

Ramifications of Electrification of the Transportation Industry

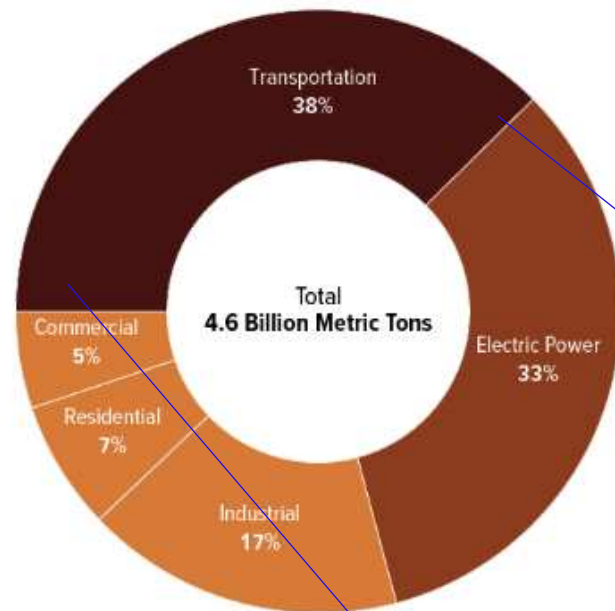
Brian Burkhard, PE, Vice President and Global Principal for Advanced Mobility Systems

November 17, 2023

Why Electrify?

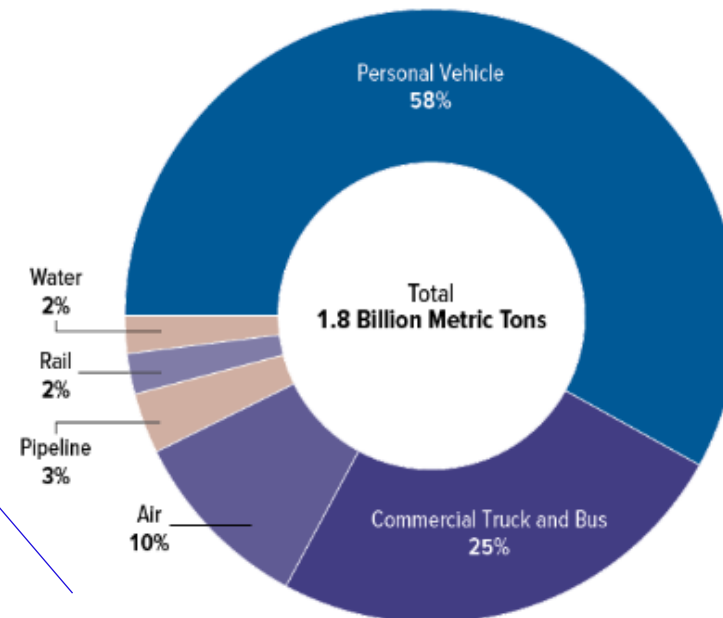


Shares of Energy-Related Emissions of Carbon Dioxide, by Economic Sector, 2021



Emissions of carbon dioxide in the transportation sector accounted for 38 percent of energy-related emissions in the United States in 2021—the largest share of such emissions of any sector of the economy.

Shares of Transportation-Related Carbon Dioxide Emissions, by Mode of Transportation, 2019



Motor vehicles—personal vehicles and commercial trucks and buses—accounted for 83 percent of emissions in the transportation sector in 2019.

The Challenge

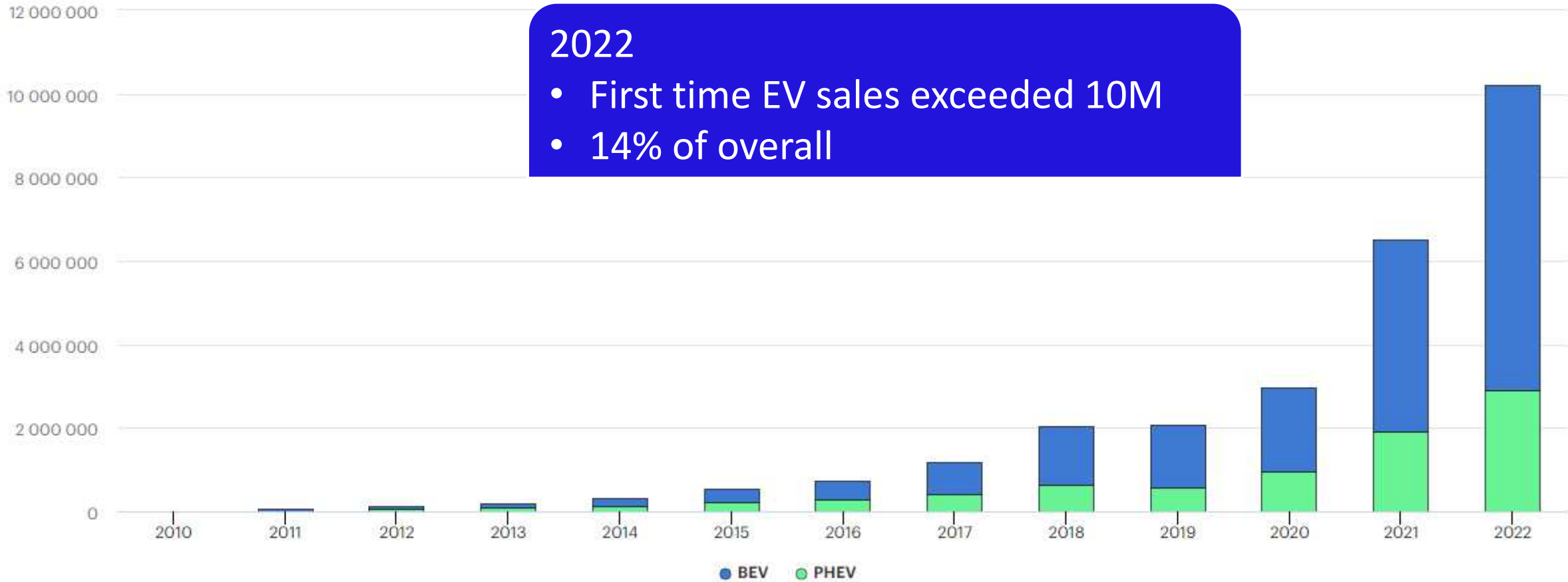


2023

- 18% of overall*
- Tesla Y is #1 seller*

2022

- First time EV sales exceeded 10M
- 14% of overall

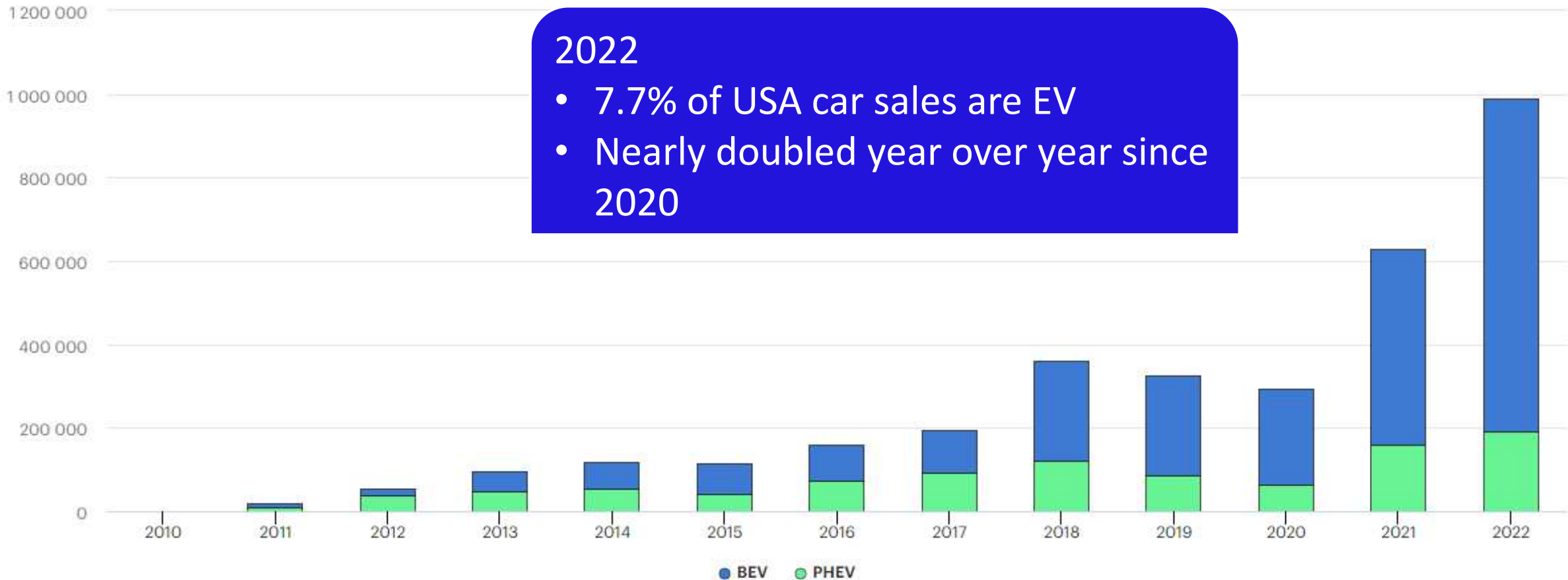


2023

- Sales over 2022 have increased by nearly 50%

2022

- 7.7% of USA car sales are EV
- Nearly doubled year over year since 2020



EV Sales Projections

World

- 2025 : 16M (CAGR = 37% from 2021)
- 2030 : 31M

USA

- 2025 : 2.9M (**CAGR = 58% from 2021**)
- 2030 : 6.8M

EV Charging Points

World

- 2025 : 6.7M (CAGR = 39% from 2021)
- 2030 : 12.7M

USA

- 2025 : 550k (**CAGR = 48% from 2021**)
- 2030 : 1.8M

EV Charging Infrastructure Facts



Only 150k public chargers in US

Doubled over 2022



70% of Americans have a garage or driveway

03-15-22

Starbucks wants to become the gas station of the future for EVs

With 15,000 locations across the U.S., the coffee chain is betting it can convince electric vehicle owners that it's the perfect place to charge up. (Literally!)



[Photo: Starbucks]

A photograph of a blue Tesla Model Y parked at a charging station in front of a Starbucks store. The car is plugged into a charging station, and a person is standing next to it. The Starbucks logo is visible on the building's awning.

What are the implications?

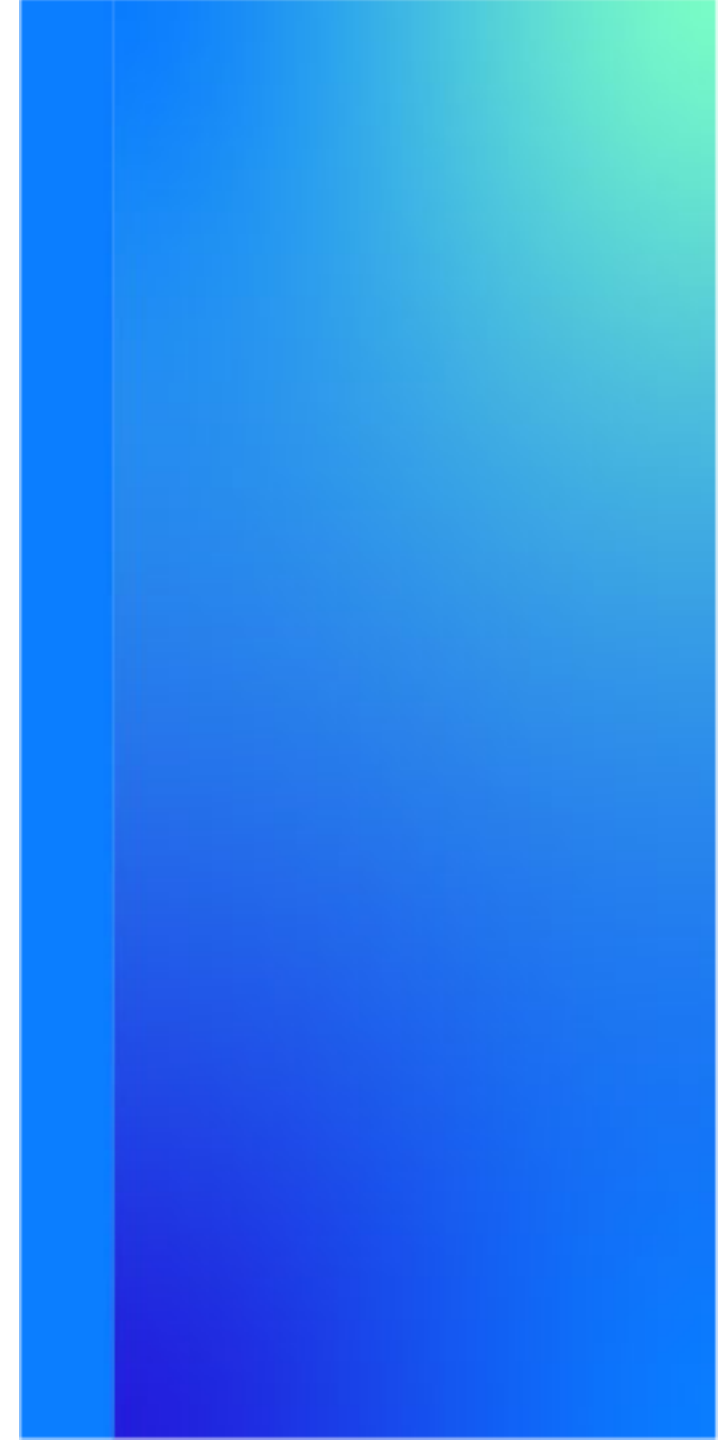


Implications

- Our urban and rural landscape will need to change.
- Infrastructure has a lot of catching up to do.
- Supply chain challenges are real.
- Manufacturing needs to retool.
- Batteries need to weigh less and hold more charge.
- We need better battery chemicals.
 - Labor exploitation
 - Hazardous waste
- EVs need to be cheaper.



What is being done?



2020 electric vehicle share of new passenger cars

- < 5%
- 5% - 10%
- 10% - 15%
- 15% - 25%
- 25% - 50%
- > 50%
- No data
- Selected 50 metropolitan regions

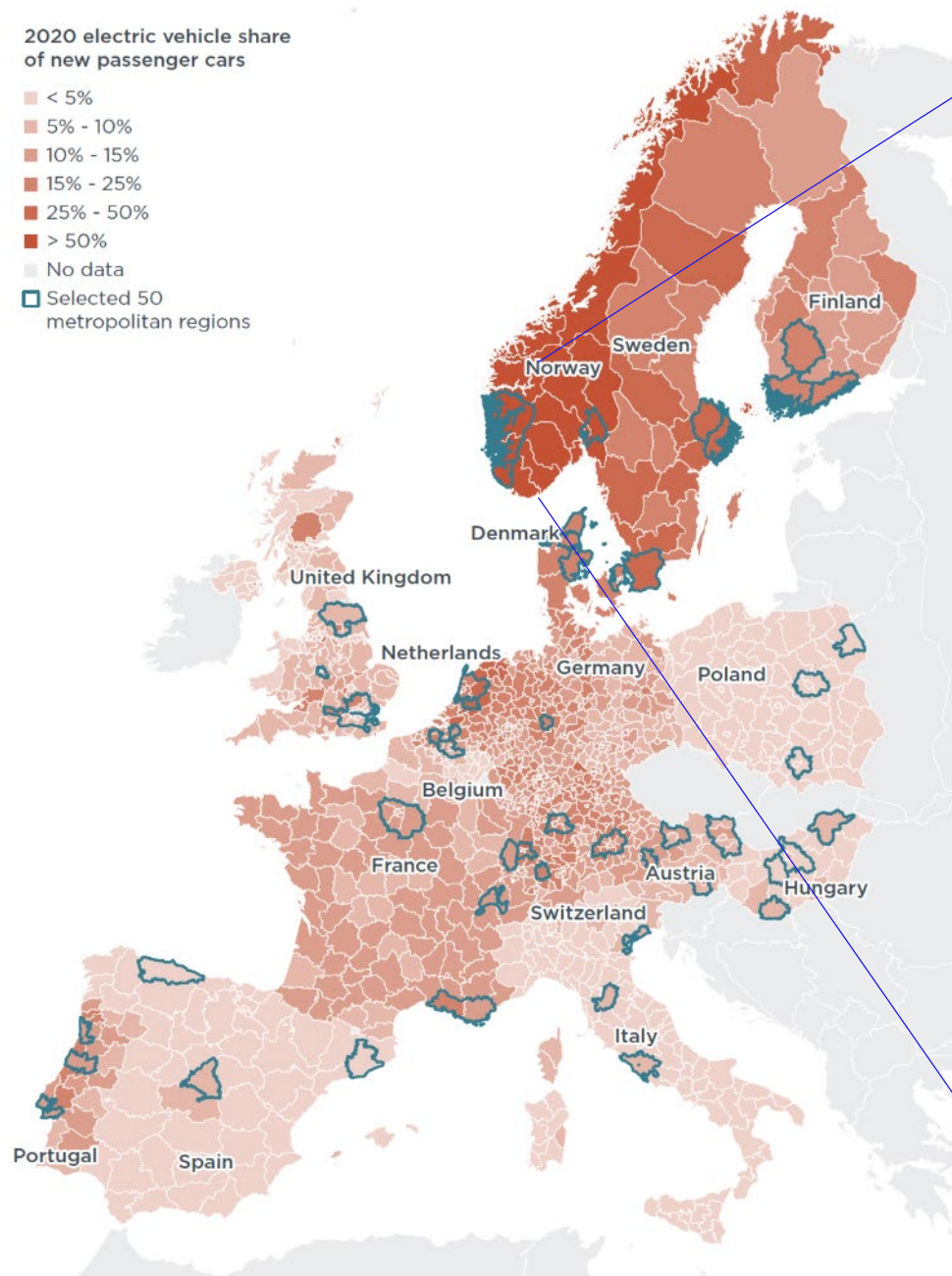


Figure 3. New electric passenger car registration share in 2020 in selected European countries. icct (2021), Update on Electric Vehicle Uptake in European Cities, <https://theicct.org/publication/update-on-electric-vehicle-uptake-in-european-cities/>



Key policy measures and targets

Year
announced

Target: 100% share of ZEVs in passenger LDV sales by 2025.

2016

Target: 100% share of ZEVs (or biogas) in urban bus sales by 2025.
Target: 75% share of ZEVs in long-distance bus sales, 50% ZEVs in truck sales and 100% share of ZEVs in heavy van sales by 2030.

2016

Ambition: 30% of ZEVs in new truck and bus sales by 2030, 100% by 2040.

2021



revel





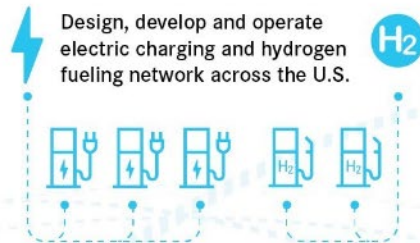
1 | CHALLENGE

Lack of a publicly available, nationwide electric charging infrastructure for commercial vehicles.



2 | MISSION

Design, develop and operate electric charging and hydrogen fueling network across the U.S.



3 | COLLABORATION

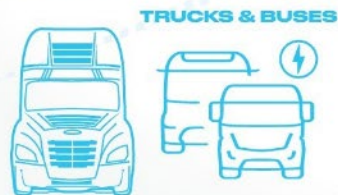
DAIMLER TRUCK
North America



BlackRock.

4 | FOCUS

Battery electric medium and heavy-duty vehicles with option for light-duty vehicles.



5 | INITIAL ROUTES



US Funding



National Electric Vehicle Infrastructure (NEVI) Program

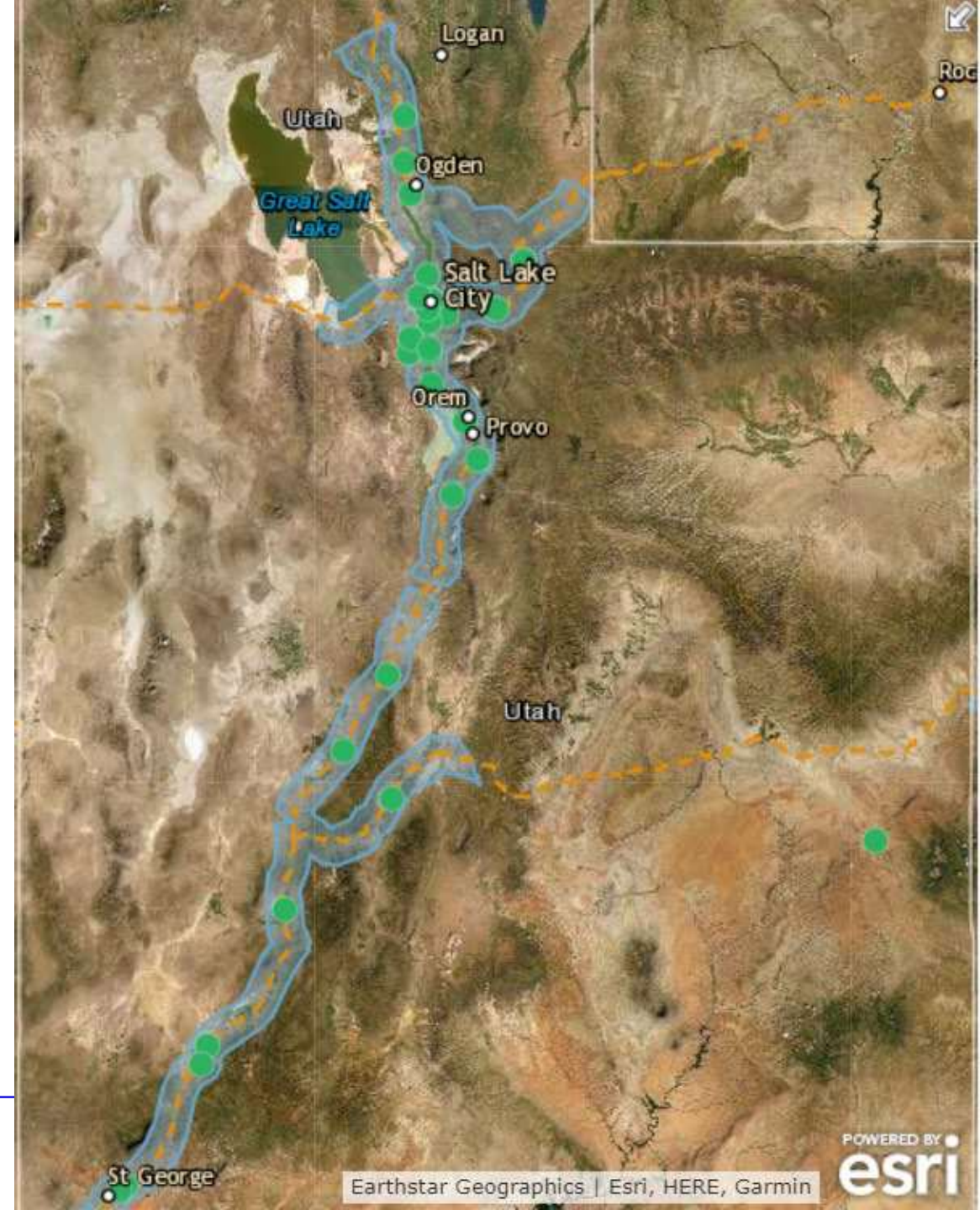
- 500,000 EV chargers nationwide by 2030
- Formulaic funding budget of \$5B (over 5 years)
- 20% local match
- Remaining \$2.5B through discretionary grant program



Joint Office of
**Energy and
Transportation**

High Points of State EV Infrastructure Deployment Plans

- Prioritized funding for designated *Alternative Fuel Corridors*
- “Fully built out” means:
 - EV charger every 50 miles along State’s portion of Interstate within 1 mile
 - EV charger can simultaneously transmit Fast DC charge four EV
 - Minimum capacity = 600kW with 150kW per port



Planning for the EV Revolution

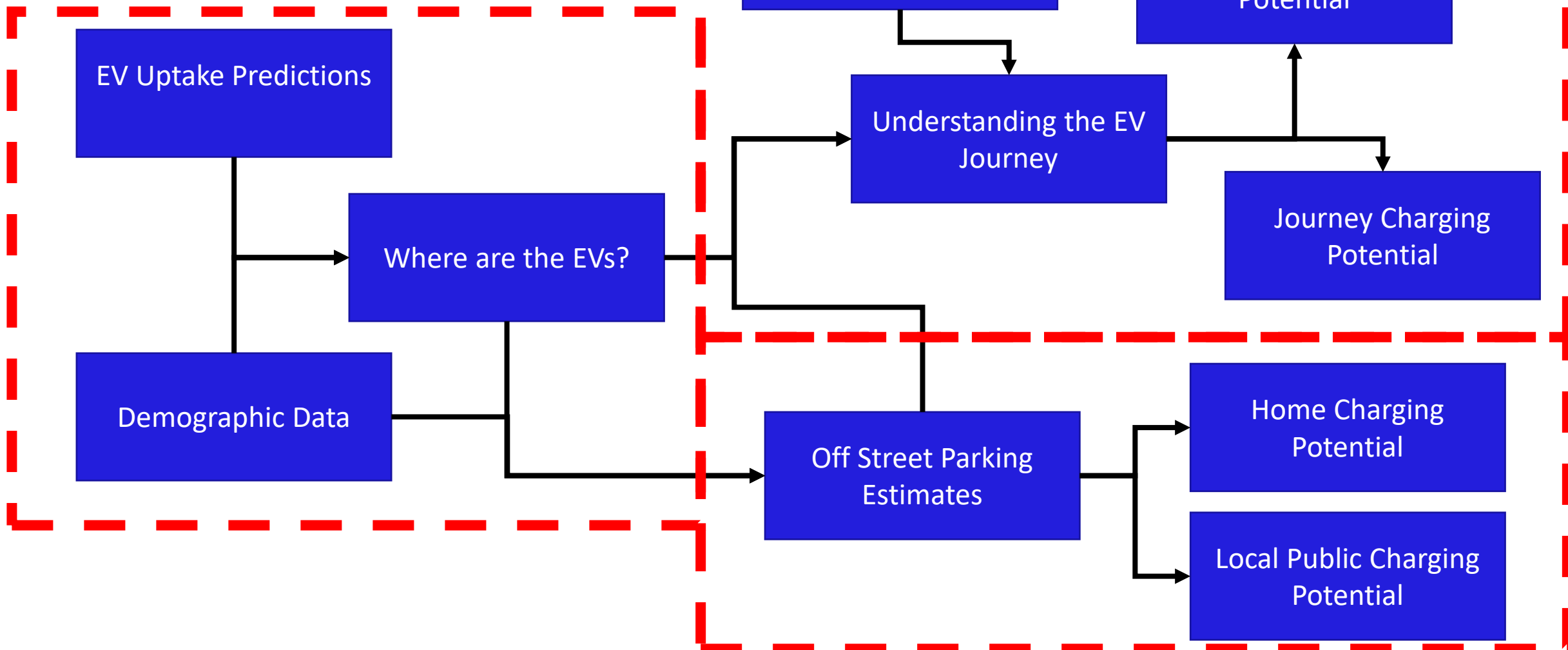
What agencies are doing now. . .

- Fleet Decarbonization/Electrification Plans
 - When and how to move from internal combustion engines (ICE) to zero-emissions vehicles (ZEV)?
- Infrastructure Electrification Plans
 - When and how to build “behind-the-fence” EV charging infrastructure?
 - When and how to build public charging infrastructure?
- Public-private-partnerships (P3)
 - NEVI seed funding of EV charging infrastructure
 - Requests for Information (RFIs)
- Wait and See

Existing Fleet				Usage and Energy Data		Recommended EV Equivalent	
Garage location	Driver Group	Vehicle ID	Mfr, Model	Average Daily Mileage [m]	Average Daily Energy Demand [kWh]	Mfr, Model	Usable Battery Capacity [kWh]*
	Agriculture		Chevrolet, Colorado	9	4.4	Ford,F-150 Lightning (4WD auto)	88
	Environmental Health		Nissan, Rouge	54	14.9	Tesla, Model Y (AWD lng rage)	73
	Environmental Health		Nissan, Rouge	30	8.4	Tesla, Model Y (AWD lng rage)	73
	Assessor		Chevrolet, Equinox	46	12.6	Tesla, Model Y (AWD lng rage)	73
	Public Guardian		Nissan, Rouge	19	6.2	Ford, Mach-E (RWD)	65
	Information Technology		Kia, Sedona	6	1.9	Ford, Mach-E (RWD)	65

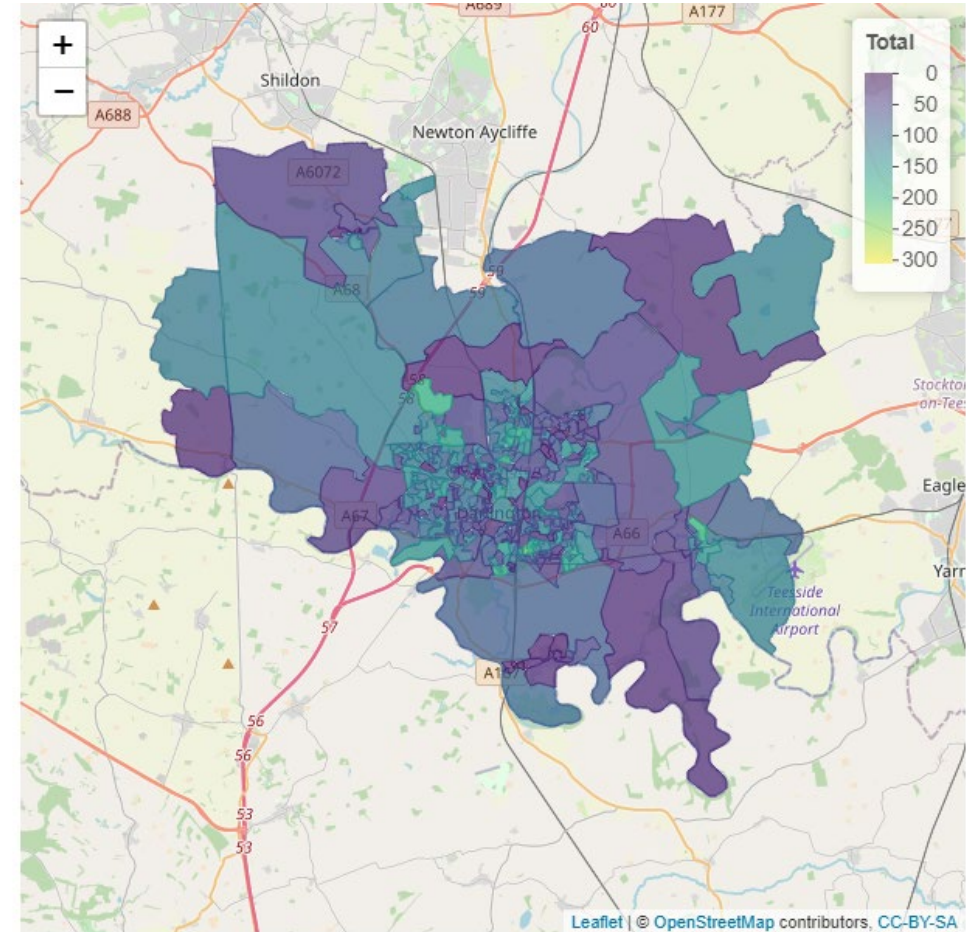
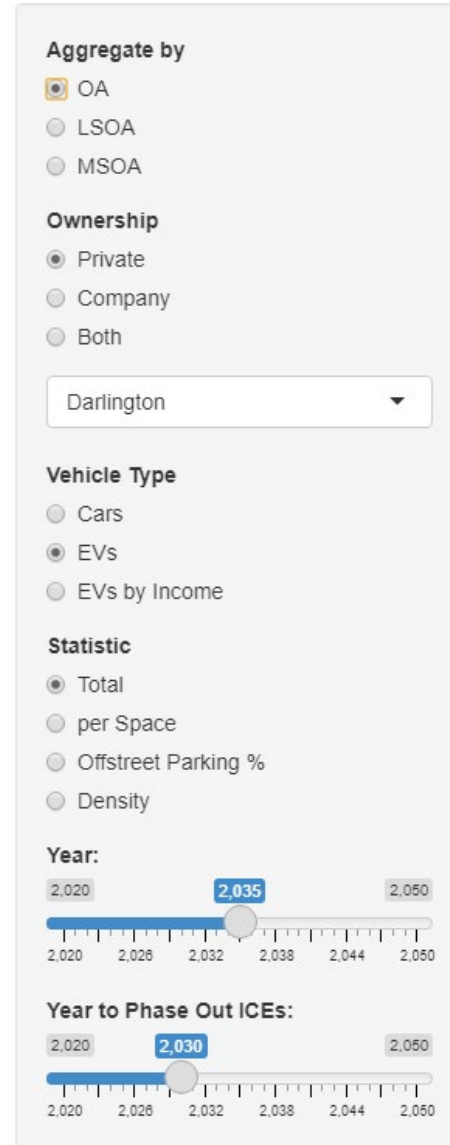


Charge Point Usage Model



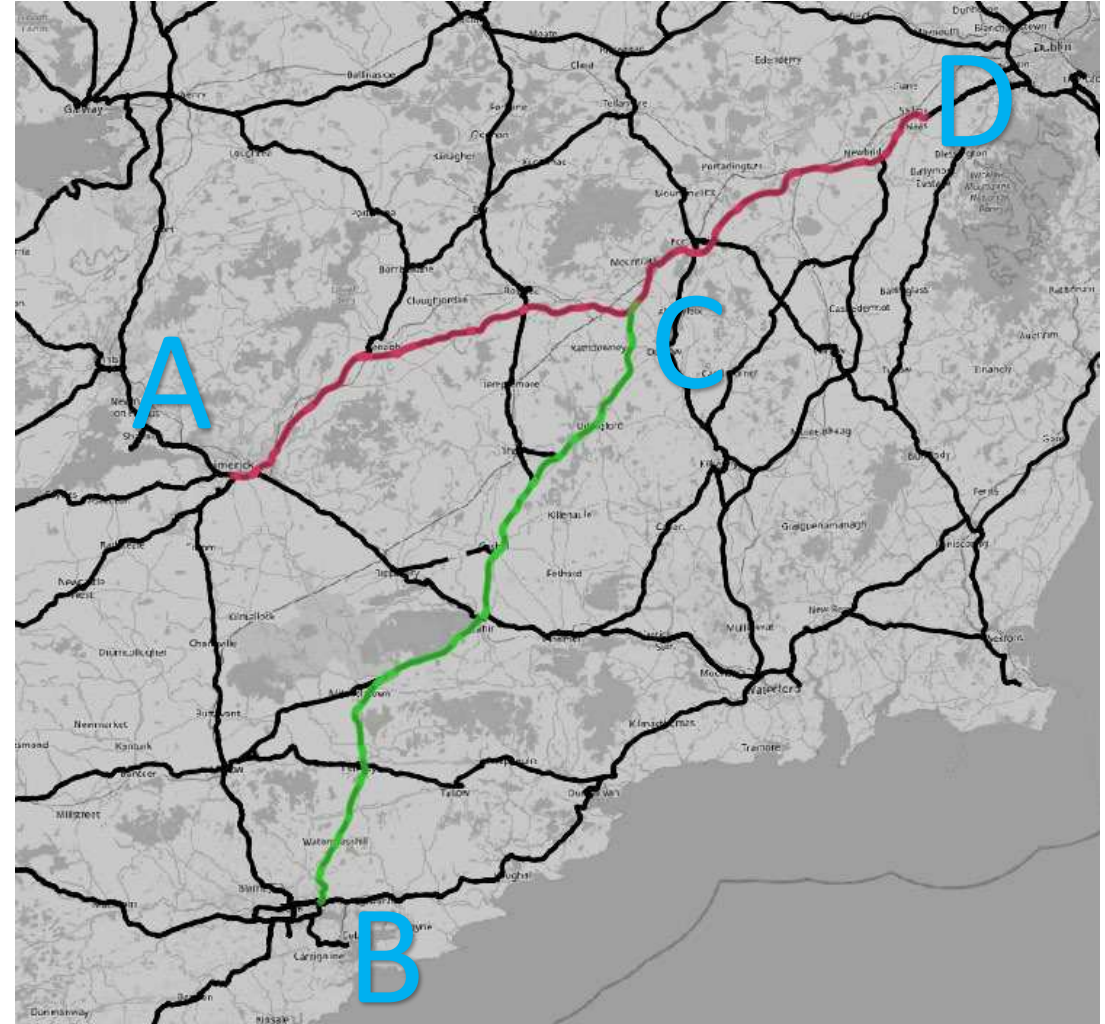
Electric Vehicle Modelling

- Understanding electric vehicle uptake requires a model that can help predict both *where* and *when* EV are likely to be bought
 - Where is important to know the location of the required infrastructure
 - When is important to know the timing for implementing this infrastructure
- The image to the right shows predicted raw totals of Electric Vehicles in Darlington in 2030, based on phasing out of ICE by 2035



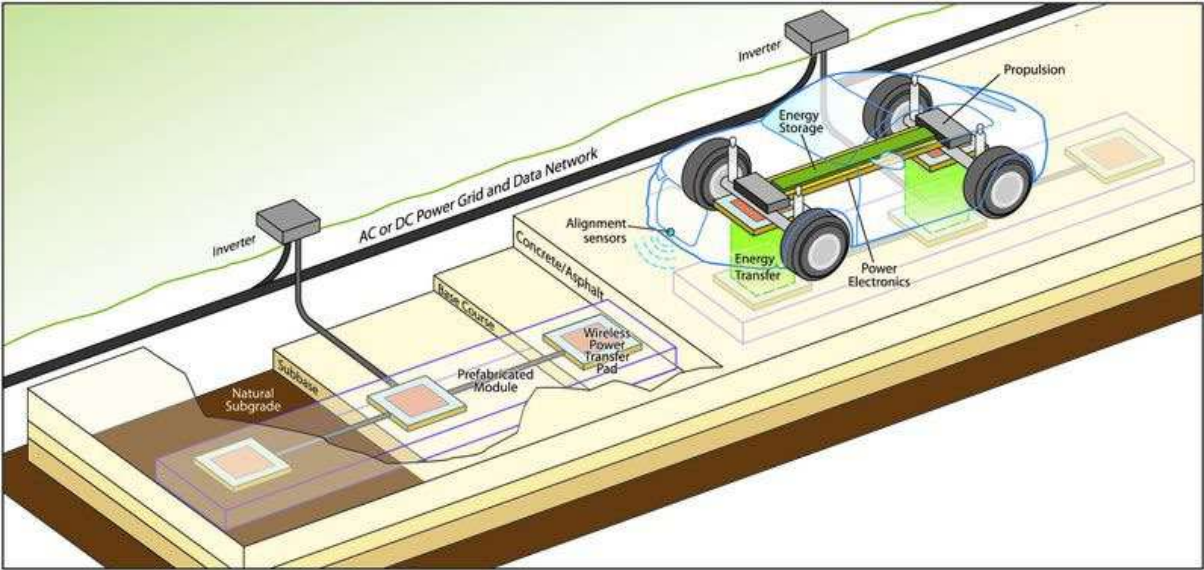
EV Tool: Journey Modelling

- By aggregating routes derived from Origin-Destination pairs, we can derive a likely fleet population for every link on the road network
- This is replicated for each possible set of Origin-Destination pairs

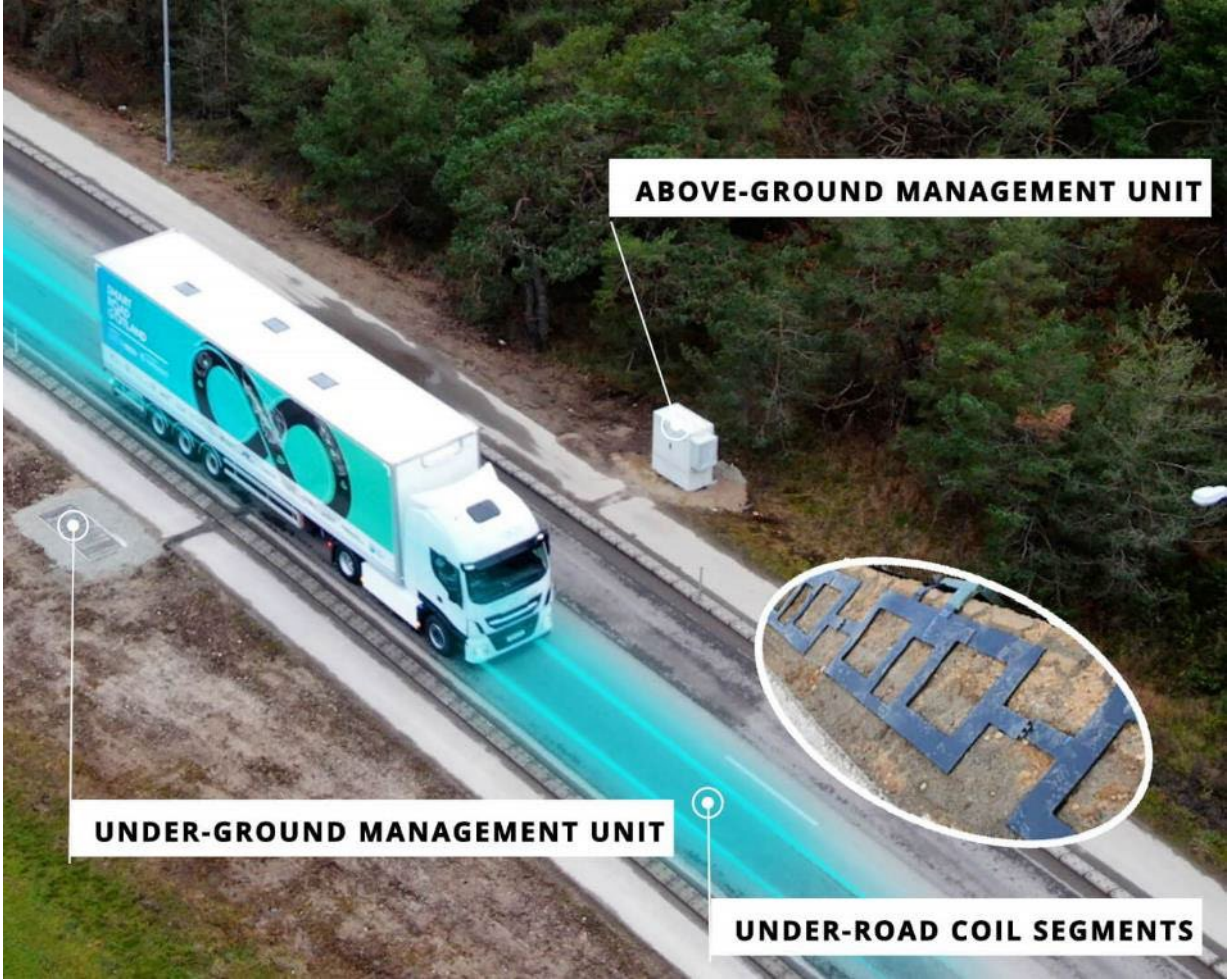


(A post note)
Inductive Charging

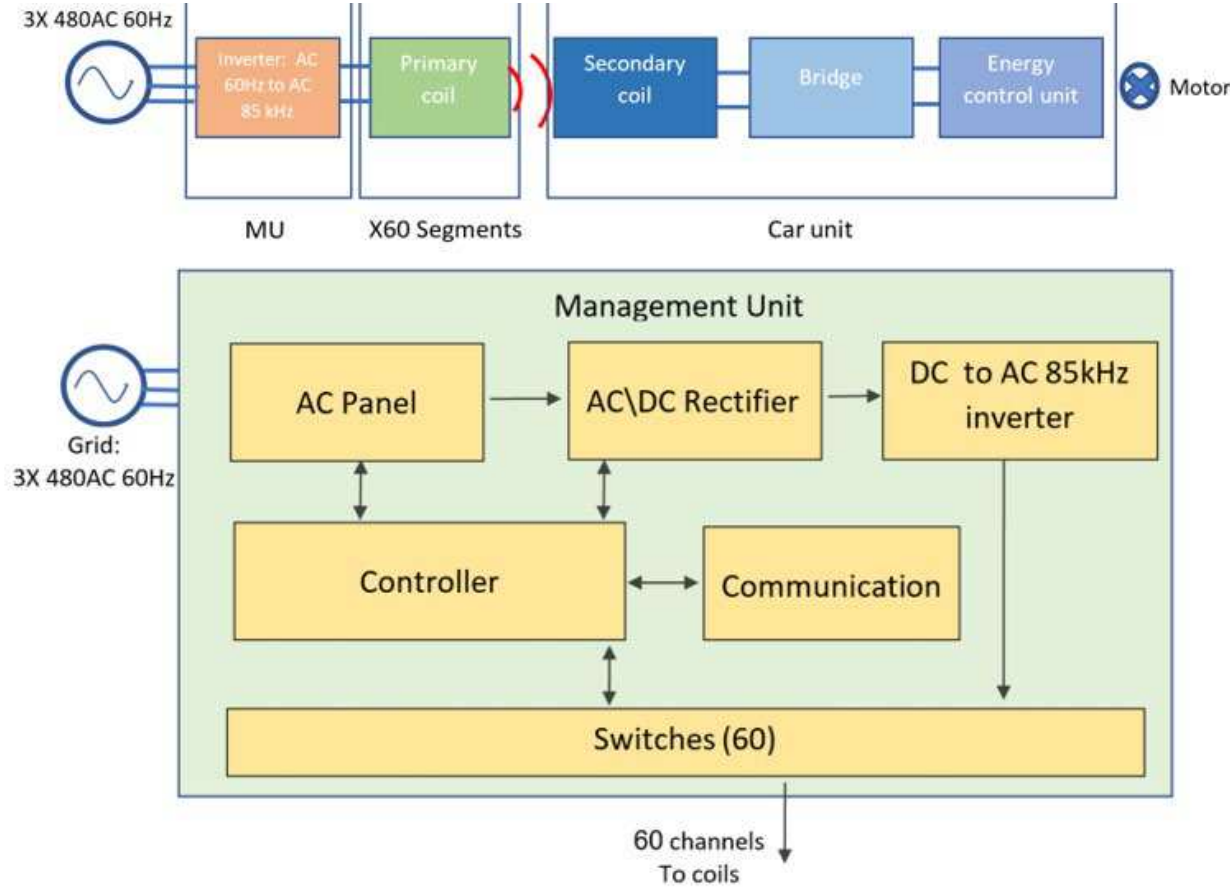
Inductive Charging



Source: Chicago Tribune



A Shared Charging Infrastructure



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