Innovative Business Models for Charging Infrastructure of Electric and Hydrogen Vehicles

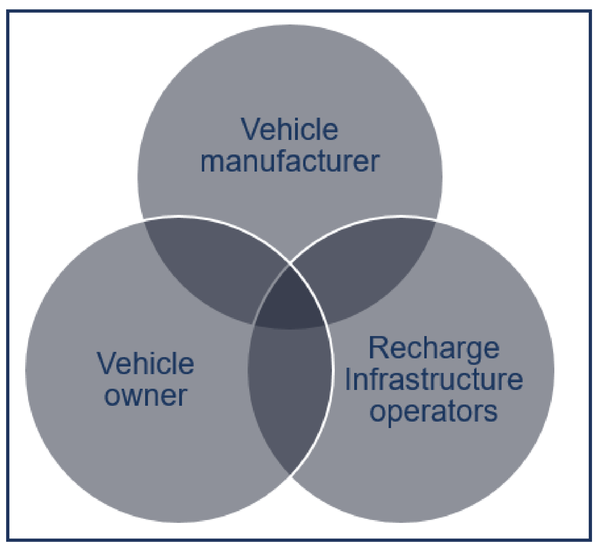
BACKGROUND & MOTIVATION

- The transport sector accounts for 30% for greenhouse emissions (GHG), one of the main causes of climate change.
- Electric and Hydrogen vehicles are a put forward as a possible solution to avoid GHG emissions related to the transportation.
- There is no clear vision about the localization of charging stations
- Although the number of these vehicles is growing fast, their diffusion is still relatively limited. While many barriers have been identified, two of them stand out: the high purchasing cost and range anxiety.

THESIS OBJECTIVE

The goal of this thesis is to perform a detailed design analysis of the required infrastructure for supplying electric and hydrogen vehicles at multiple scales: the investments, costs, efficiencies and emissions for an infrastructure capable of supplying between one hundred thousand to several million vehicles with hydrogen or electricity for 2030-2050 in various countries including France.

PROBLEM IDENTIFICATION

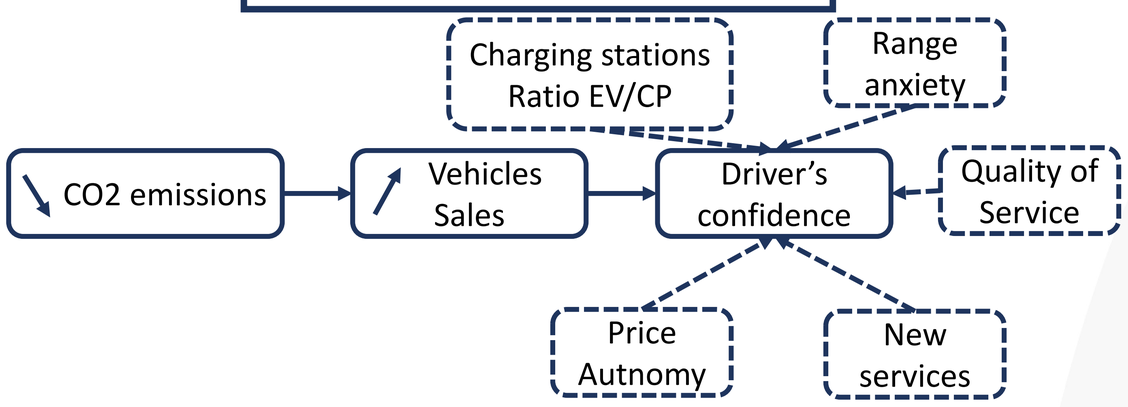


Battery capacity/Autonomy
EV price

Willigness-to-pay
Charging behabiour
Range anxiety
Private charger

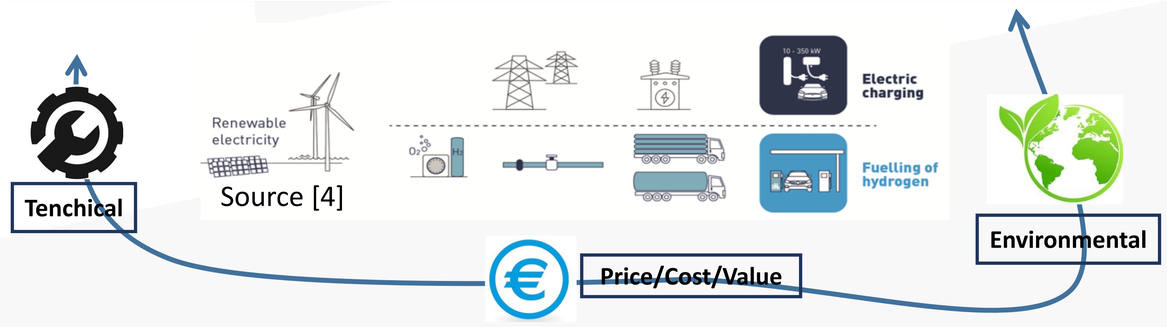
Charger's speed
Charger price
Availability

INDUSTRIAL CONTEXT



ELECTRIC VS. HYDROGEN INFRASTRUCTURE

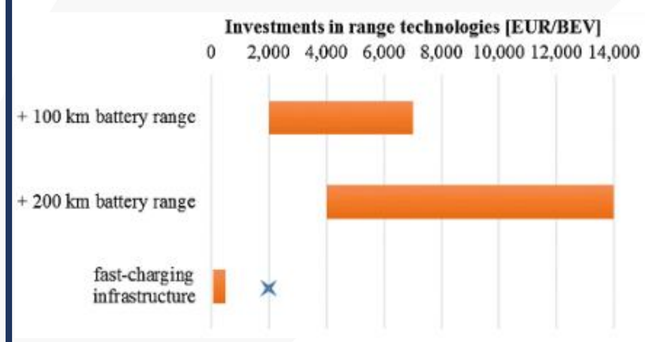
Electric Infra.	Hydrogen Infra.
Different types of sockets	One type of socket
Home/Work charging (sometimes free)	No home charging
Charging speed: from 11 hours to 30 minutes	Charging speed: up to 5 mins
Need to include queuing theory	No need for queuing theory
Modest infrastructure (to be developped)	No existing infrastructure



OPTIMIZATION FACTORS

Infrastructure	Energy Production	Energy Transportation	Energy Distribution	Energy Storage	Charger CAPEX/OPEX	EV CAPEX/OPEX	additional trip, waiting and service time cost	Environmental cost: Charger and Vehicle LCA
Elec			X		X	X	X	X
H2	X	X	X	X	X	X		X

VEHICLE DESIGN



Comparing fast chargers and battery enlargment investment in Germany based on case study of real trajectories .
A conclusion that it is by far more economically to invest in fast charging stations rather than in battery capacity enlargement.

REFERENCES

References

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[2] H. Chen, Y. Liang, H. Luo, et Y. Wang, « Plug-in Electric Vehicle Charging Congestion Analysis Using Taxi Travel Data in the Central Area of Beijing », p. 5.

[3] S. Á. Funke, P. Plötz, et M. Wietschel, « Invest in fast-charging infrastructure or in longer battery ranges? A cost-efficiency comparison for Germany », Appl. Energy, vol. 235, p. 888-899, févr. 2019.

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Publication

[5] Haidar B., da Costa P., Lepoutre J., Perez Y., **2019**, « Corri-door Project: Did it Really Boost the French Electric Vehicle Market? », Energy Challenges for the Next Decade, 16th IAEE European Conference

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