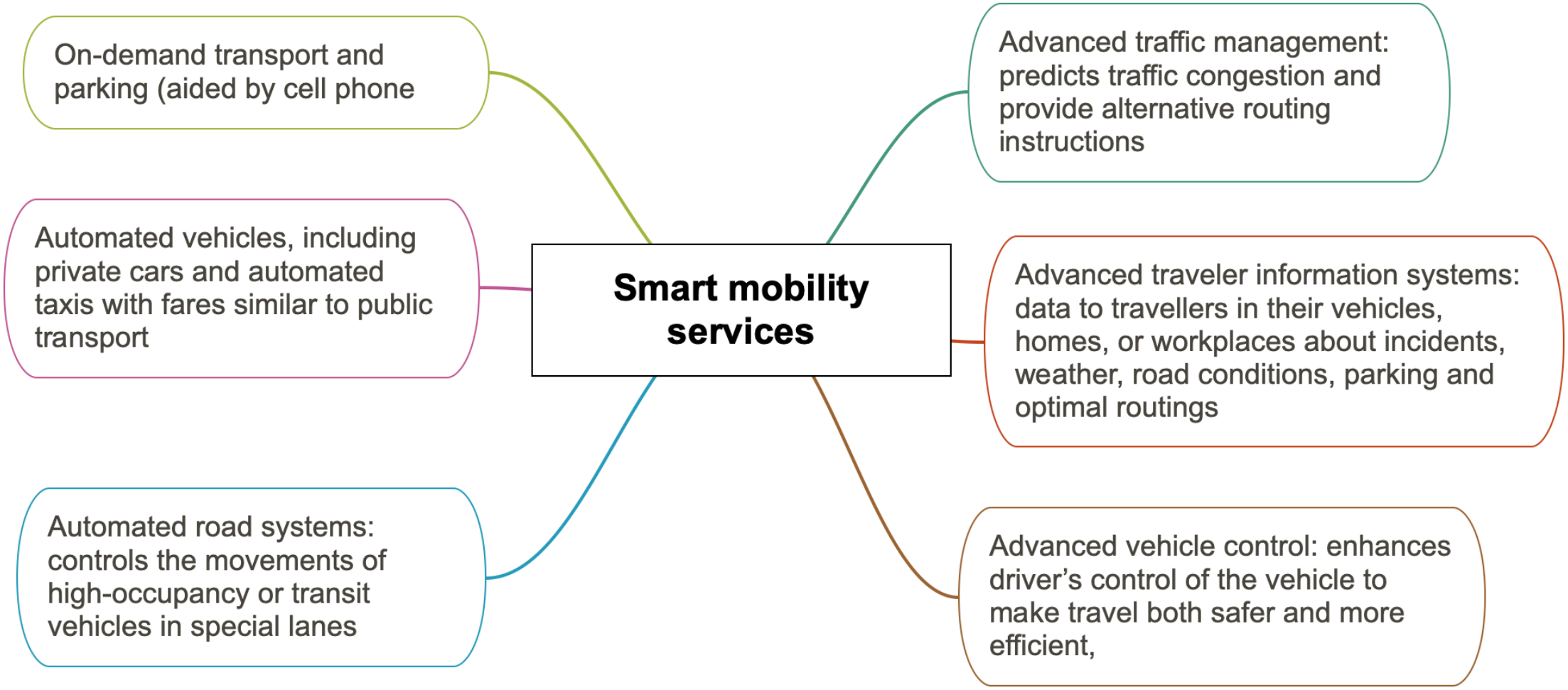


Architecture of the Smart mobility system

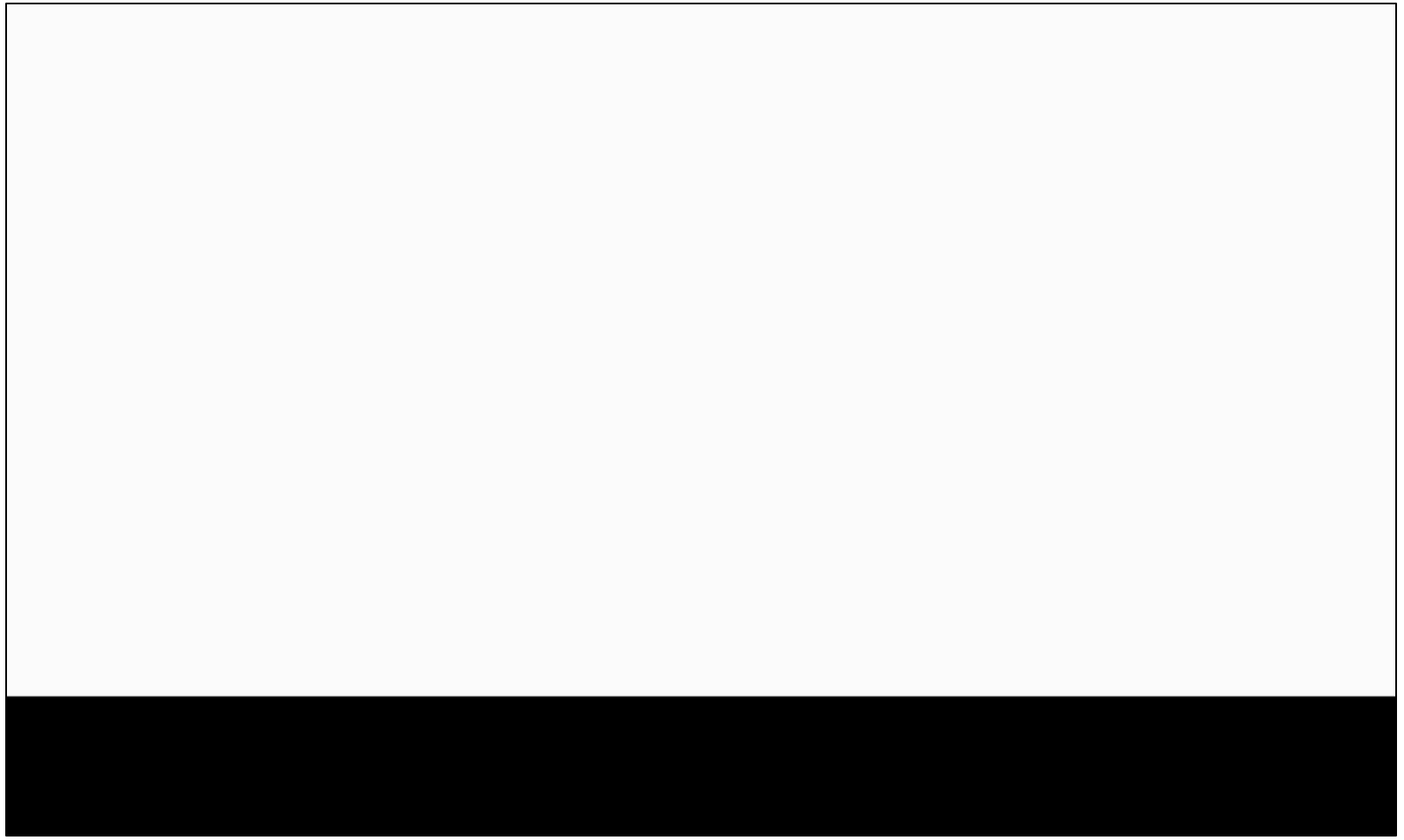


Smart mobility services



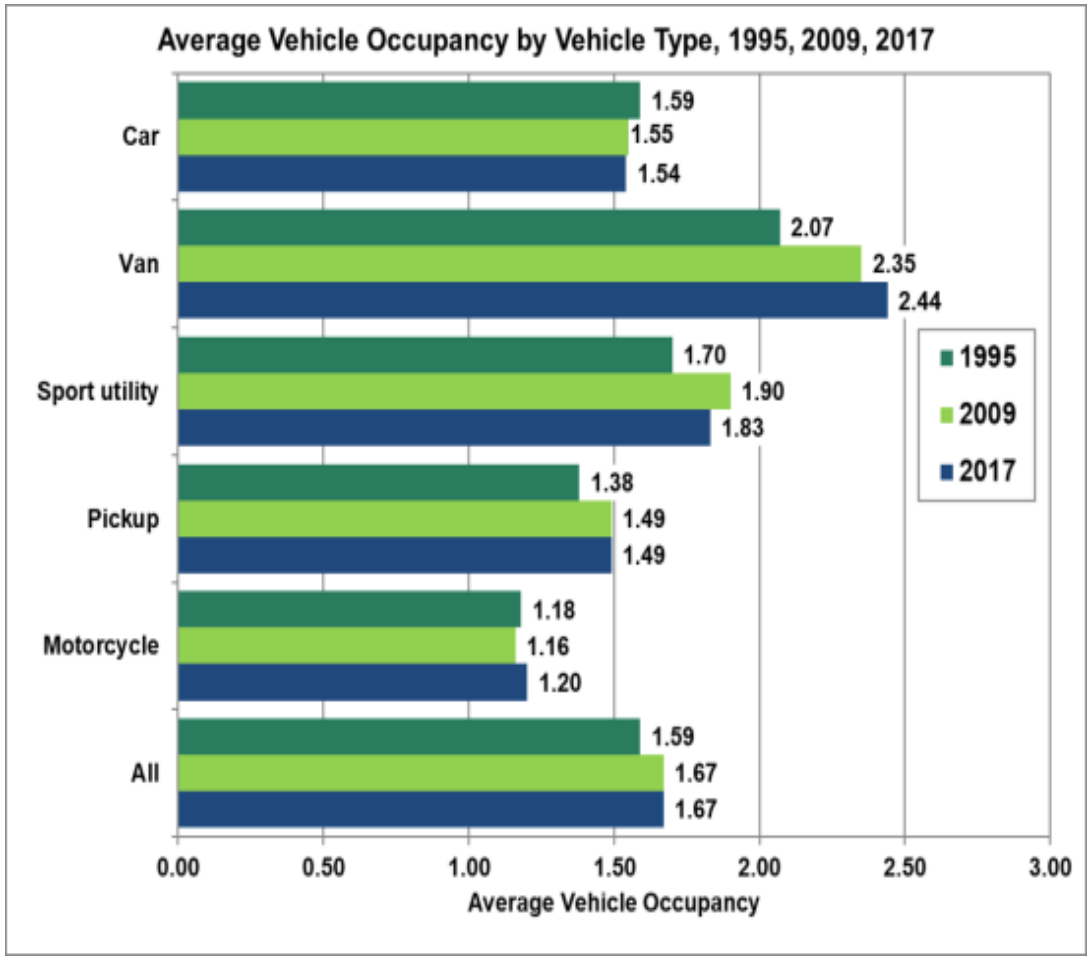
Sussman, J. *Perspectives on Intelligent Transportation Systems*; Springer: New York, NY, USA

Automated Data Collection Systems to Improve Public Transport Performance in London



Ride sharing/pooling

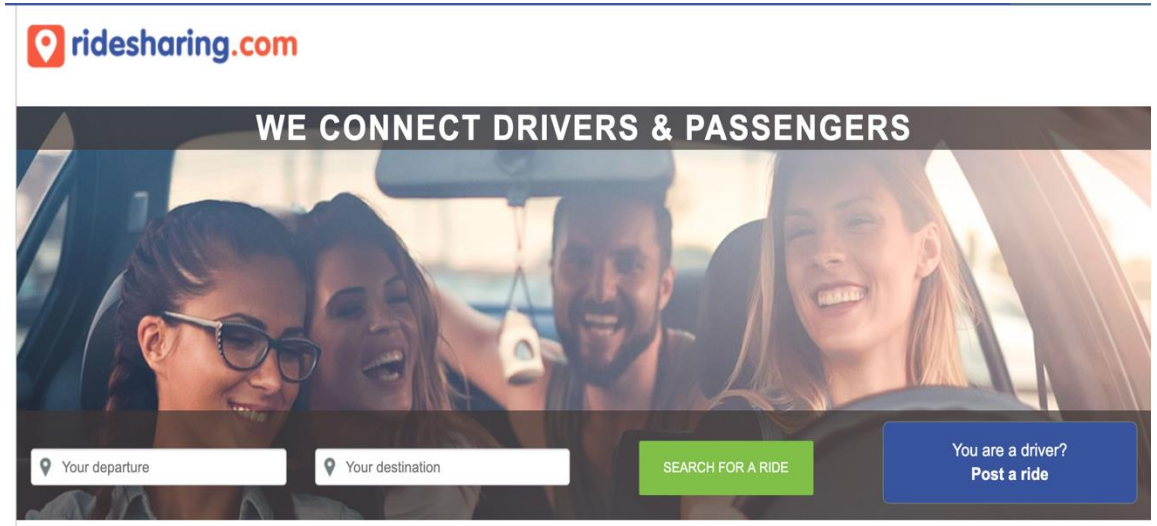
Cars occupancy in US

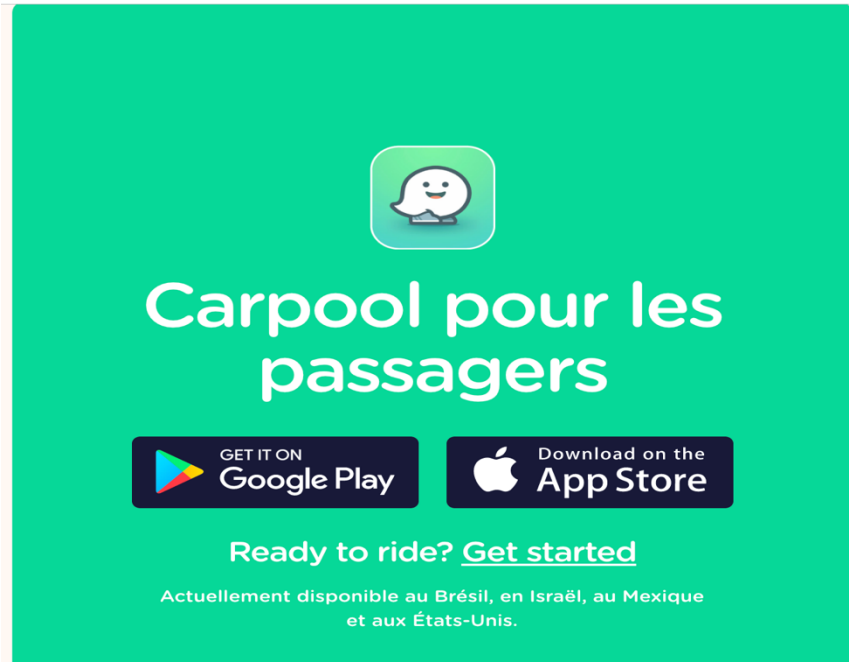


Cars occupancy Montreal

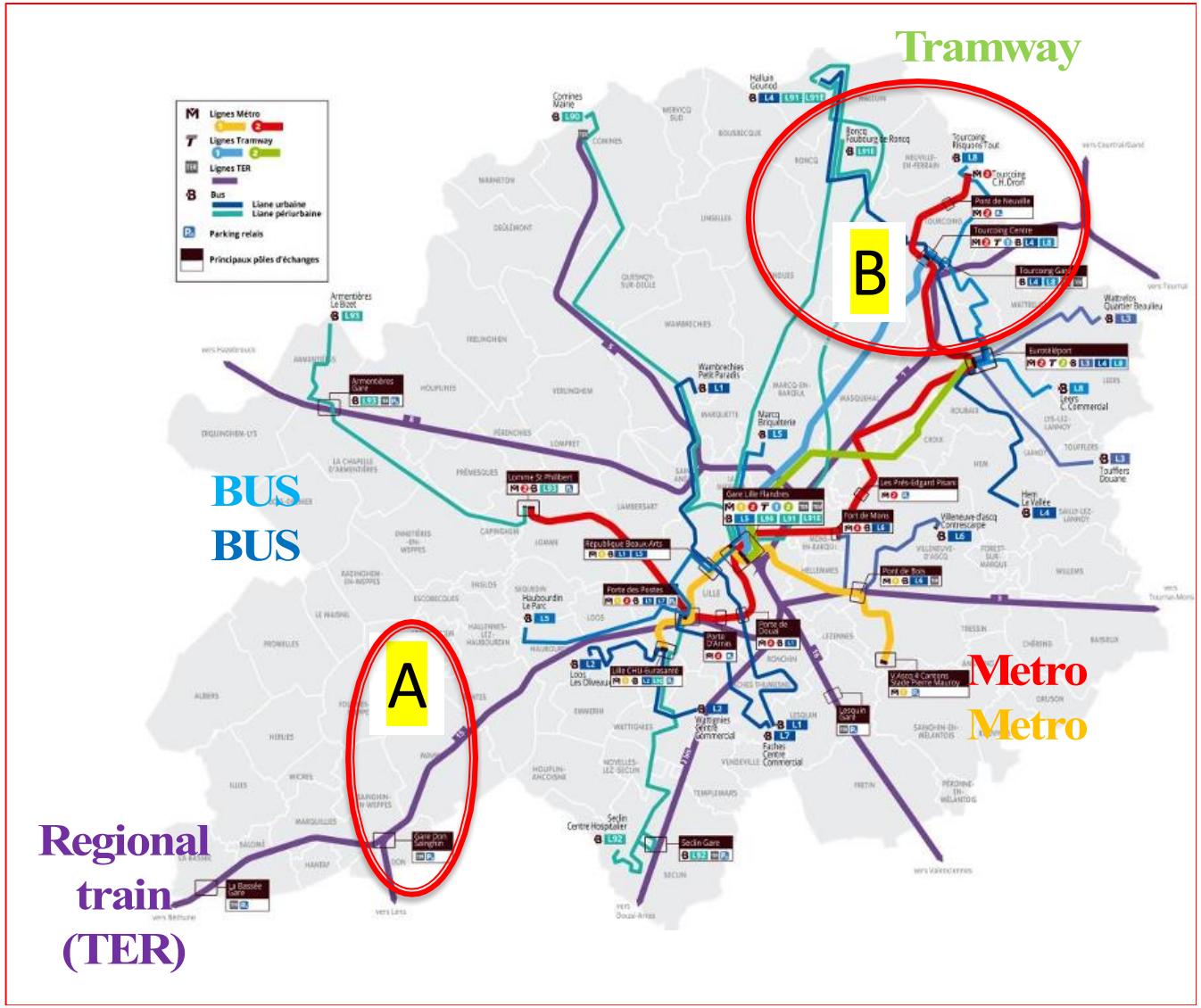
	Taux d'occupation	
	Déplacements	Passagers-km
6 h - 9 h	1,21	1,12
9 h - 12 h	1,18	1,22
12 h - 15 h	1,20	1,20
15 h - 18 h	1,24	1,16
18 h - 21 h	1,34	1,28

Ride sharing/pooling





First and last kilometers in mobility



First and last kilometers in mobility

Can smart mobility solutions answer transit's first/last mile challenge?

Automated Vehicles, Mobility-as-a-Service, Shared Mobility

MaaS ALLIANCE

MAAS THE ALLIANCE NEWS AND EVENTS LIBRARY

How Micro Mobility Solves Multiple Problems in Congested Cities

The *first mile/last mile problem* refers to one issue that can plague even cities with the best public transportation systems. Not everybody can possibly live or work within easy walking distance of a transit station or bus stop. Thus, cities still suffer from traffic congestion, parking problems, and excessive auto emissions.

NRDC

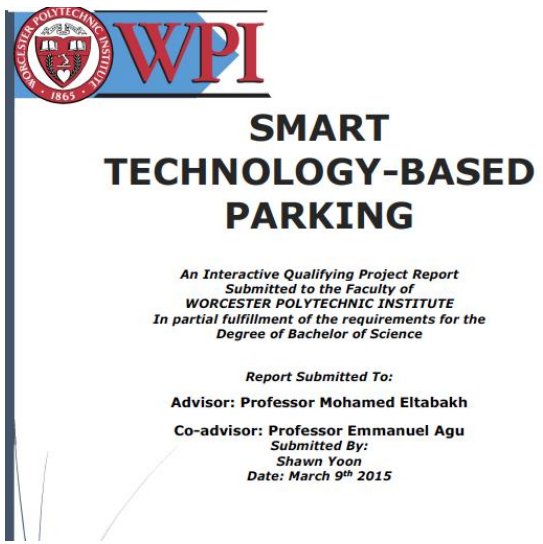
OUR WORK OUR EXPERTS OUR STORIES GET INVOLVED ABOUT US

OUR WORK › SUSTAINABLE CITIES › BUILD SUSTAINABLE CITIES

First and Last Mile Connections: New Mobility

First
Last

Smart Parking

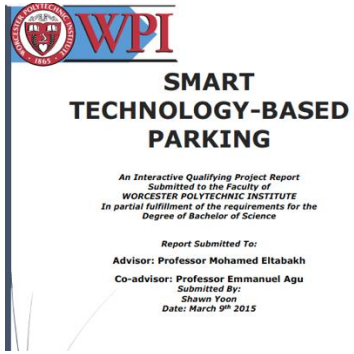


Users' needs

Table 10 Desired Smartphone Feature Distribution

#	Desired Mobile Application Features	Feature Distribution	Response	%
1	Finding Public Parking Spaces(Coin, Meter, Street)		91	74.59%
2	Map features(Browse, Navigate, Search)		84	68.85%
3	Real Time Traffic Data(Real time traffic)		79	64.75%
4	Finding Private Parking Spaces(Garage, Lots)		76	62.30%
5	Showing Detailed Parking Space Info		58	47.54%
6	Providing Mobile Payment or Reservation		51	41.80%
7	Providing Filters for Different Parking Spaces (Type, Time)		49	40.16%
8	Providing Location and Time Tracker for User's Car		32	26.23%
9	Social interaction features with other users		17	13.93%

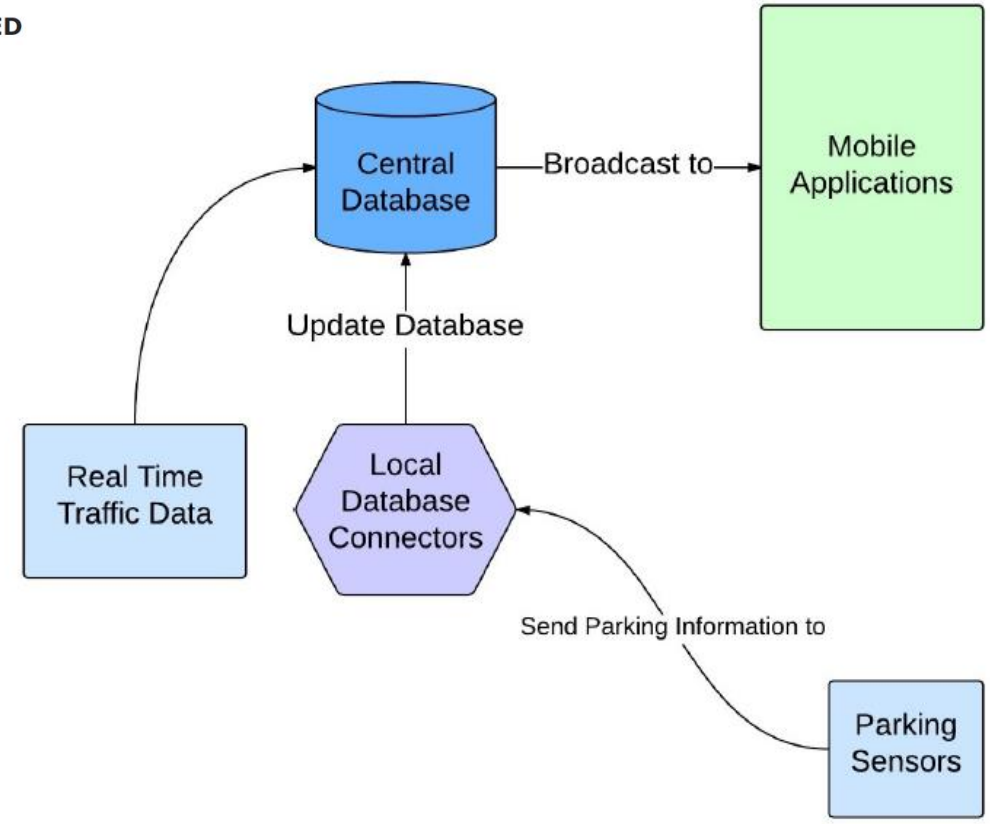
Smart Parking


WPI

SMART TECHNOLOGY-BASED PARKING

An Interactive Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science

Report Submitted To:
Advisor: Professor Mohamed Eltabakh
Co-advisor: Professor Emmanuel Agu
Submitted By:
Shawn Yoon
Date: March 9th 2015



EZPark Mobile Application (Boston)

Table 3 Core Features of EZPark

Features \ Applications	EZPark
Socialization Features (Profile, Communication)	✗
Map Features (Browse, Navigate, Search)	✓
Real Time Traffic Data (Real time traffic)	✓
Finding Public Parking Spaces (Coin, Meter, Street)	✓
Finding Private Parking Spaces (Garage, Lots)	✓
Showing Detailed Parking Space Info	✓
Providing Filters for Different Parking Spaces (Type, Time)	✓
Providing Location and Time Tracker for User's Car	✗
Providing Different Parking Restrictions for Certain Streets	✓
Providing Mobile Payment or Reservation	✗

Integrated IoT Solution For Smart Parking

Artificial Intelligence in mobility

sustainability

MDPI

Review

Applications of Artificial Intelligence in Transport: An Overview

Rusul Abduljabbar *, Hussein Dia *, Sohani Liyanage and Saeed Asadi Bagloee

Artificial intelligence (AI) is a broad area of computer science that makes machines function like a human brain.

Use of AI in transport covers large areas:

- Corporate decision making, planning, and managing.
- Improve public transport
- Connected and autonomous vehicles

Artificial Intelligence in mobility

Traffic efficiency:

- Control traffic signal
- Predict traffic congestion.

Incident Detection

identify, the time, location and the severity of an incident to support traffic managers

Incidents could be detected from social media

Twitter is a cost-effective and efficient to acknowledge incidents

Use of AI by Uber

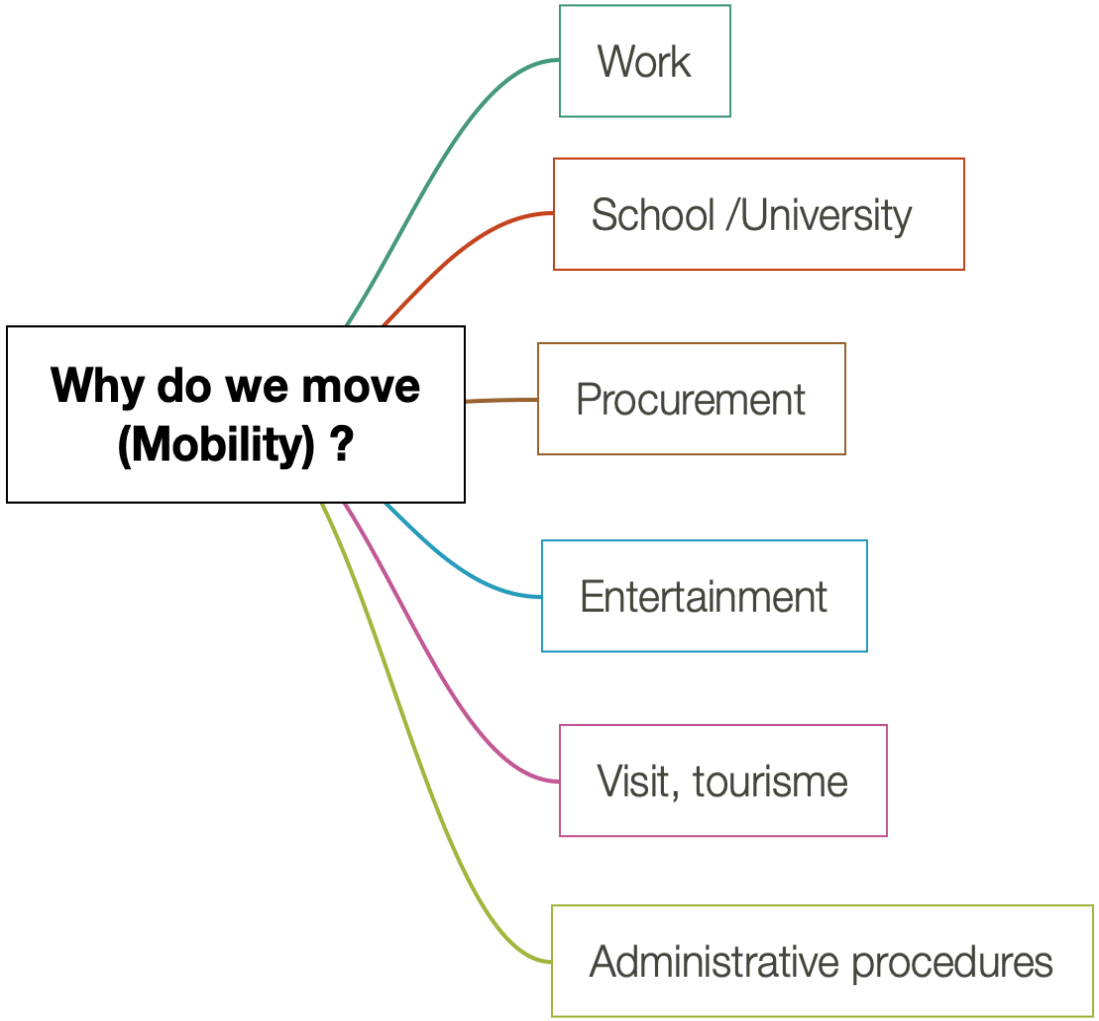
- Predict rider destinations based on the user's ride history.
- Propose route-based pricing, based on how much riders are willing to pay based on destination, time of day and location.
- Identify fraudulent drivers.
- Plan the route efficiently, estimate travel time including pick up and drop off times accurately.

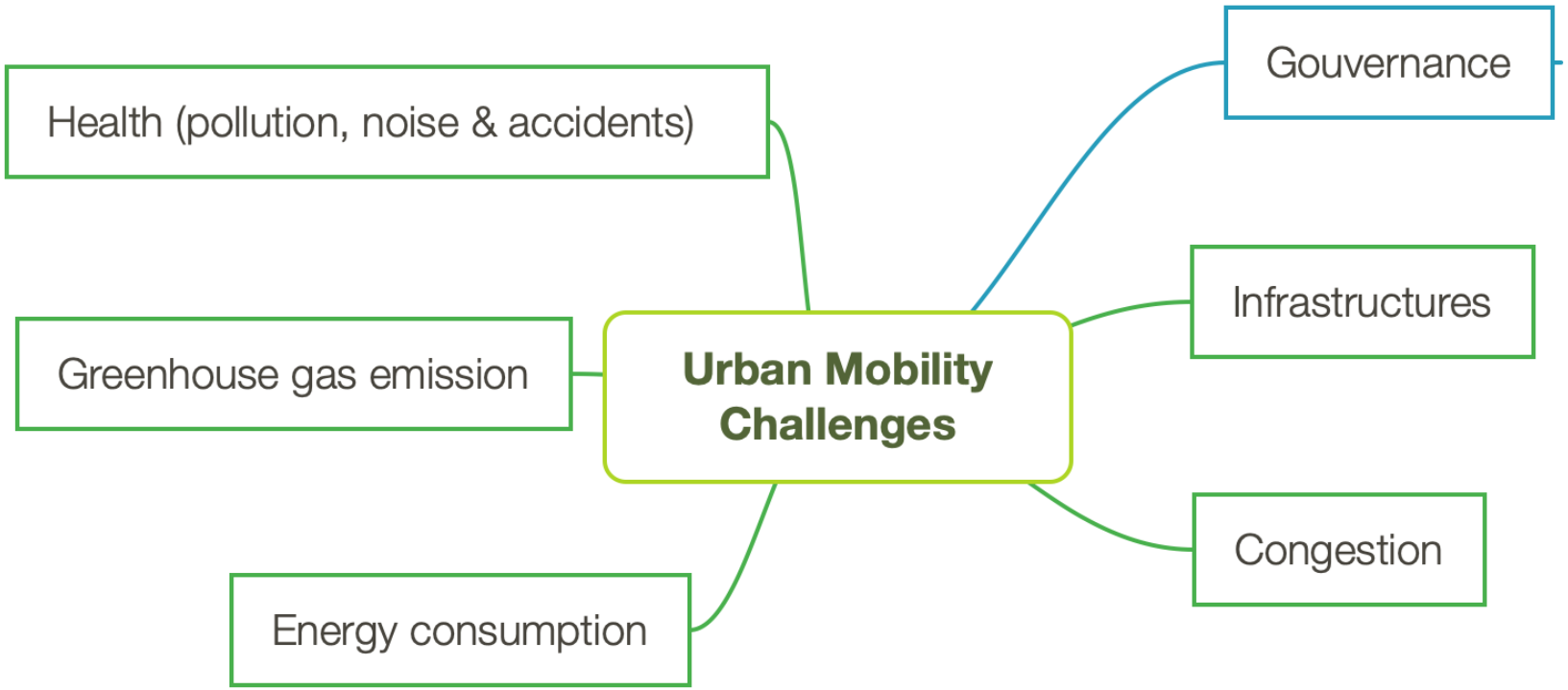
Science at Uber Applying Artificial Intelligence at Uber

Waze navigation system

Resume and Conclusion

Mobility is a core human right

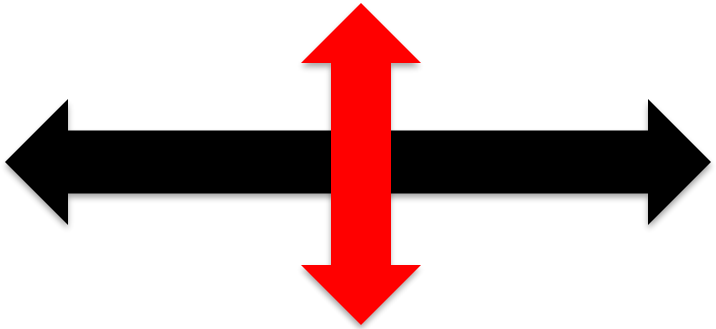



Health (pollution, noise & accidents)
Greenhouse gas emission
Energy consumption
Urban Mobility Challenges
Gouvernance
Infrastructures
Congestion

Mobility as a service

Environment
- Weather,
- Congestion
- Pollution

Mobility demand



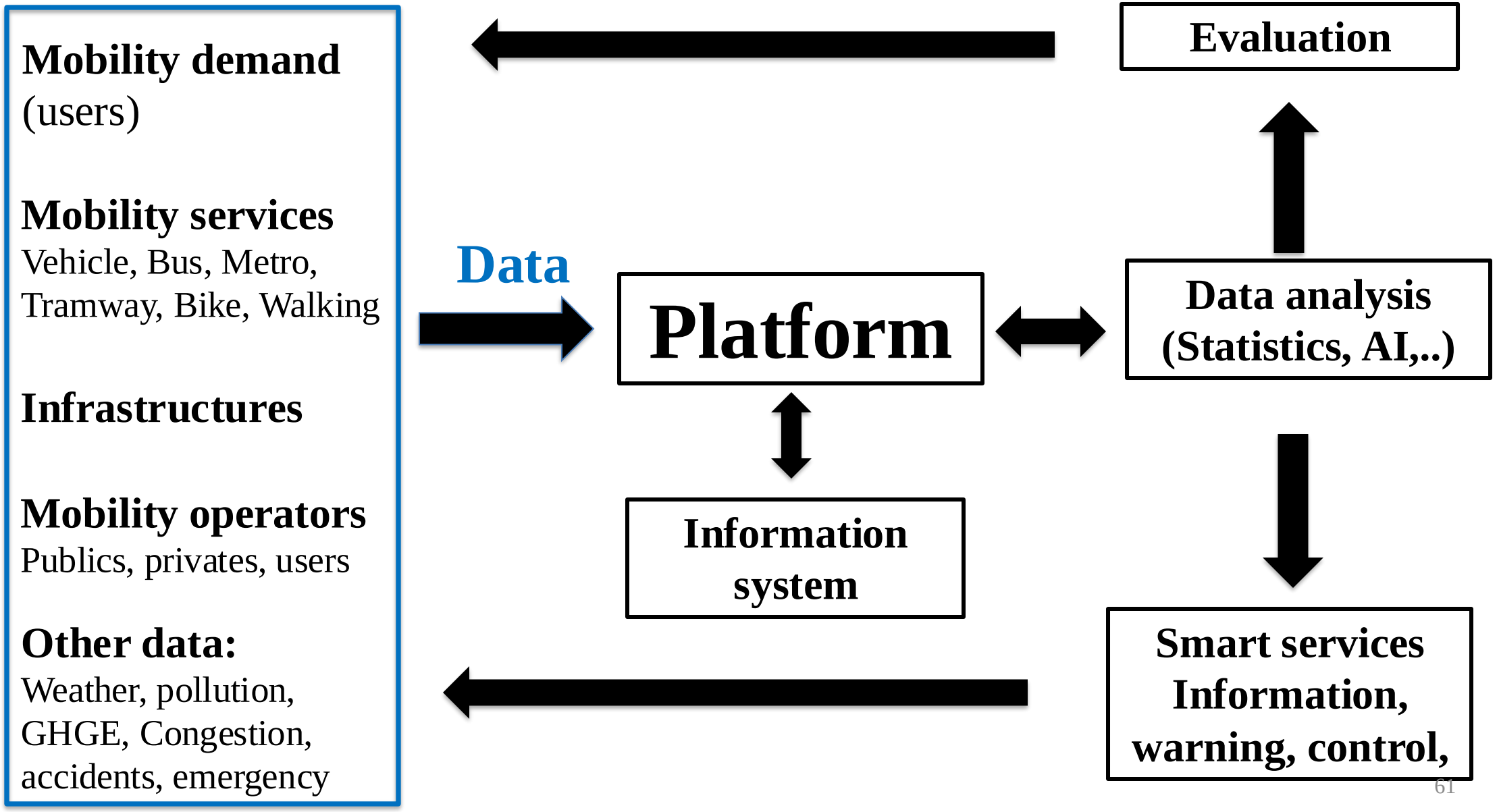
Mobility offer

- Work
- Schools
- Entertainment
- Tourism
- Shopping
- Administration
- Fright

Socio-economic
- Availability
- Time
- Cost /Income
- Quality, Security
- Social (age, disabilities,….)

- Vehicles (private, sharing,.)
- Buses
- Metros
- Tramway
- Train
- Waterway
- Bike, Walking
- **Combination**

Smart mobility system

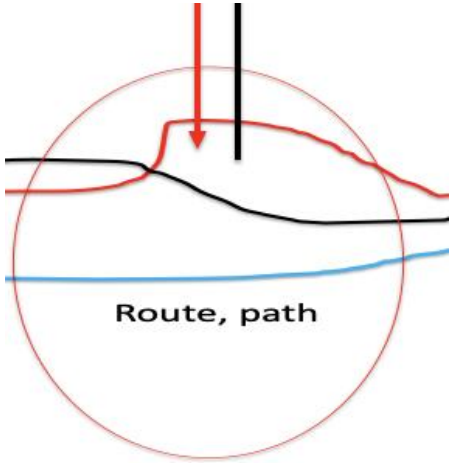


Thank you

Just How Much Waze Traffic App Knows Before You Do

Smart Bike

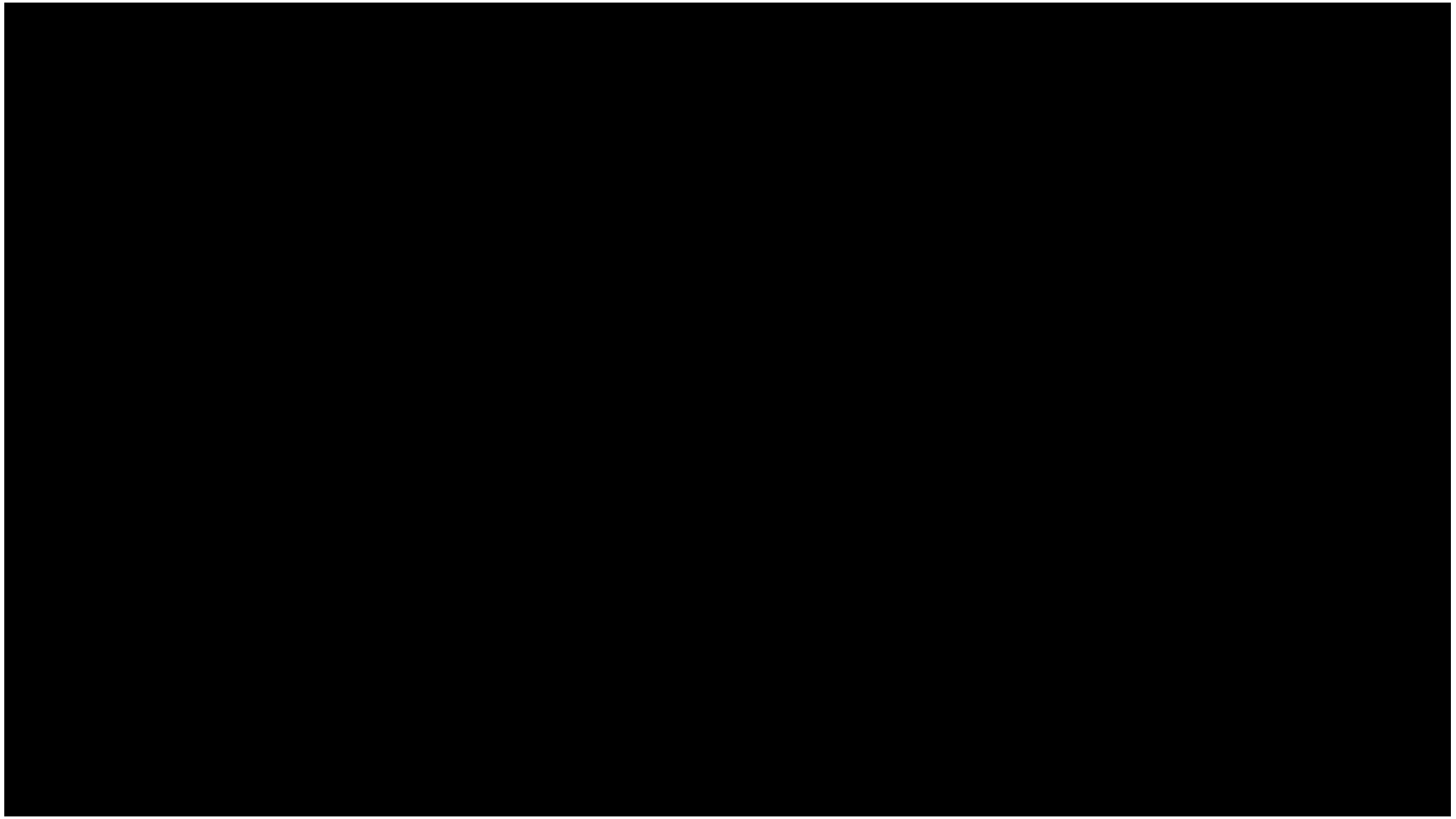
Eternal Sources
Weather, Traffic
air quality,
emergency, police



Webcam

Health monitoring

Energy consumption

Air quality

Smart Parking Powered by Machine Learning