MICHIGAN ENERGY OFFICE

Electric Vehicle Fast Charging in Michigan Communities: EV Charging Placement Optimization

7109 W. Saginaw Hwy
Lansing, MI 48917

December 19, 2018
8:00 AM – 12:00 PM

Agenda

- Welcome & Introductions
- Background
- EV Charger Placement Optimization in Michigan
- Next Steps
- Questions

Electric Vehicle - Terminology

Plug-in Hybrid EV (PHEV) – Powered by internal combustion engine and electricity from external power source

Hybrid (HEV) –Powered by ICE and alternator or regenerative braking

Battery EV (BEV) – Powered 100% by electricity from an external power source

Three common EV charging levels:[1]

- Level 1 (AC): 2 – 5 miles of range per 1 hour of charge
- Level 2 (AC): 10 – 20 miles of range per 1 hour of charge
- DC Fast Charging: 60 – 80 miles of range or more per 20 minutes of charge

Electric Vehicles - Markets

EV sales increased substantially in recent years. In 2017, compared to 2016, new EV sales increased by:[2]

- World 54%
- U.S. 31%[6]
- Michigan 11%[6]

EV sales projected to increases globally increase in electric vehicle sales projected.[2]

- In 2030: 125 – 220 million light duty electric vehicles
- In 2017: Over 1 million EVs globally

More EV makes and models will be available.

- Ford will launch 40 new EVs by 2022.[3]
- GM will have 20 new zero emissions vehicles launched by 2023.[4]
- Toyota will have all Toyota and Lexus models available as dedicated EV/electrified option by 2025[5]

Electric Vehicles - Benefits

Can improve public health and reduce ecological damage

- BEVs have zero tail pipe emissions
  - The cleaner electricity production, the greater the public health and ecological benefit from driving EVs
- Average EV in US produces less emissions than a gas car with 26 mpg (MI: 38 mpg equivalent).[6]
  - Conventional vehicles contribute 83% of emissions in transportation sector.[7]

Diversifies transportation fuel and reliance on foreign energy sources.[8]

- U.S. electricity largely produced from domestic sources

Electric Vehicles – Motivation for Adoption

- Michigan autonomous vehicle legislation (PA 332 of 2016)
- Council on Future Mobility support for EVs and autonomous vehicles.
- Light Duty Zero Emissions Equipment Supply Program
- DTE's EV rate filing with the MPSC
- Consumers Energy EV filing with the MPSC
- Michigan Electric Cooperative Association Membership support
- Michigan Municipal League interest

Electric Vehicles – Infrastructure

Currently, limited EV makes and models with high costs

Michigan has limited charging infrastructure.[9]

- <2% of US DC Fast Charger ports
- 2.2% of US Level 2 ports

Michigan ranks 4th in U.S. for plug-in EV sales, but 25th for battery EV sales.[9]

- 15.4 EVs sold/L2 port vs. 15.2 BEVs sold/DC fast charger port

Data suggests increased charging events in the future.

Electric Vehicles – Planning for the Future

Michigan Energy Office initiated steps towards developing an effective DC fast charging network ensuring worry-free EV travel through Michigan by 2030.

- Develop bare-bones system
- Provide complete connectivity

Multi-Phase Project for EV Charger Placement.

Phase	Timeline
• Phase I: Intercity EV Trips (Highways)	December 2018
• Phase 1 Supplements	Spring 2019
• Full Tourism Analysis	
• Economic Impacts Analysis	
• Phase II: Urban EV Trips (Select Cities)	Fall 2019

Stakeholder Input is Vital

Allowed adaptation of optimization model to Michigan and to reflect Michigan specific needs.

Phase 1 inputs informed by stakeholders include:

- EV ranges (battery sizes assumed),
- EV market share penetration,
- DC fast charger power and costs,
- Electricity provision costs,
- Battery performance in winter, and
- Intercity traffic demand and seasonal variation.

Community stakeholder input is vital to Phase 2.

Electric Vehicle Charger Placement Optimization Project: Phase 1 & 2

December 19, 2018

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Acknowledgement

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

MI Energy
Michigan Agency for Energy
Michigan Energy Office

Problem Statement

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Find the optimal DC fast charging infrastructure investment to support electric vehicle travel in Michigan to ensure travel continuity:

- **Where** to deploy charging stations?
- **How many** charging outlets must be built at each station?
- **What** is the approximate investment cost?

Phase I- Intercity EV Trips (Highways)

Phase II- Urban EV Trips (Select Cities)

Phase 1: High & Low-Tech Scenarios Analyzed.

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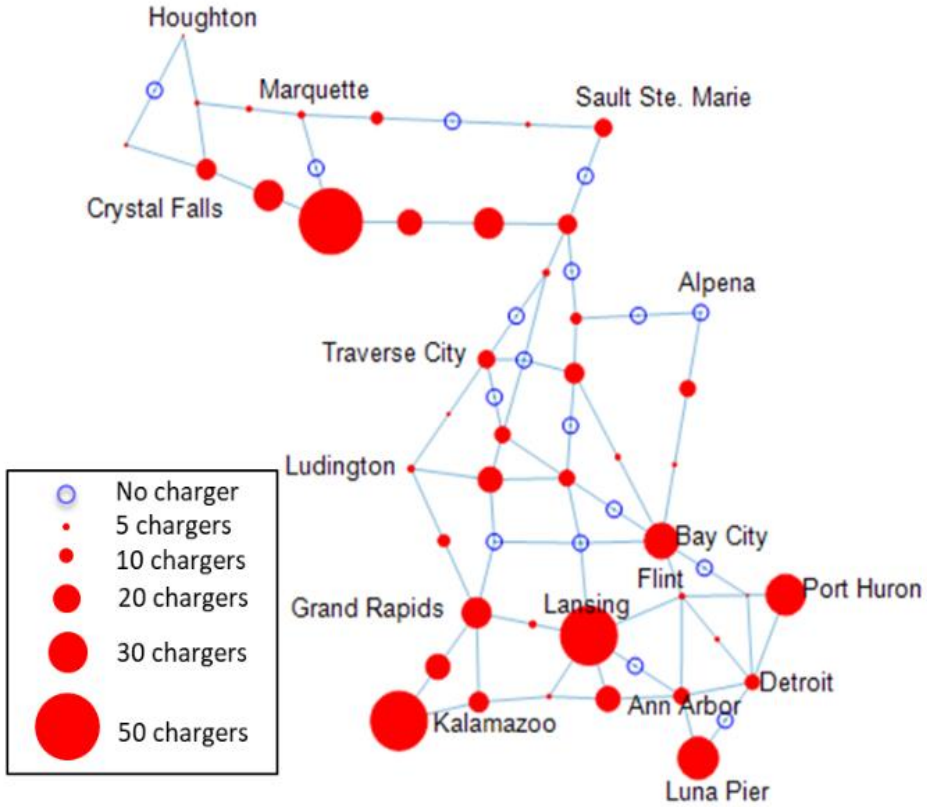
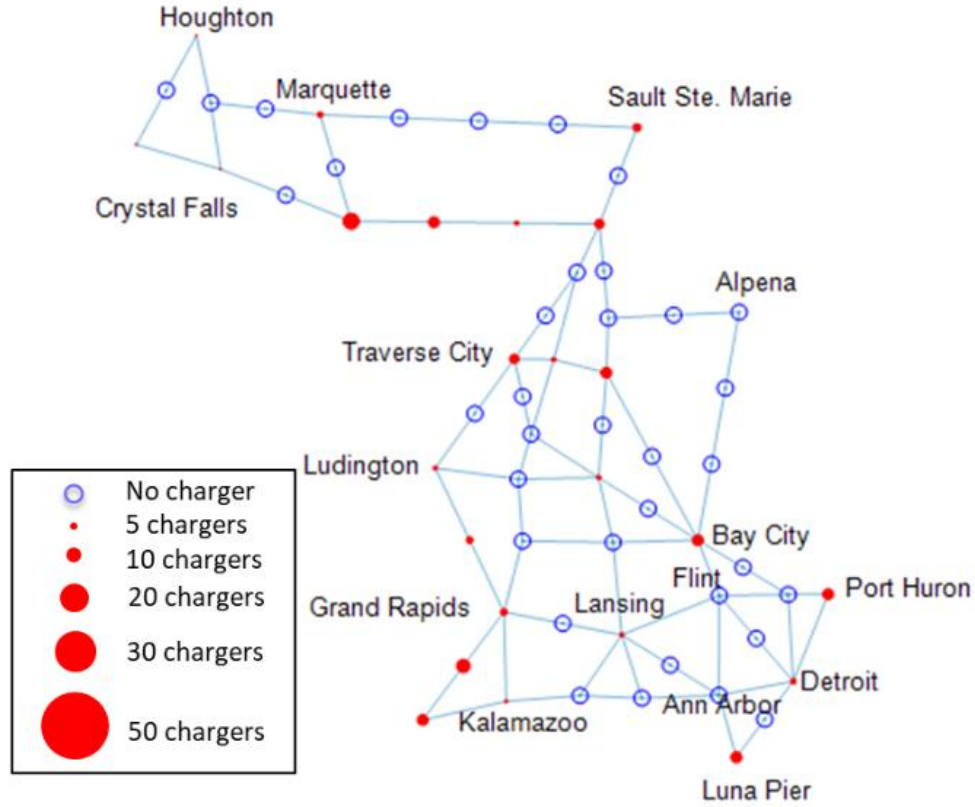
Two technology scenarios analyzed for 2020, 2025, & 2030:

- Low-Tech: 70 kWh battery with 50 kW charger
- High-Tech: 100 kWh battery with 150 kW charger



(a) 2030: Low-Tech Scenario



(b) 2030: High-Tech Scenario

Phase 2 Model for Urban Trips.

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Modeling framework considers:

- Origin-Destination travel demand (input)
- Simulated trip trajectories
- Minimizing charging station investment cost
- Minimizing travelers' detour

This phase focuses on investing in DC fast chargers for urban trips of EV users.

Phase 2 Model Framework Visualization.

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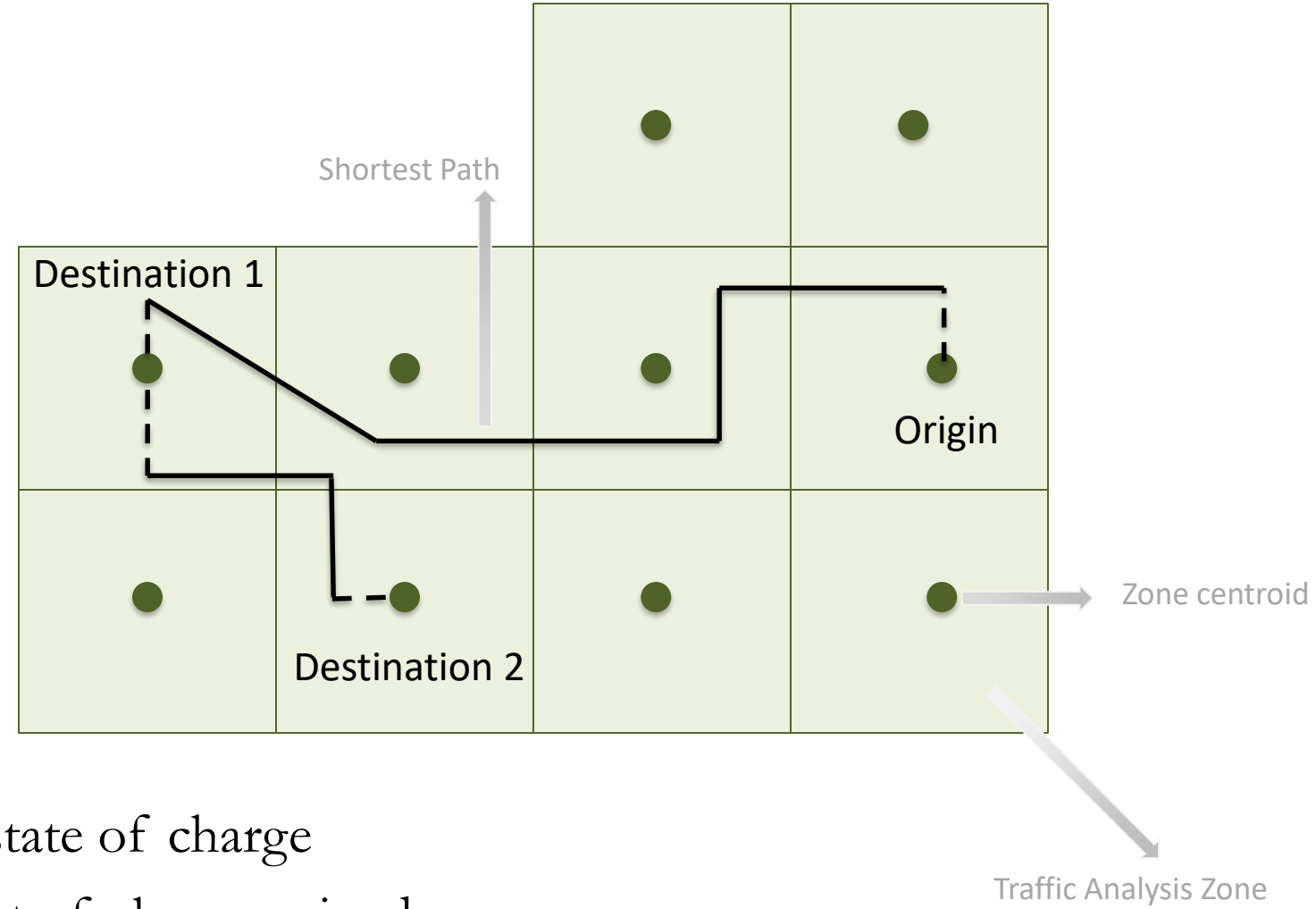

- Initial state of charge
- Amount of charge gained
- Chain of trips is unknown

Select Focus Areas will be Examined in Phase 2.

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- Ann Arbor
- Detroit
- Flint
- Grand Rapids
- Lansing
- Marquette
- Traverse City

Community Stakeholder Questions

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- Are there any limitations related to placing charging infrastructure in your community currently? Should there be areas where DCFC is not allowed?
  - *Example: No DCFC in single family residential areas, municipal streets, etc.*
- What type of EV charging are you anticipating in your community?
- What should be the configuration of the charging stations?
  - *Consolidated (similar to gas stations) or a few charging outlets in public or store parking lots*
- What should be the assumed initial state of charge?
- What should be assumed about the amount of charge gained at each charging event?
  - *Get to destination or fully charged?*
- What percent of the population lives in multi-family housing?
- What is the average land cost of each area?
- What is the existing electrical grid infrastructure along your transportation network?
  - *Utilities assistance is needed to obtain this data*

Community Stakeholder Questions

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- What battery size should be assumed for urban trips?
  - *70 and 100kwh for intercity trips*
- What is the city vs. highway battery efficiency?
- City tourism data availability?
  - *Is there any data on the number of visitors and their possible overnight stay destinations?*
- What other parameters should be considered in making EV charging infrastructure investments?
- What are the main concerns of EV users for their urban trips? Any suggestions?
- Are there any additional variables that should be considered?
- Any recommendations on who we should talk to next to gather information?

Thank you!

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