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Obtaining spatial charging demand from road transport and analysing the resulting charging infrastructure need using ev contrib

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Agenda

- Background
- ev contrib – what existed already
- Methodology
  - Added implementations
  - Application of implementation
- Future work

Background

- University division with research areas typically associated electric vehicles, charging equipment and electrical grid
- New projects asking questions related to charging infrastructure technology choices and placement
- First project connected to this (IDEAS) showed MATSim’s potential

Impacts of vehicle fleet electrification in Sweden – a simulation-based assessment of long-distance trips

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***Abstract*—Electrifying road transport is seen as one of the key components in decreasing the carbon footprint of the society as a whole. Recent developments in electric drivetrain and battery technology have helped to design vehicles with ranges that make them independent of public charging infrastructure during most sub-urban and commuting trips. Once long-haul trips are planned, however, these vehicles require a dense network of charging infrastructure. In this paper, the impact of a large-scale electrification of vehicles in long-distance trips is evaluated by combining an agent-based long distance transport model of Sweden with a detailed model of energy consumption and battery charging. Energy consumption and charging schemes are simulated for different types of vehicles and chargers. In a first**

system over the next years. Several countries have already announced an upcoming ban on the sales of fossil-fueled passenger cars, triggering a replacement of older vehicles with alternative solutions such as Battery Electric Vehicles (BEVs) or hydrogen powered Fuel Cell Electric Vehicles (FCEVs). Countries that have introduced a ban include Norway (by 2025), France, and The United Kingdom (both by 2040) [7]. More recently, Sweden and Denmark have announced a ban on sales for the year 2030 [9]. The BEV market is taking up on this and an adequate selection of vehicles will be available. The main adaption that needs to be undertaken lies, however,

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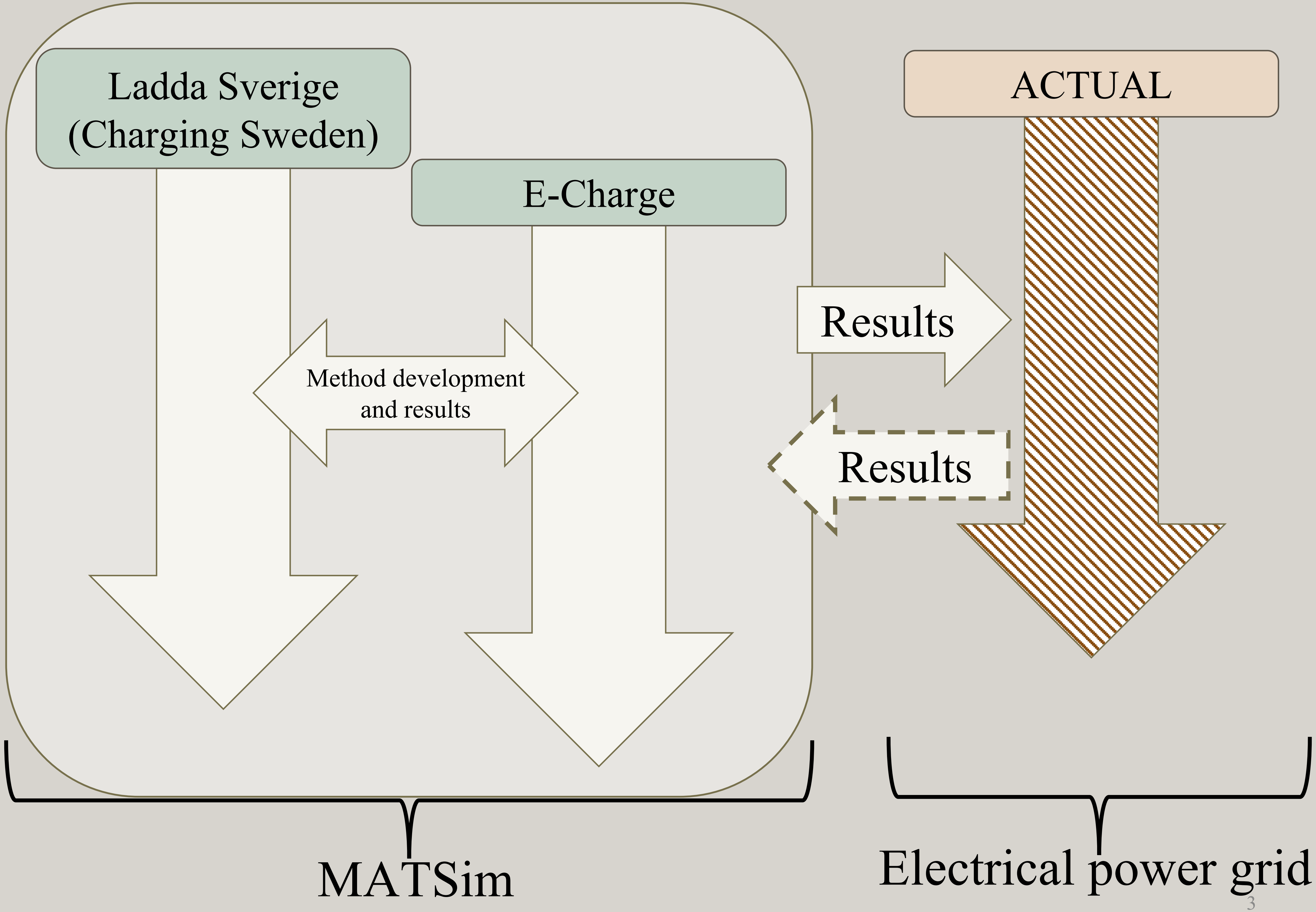
Background

Three concurrent projects

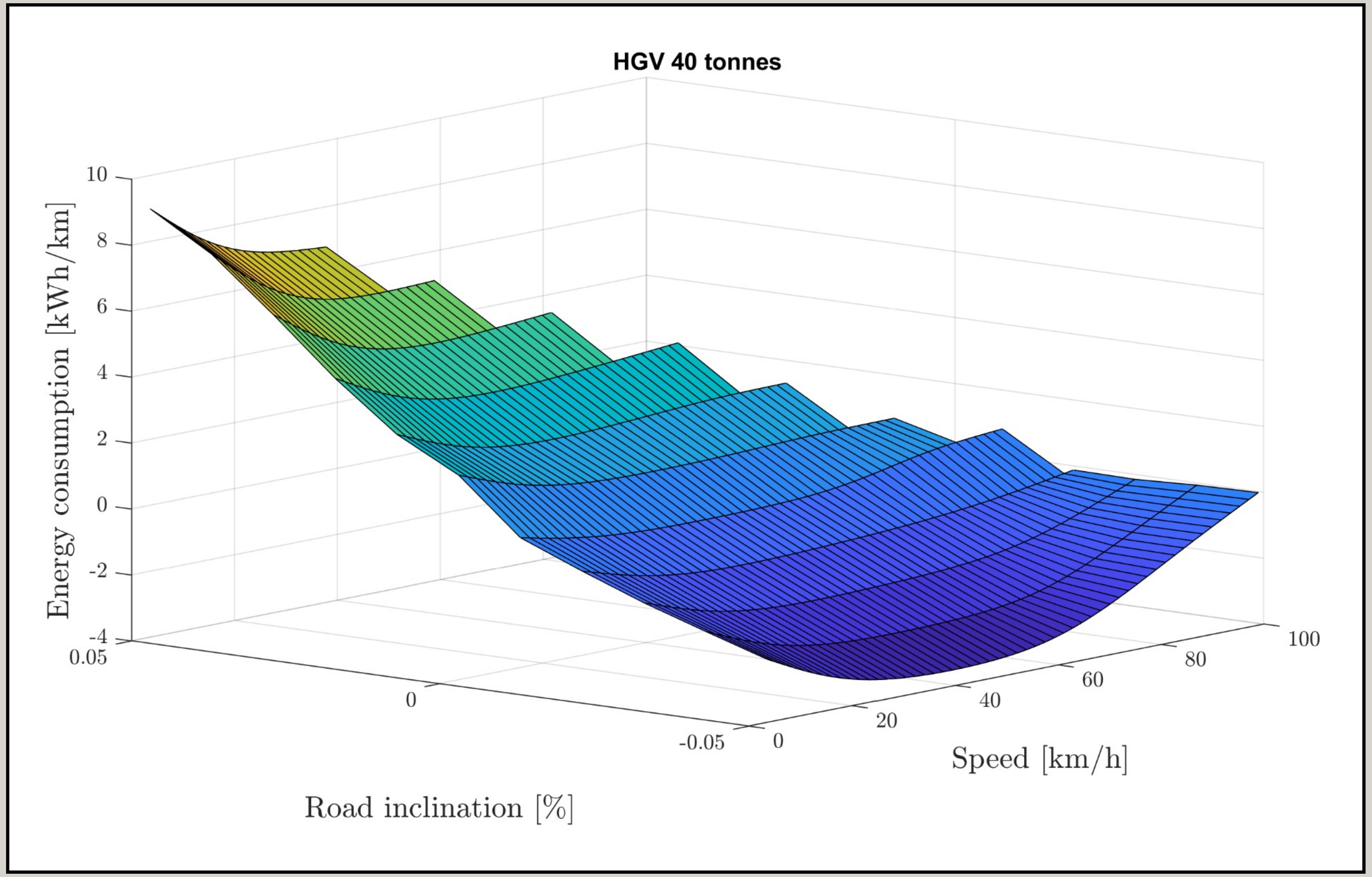
- Ladda Sverige
  - Fast charging infrastructure placement and sizes for a full-electric long distance transport transport
- E-Charge
  - System demonstration of electric long-haulage fleet
  - MATSim results focuses on necessary fast charging infrastructure for a full-electric long-haulage fleet
- ACTUAL
  - Impact of electrification of transport on electrical grid in a region of Sweden



ev Contrib

Electrical Vehicle (EV) contrib provides

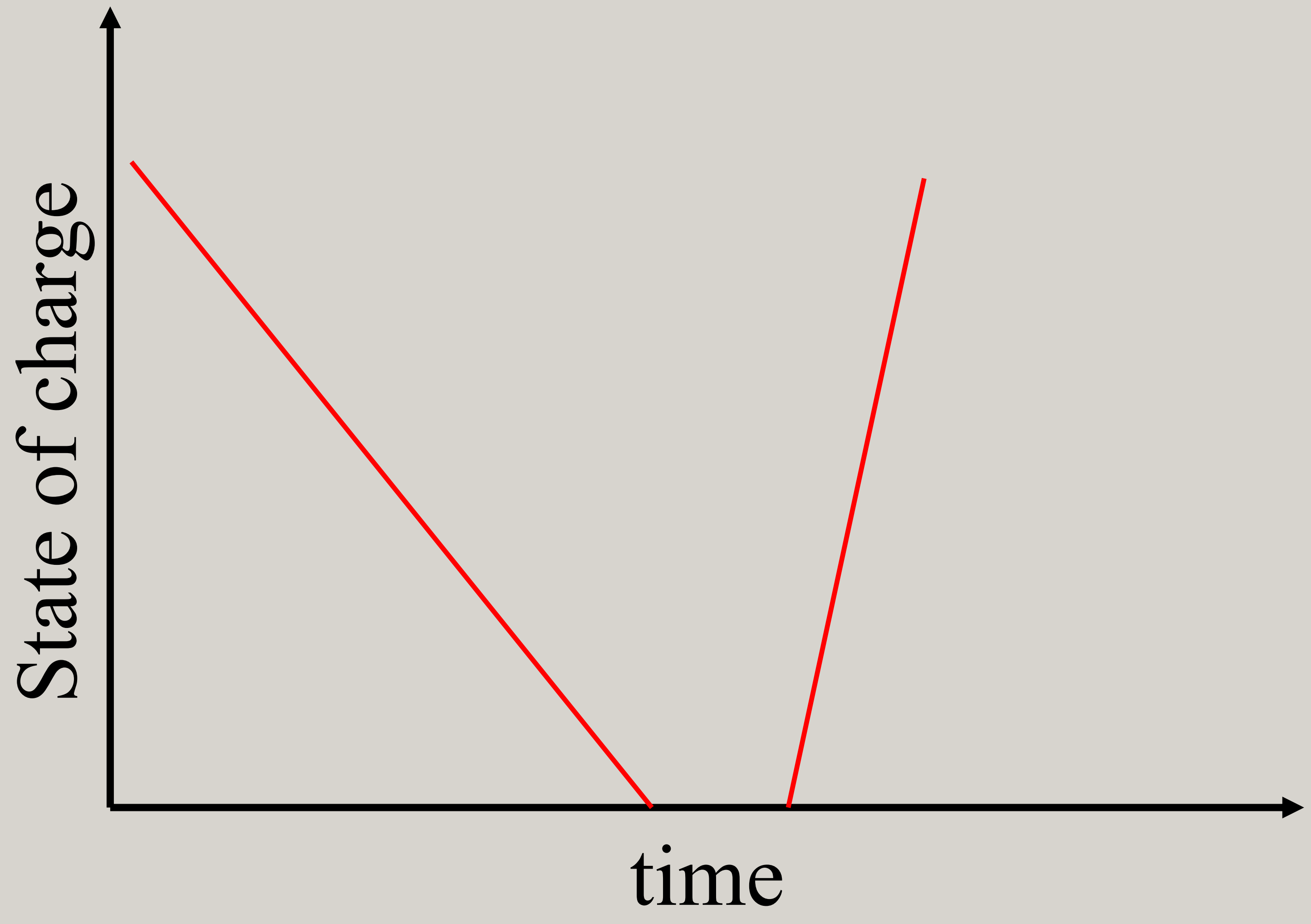
- EVs
- Fast charging stations
- Charging strategies
- Possibility to add energy consumption maps to EVs (speed and slope dependent)



ev Contrib – Battery energy

EVs' battery energy is used/monitored in

- RoutingModule to estimate charging location and assign station
- Output as Individual **State of Charge** ($\frac{\text{battery energy}}{\text{battery capacity}}$) profiles
- Exists in mobsim to keep track of energy
  - Battery energy negative without consequence
  - No event regarding battery energy of vehicle

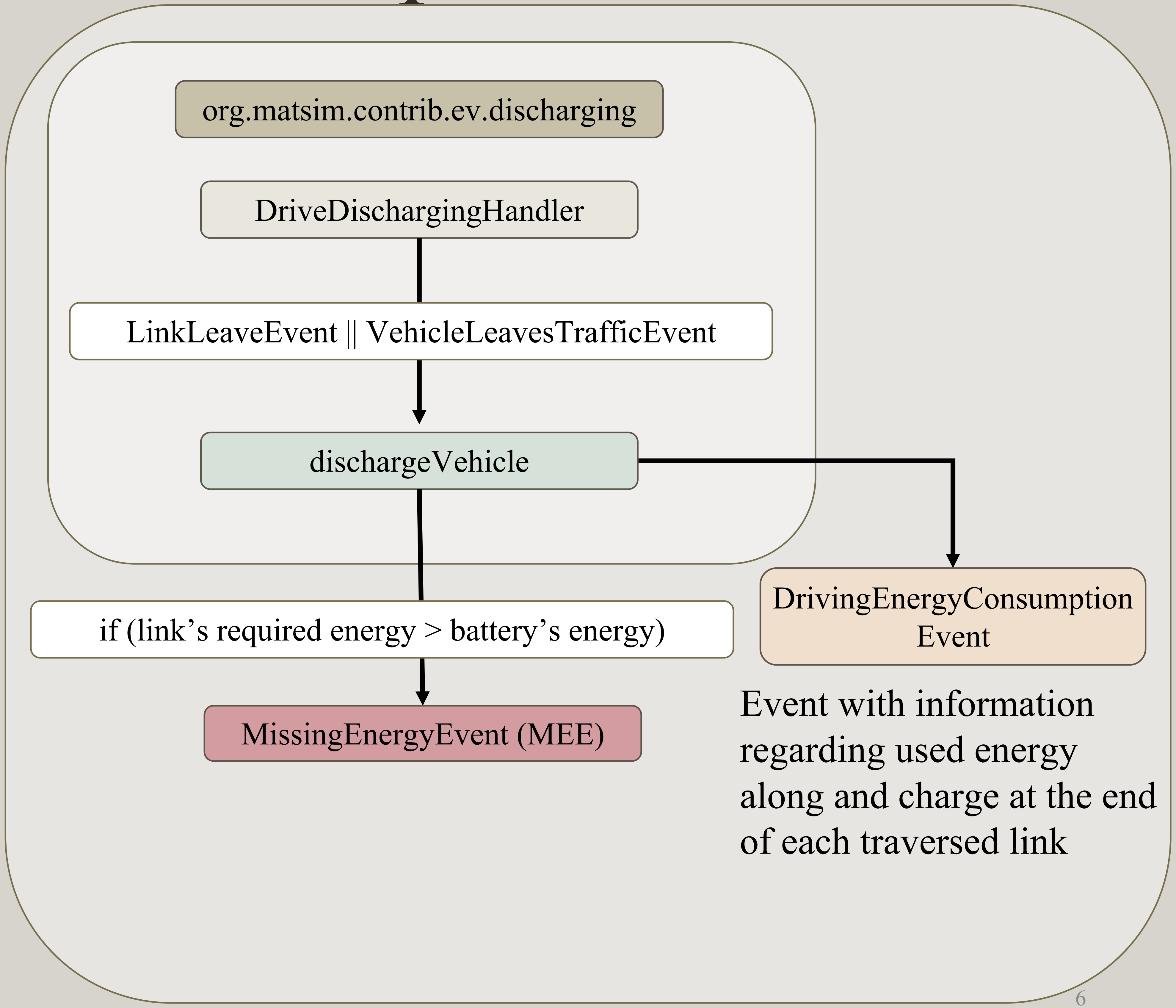


Methodology – New Implementations

Primary research goal is to find locations and evaluate charging infrastructure

Functionality needed to facilitate this:

- Battery energy tracking
- Penalising and logging of locations when falling under certain thresholds



Methodology – Application

The implementation of events logging energy makes it possible to introduce helpful EventHandlers

- LowEnergyEvent (LEE): DriveEnergyConsumptionEvent when SoC falls under a given threshold (our first value 20%)

LowAndMissingEnergyEventPenaltyHandler

Monitors MEEs and LEEs

- Penalises MEEs
- Logs LEEs resulting in MEEs coordinates

Distribution of LEEs

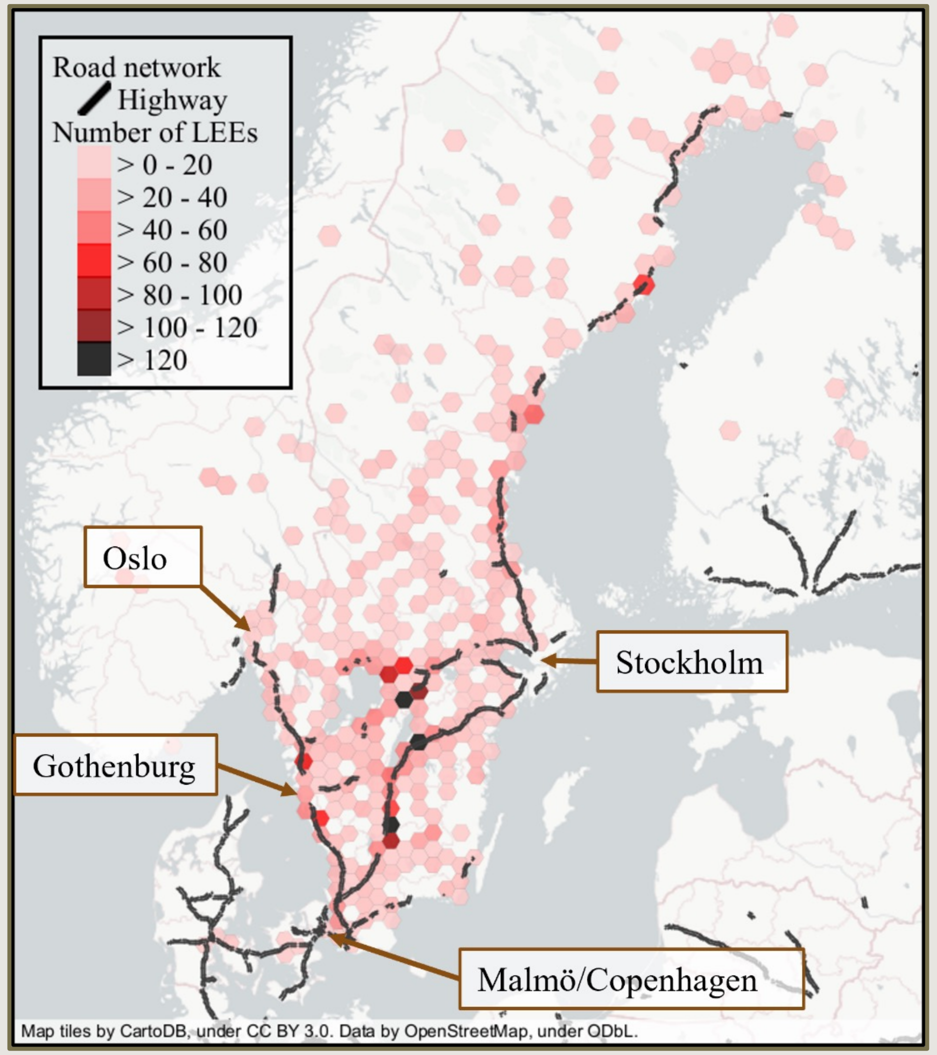
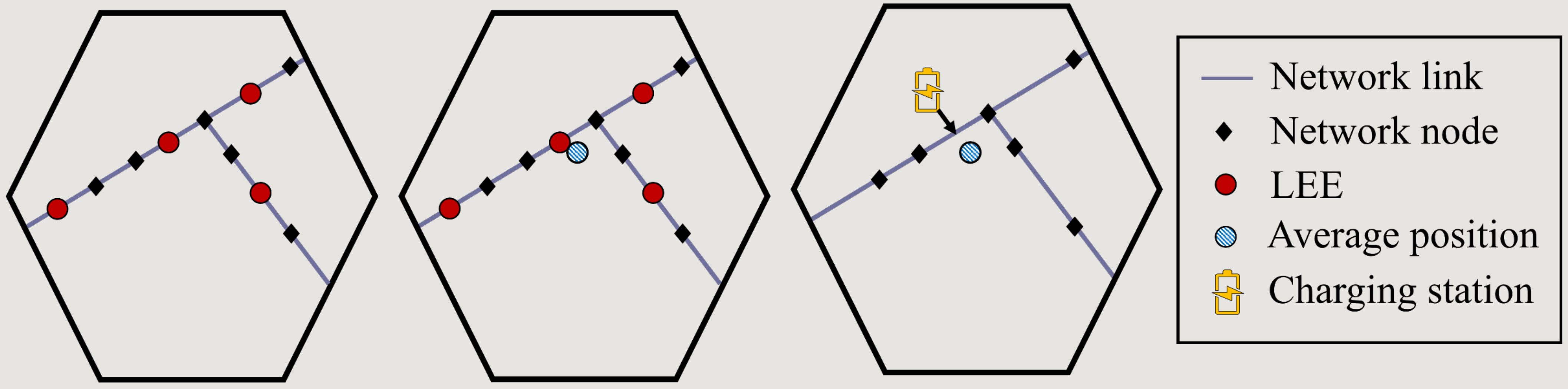


Figure made using tool Via from Simunto

Methodology – Application

Charging station placement

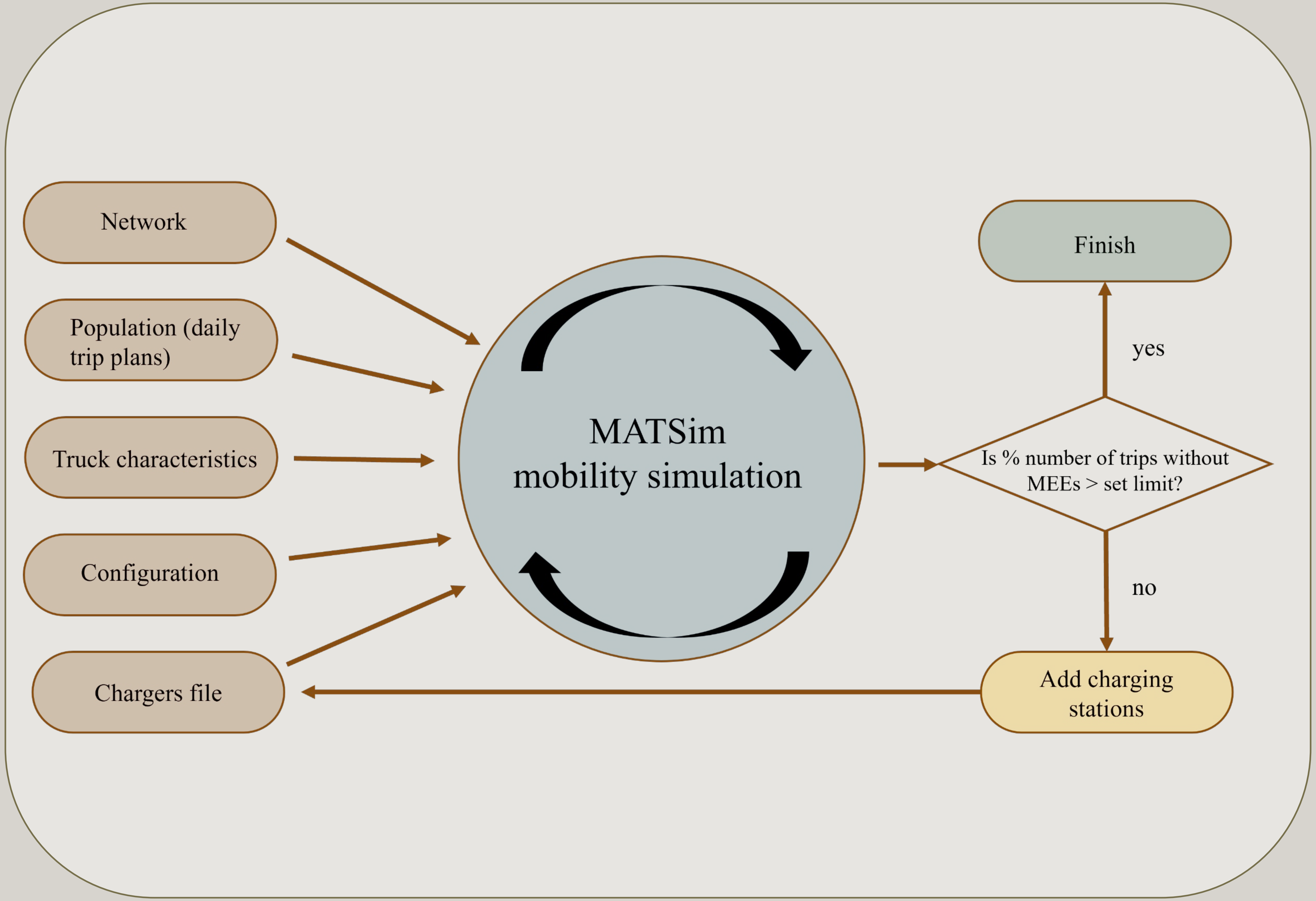
- Count LEEs
- Choose zones with highest LEE intensity
- Find average position of LEEs
- From the average position a charging station is placed at the closest link



a) b) c)

Methodology – Application

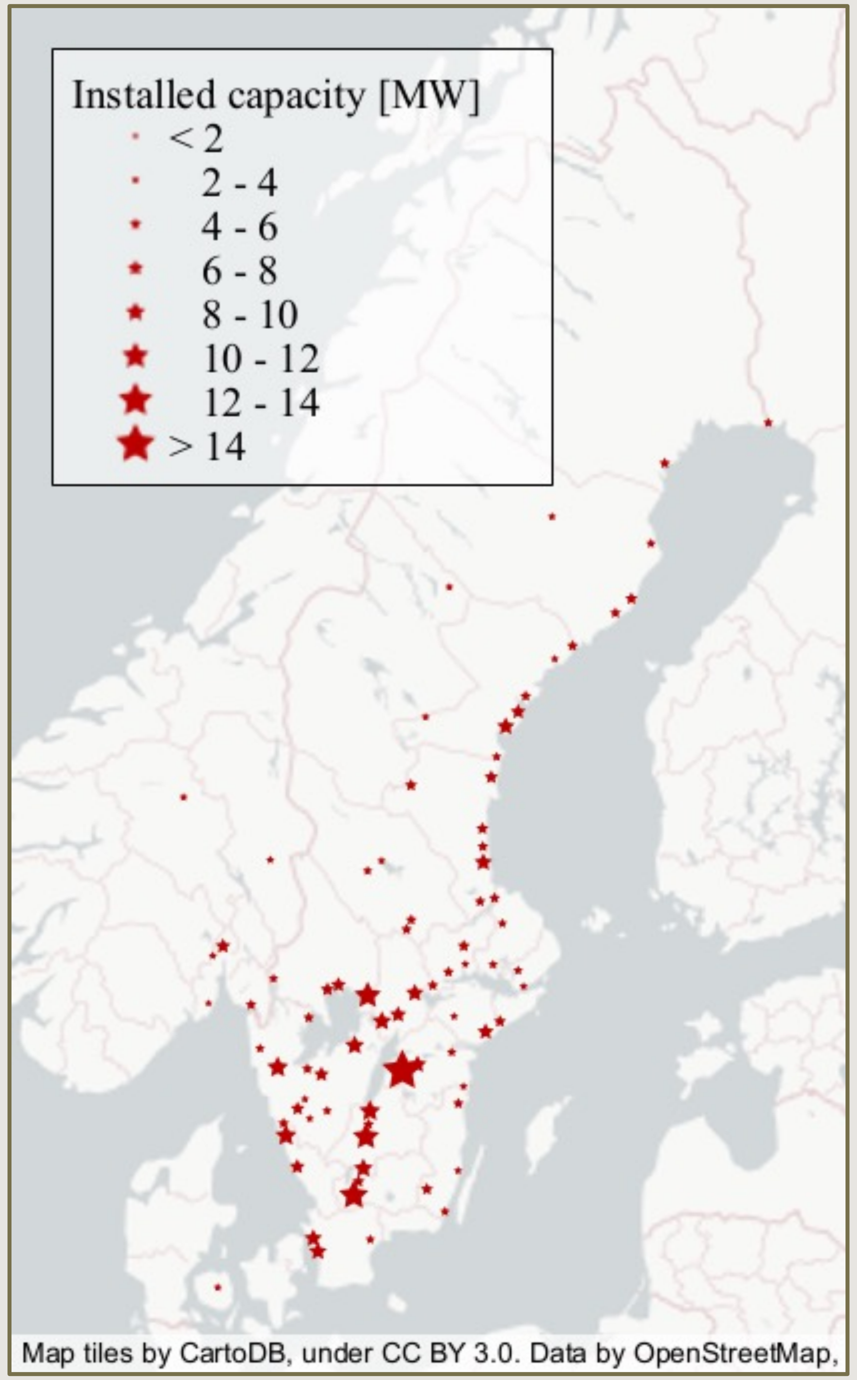
- Charging demand based on OD and detailed energy consumption maps
- Start without any charging infrastructure and add charging stations until desirable electrification coverage has been met



Methodology – Application

Example of resulting charging infrastructure

- Example shows results for long distance long haulage trucks
- Installed capacity satisfying maximum charging demand



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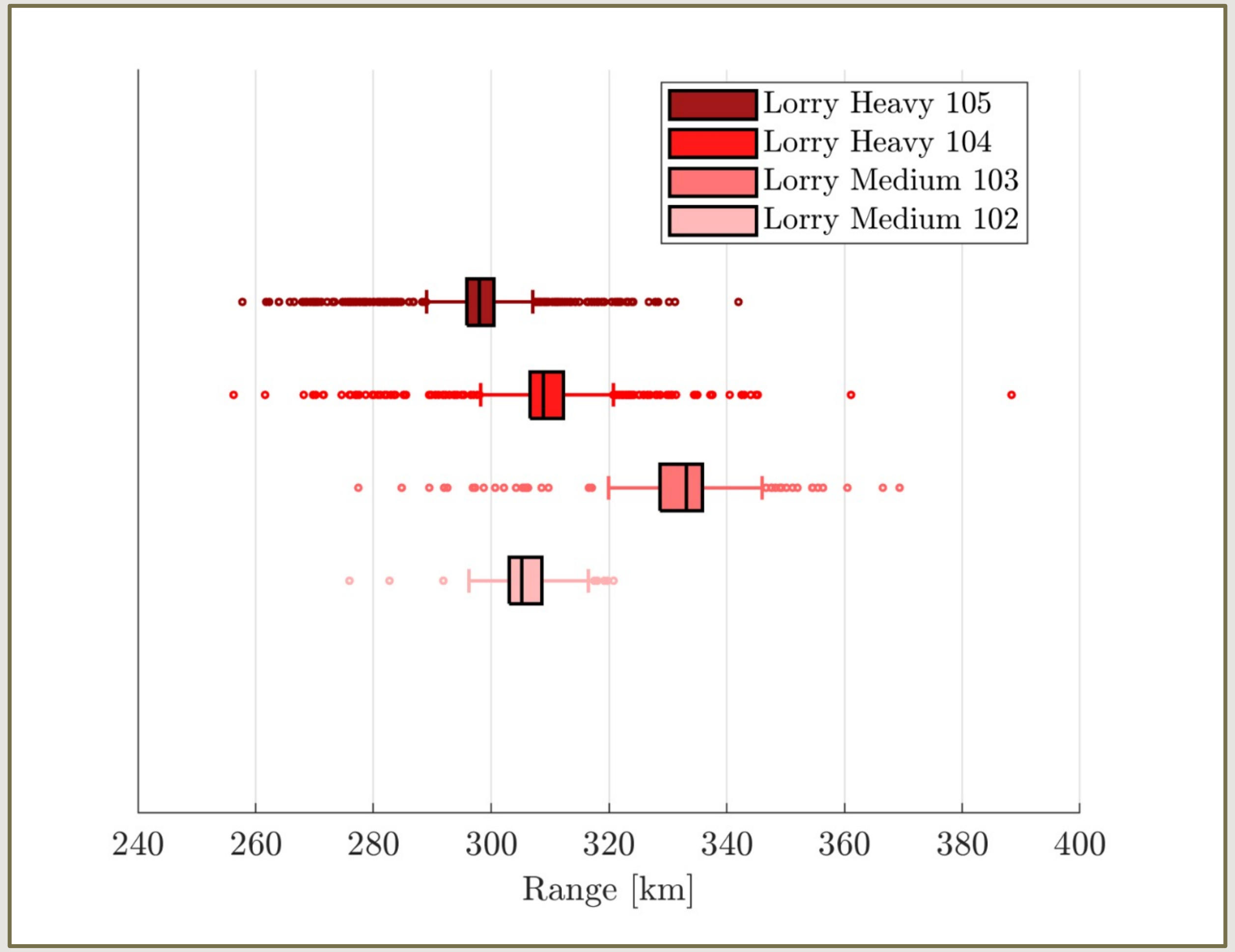
Methodology – Application

Validated using public information regarding typical ranges

RangeCalculatorHandler

- Full charge
- No charging possibility

Range of vehicles based on MEEs



Future work

1. Better estimation of charging time
   - Accurately calculate required energy
   - Use the actual charging curve
   - Consider queueing individually

2. Analyse peak power demand and queueing at charging stations
   - Accurate departure times (freight transport)
     - Accurate time at charging stations
   - Reasonable queuing times
     - Reasonable crowding of charging stations

Thank you for listening!

Questions?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