

Connected & Demountable Fuel Cell Range Extender for Electric Vehicles



(EP Tender, 2012)

Dongxiao Wu
PhD Researcher
Centre of Mobility and Transport
Coventry University

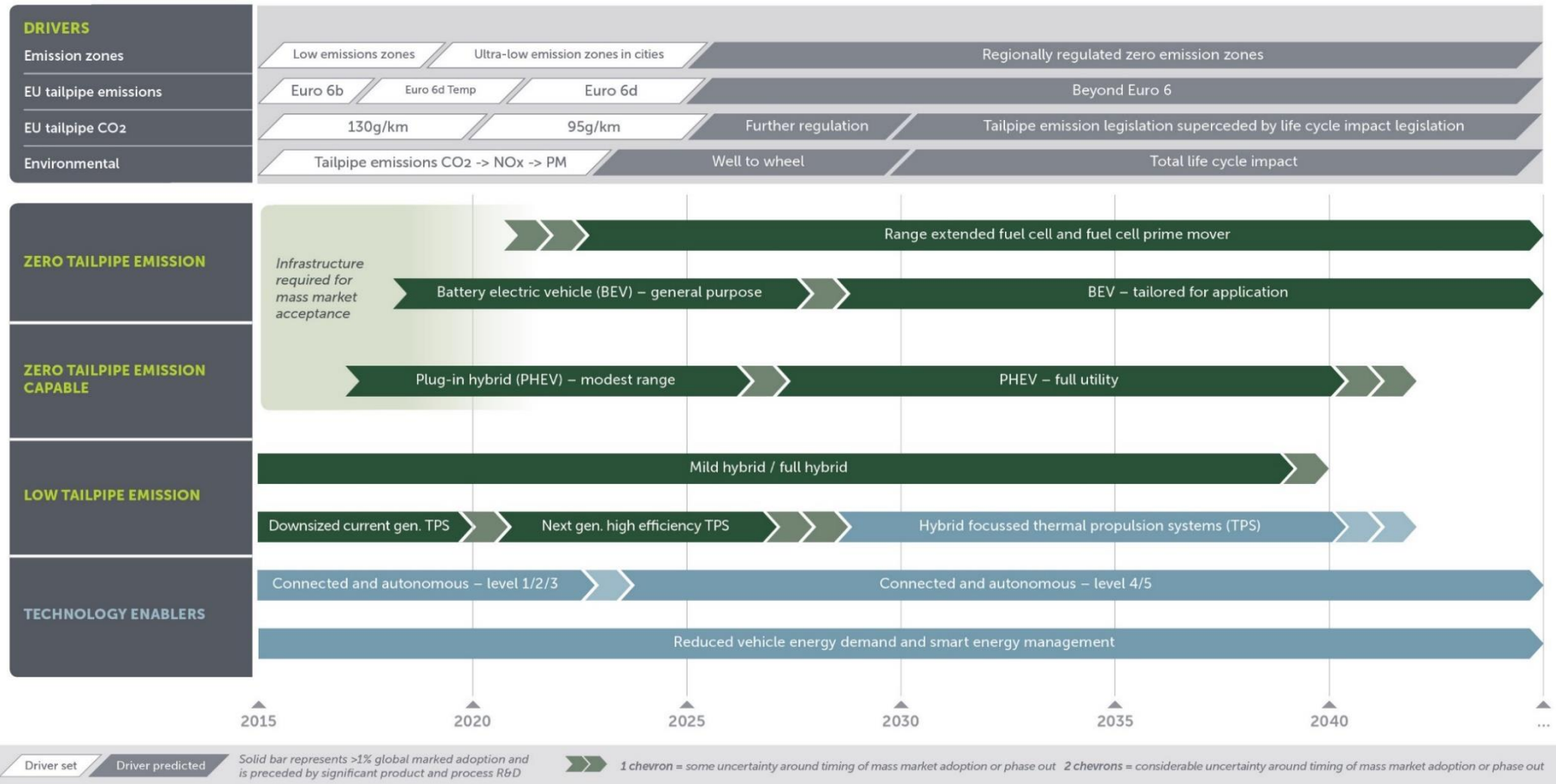
Introduction

1. Project Background
2. Problem Locating
3. Feature & Superiority of FC Range Extender
4. Typical Current Solutions
5. Ideal System Model Demonstration
6. Challenges

Project Background

PRODUCT ROADMAP 2017: PASSENGER CAR

Roadmap developed by the Automotive Council and the Advanced Propulsion Centre



University

Figure: UK Passenger Vehicle Roadmap 2017 (UK Automotive Council, 2017)

Problem Locating

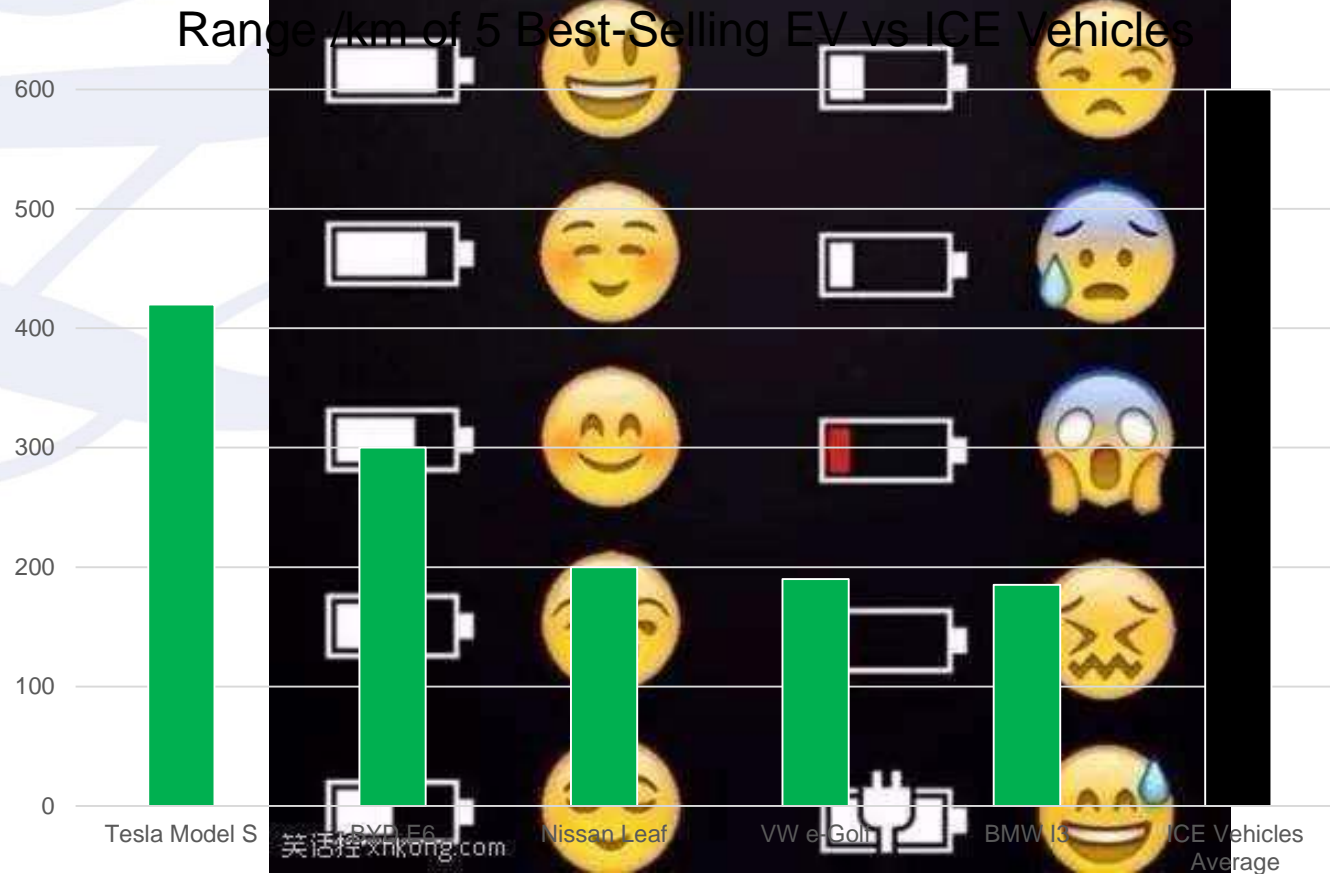
1. “Range Anxiety” – BEV’s Limited Range
2. “Convenience” – Charging Infrastructure, Charging Speed
3. “Cost” – Manufacture Investment, Purchase Price & Running Cost

“Range Anxiety”

- More than 70% of EV owners experience limited range.

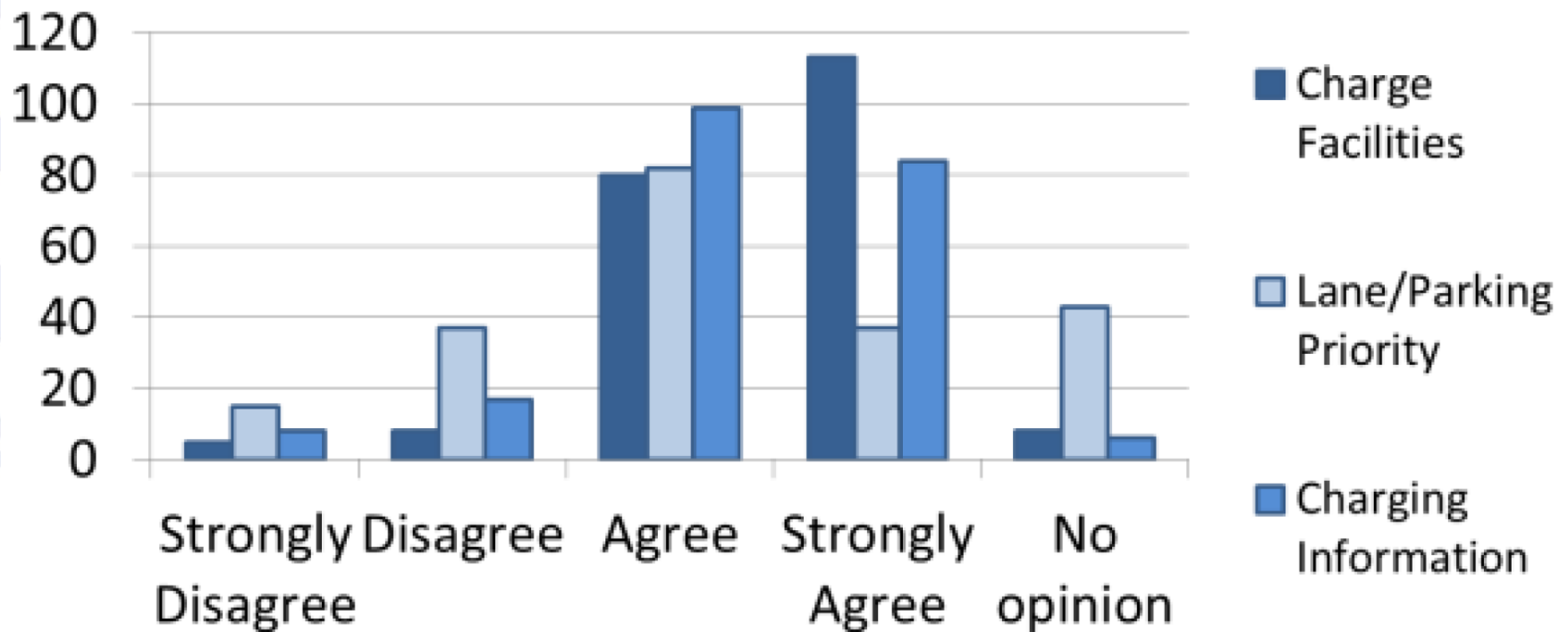
(Krupa et al., 2014)

limited Range.



“Convenience” – Infrastructure Dependency

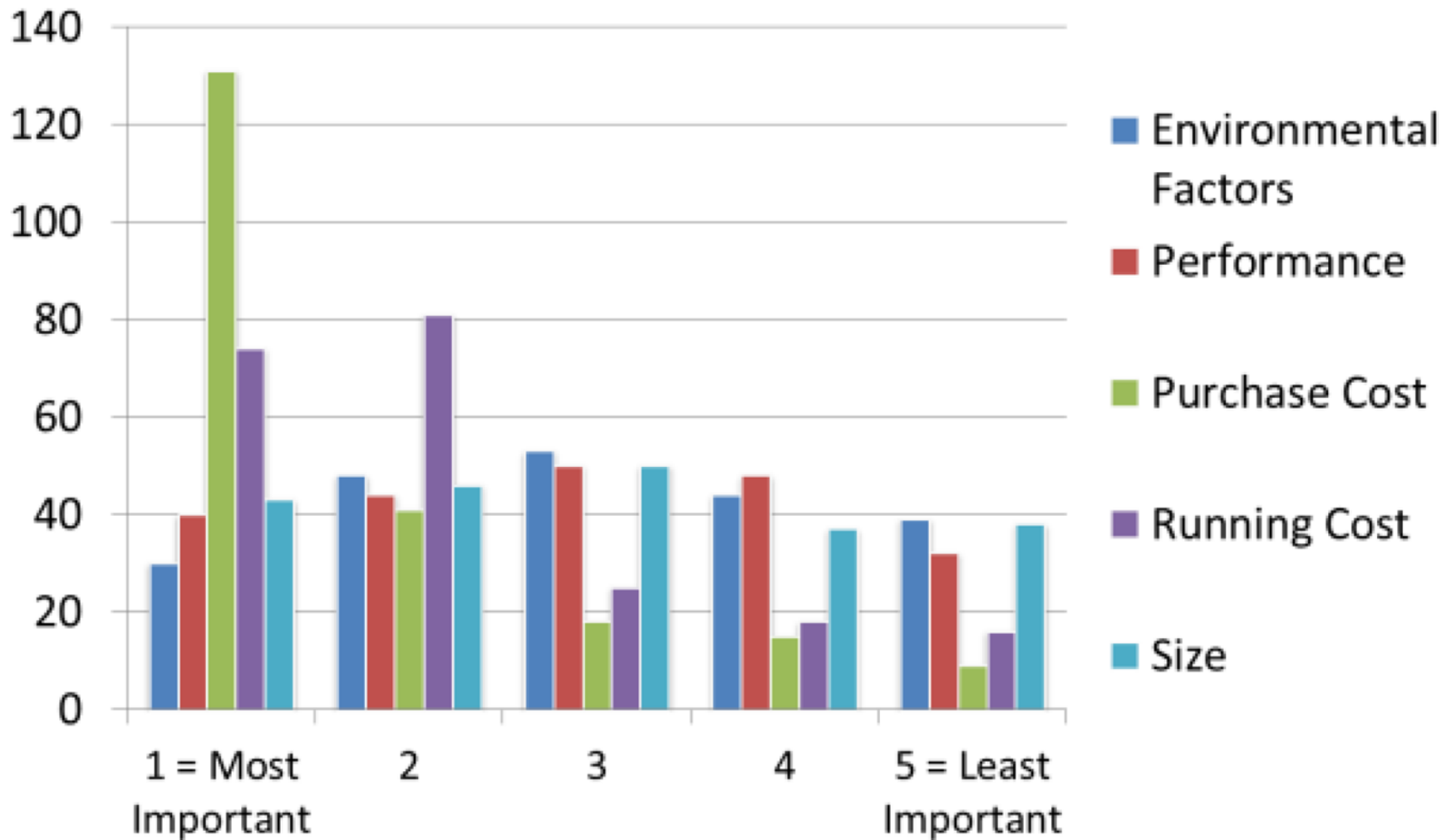
- Customer concern most on infrastructure before purchase



Rapid charging (40, 60, or 120kW): 30 minutes for 80% charge

ICE & FC vehicle: Less than 10 minutes

“Cost” – Manufacture, Purchase & Running



-)

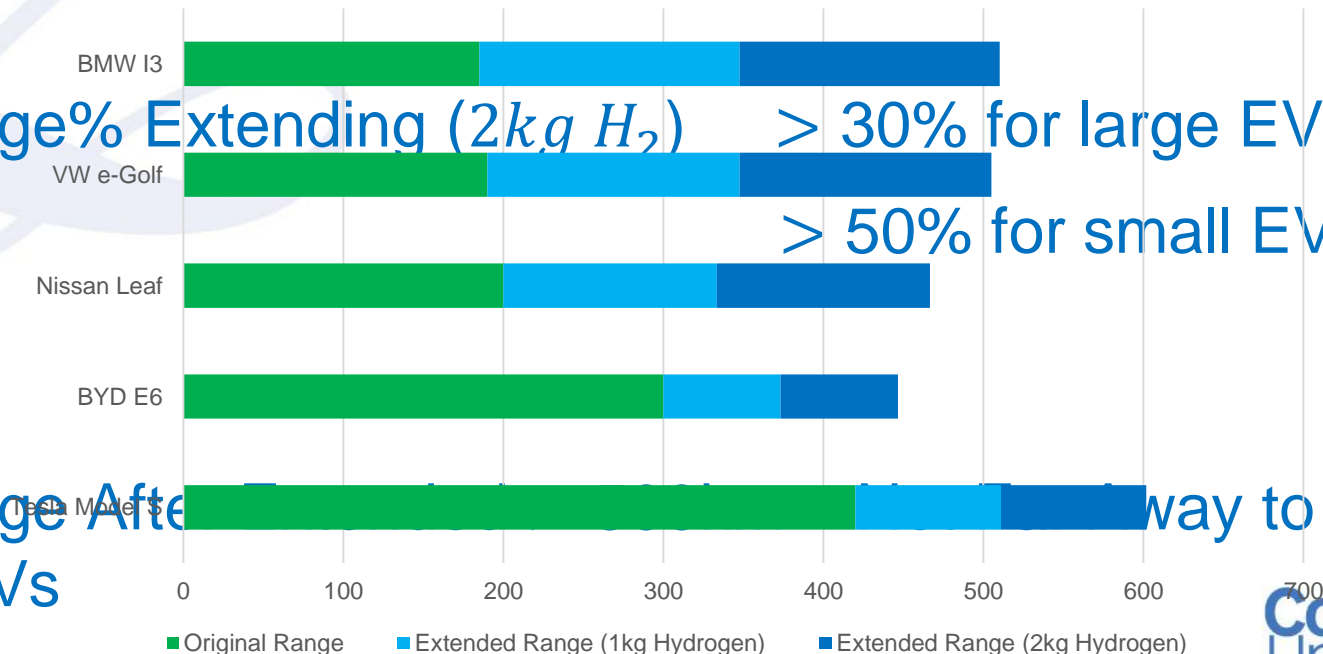
Feature – Range Extending Performance

- High Energy Density of Hydrogen →



Extending Range /km for EVs

- Range% Extending ($2\text{kg } H_2$) > 30% for large EVs
> 50% for small EVs



- Range After ICEVs way to the



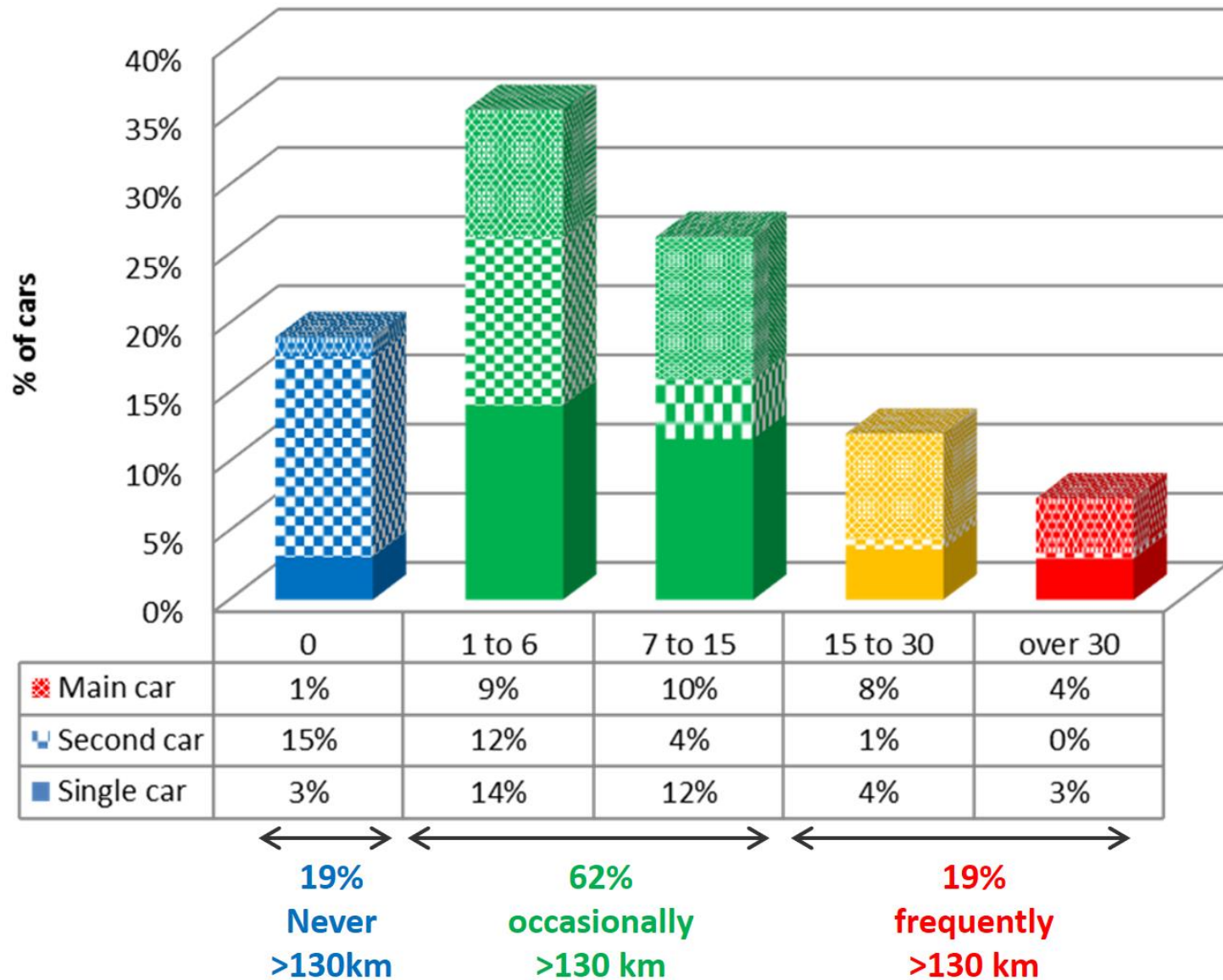
Feature – Reduce Infrastructure Dependency

- De
 - ✓ Sav
trav
 - ✓ Fle
 - Re
ele
 - Inc
co
- ons
eak
and
ity
city



% of cars making long distance trips

(per tranche of number of trips >130 km per annum)



(TNS SOFRES , 2014)

Typical Solutions

EP Tender – BEV + Gasoline Engine



4. Efficiency → ICE around 30%

Superiority

Regular BEV + Connected & Demountable FC Range Extender

✓Range ✓

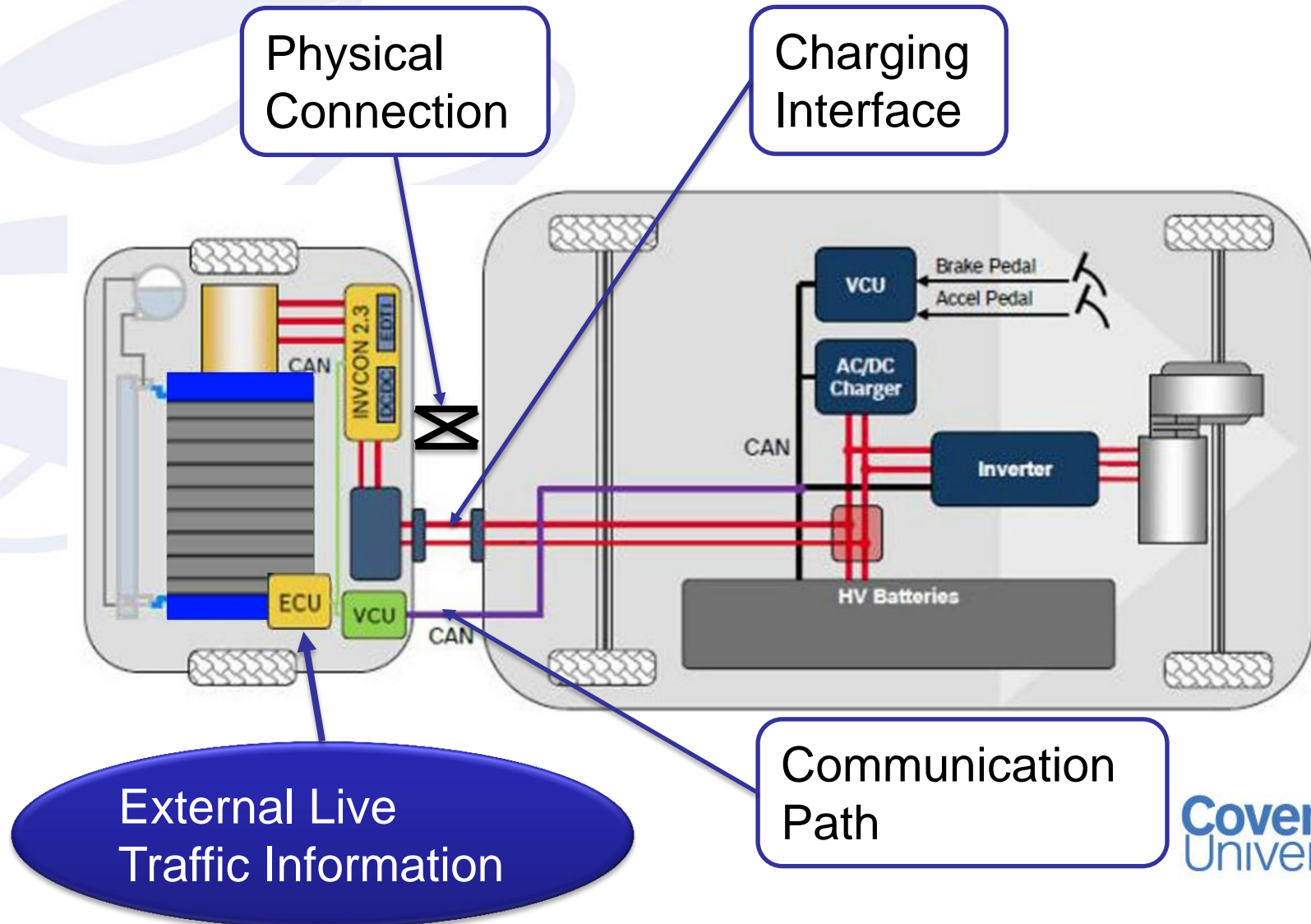
Convenience ✓

Green ✓

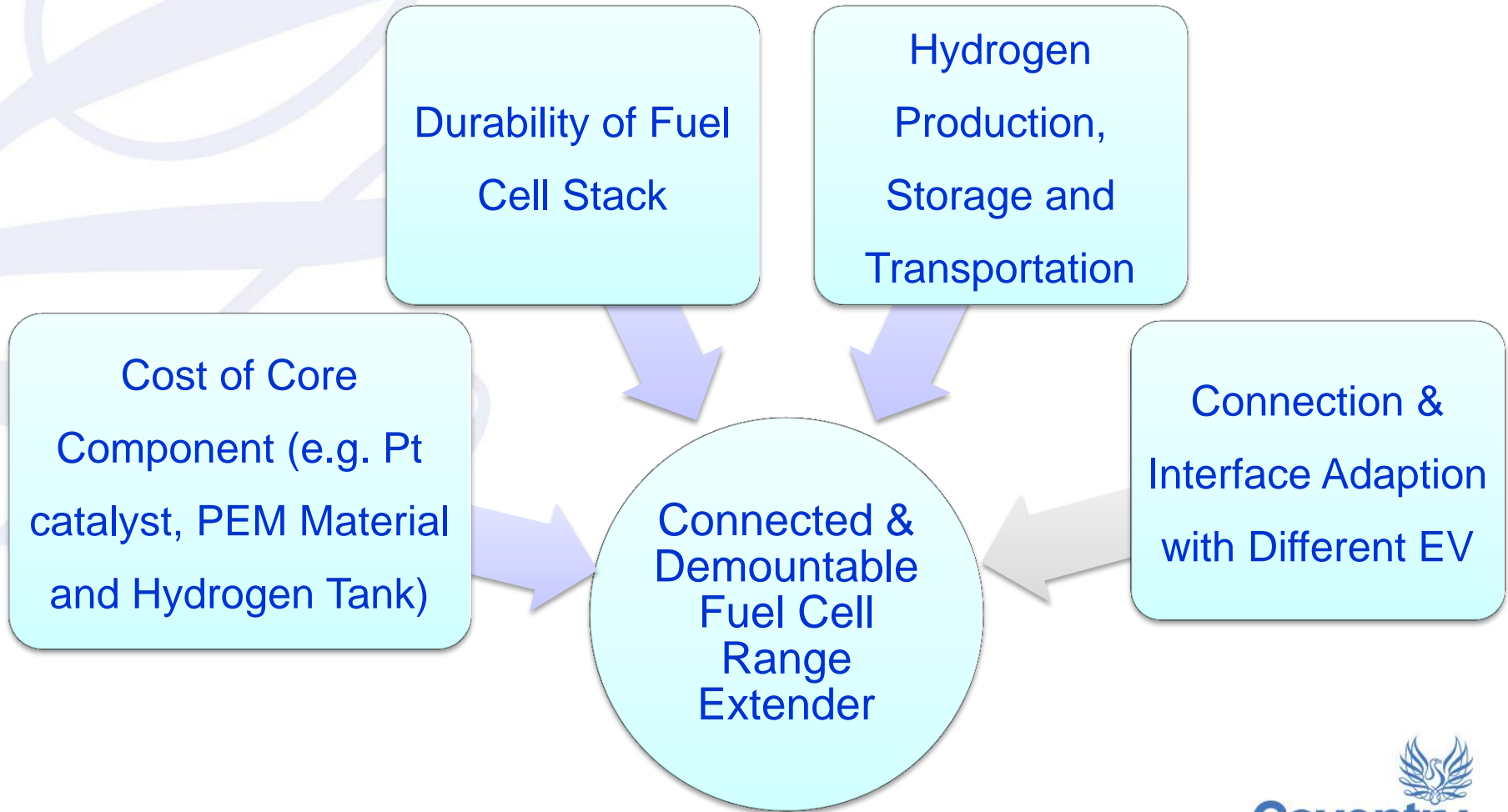
Efficiency ✓

- Avoid over-discharge & extend lifespan for battery pack
- Reduce temperature impact on battery performance
- Connect vehicle with live traffic information
 - ✓ Smooth and prioritise traffic flow → reduce traffic congestion
 - ✓ Driver assist → route optimization, charging & rental point reminder
 - ✓ Choose the best drive mode → Vehicle could response appropriately according to duty cycle and traffic condition

Ideal System Demonstration



Challenge & Future Focus



Thank you for Listening

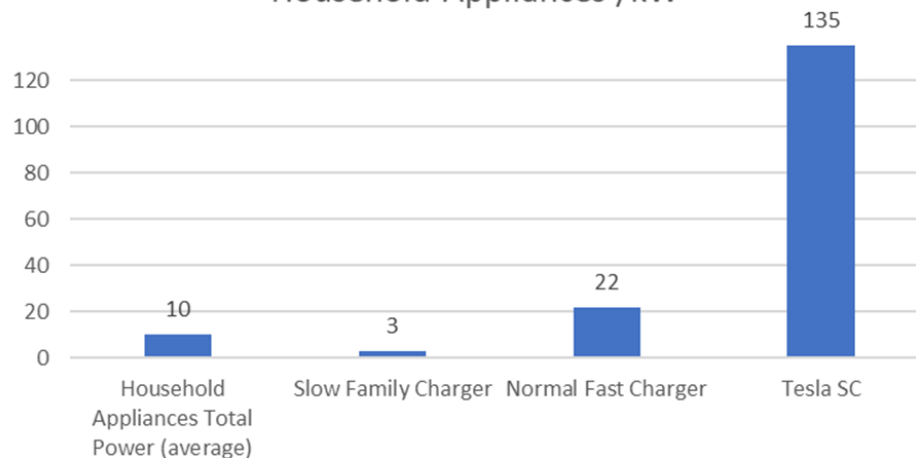


Reference

1. (Zap-Map), C. (2018). Charging connectors - Electric car charging speeds. [online] Zap-Map. Available at: <https://www.zap-map.com/charge-points/connectors-speeds/> [Accessed 14 Feb. 2018].
2. Davies, H., Nieuwenhuis, P., Newman, D. and Donovan, C. (2012). ENEVATE Project - Electric Vehicle Market Drivers and E-Mobility Concepts. ENEVATE Project. [online] Brussels: EEVC. Available at: http://www.enevate.eu/Workpackage3/wp3_paper.pdf [Accessed 27 Feb. 2018].
3. Eafo.eu. (2018). Electric vehicle charging infrastructure | EAFO. [online] Available at: <http://www.eafo.eu/electric-vehicle-charging-infrastructure> [Accessed 16 Feb. 2018].
4. Enipedia.tudelft.nl. (2018). Tesla Model S Battery - Enipedia. [online] Available at: http://enipedia.tudelft.nl/wiki/Tesla_Model_S_Battery [Accessed 17 Feb. 2018].
5. EP Tender (2018). EP Tender Range Extender. [image] Available at: <http://www.eptender.com/SiteAssets/Zoe%20+%20EP%20Tender.jpg> [Accessed 23 Feb. 2018].
6. Fuelseurope.eu. (2017). NUMBER OF PETROL STATIONS IN EUROPE END OF 2016. [online] Available at: https://www.fuelseurope.eu/wp-content/uploads/2015/06/Graphs_FUELS_EUROPE-_2017_-52.pdf [Accessed 22 Feb. 2018].
7. Krupa, J., Rizzo, D., Eppstein, M., Brad Lanute, D., Gaalema, D., Lakkaraju, K. and Warrender, C. (2014). Analysis of a consumer survey on plug-in hybrid electric vehicles. Transportation Research Part A: Policy and Practice, 64, pp.14-31.
8. Pollet, B., Staffell, I. and Shang, J. (2012). Current status of hybrid, battery and fuel cell electric vehicles: From electrochemistry to market prospects. Electrochimica Acta, 84, pp.235-249.
9. shrinkthatfootprint.com. (2018). Average household electricity use around the world. [online] Available at: <http://shrinkthatfootprint.com/average-household-electricity-consumption> [Accessed 15 Feb. 2018].
10. Union of Concerned Scientists. (2018). Infographic: Millions of Americans Could Use an Electric Vehicle. [online] Available at: <https://www.ucsusa.org/clean-vehicles/electric-vehicles/bev-ph-ev-range-electric-car#.WpXx73Zl9dg> [Accessed 24 Feb. 2018].

Appendix

Power Comparison: EV Charger vs Total Household Appliances /kW



Electricity Consumption: EV vs Household /kWh

