Willingness to pay for electric vehicles and their attributes: the impact on electric vehicles market diffusion in France

20/05/2019

Franck Pernollet

franck.pernollet@edf.fr

EVS32 A world of E.MOTION 2019 MAY 19 22

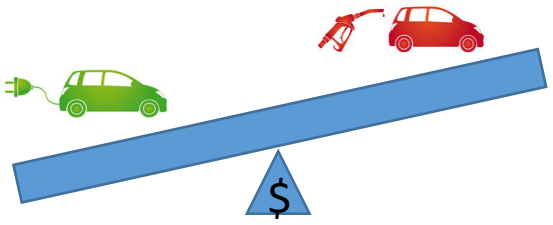
INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION

EVS 50th anniversary 1969-2019

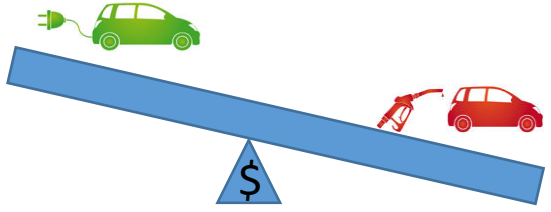
BEV is already economically attractive for some households but its market share is still low

Total cost of ownership (TCO) : car purchase, battery purchase, fuel cost, insurance, maintenance …..

TCO for small rider



TCO for high rider



- Even if BEV is already economically attractive for some households, its market share is still low in France

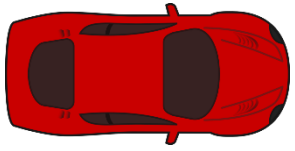
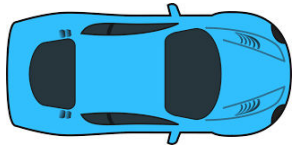
➡ Some **non-monetary constraints** influence EV adoption

Which one ? How ? And in the future ?

- A **survey** was done to better understand non-monetary barriers : EV driving anxiety, autonomy, charging time, charging point density
- Willingness to pay (**WTP**) is used to monetize these constraints and differentiate them for different household types
- These constraints are implemented in a **EV diffusion model**

Willingness to pay to quantify non-monetary barriers

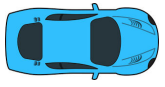
➢ **WTP : Willingness to pay** is the maximum price at or below which consumer will definitely buy one unit of a product

	 Electric vehicle	 Electric vehicle
	10 000 €	???? €
	200 km	350 km
	6 € / 100 km	6 € / 100 km
	EVSE at 3 km in urban area	EVSE at 3 km in urban area
	20 min to charge 200 km	20 min to charge 200 km

WTP to increase autonomy from 200 to 350 km

Example :

- ????? = 13 000 €

If  choose 
Then WTP_200_350 > 3000 €

- ????? = 14 000 €

If  choose 
Then WTP_200_350 < 4000 €

➡ WTP fluctuates according to users
Different categories are studied

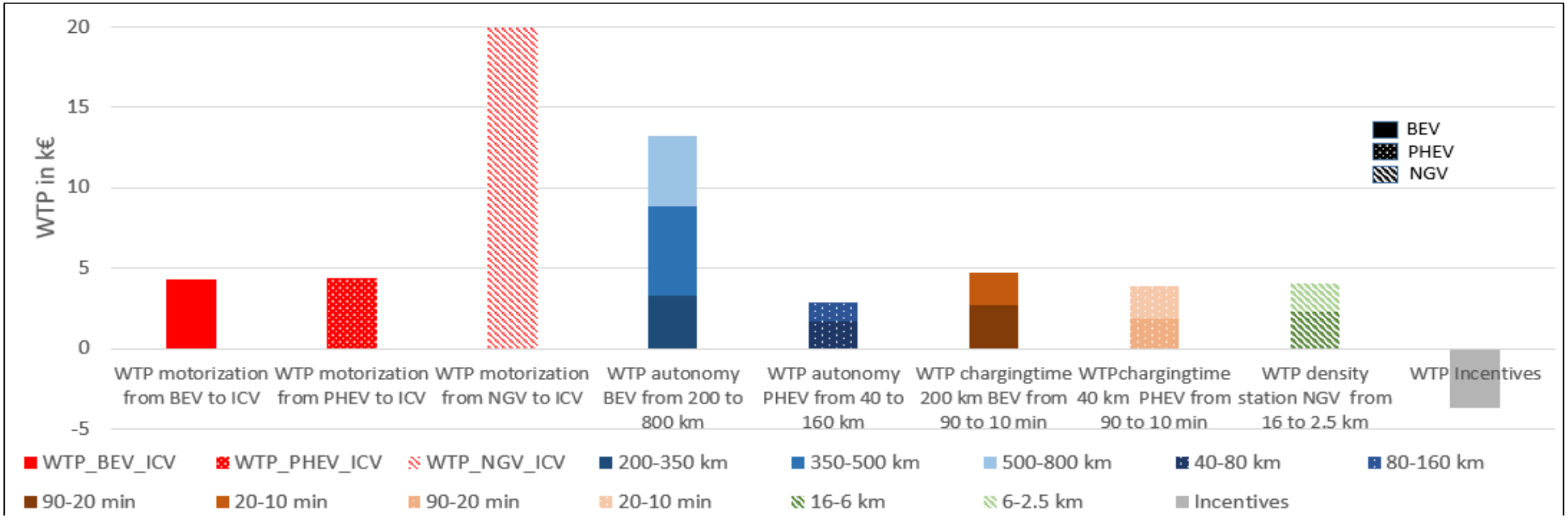
One trade-off example

	ICV	BEV	NGV	BEV
Purchase price (bonus already deducted)(without battery for electric vehicle which are rented)	12 500 €	10 625 €	14 375 €	12 500 €
Autonomy	800 km	350 km	800 km	500 km
Fuel/electricity cost for 100 km (including battery location cost for EV)	11 €	8 €	7 €	10 €
Average distance in kilometer to fuel station/charging public station	fuel station at 6.5 km in rural zone, 2.5 km in urban zone	charging station at 7 km in rural zone, 1.5 km in urban zone (0 km if charge at home)	gas station at 16 km in rural area, 6 km in urban area	charging station at 7 km in rural zone, 2.5 km in urban zone (0 km if charge at home)
Charging time in a public station /fuel tank fulling time	About 10 minutes in fuel station for **800 km**	About 10 minutes in a public charging station for **200 km autonomy** (between 5 to 11h at home)	About 10 minutes in fuel station for **800 km**	About 90 minutes in a public charging station for **200 km autonomy** (between 5 to 11h at home)
Public incentive (free parking, access to some restricted city center, reserved lane on motorway, smaller motorway tolls)…	No	No	Yes	Yes

- A representative sample of **12,000** French future vehicle buyers (web survey). We focus only on private users.
- 6 trade-off per respondent with 4 vehicles among 4 powertrains: ICV, BEV, PHEV, NGV
- Different attributes levels for each powertrain

A huge fear of natural gas powertrain

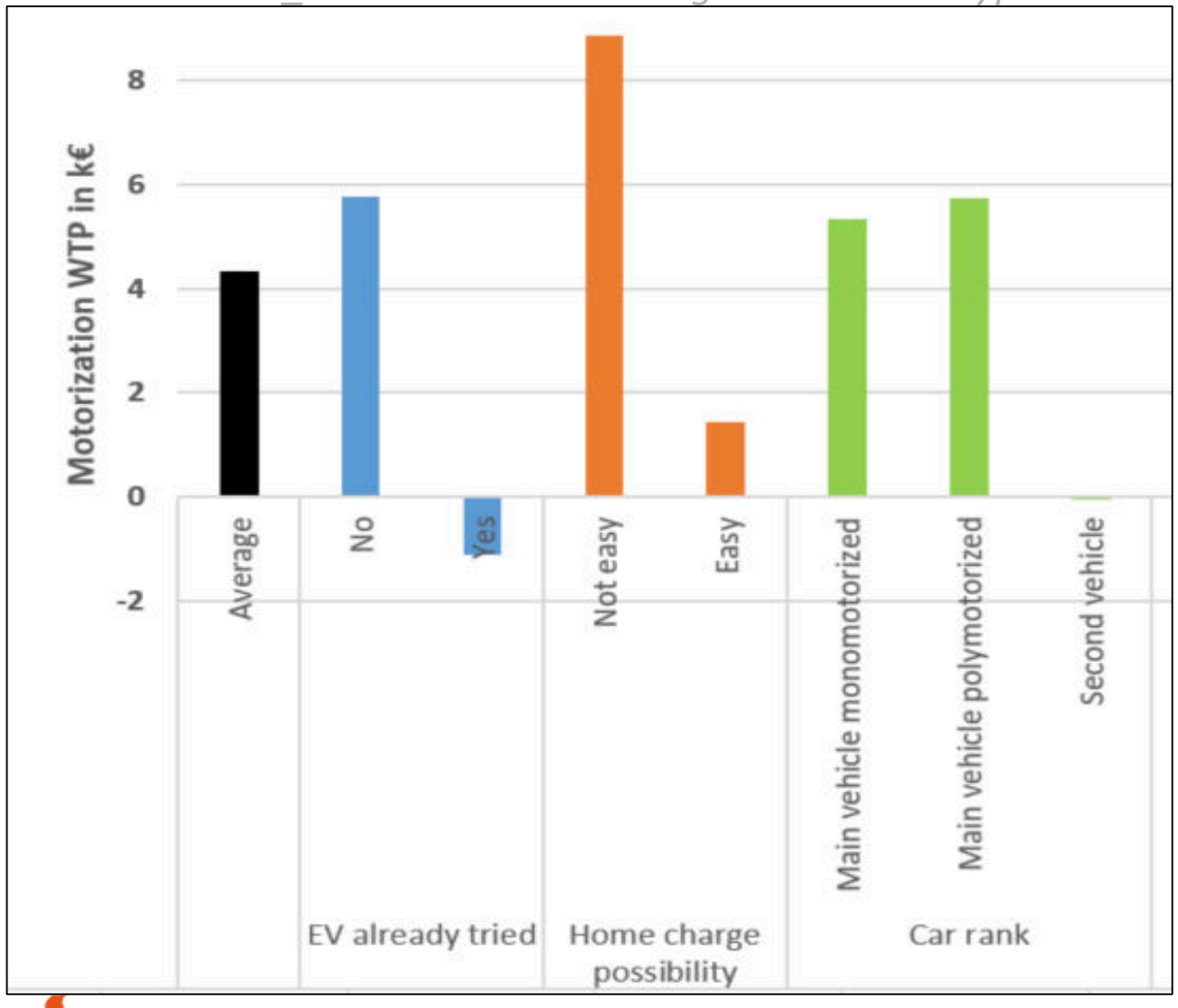
Average WTP for different attributes and different powertrains



- WTP_motorization for **BEV, PHEV, NGV** is positive : these vehicles are seen **less attractive than ICV**
- WTP_motorization_BEV is five times lower than WTP_motorization_NGV, hence **difficulties to implement NGV** in France
- WTP_incentives ≈ WTP_motorization_BEV
- People are more interested in increasing **autonomy** than reducing charging time
- Our calculations show, that for the moment, lack of public EVSE is not the predominant barrier to BEV and PHEV diffusion: people who do not have possibility to charge at home automatically discard the EV which prevent from quantifying WTP, and other are satisfied by charging points density

EV : try it and you will buy it

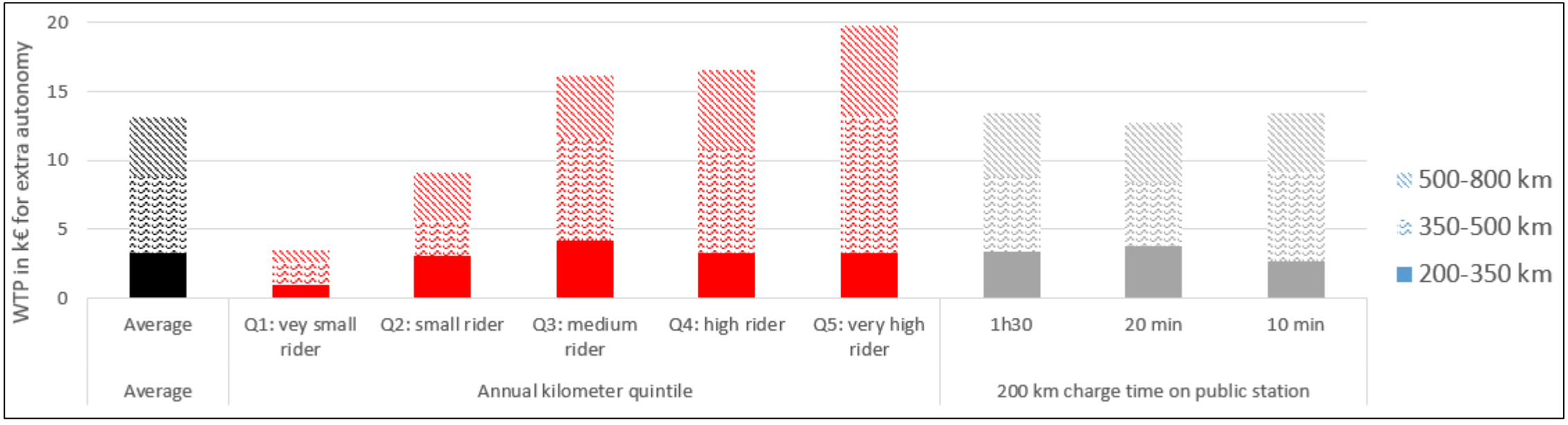
BEV WTP_motorization according to household type



- WTP_motorization takes into account all other vehicle motorization characteristics than those already tested: autonomy, charging time, charging point/fuel station density, incentives
- **Try EV and you will buy it** (6,900 € difference between the WTP)
- **People without possibility to charge at home eliminate BEV** (7,400 € difference between the WTP)
- BEV WTP_motorization ≈ 0 for second vehicle: in case of failure, people can use their main vehicle which reduces anxiety

People want more than 350 km autonomy

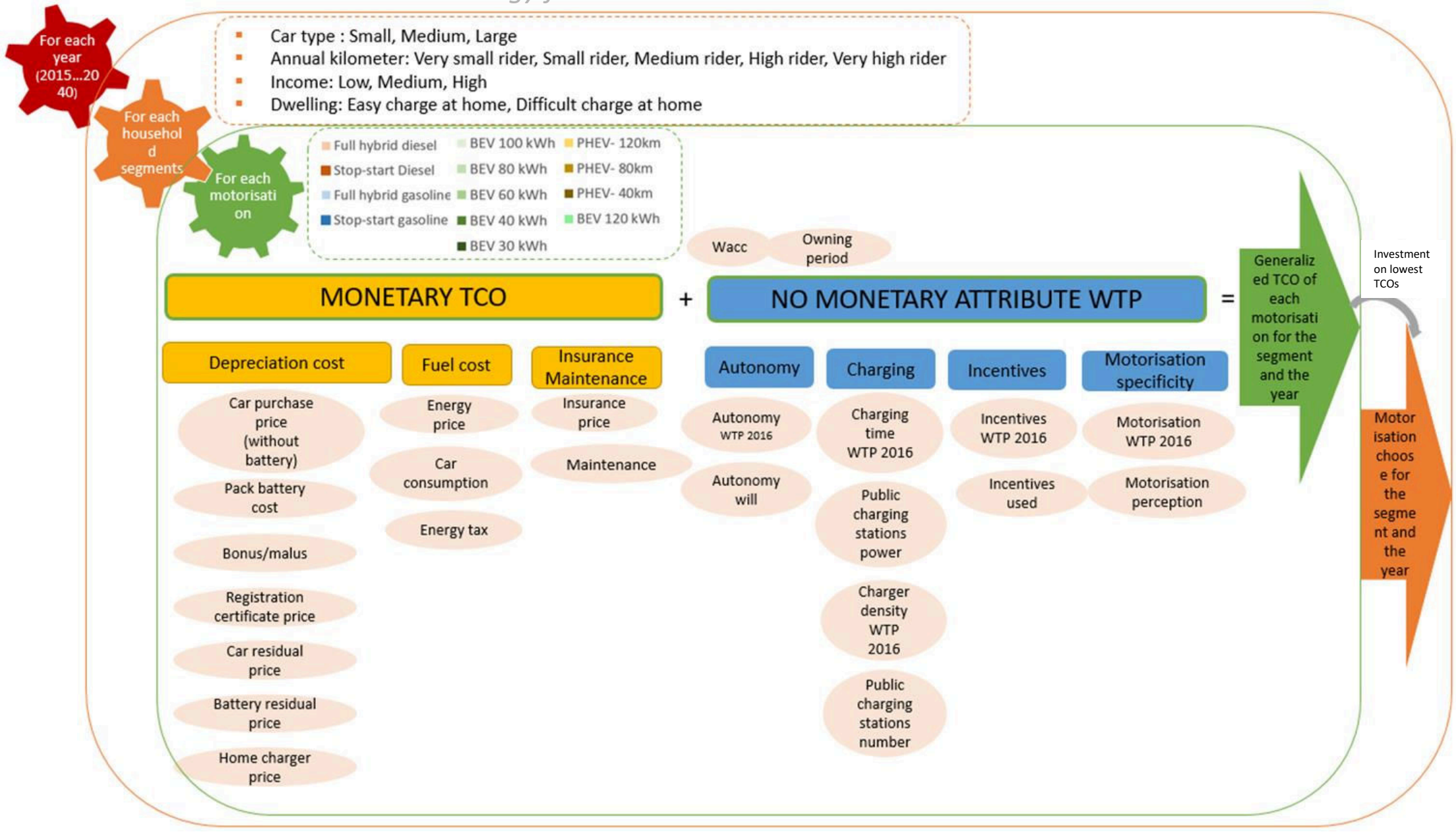
BEV WTP_autonomy according to household type



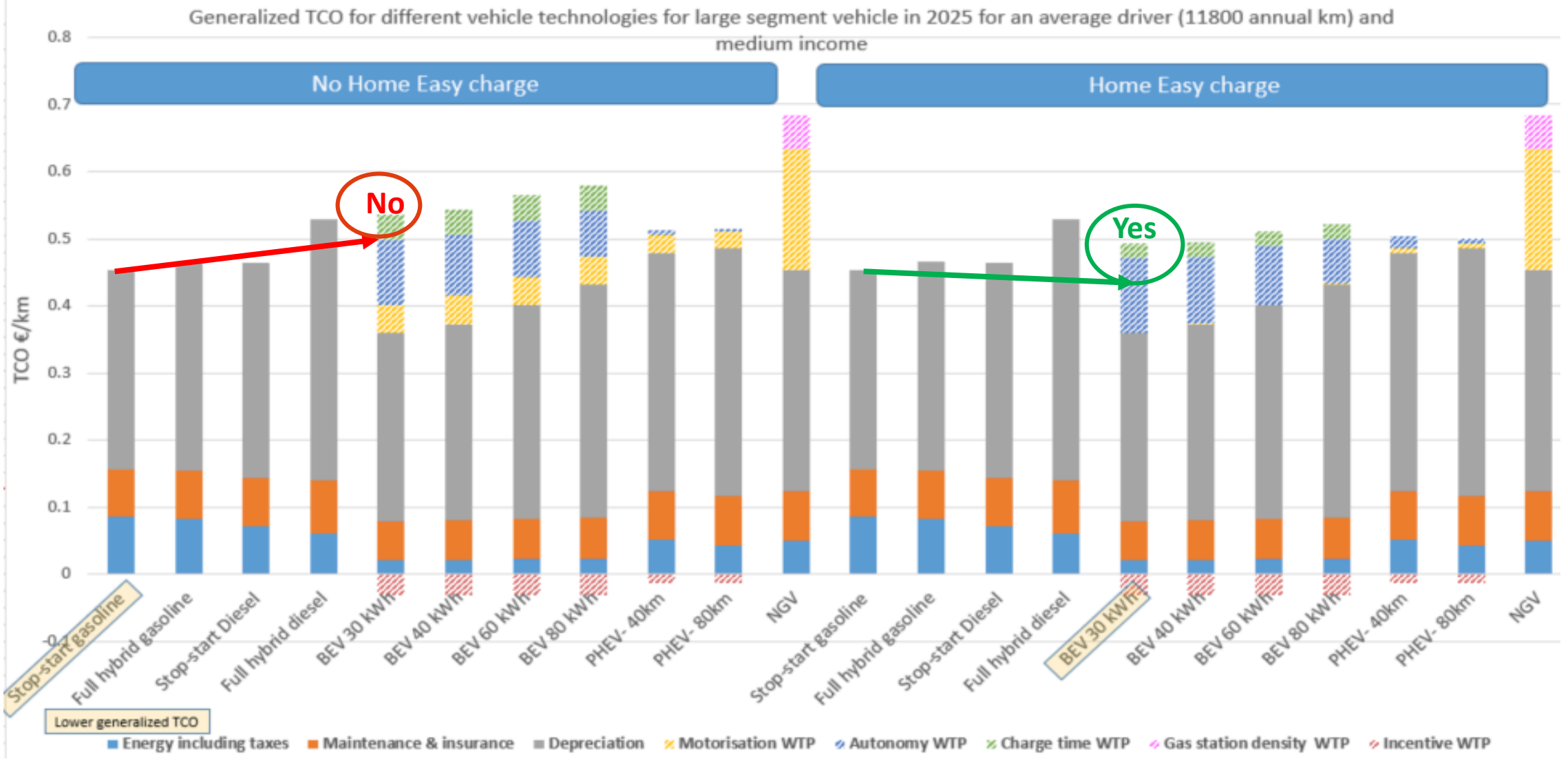
- Globally WTP_autonomy_650_800 << WTP_autonomy_200_350 << WTP_autonomy_350_500: **people want more than 350 km** for their long trip but 500 km seems enough
- Very high rider are ready to pay more for extra autonomy from 500 to 800 km
- A huge development of the public fast charging station network will not be sufficient to facilitate BEV adoption, battery autonomy being the main stake

This diffusion model add WTP to other TCO items, splitting households in 90 segments

Global methodology for market share sales: IMMOVE-PMB model



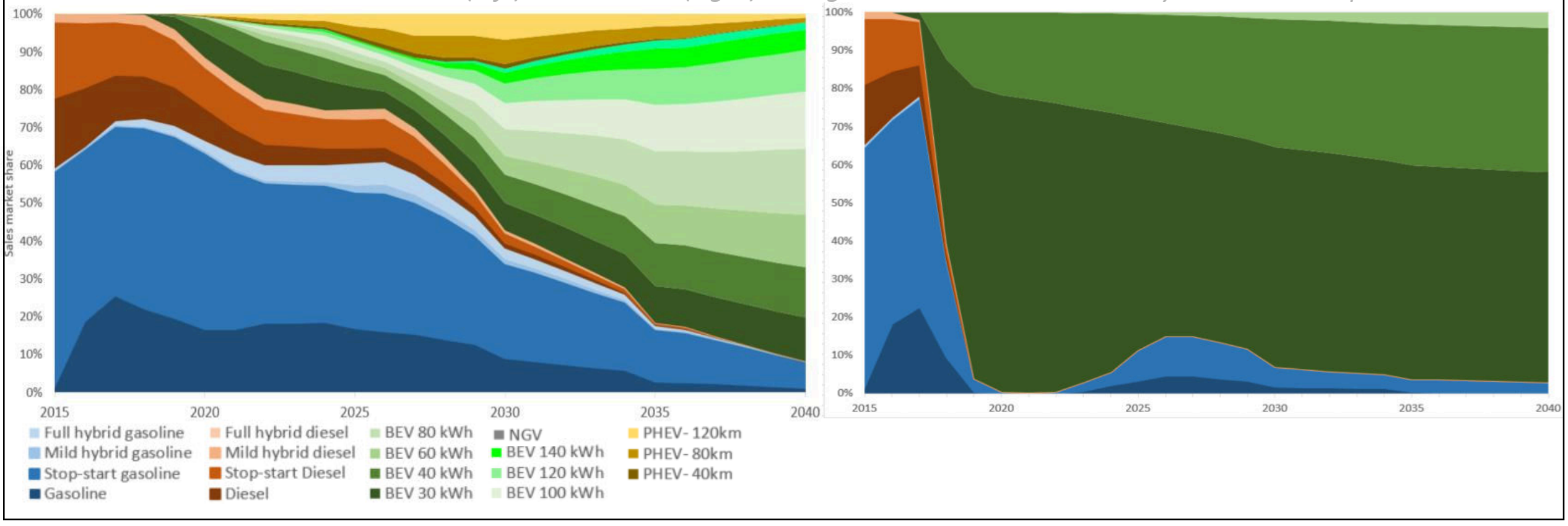
Result example: possibility to charge at home is crucial in the EV purchase decision process



- In this example, BEV monetary TCO is always lower (for battery up to 80 kWh) than ICV TCO. However for generalized TCO, it is lower only for 30 and 40 kWh BEV with easy charge at home.

Take into account non-monetary constraints slows down EV diffusion

Private vehicle sales evolution with(left) and without (right) taking into account non-monetary constraints in pro EV scenario

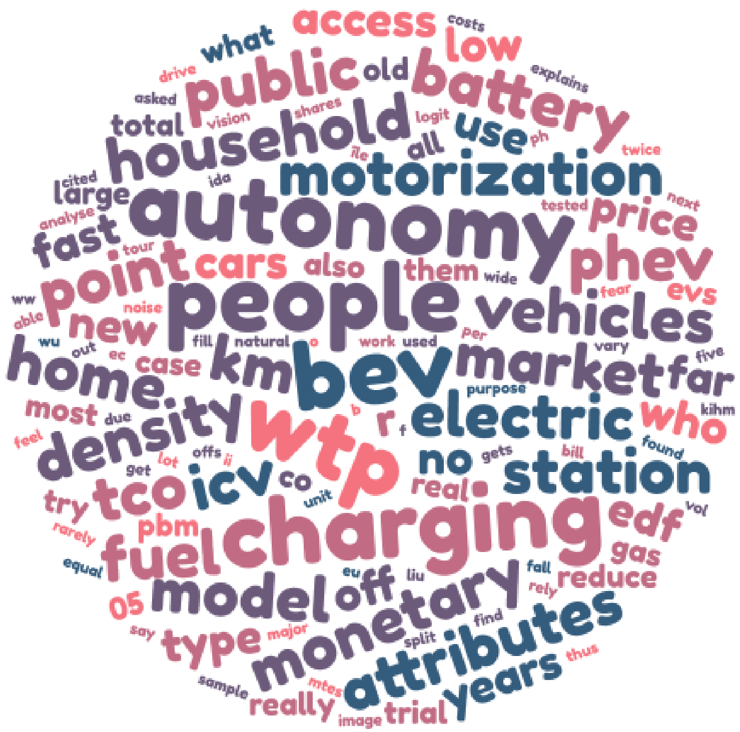


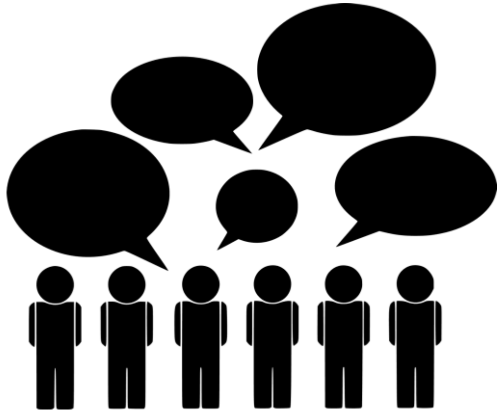
- To improve EV diffusion model, it is crucial to take into account both classical TCO and non-monetary constraints
- BEVs with low autonomy (30-40 kWh) meet some households needs
- It is also crucial to split households since they do not have same needs and constraints

Conclusion

- To improve **EV diffusion model**, it is crucial to take into account both classical TCO and **non-monetary constraints**
- It is also crucial to **split households** since they do not have same needs and constraints
- **Home charging possibility** seems to be a **prerequisite** to consider EV purchase
- **Try BEV and you will buy it!**
- People have apprehensions on BEV, they need to be reassured particularly on battery lifetime, how to charge, how to install a charging point at home
- Most of people want between 350 km to 500 km but there is a market for BEV with smaller autonomy.
- **Comparing to NGV, barriers to BEV diffusion are far lower**

Thank you

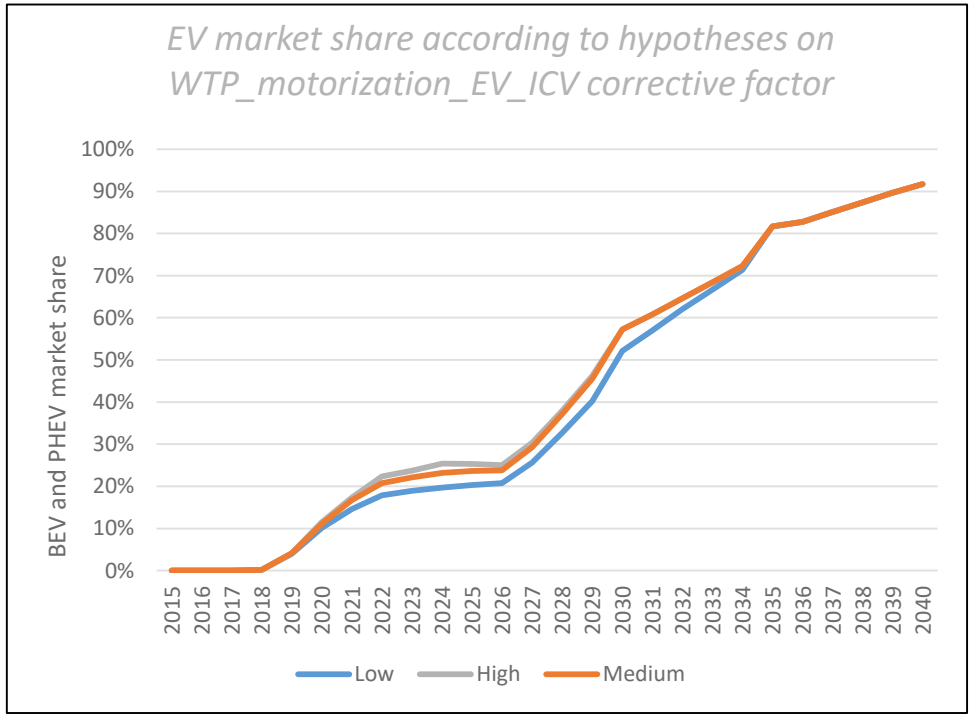

access
low
what
public
old
battery
household
total
use
motorization
autonomy
large
fast
price
point
cars
also
them
phev
people
vehicles
new
evs
home
case
km
bev
market
far
most
density
wtp
electric
who
no
station
tco
icv
real
edf
charging
fuel
gas
reduce
model
off
monetary
type
attributes
years
really
trial



Appendix

Non monetary barriers will decrease in next years

- Non monetary barriers will decrease in next years, people will understand their real autonomy needs, EV fear will decrease with EV trial ….
- We can test hypotheses on these parameters evolution



Main apprehensions (except autonomy, charge time and public charging station density) evolution considered in medium scenario for BEV and WTP_motorization_EV_ICV evolution

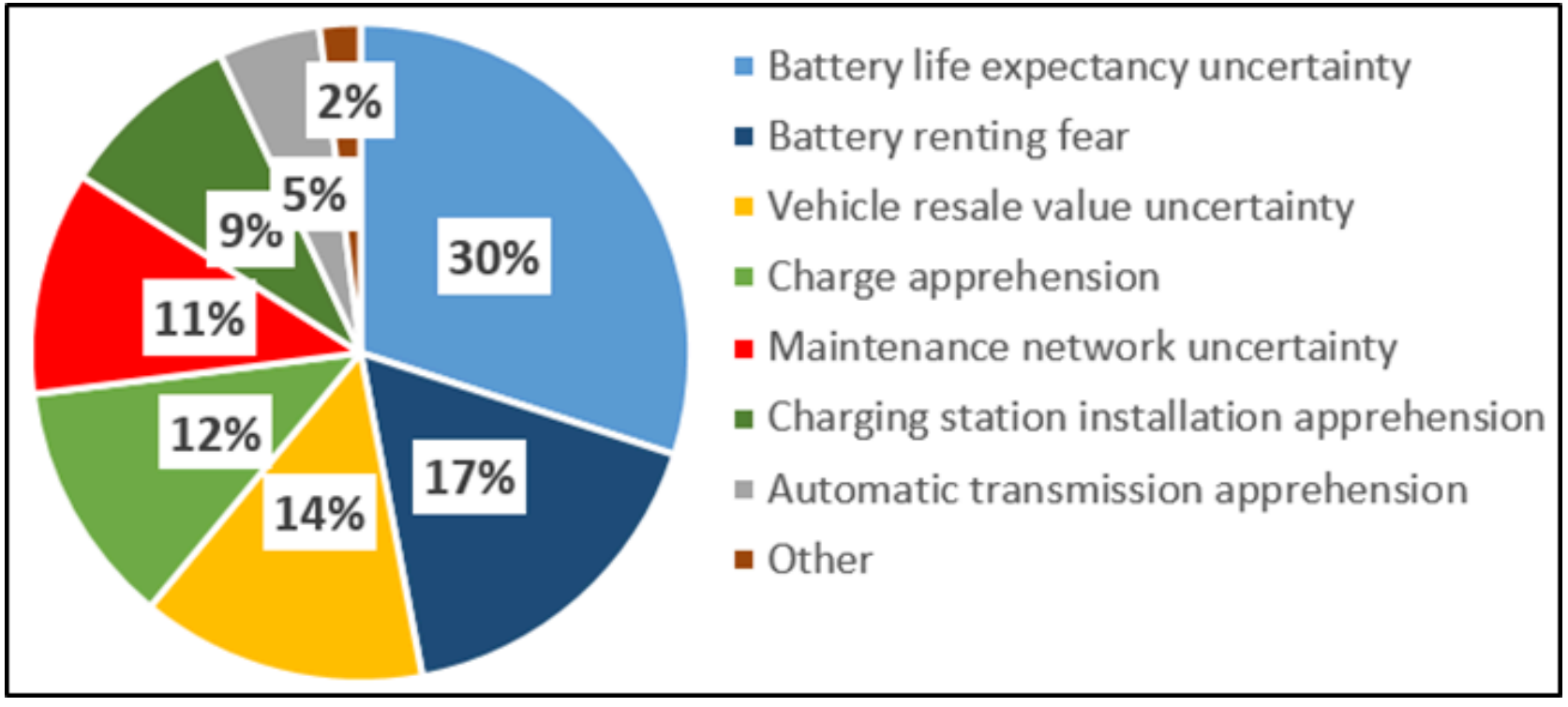
		Value compared to 2015			
	Main apprehension repartition in 2015	**2015**	**2020**	**2025**	**2030**
Battery life expectancy uncertainty	30%	100%	90%	75%	0%
Battery renting fear	17%	100%	90%	50%	0%
Vehicle resale value uncertainty	14%	100%	50%	0%	0%
Charge apprehension	12%	100%	0%	0%	0%
Maintenance network uncertainty	11%	100%	50%	0%	0%
Charging station installation apprehension	9%	100%	0%	0%	0%
Automatic transmission apprehension	5%	100%	50%	0%	0%
Other	2%	100%	50%	0%	0%
WTP_motorization_EV_ICV medium		100%	58%	31%	0%
WTP_motorization_EV_ICV high		100%	52%	22%	0%
WTP_motorization_EV_ICV low		100%	80%	60%	30%

- By communicating to reduce BEV fear, we can increase EV sales by 25% in 2025

Table 2: Different attribute levels for each motorization in the trade-off

	ICV	BEV	NGV	PHEV
Purchase price (compared to wanted purchase price)	100%	70%; 85%; 100%; 115%; 130 %	100%; 115%; 130 %	115%; 130 %
Autonomy (in km)	800	200; 350; 500; 800	800	40;80;160
Fuel/electricity cost for 100 km (including battery location cost for EV)	3;7;11;16;20	2;4;6;8;10;12;14;16;18	3;7;12;16	2;6;9;12
Average distance in kilometer to fuel station/charging public station	6.5 km in rural area, 2.5 km in urban area	11 km in rural area, 3 km in urban area 7 km in rural area, 2.5 km in urban area 7 km in rural area, 1.5 km in urban area 7 km in rural area, 0.5 km in urban area	41 km in rural area, 16 km in urban area 16 km in rural area, 6 km in urban area 6.5 km in rural area, 2.5 km in urban area	No public station 11 km in rural area, 3 km in urban area for charging station 7 km in rural area, 2.5 km in urban area for charging station 7 km in rural area, 1.5 km in urban area for charging station 7 km in rural area, 0.5 km in urban area for charging station and fuel station 6.5 km in rural area, 2.5 km in urban area
Charging time in a public station /fuel tank fulling time	About 10 minutes for 800 km	About 90 min for 200 km About 20 min for 200 km About 10 min for 200 km	About 10 minutes for 800 km	About 20 min for 40 km with electricity About 10 min for 40 km with electricity About 5 min for 40 km with electricity
Public incentive	No	Yes or No	Yes or No	Yes or No

Figure 3: Main apprehensions (except for autonomy, charge time and public charging station density) for BEV cited by surveyed people



BEV WTP_charging_time according to household type