



جامعة الملك عبدالله للعلوم والتقنية King Abdullah University of Science and Technology



Beyond Charging Stations

The future of charging infrastructure for electric vehicles



The future of transportation is electric?



The future of transportation is electric!



BRIEFING ROOM

THE WHITE HOUSE

🎲 GOV.UK

the next 2 decades.

chargepoint design

News story

FACT SHEET: President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks UK confirms pledge for zero-emission

AUGUST 05, 2021 • STATEMENTS AND RELEASES

President Biden Outlines Target of 50% Electric Vehicle Sales Share in 2030 to Unleash Full Economic Benefits of Build Back Better Agenda and Advance Smart Fuel Efficiency and Emission Standards



*Sources: Tesla, Hyundai, and Volkswagen

HGVs by 2040 and unveils new

All new road vehicles in the UK will be zero emission within

Sources of US greenhouse-gas emissions in 2020



*Source: US Environmental Protection Agency

Sources of EU greenhouse-gas emissions in 2020



*Source: statista

However, the global market share of EVs in 2022 was only **13%***

Range? Price? Charging time?

*Source: EV-Volumes

The tipping points to mainstream EV adoption*

The average price at which consumers would consider buying an EV



The average charge time at which consumers would consider buying an EV

31 MINS

The average range at which consumers would consider buying an EV

469KM

*Source: Castrol Research

The average price at which consumers would consider buying an EV

\$36,000

The average charge time at which consumers would consider buying an EV

31 MINS

The average range at which consumers would consider buying an EV



Tipping points



Tesla Model 3 2022 **Prices start at**

\$46,990

Charge time

31 MINS

Range attained after 31 mins of fast charging

350KM

The time it takes for an average American to reach



A Tesla supercharging station*



*Source: UBS Group Research

The time it takes for an average American to reach



*Source: UBS Group Research

Charging station advantages

Charging stations are likely to stay prominent in the future because of:

35Ln

High power transfer efficiency
Low maintenance requirement
Ability to fast charge

Charging stations Drawback

Pressure to the power grid Limited land resources Low utilization rate Possible extra-parking fees Lack standard for ports

Charging alternative: Wireless (Dynamic) Charging









Wireless (Dynamic) Charging





Wireless (Dynamic) Charging









Wireless (Dynamic) Charging Advantages

Distribute load on power grid Serve multiple car simultaneously Require no additional land Reduce charging time

Wireless (Dynamic) Charging Use Cases



Light commercial vehicles



Warehouse and seaport vehicles



Heavy commercial vehicles



Autonomous robots

In NYC, assume a fixed budget. Should we build

Only charging stations (CS-level 2)
 Only dynamic charging roads (DC)
 A combination of CS and DC ?

Assume that a km of DC cost 4 times as much as a CS



Datasets:

 6-month yellow taxi trip records in NYC (Jun.-Dec. 2019)*
 Map dataset from OpenStreetMap

Metric: driving disruption - % of trips that must detour from the shortest route to find charging facilities

*Source: NYC Taxi and Limousine Commission



Methodology:

 Assume the Nissan Leaf with 40 kWh battery size, energy consumption of 0.186 kWh/km
 Output of L2 CS is 6 kW/h, DC is 20 kW/h

3. A taxi stops to recharge whenever battery < 10%

Track battery level throughout the trips!



Metric: driving disruption - % of trips that must detour from the shortest route to find charging facilities



ronkers

Airport

Mt Vernon

New Rochelle

Final thoughts

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0.1

The feasibility and benefits of charging infrastructures are well understood and embraced

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0.2

Future work is needed on regulations, safety, standard, etc.

0.3

We need to join hands to develop and implement future charging infrastructures



THANKS!

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