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An Agent-Based Parking Choice Model

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Motivation: Electric and plug-in-hybrid electric vehicles

Hybrid Vehicles

Toyota Prius

Bigger batteries and el. plug added

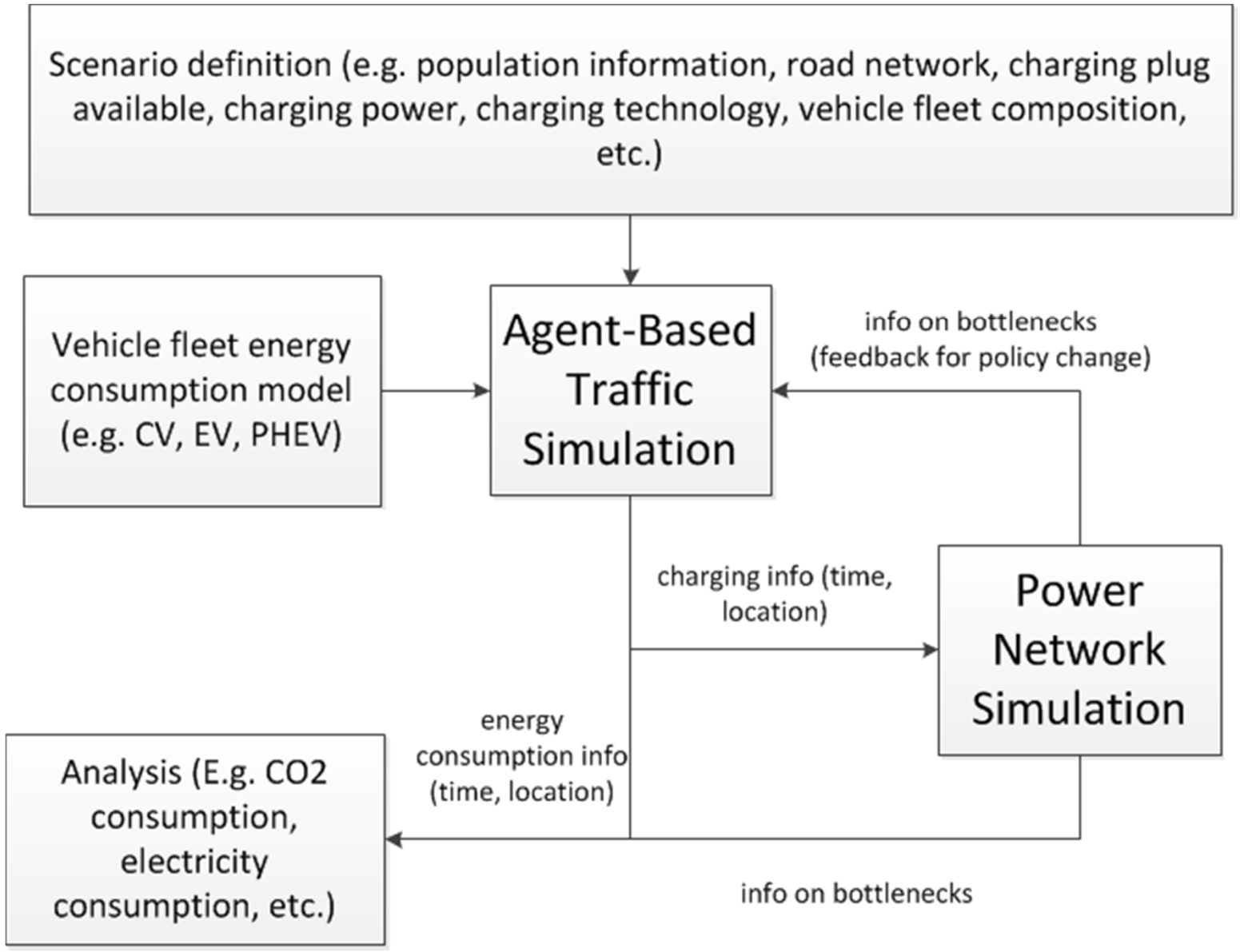
Plug-in-Hybrid Electric Vehicles (PHEV)

Chevrolet Volt

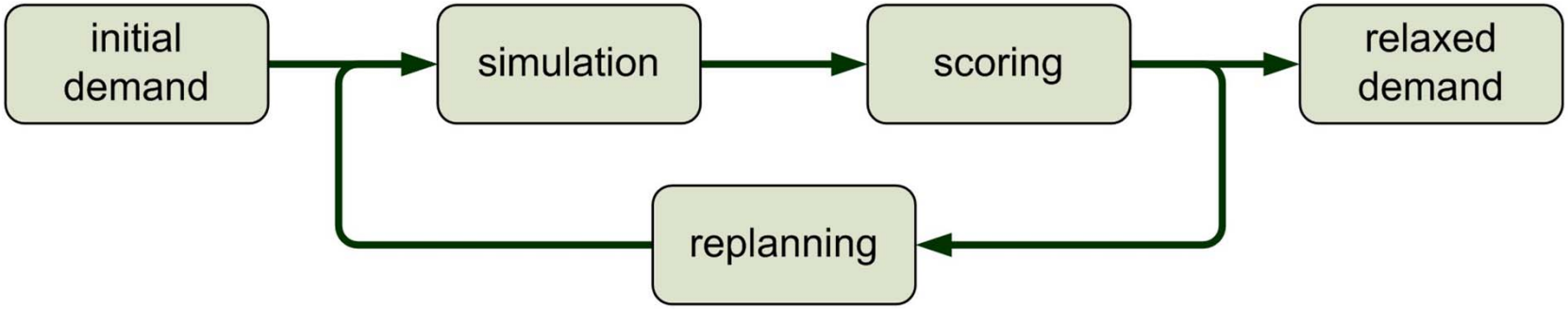
Opel Ampera

[all figures from wikipedia.org]

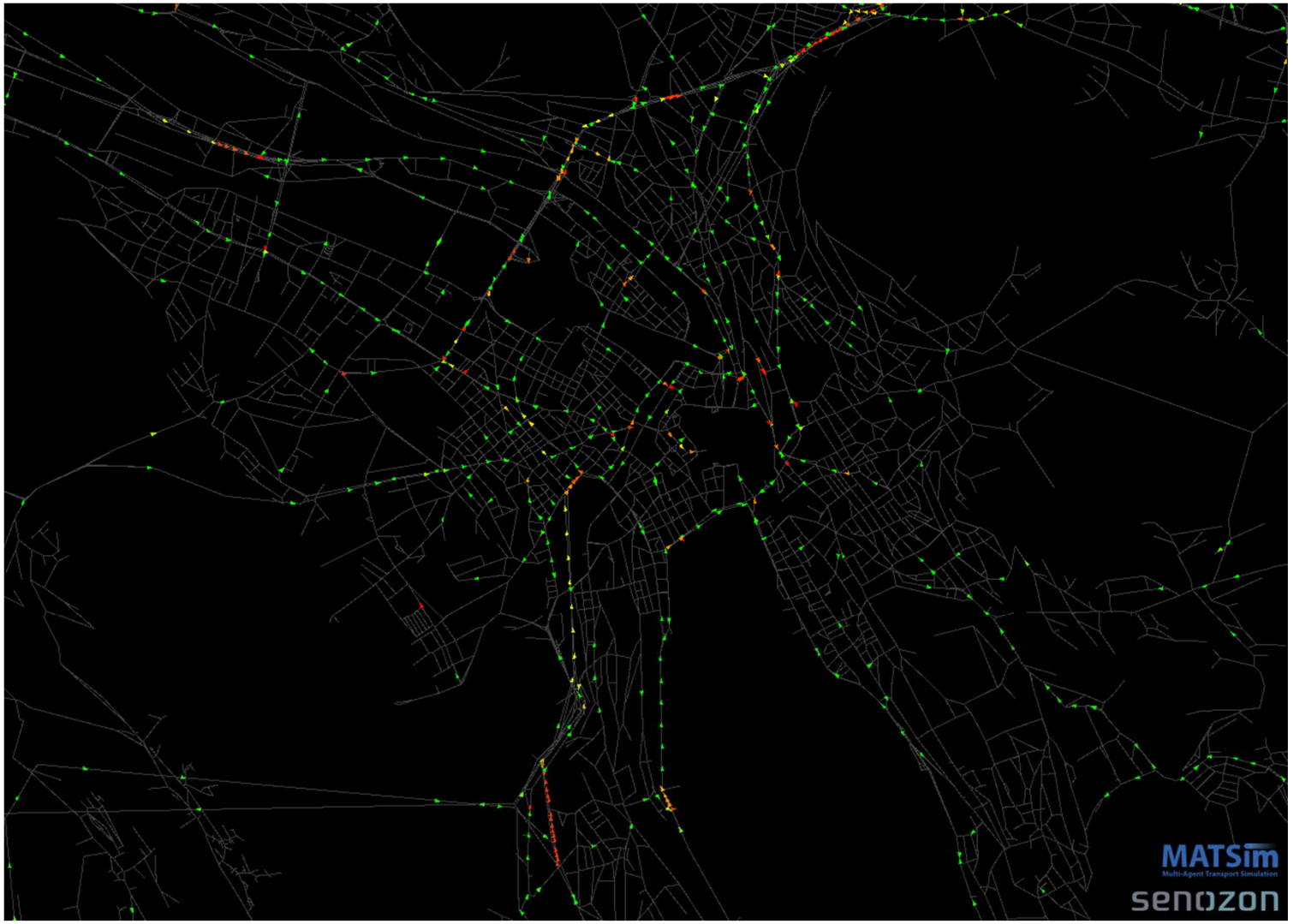
Motivation: Modelling electricity demand



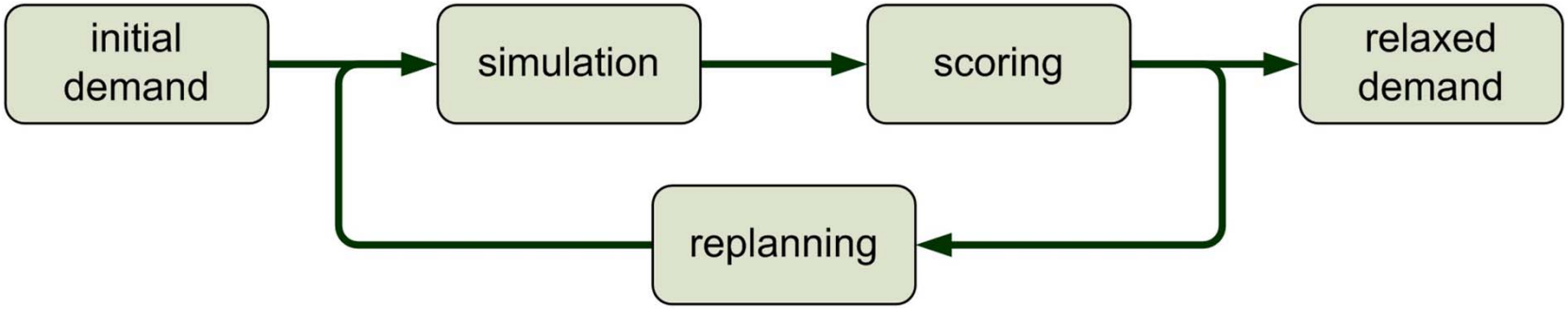
MATSim


initial demand
simulation
scoring
relaxed demand
replanning

Simulation



MATSim


initial demand
simulation
scoring
relaxed demand
replanning

A parking choice model (for MATSim)

Goals of the parking model

- Parking facilities/street parking have limited capacity (simulate occupancy)
- Trade-offs
  - Walking distance
  - Parking cost
  - Extendable to policy/scenario specific criteria, e.g. security aspects
- Modelling different types of parking (private, public, etc.)

- Parking choice vs. parking search

The parking choice model

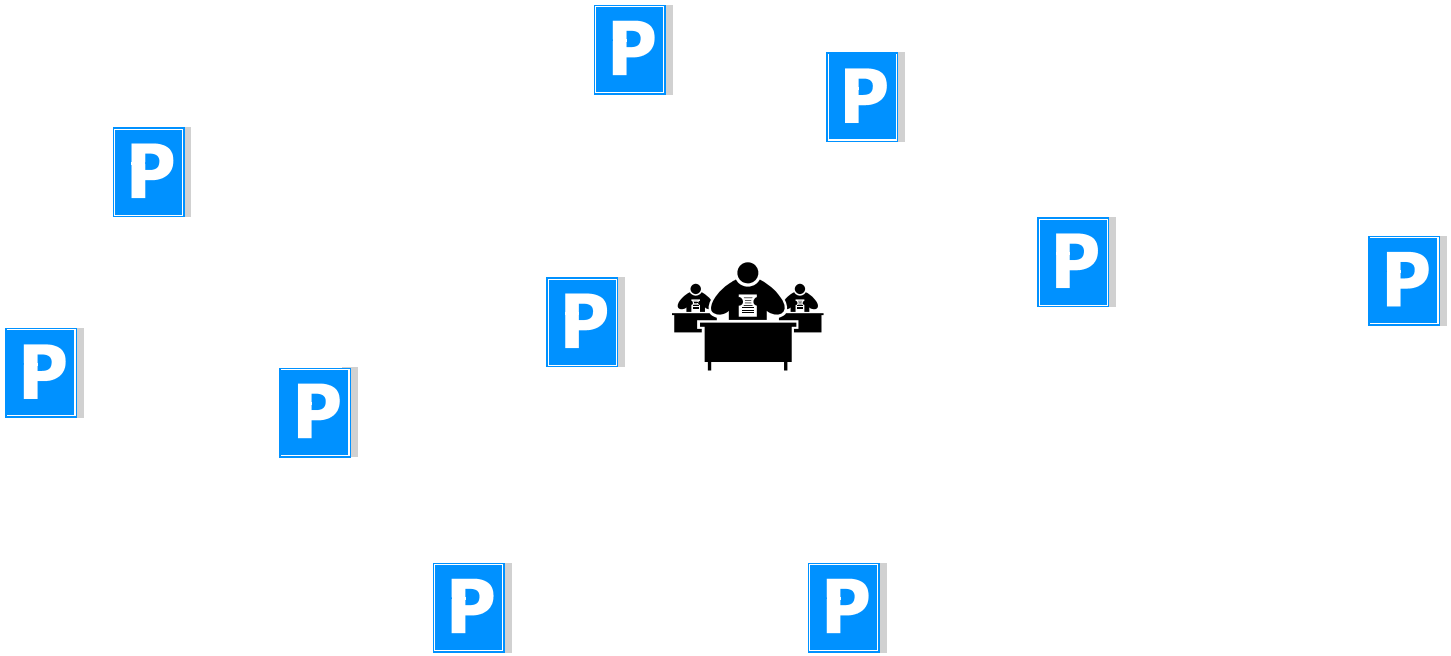
Parking types

- Public parking
- Private parking
- Reserved parking
- Preferred parking

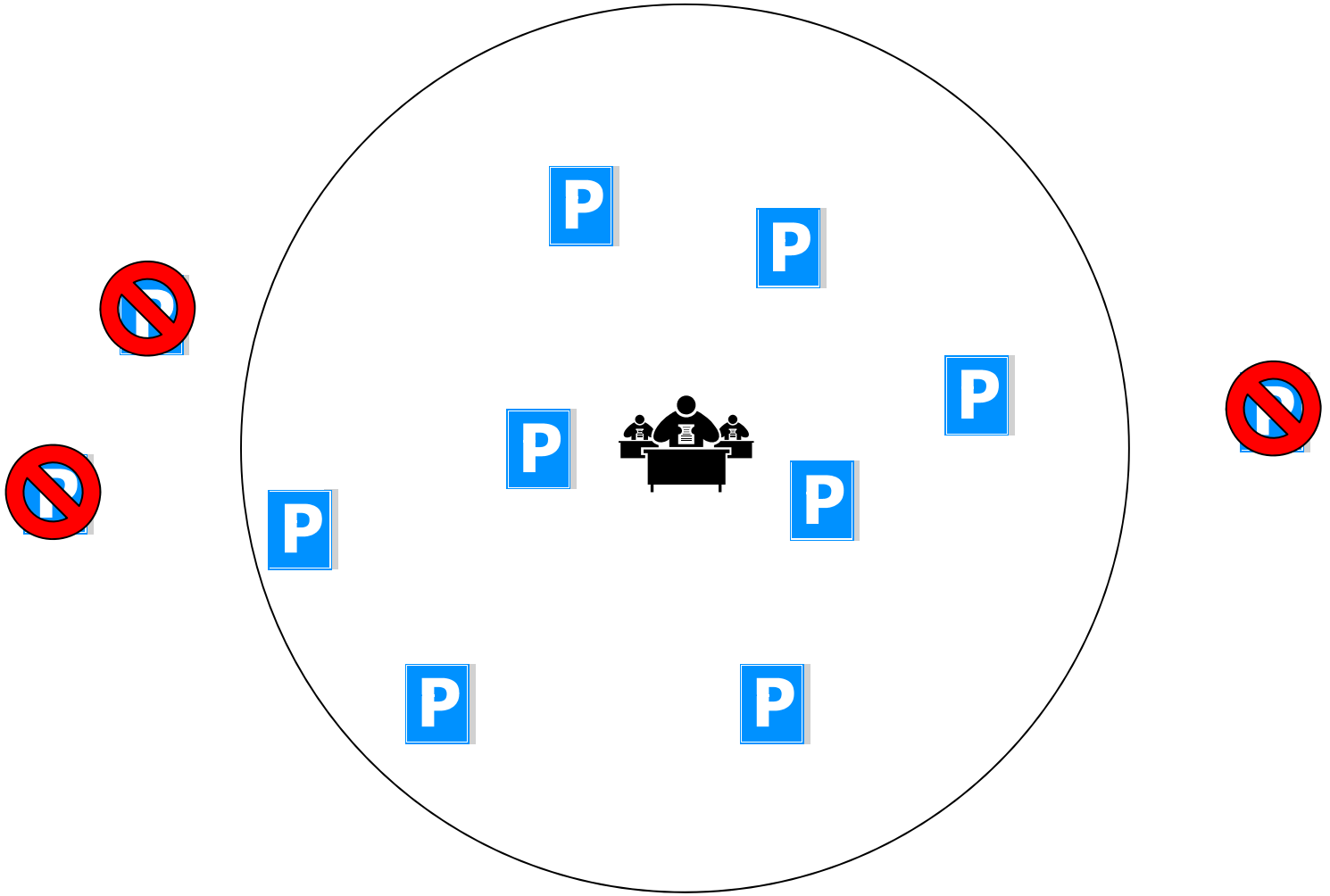
Utility function

$$U_{parking} = \sum U_{walking} + U_{parkingCost} + \cdots (1)$$

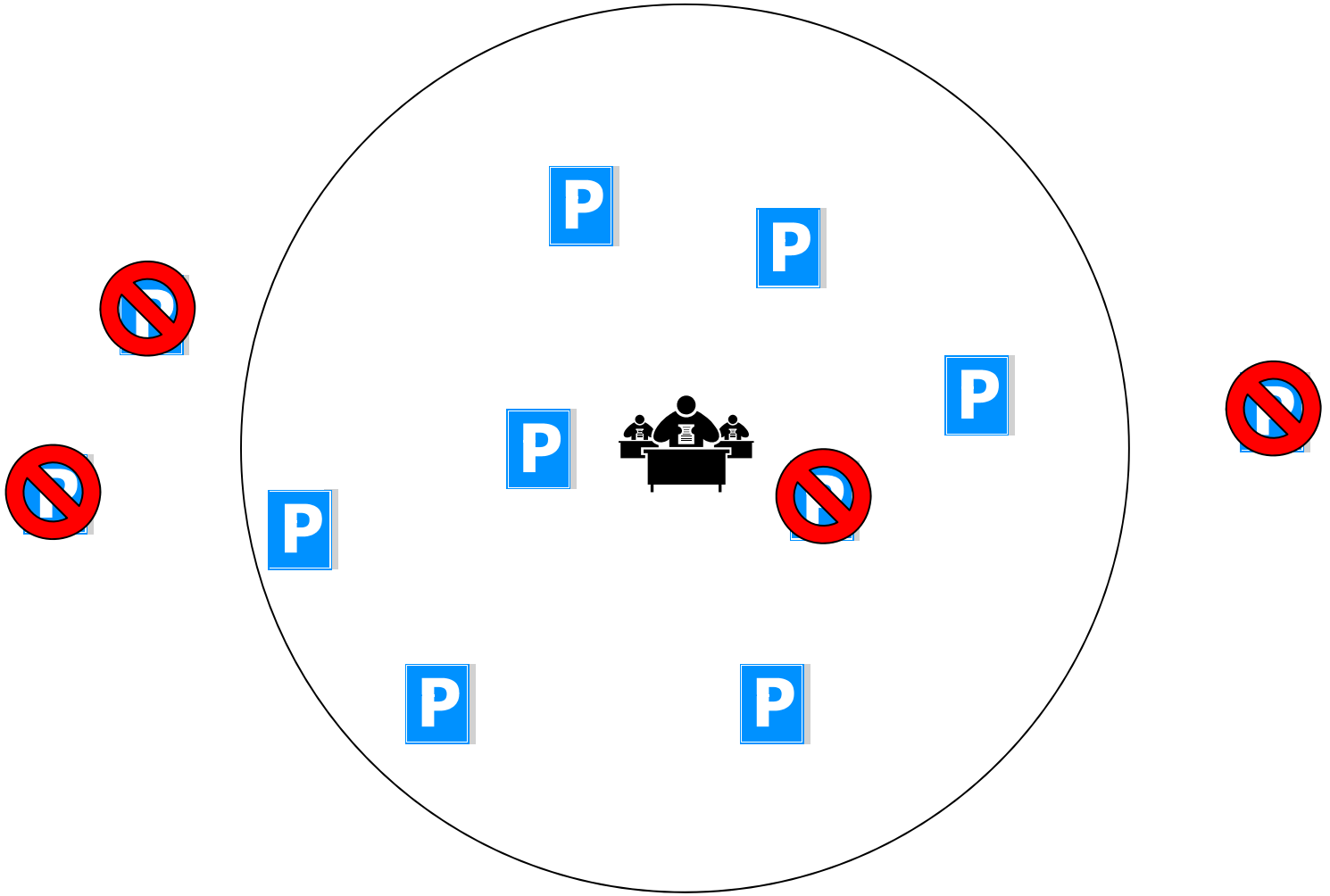
Parking choice algorithm



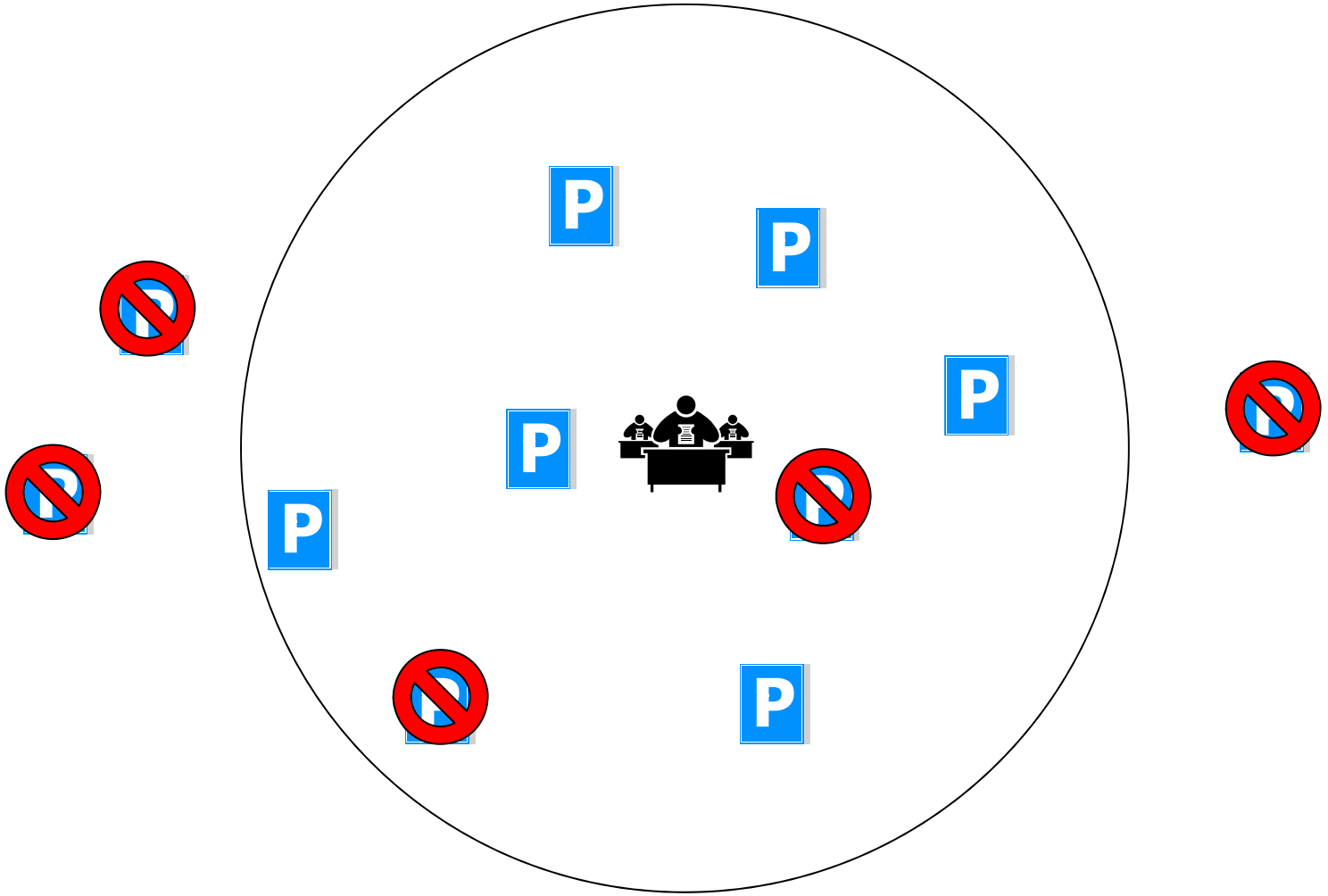
Parking choice algorithm



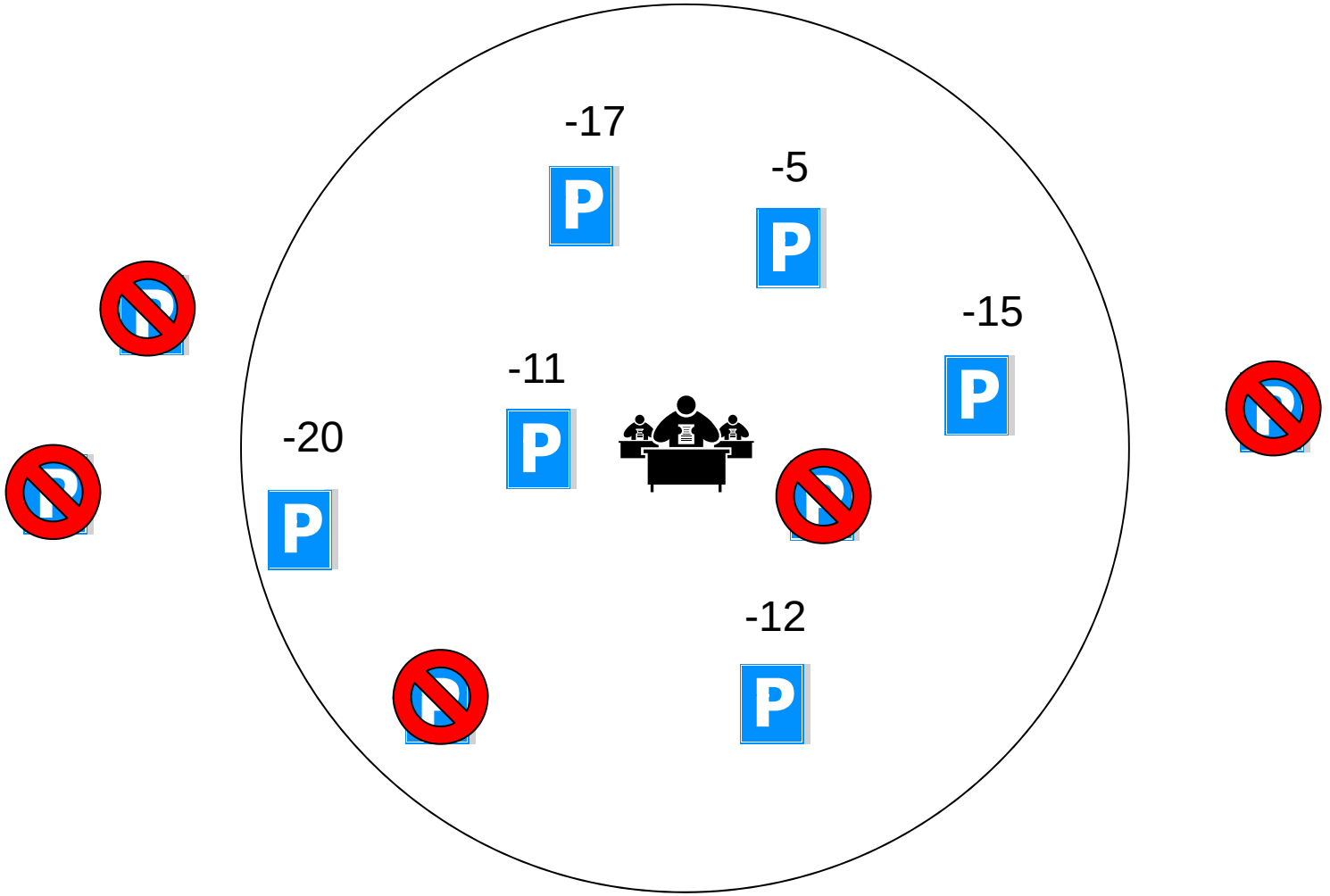
Parking choice algorithm



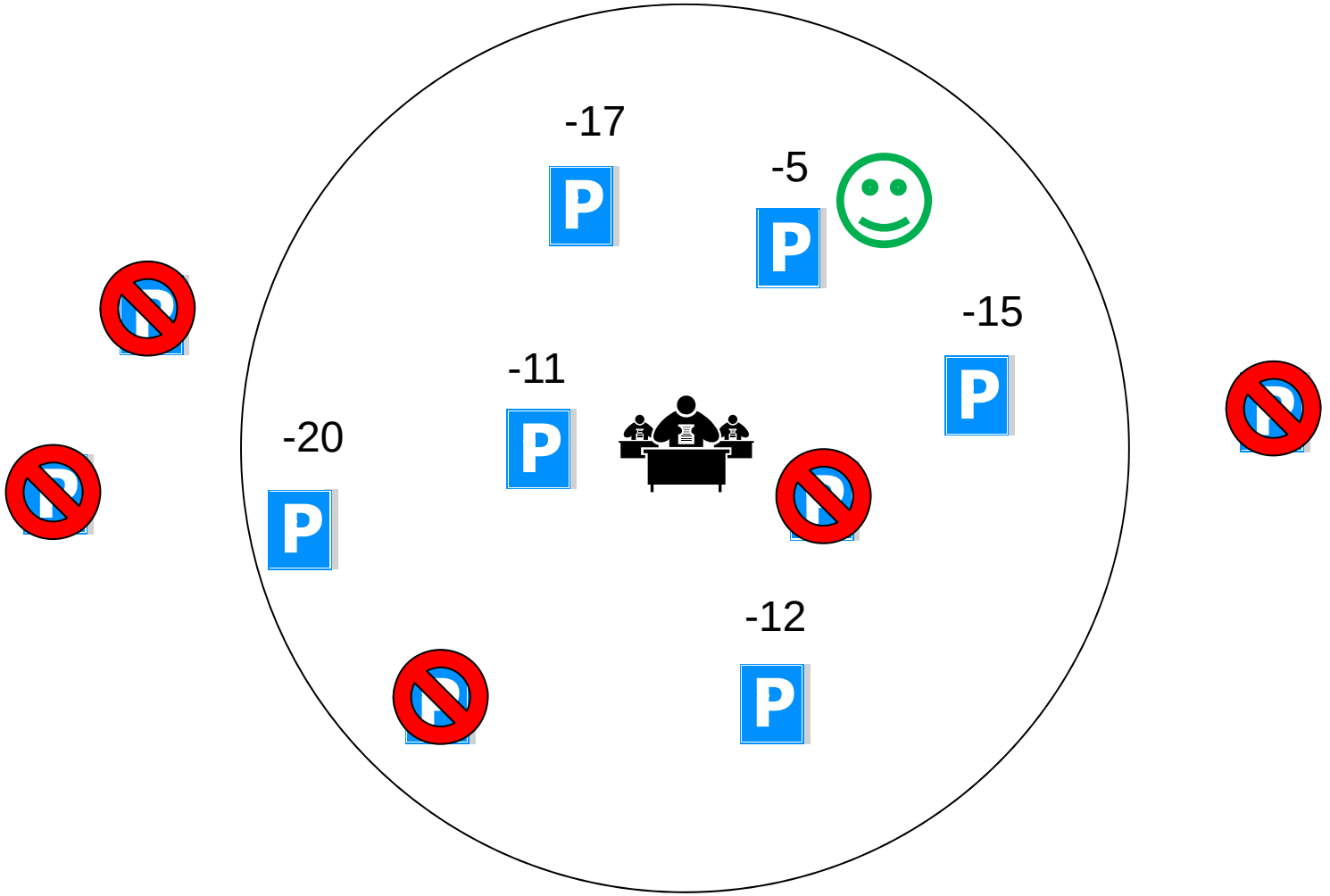
Parking choice algorithm



Parking choice algorithm



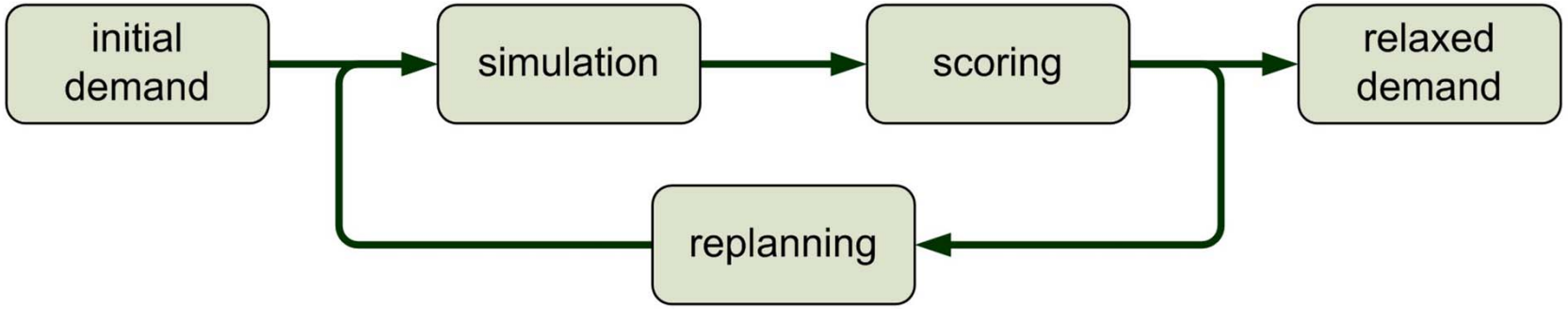
Parking choice algorithm



Feedback to MATSim

Utility score of agent's plan:

$$U_{plan} = \sum U_{travelTime} + U_{travelCost} + U_{performActivity} \cdots + \sum \boldsymbol{U_{parking}}$$



Simulation scenario - Zurich

- Simulation: all of Zurich, 30km around the city centre
- 180’000 and 18’000 agents (10% resp. 1%)
- Modes: car, public transport, bike and walk
- 50 MATSim iterations

[Source: www.wikipedia.org]

Parking infrastructure supply model

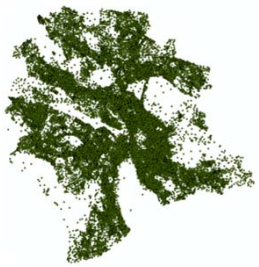
Public Parking

street parking (49’409)

garage parking (16’277)

Private Parking

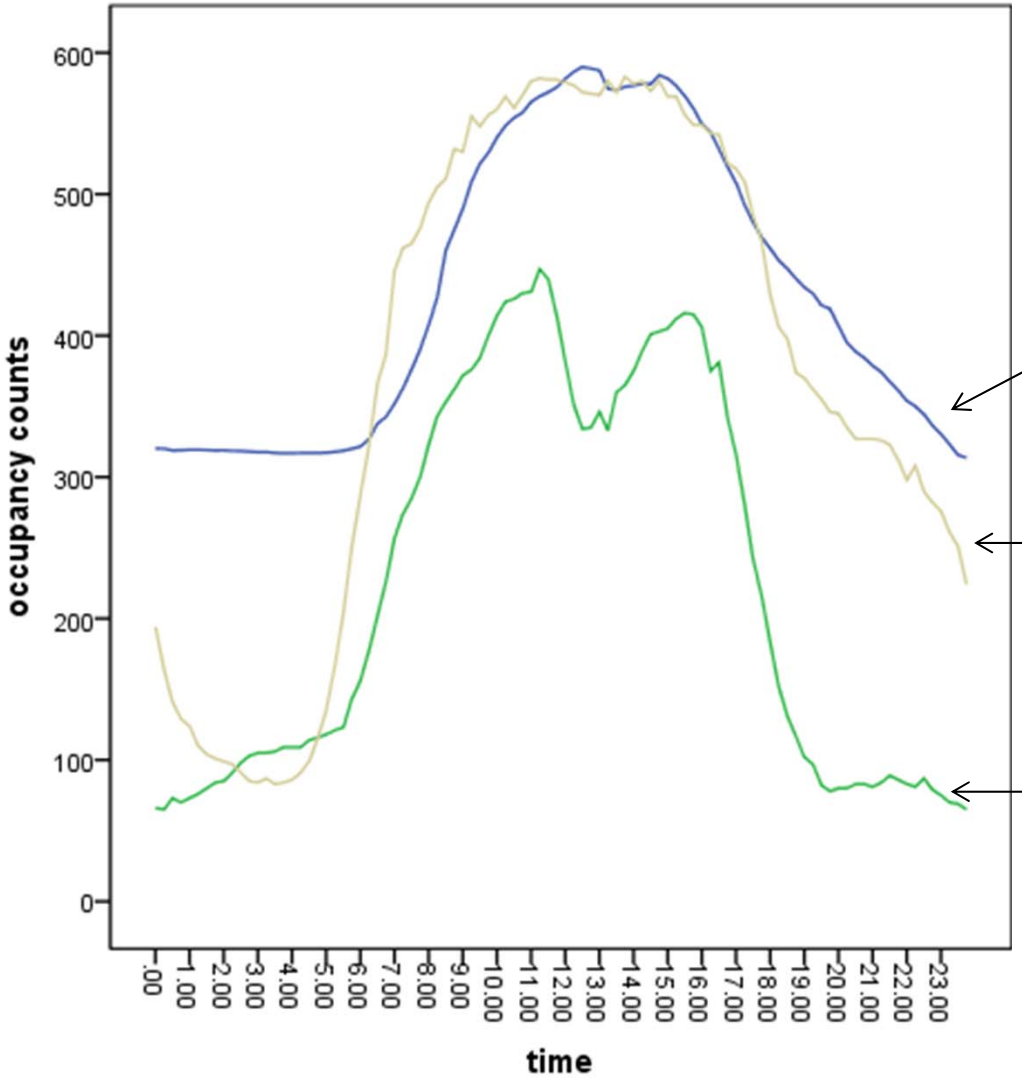
Indoor (118’531)



Outdoor (82’781)

[Parking counts from «Statistisches Jahrbuch der Stadt Zürich 2011»]

Calibration

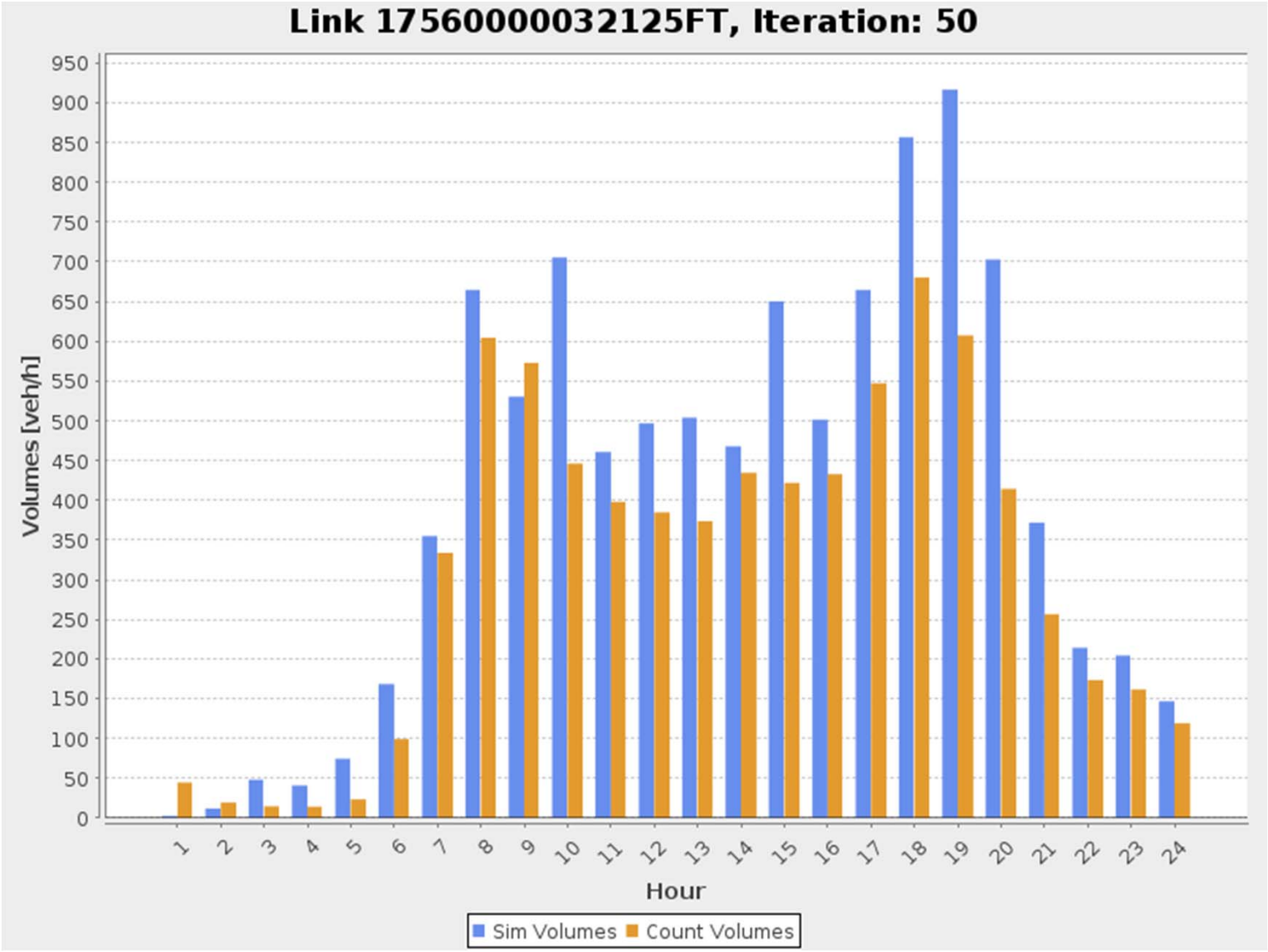


measured counts

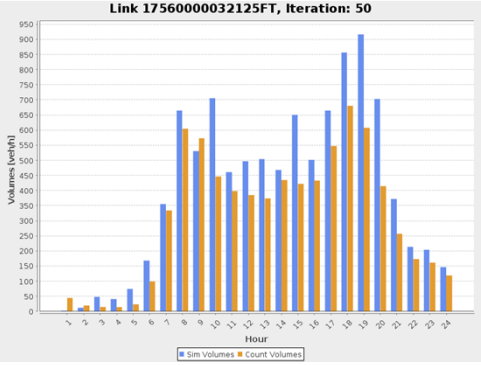
iteration 50

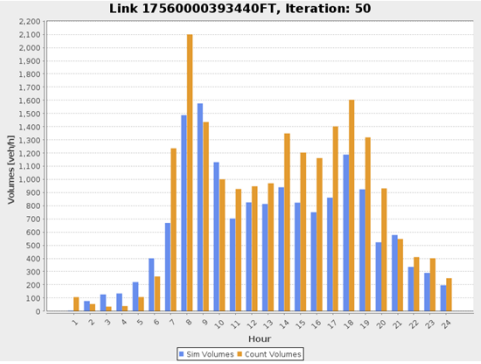
iteration 0

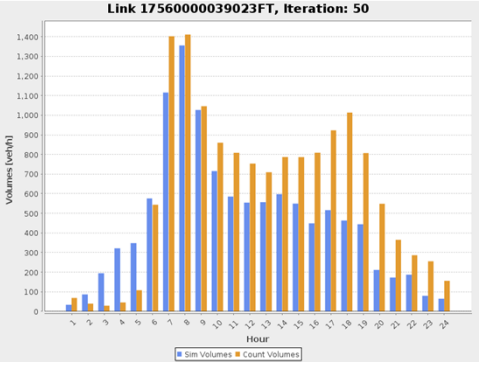
Comparison: Simulation vs. traffic counts

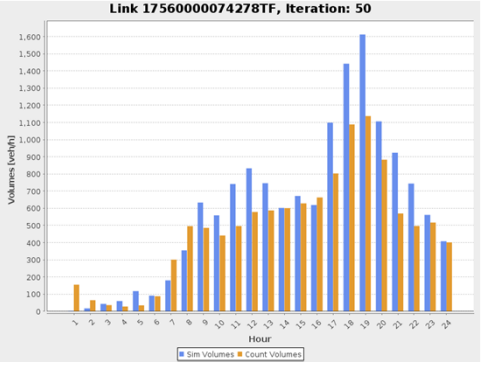


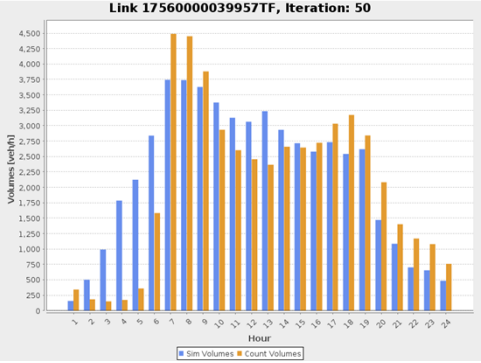
Comparison: Simulation vs. traffic counts (cont.)

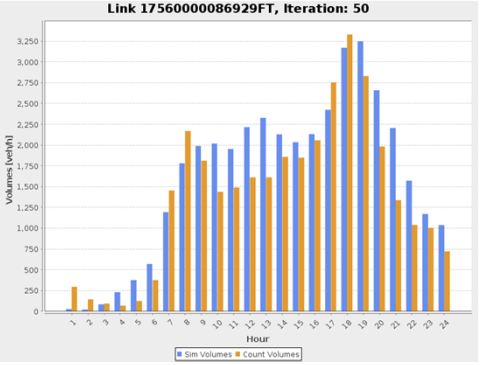












Sensitivity analysis of the parking model

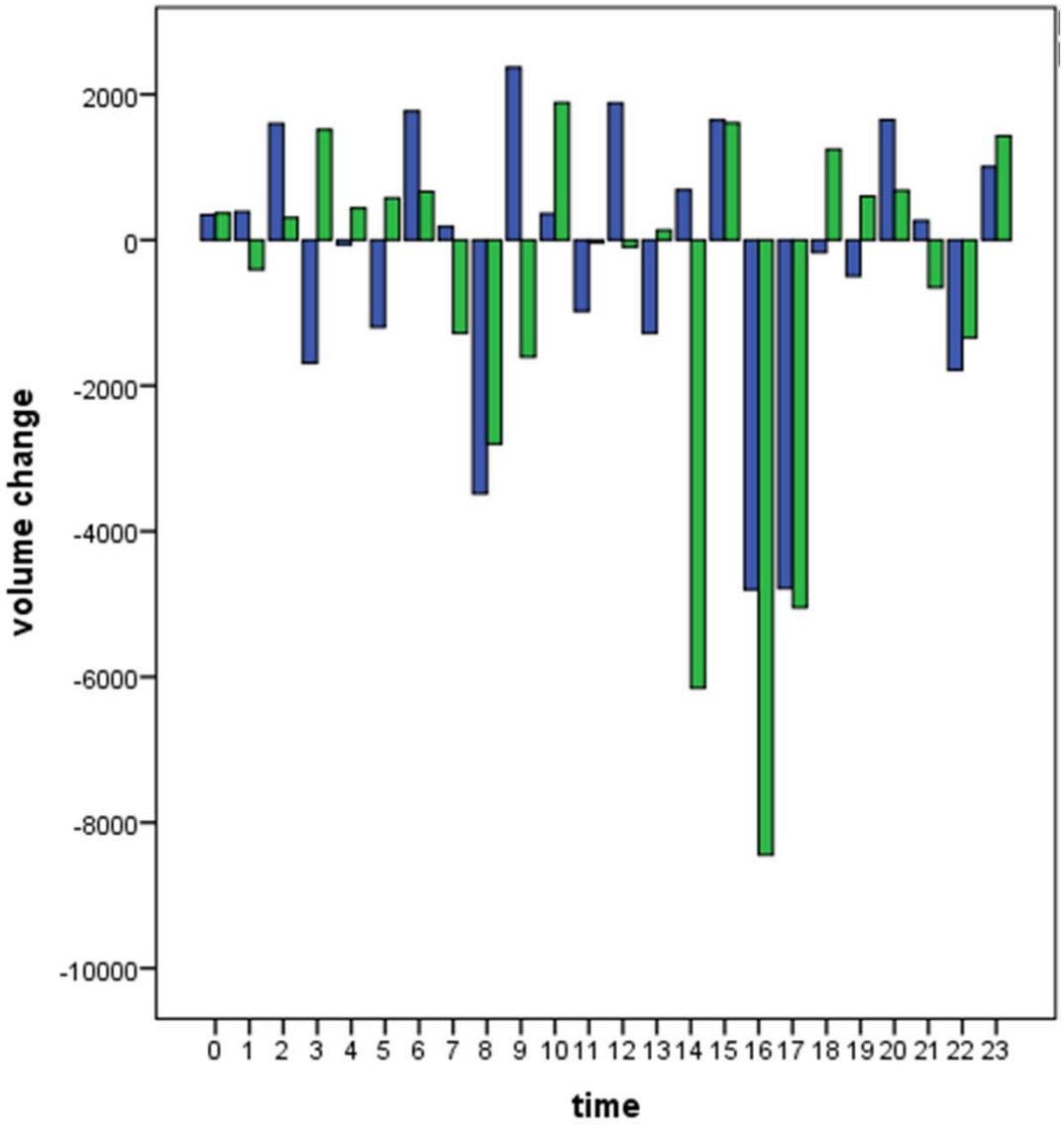
- Sensitive to changes in parking capacity/supply
- Sensitive to changes in price
- Walking distance distribution also plausible results

Sample parking policy

- Goal: reduce traffic on links with highest traffic volume during evening peak hours (16:00 to 19:00)
- Approach:
  - Identify high volume links (top 10%)
  - Identify agents traveling on these links
  - Identify activity location of previous and next activities
  - Identify clusters of activities
  - Reduce parking capacity in clusters by 30% resp. 100%

- Alternative goal:
  - Select not highest volume, but most congested links during peak hour

Sample parking policy - experiment



green: 30% reduction

blue: 100% reduction

Conclusions & future work

Conclusions

- Parking choice model
- Simulations with around 180’000 agents
- Can be used to design and test policy changes
- Improved simulation for electric vehicles

Future work

- Overall improvements
- Parking search

Questions?