Interaction Effects Between Battery Electric Trucks (BETs), Electric Road Systems (ERS) and Static Charging Infrastructure

Jakob Rogstadius,
Senior Researcher,
Systems Engineering

Research funded by European Union European Regional Development Fund
REGION BLEKINGE

Background

- EU/Sweden: Reduce traffic GHG emissions by 55% by 2030 (vs. 1990)
- Sweden ahead of EU curve, due to **biofuels**
- Ratio of EVs of new registrations, in Sweden 2022:

  56% of passenger cars, 21% of buses, 14% of light trucks, **3% of heavy trucks**
- Current approach to electric heavy trucks:
  large batteries + depot charging + fast charging stations
- Electric Road Systems () proposed

Research goal: Untangle interaction effects and capture system dynamics

- Competition and synergies between static and dynamic charging
- Emergent system effects when
  - infrastructure gets denser
  - more vehicles become electric
  - battery costs decrease and battery technology improves

Method

Methodological qualities

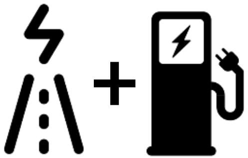
Four heavy truck classes share infrastructure

Millions of overlapping transport routes

Supply, demand and user charges in balance

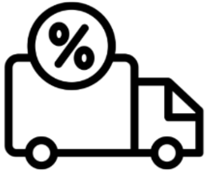
Lifecycle battery costs determined through use

Entire Swedish road network



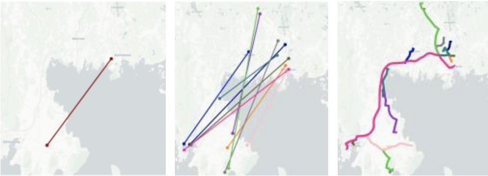
Combinations of static and dynamic charging

Competing charging infrastructure, built over time

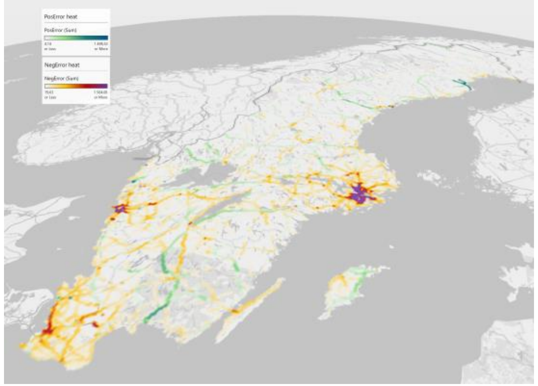


Tax revenue kept unchanged

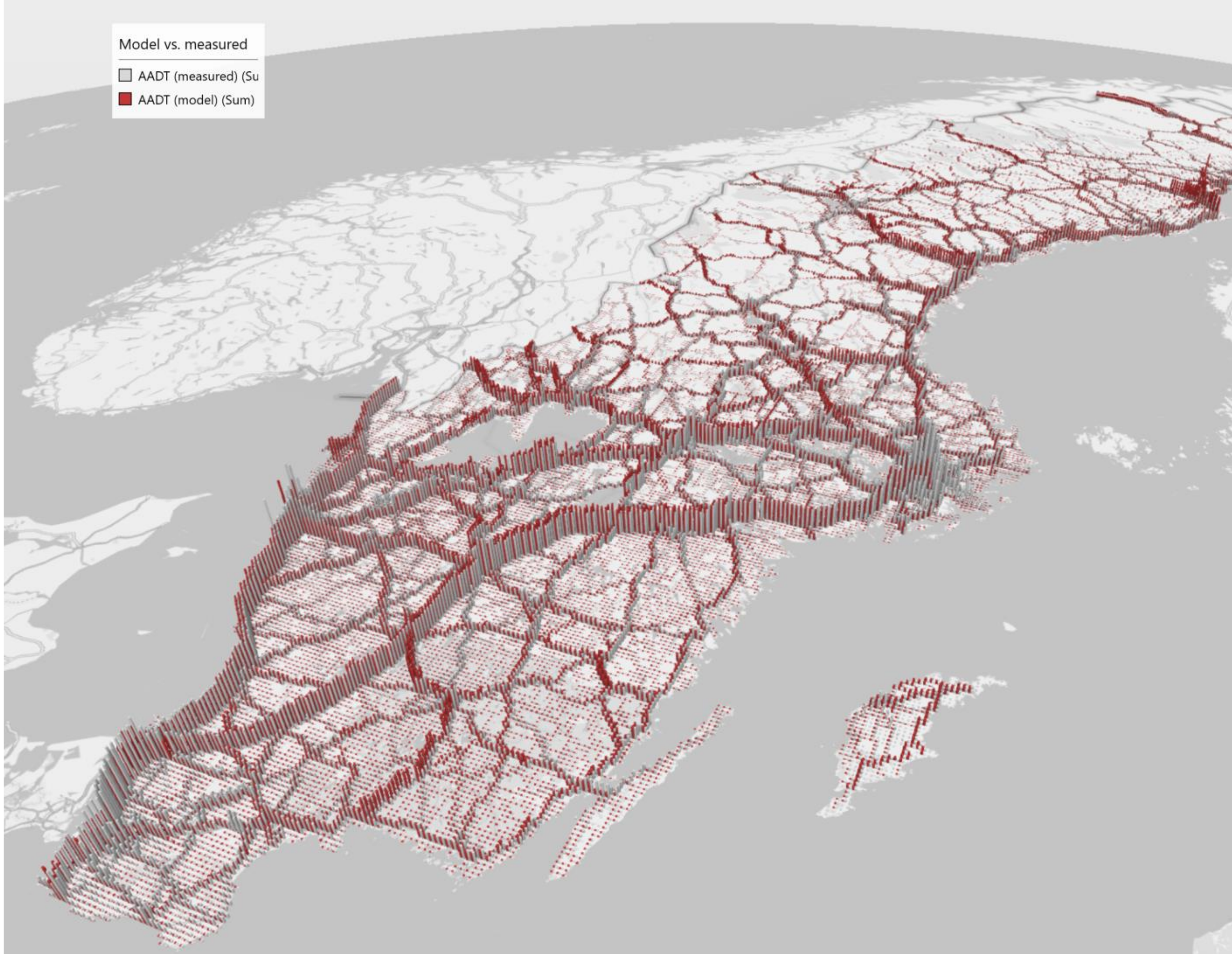
Traffic data:
200k goods flows → 2M routes



Sampling of route variants for a pair of municipalities, followed by routing along the road network



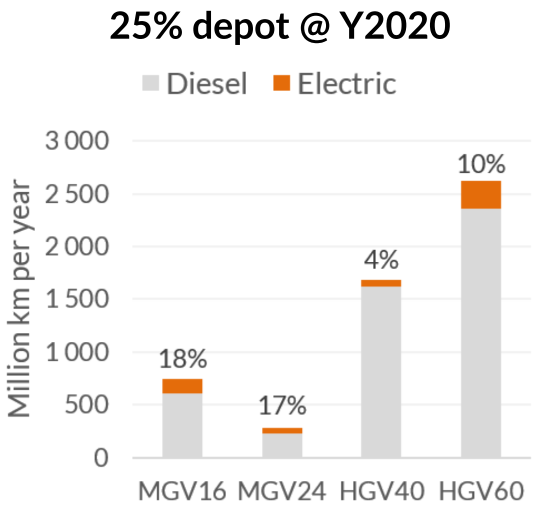
Underestimates (red) and overestimates (green) of traffic density on the road network. Underestimates may be due to lack of bus traffic.

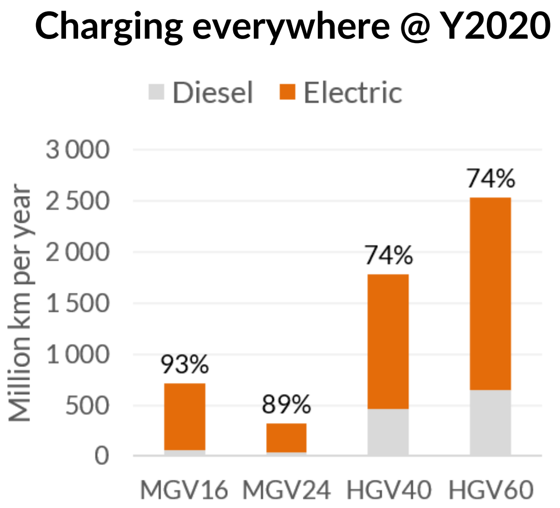


Comparison after data calibration with measured AADT

Results

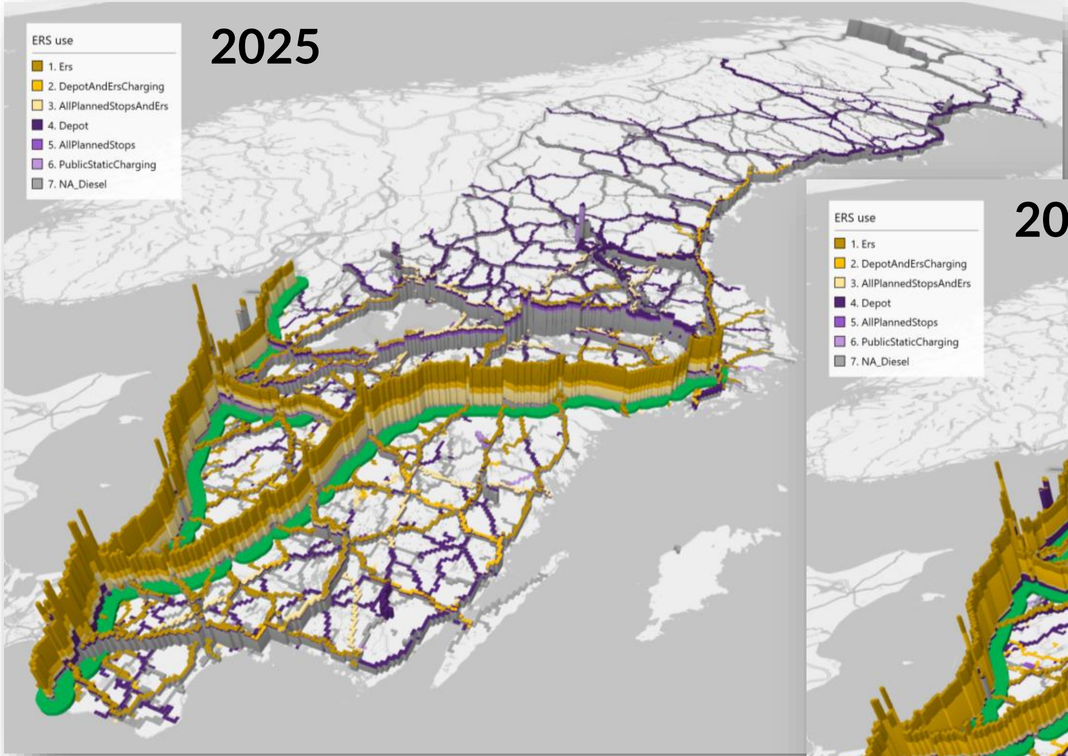
Technology (with ERS) is good enough today, but charging infrastructure is missing

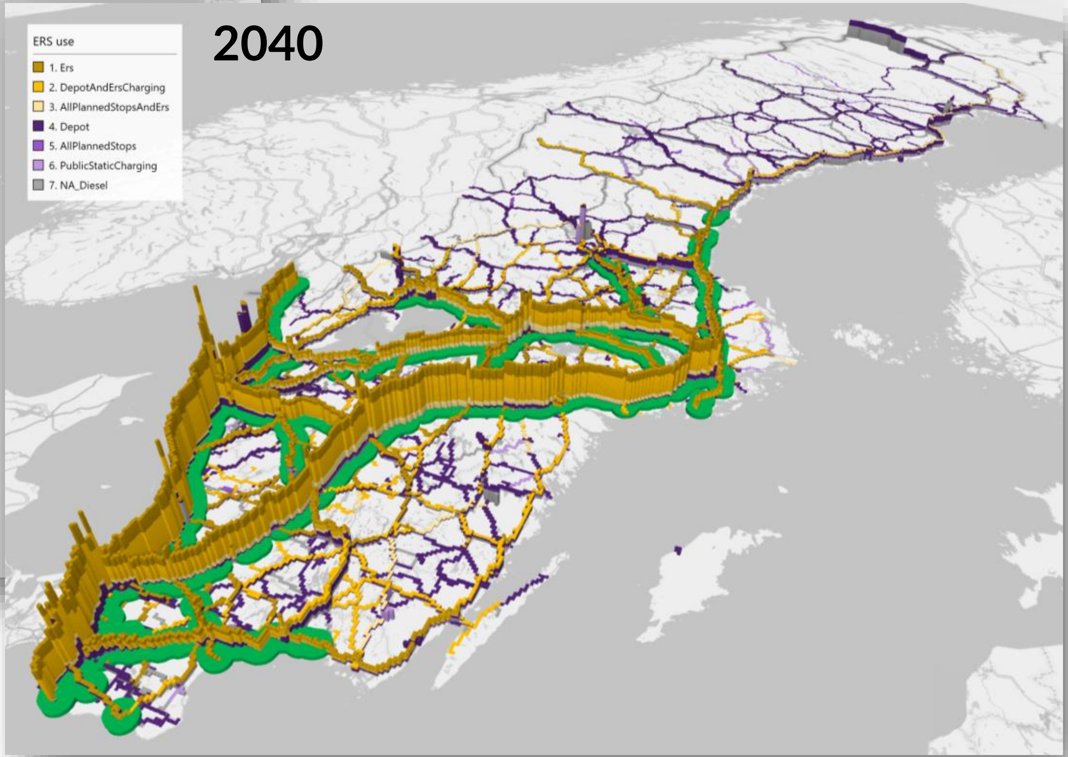




More charging infrastructure → More electrification → Lower cost, less GHG
Rapid transition is driven by cost reductions

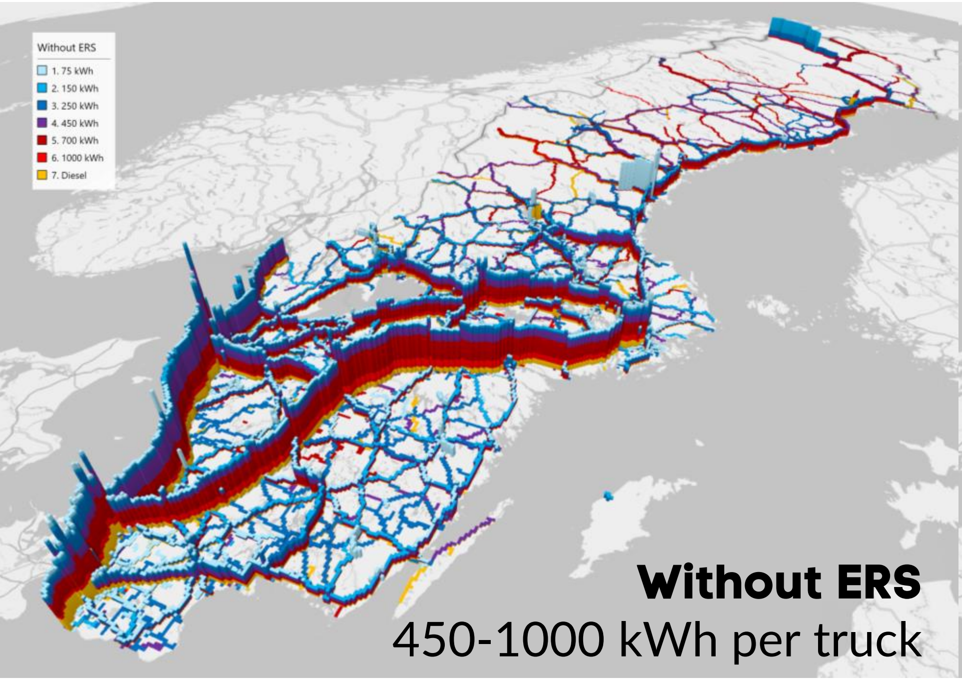
In sim, most heavy traffic uses ERS where available

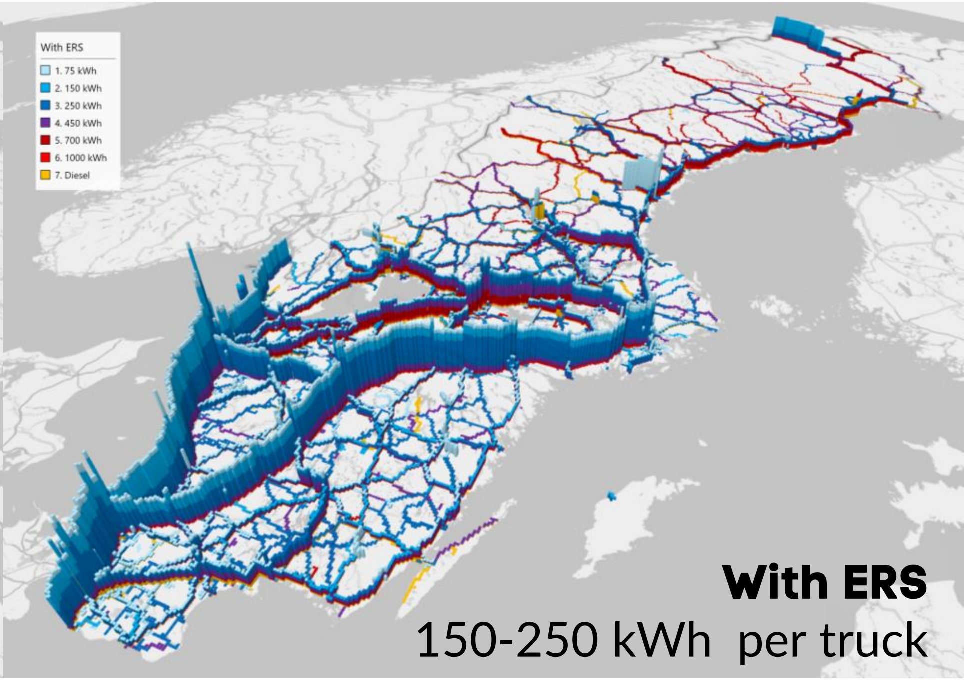




ERS

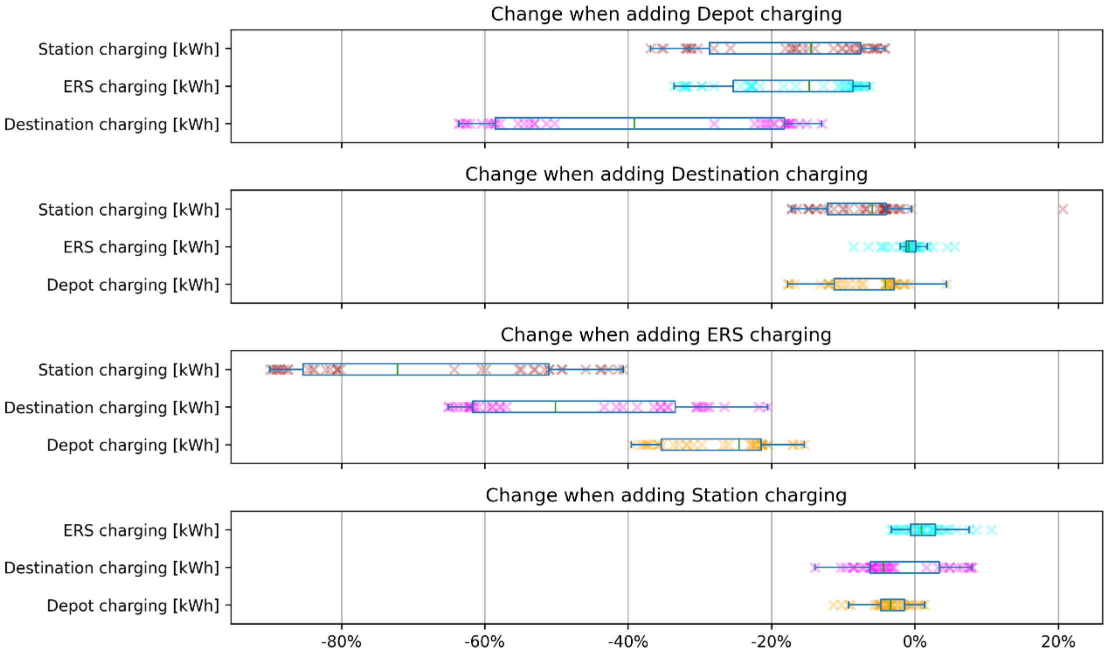
→ **Small batteries**
→ **Earlier TCO parity**
→ **Earlier electrification (at same cost and point in time)**

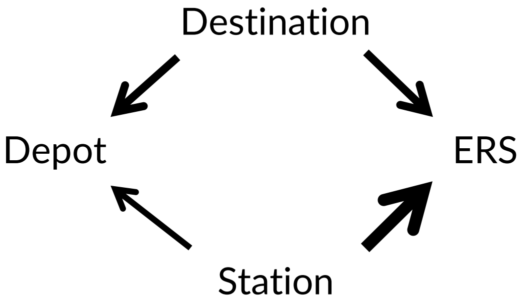




ERS reduces demand for static charging, esp. at rest stops

Change in kWh/year from A, when adding B

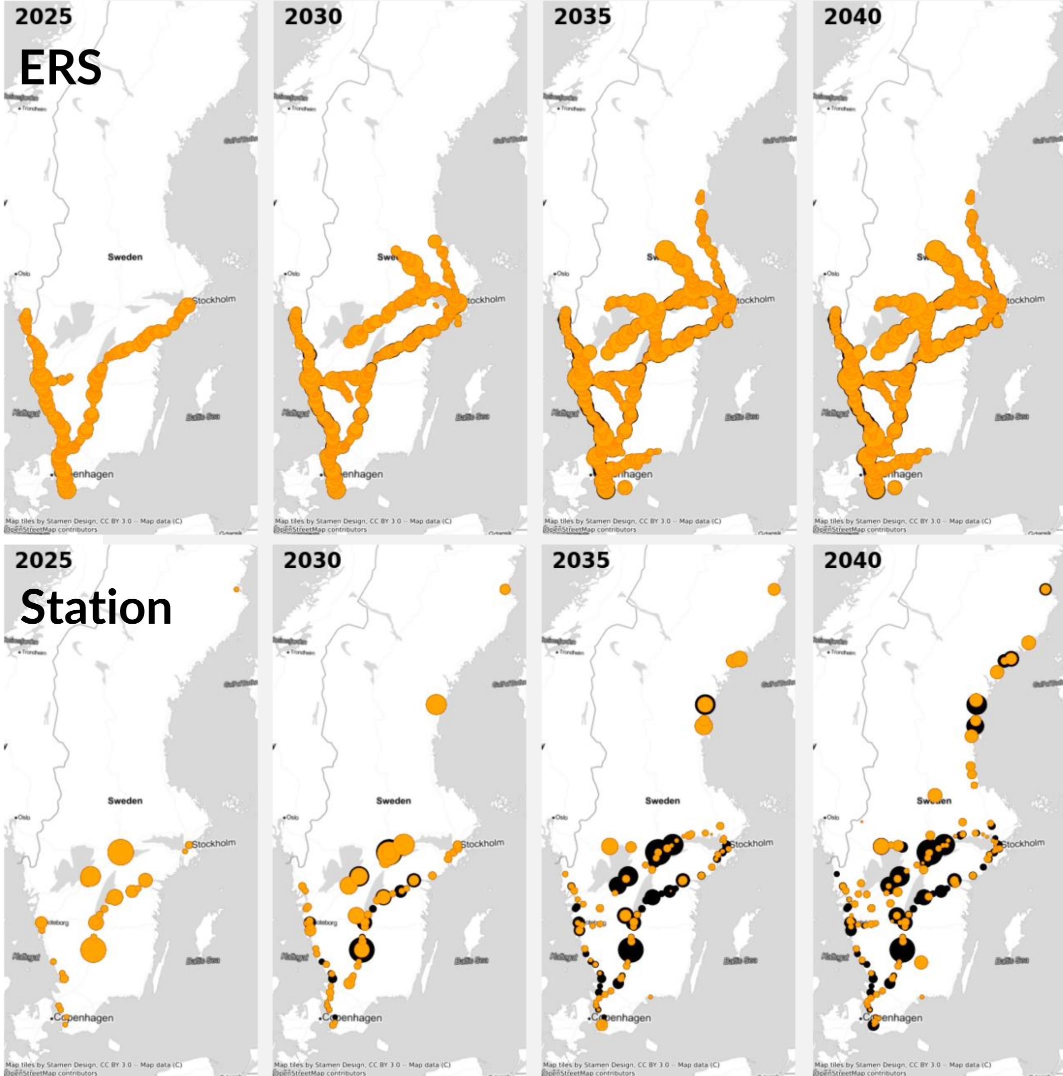




Arrow thickness depends on model parameters

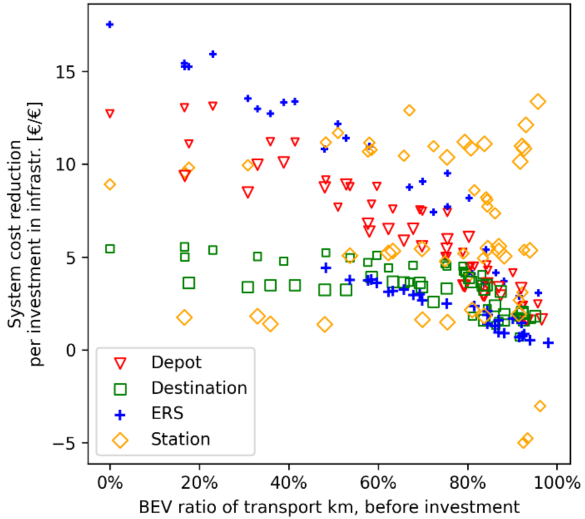
Be transparent about ERS plans, investors need to know

A growing ERS network outcompetes too large fast charging stations



Best ROI:

1) Prioritize depot and ERS charging today
2) Fill in gaps with public fast charging at rest stops
3) Later add fast charging at terminals, if truck utilization increases



>90% electrified heavy transport work requires **a lot** of charging infrastructure, **both** static and dynamic

ERS likely **needed** for 55% GHG reduction by 2030

Jakob Rogstadius

jakob.rogstadius@ri.se
0730-58 18 27

Learn more about this research