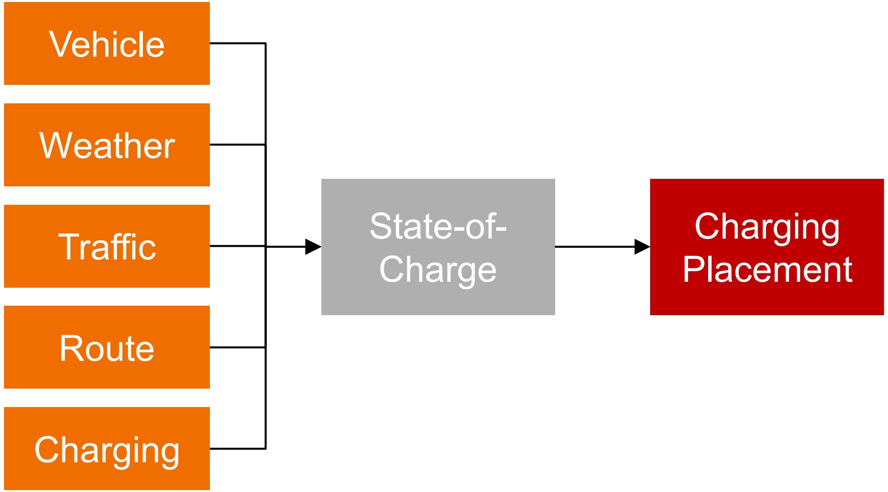
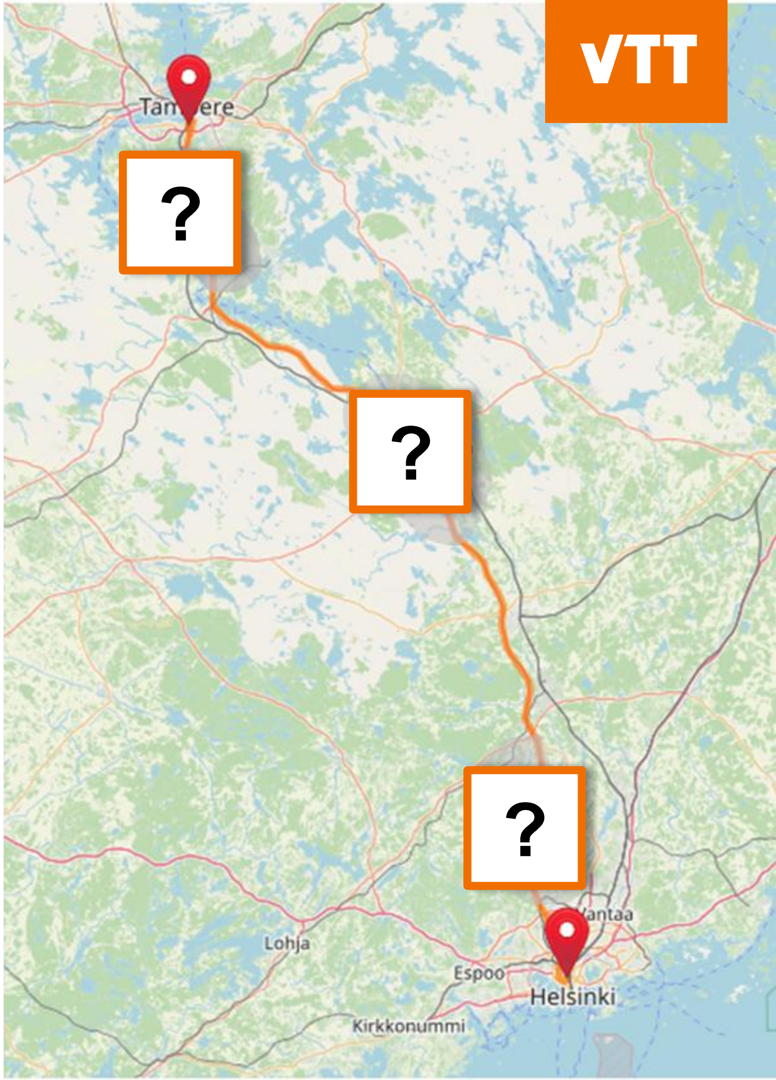
WeTRaC: Scalable EV Charging Demand Forecasting for Heavy-Duty Fleets

Alexander Aushev (presenter)

Joel Anttila, Yancho Todorov, Ari Hentunen, Mikko Pihlatie

Find the Right Sites for EV Chargers





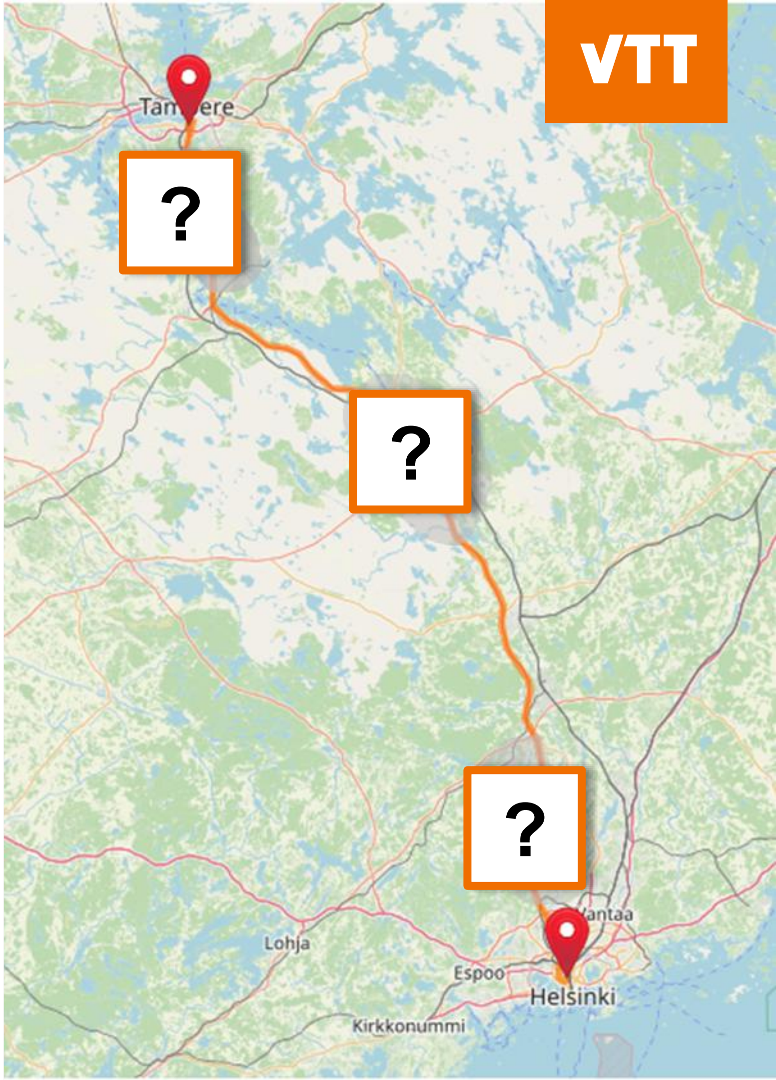
VTT

Find the Right Sites for EV Chargers

Vehicle
Weather
Traffic
Route
Charging

→ State-of-Charge → Charging Placement

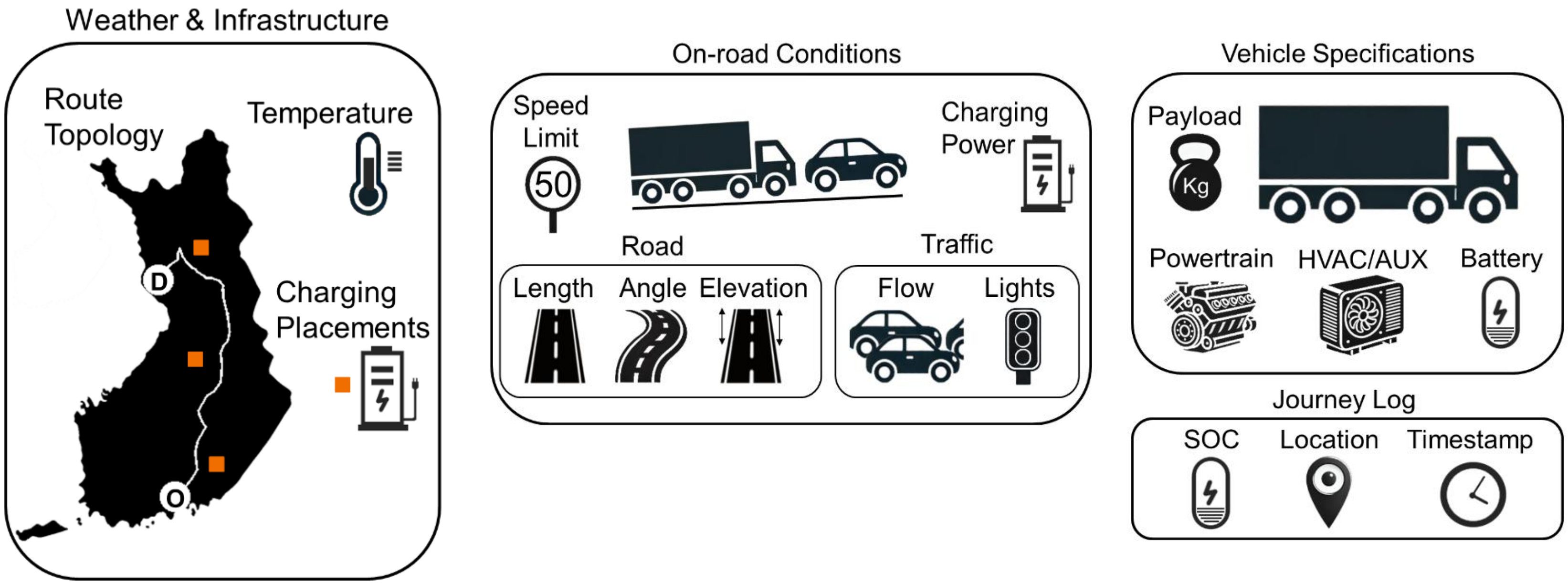
Solution: Fast, accurate SOC forecasts guide placement



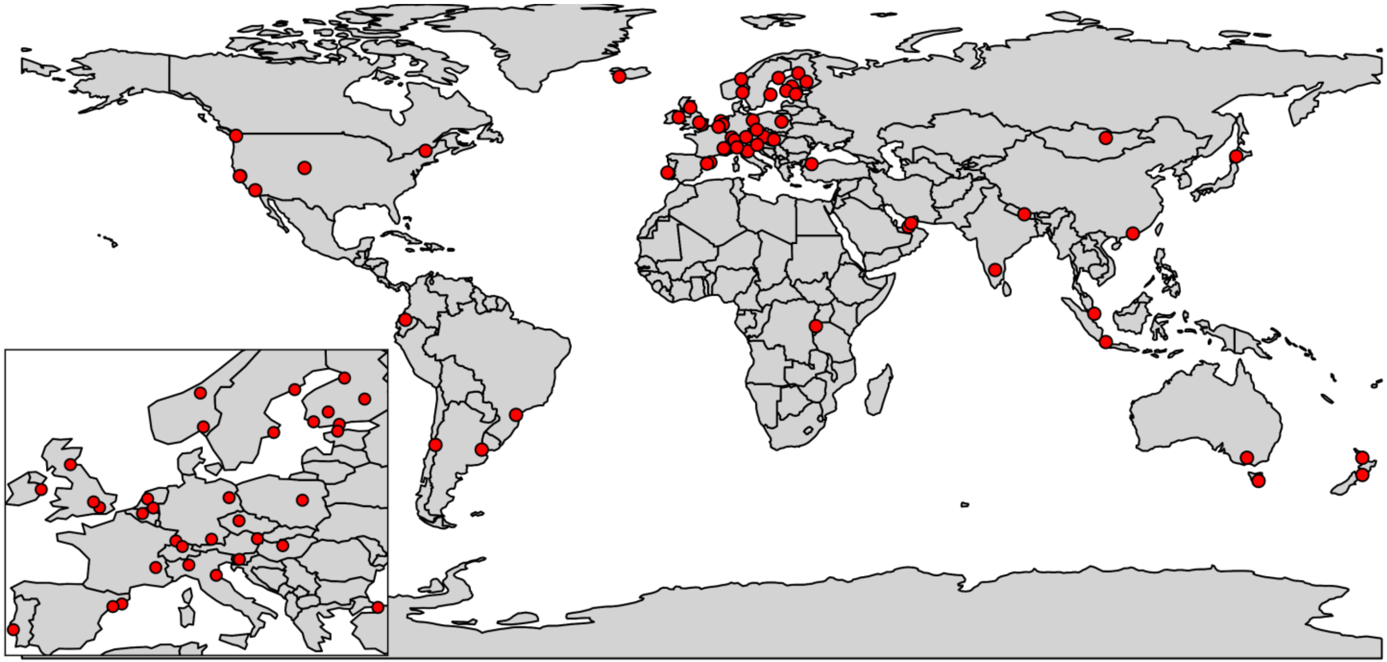
VTT

Solution

What Drives Charging Demand

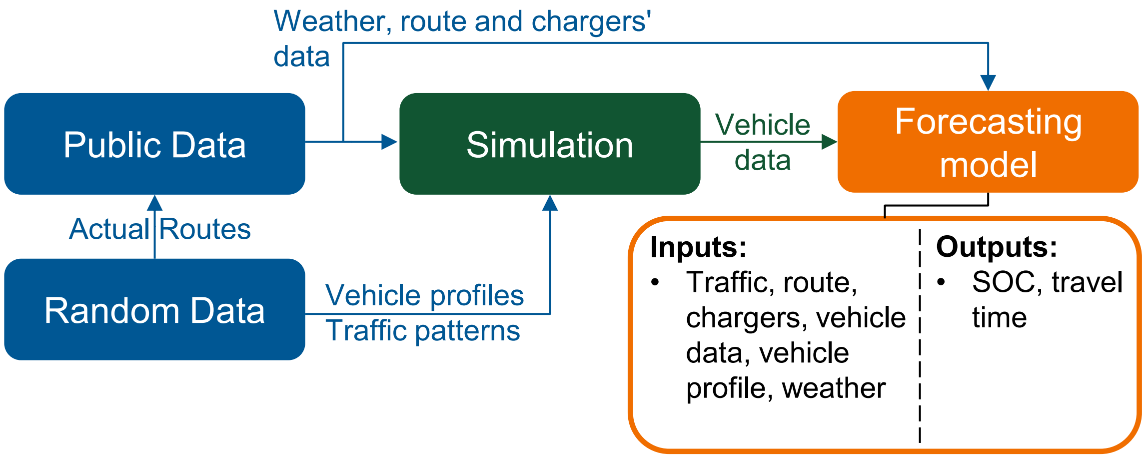


Global Open Data Powers WeTRaC



- 58 cities, 200 routes each
- OSM, OCM, elevation, weather

Fuse Open Data, Simulations, and GNNs

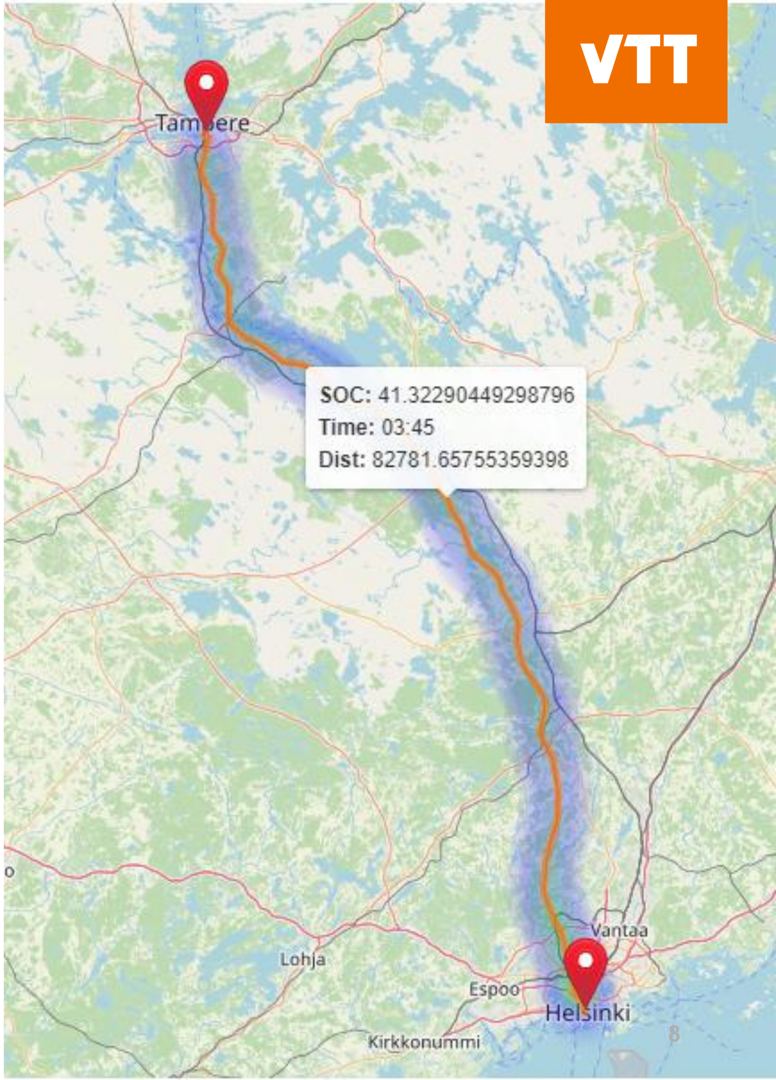


Predict SOC and Time on Every Road Segment

- **Inputs**: edge features + graph features
- **Outputs**: ΔSOC, Δ time per segment; cumulative SOC/time

500× faster than simulations

(~3.6–3.8% SOC error)



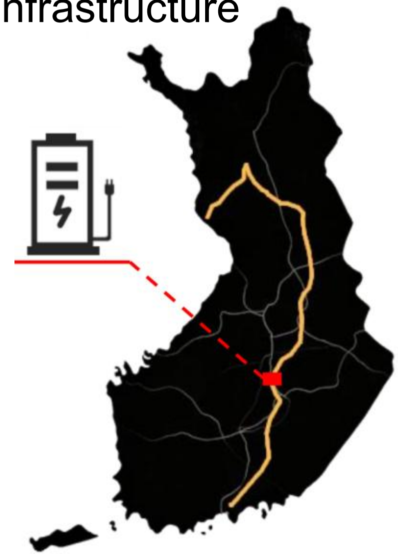
Virtual Corridor Analyses

What-if: one 1–2 MW hub on Helsinki → Oulu

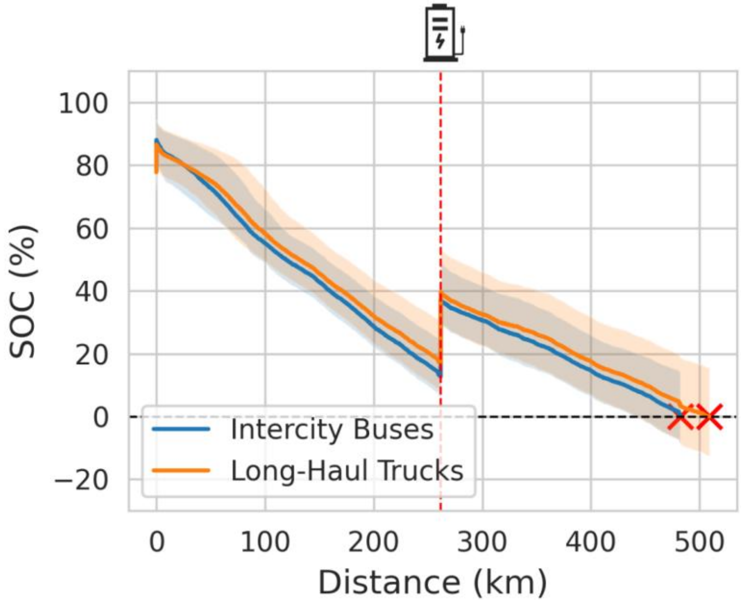
1. Define fleets

	Intercity Buses	Long-Haul Trucks
Battery Capacity (kWh)	500-1000	600-1500
Nominal Charging Power (kW)	350-600	350-2000

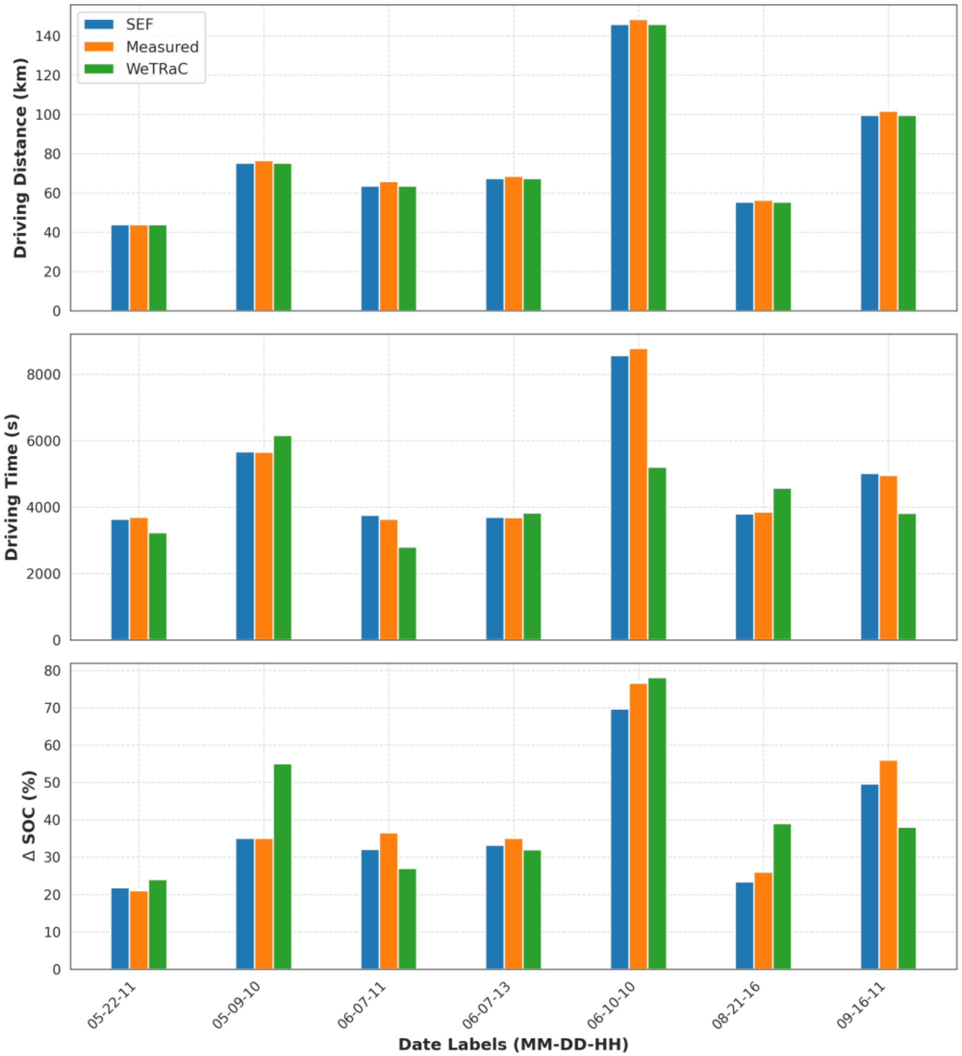
2. Select route, charger infrastructure



3. Get WeTRaC predictions (SOC, t)



Field check



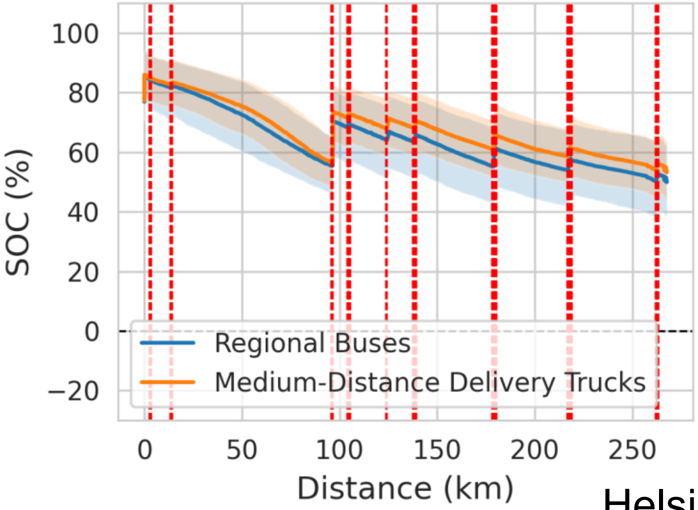
VTT

9.1 t truck, 150 kWh battery (May–Sep)

ΔSOC: WeTRaC within <5% of measurements

Time variance from frequent short stops (no en-route charging)

Corridor Planning: Helsinki→Jyväskylä & Oulu

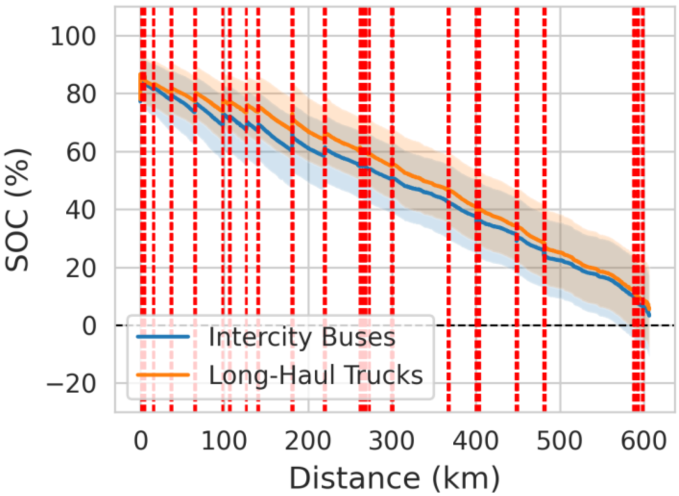


Helsinki – Jyväskylä (350-450 kW)

	Regional Buses	MD Delivery Trucks
Battery Capacity (kWh)	500-1000	600-1500
Nominal Charging Power (kW)	350-600	350-2000

Helsinki – Oulu (1-2 MW)

	Intercity Buses	Long-Haul Trucks
Battery Capacity (kWh)	500-1000	600-1500
Nominal Charging Power (kW)	350-600	350-2000



Conclusions

Key Takeaways

- Scalable, open-data EV demand forecasts (global applicability);
- ~3.7% SOC error with 500× speedup vs. simulation;
- Supports rapid corridor and siting “what-if” analyses.

Thank you!

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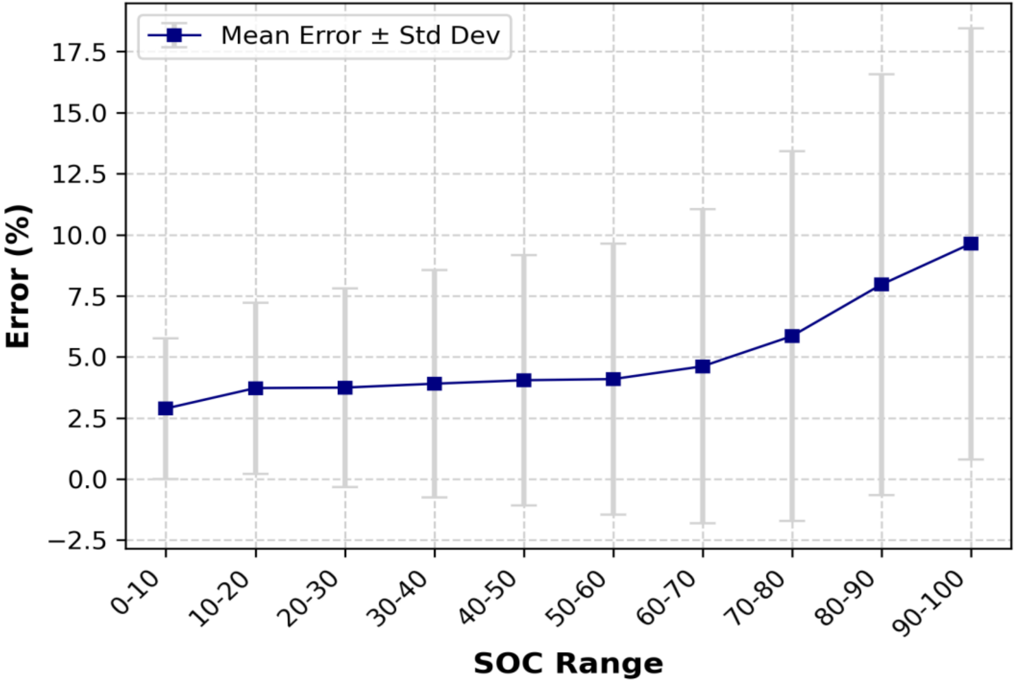
Balancing High Prediction Speed with Minimal Accuracy Trade-offs



- **Prediction Error**:

  3.76 ± 4.4 (%);
- **Prediction speed**:
  - ~ 60 msec. (~120 km)
- **Conclusion**:
  - ML models for vehicle fleet analysis, Simulations for higher accuracy;