Locating Future EV Charging Infrastructure

a Network Optimization Approach

Scott Robinson, and Vivek Nath
Navigant Consulting

https://tinyurl.com/EVmapAESP
Challenges of vehicle electrification for planning

1. Location
2. Timing
3. Size
4. Shape

Web Application
Challenges of vehicle electrification for planning

1. Location
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Methods – Road Network

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Web Application

Annual Conference 2019
Methods - Traffic

1. Annual average daily traffic (AADT) associated with nearest road segment

2. AADT converted to vehicle miles traveled (VMT) using segment length
Methods – BEV Penetration

1. Zip code forecast of vehicles on the road calculated in VAST™, a systems dynamics technology diffusion model built in R

2. Zip codes matched to ZCTA’s, and light duty market share by powertrain dissolved over the Philadelphia metropolitan statistical area (MSA)

3. VMT converted to BEVMT by multiplying by the MSA BEV market share: public chargers are shared by traffic within the MSA
Methods – GIS Network Optimization

Location allocation problems: "Location is often considered the most important factor leading to the success of a private- or public-sector organization" ESRI 2019

Minimize Facilities
Maximize Coverage
Target Market Share

Methods – GIS Network Optimization

Location Allocation

- Conducted in ArcGIS Network Analyst
- Algorithm selects **facilities** to supply **demand points** efficiently
- Involves selecting facilities from potential candidate locations, and allocating demand to facilities according to a set criteria

Methods – GIS Network Optimization

Target Market Share

- Solves the competitive facility location problem
- Chooses location and minimum number of facilities to reach a specified target market share - this translates to choosing the minimum number of EV charging stations to meet a specified share of EVMT (electric vehicle miles traveled) demand
- Uses gravity model concepts to determine demand allocation to each facility

\[
P_{ij} = \frac{S_j}{\sum_j S_j} \frac{T_{ij}^\lambda}{T_{ij}}
\]

- \( P_{ij} \): Probability of a consumer at point \( i \) travelling to location \( j \)
- \( S_j \): Size of location \( j \)
- \( T_{ij} \): Travel time from consumer at point \( i \) to travel to location \( j \)

Results – BEV Traffic Allocation Example

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Existing EV Charging Station

New Charging Station
1. New station locations are primarily in suburban areas

2. Gravity algorithm + target market share strategy prioritizes high BEV growth areas

3. Significant clustering of EV stations exists (not societally optimal)
Conclusions & Next Steps

- Understanding where public chargers will be needed is important for utilities, regardless of ownership of these assets.
- Will future siting be optimal? - *Dependent on the owner*
- Is current siting optimal? - *No, but maybe increasingly so*
- Adding in the time dimension - *Station roll out is more complex than just adding more chargers*
- Locational load forecasting - *Join EVSE loadshapes to stations by station, use case, and charger type*
Questions?

See the supporting data in the online interactive map: https://tinyurl.com/EVmapAESP