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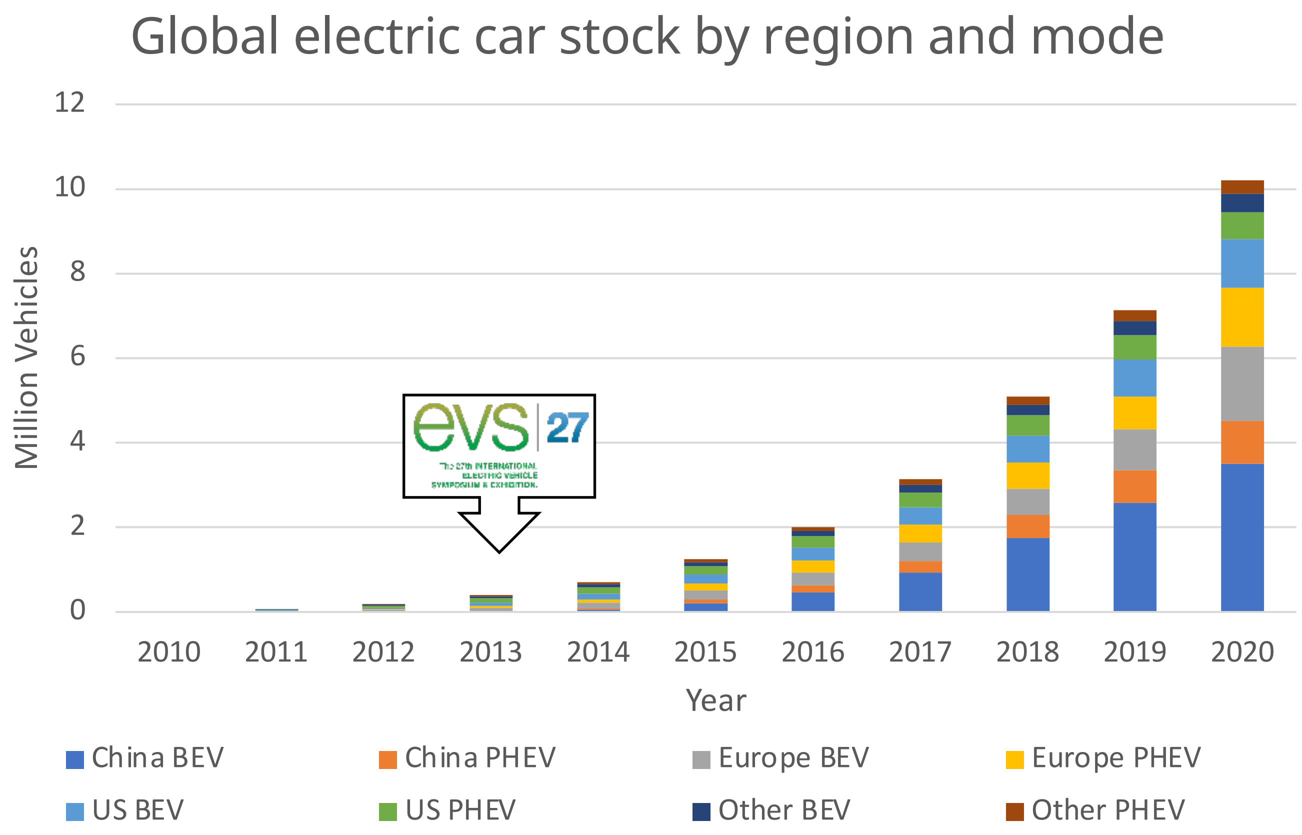
An Integrated Approach for the Planning of Public Charging Infrastructure

Dr.-Ing. Matthias Pfriem, Dr. Laurence Chittock, Karen Platt, Udo Heidl

Introduction

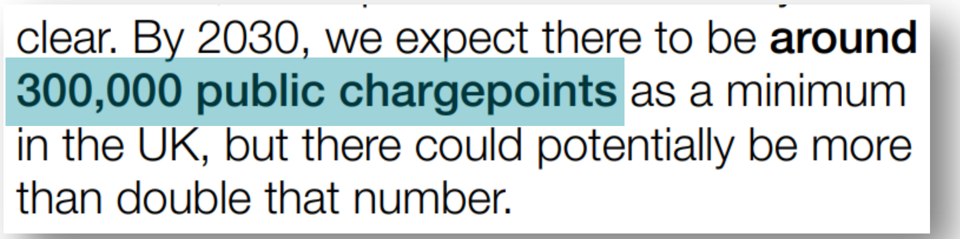


[1]

44 % of newly registered passenger cars in Germany were BEV and PHEV in April 2022, [2] 85 % in Norway in May! [15]

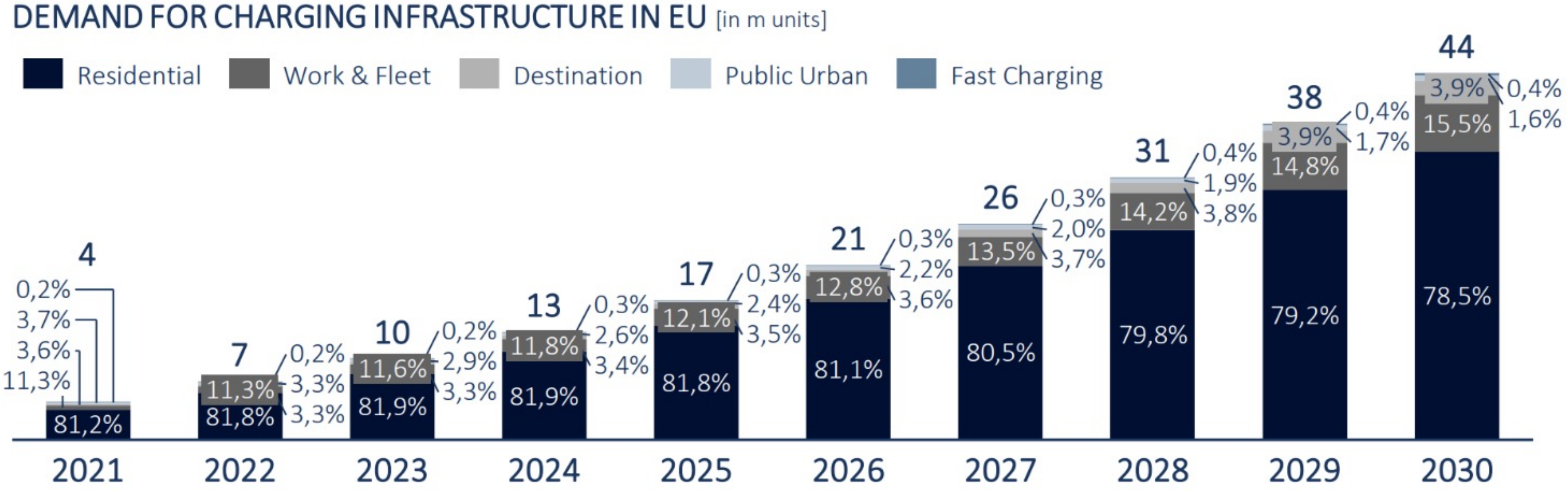
[3]

[4]



[5]

Need for Charging Infrastructure Planning and Roll-out



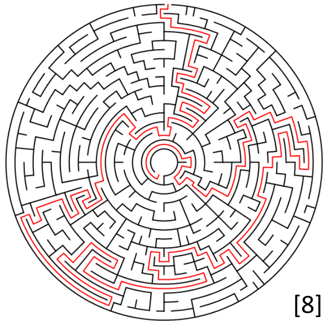
[6]

[10]

Where?


[7]

How?


[8]

Who?


[9]

Charging Infrastructure Planning – Mobility Requirements

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Where, how many, and what type of charging points do we need?

- Charging infrastructure is necessary to **enable EV usage** and encourage uptake
- **Understanding the scale of need** can help planners prioritise intervention
- Knowing where charge points are needed can help identify **gaps in supply**
- Understanding population segmentation highlights **which drivers will rely on public infrastructure**

[11]

[12]

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Charging Infrastructure Planning – Grid Constraints

Can the grid cope with the extra demand from electric cars?

- Transport is a **new load** for existing electricity grids
- Cars are not fixed assets, so understanding travel patterns **can inform load forecasting and management**
- At the distribution level, **capacity constraints** could limit infrastructure rollout
- Identification of **remaining grid hosting capacity** can help to save time and money

[13]

COST ELEMENT	LOWEST COST	HIGHEST COST
Level 2 residential charger	$380 (2.9 kW)	$689 (7.7 kW)
Level 2 commercial charger	$2,500 (7.7 kW)	$4,900 (16.8 kW); outlier: $7,210 (14.4 kW)
DCFC (50 kW)	$20,000	$35,800
DCFC (150 kW)	$75,600	$100,000
DCFC (350 kW)	$128,000	$150,000
Transformer (150–300 kVA)	$35,000	$53,000
Transformer (500–750 kVA)	$44,000	$69,600
Transformer (1,000+ kVA)	$66,000	$173,000

[14]

Note: DCFC denotes direct-current fast chargers.

Integrated Planning Approach

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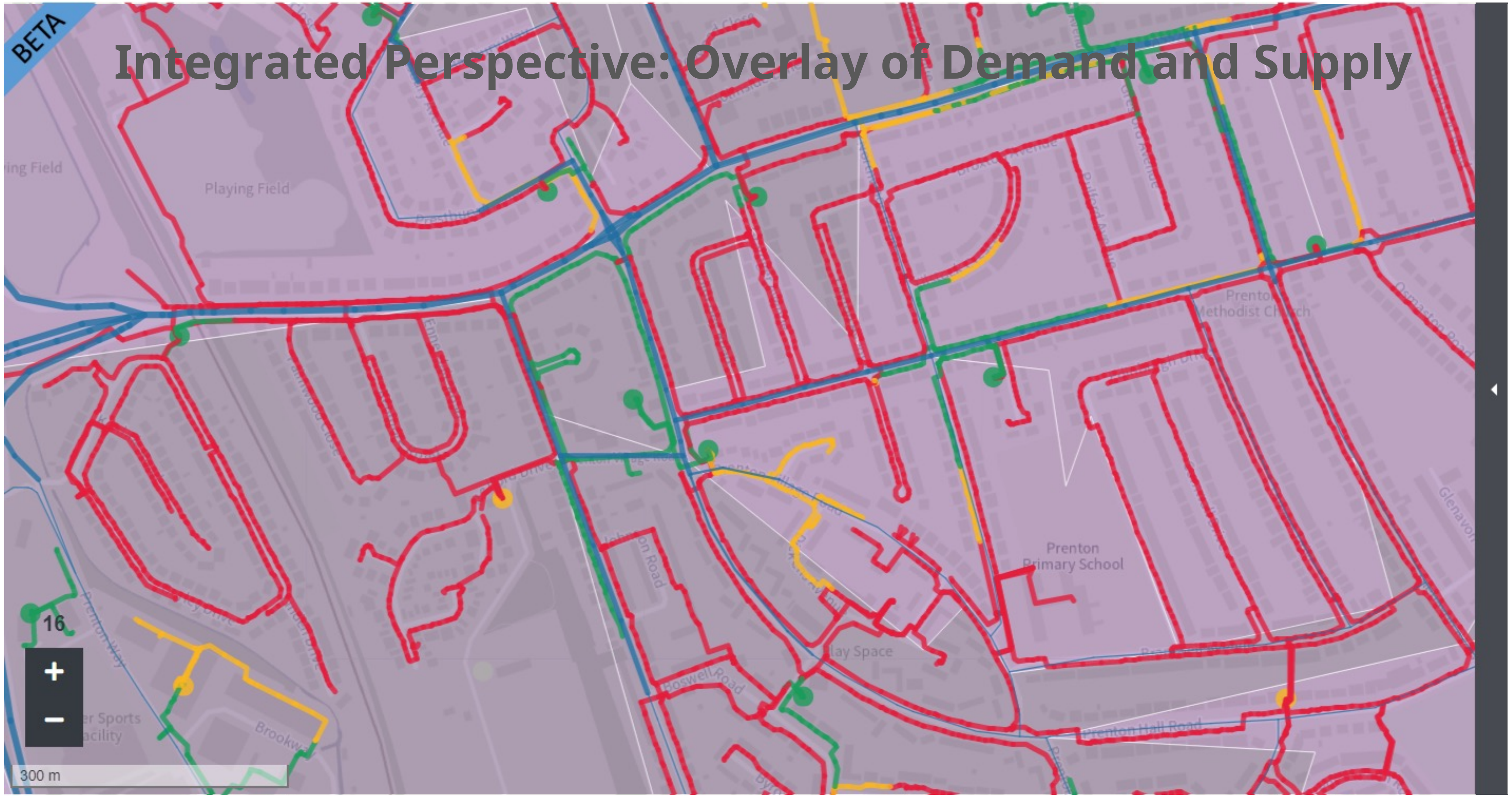

https://www.spenergynetworks.co.uk/pages/connectmore_interactive_map.aspx

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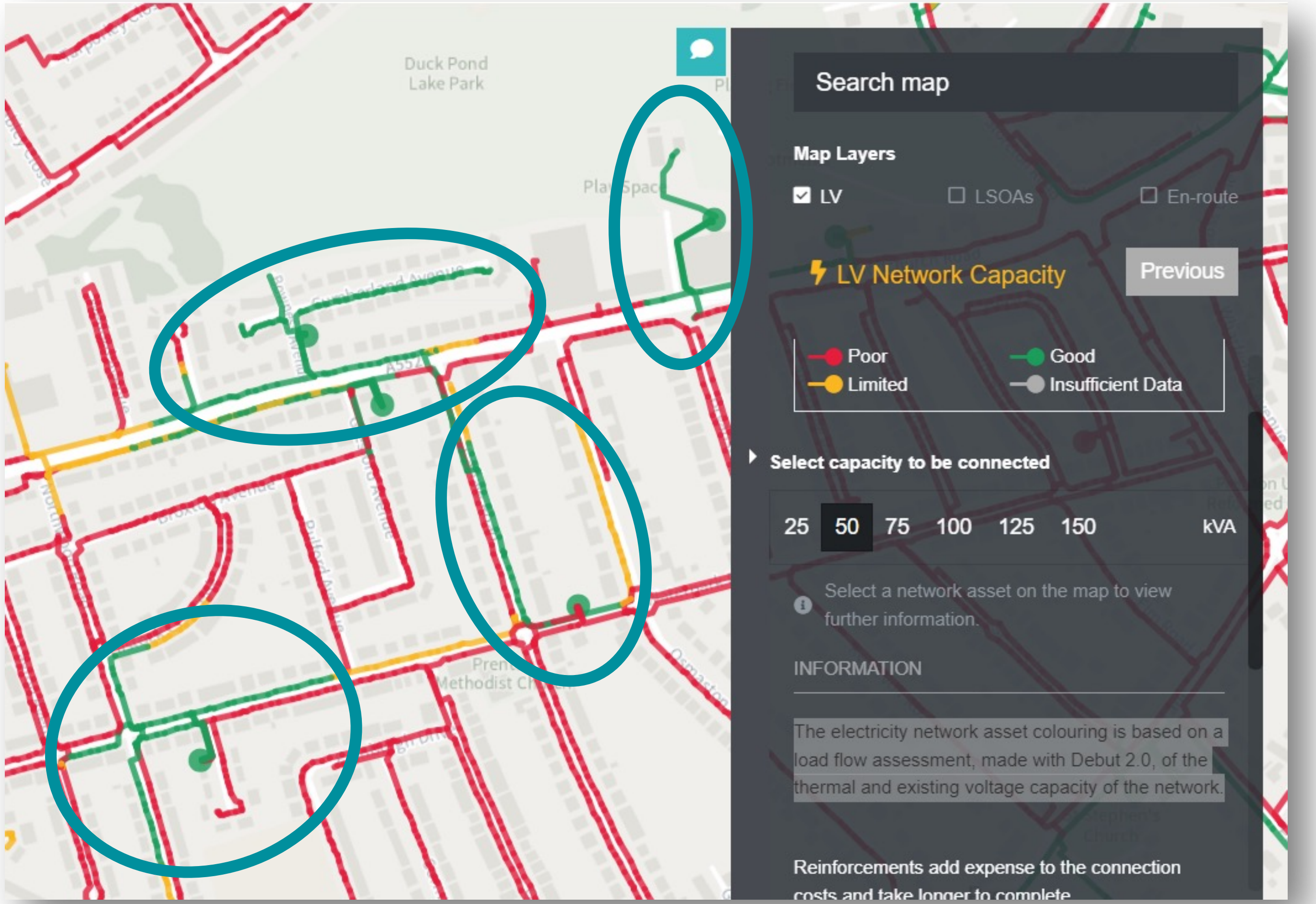
Grid Modelling

- Spatial Model of the electricity grid based on **data from distribution network operator**
- **All known network assets** with their demand characteristics included
- Simulation runs to identify **network limiting factors** (currents and voltages)
- Traffic light logic applied for **capacity of cables and transformers and substations** based on their design ratings, existing utilisation and voltage drops across the network



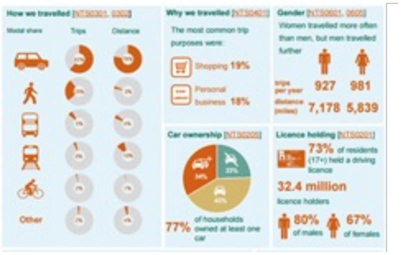
→ Identify remaining grid hosting capacity

Mobility Simulation

Road networks

Census and OSM data

National Travel Survey



Model

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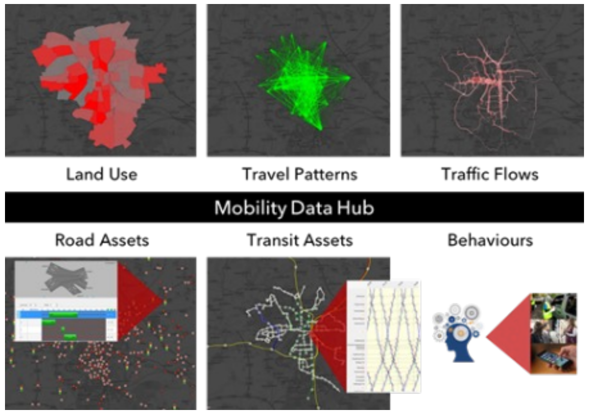
Tour-based demand model



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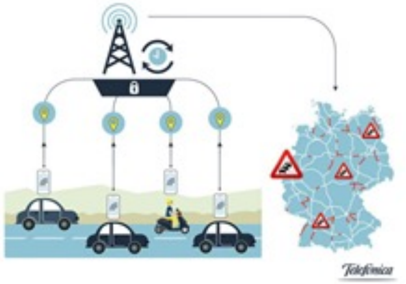
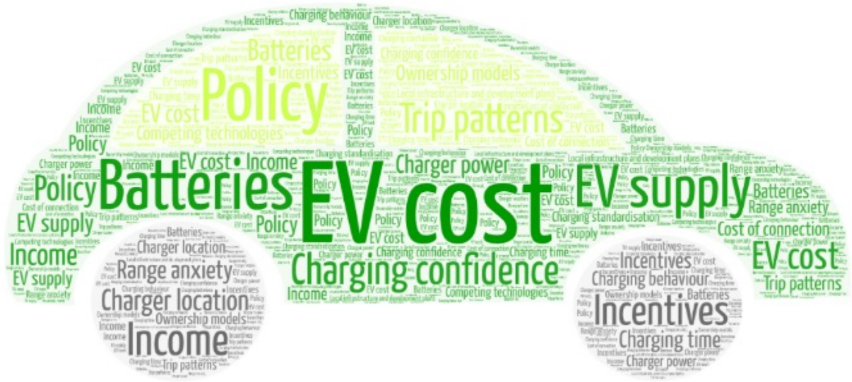
Movements data



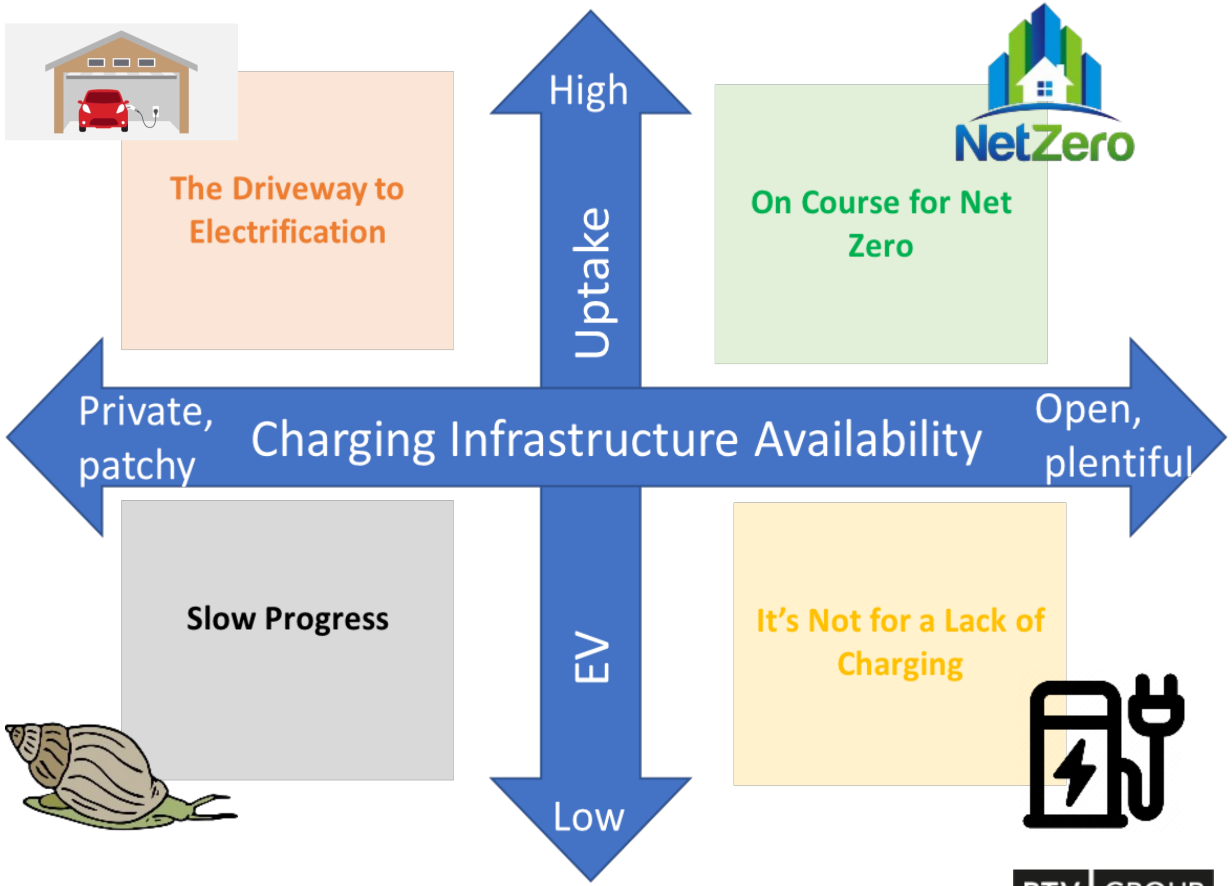
Traffic count data

Where are all the places you went today?	What time was it?	What did you do there?	How did you get there? (circle all that apply)

EV Future Scenarios



- EV Future Scenarios developed to consider a range of factors affecting **uptake and charging demand** in the future.
- Applied to anticipate demand from 2025 – 2050
- Scenarios define:
  - **Number of EVs** and who is likely to buy them
  - Vehicle technologies, including future **battery ranges**
  - The **reliance on public infrastructure**



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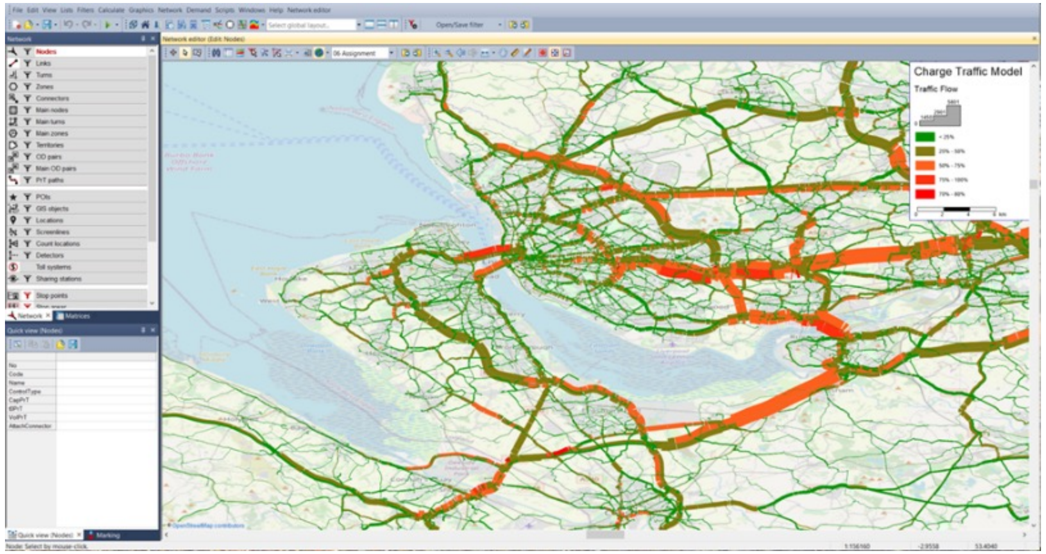
EV Modelling

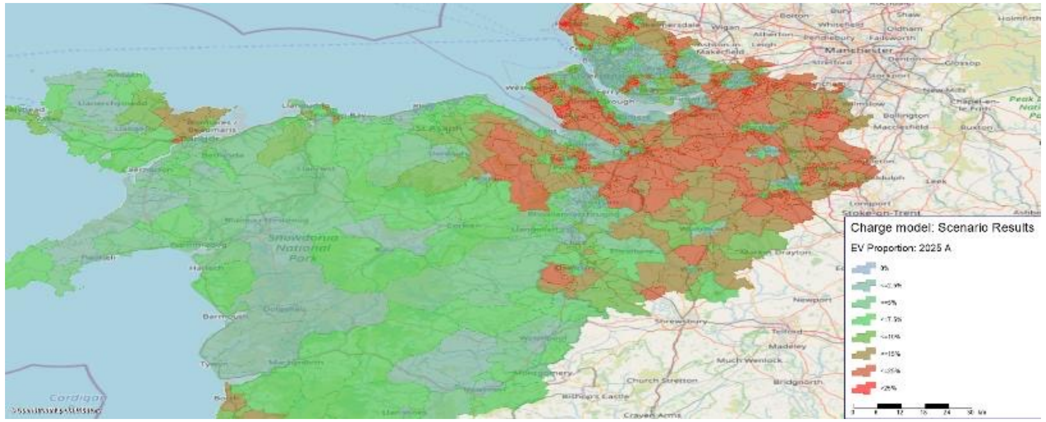
Model Characteristics:

- Activity-chain Visum model
- EV uptake modelled at individual level using zonal and person group characteristics
- Charging behaviours simulated based on trip patterns and scenario factors



Modelled travel pattern data and distribution of EV ownership helps determine:

- **Where** EVs are likely to be driven and for what purpose
- **How far** they travel & energy consumed
- **When** and where they might require charging
- **How long** the car is parked and the electricity required to charge



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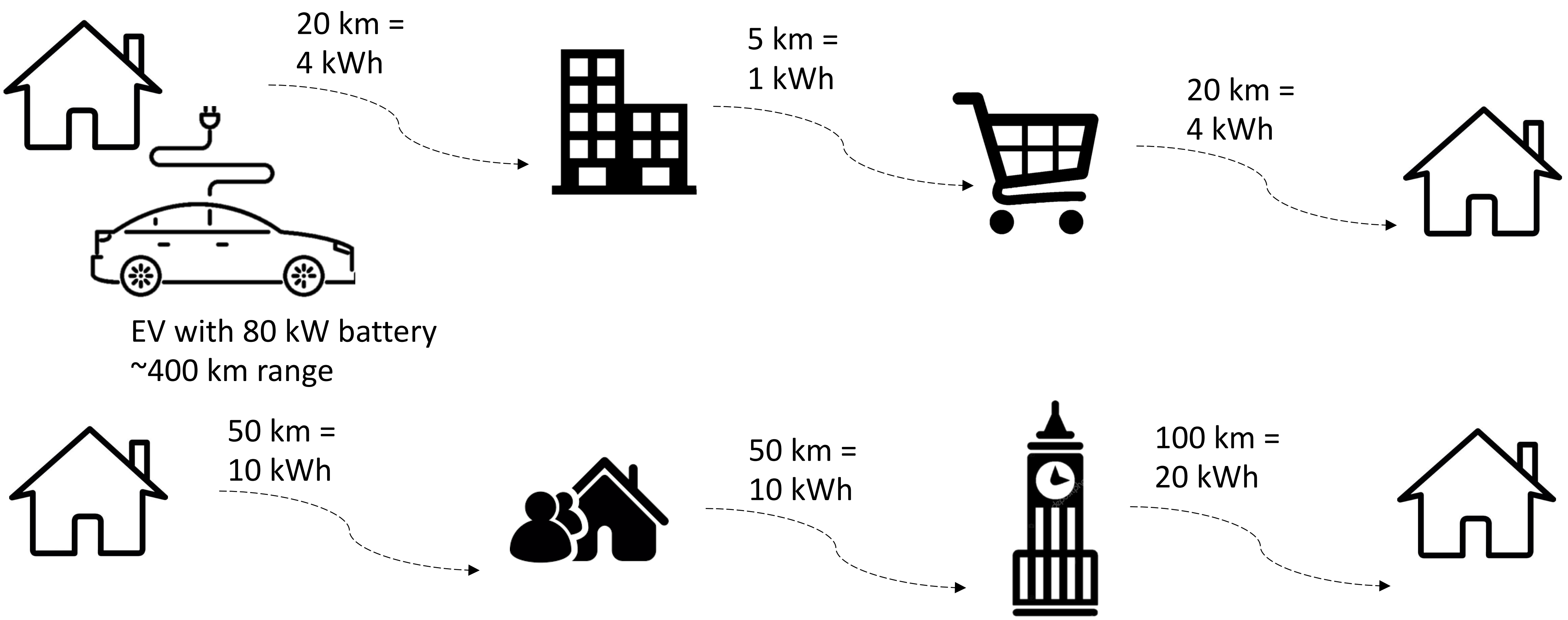
Modelling EV patterns



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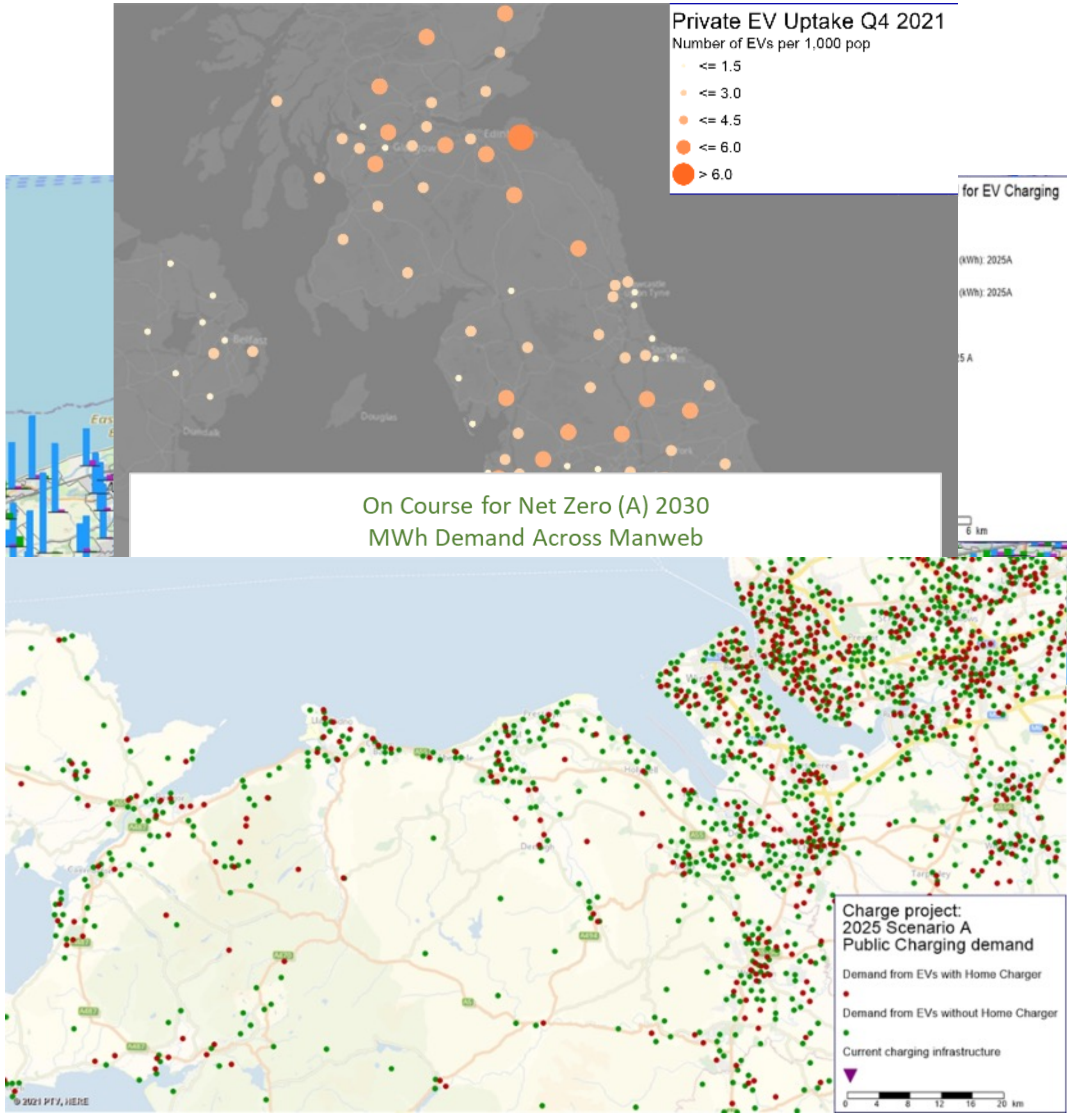
What Does the Charge Model Tell Us?

- It’s very likely that EVs **will not be distributed evenly**
- Infrastructure needs are likely to **differ by area**
- The likely **use case for infrastructure is** if it is installed in a certain location
- The scale of **impact** EV charging demand might have on the electricity network
- **Indicates what sort of future is desirable** and what is needed to build towards that future



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Use Cases: Destination Charging Demand

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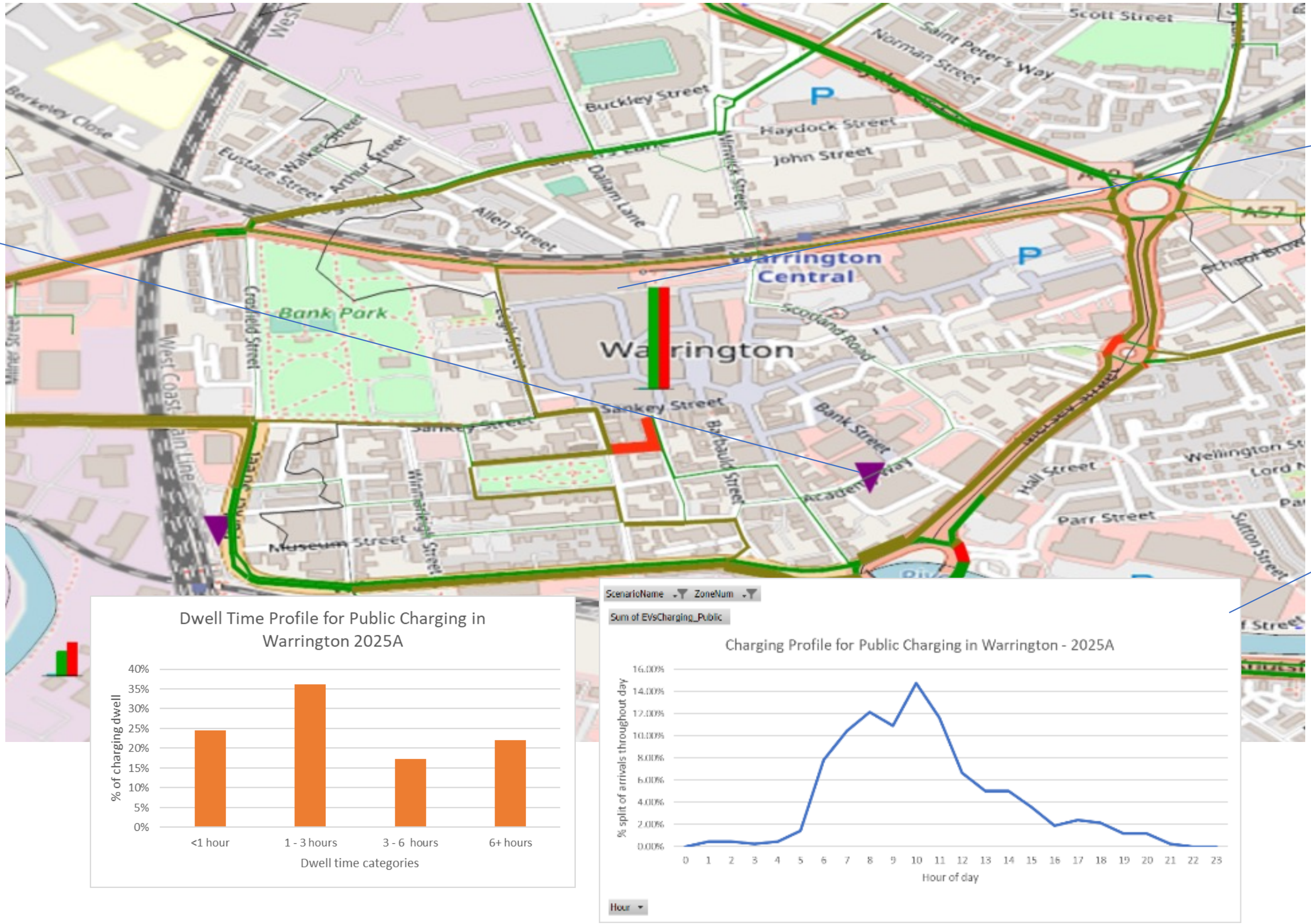
- Helps prioritise infrastructure / network investment

Current infrastructure:

30 x 2
7 kW chargers

Is there enough capacity to enable connection growth?



Based on ~10 % EV uptake in 2025, ~90-110 EVs arrive into this zone per day and want to charge

Equivalent to daily kWh:
580 – 780 kWh

Daily profile and dwell times suggest:

40 – 60 22 kW chargers &
5-10 50 kW+ chargers
/ ~1,800 kVA
required

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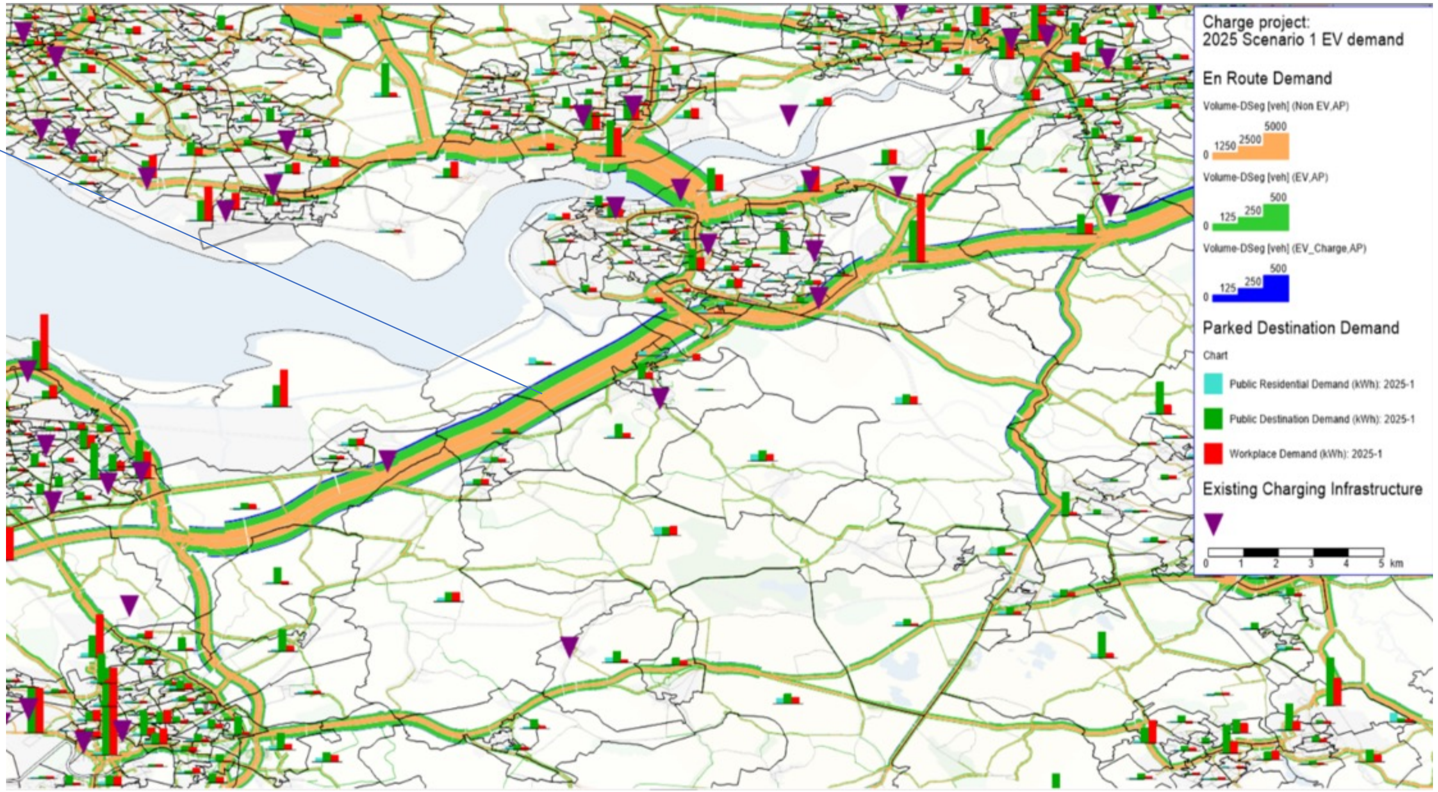
Use Cases: Enroute / Rapid Demand

- Helps identify locations and potential utilisation

Where is demand for **rapid chargers** likely?

Is current coverage of chargers suitable?

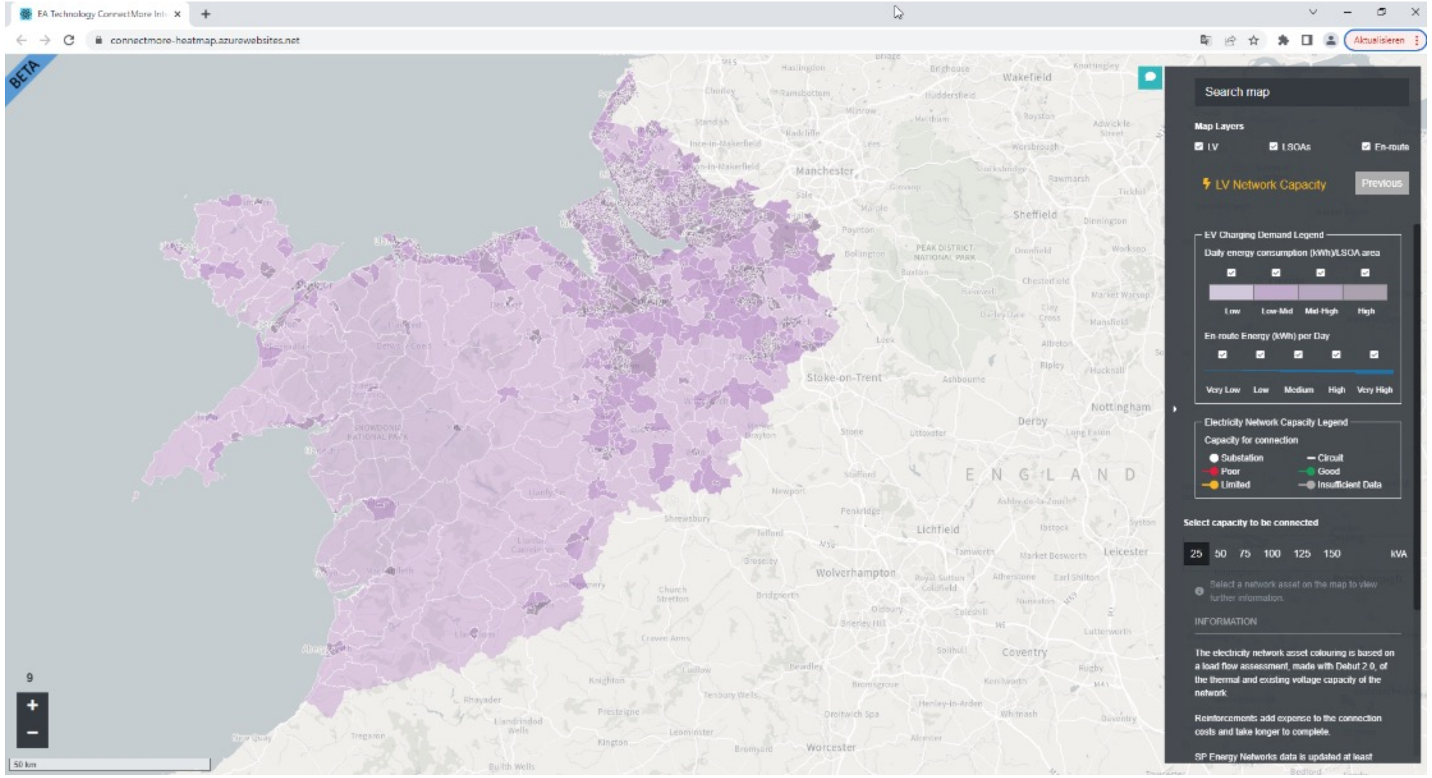


Location Optimiser tool can quantify and analyse sites that will serve the demand

Where are trips coming from and going to?

Who is likely to use these chargers and when?

Try the Web Tool Yourself!



https://www.spenergynetworks.co.uk/pages/connectmore_interactive_map.aspx

Discussion and Outlook

- **Understanding travel patterns is crucial** to assessing the requirement for charging
- Transport Model tools exist to estimate this requirement and **test different scenarios**
- **Customer segmentation** in a transport model can help understand charging behaviours and needs
- Overlaying charging demand with electricity network supply helps **identify hotspots** for rollout.
- **Smart Metering** will be needed to balance demand and maximise flexible capacity
- **Integrated planning approach** can be applied elsewhere to suggest charging requirement and network capacity

Questions

Thank you for your attention!

Dr.-Ing. Matthias Pfriem
Matthias.Pfriem@ptvgroup.com

Dr. Laurence Chittock
Laurence.Chittock@ptvgroup.com

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