Michigan Agency for Energy
Michigan Energy Office

STAKEHOLDER ENGAGEMENT MEETING
Electric Vehicle Charger Placement Optimization in Michigan

June 26, 2018
1:30-3:00 PM

Agenda

- Welcome
- Opening Remarks (Michigan Energy Office)
- MSU Project Team Presentation
- Discussion
- Questions

Electric Vehicle Charger Placement Optimization Project

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MICHIGAN STATE UNIVERSITY

June 26, 2018

Acknowledgement

This study is commissioned and funded by the Michigan Energy Office.

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Michigan Energy Office

Problem Statement

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- Find the optimal infrastructure investment to support electric vehicle travel:
  - **Where** to deploy charging stations?
  - **How many** charging outlets must be built at each station?

- The modeling framework considers:
  - EV trip feasibility
  - Minimizing charging station investment cost
  - Minimizing travelers delay including:
    - Charging time
    - Queuing delay time
    - Detour time

- The results presented here do not include tourism and seasonal variation results. Those are the next steps of this study.

System Operational Assumptions

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Battery size: 100 kWh (Average of all EVs in the market)

Confident range = 0.8 [1] (Travelers would recharge when the battery is depleted 80% of its capacity.)

Charging efficiency = 1.3 [1] (Converting energy/power ratio to charging time accounts for waste of energy while charging)

Reduced battery (Reduced battery capacity in Winter temperatures)

Performance = 70% [2]

Battery charging limit = 0.8 [1] (Users charge their vehicle up to 80 percent of its capacity as charging speed decreases significantly after this point)

Charger power = 50 kW [3] (Current average power in fast charging facilities)

Value of time = $18/h [1] (Based on users' willingness to pay)

Total demand = 2,979,998 [4] (Number of intercity trips between major cities in the state of Michigan (per day))

Major city: Any city which has a population more than 50,000.

[1] *Source: Ghamami, M., Zockaie, A., & Nie, Y. M. (2016). A general corridor model for designing plug-in electric vehicle charging infrastructure to support intercity travel. Transportation Research Part C, 68, 389-402*

[2] *Source: https://www.energy.gov/eere/electricvehicles/maximizing-electric-cars-range-extreme-temperatures*

[3] *Source: Discussion with stakeholders.*

[4] *Source: Michigan Department of Transportation origin-destination travel data .*

System Operational Assumptions

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- Market share of electric vehicles
  - *Currently assuming 3% and 6% growth for 2030*
  - *Should we test 2020, 2025 and 2030?*
- Battery type
  - *Currently 100kwh with 2.5 mile/kwh*
  - *Does this sound reasonable?*
- Battery performance in Summer and Winter
  - *Currently 70% capacity in winter*
  - *Does this sound reasonable? Is the capacity affected by A/C during Summer?*
- Charging stations
  - *Currently charging efficiency is assumed to be 1.3 and charging powers of 50kw and 150kw are being tested*
  - *Are there any other factors that should be considered for charging performance?*

Reference Road Network

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- A sketch road network for the state of Michigan.
- Major cities and interstate highways

Scenario 1: Rapid market growth

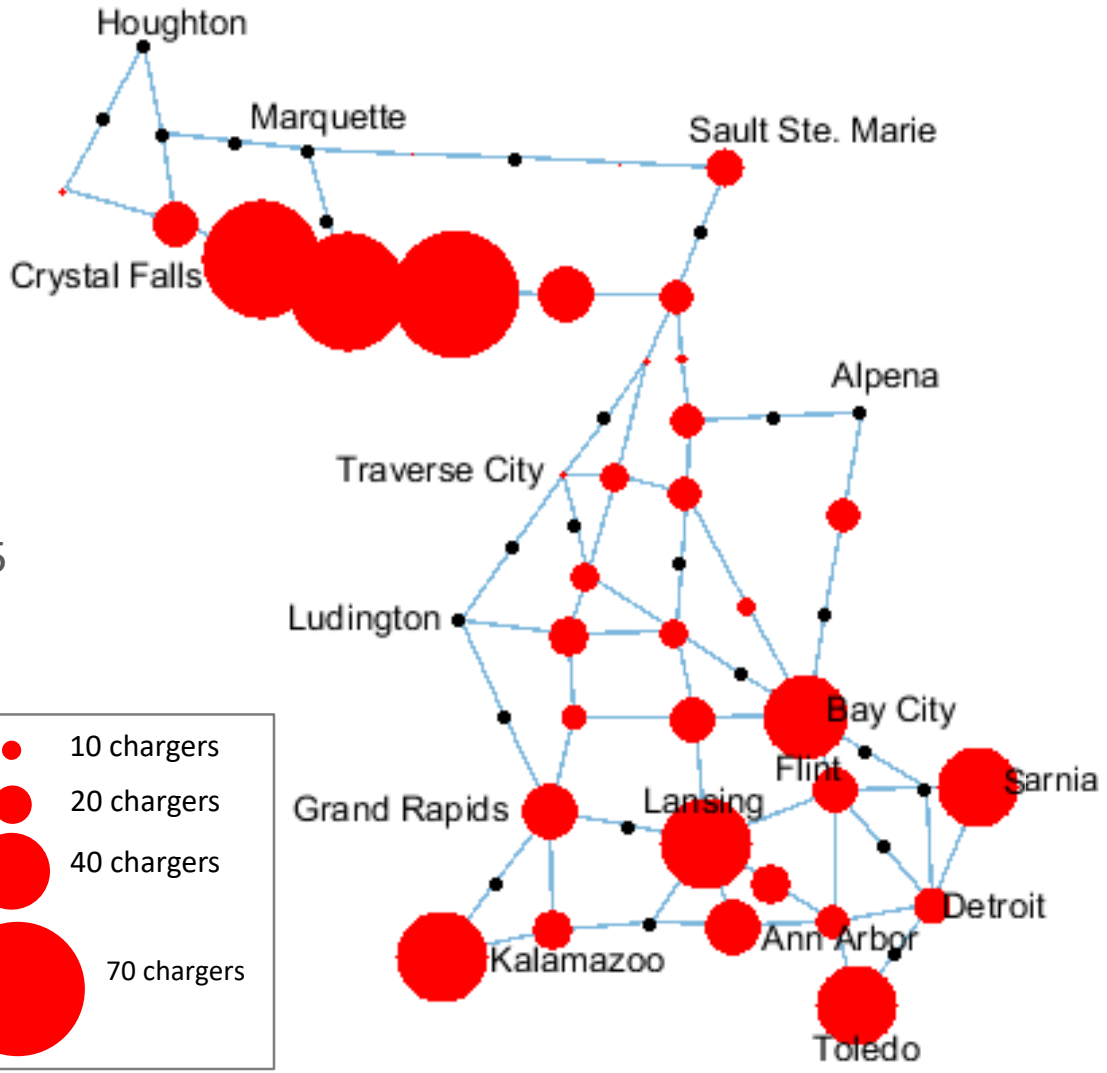
Assumptions

EV market share: 6%

EV trips: 178,784 (per day)

Results

- Number of Stations= 35
- Number of Chargers= 870
- Electricity provision cost= $3,793,695
- Land acquisition cost= $1,640,956
- Cost of chargers= $21,750,000
- Total cost= $27,184,651
- Total locational revenues= $609.12M



Scenario 2: Slow market growth

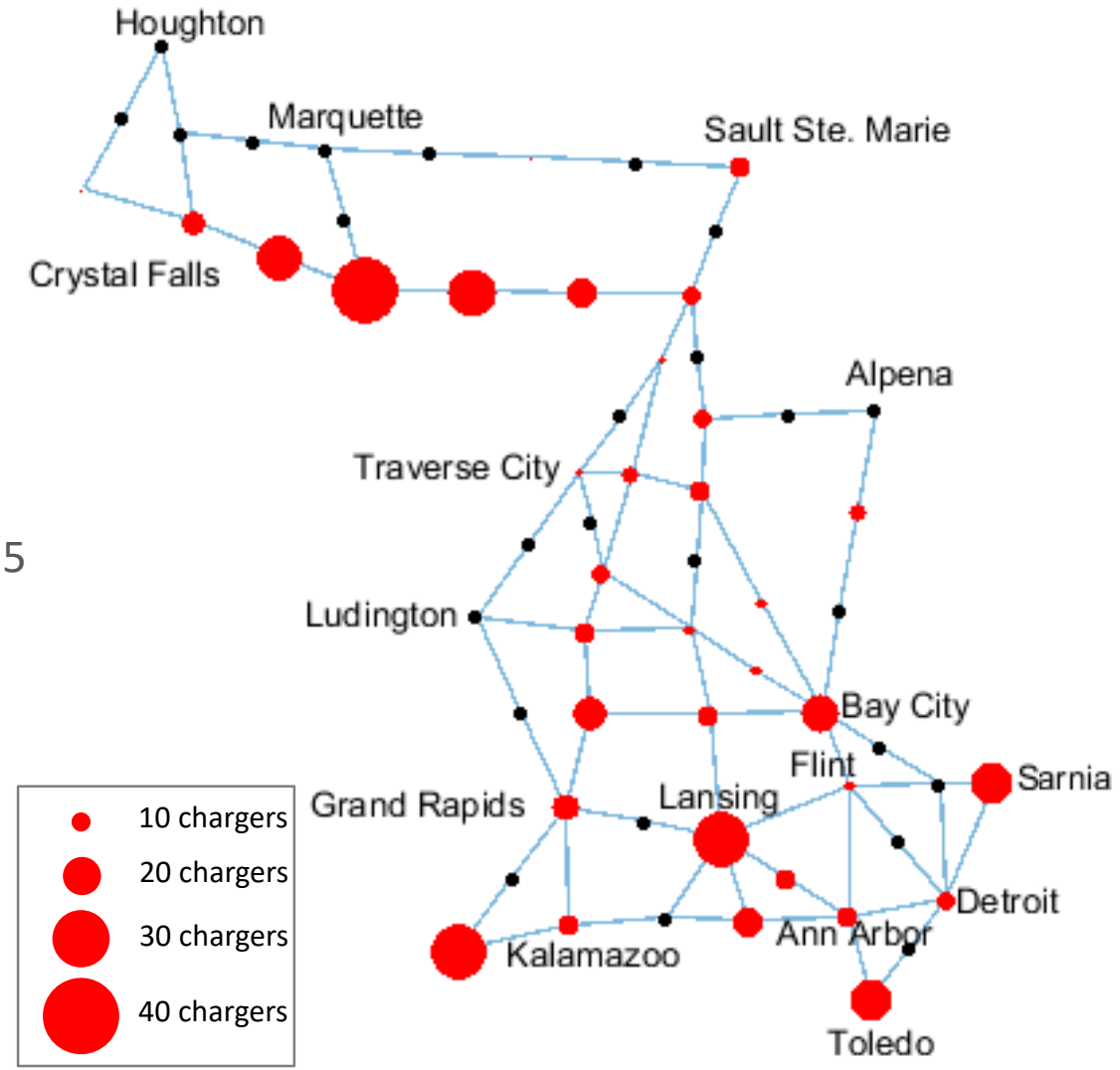
Assumptions

EV market share: 3%

EV trips: 89,392(per day)

Results

- Number of Stations= 34
- Number of Chargers= 434
- Electricity provision cost= $3,622,025
- Land acquisition cost= $816,923
- Cost of chargers= $10,850,000
- Total cost= $15,288,947
- Total locational revenues= $306.75M



Thank you!

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