



# Vivaldi, Trees, and Urban Mobility

Jakob Puchinger  
September 28, 2016

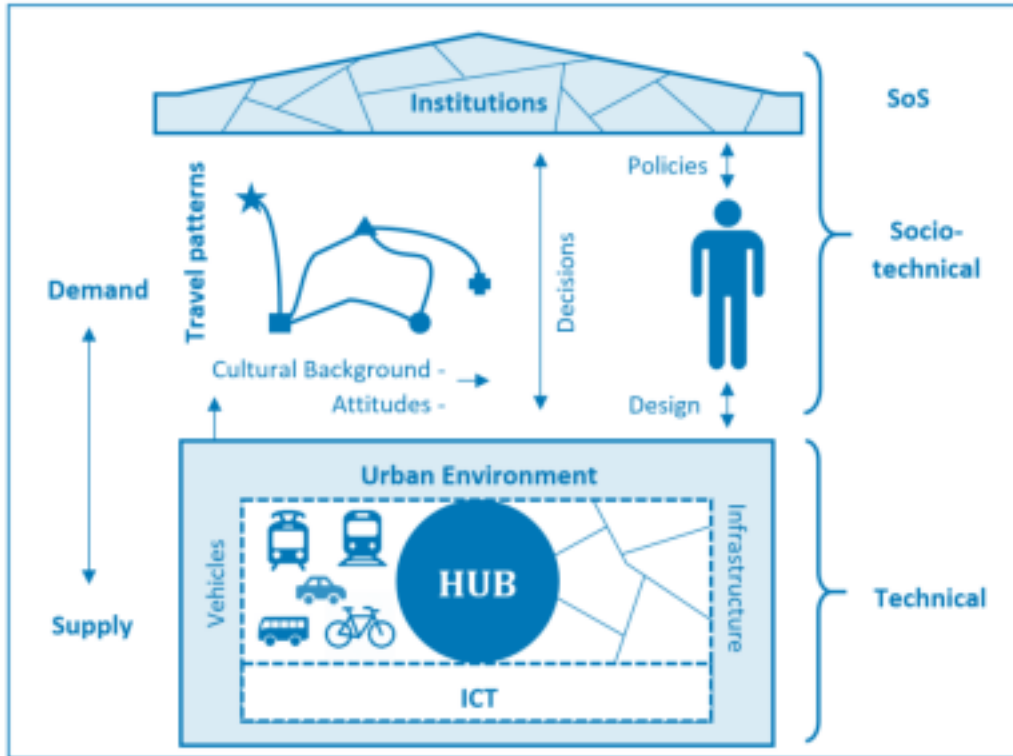








**A long personal story,  
but why is it interesting?**



- ◆ **Habits**
- ◆ **Feelings**
- ◆ **Irrationality**
- ◆ **Society**
- ◆ **Economics**
- ◆ **Housing**
- ◆ ...

**An Overview of Urban Mobility**

From: Ouail Al Maghraoui, Flore Vallet, Jakob Puchinger, Anthropolis Deliverable 1, 2016.





GIBERT  
JEUNE

LE DEPART

Glaces

CAFES  
ZAVAZZA

LE DEPART


NEUF OCC  
ESOTERISMA

SCIENCE HUMAIN  
HISTOIRE

COLLEGE - LYCEE

TELEPHONE - ENTRAIDES  
Service Continu - 24/24

PLACE  
CROISSANT



# Major Challenges in Habitability, Ecology, and Accessibility



POLLUTION  
RALENTIR

A4-A6 (A10)

PT DE VINCENNES

N302

6007

PTE DE MONTREUIL

FERMETURE

24h / 24

1.40.28



RAPPE





**Cars are by far the most used mode  
of daily transport (54%)**

**Urban public transport (19%)**

**Convenience (61%) and speed (31%)  
are much more important  
than price (12%)**



## QUE DE TEMPS PERDU SUR LES AUTOROUTES FRANCILIENNES

Voici quatre exemples de personnes travaillant à Paris, faisant un **trajet quotidien de 25 km aller et 25 km retour**, partant de leur domicile le matin aux heures de pointe, entre 7h00 et 10h00, et quittant leur lieu de travail le soir, entre 16h30 et 19h30.

**NICOLAS PERD 3 JOURS ET 18 HEURES EN UN AN, SOIT 2 SEMAINES ET DEMI DE TRAVAIL<sup>2</sup>.**

Nicolas habite à Cergy, Val d'Oise. Il emprunte l'A15 tous les matins pour aller à son travail à Paris 17e et le soir pour rentrer chez lui. Chaque jour, il perd **26 minutes** sur cet axe.

**ANAI'S PERD 2 JOURS ET 20 HEURES EN UN AN, SOIT 2 SEMAINES DE TRAVAIL<sup>2</sup>.**

Anaïs habite à Louvres, Val d'Oise. Elle emprunte l'A1 tous les matins pour aller à son travail à Paris 18e et le soir pour rentrer chez elle. Chaque jour, elle perd **20 minutes** sur cet axe.



**SANDRA PERD 3 JOURS ET 6 HEURES EN UN AN, SOIT 2 SEMAINES ET 2 JOURS DE TRAVAIL<sup>2</sup>.**

Sandra habite aux Ulis, Essonne. Elle emprunte la N118 tous les matins pour aller à son travail à Paris 16e et le soir pour rentrer

**MATHIEU PERD 4 JOURS ET 6 HEURES EN UN AN, SOIT 3 SEMAINES DE TRAVAIL<sup>2</sup>.**

Mathieu habite à Evry, Essonne. Il emprunte l'A6 tous les matins pour aller à son travail à Paris 14e et le soir pour rentrer chez lui. Chaque jour, il perd **29 minutes** sur cet axe.

**27 % of the daily commute in Île-de-France is saturated**

**For a 25 km journey this represents about 7 km of traffic jams**

**Vtraffic Study 2015  
Île-de-France**

**Belief that the urban traffic situation  
will improve in the future: 24%  
will stay the same: 35%  
get worse: 37%**



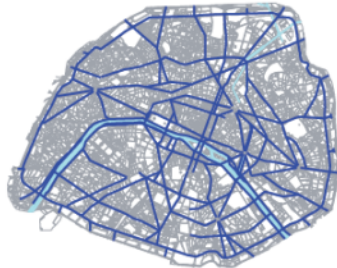
# Circulation automobile dans Paris intra-muros

(jours ouvrables)

Source : Mairie de Paris  
Direction de la Voirie  
et des Déplacements

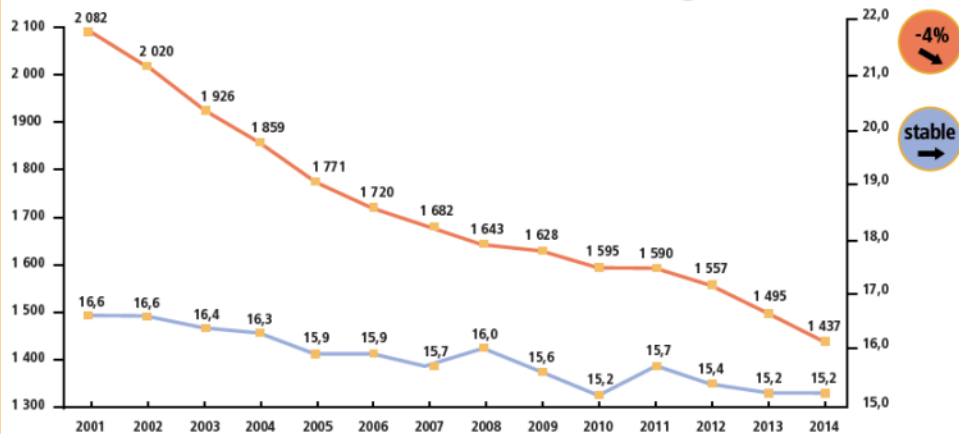
## ➔ Réseau instrumenté dans Paris intra-muros

Réseau de 196 km d'axes équipés de capteurs



## ➔ Évolution annuelle de la circulation dans Paris intra-muros sur le réseau instrumenté

➔ Evolution 2014 / 2013



-4%

stable

# City of Paris: Le bilan des déplacements en 2014



Information Service  
Destination: London  
Arrival  
Departure  
Platform  
Train Number  
Train Name  
Train Type  
Train Status  
Train Location  
Train Time  
Train Date

Paris Ligne D'Etat aux Informations

Alarm

STOP






RESU!

KOOKAI



## Déplacements en transports en commun

→ Evolution 2014 / 2013

	Métro (RATP) :	<b>1 526 millions</b> de voyages <small>*Les données 2013 ont été consolidées</small>	<b>+0,4%*</b> ↗
	RER A et B (RATP) :	<b>474 millions</b> de voyages	<b>+1,1%</b> ↗
	Réseau de surface à Paris (RATP) :	<b>433 millions</b> de voyages	<b>+6,7%</b> ↗
	dont Tramway T3 :	<b>91,4 millions</b> de voyages	<b>+13,1%</b> ↗
	Transilien SNCF : (RER A, B, C, D, E et train)	<b>745 millions</b> de voyages <small>*Les données 2013 ont été consolidées</small>	<b>-0,3%*</b> ↘

## Déplacements à vélo

	Fréquentation des aménagements cyclables		<b>+8%</b> ↗
	Nombre de déplacements à Vélib' :	<b>39 462 944</b>	<b>+13%</b> ↗

## Circulation automobile

Jours ouvrables, 7h-21h

	Paris intra-muros (réseau instrumenté) :	<b>1 437</b> véhicules* km/h ramenés au km d'axe instrumenté	<b>-4%</b> ↘
	Boulevard périphérique :	<b>5 555</b> véhicules* km/h ramenés au km d'axe	<b>stable</b> →

## Déplacements en deux-roues motorisés

	Evolution du nombre de 2 roues motorisés sur les sites enquêtés		<b>+1%</b> ↗
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# City of Paris: Le bilan des déplacements en 2014

**Home-based telework is a fairly  
restricted phenomenon in France**

**Without an exogenous shock (...)  
telework is likely to  
remain as it is today.**
















 Nous ne pouvons pas afficher cette image pour l'instant.

 Nous ne pouvons pas afficher cette image pour l'instant.

 Nous ne pouvons pas afficher cette image pour l'instant.

**AnthroPOLIS**  
HUMAN CENTERED URBAN DESIGN

**Systemx**

  
CentraleSupélec





Google Self-Driving Car



VEDECOM electric and autonomous vehicle



Uber Car



Navya Arma Car



**Autonomous vehicle fleets (...) will account for the majority of Lyft rides within 5 years.**

**By 2025, private car ownership will all-but end in major U.S. cities.**

**Enable your car to make money for you when you aren't using it.**

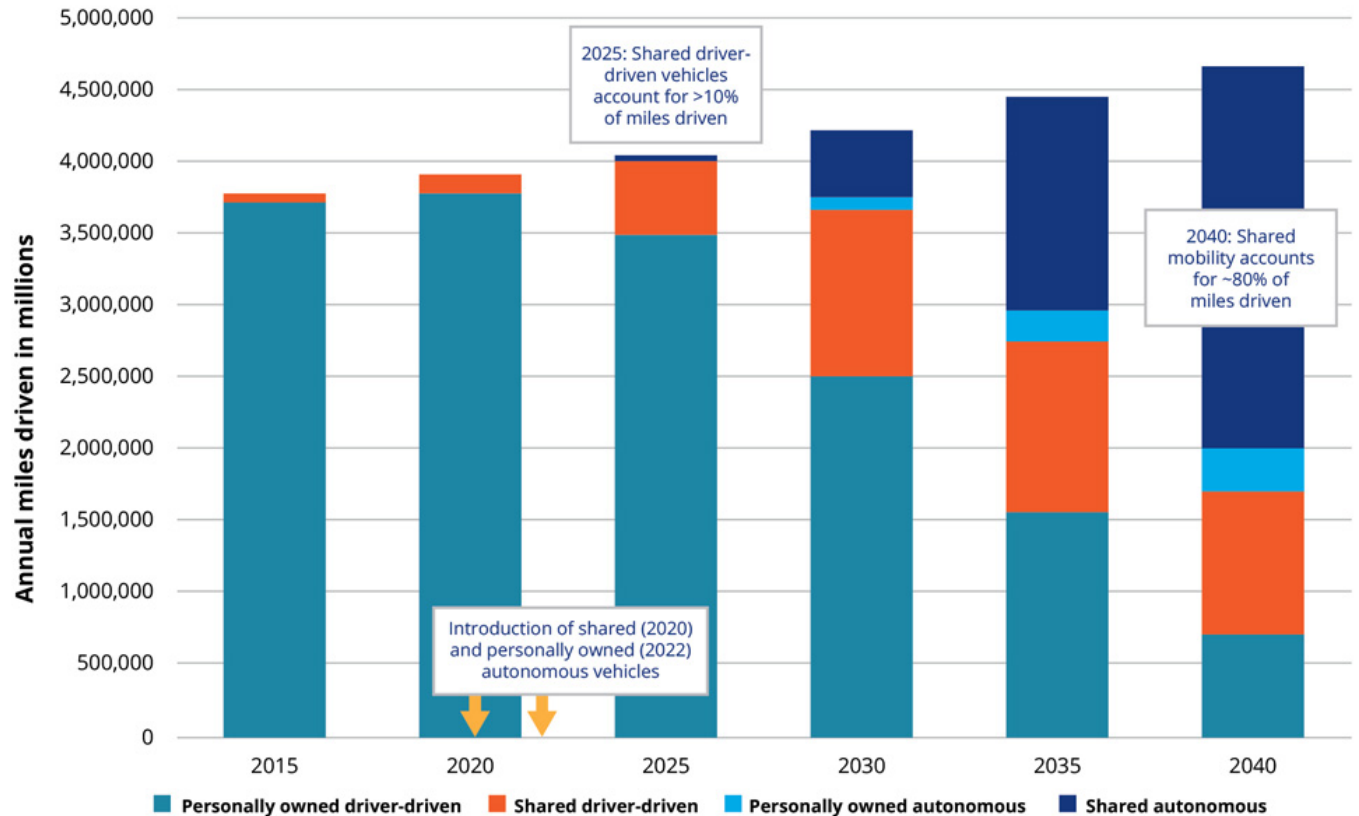
**This dramatically lowers the true cost of ownership to the point where almost anyone could own a Tesla.**

Master Plan Part Deux,  
Elon Musk, Tesla, 20/07/2016,  
<https://www.tesla.com/blog/master-plan-part-deux>

# The future of mobility: Whats next?

Deloitte University Press  
14/09/2016

Figure 2. Forecast of total miles driven in the United States



Source: Deloitte analysis based on publicly available information. See appendix for data sources.



UNIVERS  
BOHEMI

ASNIÈRES SURES  
LA DÉFENSE NANTOIRE  
COURBOVOIE PUTEAUX  
S64

RDJ  
DY-POINT  
OUIL-MA  
BERMAIN  
DENY  
70  
DAPPEL  
100m

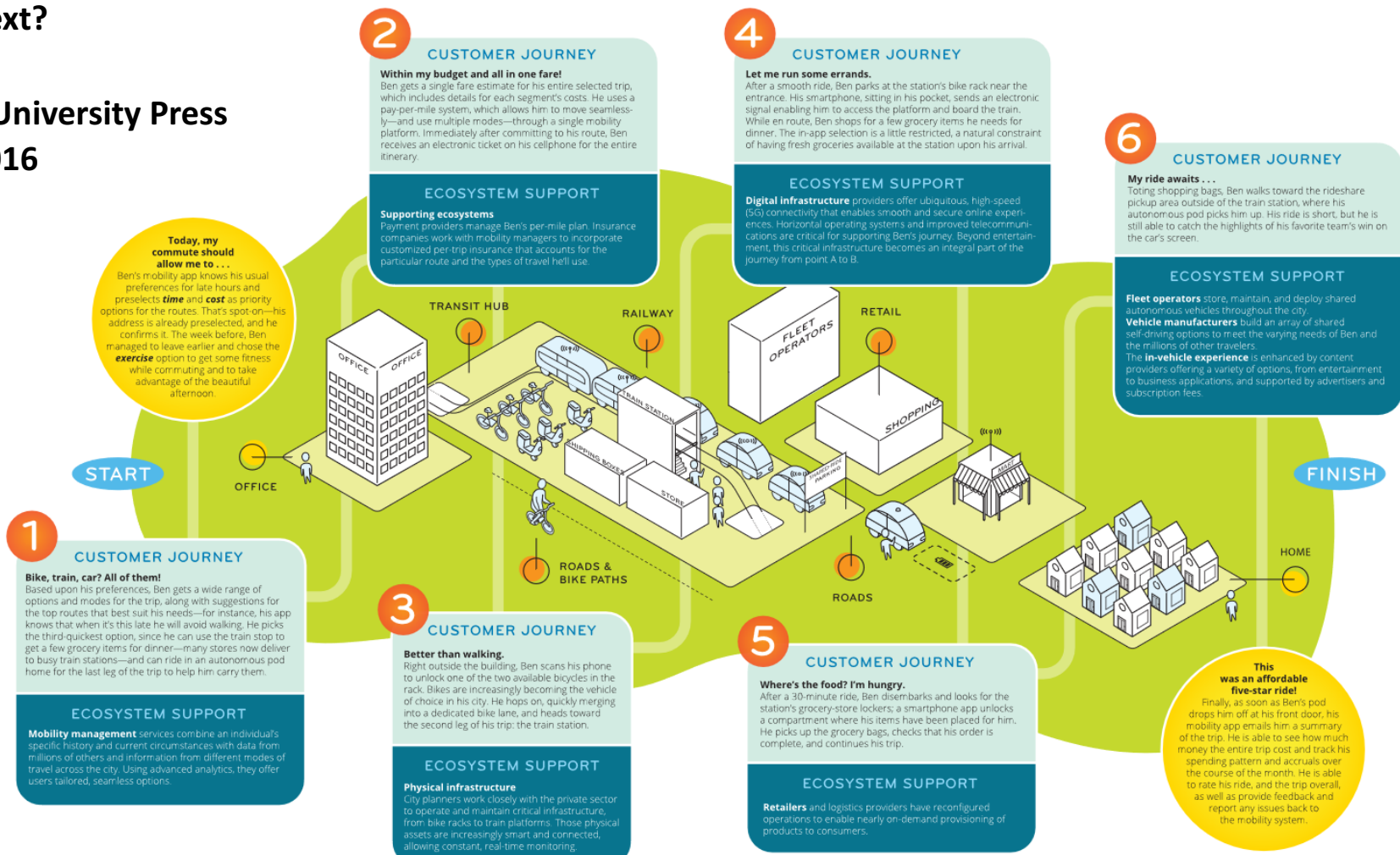


**If we take action, we can build a dream transportation system around self-driving cars. If we don't, we'll create a nightmare**

Robin Chase, Author of Peers Inc; co-founder Veniam, vehicle mesh and co-founder former CEO Zipcar  
Self-Driving Cars Will Improve our Cities. If They Don't ruin them.  
backchannel.com 10/08/2016

# The future of mobility: Whats next?

Deloitte University Press  
14/09/2016



START

FINISH

**1 CUSTOMER JOURNEY**

**Bike, train, car? All of them!**  
Based upon his preferences, Ben gets a wide range of options and modes for the trip, along with suggestions for the top routes that best suit his needs—for instance, his app knows that when it's this late he will avoid walking. He picks the third-quickest option, since he can use the train stop to get a few grocery items for dinner—many stores now deliver to busy train stations—and can ride in an autonomous pod home for the last leg of the trip to help him carry them.

**ECOSYSTEM SUPPORT**

**Mobility management** services combine an individual's specific history and current circumstances with data from millions of others and information from different modes of travel across the city. Using advanced analytics, they offer users tailored, seamless options.

**Today, my commute should allow me to . . .**  
Ben's mobility app knows his usual preferences for late hours and preselects **time** and **cost** as priority options for the routes. That's spot-on—his address is already preselected, and he confirms it. The week before, Ben managed to leave earlier and chose the **exercise** option to get some fitness while commuting and to take advantage of the beautiful afternoon.

**2 CUSTOMER JOURNEY**

**Within my budget and all in one fare!**  
Ben gets a single fare estimate for his entire selected trip, which includes details for each segment's costs. He uses a pay-per-mile system, which allows him to move seamlessly—and use multiple modes—through a single mobility platform. Immediately after committing to his route, Ben receives an electronic ticket on his cellphone for the entire itinerary.

**ECOSYSTEM SUPPORT**

**Supporting ecosystems**  
Payment providers manage Ben's per-mile plan. Insurance companies work with mobility managers to incorporate customized per-trip insurance that accounts for the particular route and the types of travel he'll use.

**3 CUSTOMER JOURNEY**

**Better than walking.**  
Right outside the building, Ben scans his phone to unlock one of the two available bicycles in the rack. Bikes are increasingly becoming the vehicle of choice in his city. He hops on, quickly merging into a dedicated bike lane, and heads toward the second leg of his trip: the train station.

**ECOSYSTEM SUPPORT**

**Physical infrastructure**  
City planners work closely with the private sector to operate and maintain critical infrastructure, from bike racks to train platforms. Those physical assets are increasingly smart and connected, allowing constant, real-time monitoring.

**4 CUSTOMER JOURNEY**

**Let me run some errands.**  
After a smooth ride, Ben parks at the station's bike rack near the entrance. His smartphone, sitting in his pocket, sends an electronic signal enabling him to access the platform and board the train. While en route, Ben shops for a few grocery items he needs for dinner. The in-app selection is a little restricted, a natural constraint of having fresh groceries available at the station upon his arrival.

**ECOSYSTEM SUPPORT**

**Digital infrastructure** providers offer ubiquitous, high-speed (5G) connectivity that enables smooth and secure online experiences. Horizontal operating systems and improved telecommunications are critical for supporting Ben's journey. Beyond entertainment, this critical infrastructure becomes an integral part of the journey from point A to B.

**5 CUSTOMER JOURNEY**

**Where's the food? I'm hungry.**  
After a 30-minute ride, Ben disembarks and looks for the station's grocery-store lockers; a smartphone app unlocks a compartment where his items have been placed for him. He picks up the grocery bags, checks that his order is complete, and continues his trip.

**ECOSYSTEM SUPPORT**

**Retailers** and logistics providers have reconfigured operations to enable nearly on-demand provisioning of products to consumers.

**6 CUSTOMER JOURNEY**

**My ride awaits . . .**  
Toting shopping bags, Ben walks toward the rideshare pickup area outside of the train station, where his autonomous pod picks him up. His ride is short, but he is still able to catch the highlights of his favorite team's win on the car's screen.

**ECOSYSTEM SUPPORT**

**Fleet operators** store, maintain, and deploy shared autonomous vehicles throughout the city. **Vehicle manufacturers** build an array of shared self-driving options to meet the varying needs of Ben and the millions of other travelers. The **in-vehicle experience** is enhanced by content providers offering a variety of options, from entertainment to business applications, and supported by advertisers and subscription fees.

**This was an affordable five-star ride!**  
Finally, as soon as Ben's pod drops him off at his front door, his mobility app emails him a summary of the trip. He is able to see how much money the entire trip cost and track his spending pattern and accruals over the course of the month. He is able to rate his ride, and the trip overall, as well as provide feedback and report any issues back to the mobility system.



**Radical changes are ahead**

**We need a  
human centered approach**





**The « Anthropolis » chair investigates human centered eco-innovations in the context of urban mobility systems and their interactions with other urban systems.**



- ◆ **Identify needs, behaviors and habits in personal mobility**
- ◆ **Define typical usage scenarios**
- ◆ **Develop observation protocols for given usage scenarios**



- ◆ **Identify future disruptive developments**
- ◆ **Innovation design for user-centered mobility**
- ◆ **Solutions encouraging ecological and sustainable transport**



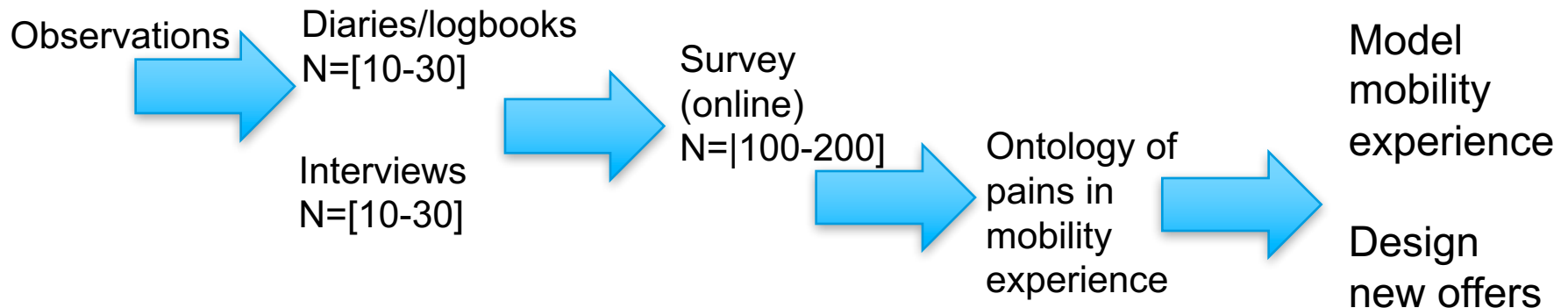


- ◆ **Adapt existing tools for impact assessment**
- ◆ **Operational design of novel mobility services**
- ◆ **Evaluate the impact of disruptive technologies**
- ◆ **Impact on business models and policy**

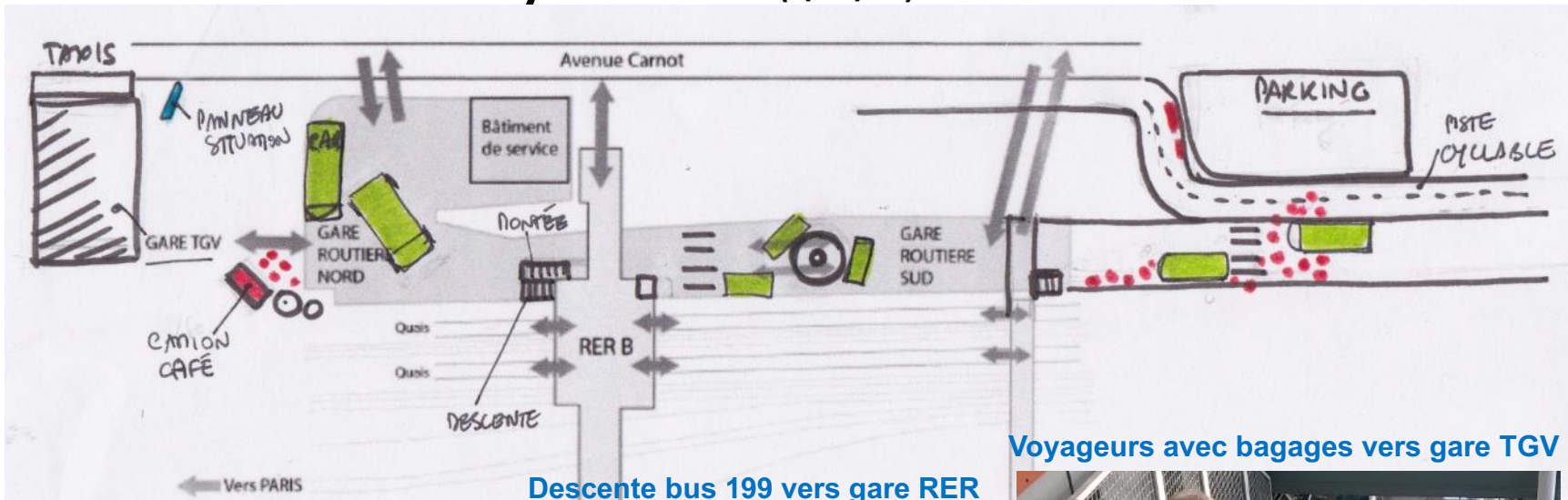


**Observation**

- ◆ **Main question:** « What are the pains/satisfactions experienced by travelers in daily urban mobility? »
- ◆ **Aim:** integrate qualitative insights on pains and satisfactions into a model of urban mobility experience; the design of new offers
- ◆ **Method:** micro-qualitative (Mariton 2008) and quantitative approach



# Observation at Massy Palaiseau (3/05/16)



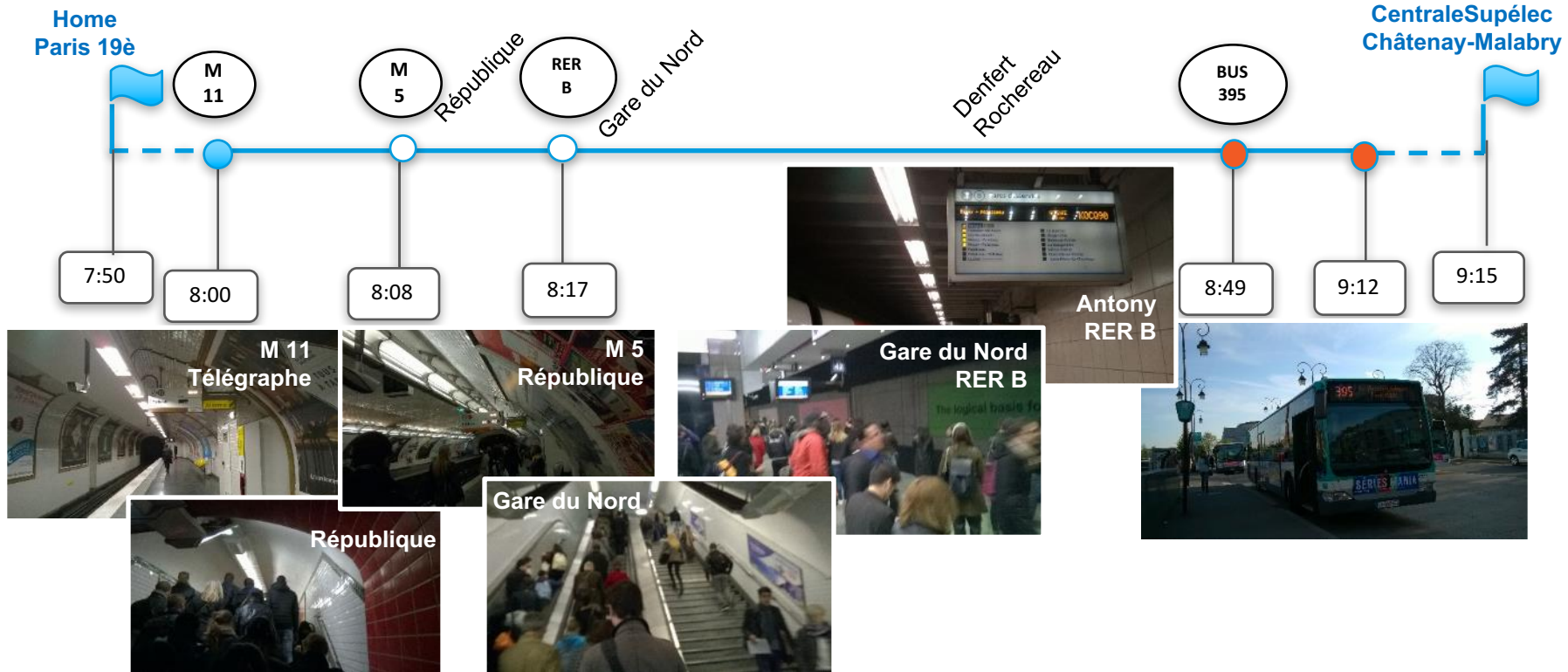
Descente bus 199 vers gare RER



Voyageurs avec bagages vers gare TGV



# Trip representations





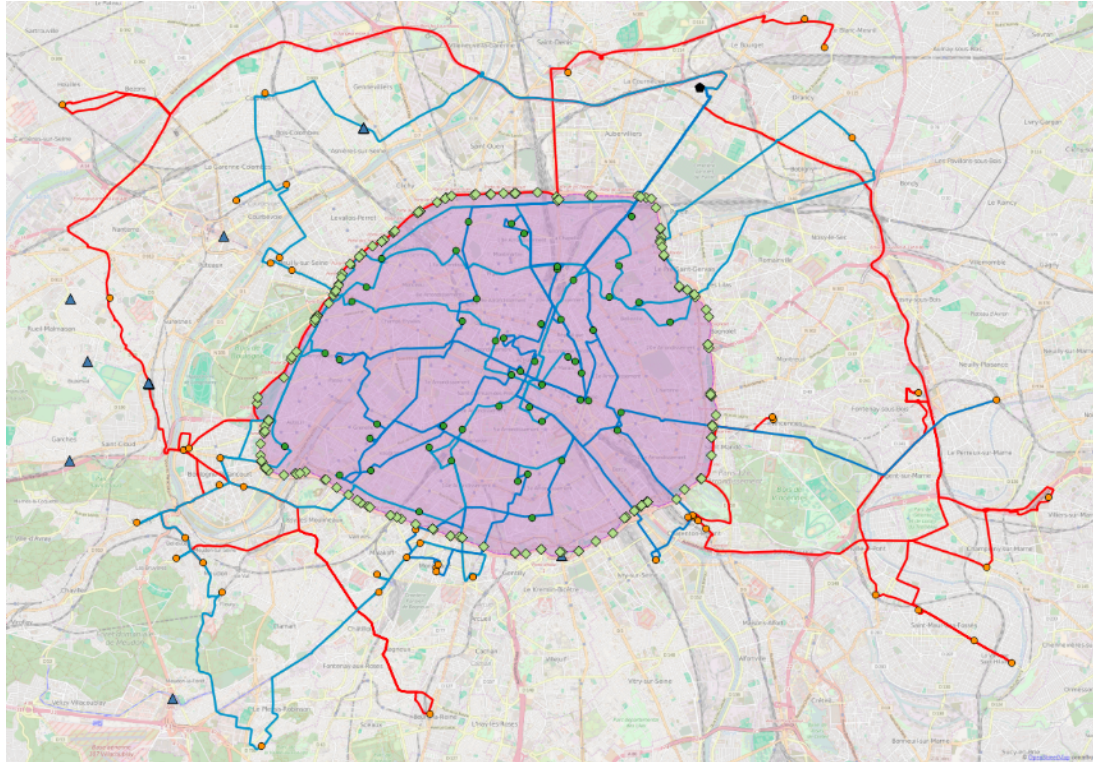
**Impact**

- ◆ **Daily fee for entering the controlled area**
  - ◆ London, Singapore, Stockholm, ..
- ◆ **Old town centers**
  - ◆ Durnham, Riga, ..
- ◆ **Milan (Area C)**
  - ◆ prohibition of old fossil fuelled vehicles
  - ◆ others have to pay a fee (€2-5)
  - ◆ electric / hybrid vehicles free of charge



G. Hiermann, R. F. Hartl, J. Puchinger and T. Vidal. Hybrid Electric Fleet Routing with City Center Restrictions. Route 2016.

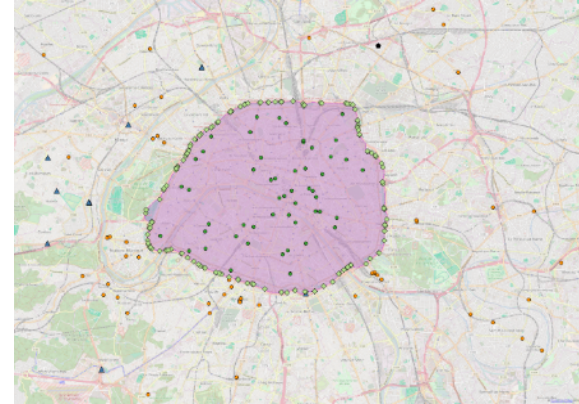
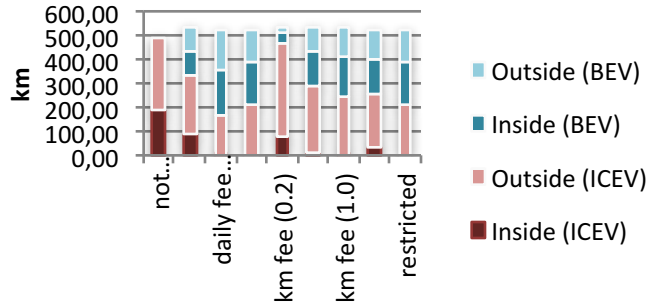
100 customers  
● 50 inside  
● 50 outside



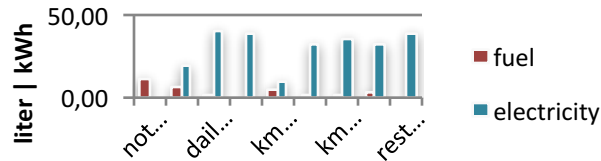
ICEV  
restricted  
— 2 ICEV  
— 5 BEV

km inside/outside  
ICEV: - /161,53  
BEV: 176,80/141,49

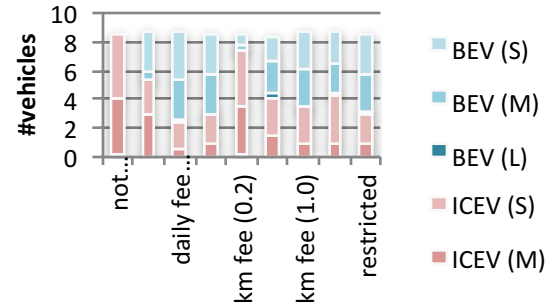
## distance travelled



## consumption inside the city center



## vehicle usage







**Flore Vallet –  
Researcher**

- Expert in Eco-Design and Innovation



**Ouail Al  
Maghraoui –  
PhD Student**

- Users, Usage Scenarios, and Novel Services



**Feirouz Ksontini –  
Research  
Engineer**

- Expert in Transport modelling



**Abood Mourad –  
PhD Student**

- Synchronization for shared mobility in an uncertain environment



**Jakob Puchinger –  
Chair Holder**

- Expert in Transportation an Operations Research



# Thank you!

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