EV Charging Infrastructure Study (Phase 2)

February 2026

Prepared for:
Michigan Office of Future Mobility & Electrification
Michigan Department of Labor &Economic Opportunity

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Acknowledgement

The researchers at Michigan State University gratefully acknowledge the Michigan Office of Future Mobility & Electrification (OFME) and Michigan Department of Labor and Economic Opportunity (LEO) for sponsoring this research, recognizing the importance and timeliness of the topic, and supporting this innovative approach to electric vehicle charging infrastructure planning. We extend our sincere thanks to the OFME team, specially Shafiq Bari, for continuous feedback and for facilitating stakeholder meetings, which provided critical information for our analysis. Finally, we deeply appreciate the many stakeholders listed below for their active engagement, willingness to share data and insights, and their valued collaboration throughout this effort.

- Michigan Office of Future Mobility & Electrification (OFME)
- Michigan Department of Labor and Economic Opportunity (LEO)
- Southeast Michigan Council of Governments (SEMCOG)

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1. Introduction

Michigan, a long-standing automotive hub, aims to expand its Electric Vehicle (EV) adoption. As of July 1, 2025, Michigan had approximately 85,311 Battery Electric Vehicles (BEVs) and 18,013 Plug-in Hybrid Electric Vehicles (PHEVs), representing about 1.25% of all vehicles registered in the state (*1*). Electric Vehicles (EVs), referring to BEVs in this study, still represent only about 1% of Michigan's eight million registered vehicles. By the end of 2025, the U.S. Department of Energy's Alternative Fuels Data Center (AFDC) reported 4,234 Level 2 chargers in 1,456 charging stations, and 1,511 Direct Current Fast Chargers (DCFCs) in 507 charging stations in Michigan (*1*). In this report, an EV charging station refers to a specific location where one or more individual chargers or charging ports are installed to replenish an electric vehicle's battery.

Phase 1 of this research developed a statewide framework for the optimal siting and sizing of Level 2 and DCFC charging stations for light-duty vehicles under a 25 % EV market share scenario[1], identifying the number and locations of chargers required to enable an efficient investment approach while ensuring feasible trips and acceptable service levels across Michigan (*2*). Phase 1 provided long-term infrastructure requirements and highlighted the importance of coordinating charger deployment with EV travel demand. Building on that foundation, Phase 2 also focuses on light-duty vehicle charging infrastructure and addresses the early stages of the transition. It evaluates the charging infrastructure needs for less than 25% EV market shares to offer transportation agencies a roadmap toward the 25% goal, recognizing that EV adoption will increase gradually over time. In addition, Phase 2 examines charging station prioritization based on the current market share (1%), identifying which stations should be developed first to guide near-term investment and installation decisions. By focusing on lower adoption levels, staged investment, and prioritization of charging station location, this phase provides actionable insights for public and private stakeholders as they begin scaling the network.

2. Problem Statement

To achieve the future 25% EV market share target, the state must plan infrastructure expansion that accommodates intermediate adoption milestones. Planning solely for the end state, particularly in a context where the target is a 25% EV market share and the current level is approximately 1%, can be inefficient for the state, as reaching that target will take considerable time. Without a well-defined plan that aligns charging infrastructure development with gradual EV growth, investments may result in infrastructure that is underutilized in the short term, wasting resources because installed capacity exceeds demand, or conversely, insufficient infrastructure as EV adoption increases. Therefore, a phased roadmap is necessary to match infrastructure supply with evolving demand and to ensure efficient allocation of resources over time.

Moreover, given that Michigan currently has an EV market share of approximately 1%, it is essential for the state to identify how many chargers are needed and where they should be located to adequately support existing demand. Equally important is guiding decision makers on which locations should be prioritized for initial development and investment, ensuring that current available resources are directed toward the most critical areas of the network to meet present charging needs and establish a strong foundation for future growth.

The second phase of this study consists of two main tasks:

- **Infrastructure development roadmap aligned with EV market share:** the first task involves applying the framework and methodologies developed in Phase 1 to estimate the optimal number and locations of chargers for EV market shares of 1%, 5%, and 10%. This analysis provides agencies with guidance on how many chargers are required at each stage and where they should be deployed as EV adoption increases incrementally toward the 25% target.

[1] The 25% market share represents the share of electric vehicles in all vehicles in operation.

- **Charging station prioritization:** the second task ranks individual charging stations based on multiple criteria, including EV and energy demand at each station, the spatial distribution of EV owners, proximity to neighboring stations, and the state of charge (SoC) of vehicles upon arrival at different locations. These criteria are integrated into a composite index that reflects the relative importance of each station, enabling classification into high-, medium- and low-priority groups for installation. This prioritization framework helps decision makers allocate resources to the most impactful stations, ensuring that early investments deliver maximum benefit to EV users.

Collectively, these tasks address the fundamental question of how to expand Michigan's EV charging network in a cost-effective, scalable manner. By generating a step-wise roadmap and identifying the first stations that should be built, the Phase 2 study equips policymakers, utilities, and private developers with actionable guidance to support the state's transition from a 1% market share toward its long-term electrification goals.

3. Data Collection

Data constitutes a vital component of any research project, forming the foundation for analysis and decision making. In Phase 1 of this study, all required data sets, along with their sources and collection processes, were described in detail (*2*). Phase 2 builds on this foundation by using the same data sets introduced in Phase 1 (*3*–*6*), and supplements with an additional data set on EV registrations in Michigan for 2025 (*1*, *7*).

In this study, the number of EVs registered in each ZIP code in Michigan as of July 1, 2025, was obtained from Michigan Department of State. Figure 1 illustrates the spatial distribution of EV owners across Michigan.

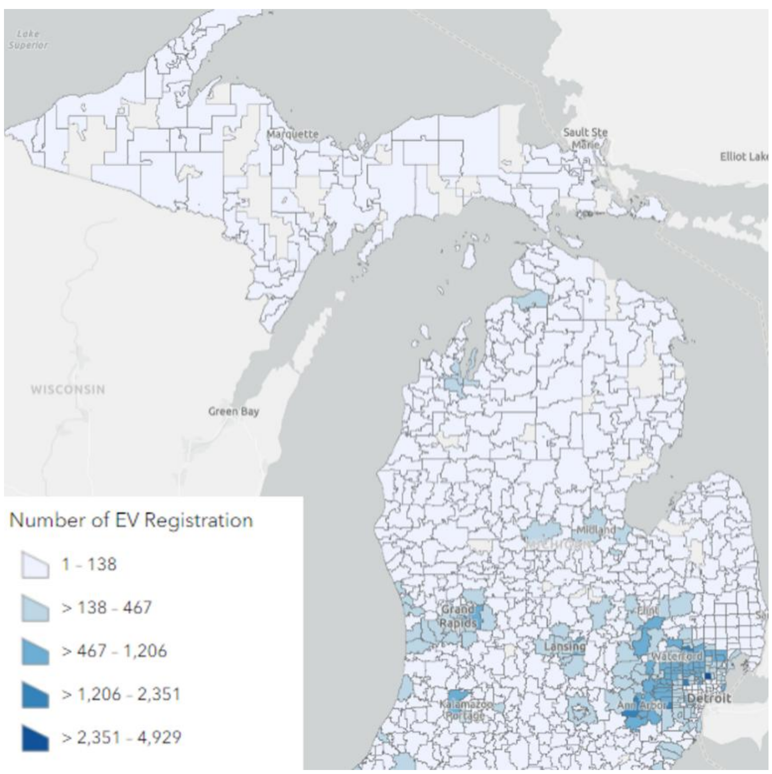


Figure 1: Michigan 2025 EV registration (*1*)

4. Infrastructure Development Roadmap

This section presents the results of a strategic plan for expanding EV charging infrastructure in Michigan to support light-duty vehicle travel under 1%, 5%, and 10% EV market share scenarios. The plan is designed to accommodate a broad range of travel needs, categorized into three primary trip types: (i) long distance intercity travel within Michigan and cross border trips between Michigan, neighboring states, and Canada in both directions; (ii) tourism-related trips; and (iii) daily urban travel. Each trip type is examined, and the results for each EV market share scenario are presented, including the optimal number and locations of required chargers and the associated costs. Finally, the total charging infrastructure needs and overall costs required to support all trip types are compared across EV market share scenarios.

4.1. Intercity charging infrastructure

This section outlines the locations and quantities of DCFCs with a power rating of 150 kW required to support intercity travel, as well as any tourism-related travel demand that can be accommodated by these chargers in Michigan, under 1%, 5%, and 10% EV market share scenarios. As discussed in Phase 1, an effective charging strategy integrates DCFCs along travel corridors with Level 2 chargers at tourism destinations where vehicles dwell for longer periods. Moreover, limited or fully occupied Level 2 chargers at destinations can redirect users to nearby DCFC stations, increasing demand and congestion at those facilities. Consequently, tourism-related travel must be considered when estimating DCFC demand along highways. Table 1 presents and compares the results for different EV adoption levels, followed by an illustration of the spatial distribution of the optimal charging station locations. It is important to note that the number of new required chargers and stations is derived by accounting for the existing charging infrastructure discussed in Phase 1.

Table 1: Intercity charging infrastructure results under different EV market share scenarios

EV market share	**1%**	**5%**	**10%**
Number of new required stations	10	13	14
Number of new required chargers	41	186	551
Total station cost	$1.57 M	$4.01 M	$8.60 M
Total charger cost	$3.21 M	$14.54 M	$43.08 M
Total infrastructure cost	$4.78 M	$18.55 M	$51.72 M

Figures 2 through 4 illustrate the optimal locations of DCFCs required to support intercity and any tourism-related travel in Michigan under 1%, 5%, and 10% EV market share scenarios, respectively.

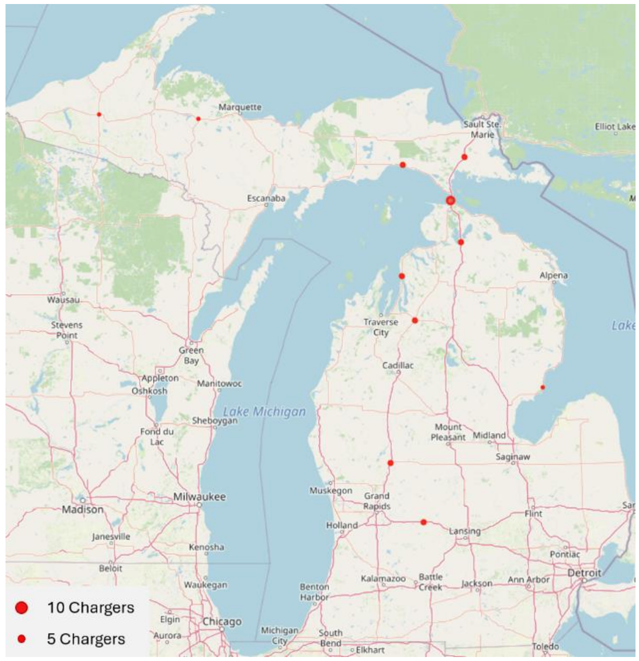


Figure 2: New required chargers to support intercity trips in Michigan under 1% EV market share

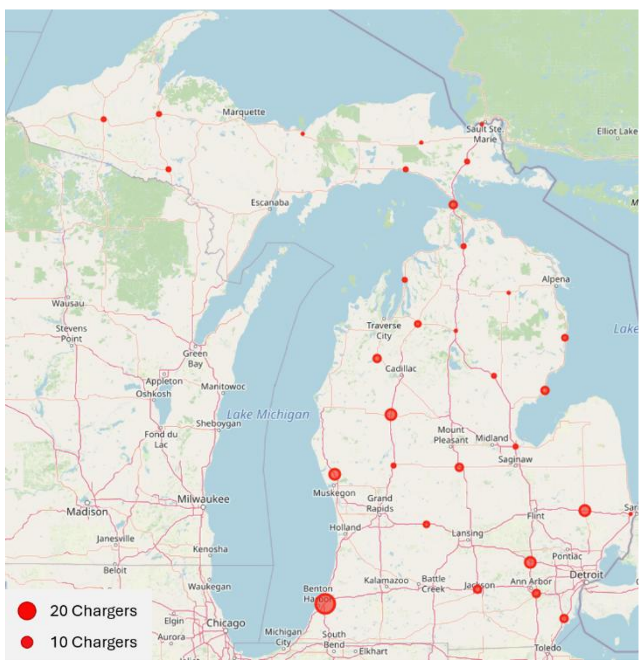


Figure 3: New required chargers to support intercity trips in Michigan under 5% EV market share

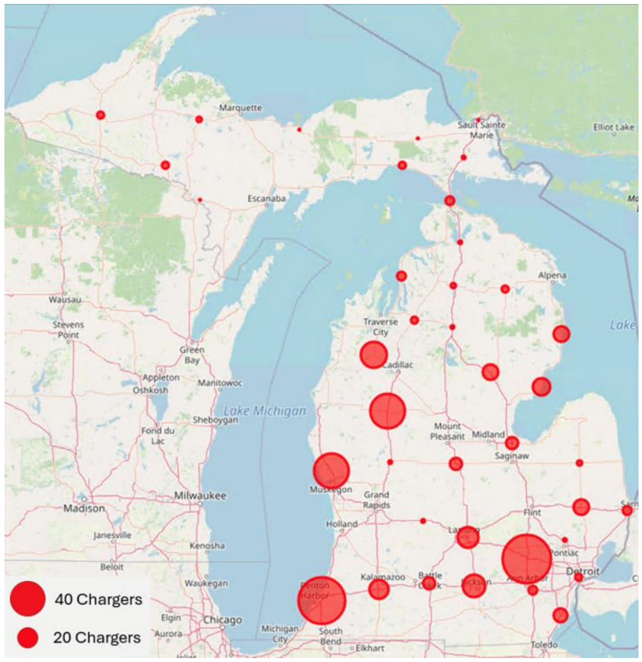


Figure 4: New required chargers to support intercity trips in Michigan under 10% EV market share

4.2. Tourism destination charging infrastructure

This section outlines the locations and quantities of Level 2 chargers with a power rating of 11 kW required to support tourism travel in Michigan under 1%, 5%, and 10% EV market share scenarios. Table 2 presents and compares the results for different EV adoption levels, followed by an illustration of the spatial distribution of the optimal charging station locations. It is important to note that the number of new required chargers and stations is derived by accounting for the existing charging infrastructure discussed in Phase 1. In addition, any unserved demand at Level 2 chargers, due to either insufficient availability or fully occupied chargers, is redirected to the nearest DCFC stations.

Table 2: Tourism charging infrastructure results under different EV market share scenarios

EV market share	1%	5%	10%
Number of new required stations	730	1,393	1,353
Number of new required chargers	748	1,926	2,936
Total station cost	\$8.18 M	\$16.09 M	\$19.87 M
Total charger cost	\$3.32 M	\$8.56 M	\$13.04 M
Total infrastructure cost	\$11.50 M	\$24.65 M	\$32.91 M
Average delay per unserved EV[1]	21.8 min	15.8 min	15.9 min
Unserved energy demand[2]	3.13 MWh	0.6 MWh	0.82 MWh
Unserved EV[3]	120	23	32

[1] Average detour time per user to reach the nearest DCFC station due to a lack of Level 2 chargers at the destination.
[2] Total charging demand remains unserved due to a lack of Level 2 chargers at the destination.
[3] Total number of users required to make a detour to reach the nearest DCFC station due to a lack of Level 2 chargers at the destination.

Figures 5 through 7 illustrate the optimal locations of Level 2 chargers required to support tourism travel in Michigan under 1%, 5%, and 10% EV market share scenarios, respectively.

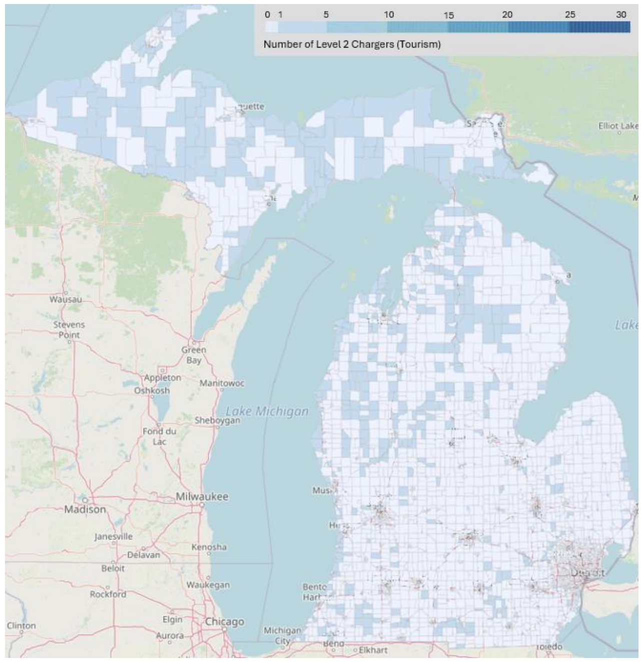


Figure 5: New required chargers to support tourism trips in Michigan under 1% EV market share

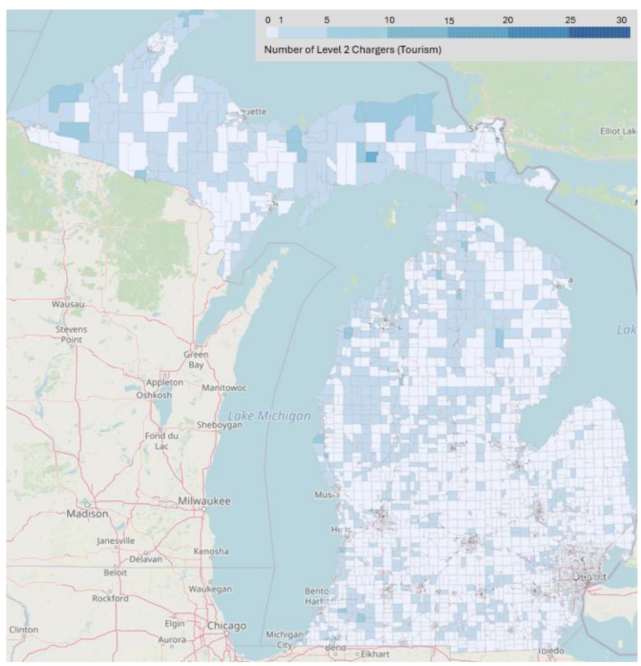


Figure 6: New required chargers to support tourism trips in Michigan under 5% EV market share

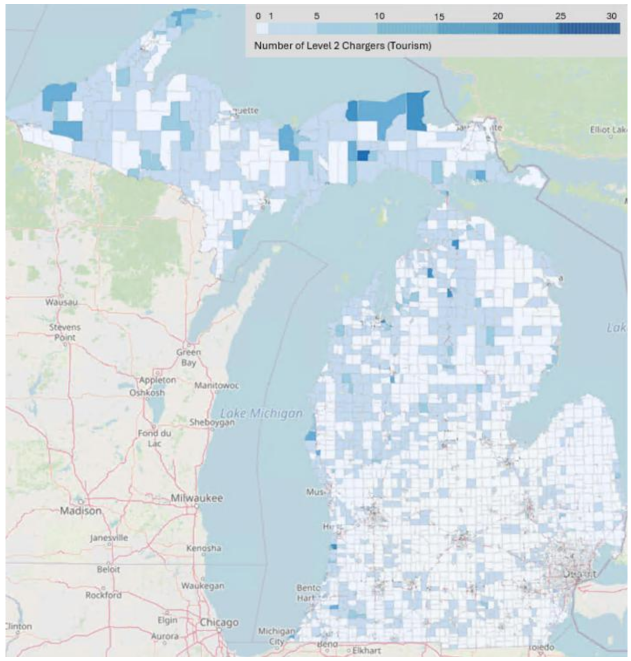


Figure 7: New required chargers to support tourism trips in Michigan under 10% EV market share

4.3. Urban area charging infrastructure

Urban trips rely on a balanced mix of Level 2 chargers, commonly located at homes, workplaces, and public destinations such as shopping centers, and DCFCs to meet the diverse charging needs of EV users. The accessibility and availability of Level 2 chargers at home and work strongly influence how frequently users rely on DCFCs during the day. This section discusses the analysis of Level 2 and DCFC infrastructure for urban travel, respectively.

4.3.1. Level 2 charging station

This section outlines the locations and quantities of Level 2 chargers with a power rating of 11 kW required at multifamily housing (MFH) units to support urban travel in Michigan under 1%, 5%, and 10% EV market share scenarios. The analysis assumes a target of providing home charging access to 50% of EV-owning MFH residents, meaning that half of EV-owning MFH units are equipped with on-site Level 2 chargers. Table 3 presents and compares the results for different EV adoption levels, followed by an illustration of the spatial distribution of the optimal charging station locations.

Table 3: Urban Level 2 charging infrastructure results under different EV market share scenarios

EV market share	1%	5%	10%
Number of new required stations	1,112	2,057	2,230
Number of new required chargers	2,006	10,739	21,423
Total station cost	$6.08 M	$11.24 M	$12.19 M
Total charger cost	$8.91 M	$47.72 M	$95.19 M
Total infrastructure cost	$15 M	$58.96 M	$107.38 M

Figures 8 through 10 illustrate the optimal locations of Level 2 chargers required to support urban travel in Michigan under 1%, 5%, and 10% EV market share scenarios, respectively.

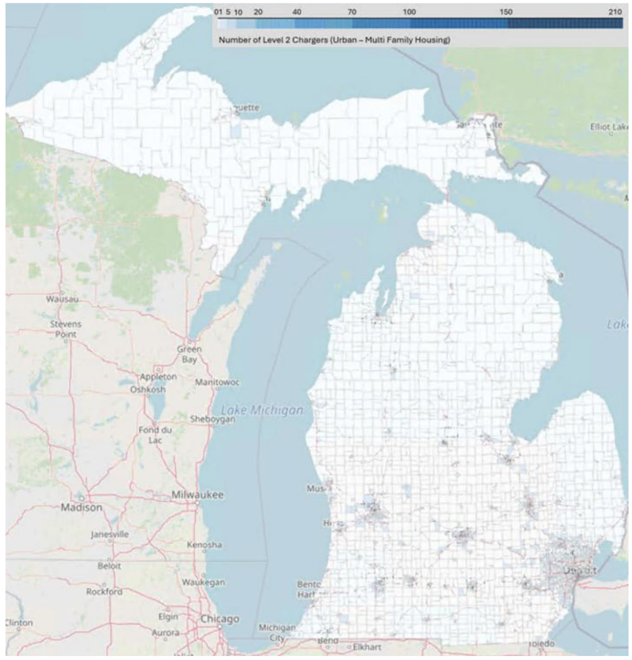


Figure 8: New required Level 2 chargers to support urban trips in Michigan under 1% EV market share

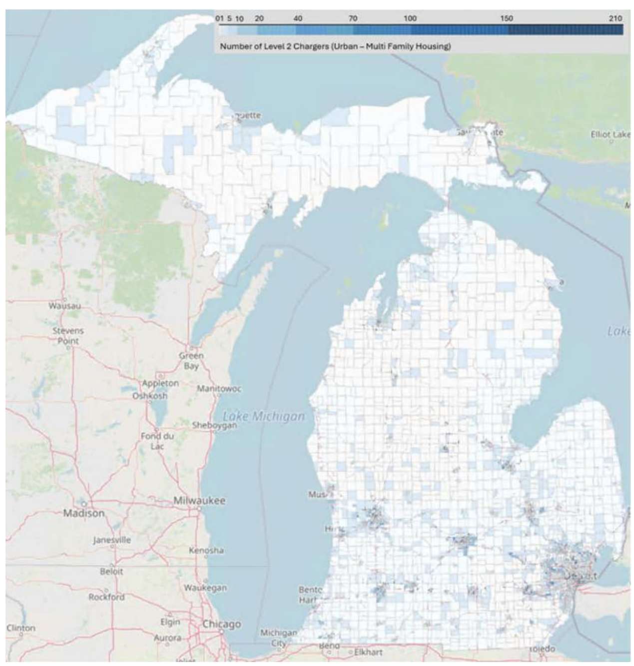


Figure 9: New required Level 2 chargers to support urban trips in Michigan under 5% EV market share

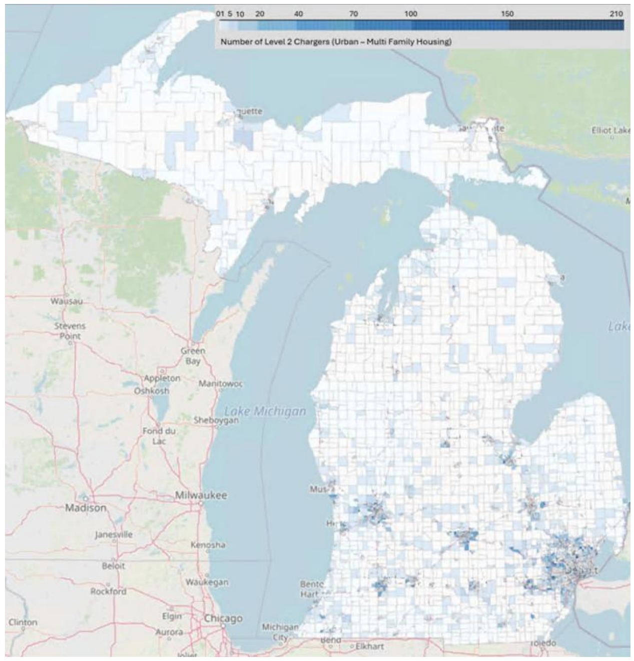


Figure 10: New required Level 2 chargers to support urban trips in Michigan under 10% EV market share

4.3.2. DCFC station

This section outlines the locations and quantities of DCFCs with a power rating of 150 kW required to support urban travel in Michigan under 1%, 5%, and 10% EV market share scenarios. Accurately estimating DCFC charging demand requires assessing the distribution of Level 2 chargers and identifying where trips begin and end, such as single-family homes, multifamily housing, workplaces, or other destinations. These factors, along with the time of day, influence whether users rely on Level 2 chargers or DCFCs, and therefore significantly affect DCFC demand. Tables 4 through 6 present and compare the results for major urban areas in Michigan across different EV adoption levels, followed by illustrations of the spatial distribution of optimal charging station locations. The last row in these tables reports the average delay per EV, which includes detour time, queuing time, and refueling time for users charging at DCFC stations. It is important to note that the number of new required chargers and stations is derived by accounting for the existing charging infrastructure discussed in Phase 1.

Table 4: Urban DCFC infrastructure results under 1% EV market share

	Marquette	Ann Arbor	Muskegon	Kalamazoo	Flint	Saginaw	Lansing	Grand Rapids	Detroit
New required stations	1	3	4	6	5	10	10	13	46
New required chargers	2	7	9	13	13	21	23	30	148
Total station cost (M$)	0.11	0.32	0.58	0.66	0.98	1.31	1.46	1.73	5.50
Total charger cost (M$)	0.16	0.55	0.70	1.02	1.02	1.65	1.80	2.34	11.65
Total infrastructure cost (M$)	0.27	0.87	1.28	1.68	2	2.96	3.26	4.07	17.15
Average delay per EV (min)	13.2	9.7	10.2	10.5	10.2	11.7	9.8	9.6	10

Table 5: Urban DCFC infrastructure results under 5% EV market share

	Marquette	Ann Arbor	Muskegon	Kalamazoo	Flint	Saginaw	Lansing	Grand Rapids	Detroit
New required stations	3	7	11	13	14	25	18	23	92
New required chargers	6	25	36	52	55	78	66	125	587
Total station cost (M$)	0.34	0.86	1.66	2.05	4.77	4.12	3.97	6.14	17.30
Total charger cost (M$)	0.47	1.96	2.82	4.07	4.32	6.10	5.17	9.74	46.22
Total infrastructure cost (M$)	0.81	2.82	4.48	6.12	9.09	10.22	9.14	15.88	63.52
Average delay per EV (min)	10.6	8.5	8.8	9.2	8.6	9.5	8.7	9.1	9.4

Table 6: Urban DCFC infrastructure results under 10% EV market share

	Marquette	Ann Arbor	Muskegon	Kalamazoo	Flint	Saginaw	Lansing	Grand Rapids	Detroit
New required stations	5	10	14	16	15	31	24	26	102
New required chargers	12	51	66	94	108	142	145	250	1080
Total station cost (M$)	0.57	1.62	2.74	3.05	10.77	6.70	8.84	10	26.60
Total charger cost (M$)	0.94	3.99	5.17	7.37	8.48	11.11	11.36	19.48	85.03
Total infrastructure cost (M$)	1.51	5.61	7.91	10.42	19.25	17.81	20.2	29.48	111.63
Average delay per EV (min)	9.7	8.2	8.5	9.1	8.6	9.1	8.5	9.1	9.3

Figures 11 through 13 illustrate the optimal locations of DCFCs required to support urban travel in Michigan under 1%, 5%, and 10% EV market share scenarios, respectively.

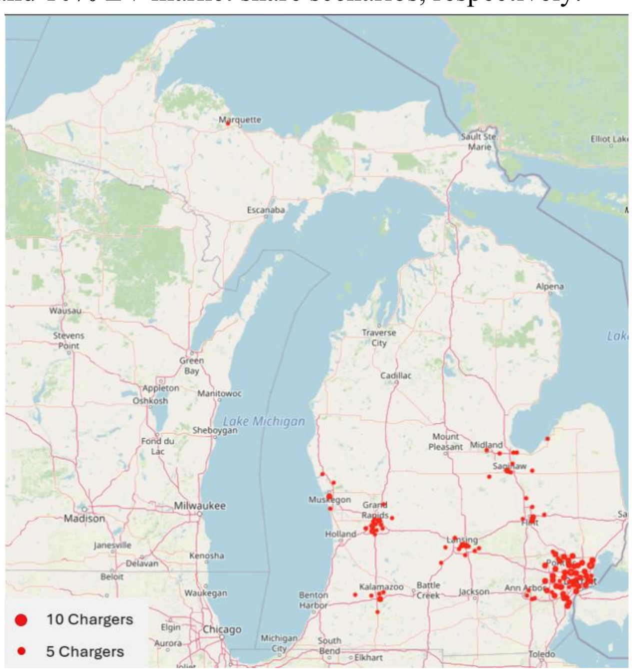


Figure 11: New required DCFCs to support urban trips in Michigan under 1% EV market share

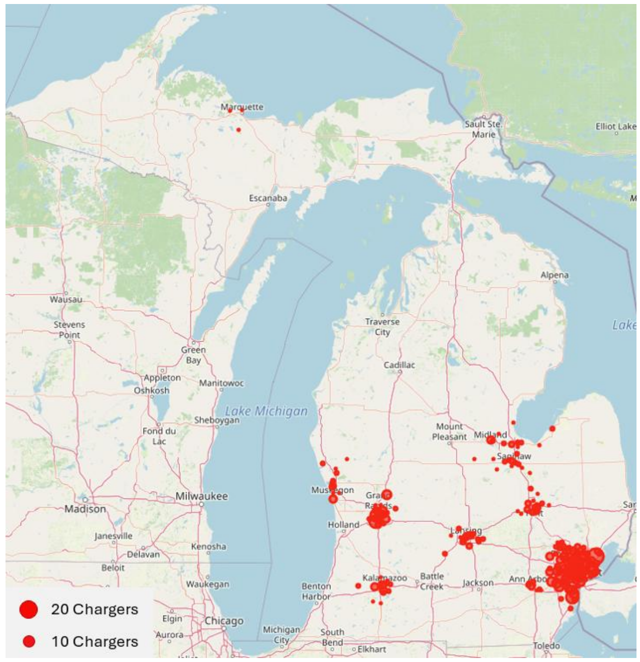


Figure 12: New required DCFCs to support urban trips in Michigan under 5% EV market share

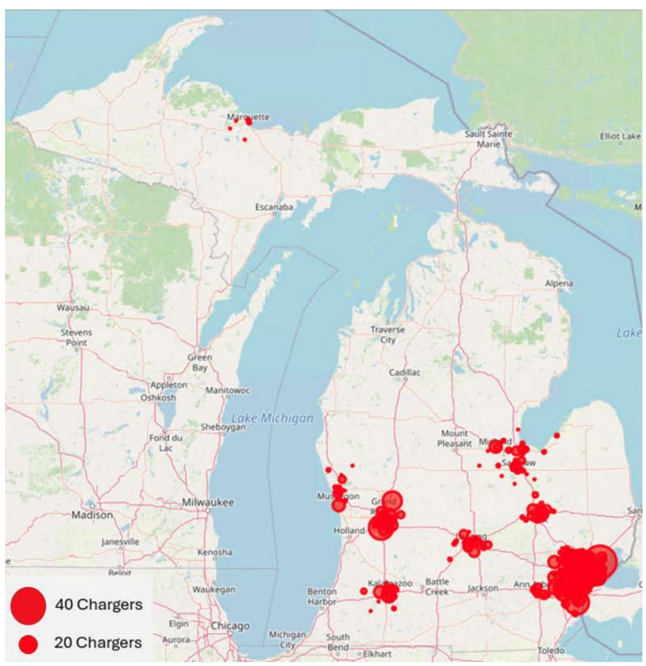


Figure 13: New required DCFCs to support urban trips in Michigan under 10% EV market share

4.4. Infrastructure roadmap summary

This section provides a comprehensive summary of the results, reporting the total number of chargers required by charger type (Level 2 and DCFC) to support each travel category, intercity, tourism, and urban, under 1%, 5%, and 10% EV market share scenarios. For each scenario, the corresponding total infrastructure cost is also presented, allowing agencies to understand how infrastructure requirements scale as EV adoption increases. Table 7 illustrates this summary.

Table 7: Summary of charging infrastructure results under different EV market share scenarios

		Number of new required chargers			Cost of new required chargers		
		DCFC	Level 2	Total	DCFC	Level 2	Total
1% EV market share	Intercity trips	41	-	41	$4.78 M	-	$4.78 M
	Tourism trips	-	748	748	-	$11.50 M	$11.50 M
	Urban trips	266	2,006	2,272	$33.54 M	$15 M	$48.54 M
	Total	307	2,754	3,061	$38.32 M	$26.5 M	$64.82 M
5% EV market share	Intercity trips	186	-	186	$18.55 M	-	$18.55 M
	Tourism trips	-	1,926	1,926	-	$24.65 M	$24.65 M
	Urban trips	1,030	10,739	11,769	$122.08 M	$58.96 M	$181.04 M
	Total	1,216	12,665	13,881	$140.63 M	$83.61 M	$224.24 M
10% EV market share	Intercity trips	551	-	551	$51.72 M	-	$51.72 M
	Tourism trips	-	2,936	2,936	-	$32.91 M	$32.91 M
	Urban trips	1,948	21,423	23,371	$223.82 M	$107.38 M	$331.2 M
	Total	2,499	24,359	26,858	$275.54 M	$140.29 M	$415.83 M

As shown in Table 7, scaling the network to support 1%, 5%, and 10% EV market share requires approximately 3,061; 13,881; and 26,858 chargers, with associated costs of $64.82 million, $224.24 million, and $415.83 million, respectively. These results indicate that the number of required chargers and the corresponding cost do not increase linearly with EV market share. This pattern arises because charging infrastructure needs are shaped by users' travel patterns, how far and where people drive, which do not necessarily scale in proportion to the number of EVs on the road. Moreover, infrastructure costs do not increase linearly because grid upgrade expenses follow a stepwise pattern, increasing only when existing capacity limits are reached, rather than increasing gradually with energy demand. The only cost component that grows roughly in proportion to EV market share is the installation of urban Level 2 chargers, since their estimation is tied directly to the number of residential units in the urban area. This summary enables direct comparison across travel types and adoption levels, supporting informed planning and investment decisions to ensure that Michigan's charging network evolves efficiently and cost-effectively with market growth.

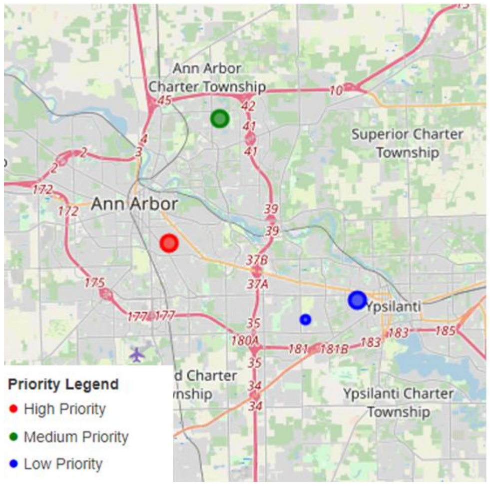
5. Charging Station Prioritization

Building on the roadmap presented in the previous section, which outlined charging infrastructure development strategies for EV market shares ranging from 1% to 10%, this section narrows the focus to the current conditions. Specifically, with EV adoption at approximately 1%, the analysis examines where charging infrastructure should be prioritized to effectively support existing demand. By identifying which recommended charging locations are most critical to current level of EV operations across the state, this section provides a more detailed assessment of near-term infrastructure needs based on the spatial distribution of current EV ownership. This prioritization of new charging stations in Michigan is based on the estimated number and locations identified in the previous section. To assess the relative importance of each new charging station, the study evaluates multiple factors: (i) total EV demand at the station, (ii) total energy demand at the station, (iii) the spatial distribution of EV owners, (iv) the SoC of vehicles upon arrival, and (v) proximity to neighboring stations. The following paragraphs elaborate on each factor and discuss why it serves as a meaningful indicator of a station's priority within the network. The analysis then describes how charging stations are classified into three priority levels, low, medium, and high, for both urban and intercity trips based on these indicators, followed by a spatial visualization of the prioritized stations on the map.

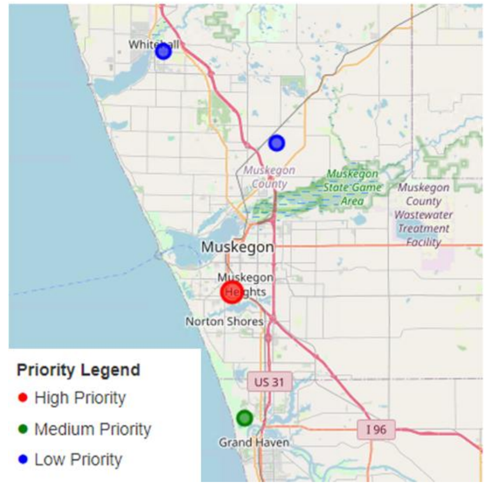
- **Total EV and energy demand**: The first two factors, total EV demand and total energy demand at each charging station, are derived from the optimization framework developed in Phase 1. These metrics indicate how many vehicles are expected to charge at a given location and the total energy required to serve them. Higher values for either factor signal greater importance for that station. If a high-demand station is not installed, a larger number of users would be forced to detour to more distant locations, increasing travel inconvenience and user dissatisfaction. In addition, unmet energy demand would be redistributed to nearby stations, leading to higher congestion and longer delays across the surrounding network.
- **Spatial distribution of EV owners**: Another important factor is the spatial distribution of EV owners. For each charging station, the trajectories of vehicles expected to charge there are extracted from the simulation and optimization framework developed in Phase 1 and analyzed to determine their origin zones. In addition, the number of EVs registered in each ZIP code, obtained from Michigan Department of State, is used to represent current EV ownership patterns. A charging station that serves a greater share of vehicles originating from zones with higher EV registrations is considered more important, as these areas are likely to generate more EV trips than those captured in the simulation alone and therefore indicate a stronger potential demand for charging infrastructure.
- **The SoC of vehicles upon arrival**: The next factor is the SOC of vehicles upon arrival at each charging station, derived from the optimization framework developed in Phase 1. For this reason, the SOC of all users arriving at a given station is sorted, and the average of the lowest quartile is calculated to represent the most critical users. A lower average SOC indicates higher importance, as users arriving with low charge have limited flexibility to detour to alternative stations. In such cases, the absence of a charger at that location increases the likelihood of users experiencing infeasible trips or becoming stranded, making the station more essential within the network.
- **Proximity to neighboring stations**: The last factor is the proximity to neighboring stations. For each station, the average distance to the closest surrounding stations is calculated to determine how isolated it is within the network. A larger average distance indicates that few or no alternative stations are located nearby, making that location more critical. If such a station were not installed, users would need to make significantly longer detours to reach another charger, increasing travel delays and potentially causing some trips to become infeasible due to battery limitations.

For each urban area, all new charging stations are evaluated using the five aforementioned factors. For every factor, the stations receive a normalized score between zero and one, where one represents the highest importance for that factor and zero represents the lowest. The normalized scores are then summed across the five factors for each station, providing an aggregate score that represents the station's overall relative importance within the network. The new charging stations are then ranked by their overall relative importance. The top one-third are classified as high-priority, the middle one-third as medium-priority, and the bottom one-third as low-priority.

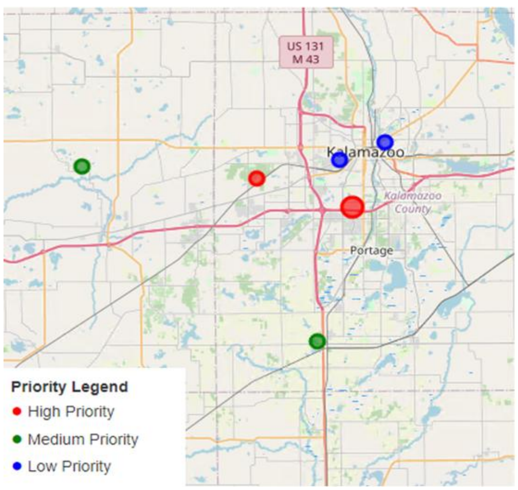
The following figures present the spatial distribution of prioritized charging stations under 1% EV market share for each major urban area in Michigan (urban areas are sorted based on the number of EV trips). The radius of each circle is proportional to the number of required chargers at that location. The prioritization analysis was not conducted for Marquette because the city requires only one new charging station under the 1% EV market share scenario, leaving no additional stations to rank. Detailed tables for each urban area, including station locations, individual factor scores, overall scores, and priority rankings, are provided in Tables 8 through 15 in the Appendix.



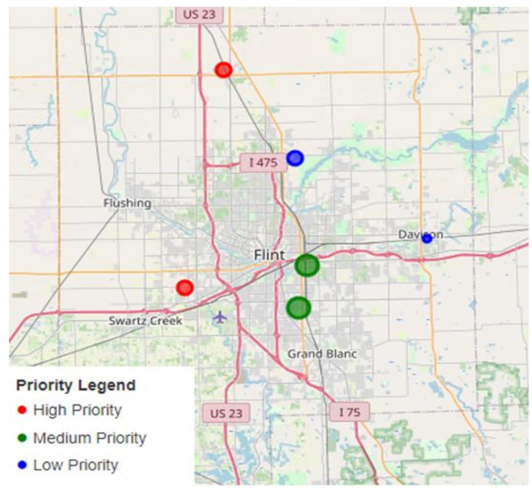
a) Ann arbor



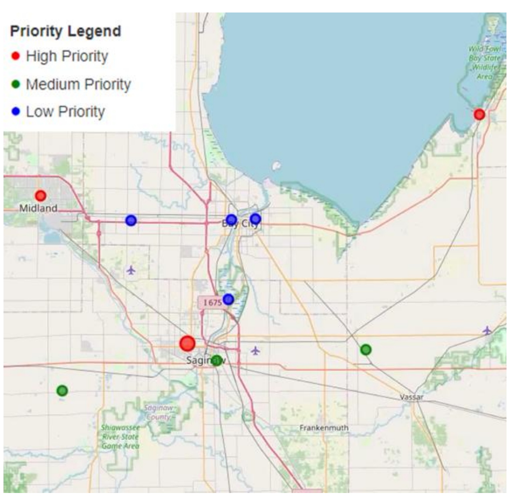
b) Muskegon



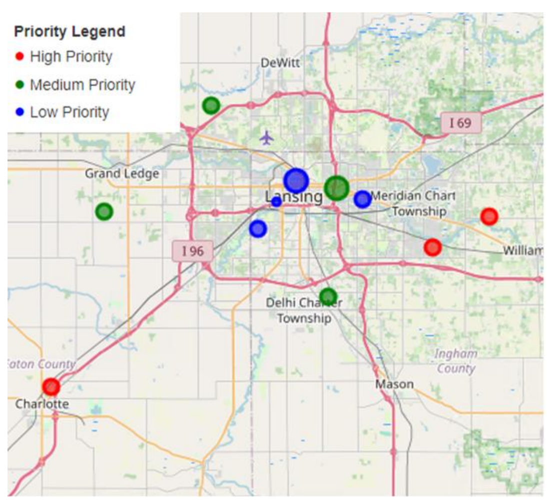
c) Kalamazoo



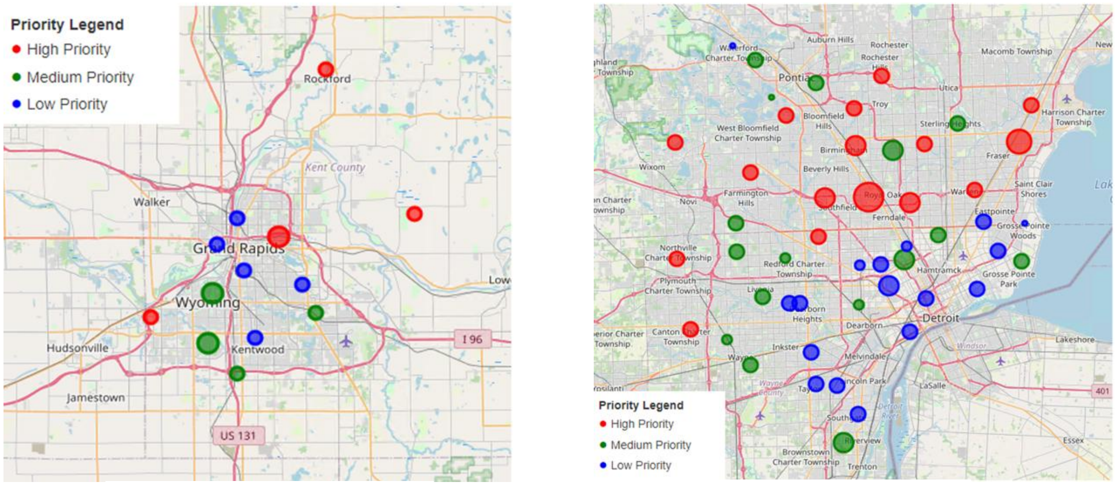
d) Flint



e) Saginaw



f) Lansing



g) Grand Rapids h) Detroit

Figure 14: Charging stations prioritization in urban areas under 1% EV market share

For intercity trips, all new charging stations are evaluated using only two factors: total energy demand at each station and proximity to neighboring stations. The remaining factors are not considered because EV demand is fully correlated with energy demand; therefore, including both would be redundant and would not affect the prioritization results. In addition, the spatial distribution of EV owners and SoC upon arrival are excluded from the intercity analysis because the intercity framework relies on aggregated demand and does not model individual vehicle trajectories.

Finally, each station is assigned a normalized score between 0 and 1 for each factor, where 1 indicates the highest importance and 0 the lowest. The normalized scores are then summed across the two factors to obtain an aggregate score representing each station's overall relative importance within the network. Based on this aggregate score, new charging stations are ranked, with the top one-third classified as high priority, the middle one-third as medium priority, and the bottom one-third as low priority.

Figure 15 presents the spatial distribution of prioritized charging stations for intercity trips in Michigan under a 1% EV market share. The radius of each circle is proportional to the number of required chargers at that location. A detailed table of intercity charging station prioritization, including station locations, individual factor scores, overall scores, and priority rankings, is provided in Table 16 in the Appendix.

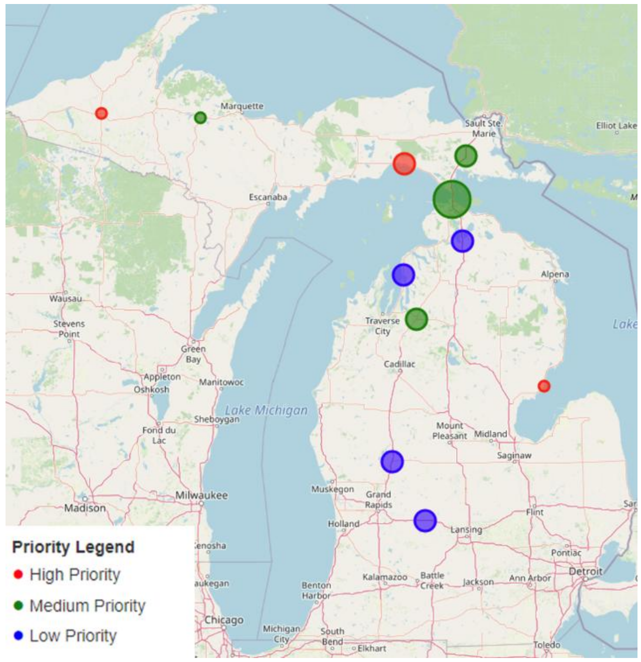


Figure 15: Charging stations prioritization for intercity trips under 1% EV market share

It is important to note that this prioritization is based on the 1% EV market share scenario. This aligns with the current EV market share in Michigan and reflects the goal of supporting near-term investment decisions by identifying the stations that would deliver the greatest immediate benefit to users. In addition, some of the factors used in prioritization, such as the spatial distribution of EV owners and the proximity to neighboring stations, are only available for the current market conditions, and their future patterns at higher market shares are not yet known. To accurately prioritize charging stations at higher market shares, it would be necessary either to reach market conditions closer to those levels so the factors can be observed directly, or to develop strong assumptions about how those factors will evolve in the future.

6. Conclusion

The second phase of the EV Charging Infrastructure Study focuses on how Michigan can expand its charging network gradually, instead of planning only for the long-term target of 25% EV market share. Phase 2 provides a phased roadmap that aligns infrastructure development with incremental adoption levels and prioritizes near-term investments. This staged approach is critical to avoid inefficient investments that either exceed near-term needs or fall short as EV adoption increases. By focusing on the current market share of roughly 1% and near-term infrastructure needs, this study offers practical guidance to agencies, utilities, and developers on making investments that maximize benefits for today’s users while building a strong foundation for future growth.

Two core tasks structure this phase of the study. First, the EV market share analysis applies the optimization framework developed in Phase 1 to estimate the number and location of chargers required to accommodate 1%, 5%, and 10% adoption levels. This analysis differentiates between Level 2 and DCFC stations and evaluates infrastructure needs across intercity, tourism, and urban travel using travel demand modelling. Second, the charging station prioritization task ranks the new stations identified under the 1% scenario using a composite index that incorporates total EV demand, total energy demand, the spatial distribution of EV owners, the state of charge of arriving vehicles, and the proximity of neighboring stations. Stations with the highest aggregate scores are designated as high-priority, providing decision-makers with evidence-based guidance on where early investments are likely to yield the greatest user benefits.

The analysis indicates that scaling the network to support 1%, 5%, and 10% EV market shares requires approximately 3,061, 13,881, and 26,858 chargers, with associated costs of roughly $64.82 million, $224.24 million, and $415.83 million, respectively. Notably, the number of chargers and overall costs do not increase linearly with market share. This nonlinearity arises because charging needs are driven by users' travel patterns rather than solely by the number of vehicles, and because major cost components, such as grid upgrades, increase in stepwise increments when capacity thresholds are reached, rather than proportionally with each additional charger. An exception is the deployment of urban Level 2 chargers, which scales more directly with adoption because they are tied to residential units. The prioritization results complement these findings by focusing on the current 1 % market share, helping direct initial investment to locations that provide the greatest immediate benefit, while establishing a foundation for future updates as EV adoption expands.

7. References

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8. Appendix

This section presents detailed tables of charging station prioritization for both urban and intercity trips. Each row represents a charging station and reports its coordinates, the number of new required chargers, individual scores for each prioritization factor, the aggregated final score, and the resulting rank and priority classification. For clarity and consistency in presentation, the individual prioritization factors are abbreviated and reported in the tables as follows:

- **f1:** Normalized score for total EV demand at the station
- **f2:** Normalized score for total energy demand at the station
- **f3:** Normalized score for the spatial distribution of EV owners
- **f4:** Normalized score for the SoC of vehicles upon arrival
- **f5:** Normalized score for proximity to neighboring stations

Table 8: Charging station prioritization for Ann Arbor at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
42.265812	-83.730071	2	0.311	0.321	0.128	0.824	0.545	2.129	1	High
42.314174	-83.703167	2	0.183	0.185	0.149	0.838	0.692	2.047	2	Medium
42.243108	-83.630933	2	0.296	0.280	0.046	0.825	0.492	1.939	3	Low
42.235676	-83.658011	1	0.203	0.208	0.057	0.834	0.402	1.705	4	Low

Table 9: Charging station prioritization for Muskegon at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
43.19437	-86.255003	3	0.312	0.304	0.061	0.833	0.277	1.787	1	High
43.083899	-86.239839	2	0.242	0.237	0.105	0.829	0.365	1.777	2	Medium
43.40452	-86.337425	2	0.076	0.081	0.068	0.837	0.653	1.715	3	Low
43.323952	-86.20206	2	0.155	0.177	0.067	0.870	0.432	1.702	4	Low

Table 10: Charging station prioritization for Kalamazoo at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
42.267436	-85.715779	2	0.170	0.182	0.482	0.844	0.409	2.087	1	High
42.240477	-85.602584	3	0.309	0.295	0.279	0.841	0.273	1.997	2	High
42.278647	-85.921107	2	0.059	0.062	0.245	0.870	0.717	1.952	3	Medium
42.1166	-85.643675	2	0.051	0.057	0.284	0.839	0.569	1.801	4	Medium
42.300325	-85.564658	2	0.212	0.191	0.157	0.835	0.385	1.782	5	Low
42.284	-85.617592	2	0.165	0.173	0.177	0.835	0.310	1.660	6	Low

Table 11: Charging station prioritization for Flint at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
43.182506	-83.741552	2	0.056	0.052	0.242	0.856	0.745	1.952	1	High
42.986128	-83.785653	2	0.178	0.180	0.185	0.854	0.410	1.808	2	High
42.968708	-83.656847	3	0.221	0.218	0.193	0.846	0.327	1.805	3	Medium
43.006945	-83.647431	3	0.227	0.221	0.133	0.845	0.293	1.719	4	Medium
43.030913	-83.510972	1	0.054	0.051	0.185	0.838	0.577	1.705	5	Low
43.103245	-83.660317	2	0.092	0.095	0.099	0.847	0.473	1.606	6	Low

Table 12: Charging station prioritization for Saginaw at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
43.630627	-84.242685	2	0.162	0.150	0.138	0.842	0.288	1.581	1	High
43.735048	-83.462844	2	0.022	0.022	0.100	0.858	0.527	1.529	2	High
43.440851	-83.982829	3	0.185	0.186	0.071	0.836	0.195	1.472	3	High
43.380014	-84.204752	2	0.041	0.051	0.091	0.870	0.344	1.397	4	Medium
43.419226	-83.930459	2	0.126	0.124	0.048	0.854	0.208	1.360	5	Medium
43.433074	-83.665142	2	0.030	0.033	0.099	0.848	0.329	1.339	6	Medium
43.599229	-84.082358	2	0.064	0.064	0.096	0.864	0.205	1.293	7	Low
43.600331	-83.903874	2	0.121	0.119	0.059	0.837	0.092	1.227	8	Low
43.497774	-83.909011	2	0.079	0.075	0.068	0.856	0.144	1.223	9	Low
43.601637	-83.861866	2	0.086	0.079	0.058	0.834	0.115	1.172	10	Low

Table 13: Charging station prioritization for Lansing at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
42.71689	-84.33675	2	0.066	0.071	0.513	0.855	0.290	1.795	1	High
42.57704	-84.825201	2	0.030	0.031	0.242	0.858	0.531	1.692	2	High
42.691083	-84.399767	2	0.041	0.046	0.469	0.870	0.213	1.640	3	High
42.740155	-84.506898	3	0.184	0.177	0.236	0.845	0.106	1.548	4	Medium
42.807905	-84.647423	2	0.079	0.078	0.256	0.860	0.259	1.532	5	Medium
42.72067	-84.766064	2	0.040	0.040	0.255	0.858	0.315	1.509	6	Medium
42.651527	-84.5171	2	0.081	0.082	0.253	0.865	0.190	1.470	7	Medium
42.746182	-84.551962	3	0.179	0.169	0.166	0.844	0.109	1.467	8	Low
42.706783	-84.595029	2	0.107	0.114	0.161	0.846	0.140	1.368	9	Low
42.730604	-84.477829	2	0.099	0.095	0.188	0.829	0.133	1.344	10	Low
42.729078	-84.573454	1	0.018	0.023	0.101	0.855	0.120	1.117	11	Low

Table 14: Charging station prioritization for Grand Rapids at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
43.12755	-85.561016	2	0.081	0.076	0.055	0.865	0.543	1.619	1	High
42.994628	-85.452956	2	0.026	0.028	0.174	0.868	0.459	1.555	2	High
42.898869	-85.776298	2	0.043	0.050	0.047	0.873	0.270	1.282	3	High
42.973056	-85.618665	3	0.119	0.122	0.045	0.839	0.144	1.269	4	High
42.920786	-85.700332	3	0.107	0.103	0.031	0.851	0.158	1.251	5	Medium
42.874925	-85.705436	3	0.104	0.100	0.036	0.845	0.155	1.240	6	Medium
42.902637	-85.573521	2	0.075	0.077	0.039	0.843	0.206	1.239	7	Medium
42.846711	-85.669557	2	0.049	0.053	0.065	0.873	0.197	1.237	8	Medium
42.928888	-85.590991	2	0.072	0.070	0.068	0.833	0.169	1.212	9	Low
42.96696	-85.694509	2	0.069	0.071	0.031	0.856	0.139	1.165	10	Low
42.942562	-85.662047	2	0.058	0.054	0.026	0.849	0.130	1.118	11	Low
42.990935	-85.669548	2	0.050	0.052	0.035	0.843	0.134	1.113	12	Low
42.880126	-85.6486	2	0.046	0.043	0.025	0.843	0.139	1.097	13	Low

Table 15: Charging station prioritization for Detroit at 1% EV market share

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
42.555673	-83.497388	3	0.018	0.017	0.132	0.857	0.164	1.187	1	High
42.641113	-83.147719	3	0.012	0.012	0.154	0.869	0.120	1.167	2	High
42.590358	-83.309899	3	0.015	0.015	0.181	0.849	0.094	1.155	3	High
42.599174	-83.194224	3	0.018	0.018	0.171	0.854	0.089	1.149	4	High
42.485065	-83.242763	4	0.027	0.029	0.114	0.866	0.086	1.123	5	High
42.554494	-83.074851	3	0.025	0.023	0.133	0.845	0.095	1.121	6	High
42.48585	-83.169554	6	0.050	0.052	0.076	0.853	0.082	1.113	7	High
42.552101	-83.190789	4	0.039	0.039	0.099	0.844	0.091	1.112	8	High
42.494941	-82.989837	3	0.018	0.018	0.142	0.835	0.097	1.110	9	High
42.517991	-83.369226	3	0.018	0.019	0.103	0.851	0.117	1.108	10	High
42.479434	-83.099422	4	0.033	0.035	0.106	0.853	0.072	1.100	11	High
42.556754	-82.914486	5	0.045	0.046	0.050	0.848	0.100	1.090	12	High
42.436122	-83.254234	3	0.029	0.030	0.082	0.867	0.083	1.089	13	High
42.406956	-83.49514	3	0.012	0.012	0.090	0.845	0.124	1.083	14	High
42.317162	-83.471752	3	0.016	0.015	0.088	0.839	0.124	1.082	15	High
42.603922	-82.892649	3	0.011	0.011	0.059	0.857	0.141	1.079	16	High
42.613849	-83.333822	1	0.002	0.002	0.143	0.843	0.086	1.076	17	Medium
42.452996	-83.39394	3	0.012	0.013	0.116	0.836	0.097	1.074	18	Medium
42.545777	-83.127856	4	0.017	0.018	0.102	0.854	0.083	1.074	19	Medium
42.631735	-83.258753	3	0.012	0.012	0.111	0.849	0.087	1.070	20	Medium
42.271064	-83.370025	3	0.028	0.027	0.046	0.860	0.108	1.069	21	Medium
42.348137	-83.185694	2	0.022	0.021	0.090	0.849	0.084	1.067	22	Medium

Latitude	Longitude	New Required Chargers	f1	f2	f3	f4	f5	Final score	Rank	Priority
42.416781	-83.392519	3	0.018	0.019	0.077	0.851	0.093	1.058	23	Medium
42.437839	-83.050638	3	0.010	0.010	0.124	0.840	0.073	1.056	24	Medium
42.580523	-83.018467	3	0.008	0.008	0.084	0.843	0.112	1.055	25	Medium
42.66149	-83.361927	3	0.012	0.011	0.103	0.839	0.089	1.054	26	Medium
42.171992	-83.211148	4	0.037	0.036	0.039	0.854	0.089	1.054	27	Medium
42.406606	-83.10864	4	0.031	0.033	0.066	0.865	0.053	1.048	28	Medium
42.408381	-83.31091	2	0.017	0.016	0.071	0.858	0.081	1.043	29	Medium
42.303966	-83.409531	2	0.021	0.021	0.056	0.845	0.100	1.042	30	Medium
42.404086	-82.910093	3	0.011	0.010	0.106	0.823	0.091	1.040	31	Medium
42.359001	-83.349495	3	0.027	0.027	0.056	0.850	0.077	1.038	32	Medium
42.350104	-83.303429	3	0.020	0.019	0.072	0.844	0.073	1.029	33	Low
42.313639	-83.098721	3	0.020	0.019	0.033	0.852	0.104	1.028	34	Low
42.28747	-83.267076	3	0.013	0.013	0.083	0.833	0.085	1.026	35	Low
42.350042	-83.285747	3	0.015	0.014	0.062	0.856	0.073	1.020	36	Low
42.417506	-82.950022	3	0.033	0.031	0.034	0.844	0.071	1.014	37	Low
42.399842	-83.148526	3	0.031	0.030	0.046	0.852	0.052	1.011	38	Low
42.678957	-83.400129	1	0.002	0.002	0.075	0.810	0.122	1.011	39	Low
42.372552	-83.134346	4	0.028	0.029	0.029	0.862	0.058	1.006	40	Low
42.246933	-83.257984	3	0.017	0.015	0.042	0.854	0.072	0.999	41	Low
42.356122	-83.071408	3	0.016	0.017	0.039	0.844	0.081	0.996	42	Low
42.208037	-83.18724	3	0.024	0.024	0.034	0.833	0.080	0.995	43	Low
42.398631	-83.184201	2	0.016	0.016	0.039	0.840	0.068	0.979	44	Low
42.454598	-82.974213	3	0.019	0.018	0.034	0.830	0.074	0.976	45	Low
42.423131	-83.104481	2	0.020	0.021	0.030	0.850	0.053	0.975	46	Low
42.244703	-83.22341	3	0.013	0.014	0.040	0.841	0.066	0.974	47	Low
42.368779	-82.984615	3	0.009	0.009	0.026	0.826	0.100	0.970	48	Low
42.45257	-82.903707	1	0.006	0.005	0.046	0.830	0.082	0.969	49	Low

Table 16: Charging stations prioritization for intercity trips at 1% EV market share

City	Latitude	Longitude	New Required Chargers	f2	f5	Final score	Rank	Priority
Bruce Crossing	46.534859	-89.17862	2	1.000	1.000	2.000	1	High
Naubinway	46.093975	-85.339534	4	0.664	0.750	1.414	2	High
Au Gres	44.107737	-83.568088	2	0.777	0.213	0.989	3	High
Champion	46.49724	-87.920075	2	0.297	0.411	0.708	4	Medium
Kalkaska	44.716742	-85.18996	4	0.467	0.039	0.507	5	Medium
Rudyard	46.163953	-84.561024	4	0.009	0.429	0.438	6	Medium
Mackinaw City	45.779153	-84.733437	7	0.429	0.005	0.434	7	Medium
Kewadin	45.116122	-85.350205	4	0.366	0.004	0.370	8	Low
Ionia	42.879412	-85.075158	4	0.274	0.021	0.295	9	Low
Howard City	43.424696	-85.495913	4	0.124	0.086	0.210	10	Low
Indian River	45.410854	-84.605315	4	0.163	0.014	0.177	11	Low