SAEV Modeling Framework

**Trip Generation**
- Use local travel demand model data to generate trips to simulate origin-destination travel demand

**Charging Station Generation**
- Charging station site selection to ensure sufficient infrastructure coverage

**SAEV Fleet Generation**
- Determine the necessary fleet size to serve travel demand

**Operation**
- Continuous daily operation based on the station and fleet configuration
SAEV Simulation Implementation

**Pixelated Network**
- Discretized network (0.25x0.25 mi cells)
- Restricts vehicle movement to Manhattan grid
- Vehicle moves to adjacent cell in discrete 5 min intervals
- Faster run time due to discretization (of space and time)

**Street-level Map**
- Map data to construct nodes and links
- Latitude & longitude are transformed to Cartesian coordinates
- Origin & destination positions are mapped to the nearest node using nearest-neighbor search (NNS)
- Slower run time due to continuous real-time operations
Vehicle & Infrastructure Impacts (1)

Fast charging infrastructure & longer range vehicles reduce required fleet size.

Fleet Size by Vehicle & Charging Infrastructure Type
(SAEV door-to-door w/o ridesharing)
With ridesharing, longer range SAEVs consistently require smaller fleet size no matter the vehicle capacity.
Short range SAEVs incur more zero occupant miles due to more frequent trips to charging stations (w/o ridesharing).

VMT by Vehicle & Charging Infrastructure Type (SAEV door-to-door w/o ridesharing)
For scenarios with ridesharing, short range SAEVs’ impact on zero occupant miles is consistent.

- “Empty” VMT comprises 13-16% of total VMT for SR SAEV scenario and 9-11% for LR SAEV scenario.
- Assuming all travelers are willing to participate in ridesharing, about 35% of all vehicle miles traveled include at least two passengers.
Short range SAEVs reduce operation costs (per occupied mile traveled) assuming flat rate electricity pricing.

Cost per Occupied Mile Traveled
(With Ridesharing & w/o Ridesharing)
SAEV-Grid Interaction

• If SAEVs provide transportation services to 10% of the 2017 transportation demand in the Seattle region, the estimated total electricity consumed by SAEV is 2500 MWh per day.

• At 100% market penetration, this would represent a ~20% increase in regional electricity consumption.
Unmanaged SAEV charging exhibit peak charging periods which coincide with existing peak hours of electricity use.
With increased battery capacity, LR vehicles exhibit superior ability to avoid charging on-peak. Compared to unmanaged charging, electricity costs can reduce 10% (SR SAEVs) to 34% (LR SAEVs).
Under **real time electricity pricing** scheme, **LR vehicles** are able to decrease electricity cost by 36 to 43% compared to SR vehicles with smart charging.
SAEVs: Key Findings

• Many different ways for SAEVs to impact the future of urban mobility and energy.

• As a mobility service competing with private vehicle ownership:
  • One single occupant SAEV can replace 4 to 7 privately owned vehicles with 7-14% zero occupant miles.
  • One SAEV with dynamic ridesharing can replace 8 to 13 privately owned vehicles with 9-16% zero occupant miles.
  • SR SAEVs require larger fleet sizes and induce greater zero occupant miles compared to LR SAEVS.

• Interacting with the electric grid:
  • Unmanaged charging ("charge as needed") of SAEV fleets will increase evening peak electricity use.
  • LR SAEVs are more responsive to smart charging compared to SR SAEVs, and are able to decrease electricity costs 30-40% in TOU and RTP pricing scenarios.
Thank you for your time!