CHARGING GREENFIELD

CITY OF GREENFIELD

Electric Vehicle Charging Plan

January 2024

[This page is left blank]

ACKNOWLEDGEMENTS

We would like to express gratitute to everyone who contributed to the creation of this plan: the Greenfield residents, Mayor Chuck Fewell who initated this study, the Steering Committee members, and the Indianapolis Metropolitan Planning Organization.

City of Greenfield

Consultant

ms consultants, inc.
engineers, architects, planners

Steering Committee Members

Jason Koch

Joan Fitzwater

Evan Beaty

Donna Butler

Jeffrey Lowder

Dan Riley

George Plisinski

Randy Sorrell

Steve Ostewig

Jane Webb

Ellen Kueker

DISCLAIMERS:

The City of Greenfield does not endorse products or manufacturers mentioned in this plan. Trademarks or manufacturers' names appear in this plan only because they are considered essential to the objective of the plan.

Title VI Statement (required by our Title VI plan)

The Indianapolis Metropolitan Planning Organization (IMPO) values each individual's civil rights and wishes to provide equal opportunity and equitable service. As a recipient of federal funds, the IMPO conforms to Title VI of the Civil Rights Act of 1964 (Title VI) and all related statutes, regulations, and directives, which provide that no person shall be excluded from participation in, denied benefits of, or subjected to discrimination under any program or activity receiving federal financial assistance from the IMPO on the grounds of race, color, age, sex, sexual orientation, gender identity, disability, national origin, religion, income status or limited English proficiency. The IMPO further assures every effort will be made to ensure nondiscrimination in all of its programs and activities, regardless of whether those programs and activities are federally funded. For any and all inquiries regarding the application of this accessibility statement and related policies, please view the IMPO Title VI page, indympo.org/policies.

Language Access

If information is needed in another language, contact 317-327-5136. Si se necesita información en otro idioma, comuníquese con 317-327-5136.

INDOT/FHWA

This plan was prepared in cooperation with the State of Indiana, the Indiana Department of Transportation, and the Federal Highway Administration. This financial assistance notwithstanding, the contents of this document do not necessarily reflect the official view or policies of the funding agencies.

CONTENTS

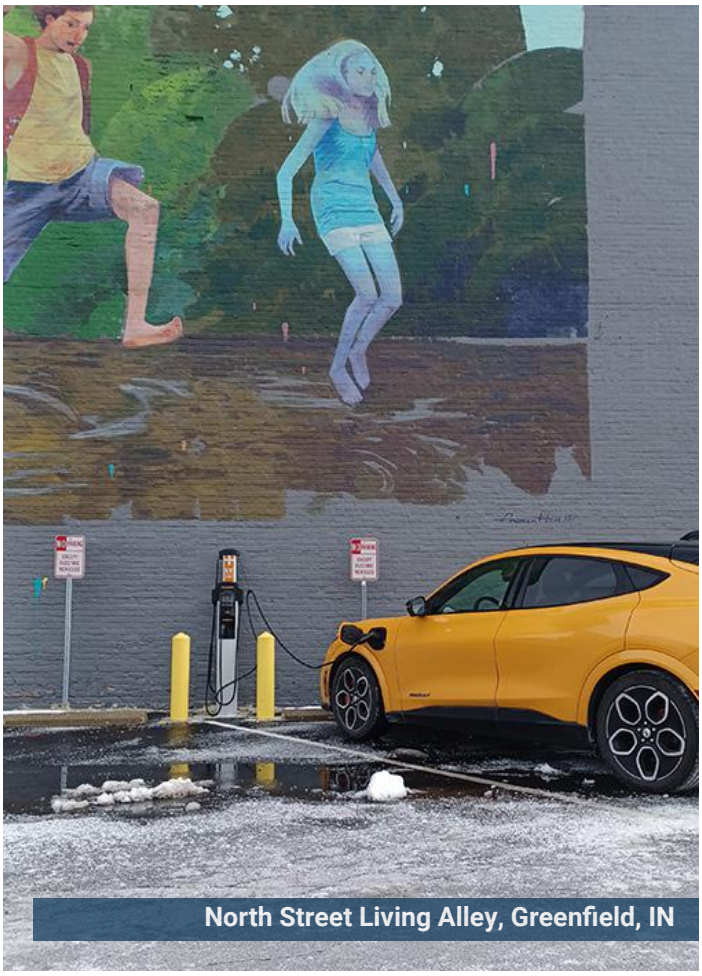
EXECUTIVE SUMMARY

WHAT IS CHARGING GREENFIELD?

The Charging Greenfield Plan, that began as an initative from Mayor Fewell's office, is a proactive step taken by the City of Greenfield to deploy Electric Vehicle Charging Stations (EVCS) in the Greenfield community in support of its green initiatives, alternative transportation policies, and the city and county's economic development activities.

This plan explains why it is important to plan for electric vehicles (EVs), what role the government can play in the safe and equitable EVCS development, and how the city can prepare itself for ways the EV market can behave in the future. The intention is to provide the city with a guidebook to help their decision making regarding the EVCS.

Planning for EV charging is a component of a wider Comprehensive Plan policy because it relates to land uses, public utilities, transportation, and the use of publically owned property and thoroughfares.



North Street Living Alley, Greenfield, IN

KEY TERMS AND PHRASES

The EV market is emerging and has developed its own set of terms. As a rapidly evolving field, a few of these terms may change in the future. To keep this plan clear to the reader today and in the future, this section establishes the key terms, abbreviations, and phrases used throughout this plan. Also, EV Factsheets in **Appendix D** provide additional explanation and illustrations that help demystify electric vehicles and charging.

Vehicles

EV - Electric Vehicle

A vehicle that uses battery to power its movement either all the time or sometimes and can be charged. It includes all-battery and plug-in hybrid electric vehicles.

BEV - Battery Electric Vehicle

An all-battery electric vehicle that can be charged and does not use any gasoline. Sometimes, this type of vehicle is referred to as PEV (plug-in electric vehicle), but in this plan, the term BEV is used.

PHEV - Plug-in Hybrid Electric Vehicle

A vehicle that can run using both battery and gasoline and can be charged. The battery capacity is lower than that of a BEV.

Hybrid Vehicle

A vehicle that can run using both battery and gasoline, but cannot be charged. The battery size and capacity is lower than that of a PHEV.

ICE - Internal Combustion Engine

A vehicle that runs only on gasoline or another fossil fuel that powers an internal combustion engine.

Charging

Level 1 Charging

Charging an EV by plugging it into a standard 120 volt AC electric circuit. Every EV comes with a cord that can be plugged into a wall, like any other electric appliance. The charging speed is slow.

Level 2 Charging

Charging an EV using a 208/240 volt AC electric circuit. This charging involves adding an EV charging device that plugs into an outlet at home or in a parking area and then the EV is plugged into this charger. The charging speed is medium.

DCFC - Direct Current Fast Charging

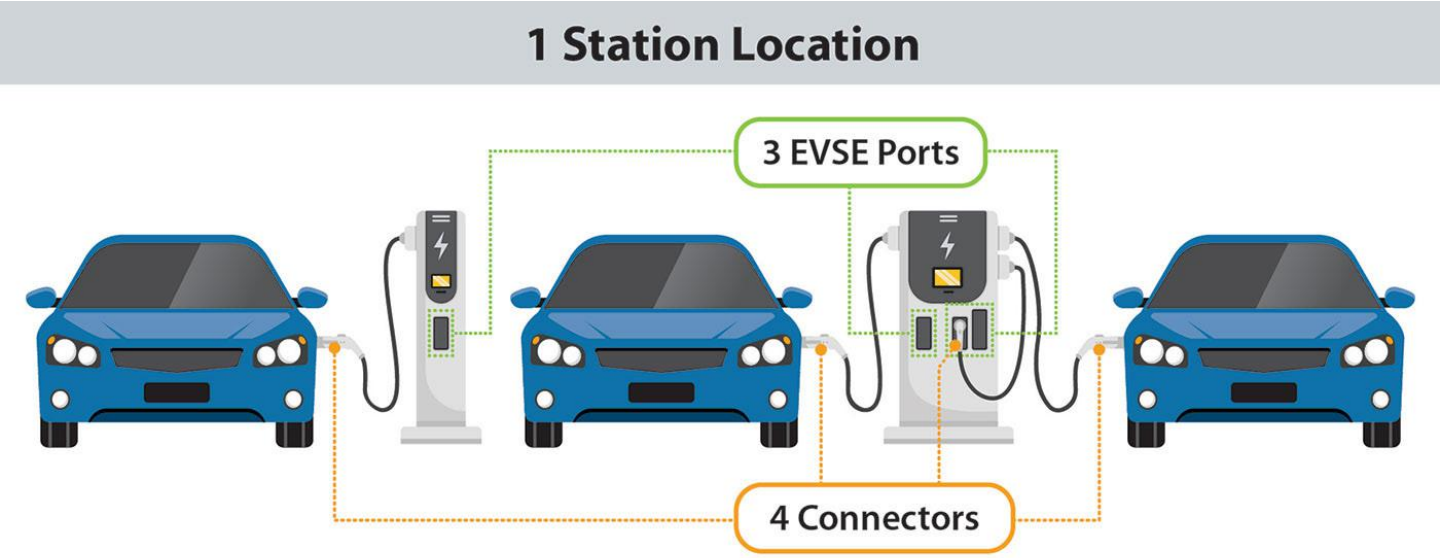
This is fast charging, sometimes referred to as a Level 3 DC charging, that uses a 3-phase 480 volt AC electric circuit but delivers direct current (DC) to the vehicle. The charging speed is fast.

EVCS - Electric Vehicle Charging Station

A place that has one or more electric vehicle chargers or other charging equipment. This term encompasses not just the physical hardware to charge EVs, but also the location, services, and infrastructure where EVs can be charged.

Figure 0.1 An EV charging station

Figure 0.2 Typical elements of an EV charging station. Source (1)



EVSE - Electric Vehicle Service Equipment

Hardware equipment that safely supplies and manages the flow of electricity from a host facility into an EV. EVSE may also include communication, metering, GPS, and other features that assist EV drivers and facility owners.

EVSE Port

An EVSE port provides power to charge only one vehicle at a time even though it may have multiple connectors.

Connector

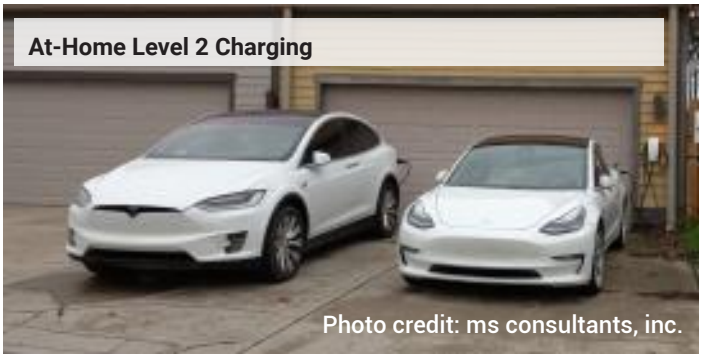
A connector is what is plugged into a vehicle to charge it. Multiple connectors and connector types (such as J1772 and CCS) can be available on one EVSE port, but only one vehicle will charge at a time. Connectors are sometimes called plugs.

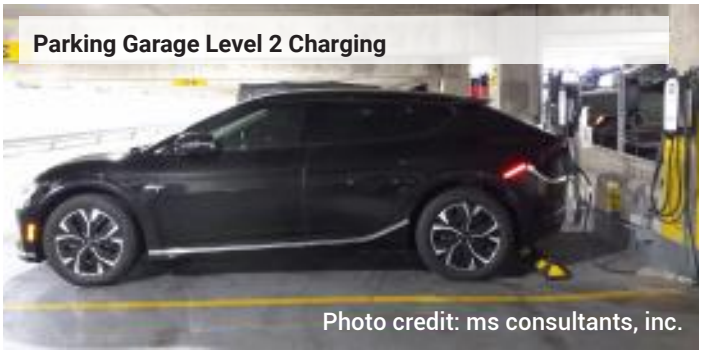
Why does the number of charging ports and connectors differ?

Imagine charging your phone. A USB charger with two ports is plugged into an outlet, but you need to charge 3 phones with different plug requirements: a micro-USB, a USB-A, and a USB-C. You plug 2 charging cables to charge two phones and then charge another phone later using a third cable.

A single EV charger is like a USB charger, an EVSE port is like a USB port, and an EVSE connector is like a USB cable that has only one type of a plug (USB-A, USB-C, etc.). Instead of you carrying around "USB" cables, or connectors, to plug into the charger, the EV charging station installs several cables with several kinds of plugs. Sometime two EV connectors are internally connected into one port. So, while an EV charger may look like it has 3 cables and able to charge three cars at a time, it actually is able to charge only two if it has only two ports.

Figure 0.3 Charging at home and elsewhere





PLANNING CONTEXT

Planning for EV charging infrastructure is a new specialization in planning. It is helpful to understand the types of planning because each one has a different set of considerations of who needs EV charging, what kinds, and where.

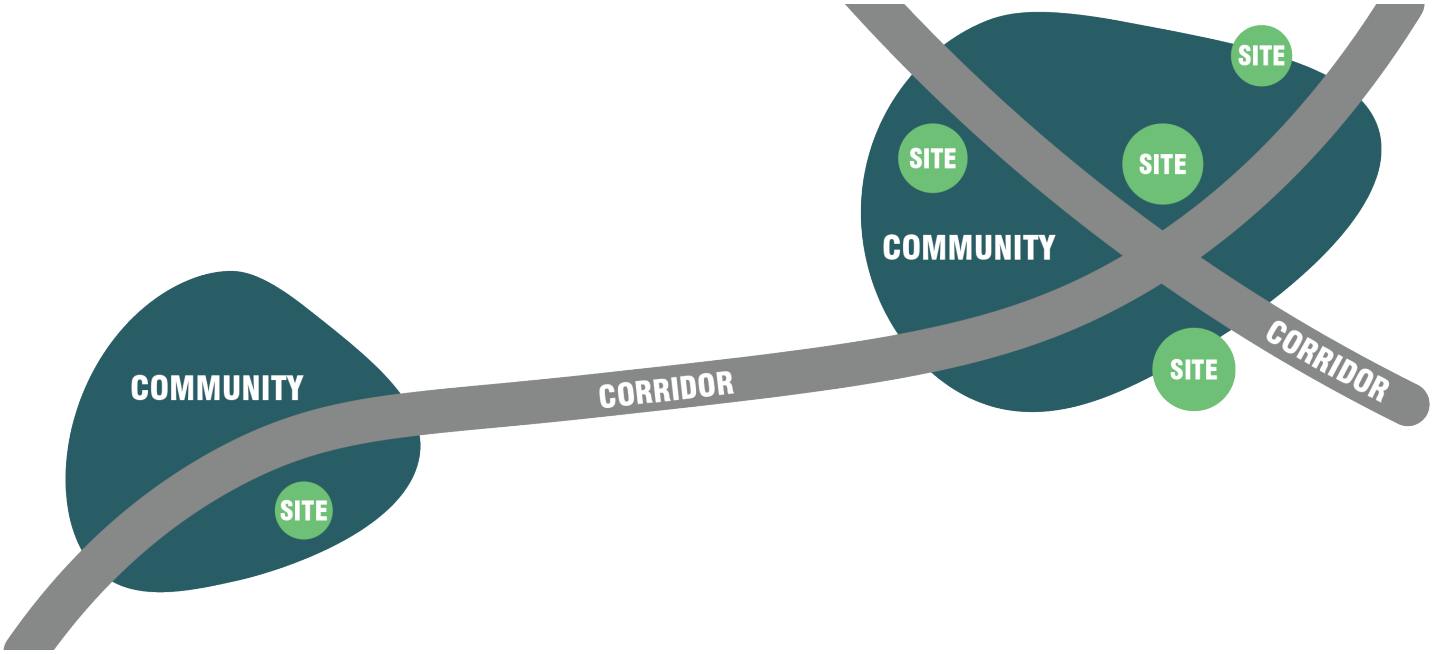
There are three main geographic levels of electric vehicle charging infrastructure planning (see figure below for illustration).

- **Corridor**. Corridor-level planning supports infrastructure along the roads that facilitate interregional travel. It focuses on the needs of travelers and fleet operators that mostly need fast charging.
- **Community**. Community-level planning focuses on the various needs for EV charging within a small region, city, or a town.
- **Site**. Site-level planning focuses on developing a specific predetermined site by installing EV charging infrastructure.

Charging Greenfield Plan serves as a *community-level* planning guide with some recommendations for sites best suited for EV charging development. Also discussed is how Greenfield fits into the current corridor-level state plan for EV charging.

EV drivers use all levels of charging starting with at-home charging and finishing with fast 20-30-minute charging sessions at a variety of locations. Some residents may not be able to have at-home charging, so there is a need to think about the areas and type of charging that could fit the needs of all residents.

Keeping in mind the community-level planning context, the main focus of this plan is to understand the current and future needs for EV charging in Greenfield and to determine which areas within Greenfield may need additional EV charging infrastructure support.



VISION AND GOALS OF THIS PLAN

VISION

The City of Greenfield will be proactive and flexible to respond to the adoption of electric vehicles and be EV-ready.

Current & Future Demand

GOAL

Understand the current and future needs for EV charging stations in Greenfield.

Chapter 1 goes over the current EV market trends. Chapter 2 focuses on the needs in Greenfield and Hancock County. Finally, Chapter 3 presents estimated future EVCS demand scenarios.

Public Support

GOAL

Develop educational materials to inform Greenfield residents about EVs and constructing charging stations to meet market demand.

The plan contains factsheets that explain what EVs and EV charging stations are, list their benefits and answer other frequently asked questions.

Possible Host Sites

GOAL

Determine locations throughout Greenfield which could potentially host EV charging stations.

Chapter 3 combines analysis of the possible EV charging market needs in Greenfield, travel patterns, and consumer preferences to propose a list of potential EV charging locations.

Grants & Funding

GOAL

Identify funding sources for EV charging station installation and compile data for grant application readiness.

Chapter 4 lists funding sources that Greenfield could tap into for EV charging infrastructure projects. While the intent of most grants is for a private entity to eventually operate EVCS, the eligible applicants for grants are government entities.

Government Policies

GOAL

The City of Greenfield will be mindful about policies that could encourage EV market growth while also providing for safe EV charging integration.

Chapters 1 and 2 explain why government's role in the EV market is important. Chapter 4 compiles examples of policies that can help Greenfield reach the stated goal.

PLAN HIGHLIGHTS

To serve as a good guide to the city leadership and community about EVs and EVCS, the Charging Greenfield Plan provides information, analysis, and recommendations that help answer the following questions:

- What is the current and future market demand for EVs in Greenfield?
- What are consumers interested in?
- Who will need access to publicly accessible EVCS in Greenfield?
- What EV charging infrastructure may be needed in Greenfield in the next 5-10 years?
- What are the most suitable EVCS locations in Greenfield?
- What role can the local government play in the EV market?
- How can the government make the best decisions regarding EVs and EVCS policies and projects?

Charging Greenfield Plan is structured in the following way.

CHAPTER 1. WHY PLAN FOR EVs?

This chapter goes over the state of EVs today and the need for EV planning in general. It explains what EVs and EV charging stations are, goes over EV market trends. It shows the kinds of actions other cities have taken to help with EV integration into the community. It explains what barriers to EV charging currently exist and explains the need for a more proactive approach to providing EV charging infrastructure.

CHAPTER 2. EVs IN GREENFIELD TODAY

This chapter describes the current state of the EV market in Greenfield and Hancock County. It shows how planning for EVCS is connected to other planning policies in Greenfield. It records the existing EVCS and provides housing and vehicle analysis to explain where the need for EV charging may occur in the future. It also records the results of the public engagement activities to show what Greenfield residents think of EVs today and what future EVCS needs they may have.

CHAPTER 3. EVs IN GREENFIELD TOMORROW

This chapter provides the answers to the most important questions listed above. It records the possible scenarios of how the EV market could play out in Greenfield in the next 5-10 years, what EVCS would be needed and where. It also establishes priority areas for EVCS projects in Greenfield.

CHAPTER 4. MAKING GREENFIELD EV-READY

This chapter provides more detailed information about the sites that are most suitable for EVCS development based on the market analysis, travel pattern analysis, and public engagement results. The roles of participants in designing, installing, and operating EVCS are explained. The chapter also covers grants and funding recommendations that could be suitable for Greenfield projects, should the city choose to apply for them. Finally it provides recommendations for policy updates regarding land use regulations, utility and public safety policies.

APPENDICES

Information that is highly technical is recorded in the Appendices, like additional data, methodologies, and ordinance language examples as well as educational EV factsheets.

KEY FINDINGS

Current & Future Demand

Understand the current and future needs for EV charging stations in Greenfield.

- ***EV market growth***. *The EV market has been rapidly growing in the US and Indiana and is not stopping. While EV adoption in Greenfield currently is at its infancy, it will be growing. Market trends are discussed in more detail in Chapters 1 and 2.*
- ***Priority Locations in Greenfield***. *Greenfield residents living close to US 40 and SR 9 are likely to need access to publicly accessible EV charging in the future because of the highest shares of multi-family housing, rental housing, and older homes that may not be able to provide for at-home charging. The discussion of the priority areas is in Chapter 2 and the priority areas are shown in Chapter 3.*
- ***Future demand for publicly accessible EV charging***. *Scenarios of future EV charging needs in Greenfield show that anywhere between 106-278 charging ports (or about 10-30 station locations) could be needed in 10 years. The Table below summarizes the number and kind of charging ports per scenario.*

Total Number of Publicly Accessible Charging Ports Needed

	SCENARIOS OF FUTURE CHARGING PORT NEEDS	LOW 2028-2030 5YR 700 BEV		MEDIUM 2031-2033 10 YR AVG 2000 BEV		HIGH 2033 10 YR OPT 4000 BEV	
	PERCENT OF DRIVERS WITH ACCESS TO HOME CHARGING	61 %	75 %	61 %	75 %	61 %	75 %
Public	Level 2	46	33	120	94	247	194
	DCFC	6	6	15	12	31	25
	Total public	52	39	135	106	278	219

Possible Host Sites

Determine locations throughout Greenfield which could potentially host EV charging stations.

- ***Possible EV charging locations***. *A detailed analysis of land uses and trips in Greenfield, coupled with input from the public and stakeholders, resulted in recommending **41 publicly- and privately-owned sites** across the city that can successfully deploy EVCS.*
- ***Publicly-owned sites suitable for EV charging***. *Six sites, owned by the city or non-for-profits from the list of 41 recommended sites may be suitable for addition of EV charging: Downtown area, Brandywine Park, Riley Park, Beckenholdt Park, Hancock Public Library, and Greenfield-Central High School. Preliminary site analysis with infrastructure recommendations are presented in Chapter 4.*

Government Policies

The City of Greenfield will be mindful about policies that could encourage EV market growth while also provide for safe EV charging integration.

- ***Becoming EV-Ready.*** *Certain policies will need to be put in place to prepare the community for EV adoption including updating ordinances & permitting, public safety training, and utility policies. Chapter 4 goes over all of these areas and lists recommendations.*
- ***Land Use and Building Standards.*** *Examples of land use and building standards are provided in Chapter 4 that could prepare the city for the review of EV projects.*
- ***Public Safety****. Chapter 4 has resources and guidelines on how the public safety personnel could prepare itself for EV-related situations.*
- ***Electric Utility****. Charging suitability based on grid capabilities and some strategies to control electricity use are discussed in Chapter 4.*
- ***EVCS Partnerships****. Chapter 4 describes what roles various actors can play in building and operating an EV charging station. The city and electric utility already play a permitting role, but could also take on other roles.*

Grants & Funding

Identify funding sources for EV charging station installation and compile data for grant application readiness.

- ***Grant Choice.*** *While there are several grants out there that Greenfield could be eligible for, the most feasible would be a federal Community CFI grant and some TIP grants from Indianapolis MPO. More details can be found in Chapter 4.*
- ***Grant Readiness.*** *Scenario planning, public engagement, priority areas based on equity analysis, and city-wide site recommendations in this plan can be used to justify the need for the grants. Also, no matter what grant path is chosen, federal minimum EVCS standards will likely be applicable to all of them.*

Public Support

Develop educational materials to inform Greenfield residents about EVs and constructing charging stations to meet market demand.

- ***EV FAQs.*** *At the end of this plan, there is a great resource called EV Factsheets to share with the public to teach them about the electric vehicles, charging, associated costs and maintenance and many other topics.*
- ***Website.*** *Devoting a page on the city's website to share EV Factsheets and this plan and sharing updates on city-led EV policies, projects and initiatives would be a good way to connect to Greenfield community on the EV-readiness topic.*

REFERENCES

1. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Developing Infrastructure to Charger Electric Vehicles.*** Link: https://afdc.energy.gov/fuels/electricity_infrastructure.html.

1 | WHY EVs?

Market and policy trends, technological advancements in EV battery range, and economies of scale are driving growth in EVs that did not slow even during the COVID-19 pandemic. Manufacturers have created hundreds of EV models with more battery capacity to alleviate consumers' anxiety over trip ranges. Charging stations are now a critical gap in the market, and the construction of charging stations is lagging behind the demand for EVs. This chapter goes over the market trends in detail and explains why it is important to plan for EV charging .

WHY PLAN FOR EVS?

Since the Tesla Roadster and Nissan Leaf were introduced in the late 2000's, hundreds of new Electric Vehicle (EV) models have entered the market, from sedans and SUVs to school buses and semi-trucks. It took a decade to reach the first million of EVs sold in the US by 2021, and only two more years to reach the three million vehicles sold (2). Sales are increasing rapidly not just in the United States, but also in Indiana and Hancock County (Appendix A). The EV market trend is turning from an niche market into a palpable present reality for many consumers. As more people purchase electric vehicles, planning is needed to prepare the Greenfield community and its electric grid.

The prices for EVs have been decreasing, the battery storage capacity of an EV has increased by 350% in the past decade (Appendix A), the offering of sedan and SUV models has gone up to over 400 models, but one hurdle still remains: a reliable widely accessible charging network.

Without widely-available EV chargers, people may be hesitant to purchase an EV. Without seeing the demand for charging from the EV drivers, businesses are hesitent to invest in installing and maintaining a charger. This leads to a chicken-and-egg problem: should there be enough consumers purchasing EVs before the private market is willing to provide enough EV chargers, or should the market install widespread, public EV chargers so that more consumers will feel more comfortable purchasing EVs?

The federal government has stepped in with several billion dollars of funding from the Infrastructure Investment and Jobs Act (IIJA) to catalyze EV charging infrastructure deployment (3). This funding will develop a national network of EV charging, so that cross-country EV travel is reliable. While a lot of the funds are dedicated to EV charging near highways and selected state routes, some local charging infrastructure funding is eligible too.

Rivian SUV. Image source: 1.

EV Chicken-and-Egg Problem

Without widely-available EV chargers, people may be hesitant to purchase an EV. Without widely-used EVs, the private market may not install EV chargers due to the lack of demand. Proactive government support for EV charging installation can resolve this conundrum.

It is epxected that the private market will provide most EV charging infrastructure (4), but cities need to be proactive about providing adequate and reliable charging infrastructure as well. The market typically serves people who can pay for the service. Most current EV drivers have a garage and ability to use at-home charging and rely on publicly accessible charging mostly during travel. However, there are a number of consumers like residents of senior housing, multi-family housing, and people who live in old houses without the garages, sometimes refered to as "garage orphans" (5). These consumers don't have at-home infrastructure for charging, which is the cheapest way to charge and will be at the mercy of the market prices for EV charging. The government can step in to provide some more affordable and equitable EV charging options for its residents close to the charging desserts.

Charging Greenfield Plan is the City of Greenfield's proactive approach to preparing for EV future. This plan identifies locations for possible new EV charging infrastructure, while supporting the City's other economic development and sustainability initiatives. This plan includes information on EV trends, estimates Greenfield's charging needs, and inventories possible upgrades to the electric grid. Importantly, the plan identifies areas in Greenfield where residents and visitors may need public charging access the most.

EV MARKET PLAYERS

To understand EV market trends and the role that the government can play in the EV market, it is important to know EV market players and their function. The market trends presented in this chapter describe what is happening within each market segment and what to expect in the future.

Currently available funding and tax rebates permeate and support most of these market segments.

Car Manufacturers

Companies that produce electric vehicles. Vehicles encompass any vehicle style: golf carts, passenger cars, vans, cab chassis, buses, and semi-trucks.

EV Drivers

Just like there is a myriad of electric vehicles, EV drivers range from a person driving a personal vehicle to government and business fleet drivers.

Electricity Providers

"Fuel" for EVs comes from the electric grid that is built and maintained by private and public entities. In Greenfield, Greenfield Power and Light agency is in charge of the electric grid.

Charging Site Hosts

These are places where EV charging stations are located: private or public lots or along streets.

EVSE Providers

This category includes entities that create, install, and maintain the hardware of the EV charging equipment. They come into play at a site-level planning stage.

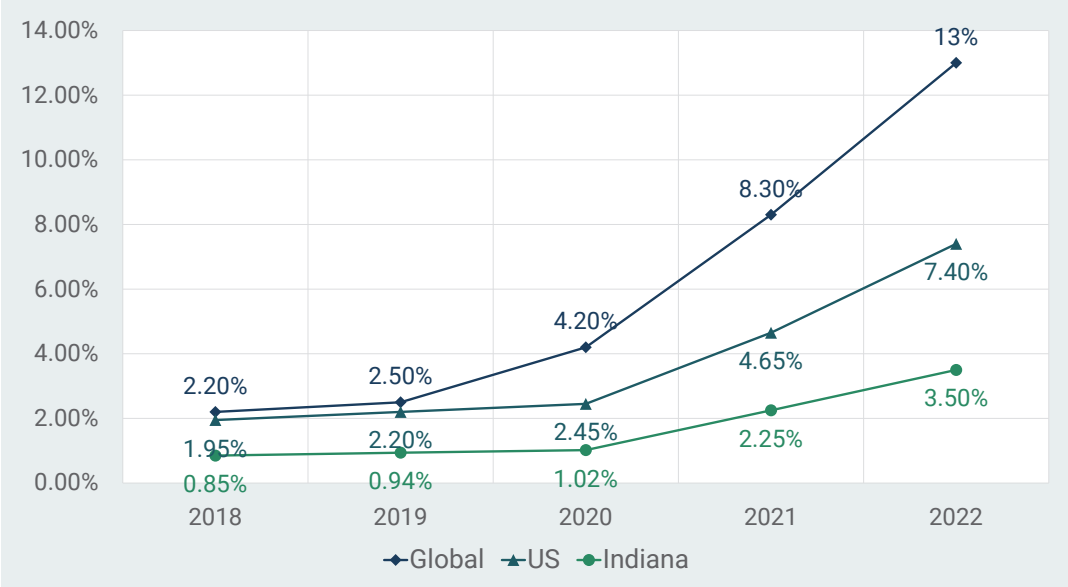
EV MARKET TRENDS

GROWTH IN THE EV MARKET

Purchases of electric vehicles are growing quickly globally, nationally, and in Indiana (Figure 1.1). In Indiana in 2022, 3% of all vehicles sold were EVs compared to less than 1% in 2019 (13). Figure 1.2 shows that the share of battery electric vehicles (BEVs) registrations is also increasing.

Consumer EV confidence is rising fast. A survey was conducted among consumers who intend to buy a vehicle in the next 24 months to find out their preference in 2022 (6). Over half (52%) global consumers and almost a third of the US consumers (29 %) say they will choose an EV or hybrid vehicle (6).

Figure 1.1 Percent of Electric Vehicle Sales, of all Sales (Sources: 11, 12)



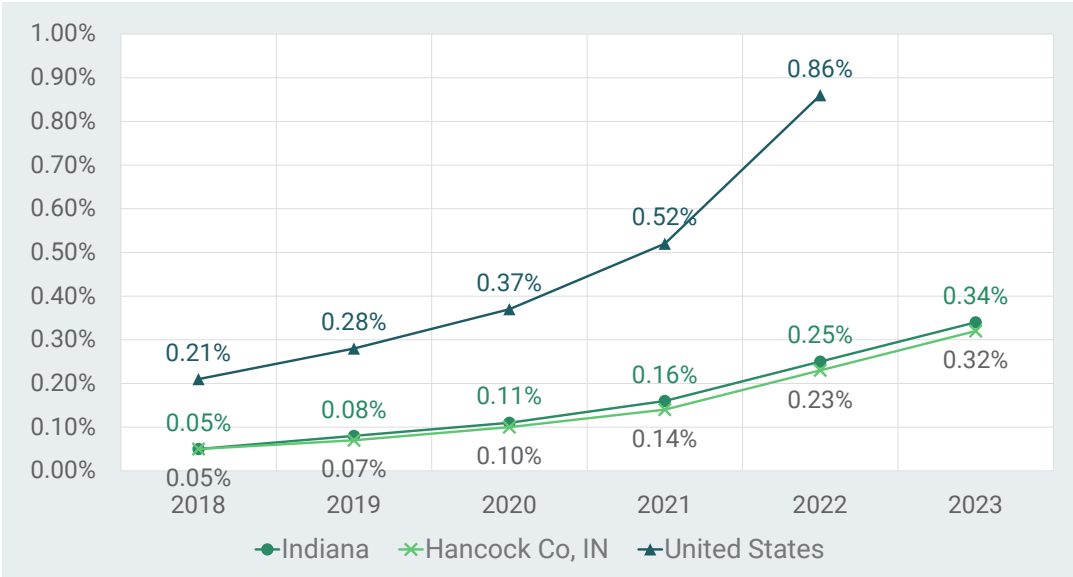
Future Trends of EV Sales

Although it is clear that EV use will continue to rise, forecasts vary. In general, agencies predict that EVs will make up between 25 and 50 percent of all vehicle sales by 2030 (4, 7, 8, 9, 10).

This expected increase of EVs stems from a combination of policy and market factors including:

- Growing concern over air pollution and climate change
- Depleting oil supply and volatile oil prices
- Lowering EV prices and advancements in battery range
- Affordable prices as electric vehicles are resold as used cars

Figure 1.2 Percent of Battery Electric Vehicles (BEVs) Registrations, of all Sales (Sources: 13, 14)



+350%
in average battery range in the last decade (Appendix A)

INCREASE IN EV VARIETY

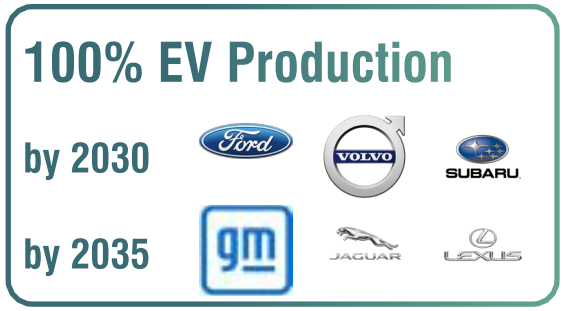
The introduction of mass-produced EVs began in 2008 with the Tesla Roadster, shortly followed by the Nissan Leaf in 2009 (16, 17). For years, these models dominated the EV industry. But, in the last few years, hundreds of new EVs have been produced, by both traditional manufacturers and new companies (like Rivian, Lucid, Fisker, NiO, and Nikola).

Today, over 300 EVs are available, from sedans and luxury SUVs to semi-trucks and municipal refuse trucks. Nearly any gas-powered vehicle is available in an equivalent EV (see Figure 1.3 for examples).

Figure 1.3 Examples of EVs (Image sources: 1, 18, 19)

Many car manufacturers are setting ambitious goals. Volkswagen and Audi are planning to cease production of any internal combustion engine vehicle (ICE) by 2025 (7). Figure 1.4 shows that Ford, Volvo, and Subaru are aiming to produce only EVs by 2030, while GM, Jaguar, and Lexus aim to do the same by 2035 (7). Other companies, like Jeep and Nissan, are aiming to sell only BEVs in Europe by 2030 (7).

Figure 1.4 Manufacturer Commitments (Image sources: 20, 21, 22, 23, 24)



GROWING NUMBERS OF EV CHARGERS

Between 2012 and 2022, the number of EV charging stations (EVCS) in the United States increased more than seven-times over, from 6,200 stations to nearly 54,000 (see **Appendix A**). Other alternative fuel stations are now less dominant, and EV charging stations are the leader in the alternative fuel industry, making up 85% of all alternative fuel stations in 2022. The current federal administration plans to fund 500,000 new charging stations by 2030 (15). The goal is to create a robust, reliable, and national charging network to enable EV cross-country travel.

Charging Locations

EVs can be charged in many places: home, work, and other public places. Figure 1.5 shows where charging occurs today in the United States (4). Market experts predict the future residential charging may decrease to 50 % as consumers who lack garages find more public chargers, at work, or in other locations (10).

+860 %
charging stations in the last decade in the US (Appendix A)

Also, EV charging may look different across communities. For example, cities with many historic and/or multi-family houses may not have the same access to at-home charging as communities with newer subdivisions and homes with garages (10).

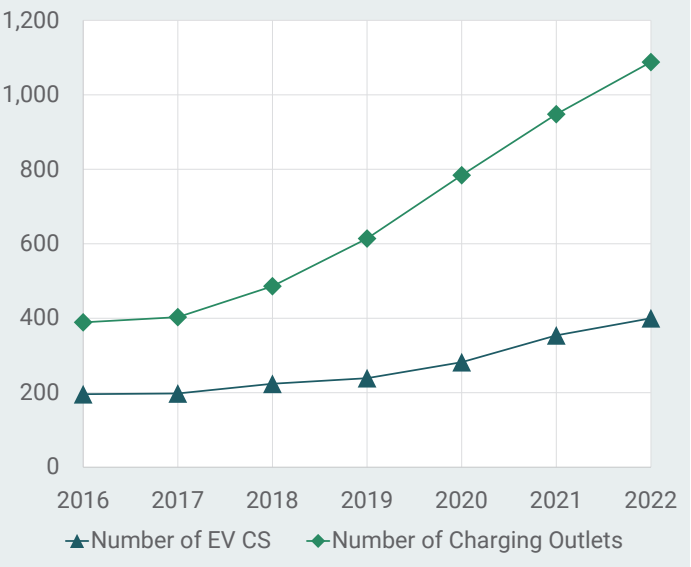
Figure 1.5 Current Charging Locations (Data source: 11)

EV CHARGING IN INDIANA

The number of EV charging stations (EVCS) are increasing nationally and in Indiana. Many charging stations offer more than one charging outlet, and can charge multiple vehicles simultaneously.

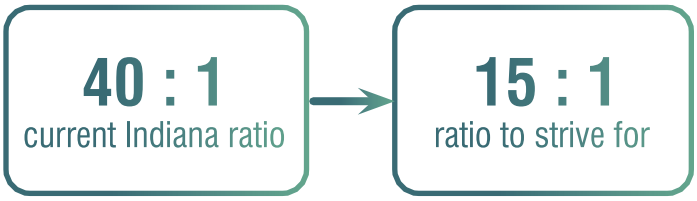
Figure 1.6 shows that the number of EVCS and outlets have been increasing in Indiana.

Figure 1.6 Indiana Charging Stations and Outlets, 2016-2022 (14)



EV Charging Stations are in Demand

Currently, there are 40 electric vehicles for every charging outlet in the State of Indiana (14). Experts recommend that to fully support demand, there should be 15 electric vehicles for every charging outlet (25). More charging outlets and stations are needed to meet today's demand in addition to the expected increases in demand in the future.



Indiana Charging Infrastructure Providers

Several companies provide Level 2 and DCFC stations in Indiana. Figures 1.7 and 1.8 below show most common providers (13).

Roughly 75% of Indiana's Level 2 and DCFC stations are open for public use, but more chargers are needed that operate 24 hours a day, seven days a week. Additionally, more DCFC stations are needed that can provide charging to all car models, especially non-Tesla vehicles.

Figure 1.7 Indiana Level 2 Providers

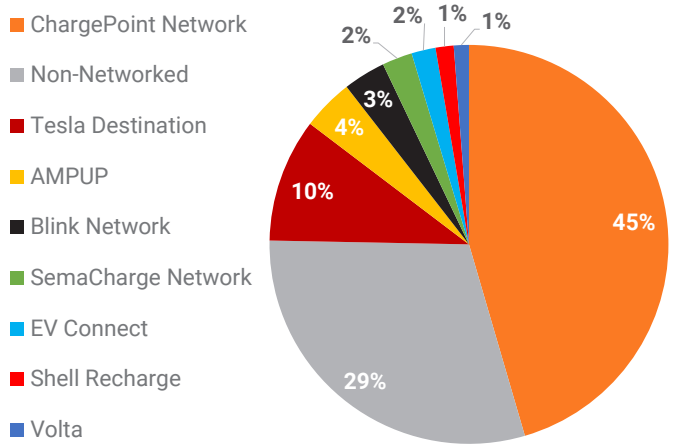
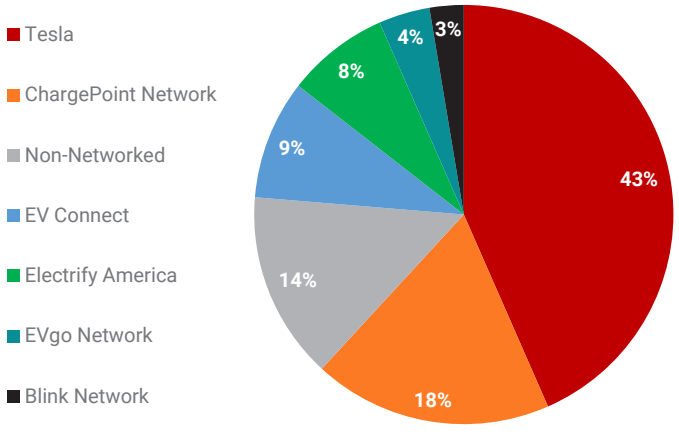


Figure 1.8 Indiana DCFC Providers



BARRIERS TO CHARGING ACCESS

Although most EV charging is expected to occur at home, there are a number of reasons why not all EV owners will be able to do so including (10):

- Renters in apartments, senior housing, and single family homes rely on a landlord to install an EV charger or permit the electric upgrade.
- Many older homes lack a garage with adequate electric supply to support a home charger. Often, upgrades to the electric panel and wiring are needed, which can be costly.

Nationally, 75 % have private parking and access to charging (26).

Because of these factors, it is likely that higher-income households will participate in the EV market sooner than lower-income households.

However, today's EVs will be tomorrow's used car. With less moving parts and maintenance then other vehicles, EVs will be a viable and affordable option on the used car market, but only if households have access to charging.

A robust network of EV charging stations is needed, especially in the areas with higher rates of renters and older housing stock.

CONSUMER CHARGING PREFERENCES

If EV drivers have a choice where to charge their vehicles, they prefer the following general locations in this order (26):

1. at home;
2. at work;
3. publicly available charging (local);
4. publicly available charging along highly traveled routes (travelers).

When EV drivers search for public charging, they prefer to choose locations that are convenient and highly visible with the following features (27):

- 24-hour access
- Safety
- Lighting
- Restrooms

Given these features, the typical locations for charging are grocery stores, shopping centers, food and recreational establishments, hospitals, and other businesses where drivers are highly concentrated (28).

It is important to note that consumers have slightly different preferences for the charging locations depending on the length of their stay to charge. Level 2 charging is good for coupling with locations where people park their cars for a few hours or overnight, while DC Fast Charging is good for parking for less than an hour (29).

Example Locations:

- Level 2: retail stores, restaurants, theaters, hotels, shopping malls, parking lots and garages, office parks, airports.
- DCFC: convenience and grocery stores, coffee shops, drug stores, fast food restaurants.

WHAT OTHER CITIES ARE DOING

Warsaw, IN

Photo Credit: Ink Free News

The City of Warsaw combined Indiana Volkswagen Settlement funds and a contribution from the local Zimmer Biomet office to install Level 2 charging stations in their downtown. This public-private partnership was not only between the City and Zimmer Biomet, but also the Kosciusko Chamber of Commerce and the Michiana Area Council of Governments - leveraging relationships at the local and regional levels in addition to private sector partners (30).

Goshen, IN

Photo Credit: Goshen News

The City of Goshen installed three Level 2 charging stations available to the public 24/7 using some Volkswagen Settlement Funds for construction. The public library is one of these locations while the other two are in the downtown area to attract more visitors.

The City held several outreach events to educate residents about electric vehicles in Fall 2022. These events allowed drivers to sit behind the wheel of an electric vehicle, learn about how long cars take to charge, and other similarities and differences between EVs and traditional cars.

The city also passed ordinances to handle station charging fees and amending parking requirements to include EV spaces (31).

El Dorado, AR

Photo Credit: Magnolia Reporter (Source: 32)

Several private sector entities partnered to install size 240-volt publicly available Level 2 charging stations in the downtown Murphy Arts District:

- Station Lithium Ltd
- Entergy
- Adopt a Charger
- South Arkansas Community College

These stations offer faster charging than lower voltage Level 2 stations. This project also was on Community College-owned land so it shows the a public-private partnership responding to local market conditions with being municipal-driven (32).

Chatham County, NC

Photo Credit: Chatham County (Source: 33)

The county installed two publicly-accessible charging stations at privately-owned host sites. Construction came in part from the Volkswagen Settlement Fund allocated to North Carolina. Not only was the electric utility Duke Energy involved in the design and construction, but so was the charging network ChargePoint.

The first location is a Level 3 station at Smithfield's Chicken'n Bar-B-Q in Siler City and the second is a Level 2 station at Chatham County Agriculture and Conference Center in Pittsboro (33).

Lancaster, CA

Photo Credit: Emmett Werthmann, Flickr (Source: 35)

The City of Lancaster, CA, partnered with a few EV charging companies in 2017 to provide Level 2 charging installed on five streetlights along its downtown boulevard and in the existing parking lot. A grant from the Antelope Valley Air Quality Management funded 80% of the project cost, while the private sponsors paid for the remaining 20%. There is no payment for these chargers.

Since this pilot project, the city has continued installing new EV charging infrastructure, typically installed and maintained by a private third party. The Lancaster City Council sets the prices for these chargers including a charge session flat fee, a kWh rate, and a parking fee for vehicles parked for more than a 4-hour charging period (34).

Melrose, MA

Photo Credit: National Grid (Source: 37)

The City of Melrose partnered with National Grid to install 16 pole-mounted Level 2 chargers. National Grid, an electric utility company that wants to be at the forefront of clean energy revolution, identified the city with its sustainability goals as a perfect place for a pilot project.

Melrose's Sustainability Manager said, "The hope is that as drivers see access to charging is easy around Melrose, they will choose an electric vehicle for their next car purchase. And there's a lot of interest in the concept from communities with high numbers of renters and others who don't have garages and driveways to install a charger." (36)

CHAPTER TAKEAWAYS

- *EVs are becoming a rapidly growing market globally, in the US, and in Indiana. With many car manufacturers switching production from gas-powered to electric vehicles, it is likely that a lot of future vehicles sold will be electric and driving an EV will be a norm.*
- *Improvements in the EV battery range, price, and number of models, and cheaper cost of "fueling" and maintaining an EV will eventually make it easier for consumers to purchase EVs. However, some people are still hesitant to purchase EVs due to the lack of publicly available charging infrastructure. Indiana is behind on providing charging even to the existing EV drivers.*
- *The market has been slow to produce a reliable charging network that covers all major inter-state travel routes, because of waiting on more people to buy EVs.*
- *While most charging is predicted to happen at home, it has become clear that there are a few restrictions to charging at residencies. Multi-family and rental properties are less likely to upgrade their premises with EV charging, so tenants must find EV charging elsewhere. Also, owners of older houses either might not have a garage or have to upgrade their electrical panel and wiring to accommodate a Level 2 EV charger. This creates a barrier to convenient at-home charging at a reasonable utility price.*
- *The federal government has been providing major funding to support EVCS development along the major inter-state routes and within communities to alleviate range anxiety and encourage the private market to build and operate EVCS.*
- *Local communities across the United States have been taking steps to encourage and support EV use. Some have provided EV charging to its residents at no or low cost to reduce range anxiety and installed EV charging in areas where EV charging stations installation is unlikely to happen from the private sector (e.g., on-street parking used for EV charging).*

REFERENCES

1. Autoblog. ***2022 Rivian SUV and truck images***. Link: https://www.autoblog.com/.
2. Randall, Tom. Bloomberg. September 14, 2023. ***US Electric Vehicle Sales Reach Breakthrough Pace***. Link: https://www.bloomberg.com/news/articles/2023-09-14/us-likely-surpassed-crucial-million-per-year-ev-milestone.
3. U.S. Department of Transportation. February 15, 2023. ***Biden-Harris Administration Announces Latest Steps to Deliver a National Network of Convenient, Reliable, Made-in-America Electric Vehicle Chargers***. Link: https://www.transportation.gov/briefing-room/biden-harris-administration-announces-latest-steps-deliver-national-network.
4. McKinsey & Company. April 18, 2022. ***Building the electric vehicle charging infrastructure America needs.*** Link: https://www.mckinsey.com/industries/public-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs.
5. Lubinsky, Adam. American Planning Association. August 24, 2023. ***How to Pave the Way for Equitable EV Adoption***. Link: https://www.planning.org/planning/2023/summer/how-to-pave-the-way-for-equitable-ev-adoption/#:~:text=More%20than%20one%2Dthird%20of,though%20EVs%20are%20increasingly%20affordable.
6. Ernst & Young. ***Why consumers are charging toward electric vehicles***. Link: https://www.ey.com/en_us/automotive-transportation/mobility-consumer-index-wave-3.
7. S&P Global. ***Electric Vehicle Trends.*** Link: https://www.spglobal.com/mobility/en/topic/electric-vehicle-trends.html#:~:text=The%20forecasts%20for%20global%20BEV,production%20of%2097%20million%20cars.
8. Goldman & Sachs. February 10, 2023. ***Electric vehicles are forecast to be half of global car sales by 2035.*** Link: https://www.goldmansachs.com/intelligence/pages/electric-vehicles-are-forecast-to-be-half-of-global-car-sales-by-2035.html.
9. International Energy Association. April 26, 2023. ***Demand for electric cars is booming, with sales expected to leap 35 % this year after a record-breaking 2022.*** Link: https://www.iea.org/news/demand-for-electric-cars-is-booming-with-sales-expected-to-leap-35-this-year-after-a-record-breaking-2022.
10. McKinsey & Company. October 5, 2023. ***Can public EV fast-charging stations be profitable in the United States?*** Link: https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/can-public-ev-fast-charging-stations-be-profitable-in-the-united-states.
11. EV-Volumes. ***Global EV sales rate statistics***. Link: https://www.ev-volumes.com/.
12. Alliance for Automotive Innovation. EV Sales Dashboard. Link: https://www.autosinnovate.org/EVDashboard.
13. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Maps and Data***. Link: https://afdc.energy.gov/data.
14. Indiana Office of Energy Development. ***Indiana Vehicle Fuel Dashboard***. Link: https://www.in.gov/oed/resources-and-information-center/vehicle-fuel-dashboard/.
15. U.S. Department of Transportation. March 14, 2023. ***Biden-Harris administration opens applications for first round of $2.5 billion program to build EV charging in communities & neighborhoods nationwide***. Link: https://www.transportation.gov/briefing-room/biden-harris-administration-opens-applications-first-round-25-billion-program-build.
16. Tesla. April 20, 2010. ***Tesla Motors Begins Regular Production of 2008 Tesla Roadster.*** Link: https://www.tesla.com/blog/tesla-motors-begins-regular-production-2008-tesla-roadster.
17. Business Insider. August 1, 2009. ***Nissan unveils its electric car, the LEAF, and its plan to change the world***. Link: https://www.businessinsider.com/nissans-leaf-and-its-crazy-plan-to-change-the-world-2009-8.
18. Peterbuilt. ***Refuse truck, model 520EV image***. Link: https://www.peterbilt.com/trucks/electric/520EV.
19. Blue Bird. ***Electric School Bus image***. Link: https://www.blue-bird.com/buses/vision/vision-electric-bus.
20. Wikipedia. ***Ford logo*** image. Link: https://en.m.wikipedia.org/wiki/File:Ford_Motor_Company_Logo.svg.

21. CleanPNG. ***Volvo logo i***mage. Link: https://www.cleanpng.com/png-volvo-cars-ab-volvo-geely-cars-logo-brands-640958/preview.html.
22. 1000logos. ***Subaru, Jaguar logo*** images. Link: https://1000logos.net/.
23. Gmauthority. ***GM logo*** image. Link: https://gmauthority.com/blog/2021/01/general-motors-unveils-new-logo/.
24. StickPNG. ***Lexus image*** logo. Link: https://www.stickpng.com/img/icons-logos-emojis/car-logos/car-logo-lexus.
25. EVAdoption. April 8, 2019. ***What is the "minimum accepatbale" ratio of EVs to Charging Stations?*** Link: https://evadoption.com/what-is-the-ideal-ratio-of-evs-to-charging-stations/.
26. Hardman et al. Transportation and Environment. Transportation Research Part D 62 (2018) 508–52. ***A review of consumer preferences of and interactions with electric vehicle charging infrastructure.*** Link: https://www.sciencedirect.com/science/article/pii/S1361920918301330.
27. Indiana Department of Transportation. ***INDOT Electric Vehicle Infrastructure Plan 2023.***Link: https://www.in.gov/indot/current-programs/innovative-programs/electric-vehicle-charging-infrastructure-network/#tab-598333-Deployment_Plan_and_Maps .
28. U.S. Department of Energy. Energy Efficiency & Renewable Energy Office. Alternative Fuels Data Center. ***Charging Electric Vehicles in Public.*** Link: https://afdc.energy.gov/fuels/electricity_charging_public.html.
29. U.S. Department of Energy. Energy Efficiency & Renewable Energy Office. Alternative Fuels Data Center. ***Plug-In Electric Vehicle Handbook for Public Charging Station Hosts***. Link: https://afdc.energy.gov/files/pdfs/51227.pdf.
30. inkFreeNews. October 17, 2022. ***Chamber Celebrates New Warsaw Electric Vehicle Charging Stations***. Link: https://www.inkfreenews.com/2022/10/17/chamber-celebrates-new-warsaw-electric-vehicle-charging-stations/.
31. The Goshen News. December 20, 2022. ***Goshen establishes new electric vehicle charging station fees***. Link: https://www.goshennews.com/news/goshen-establishes-new-electric-vehicle-charging-station-fees/article_ae9ef356-80a3-11ed-b4d2-d306ff5dee68.html.
32. Magnolia Reporter. May 6, 2022. ***Electric vehicle charging stations come to El Dorado***. Link: http://www.magnoliareporter.com/news_and_business/local_business/article_1ccaa21a-cd37-11ec-b324-c3fabd15a629.html
33. Chatham Journal Newspaper. June 14, 2022. ***Chatham County installs two electric vehicle charging stations.*** Link: https://chathamjournal.com/2022/06/14/chatham-county-installs-two-electric-vehicle-charging-stations/.
34. City of Lancaster. September 11, 2020. ***City Council Approves to Update the Costs of Electric Vehicle Stations.*** Link: https://www.cityoflancasterca.org/Home/Components/News/News/9520/20?arch=1&npage=2.
35. Flickr. Emmett Werthmann. ***Pole-Mounted EV Charging Infrastructure.*** Link: https://www.flickr.com/photos/embarq/albums/72157719597524889/.
36. City of Melrose. April 22, 2021. ***City of Melrose introduces innovative electric vehicle charger program***. Link: https://www.cityofmelrose.org/home/news/city-melrose-introduces-innovative-electric-vehicle-charger-program.
37. National Grid. April 22, 2021. ***National Grid Deploys Innovative EV Chargers in Melrose, MA***. Link: https://www.nationalgridus.com/News/National-Grid-Deploys-Innovative-EV-Chargers-in-Melrose,-MA/.

2 | EVs IN GREENFIELD TODAY

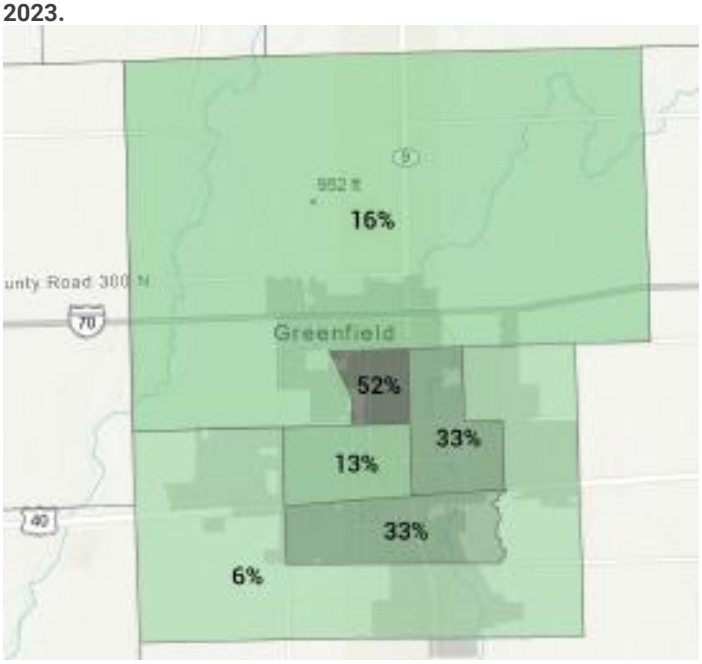
After looking at national and state-level trends, this chapter focuses on Greenfield to explore how Greenfield residents use vehicles, where they can already charge EVs, and where they'd prefer to see charging gathered from public input. This chapter also provides analysis of possible barriers to at-home charging in Greenfield based on the type of housing, its age, and renter-owner statistics as well as public input. Finally, the chapter ends with looking at the existing Greenfield plans and policies to see how EVCS projects can be integrated into them.

WHAT AREAS MAY NEED CHARGING?

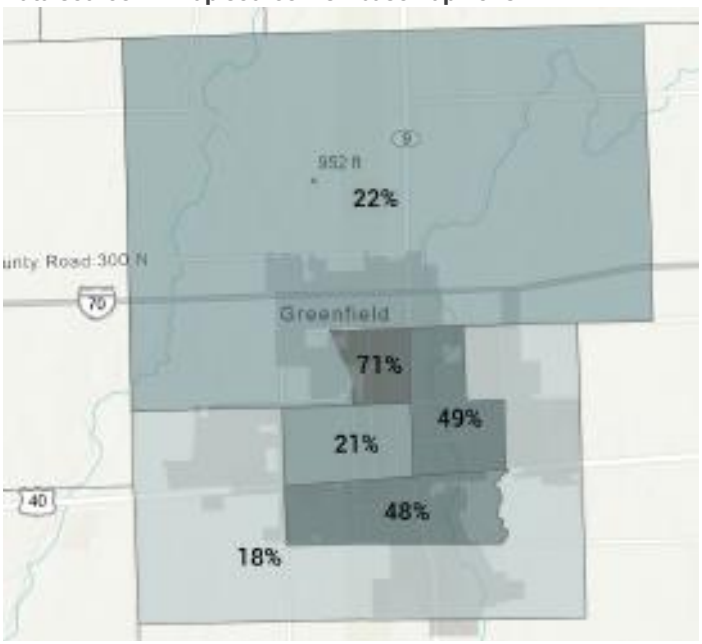
Vehicle Use

94 % of Greenfield residents drive to work, 4 % work at home, and 2 % use other means of transportation like walking, bicycling, or rideshare services (Appendix A). 99 % of home owners and 90 % of renters in Greenfield own at least one vehicle (1). This shows that Greenfield residents rely heavily on cars.

Map 2.1 Percent of multi-family housing in Greenfield by Census Tract, 2021. Data source: 3. Map source: Esri basemap 2023.



Map 2.2 Percent of renters in Greenfield by Census Tract, 2021. Data source: 2. Map source: Esri basemap 2023.



Single-Family vs. Multifamily Housing

Multi-family dwellings (2+ dwelling units) usually have no garages where EVs could be charged, and that creates a barrier for at-home charging. Map 2.1 shows percentages of multi-family dwelling units.

Owner vs. Renter Housing

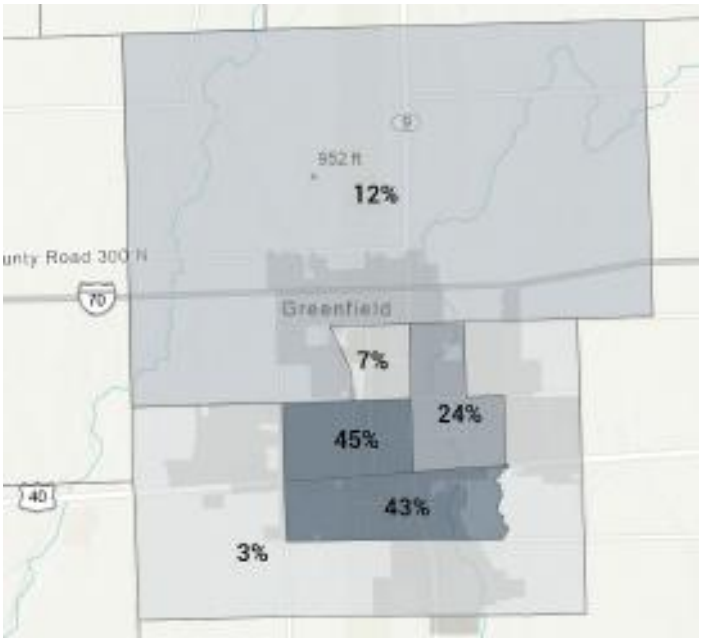
Rental housing that includes single-family homes, duplexes and other types of housing, relies on the landlord to accommodate EV charging. Since it is an additional cost to the landlord, they may not accommodate the renter, and that creates a barrier to at-home charging. Map 2.2 shows the percentages of renters in and around Greenfield.

Dwelling Age

Older houses may need a major electric upgrade before EV users can install a Level 2 charger, which adds to the overall cost of integrating EV charging at home and may be a barrier to at-home charging.

During the 1960s, circuit breaker panels became the norm and started including 120-volt and 240-volt circuit options necessary for EV charging today (2). If a house was built before the 1960s and has not had a major electric circuit and wiring upgrade, it may need one to support EV charging. Map 2.3 shows the percentage of housing built before 1960s.

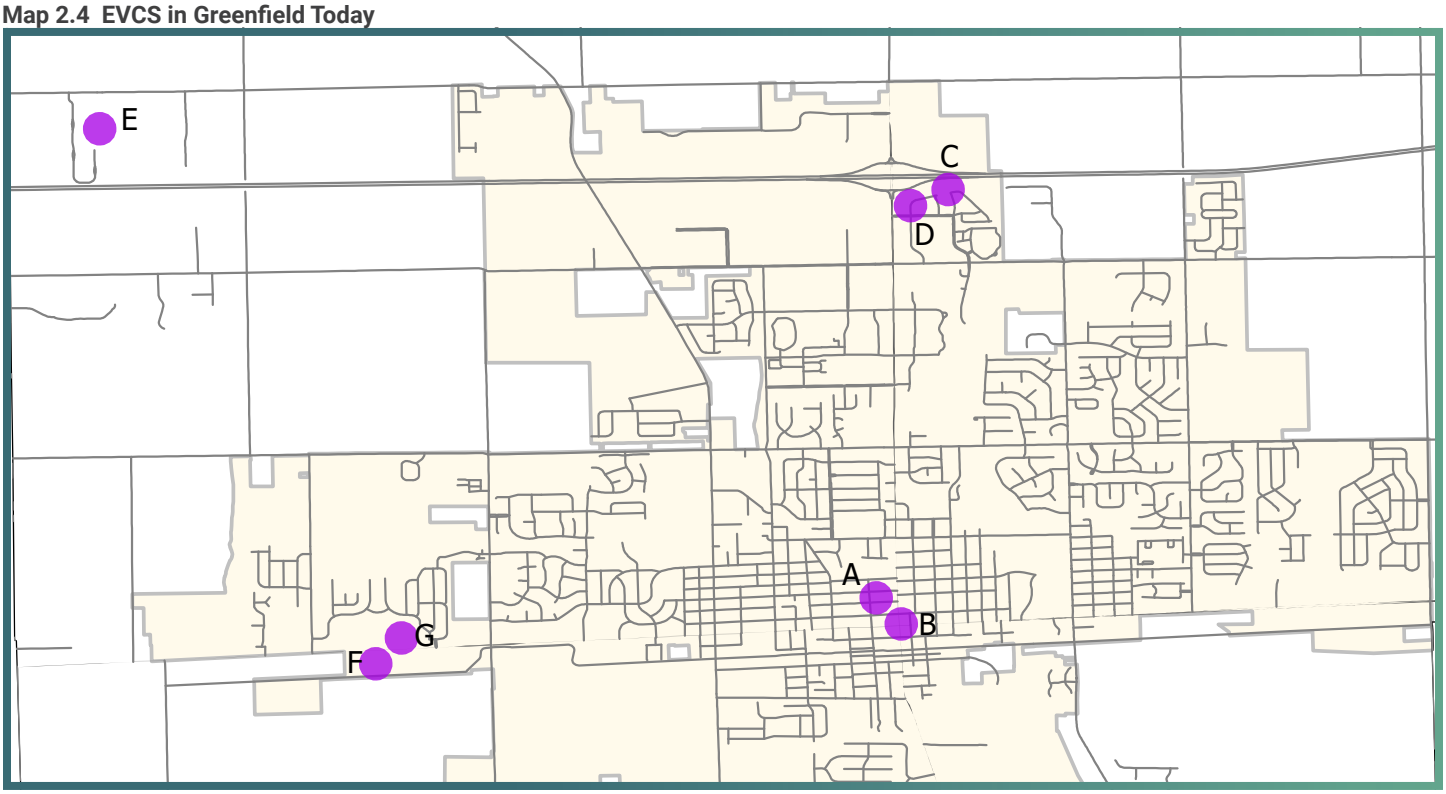
Map 2.3 Percent of houses built before 1960s in Greenfield by Census Tract, 2020. Data source: 4. Map source: Esri basemap 2023.



WHERE CAN EVs CHARGE IN GREENFIELD?

Today, six EV charging stations exist in the City of Greenfield as shown in Map 2.4. Just outside of the city limits, the Heartland Resort also has outlets at every campsite with proper voltage for EV charging. The only stations open to the public are in Downtown Greenfield at the parking lots on Main Street and at the City Hall. Table 2.1 contains the cost to charge (if known), operating hours, station level, and charging network for each charging station as of November 2023.

Map 2.4 EVCS in Greenfield Today



Source: Jurisdictions, roads (ESRI basemap, 2023), Greenfield EV Stations (Plugshare.com, 2023)

Table 2.1 Greenfield EVCS Information

ID	LOCATION	COST	HOURS	LEVEL	NETWORK
A	W Main St Parking Lot	$2 per session + $0.50 per KWH	24 hours	Level 2	Chargepoint
B	City Hall Parking Lot	$2 per session + $0.50 per KWH	6 pm - 8 am M-F 24 hours Sa-Su	Level 2	Chargepoint
C	Fairfield Inn and Suites	Free for guests	24 hours (Guests Only)	Level 2	Non-Networked
D	The Nest by Star Abode	$4 per session + $0.20 per KWH	24 hours (Guests Only)	Level 2 Level 3	Non-Networked Tesla
E	Heartland Resort	Free for guests	24 hours (Guests Only)	Level 1	Non-networked
F	Capitol City Ford	Unknown	9 am - 7 pm (Closed Sunday)	Level 2	Non-networked
G	Dellen Chrysler Jeep Dodge	Unknown	8 am - 6 pm (Closed Sunday)	Level 2	Non-networked

Source: Plugshare (November 2023)

WHAT DOES GREENFIELD KNOW ABOUT EVs?

Two pop-up public events were held to gather input from Greenfield residents about EVs. The first was Hancock County Community Night on July 19, 2023 and the second was a concert at Depot Park on August 26, 2023. A local dealership showcased an EV for the evening to demonstrate its capabilities. 25 families responded across both events and asked a few questions about their knowledge and opinion on EVs.

HANCOCK COUNTY COMMUNITY NIGHT

JULY

						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	***19***	20	21	22
23	24	25	26	27	28	29
30	31					

Photo Credit: ms consultants, inc.

AUGUST

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

DEPOT PARK CONCERT

Photo Credit:: Daily Reporter (5)

MATERIALS

The posters below were created for the for the pop-up engagement events. Families were asked three questions about EVs and an EV trivia quiz was put together as a fun and educational activity. Question results and analysis can be found on the following two pages.

CHARGING GREENFIELD

A New Plan for Electric Vehicle Charging

ms consultants, inc.
engineers, architects, planners

What's this about?
The Charging Greenfield Plan is a new initiative funded by IndyMPO to identify new locations for EV charging stations in Greenfield. How do you feel about electric vehicles in Greenfield? Let us know!

1 THE NEXT TIME YOU BUY A CAR, DO YOU EXPECT IT TO BE AN ELECTRIC VEHICLE?

YES! NO!

2 WOULD YOU BE ABLE TO CHARGE AN ELECTRIC VEHICLE AT YOUR RESIDENCE?

YES! NO!
- RENTERS
- APARTMENTS

3 WHERE IN TOWN WOULD BE A GOOD PLACE FOR AN ELECTRIC VEHICLE CHARGING STATION?

Avg. Mileage/ Charge: 260 miles

Average Daily Drive: 30 miles

Average Cost to Charge: $1/Gallon

ms consultants, inc.
engineers, architects, planners

4 THINK YOU'RE AN EXPERT ON EV'S? PROVE IT WITH OUR TRIVIA GAME!

1) Who provides electricity to Greenfield?	A
A) Greenfield Power and Light	
B) Greenfield: LIGHT IT UP	
C) The Greenfield Electric Company	
D) Powering Greenfield	

2) Which companies set a goal to produce 100% EV by 2030?	A
A) Ford, Volvo, Subaru	
B) GM, Lexus, Kia	
C) Kia, Honda, Jeep	
D) Cadillac, Jaguar, BMV	

3) About how many EV Charging Stations are there in Indiana today?	C
A) 100	
B) 300	
C) 500	
D) 700	

4) What is the ratio of EV vehicles to charging outlets that we need for a reliable network?	B
A) 5 cars to 1 station	
B) 15 cars to 1 station	
C) 50 cars to 1 station	
D) 100 cars to 1 station	

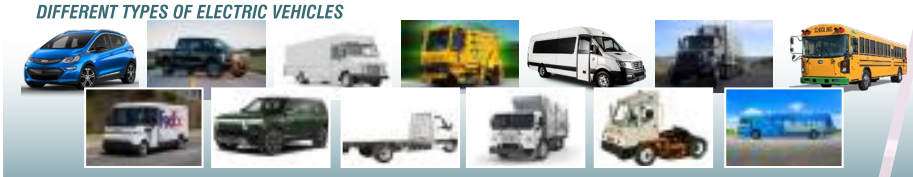
5) When was the first electric car built in the US?	B
A) 1828	
B) 1891	
C) 1954	
D) 2008	

6) How many EV models of passenger cars are available on the market?	D
A) 50-100	
B) 100-200	
C) 200-300	
D) 300-400	

7) What will Charging Greenfield NOT do?	A
A) Recommend places for city-funded EV chargers	
B) Support businesses that want to build EV Chargers	
C) Identify electric upgrades to support growing EV use	
D) Have short and long term recommendations	

8) What types of EV's are available?	D
A) Sedans, SUVs, and pickups	
B) Buses and vans	
C) Commercial vans, semis, and garbage trucks	
D) All of the Above	

DIFFERENT TYPES OF ELECTRIC VEHICLES



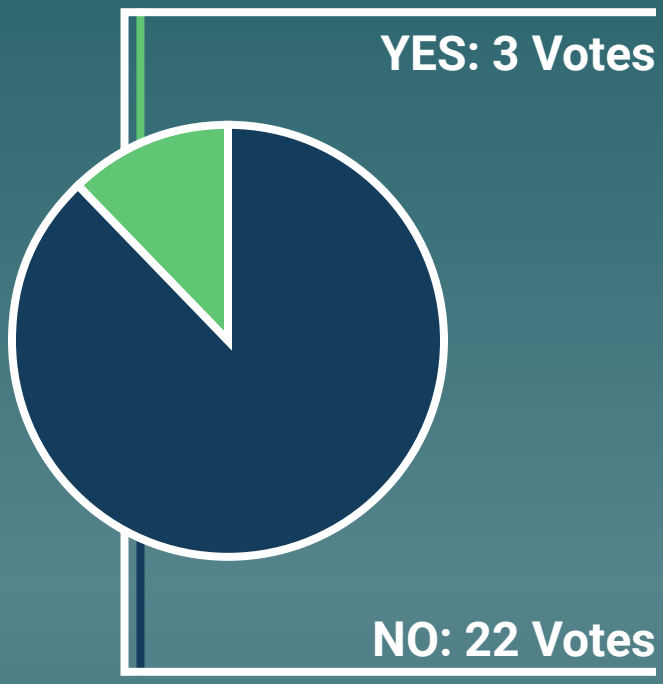
HOW'D YOU DO? WRITE YOUR SCORE BELOW!

PUBLIC ENGAGEMENT RESULTS

25 families responded across both events. The results are tallied below along with reasons why people answered "No" to Questions 1 and 2.

Question 1

The next time you buy a car, do you expect it to be an electric vehicle?

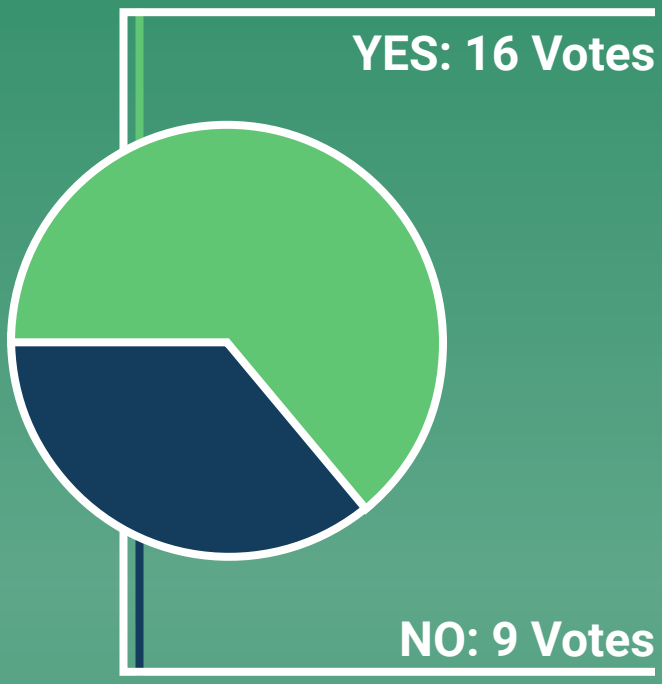


Why people responded "No"

- ***Price*** (#1 across both events)
- Ethical mining concerns
- Home electric panel upgrade expense
- Dependency on foreign imports for materials
- Battery range concerns
- Time spent charging on road trips
- Wait and see on this new technology
- Personal preference for gas powered vehicles

Question 2

Would you be able to charge an electric vehicle at your residence?

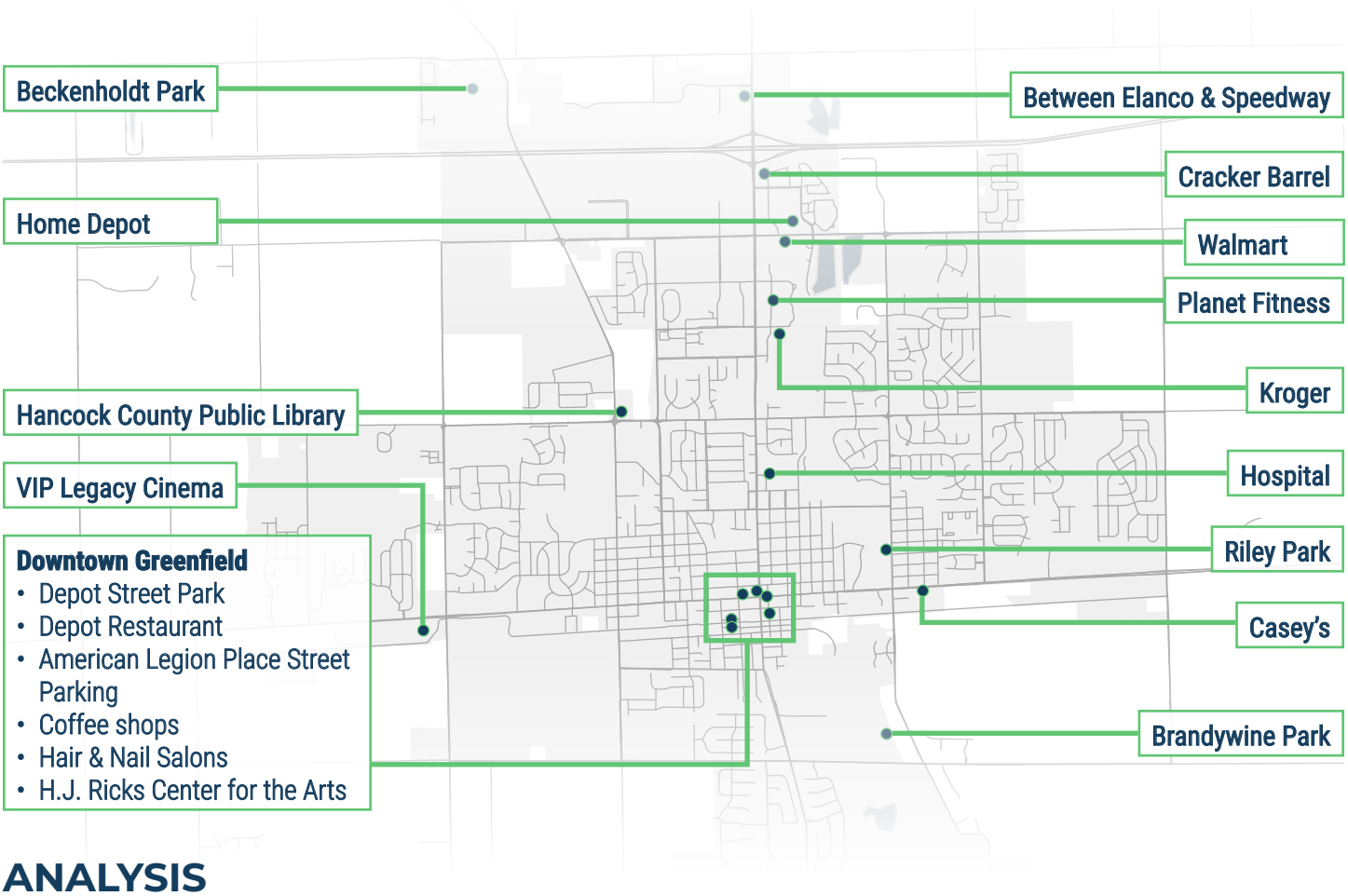


Why people responded "No"

- No garage at home
- No electricity in garage
- Use garage for storage
- Currently renting

Question 3: Where in town would be a good place for an electric vehicle charging station?

Responses centered around grocery shopping, eating, personal services, and recreation. The most popular spot for fast charging was a grocery store due to the convenience of pairing a weekly charge with a grocery trip. The most popular spots for Level 2 charging were recreation spots.



ANALYSIS

A few families surveyed already had an EV or a hybrid. These people recommended the locations of fast charging close to I-70. Most people in Greenfield are not yet ready to make the jump to an electric vehicle and the main reason is the vehicle cost. People had concerns about where and how long to charge and in general were not sure if the EV trend is going to stick.

The discussion about the access to at-home charging was the most revealing. The future market assumes that most charging will happen at home. However, when Greenfield residents were asked the question about availability of at-home charging, there were some household limitations to the installation of at-home charging, such as:

- An old home located south of US 40 that doesn't have a garage or parking on the property.
- An old home in downtown with an old electric panel and wiring. A person considered switching to EV, but the cost of upgrading electric panel and wiring at the house to fit a Level 2 charger stopped them from doing so.
- A medium-aged home, whose attached garage has been converted to a room.

These responses strengthen the need for public charging in Greenfield neighborhoods with older homes in addition to other typical barriers like living in a multifamily dwelling.

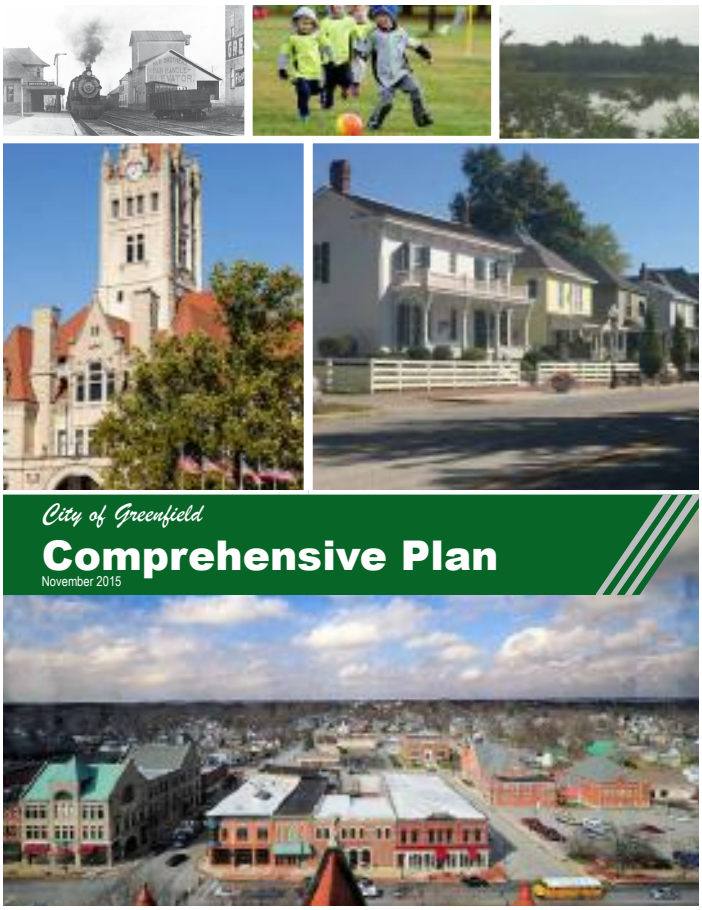
HOW DO EVCS FIT WITH GREENFIELD'S PLANS?

COMPREHENSIVE PLAN

The current Comprehensive Plan was adopted in 2015. The City is developing its next Comprehensive Plan due to be completed in 2024, but planning for EV charging fits into the vision and values of the existing plan.

Four elements make up the community vision of the 2015 plan:

- Heritage/Legacy
- Economic Development
- Livable Community
- Collaboration/Education



EVCS integration into Greenfield can be done in a way that supports all of these principles. For example, Level 2 charging with its small footprint and longer charging time can be installed in parking lots and on-street parking areas. This encourages EV drivers to enjoy Greenfield's heritage and support local businesses.

EVs and Community Health

EVCS encourages the transition to BEVs that emit no air pollutants, thus, improving local air quality. A study recently conducted in California, where EV adoption has been the largest in the nation, found that there is less local air pollution and fewer asthma–related emergency room visits (6).

Electricity Demand

Planning for EVCS in Greenfield must be mindful of the impact charging will have on the electric utility. In the 2015 plan, there were no forecasts of major electricity demand increases. However, growth of EVCS will need to be included in future forecasts which may result in grid upgrades and new management strategies to handle larger amounts of people charging EVs more regularly.

Consistency with the Character of the Existing and Recommended Uses

Public Level 2 charging is typically an accessory land use to a parking lot, while DC fast charging may be a land use on its own, similar to a gas station. Level 2 charging would be consistent with other commercial and residential areas and can already be seen with the public charging station in Downtown Greenfield. Industrial and commercial development for the area around the SR 9 and I-70 intersection is consistent with the sites suited for DCFC charging.

THOROUGHFARE PLAN

Three goals in the 2020 Thoroughfare Plan synchronize well with EV charging installations:

- Promote a healthy lifestyle by encouraging pedestrian and bicycle modes of travel.
- Plan for future growth and economic development opportunities.
- Maintain the existing transportation system while also planning for future improvements.

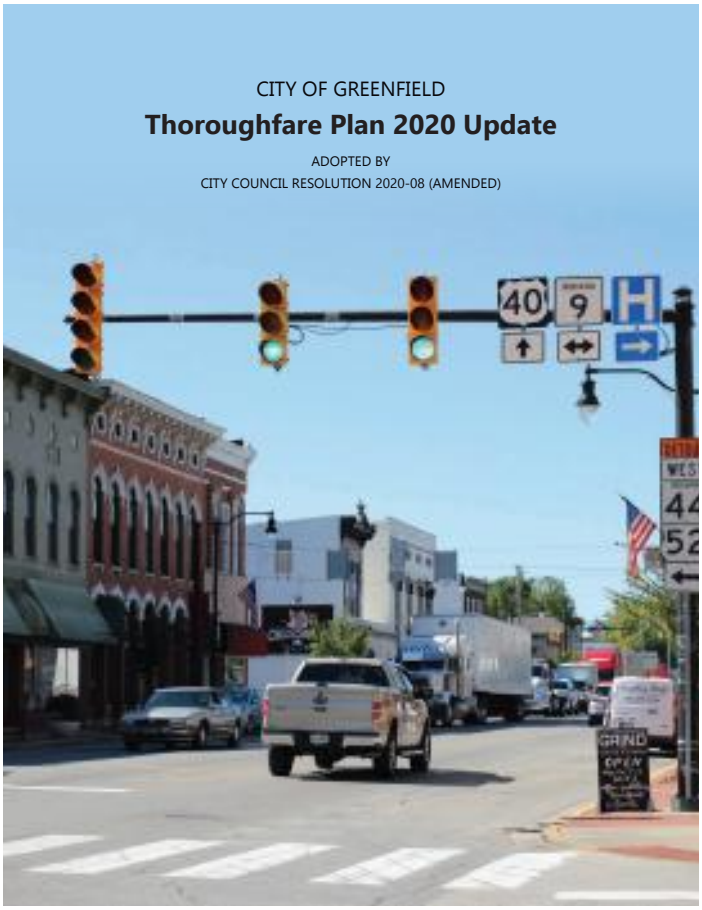
Transitioning to EVs improves local air quality, which in turn can make the outdoor experience for pedestrians and bicyclists healthier.

EV charging stations supplement the second goal by attracting EV drivers to areas of economic activity. Also, creation of a city-wide charging network can attract visitors as well as improve convenience for existing residents who need access to public charging.

Finally, EVs are a piece of the future of transportation so building out an EVCS network is part of accomplishing the third goal. For example, Greenfield could combine Level 2 charging with some local street improvement projects as part of parking considerations.

Complete Streets Policy

The City adopted a Complete Streets policy as part of this planning effort and installing charging stations fulfills the spirit of the policy by providing infrastructure for EV drivers.



CAPITAL IMPROVEMENT PLAN

The Capital Improvement Plans list projects what the city intends to construct and maintain over the next decade - usually infrastructure improvements and development of public spaces.

The 2020 Capital Improvement Plan (CIP) included completion of a project with an EV charging station: the North Street Living Alley. While EV installations are not called out as a priority in this plan, it does include the South Street Redesign project which could be a good candidate to include EV infrastructure. When the time comes for the CIP update, this plan can help inform which projects could include an EV charging station moving forward.

CHAPTER TAKEAWAYS

- *EV charging fits into the city's vision by creating a healthier environment for its residents, providing more transportation options, and encouraging economic development. However, most existing plans and policies do not call out EV charging as a specific priority. Charging Greenfield Plan establishes it as a priority and the next two chapters provide recommendations on specific things Greenfield can do to become EV-ready.*
- *The use and familiarity with EVs in Greenfield is at its infancy, but conversations with Greenfield residents have shown that they are paying attention to the subject and would like to learn more about it. Public education is very important to successful EVCS integration into the community.*
- *Analysis of housing data and public input showed that there may be barriers to at-home charging in Greenfield. Priority areas that will need publicly-available EV charging at an affordable rate are shown in the next Chapter.*

REFERENCES

1. U.S. Census Bureau. "TENURE BY VEHICLES AVAILABLE." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B25044, 2020.
2. The Spruce. May 25, 2022. ***How electrical service panels have evolved***. Link: https://www.thespruce.com/service-panels-changed-in-the-1900s-1152732.
3. U.S. Census Bureau. "HOUSEHOLD AND FAMILIES." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table S1101, 2021.
4. U.S. Census Bureau. "YEAR STRUCTURE BUILT." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B25034, 2020.
5. Daily Reporter. February 24, 2023. ***SAVE THE DATE: Depot Street Park concert lineup announced.*** Link: https://www.greenfieldreporter.com/2023/02/24/save-the-date-depot-street-park-concert-lineup-announced/.
6. Garcia, et al. ***California's early transition to electric vehicles: Observed health and air quality co-benefits***. Science of The Total Environment, Volume 867, 2023, 161761, ISSN 0048-9697. Link: https://doi.org/10.1016/j.scitotenv.2023.161761. (https://www.sciencedirect.com/science/article/pii/S0048969723003765)

3 | EVs IN GREENFIELD TOMORROW

This chapter explores possible scenarios of how the EV market could play out in Greenfield in the next decade and how much charging infrastructure would be needed to satisfy the demand as well as provide equitable charging for those that may not have access to at-home charging. A list of potential sites across the city is presented to show a variety of uses that are ripe for future EVCS partnerships. Finally, a few priority areas in Greenfield are recommended for providing access to EVCS where the market may not provide solutions on its own.

HOW MANY EVCS ARE NEEDED?

The first question to answer in achieving the goals of Charging Greenfield is how many charging stations are needed to meet current and future demand. This requires projecting the EV market into the future - which was achieved by using scenario planning.

WHAT IS SCENARIO PLANNING?

Scenario planning looks at multiple potential future outcomes and develops strategies that support each one. Using this technique allows jurisdictions to prepare for events that may not be anticipated by only looking at current market trends. It also provides options so a jurisdiction can be flexible in their approach over time - which fulfills the vision of this plan!

For example, if EVs suddenly show very fast adoption rates, then Greenfield can follow the recommendations from the high EV adoption scenario. Conversely, if the EV market slows down or doesn't pick up the pace in Greenfield like in the rest of the U.S., Greenfield can use the recommendations found in the low EV adoption scenario.

GREENFIELD EV SCENARIOS

Three scenarios were developed with different rates of EV adoption to assist how Greenfield responds to shifts in the EV market: LOW, MEDIUM, and HIGH. Each scenario includes a range depending on how many residents will be able to charge EVs at home: 61% and 75% (Figure 3.1).

To calculate the number of charging ports needed for each scenario, the EVI-Pro Lite Tool from the US Department of Energy was used.

Appendix B contains a detailed explanation of the scenario development methodology.

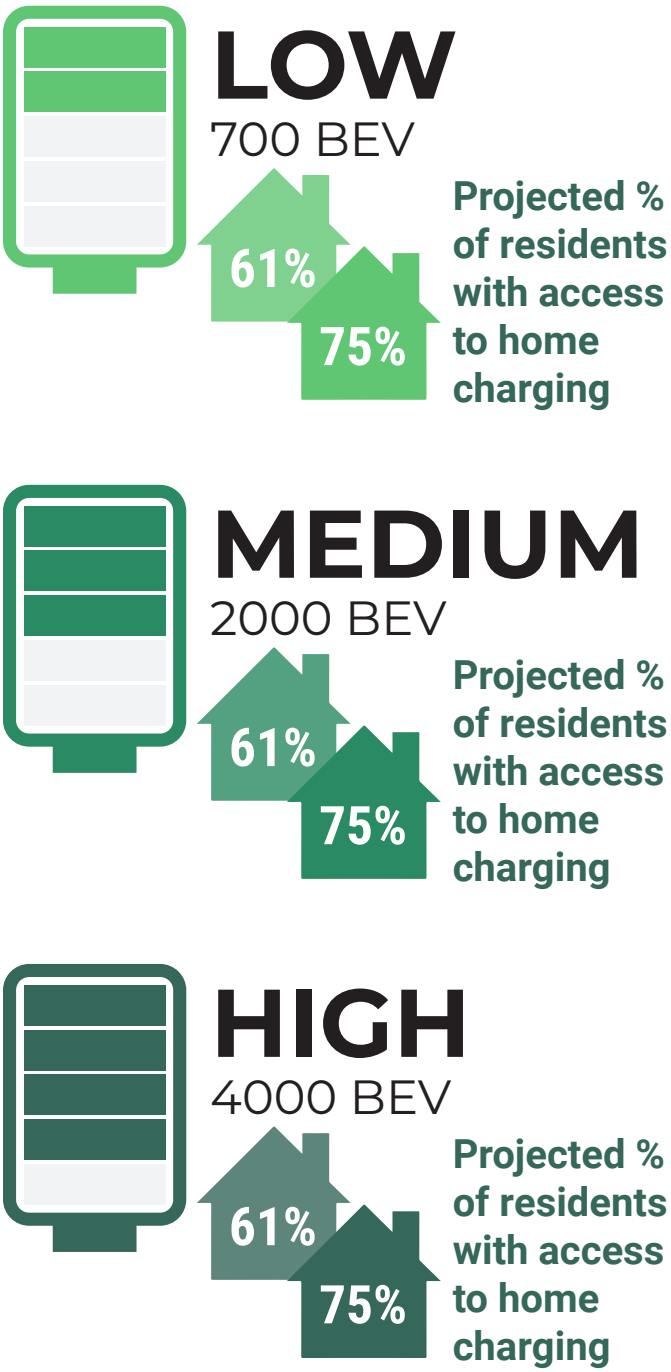
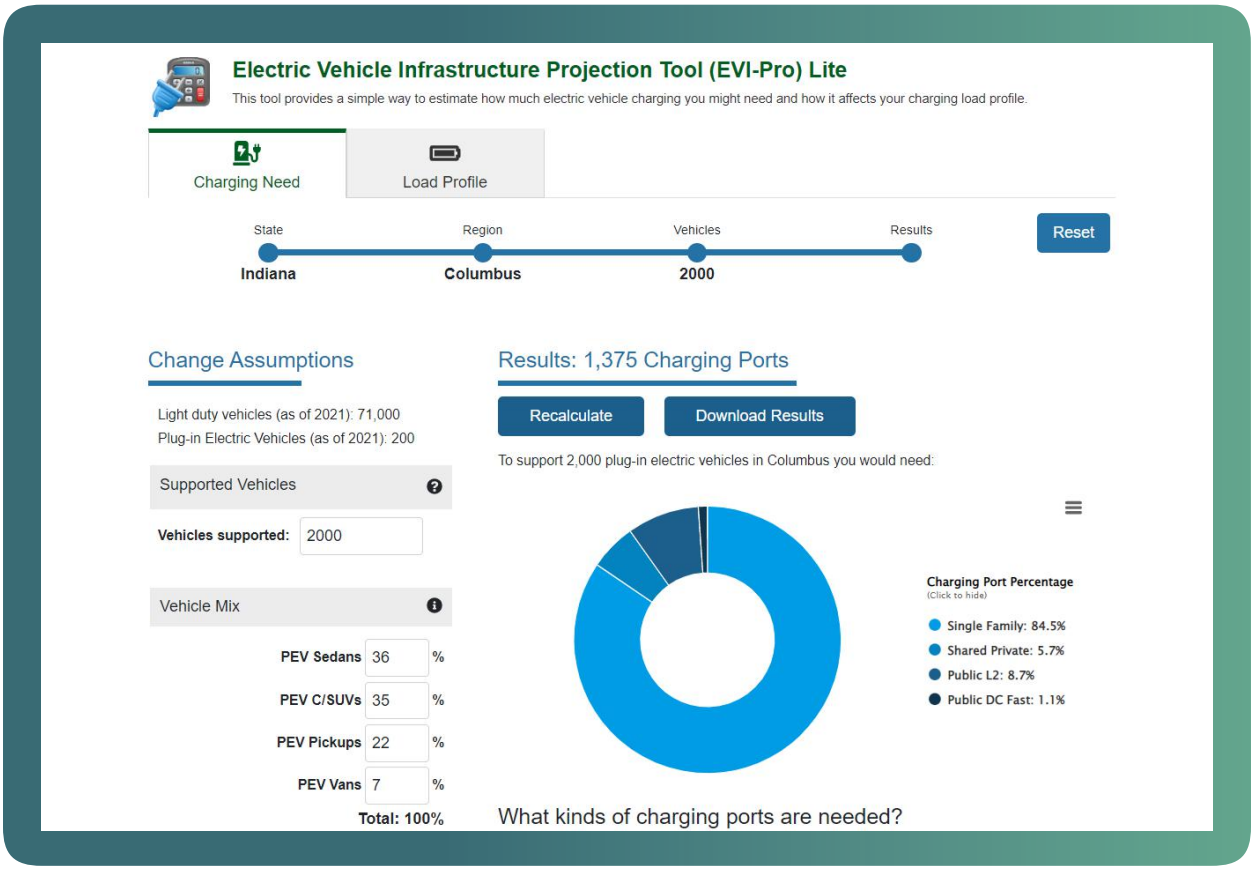


Figure 3.1 Scenarios for EV Charging Demand in Greenfield

EVI-PRO LITE TOOL

The US Department of Energy has a tool on their website called the Electric Vehicle Infrastructure Projection Tool Lite (EVI-Pro Lite) that estimates the number of charging ports a region could need depending on EV adoption rates. The inputs and outputs of this tool clarified what the EV scenarios should look like for Greenfield.

Figure 3.2 EVI-Pro Lite Tool. Source: 1.



INPUTS

- State or Metropolitan Area
- Number of light-duty BEVs to support
- Share of people that have access to home charging;
- % of vehicle types in the mix (sedans, SUVs, vans, & pick-up trucks);
- % of plug-in hybrids that the charging network would support; and
- Extent to which the network would support plug-in hybrids (full, partial, none).

OUTPUTS

Privately Accessible Charging Ports

- Single family home Level 1
- Single family home Level 2
- Shared-Use Level 2

Publicly Accessible Charging Ports

- Level 2
- Level 3 (DCFC)

SCENARIO RESULTS

Table 3.1 below shows the results from the EVI-Pro Lite Tool. The **green rectangle** below contains the number of charging ports on which the City of Greenfield should focus. These counts are the number of publicly-available EV ports projected by the tool and would be eligible for federal and state grant funding. The EVI-Pro Lite Tool assumes homeowners and private-sector businessowners will take care of the "Private" section by responding to EV market forces.

Note that this is the number of ***charging ports***, NOT the number of ***charging station locations***. A single location may have any number of Level 2 and/or DCFC ports.

Table 3.1 Number and Kind of Charging Ports for Three EV Adoption Scenarios

		2028-2030 5YR 700 BEV		2031-2033 10 YR AVG 2000 BEV		2033 10 YR OPT 4000 BEV	
	PERCENT OF DRIVERS WITH ACCESS TO HOME CHARGING	61 %	75 %	61 %	75 %	61 %	75 %
Private	Single Family (level 1)	138	170	385	473	770	946
	Singel Family (level 2)	279	341	777	955	1553	1909
	Level 2 (e.g., workplace)	30	22	78	56	159	111
	Total Private	447	533	1240	1484	2482	2966
Public	Level 2	46	33	120	94	247	194
	DCFC	6	6	15	12	31	25
	Total public	52	39	135	106	278	219

Examples of locations of charging ports according to the EVI-Pro Lite website:

- **Private Level 2:** multi-family dwelling units, private workforce charging.
- **Public Level 2:** retail, recreation center, community center, healthcare facility, education facility, transportation facility, neighborhood (on-street), office.
- **Public Level 3:** retail, recreation center.

WHERE COULD EVCS GO IN GREENFIELD?

The next step after determining how many charging stations Greenfield may need is to determine where these new stations could go.

Potential sites were identified to guide Greenfield when the city is ready to pursue EVCS projects. Geographic data analysis was the primary method of identifying candidate parcels which were then cross-referenced with input from Greenfield residents. The steering committee added to the methodology further by asking the consultants team to include data about each potential site that would help city staff approach private landowners and pursue grant funding. In total, 41 sites were identified across the city.

SITE ANALYSIS PROCESS

Land uses were examined that attract different kinds of trips for residents of Greenfield and regional visitors and are summarized to the right.

Each land use type was mapped using Geography Information System (GIS) software. The list was narrowed by examining parking availability at each parcel.

Locations were also mapped from steering committee and pop-up event input to compare with the land use analysis. This resulted in the final list of 41 potential sites. See **Appendix B** for a step-by-step explanation of the methodology.

EQUITY ANALYSIS

The potential sites cover 16 of the 17 census block groups in Greenfield. Income and poverty statistics were also analyzed to confirm residents across all income levels would be near EV charging stations. See **Appendix B** for the detailed Census data discussion.

The one block group with no locations is the Northeast quadrant of Downtown Greenfield. This block group is very near to the existing and potential charging stations in Downtown and Riley Park.

The even distribution of charging stations across the city as well as the focus on apartment buildings, downtown parking, and healthcare facilites in the land use analysis include potential locations where lower-income residents can access EV charging as the network is built out.

USING THE RESULTS TO IDENTIFY HOST SITES

Map 3.1 plots the 41 potential sites across the city using green dots. Each dot matches an entry in Table 3.2 with information about each site. The purpose of Table 3.2 is to assist City of Greenfield staff when approaching partners for EVCS installation as well as when seeking federal and state grant funding for EVCS installation.

Chapter 4 contains detail about nine (9) locations from the table to help city staff with grant and infrastructure readiness: three privately-owned sites that could support DCFC stations and six sites owned by the city or non-for-profit organizations.

1) Level of Charging

Level 2 or DCFC charging stations are recommended to provide an overall indication of how fast a vehicle can achieve a charge. Level 2 chargers can range anywhere from 3-80 kWs. DCFC chargers are range from 80-360 kWs. Capacity ratings for charges are typically specified based on the assumption that the battery will charge to 80% full within a reasonable amount of time. Within these broad ranges, the rate of charge and how long to get to an 80% battery charge widely varies.

2) Possible Number of Ports

The number of ports at each station primarily reflects the proposed use and expected number of visitors at a location. For example, more drivers will visit a retail store on average per day, than a public park. Number of ports is also a function of how large the parking space is. If there are only 20 spaces, the community may only specify one or two stations. However, if it is a large parking lot, more ports can be added.

3) Charging Capacity

For the sites identified, the capacity for the charging station is based on an assumed dwell time at each location. This is estimated from how long a driver may likely spend at an EVCS to obtain a "significant" charge.

- Residential Apartments, 8-10 hours of charging at a Level 2, 3-10 kW station
- Park Districts, 2-3 hours of charging at a Level 2, 20-60 kW station
- Retail, Dining, 1-2 hours of charging at a Level II 60-80 kW station
- Fuel station or large retailer, 1-2 hours of charging at a Level 3 (DCFC) 80-360 kW station

4) Accessibility

This column refers to who can access an EVCS.

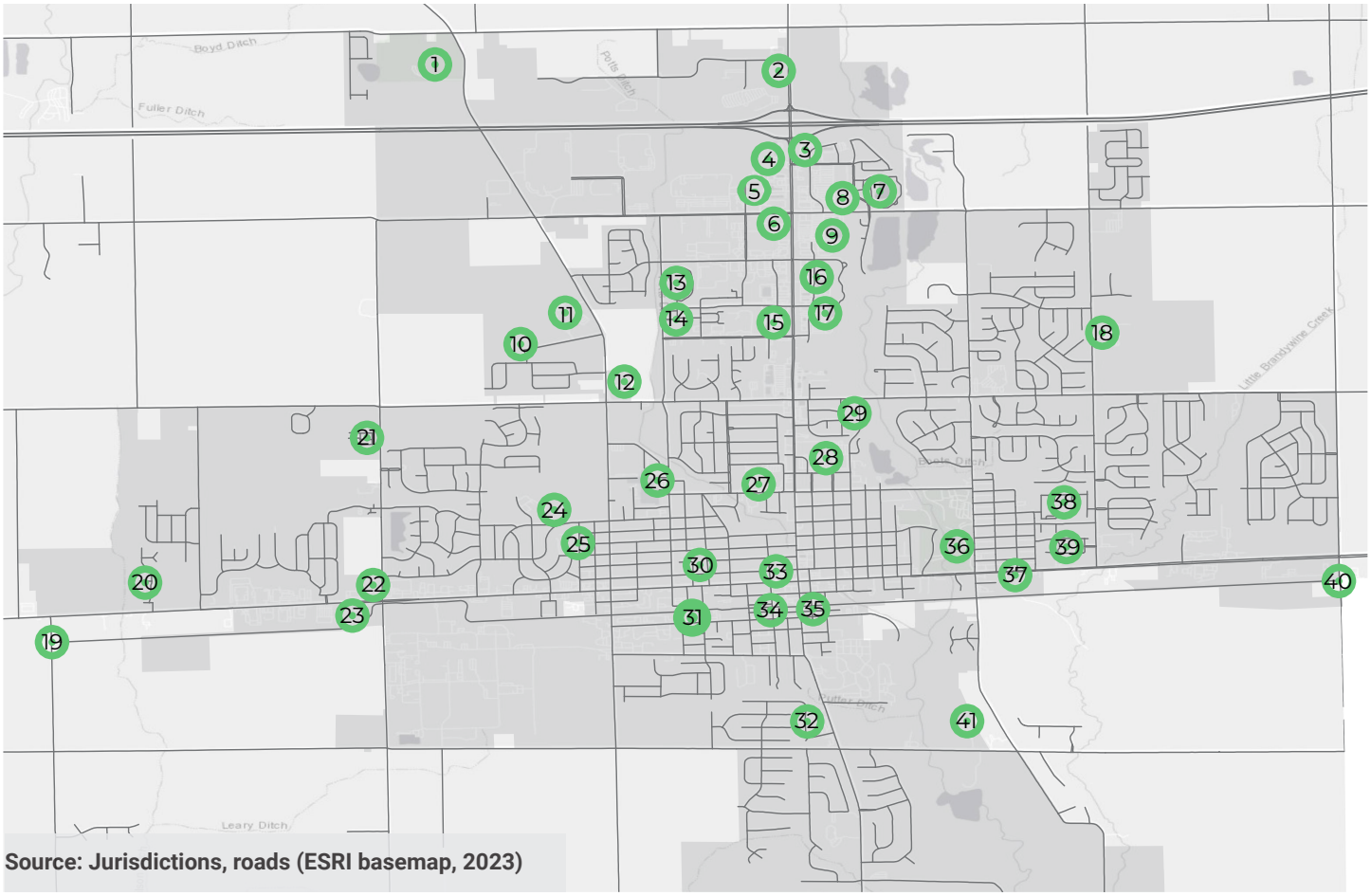
- Public - an EVCS is available to the public 24/7 or during certain hours
- Private - an EVCS is restricted to employees or authorized visitors to this location; typically apartment complexes and non-retail businesses

5) Time of Day

This column refers to when someone can access an EVCS. (See p. 48 for more information)

ID	LOCATION	1 LEVEL	2 POSSBILE # OF PORTS	3 CHARGING CAPACITY (KWH)	4 ACCESSIBILITY	5 TIME OF DAY
1	Beckenholdt Park	2	2	20-60	Public	DTD
2	Starbucks (Future)	3	1	200-360	Public	24/7

Map 3.1 Potential Sites for EV Charging Stations in Greenfield



Source: Jurisdictions, roads (ESRI basemap, 2023)

Table 3.2 Potential Sites for EVCS around Greenfield

ID	LOCATION	LEVEL	POSSBILE # OF PORTS	CHARGING CAPACITY (KWH)	ACCESSIBILITY	TIME OF DAY
1	Beckenholdt Park	2	2	20-60	Public	DTD
2	Starbucks (Future)	DCFC	1	200-360	Public	24/7
3	Cracker Barrel	2	2	20-60	Public	24/7
4	Quality Inn & Suites	2	6	10-20	Private	PMD
5	Super 8	2	5	10-20	Private	PMD
6	Country Inn & Suites	2	6	10-20	Private	PMD
7	Greenfield Crossing Apartments	2	2	3-10	Private	PMD
8	Home Depot	2	4	80-360	Public	24/7
9	Walmart	DCFC	4	80-360	Public	24/7
10	Greenfield Baseball Park	2	2	3-10	Public	DTD
11	Greenfield-Central Junior High School	2	2	3-10	Public	ASH-N
12	Hancock County Public Library	2	2	20-60	Public	ASH-N
13	Greenfield Village Apartments	2	4	3-10	Private	PMD
14	Broadway Village Apartments	2	4	3-10	Private	PMD
15	Hitherto Coffee and Gaming Parlour	2	2	20-60	Public	24/7
16	Planet Fitness	2	4	20-60	Public	24/7
17	Kroger	2	4	60-80	Public	24/7
18	JB Stephans Elementary School	2	2	20-60	Public	ASH-N
19	Pennsy Trailhead West	2	2	20-60	Public	DTD
20	Prairie Meadows Apartment Homes	2	4	3-10	Private	PMD
21	Stonehurst Pointe Apartments	2	4	3-10	Private	PMD
22	Leo's Market	2	2	20-60	Public	24/7
23	VIP Legacy Cinema	2	4	20-60	Public	24/7
24	St. Michael Catholic Church & School	2	2	20-60	Public	24/7
25	Weston Elementary School	2	2	3-10	Public	ASH-N
26	Greenfield-Central Senior High School	2	4	20-60	Public	ASH-N

Table 3.1 (con't) Potential Sites for EVCS around Greenfield

ID	LOCATION	LEVEL	POSSBILE # OF PORTS	CHARGING CAPACITY (KWH)	ACCESSIBILITY	TIME OF DAY
27	Greenfield Intermediate School	2	2	3-10	Public	ASH-N
28	Hancock Regional Hospital	2	4	20-60	Public	24/7
29	Apartments along Swope St	2	4	3-10	Private	PMD
30	Lincoln Park Apartments	2	4	3-10	Private	PMD
31	Broadway Flats Apartments	2	4	3-10	Private	PMD
32	Bomar Plaza	2	1	80-160	Public	24/7
33	H.J. Ricks Center for the Arts	2	2	3-10	Public	24/7
34	Downtown street parking	2	4	20-60	Public	24/7
35	American Legion Place-Street Parking	2	2	20-60	Public	24/7
36	Riley Park	2	2	20-60	Public	DTD
37	Casey's	2	2	20-60	Public	24/7
38	Preservation on Blue Road	2	2	3-10	Private	PMD
39	Bluestone Apartments	2	4	3-10	Private	PMD
40	Pennsy Trailhead East	2	2	20-60	Public	DTD
41	Brandywine Park	2	4	20-60	Public	DTD

Time of Day is broken down into four categories.

For privately-owned sites, the property manager determines who is allowed to use the charging stations and when.

At parks and recreational facilities, it is recommended the charging hours follow the hours of the park usage which is often Dawn Until Dusk.

Publicly available stations in Downtown and at shopping centers are always open for charging.

Lastly, schools can provide publicly available charging after hours and in the summers to protect students, faculty, and staff.

PMD: Property Manager Discretion

DTD: Dawn Til Dusk

24/7: Open 24 hours, 7 days/week

ASH-N: After School Hours - Non-Student

WHO WILL NEED PUBLIC EVCS?

It has been previously discussed that there may be barriers to at-home charging for a variety of reasons. Residents of multi-family housing, renters, and people with old houses and no garages are likely to have no access to a readily available EV charger or infrastructure to install one.

This creates a need for publicly available EV charging, ideally at an affordable rate, so that this charging is close to the price of at-home charging.

Priority Areas

Chapter 2 showed percentages of multi-family dwellers, renters and houses built before 1960s. Based on that data, two maps of priority areas in Greenfield are presented here in Maps 3.2 and 3.3.

Public EV charging should go in the areas of high and medium priority, or very close to those areas, so that people who do not have access to at-home charging can obtain it.

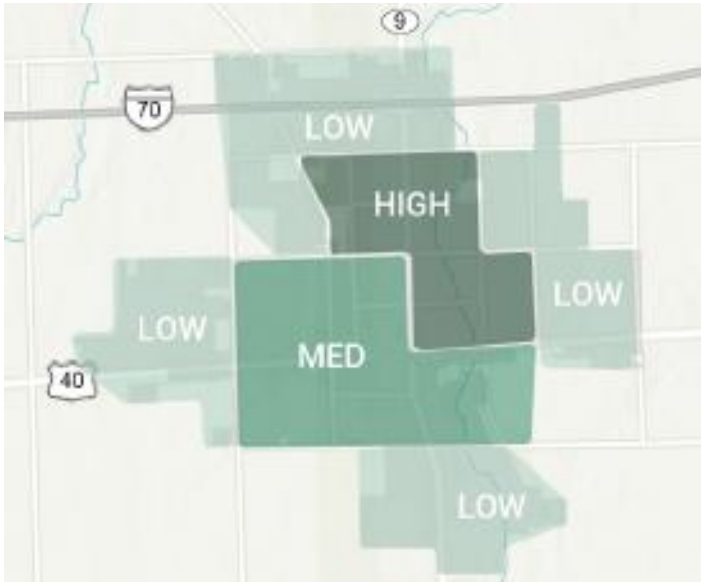
Poverty Levels

The poverty level in Greenfield is at 10 %, being slightly below the national percentage of 11.5 % (see **Appendix A**). The poverty rate does not vary much between the census tracts, but the tracts with the poverty levels above 11.5 % are south of US 40 (see **Appendix A**), where the high priority area is recommended due to the age of the houses and a medium priority due to the share of renters.

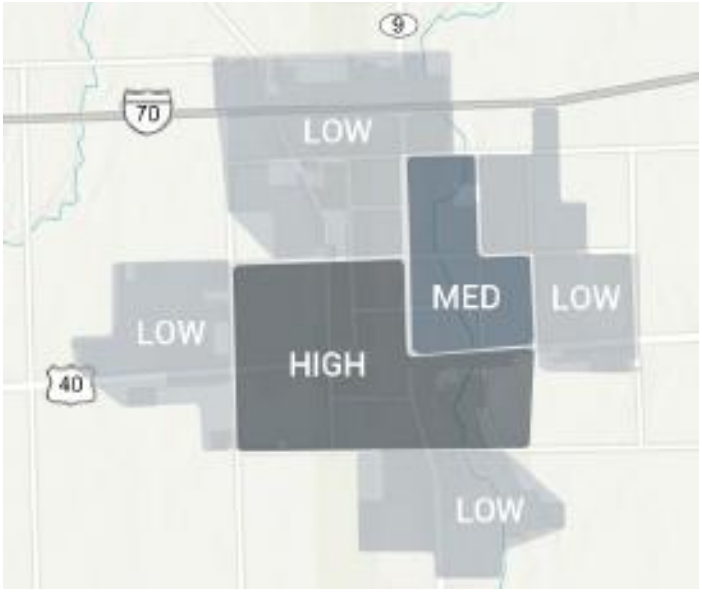
Climate and Economic Justice (CEJ)

According to the Climate and Economic Justice Screening Tool (2), areas that are marked as high or medium on either priority map also appear on the CEJ map due to lower income, higher energy cost, and lower life expectancy.

Map 3.2 Priority Area Map, Multi-Family and Renter. Map source: Esri basemap 2023.



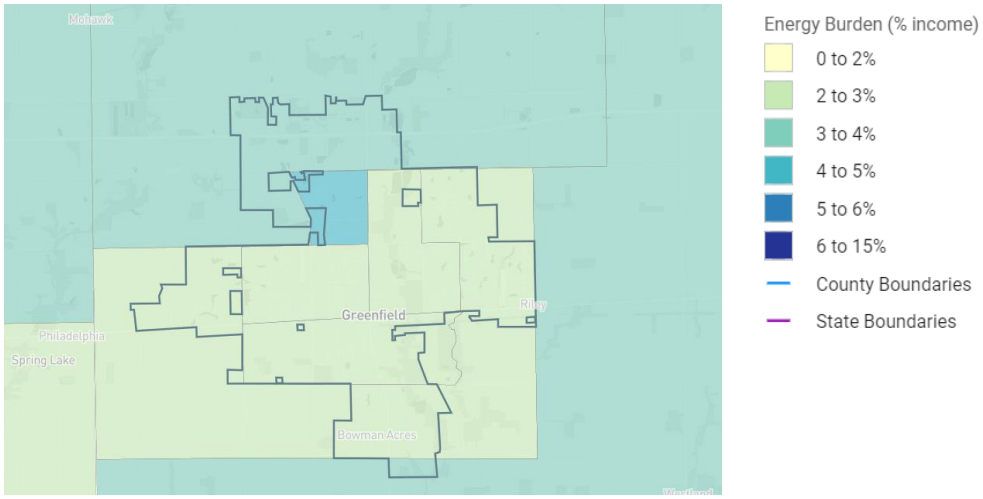
Map 3.3 Priority Area Map, Housing Age. Map source: Esri basemap 2023.



Energy Cost Burden (LEAD)

U.S. DOE developed a tool called the Low-Income Energy Affordability Data tool (3). The LEAD tool shows what share of income people spend to pay for energy. The bigger the share, the more burdened they are. The US percentage varies between 2-3 %. In Indiana, the average share is 3 %. In Hancock County, it is 2 %. Map 3.4 shows the energy burden by census tract. It appears that most Greenfield residents spend 2% of their income on energy, with the highest energy burden at 4 % in CT 4104.01.

Map 3.4 Share of income spent on energy costs (Image source: 3)



CHAPTER TAKEAWAYS

- *While it's hard to predict how much and how quickly the EV market will grow in Greenfield, past experiences in communities in Indiana and across the US that are ahead of Greenfield in EV adoption provide possibilities of what could happen in the future.*
- *Scenarios show the possible EVCS demand in Greenfield in the next 5-10 years with the breakdown of the types of uses that are well-suited for pairing with EVCS, including some government sites like parks.*
- *A detailed analysis of land uses and trips in Greenfield, coupled with input from the public and stakeholders, resulted in a table of all possible city- and privately-owned sites that can successfully deploy EVCS.*
- *Priority areas are provided to focus efforts on removing the barriers to at-home charging.*

REFERENCES

1. U.S. Department of Energy. Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite***. Link: https://afdc.energy.gov/evi-pro-lite.
2. Climate and Economic Justice Screening Tool. Link: https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.
3. U.S. Department of Energy. ***Low-income Energy Affordability Data Tool***. Link: https://www.energy.gov/scep/slsc/lead-tool.

4 | MAKING GREENFIELD EV-READY

This chapter recommends a strategy of how Greenfield can prepare the community for the electrification of vehicles. Detailed information is provided for the best-suited sites. Explanations of the roles of an EVCS host and developer in this Chapter add an understanding of how future partnerships could be arranged. Some grants and funding resources are discussed that could help the city, non-for-profits, and businesses to finance EVCS installation and operation. Finally, recommendations are given on public safety preparedness, utility strategies, and the land use regulations relevant to governing EVCS that Greenfield could consider adopting in the future.

EVCS TECHNICAL ANALYSIS OF SELECT SITES

Chapter 3 shows all possible locations for EVCS, including publicly owned sites spread throughout the city limits. After taking into account such factors as proximity to existing and potential future vehicle charging stations, existing electrical infrastructure, nearby attractions, and anticipated use, six (6) locations owned by the City of Greenfield or non-for-profit organizations were analyzed for EVCS suitability. Three privately-owned sites were also examined as potential DC Fast Charging locations.

The practicality of installing charging stations at these locations is discussed here based on a preliminary site visit and discussion with Greenfield Power and Light. The exhibits on the following pages provide preferred EVCS locations at each site, a notation of existing electrical infrastructure, and potential conduit routes/electrical upgrades.

It should be noted that electrical infrastructure upgrades and environmental assessments will need to be performed during the detailed design phase. The scope of this planning study was limited to identifying the best sites within the city limits. The exact location of the chargers at each location may be revised at time of design if the engineer determines an alternative location would be more cost effective. Recommendations for electrical tie-ins are based off of preliminary discussions with Greenfield Power and Light, however exact sizing of the equipment and the need to install new equipment will be determined during the design phase. Table 4.1 shows the list of selected sites.

Guidelines

The six sites, owned by the city or other non-for-profit organzations, were selected based on the following criteria:

- Community and stakeholder engagement input
- Public accessibility and need
- Proximity to nearby attractions
- Proximity to anticipated electrical tie-in location
- Lack of visible environmental constraints
- Limited hardscape that would be cost prohibitive

Table 4.1 List of selected sites for EVCS technical site analysis

SITE	NAME	ADDRESS
1	Beckenholdt Park	2770 N Franklin St. Greenfield, IN 46140
2	Brandywine Park	900 E Davis Rd. Greenfield IN 46140
3	Riley Park	280 Apple St. Greenfield IN 46140
4	Downtown Parking	101 W South St. Greenfield IN 46140
5	Hancock County Public Library	900 W McKenzie Rd. Greenfield IN 46140
6	Greenfield-Central High School	810 N Broadway St. Greenfield IN 46140

BECKENHOLDT PARK

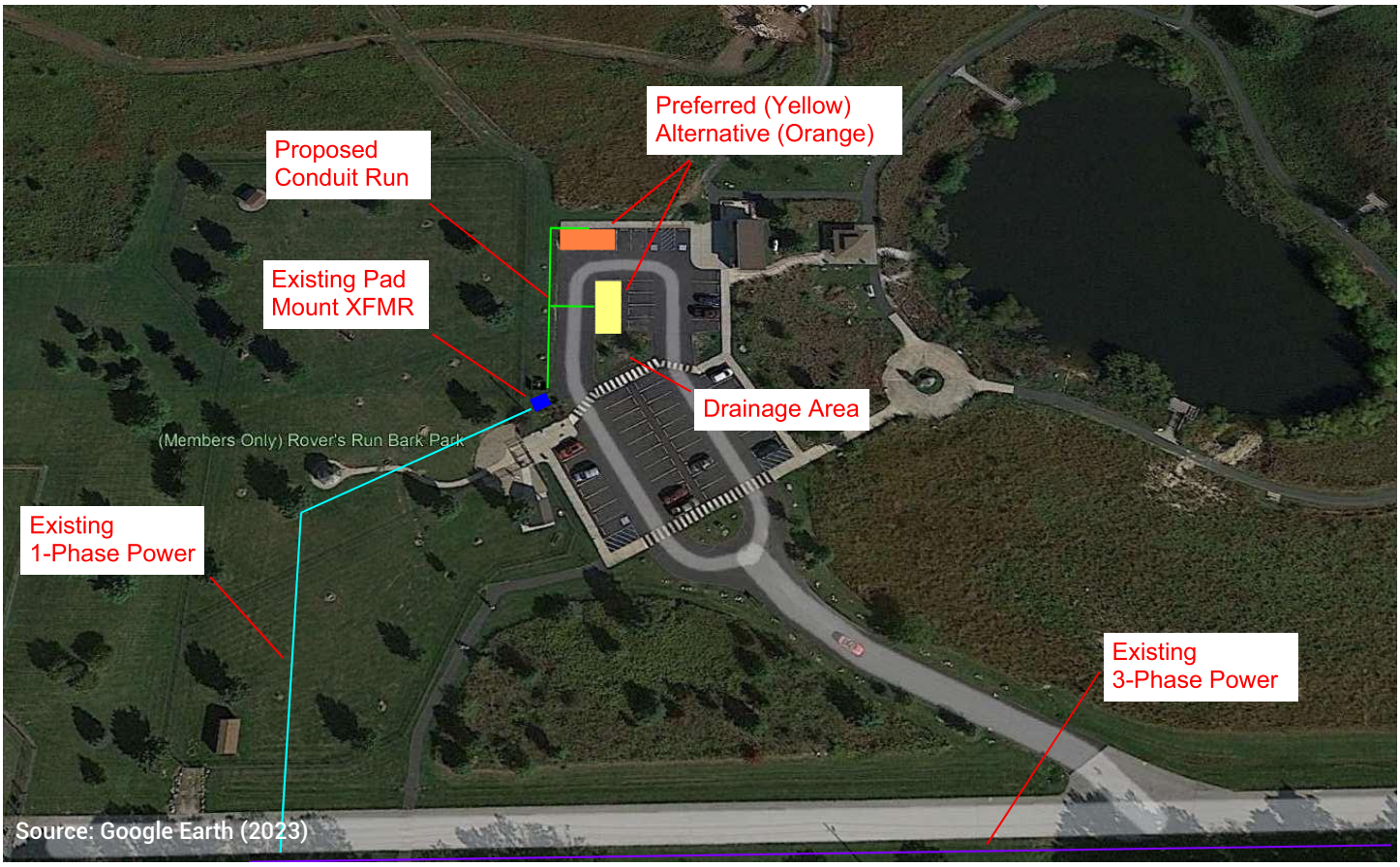
Beckenholdt Park is a 75-acre park located north of I-70. The park includes walking trails, a fishing pond, Rover's Run Dog Park (Membership Required), and the Beckenholdt Pavilion and Amphitheater. There is a small parking lot located between the dog park and maintenance facilities. The site has existing single phase power as shown in the exhibit. It is anticipated that the existing 25kVA pad mount transformer would need up-sized and new conduit run to the proposed location of chargers.

Chargers could be located in a number of locations within the parking lot, preferred location selected based on proximity to existing electrical infrastructure, minimizing the length of conduit and disturbance to pavement.

There is a potential drainage area identified at the center of parking lot - the best practice would be to avoid disturbance.

Photo credit: ms consultants, inc.

Photo credit: ms consultants, inc.



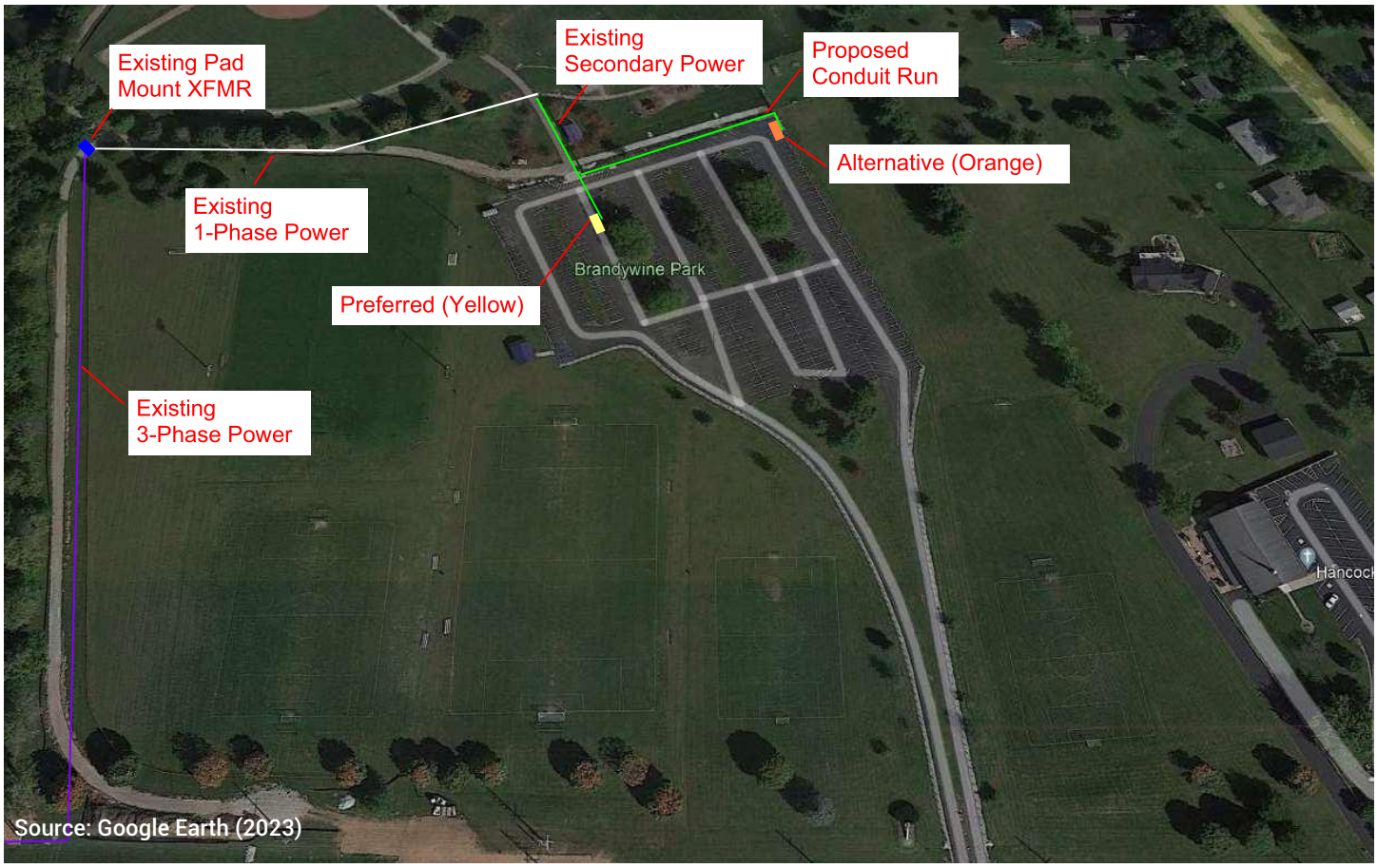
BRANDYWINE PARK

Brandywine Park is a 60-acre sports complex located southeast of downtown Greenfield. The park includes athletic fields for soccer, baseball/softball, as well walking trails and concessions. There is existing secondary power which runs throughout the parking lot, tied back to the primary which runs N-S along the east side of the park.

- Chargers could be located in a number of locations within the parking lot, preferred location selected based on proximity to existing electrical infrastructure, minimizing the length of conduit and disturbance to pavement.
- Anticipated new pad mount transformer would need to be installed within parking lot at location of charging station.

Photo credit: ms consultants, inc.

Photo credit: ms consultants, inc.



RILEY PARK

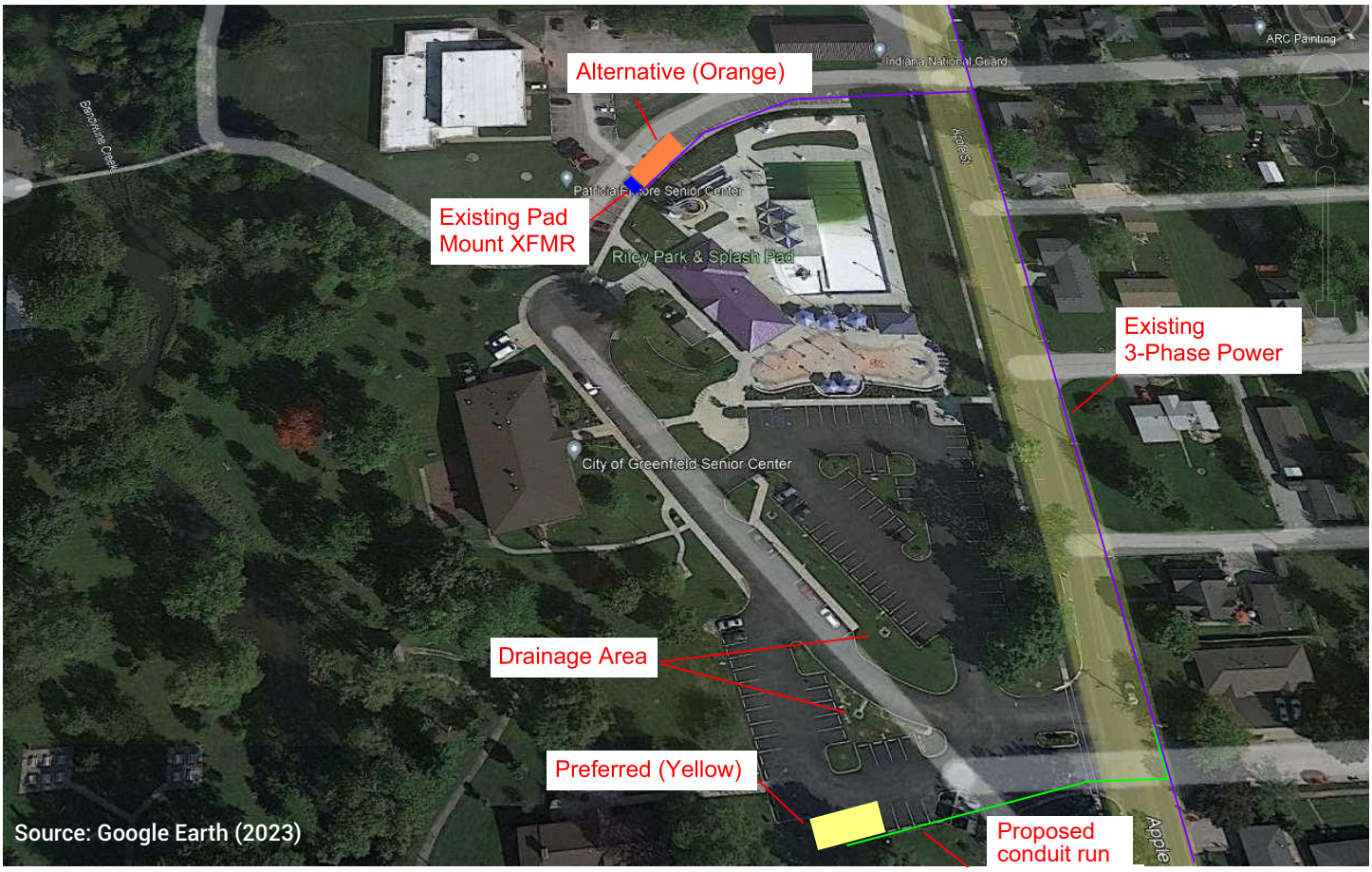
Riley Park is a 40-acre park located east of downtown Greenfield. The park includes athletic field, pool, picnic areas, playgrounds, and walking trails. The Indiana National Guard has a building just north of the pool. There is an existing 150kVA pad mount transformer just outside the pool fence on the north side. There is limited electrical infrastructure on the south side parking. Existing three phase power runs N-S along the east side of Apple St.

Chargers could be located in a number of locations within the parking lot, preferred location selected based on central location. Alternative location would be more cost effective, but there are concerns due to the limited parking. Additionally, proximity to the pool where it could be tampered with by children is a concern.

- The site was observed in October and the parking lot was visibly empty at the time. However, it is anticipated the lot fills up in the summer when the pool is open.
- Preferred location would need to tap off existing distribution on the east side of Apple street, bore under the road and run new conduit to charger location. A new pad mount transformer would be assumed.
- Potential drainage area identified at the center of parking lot, best practice would be to avoid disturbance.


Photo credit: ms consultants, inc.


Photo credit: ms consultants, inc.



Source: Google Earth (2023)

DOWNTOWN PARKING

There is a public parking lot located at the corner of Pennsylvania and South Streets next to Greenfield Fire Station 21. The lot is within walking distance of a number of downtown attractions including shops, restaurants, government buildings, walking tails, and the Depot Street Park. Three phase power runs E-W on the south side of the lot. There is an existing EV charging station two blocks north of this location. Parking is open to the public and free of charge.

- Chargers could be located in a number of locations within the parking lot, preferred location selected based on proximity to existing electrical infrastructure, minimizing the length of conduit and disturbance to pavement.
- Recommend taping off existing pole mount transformers located on the south side of the parking lot. It is anticipated a new pad mount transformer would be required.


Photo credit: ms consultants, inc.


Photo credit: ms consultants, inc.

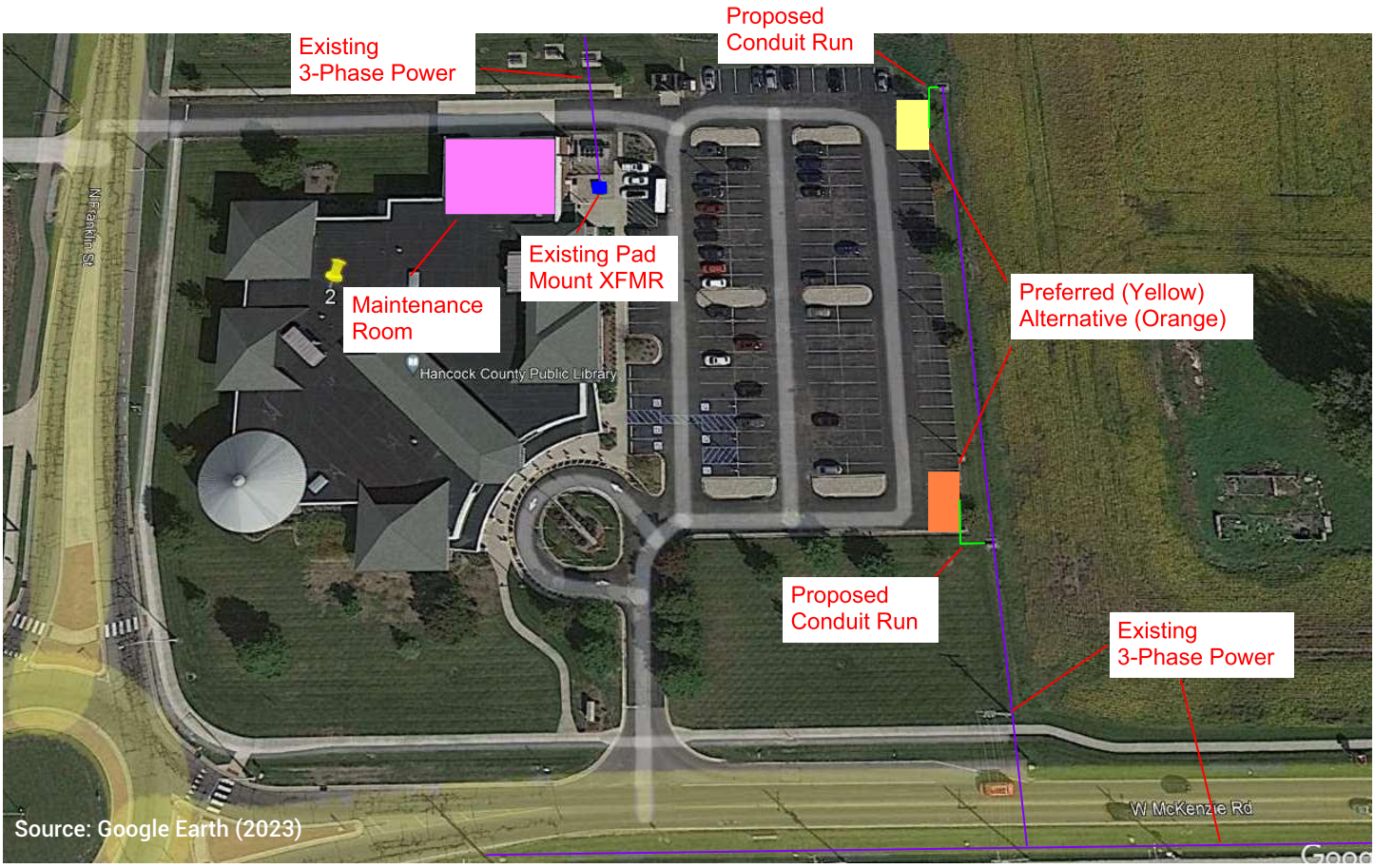
HANCOCK PUBLIC LIBRARY

Hancock County Public Library is a public library available to all residents of Hancock County. It is located just South of I-70 at the intersection of Franklin St. and McKenzie Rd. The site has existing 3-Phase power that runs along the east side of the parking lot, including two pull boxes at the SE and NE corners. There is an existing pad mount transformer outside the libraries maintenance room which is fed from distribution off of Franklin St.

- Chargers could be located in a number of locations within the parking lot, preferred location selected based on proximity to existing electrical infrastructure, minimizing the length of conduit and disturbance to pavement.
- Recommend taping off existing 3-Phase power on the east side of the parking lot and installing a new pad mount transformer.

Photo credit: ms consultants, inc.

Photo credit: ms consultants, inc.



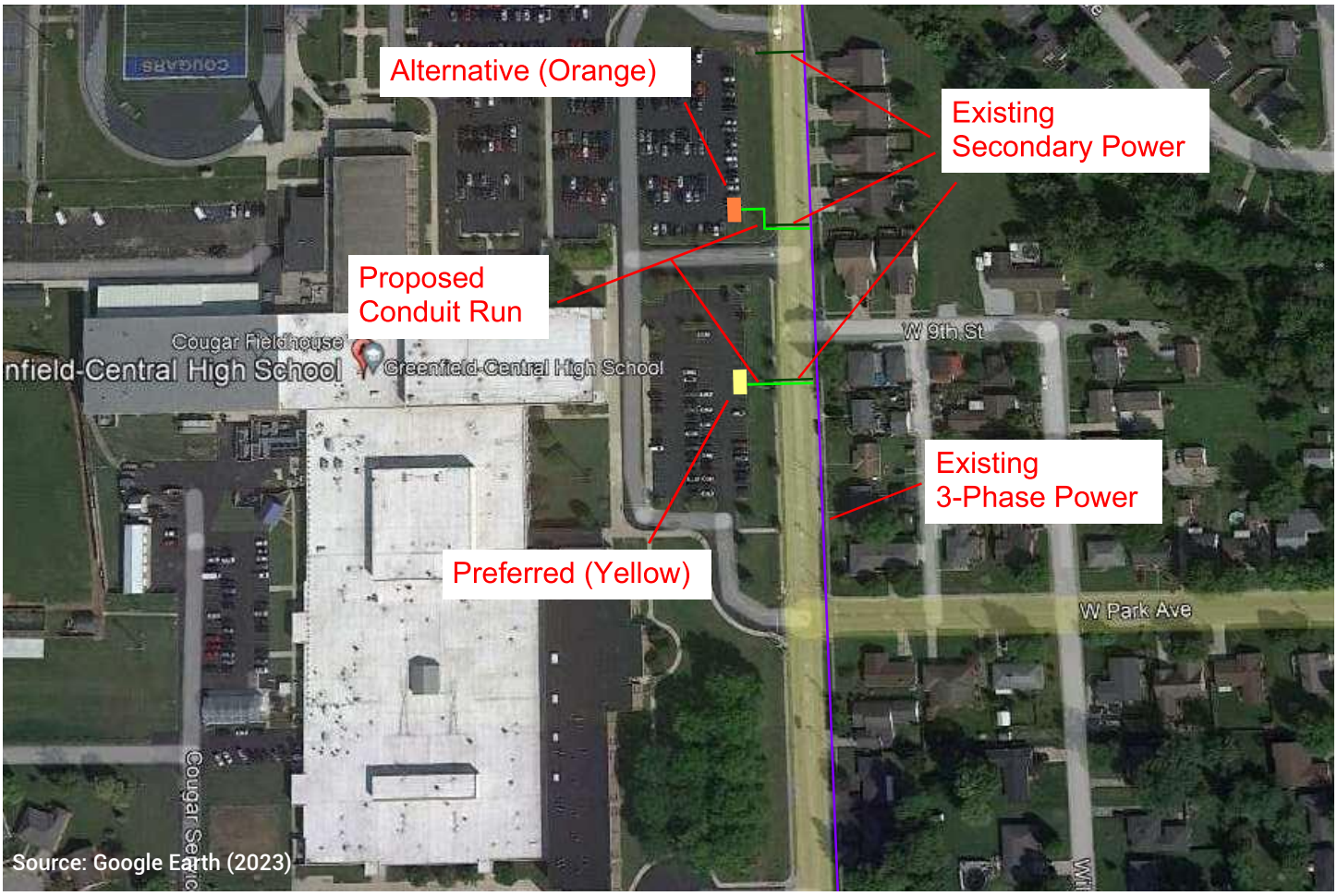
GREENFIELD-CENTRAL HIGH SCHOOL

Greenfield Central High School is located Northwest of downtown Greenfield. The high school has multiple parking lots on the east side adjacent to Broadway St. Existing three phase power runs N-S along the east side of Broadway St. The parking lot adjacent to the athletic fields has limited electrical infrastructure.

- Chargers could be located in a number of locations within the parking lot, preferred location selected based on proximity to existing electrical infrastructure, minimizing the length of conduit and disturbance to pavement.
- Anticipated new pad mount transformer would need installed within parking lot at location of charging station.

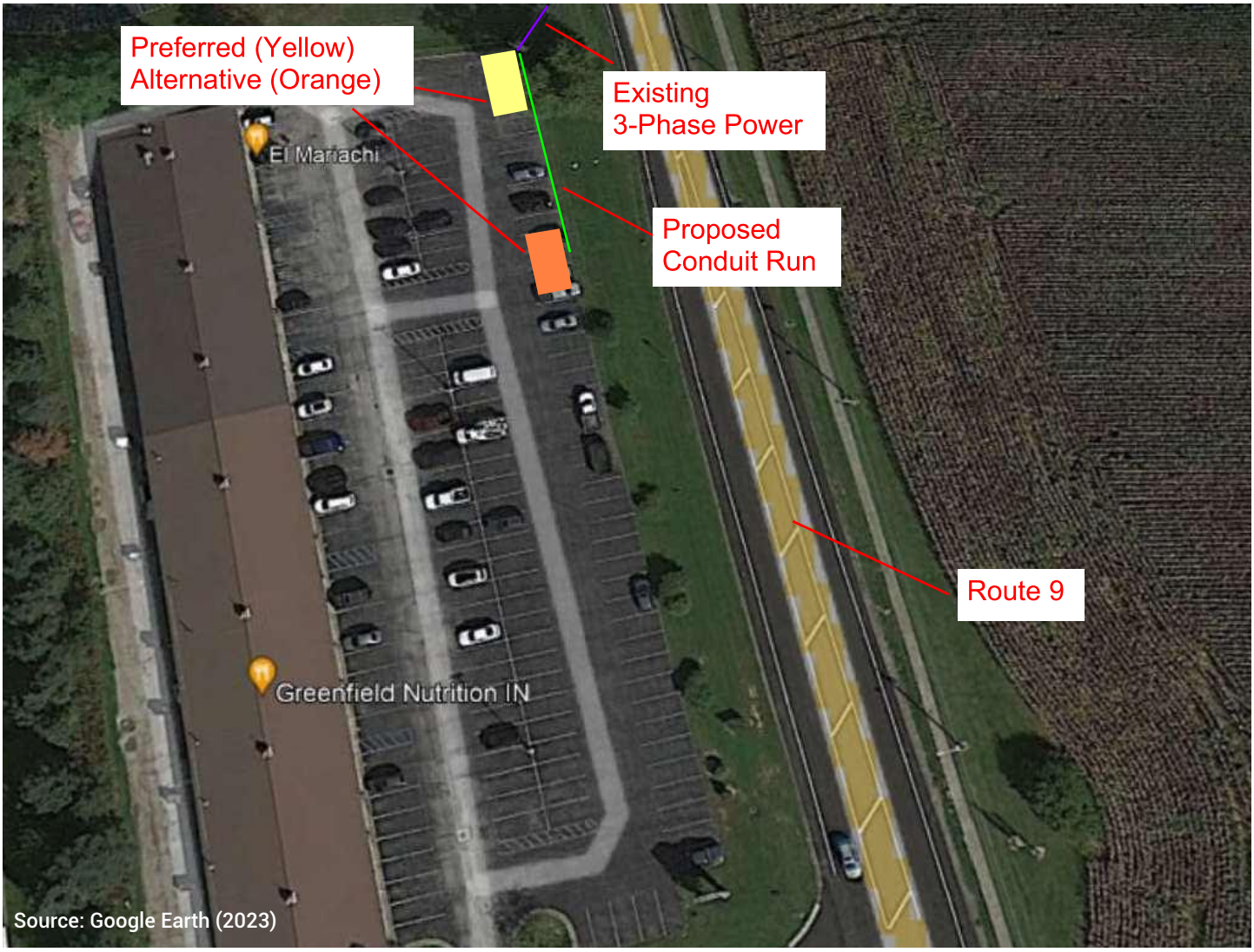
Photo credit: ms consultants, inc.

Photo credit: ms consultants, inc.



BOMAR PLAZA

This strip center managed by Harshman Property Services has a variety of small business and over 50 parking spaces. It is located next to a three-phase utility line. An EV Charging Station can be located next to the line, on the edge of the property along State Route 9. Just south of Downtown, this location would provide a convenient charge point nearby residential areas on the south side of Greenfield. Although located next to a Marathon gas station, it would be an alternative to charging if the gas station does not convert one of the pumping stations to an electric charging station.



SPEEDWAY / NEW STARBUCKS

New Starbucks has been recently built north of I-70 and south of Speedway gas station. Speedway is located is located within ¼ mile of a Greenfield Power and Light substation. If Speedway offers electrical charging, this would be an ideal location for a DC Fast Charging Station that will likely be popular with consumers traversing the interstate. As an alternative, the new Starbucks would also be a convenient charging location for its customers who desire a 20-30 minute charge.

WALMART PLAZA

In a tally from the public, several residents relayed that they would likely charge their vehicles at one of the larger retail box stores along Route 9. Walmart was mentioned as a safe and convenient location.

Between these private and public locations, Greenfield can enjoy a mix of Level 2 and DCFC Charging stations that would provide over 10 options for publicly-assessable charging.

THE ROLES OF HOSTS AND DEVELOPERS IN CHARGING PROJECT DEVELOPMENT

Many new businesses have been created throughout the EV and charging port supply chain. New companies are taking on various project roles.

- Charge Point Developers typically provide initial design and financing for charging stations projects.
- Electric Vehicle Supply Equipment (EVSE) manufacturers provide the charging port.
- City governments and regional planning agencies apply for state and federal grants to reduce the costs of EVCS project administration and implementation.
- Other nonprofits create workforce development paths to train charging installers through government sponsored certification programs.
- Urban planning and engineering firms are called upon to design programs in the best interest of the community.

An entire industry has been born, and the cost burden of installing charging infrastructure is distributed among many partners. Table 4.2 shows the key roles involved in developing, building and operating an EV charging station.

Though a turn-key solution is the easiest, the EV charging market is now unbundled. Now a commercial business or residential customer can purchase their equipment from one manufacturer, have it installed by another contractor and enter into an operations and maintenance agreement with a third provider.

Initially, charging was free but now free charging is rarely offered as many software companies have developed apps and platforms to provide payment services with a credit card. The market is becoming even more sophisticated as new services are emerging. For example, a Charging-as-a-Service (CaaS) model pushes financial burden beyond the host site, and onto a provider offering software services for payment, alerts, and a demand-use control plan, where the driver who pays a higher rate, gets to charge faster than others at the same station.

Although the private market may eventually install chargers that can serve the entire market, city planners are often concerned that this will not happen fast enough to meet the demand for publicly available charging, especially in lower income areas. Communities are choosing to help expedite the process.

Table 4.2 Roles of the organizations involved in an EV Charging station project

ROLES OF THE ORGANIZATIONS INVOLVED IN AN EV CHARGING STATION PROJECT	
Project Developer	Oversees all aspects of a project including contracting, supply purchasing and financing
Site Host	Allows placement of a charging station on property and provides a safe, clean space for vehicles to charge
Engineer	Provides site layout, researches codes and regulations, coordinates utility connection, analyzes demand requirements
Utility Provider	Receives site applications and determines grid connection requirements.
Municipality	Oversees strategic placement of charging station, adopts and enforces code regulations, applies for public funding
EVSE Supplier	Sells port equipment to the Developer or Owner
EVSE Installer/ Contractor	Installs equipment and ensures it is installed to site specifications of engineer or EVSE Supplier
Operator	After commencement of operations, performs maintenance and monitors equipment for charge readiness

Once an EV project is scoped, there are different proactive approaches that Greenfield can initiate. For example, it can organize a regional bid to developers for construction, installation, and ongoing operation of EV Charging Stations.

As host sites are identified, the Host Partner would share in a portion or all of the costs for charging installation. A host site would sign an agreement with an EVSE manufacturer or a Project Developer for ongoing operations and maintenance of the charging unit.

If grant incentives are available, Greenfield can utilize this money to help the Developer or Host Partner to offset the initial costs. In exchange, the Host Partner would agree to meet any technical and reporting requirements that were established by the original grant funder or any requirements of a jurisdictional agency, such as INDOT, the Department of Energy (DOE), or the Federal Highway Association (FHWA). This project would involve not only design and construction, but would obligate the Host and Developers to report on charging port usage for a term of five years or more, so that program benefits can be monitored.

OPERATION & MAINTENANCE TIPS

A successful community EV Charging Plan will provide ample opportunities for charging when needed. The goal is not to just add infrastructure and meet Day 1 operation dates, but to ensure that the charging stations are always operating and well-maintained.

One of the critical barriers in EV Adoption is travel anxiety – concern from a driver that their battery will be depleted, and they won't get to their destination. When drivers plan for charging on their route, they assume (or hope) that the charge port will be working. Charge Point Operators (CPOs) must have the systems and support in place for ongoing operations and maintenance.

When Greenfield begins working with charging providers, here are some operating areas to discuss for Day 2 service and the rest of its operating life.

Maintenance and Warranty Costs

General maintenance for charging infrastructure includes storing charging cables securely, checking parts periodically, monitoring connectivity equipment and keeping the equipment and the site clean. Before the chargers are installed, establish responsibility for maintenance costs and determine if the site host, charging network, or installer is responsible.

Chargers may need intermittent repairs and troubleshooting, as well. Common repair issues include tangled or mangled cables, communication errors and reset, and wear and tear on the connector due to improper use or vandalism. Maintenance contracts should include both a response time, time to perform a given repair, and an overall uptime of the equipment.

Warranty pricing varies by manufacturer; plans can be fixed-term, renewable, and included with equipment costs. According to the California Energy Commission's EV Charger Selection Guide (1), annual extended warranties for DC fast chargers can cost over $800 per charger per year. Level 1 and Level 2 chargers may have a fixed-length warranty for a lower cost, but the owner is then responsible for repair costs after the term ends.

Fleet Operations

For communities and businesses managing fleet operations, the facility manager needs to track how much charge is left in each vehicle when it's dispatched and understand the state of readiness of the charging equipment when vehicles return to the operating hub.

For your vehicles:

- Check with the manufacturer what the optimal charge level is (typically 80%) and understand how quickly the vehicle can be charged. Get to know your fleet by studying the charge statistics for each vehicle, based on the driving routes expected.
- Adjust your plan in extreme weather since cold and heat will derate the charge (more power is required to manage ancillary systems such as HVAC and lights).
- Be ready to dispatch to site of stranded vehicle for tow or research the ability to have a mobile port that can charge the battery enough for the vehicle to return to the hub.
- For vehicles only used in certain seasons, (i.e., street sweeper or plow truck) consider a hybrid vs BEV as they become available on the market. BEV vehicles are like diesel engines, they work better if used frequently.

For your charging station:

- The driver feels reassured that they will have a positive charging experience if the site is well maintained and safe. Establish a requirement in the permitting process that all hosts must provide a site layout in order to receive a permit to install the charger and energize it. The site detail should include the size of the concrete pad for the port, bollards to protect the equipment, paint striping for the parking slots, lighting, and signage.
- Perform regular inspections to ensure that the port is working properly, and the site is free of hazards.
- The CPO will offer analytic platforms that will help you monitor the charging ports from your desktop. The platform should report whether the charger is operating or in use. However, more sophisticated platform can optimize use of the

equipment and readiness and suggest plug in and charging cycles that minimize the cost of electricity.

- Most port communications can rely on a 4G LTE cellular connection to enable payment operations and collect operating data. Test the signal strength periodically to determine its reliability, and talk to the CPO about other options, such as cabling or 5G networks.

Electricity Costs

Electricity costs for the charging equipment owner will depend on the type of equipment installed, as well as the time of day and length of time the charging station is used. Rates utilities charge for electricity may vary based on time of day, and charging station hosts may choose to charge drivers a variable rate based on when they charge.

The cost of electricity to charge vehicles includes per kilowatt-hour (kWh) charges, which are typically based on the highest 15-minute average use recorded over a billing period. Direct-current (DC) fast charging equipment is more likely to trigger demand charges than Level 1 and Level 2 charging. Note that some utilities offer time-of-use rates or other rate incentives for charging infrastructure owners.

Collecting Fees

While charging was free in most cases initially, a fee for use of charging infrastructure is now mainstream. Networked charging infrastructure can generally be categorized as member-only access or open access. The former requires a network membership to use in order to pay for charging and gain full access to all the features and services of a given network (e.g., a wholesale club membership model). However, open access charging infrastructure is preferred to meet the goals of accessibility. Even if a port has membership benefits, non-members should be offered an opportunity access to call a customer service center or pay onsite with a credit card.

Fees can be collected at the charging unit, via credit card, or over a phone App, therefore, an Internet connection is essential. Alternatively, site hosts can collect fees through the use of non-networked charging infrastructure through radio-frequency identification (RFID) capabilities, mobile applications, or in-person payments (such as with a parking attendant). An example fee structure can be found in the Federal Energy Management Program Federal Workplace Charging Program Guide (2).

Data Collection

Capturing and analyzing charging infrastructure uptime and utilization data is a key component to successful charging station management. Most charging networks provide utilization data to site hosts through an online portal for analysis. Hosts may capture data for non-networked charging infrastructure by installing a separate electric meter, third-party data analytics software, or through other options offered by the charging infrastructure manufacturer. Utilization data can be used to track progress towards emissions and energy goals, determine if a certain pricing structure is successful, and evaluate the need for additional charging infrastructure in the area. Data reports should share the report ID, number of charges per day or month, the amount of electricity used, average charge time, and uptime.

Many federal grants for public chargers require that the jurisdictional official and the Host or CPO enter into a maintenance agreement for at least five years. This agreement obligates the Host or CPO to maintain the charging station so that the equipment is up and running. Be prepared to inspect the station periodically for regular safety checks to ensure proper functioning and avoid hazards at the site or require the CPO to send in their operating reports with the same information. Some agreements require uptime to be better than 95% of the station's open hours, setting a high bar for charge point operators. The maintenance agreement can stipulate that charge port works, drivers can pay easily and quickly, and that the utility bill for the charger is paid.

HOW CAN EVCS INSTALLATION BE FUNDED?

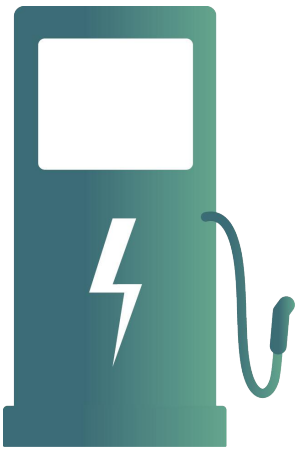
An important element that has been helping the EV and EVCS market grow faster, stronger and more comprehensively is funding. Grant funds can reduce the cost of several EV-related needs: charging infrastructure, grid upgrades, purchasing EVs, workforce development and more.

$7.5 billion+
IIJA funding for charging infrastructure (7)

$13 billion+
IIJA funding for grid improvements (8)

The major federal fundings sources are:

- Infrastructure Investment and Jobs Act (IIJA) of 2021 also known as BIL (Bipartisan Infrastructure Law), available until 2026.
- Inflation Reduction Act of 2022, available until 2031.



Charging Infrastructure

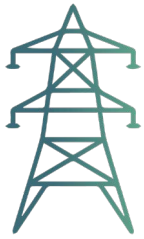
A reliable, robust network of EV charging stations decreases range anxiety and encourages more people to purchase EVs. The private market alone hasn't created such network, so the federal government has created two programs to help fill in the gaps: National Electric Vehicle Infrastructure fund (NEVI) and Charging and Fueling Infrastructure grant (CFI) as part of IIJA. Also, many IIJA funds and grants allow EV charging infrastructure to be a component of a transportation project.

The goal of the NEVI program is to create a network of EV chargers at regular intervals along highways and select state routes. The CFI program's goal is to supplement the NEVI network with Level 2 and DCFC charging, along highways and in local communities.

Several IIJA transportation funds flow into the state (the Indiana State Transportation Improvement Program (STIP)) and local MPO (metropolitan planning organization) departments that can be used for EV charging infrastructure improvements.

EV Purchase or Retrofit

Several federal and state funds can be used to retrofit older vehicles with new clean EV technologies, like Volkswagen Environmental Mitigation Trust, or acquire EVs, like the Clean School Bus program. Many other transportation federal grants deem EV retrofitting as an eligible item on a transportation project.



Grid Upgrades

Part of IIJA funds are grants are available for electric grid upgrades (GRIP): Grid Resilience Utility and Industry Grant, Smart Grid Grant, and Grid Innovation Program. Smart Grid Grant supports projects that facilitate EV integration (3).

Tax Credits for EVs and EV Charging

Inflation Reduction Act of 2022 introduced several EV-related federal tax credits that can decrease the cost of buying an EV or installing EV charging for individuals, businesses and other entities. Here are some examples:

- New and used EV cost tax credit of up to $7,500 (4)
- EV home charger installation tax credit of 30 % not to exceed $1,000 between 2023-2032. The cost may include not only the charger, but also the cost of electric infrastructure upgrade necessary to install the charger (5).
- EV charging station installation expense may be eligible for up to 30 % tax credit of the cost not to exceed $100,000, if it's located in a census tract with at least 20 % poverty level or a certain median family income level (6).

Most of the funds for EV charging infrastructure originate in IIJA and are available either as competitive grants directly from the federal government, or trickle down to the state and local infrastructure projects on a formula basis and are available as grants from INDOT (Indiana Department of Transportation) or Indianapolis MPO (Metropolitan Planning Organization).

Federal Competitive Grants

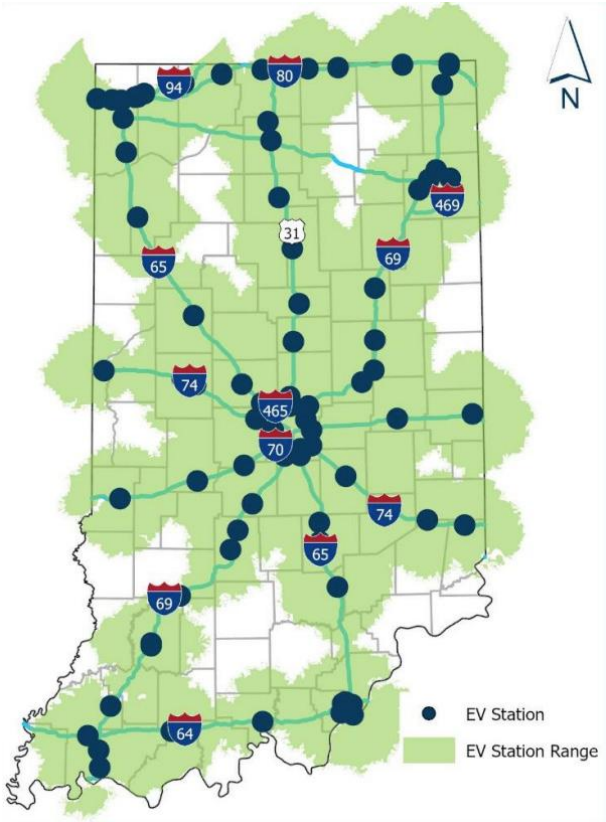
The following discretionary, or competitive, grants are available for EVCS projects directly from the federal government (9):

- Charging and Fueling Infrastructure (CFI)
- Rebuilding American Infrastructure with Sustainability and Equity (RAISE)
- Infrastructure for Rebuilding America (INFRA)

The CFI program goal is to supplement the NEVI EV charging network with Level 2 and DCFC charging, along highways and in local communities.

RAISE and INFRA consider EVCS as an eligible project as a component of a transportation project.

Map 4.1 Candidate EV Charging Locations in Indiana (Source: 11)



State Competitive Grants

There are two main state sources for EV charging infrastructure in Indiana, both originate from IIJA:

- National Electric Vehicle Infrastructure (NEVI)
- State Transportation Improvement Program (STIP)

NEVI

The goal of the NEVI program is to create a network of EV chargers at regular intervals along highways and select state routes throughout the United States. The fund is administered by the state Departments of Transportation.

INDOT created a NEVI plan and obtained the federal funding to start building out the state charging network. Map 4.1 shows the current candidate locations that INDOT identified in its plan as priority locations to create a network of chargers that would cover most of the state.

No locations were identified in Hancock County in the NEVI plan. However, if the charging stations identified on the map are built out and some of the NEVI funding remains, INDOT may open other rounds of funding for EV charging stations along the AFC not identified on the map. For Greenfield, eligible location would be within 1 mile of I-70.

STIP

Part of STIP funds come from IIJA and some of those funds allow EV charging infrastructure to be part of the transportation improvement projects.

Other programs, like VW Mitigation Trust were used in the past to fund EVCS projects, but its EVCS funding has been fully allocated as of November 2023.

Indianapolis MPO Competitive Grants

EVCS projects may be eligible under several programs administered by Indianapolis MPO TIP:

- *Surface Transportation Block Grant (STBG)*
- *Congestion Mitigation and Air Quality Improvement (CMAQ)*
- *Carbon Reduction Program (CRP)*

2023 IMPO Guide to Funding provides the details on how to apply for the grants (10).

Comparison of Indiana NEVI and CFI Grants

NEVI and CFI grants are the most popular to apply for to fund EVCS projects. CFI is split into two types of grants: Corridor grants for EVCS projects along the Alternative Fuel Corridors (AFC) and Community grants for EVCS projects that can be located anywhere in the community (12). Table 4.3 compares the features of these two grant options.

Table 4.3 Comparison of NEVI and CFI grants

	INDIANA NEVI	CFI (CORRIDOR)	CFI (COMMUNITY)
Location	Within 1 mile of the Alternative Fuel Corridor[1], every 50 miles (according to the state-developed NEVI plans).	Within 1 mile of the Alternative Fuel Corridor.	On any public road or publicly accessible site (or along AFC if desired, but not required).
Award Size	No min or max	Min: $1,000,000 Max: no max	Min: $500,000 Max: $15,000,000
Private Entity Partnership	Requires a partnership	Requires a partnership	Doesn't require a partnership
Eligible Costs	Pre-construction and design, construction, post-construction, and operations and maintenance (up to 5 years after construction).	Procuring, installing and operating EV chargers (some operating costs for up to 5 years).	Planning, designing, procuring and installing EV chargers. Up to 5 % of the award can be also used for public education and community engagement.
Priority in projects is given to…	Projects that can be executed by an experienced team that can design, build, and operate EVCS after the grant funds run out.		Projects located in rural areas; projects that expand access of EV charging to low- and medium income families and within communities with a low ratio of private parking spaces to households or a high ratio of multi-unit dwellings to single family homes, as determined by the Secretary.
Cost Share	80 % federal source(s) + 20 % non-federal source(s). Private entity MUST supply the non-federal share.		
Award Type	Cost reimbursement (expenses incurred after signing the grant contract)		

1 According to FHWA, the 1 mile from interstate exits or highway intersections along AFCs should be measured as the shortest driving distance from the Interstate Highway System exit or highway intersection to the proposed station at the time of the proposal. Additional information on how measurement shall be made follows:
a) If the EV corridor is a freeway/interstate or has full access control, the distance shall be measured from the entrance driveway of the charging site to the center point of the nearest ramp or loop intersection with the local/adjoining road.
b) If the EV corridor is not a freeway/interstate or full access-controlled highway4F6, the distance shall be measured from the entrance driveway of the charging site to the center point of the intersection of the EV Corridor with the street on which the charging site is located, or to the edge centerline of the EV Corridor if the charging site has direct access to the EV Corridor.

Federal Minimum EVCS Requirements

No matter which grant is used, if the original funding source is IIJA, the project most likely will have to meet the minimum EVSE requirements listed in 23 CFR Part 680 (aka Title 23 federal-aid projects (13)).

Title 23 establishesthat projects funded under the NEVI Formula Program and projects for the construction of publicly accessible EV chargers under certain statutory authorities, including any EV charging infrastructure project funded with Federal funds, is treated as a project on a Federal-aid highway, except where explicit limited applicability is noted in the regulatory text.

These minimum requirements cover a range of topics. Comparison of the requirements relevant to this plan are provided in Table 4.4. Most standards are the same across all grants and the differences appear when the EV charging station is located along an AFC Corridor or not.

Other standards include the following: procurement process, EV charging payment methods, EVSE certification, physical security of the site, minimum 5-year operation and maintenance, certification requirement for the technicians servicing the station, data privacy, data submittal, customer service requirements, charging network connectivity, minimum uptime and ability to report real-time data online regarding the charger's availability, location, and pricing online, and a few others.

Table 4.4 Comparison of some EVSE minimum federal requirements

	INDIANA NEVI	CFI (CORRIDOR)	CFI (COMMUNITY)
Availability to public	24/7	24/7	Accessible during entity's operating hours
Minimum number of charging ports	4 DCFC minimum	4 DCFC minimum	4 minimum (either DCFC or Level 2)
Charging ports	Other kinds of ports and level of charging is allowed in addition to the minimum above.		
Connector type	DCFC along AFC: Each port must have at least one (1) CCS Type 1 connector. (Other connector types are allowed as long as CCS is provided.) AC Level 2 charging port must have a permanently attached J1772 Connector.		
Power level	DCFC along AFC • Voltage: 250 – 920 volts • Power: 150 kWh minimum continuous supply of power simultaneously from each port AC Level 2 • Power: 6 kWh minimum continuous supply of power simultaneously from each port		

Workforce Development

Long-term planning for EVCS would greatly benefit from training the local workforce to operate and maintain EVCS. EVCS funded with federal-aid grants that need to meet Title 23 minimum standards require that EVCS is installed by an electrician certified through the EV Infrastructure Training Program (EVITP) or a state-based equivalent continuing education (CE) credit. Here is an example program from the US EPA (14).

The following grants can cover the cost of workforce development (8):

- MPO: STBG, CMAQ, CRP
- State: NEVI
- Federal: CFI

GOVERNMENT PREPARATION FOR EVs

There are three areas within the government that can take steps today to prepare the community for EV and EVCS integration:

- Regulations and permitting processes
- Utility rates
- Public safety training

LAND DEVELOPMENT & BUILDING CODE CONSIDERATIONS

This section provides the City of Greenfield with recommendations about incorporating EVCS into the local code to prepare for a larger amount of EV charging in the future. Development standards are regulations which regulate the construction and occupancy of structures within a jurisdiction. Examples of development standards include minimum lot size, maximum height, setback requirements, etc. In the City of Greenfield, the Unified Development Ordinance (UDO) contains the development standards, so the recommendations below are for the UDO. Land use regulations center around the following main components:

1. Defining the land use,
2. Deciding where the use is allowed, and
3. Creating minimum development standards applicable to the use.

DCFC Charging by a Grocery Store

Photo credit: ms consultants, inc.

DCFC Charging for Heavy-Duty Vehicles

Photo credit: Portland General Electric (15)

EV STATIONS AS LAND USE

EV charging is a way to fuel a vehicle and at first seems similar to a gas station. However, here are several differences between EV charging and a gas station that simplify considerations for development standards:

- Most charging happens at home, so any non-home charging is supplemental.
- Charging a vehicle with electricity can happen in more places than a gas station because of only needing to tap into the local electrical grid.
- EV charging stations require less regulation than gas stations since gasoline is a hazardous material.
- EV charging stations do not require freight deliveries because the station is powered from the grid instead of underground fuel tanks.

Different levels of charging create a need for a different definition of use and affect how the zoning ordinance could regulate the use.

Exempt

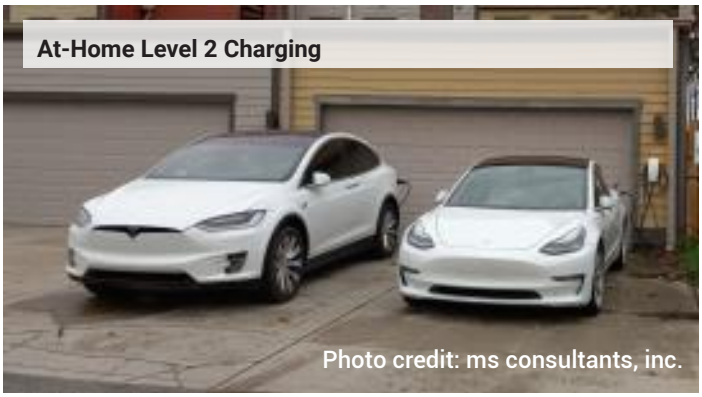
Most charging happens at home using a Level 1 or 2 charger that looks like an appliance that one plugs into a socket. As such it is more of an appliance or an accessory structure like a mail box that is often exempt from permit requirements.

Accessory

Other types of charging look like an accessory structure added to a parking lot or garage. The primary use of the lot remains mostly the same. The only additional structures that add to the overall footprint and look of such accessory additions is the electric equipment installed on site to service the chargers. Typically, the more DCFC chargers are added to the site, the more electric equipment is added necessitating screening standards and review of how the parking and landscaping areas are affected.

Primary

The most intense possible EV charging station use would be a stand-alone station. In addition to the normal considerations for EV chargers, like screening and landscaping, these stations may need special considerations for the design of parking spaces and traffic circulation on and off-site.



Conditional Use

Due to the evolving nature of the EV charging station use and design captured in some use characteristics described above, it may be necessary to add EV charging stations as a Conditional Use and list features that would turn it into a Conditional Use, like a need to redesign parking circulation, a need for a significant electric upgrade, significant increase in trip generation, and so on.

A list of additional considerations to keep in mind when defining uses as well as examples of use definitions are in **Appendix C.**

DEFINITIONS

The discussion of the EVCS use characteristics as well as its components leads to a need to add some new terms to the UDO listed in the action item box.

ACTION ITEM

Add new, EV-related terms to the UDO.

Uses: *EV Charging station (EVCS), as a primary and accessory use.*

Technological components: *EV (electric vehicle), EVSE (electric vehicle supply equipment), EV charger, etc.*

EV specific land use terms

- *EV-capable: the installation of electrical panel capacity with a dedicated branch circuit and a continuous conduit from the panel to the future EV parking spot(s).*
- *EV-ready: installation of electrical panel capacity and raceway with conduit to terminate in a junction box or 240-volt charging outlet.*
- *EVSE-installed: Installed means the installation of electric panel, conduit, and an EV charger (Level 2 or DCFC).*

DEVELOPMENT STANDARDS

For the purposes of creating development standards, one needs to understand the "anatomy" of the EV charging station. The typical components that you will see on site are: Level 2 or DCFC chargers that are located by a parking spot, electric utility structures that service the chargers, some "EV use only" signage by the parking spot or marking of the parking spot, and some barriers that indicate where the vehicle should stop before hitting EV chargers. See examples of existing EV charging stations below.

The main areas where development standards for EVCS would need to be updated are:

- Parking number requirements
- Parking space design, including EV ADA space
- Screening standards
- Encroachments
- Sign standards

BUILDING STANDARDS

It is important to note that certain EVSE-specific structural standards come from the Indiana Residential, Building and Electric Codes. Typically, local governments adopt the state codes by reference into the city code.

Indiana is in the process of updating its Electric Code and may adopt it in 2024. This code update should include some EVSE-related new standards (17).

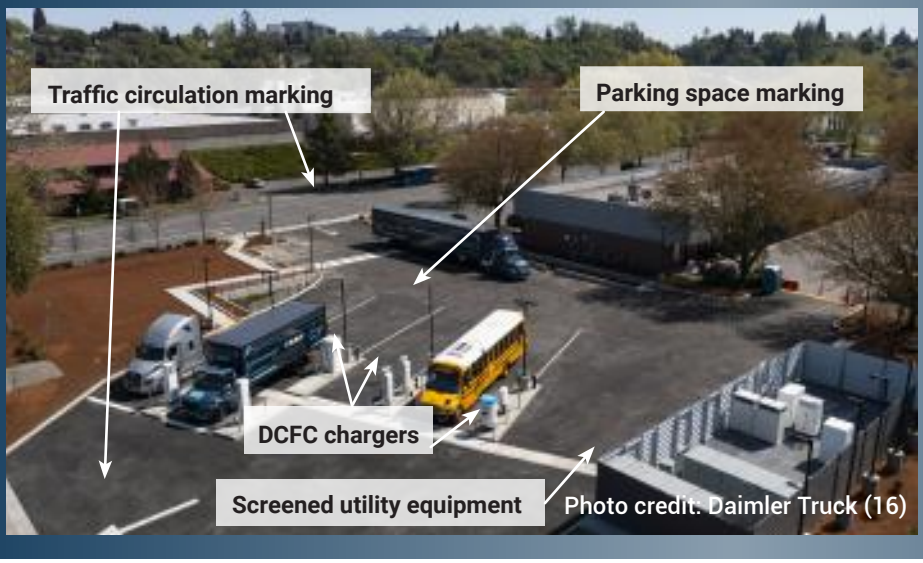
Action Item

Update building and electric permit requirements and procedures for EVSE

Once Indiana DHS adopts a new Electric Code, the local building department should update its permitting procedures to be able to review applications per new standards.

Development Standards in Action

This station is in a parking lot among several retail businesses. It has two Level 2 chargers and one DCFC charger. Charging ports, utility equipment, and bollards are placed in an existing landscaped area. Four parking spots are marked for EVCS use with a hashed area between two DCFC spots.



This station is located in a commercial retail area with food establishments, other retail, and light industrial land uses. The station has four Level 2 chargers and nine Level 3 (DCFC) chargers.

Since this station is for light-to-heavy-duty vehicles, the design includes larger, clearer indicators for vehicular circulation, parking spot size, location of the charging ports, and screening of the utilities.

PARKING REQUIREMENTS

The most common land use requirement related to EVCS are the amount of required parking spaces for charging. **Appendix C** includes detailed examples of such requirements.

ADA EV REQUIRED SPACES

Any parking requirements adopted should be drafted with ADA accessibility in mind. The United States Access Board released *Design Recommendations for ADA-Accessible EVCS* in 2023 (18). This guide provides various scenarios on the best design standards for the intersection of EVCS and accessibility and can be used to create minimum design standards.

The topics covered in this report are:

- Minimum parking spot width, depth, and angle.
- Minimum width of the hashed area around the vehicle
- Location and movement connectivity requirements to move safely between an EV charging space and a building
- Ground floor requirement without curbs to allow access to the charger.

Action Item

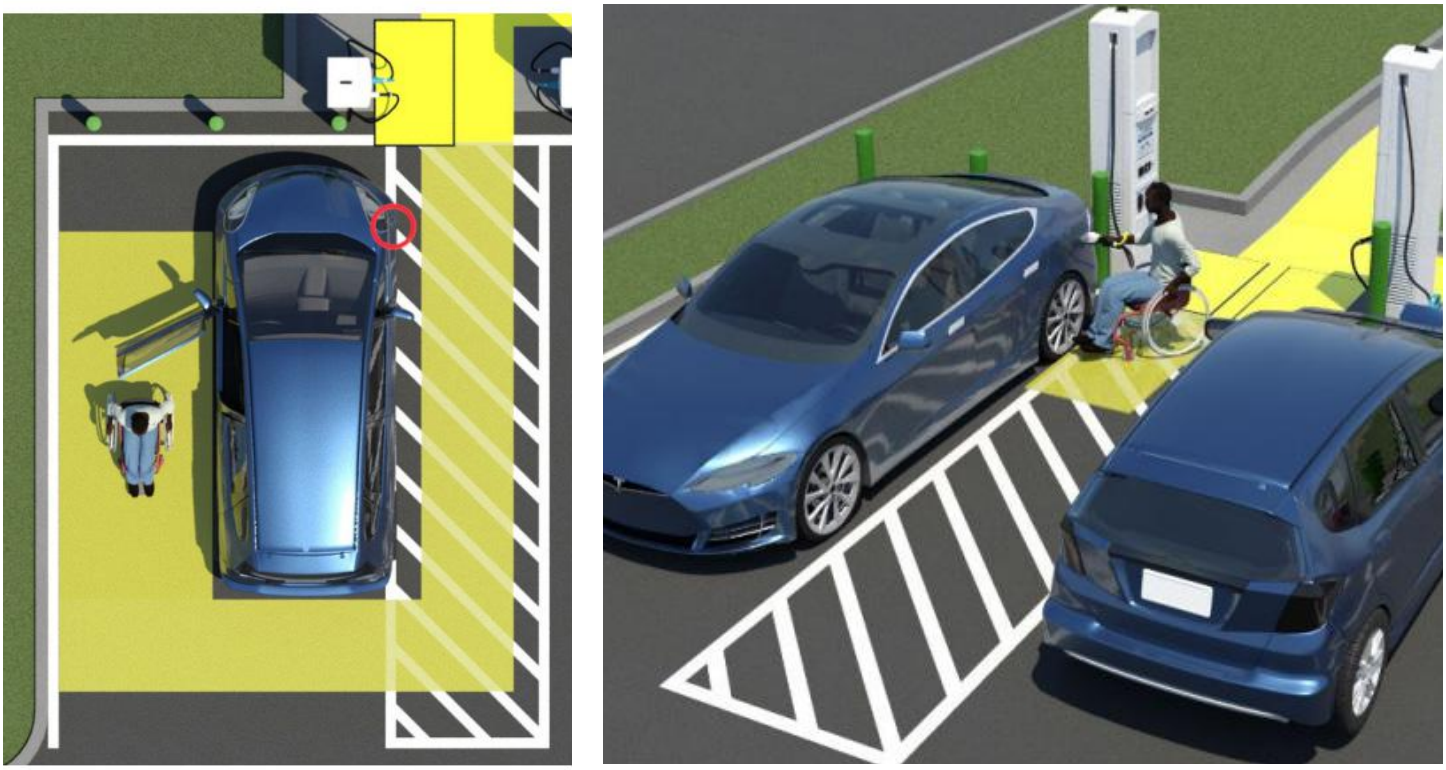
Add EV parking minimum requirements to the UDO.

Appendix C shows detailed examples, but general principles of EV parking minimums are summarized below:

- *Typically expressed as a percentage or ratio of the required number of total spaces*
- *Commonly created for multi-family residential, lodging, and commercial uses*
- *Required in some jurisdictions only if the use reaches a certain number of total parking spots*
- *Can have separate requirements for shares of EVSE-installed, EV-ready, and EV-capable spots. This is a good way to require some ready-to-use chargers today, but have the utility infrastructure ready for future expansion.*

Figure 4.1 illustrates the considerations for ADA-accessible EV parking spaces.

Figure 4.1 ADA Accessible Parking Space Illustration (Image source: 17)



SCREENING STANDARDS

The more chargers are installed on site, especially for fast charging, the more additional utility equipment will be installed to service the charging stations. Developers may wish to install screening with a secure fence to restrict access regardless of the amount of utility equipment.

ACTION ITEM

Require or encourage developers to apply screening to utility infrastructure

It is up to a jurisdiction to decide whether any other screening standards should apply: a specific fencing material, landscaping, etc.

Photo credit: ms consultants, inc.

Photo credit: ms consultants, inc.

Figure 4.2 Examples of utility screening methods

SIGN STANDARDS

To keep sign regulations consistent among the uses, it is recommended that the type of signage allowed for structures like EV chargers are similar to what is allowed for similar structures, such as gasoline pumps.

ACTION ITEM

Add sign regulations for EV Chargers

Sign standards should be consistent with what is allowed for other uses.

Publicly available Level 2 and DCFC chargers typically have the following components that may be considered as signage: business identification (name and/or logo of the charging network), text that instructs people how to use the charger, and a screen with payment information. These are the typical components of signs that gas pump stations have as well. **Appendix C** shows specific areas in Greenfield's UDO where the existing sign standards can be updated to clarify that the requirements apply to EVCS as well.

ENCROACHMENTS

EV chargers are often installed in existing landscaping in parking lots or along commercial buildings and doing so means keeping parking lot layouts the same before and after EVCS installation. The utility structures are sometimes allowed to be added into the landscaped areas or can be built as an addition to a parking lot outside of the landscaping. This depends on how the local government permits accessory and utility structures in conjunction with landscaped areas and easements.

ACTION ITEM

Treat EVSE utility structures as any other accessory structure.

Doing so relates to permitting their location in drainage and utility easements, or their encroachment into landscaped areas or setbacks.

UTILITY CONSIDERATIONS

The "fuel" for electric cars comes from the electric grid. As more people purchase vehicles that use electricity, cities must consider how the electric grid will handle EV technology.

If, for example, an ambitious goal of 50% EV adoption was achieved in the United States by 2030 (6), the nation's electric grid would need to supply 6-10 percent more electricity (19). In general, this is not a large increase. However, it is not the total demand for electricity that electric utilities must consider most carefully, but rather the peak demand.

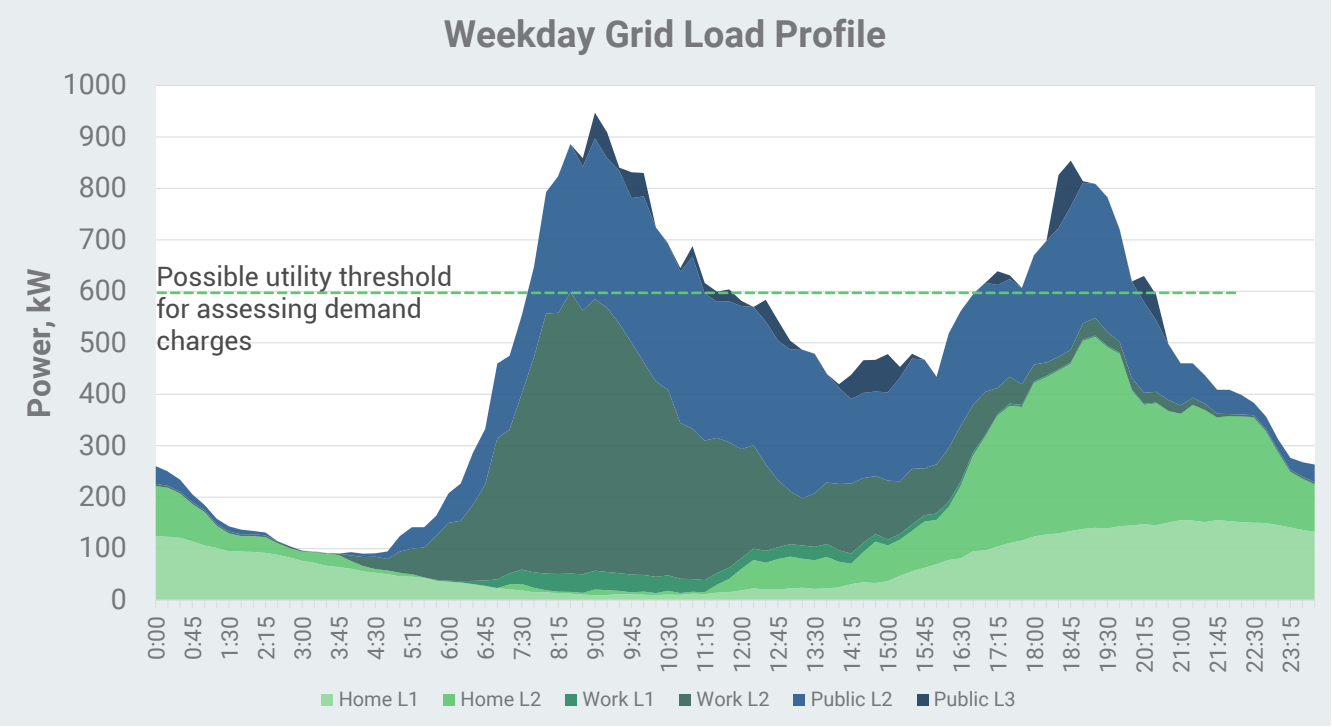
Peak and Off-Peak Demand

Spikes in the amount and speed of electricity drawn from the grid at a given time can indicate peak demand. Typical peaks occur during the work day and at night when most people come home from work or school in the evening and turn on appliances all at once (electric stove, TV, PlayStation, etc.) (20).

If 1,000 additional BEV users were added to a central Indiana community and they charged their vehicles as soon as they reached their charging destination, then the additional load added to the grid could look like the one shown in Figure 4.3.

For example, when the workers reach their job in the morning on a weekday and plug their cars into Level 2 chargers, then they will significantly contribute to a load peak between 7 am and noon and require almost 1,000 kW in addition to the existing load (Figure 4.3). Similarly, when most people come back from work or school and start charging cars immediately upon arriving home, then they will contribute to the load peak between 4:30 pm and midnight.

Figure 4.3 Additional electricity needed to support charging of 1,000 BEVs in an Indiana community on weekdays



Data source: AFDC, EVI-Pro Lite Load Profile modeling tool (21)

A NOTE ABOUT THE GREENFIELD ELECTRIC GRID

Current Grid Suitability for DCFC and Level 2 Charging

It was noted during the discussion between Greenfield Power and Light and the consultant that the sites located north of I-70 and adjacent to the existing Greenfield substation would be best suited for Fast Chargers. There is a spare circuit at this location which would have sufficient capacity for the power demand of these chargers. For sites south of I-70 it is understood that the existing infrastructure could support Level 2 chargers.

Analysis of Electric Infrastructure at Some Recommended Sites

It can be assumed electrical upgrades will be required for the sites detailed at the beginning of this chapter to support the installation of Level 2 and DCFC chargers. The size and layout of electrical components will be dependent on the quantity and arrangement of chargers at each site. Greenfield Power and Light maintains spare 250 kVA transformers as part of their resource planning, which may be sufficient size for level 2 chargers at these locations. The required upgrades for each site would need to be determined at time of design.

Peak Shaving Strategies

Time-of-use rate. Some utility companies developed pricing strategies that help "shave" the peak demand spikes. They provide a smaller rate for using electricity during off-peak times to encourage the use of electricity at "off-peak" times and by that, reduce the demand during peak demand times. Local examples of such strategies are AES Indiana (23) and Indiana Michigan Power (24). Both utility companies also provide special rebate programs to help people pay for the cost of purchasing a Level 2 charger.

Demand Charges. Some utilities establish an additional charge on top of an existing electric rate for the use of more power during peak demand times (25). They establish a threshold power demand, like the dashed green line shown in Figure 4.3, and establish a higher electricity price during the times when the demand for power goes above the threshold.

Greenfield Power and Light can consider programs that encourage people to charge at certain times to manage the peak demands. Also, programs like the ones started in the City of Melrose, MA (Chapter 1), where the power company installs Level 2 chargers on the utility poles throughout the city could also be considered by Power and Light.

PUBLIC SAFETY POLICIES

It is important to prepare the local first responders for dealing with accidents related to EV use. The National Fire Protection Association has created the EV Community Preparedness Training (22). Training like this should be used to prepare the local public safety staff. Public Safety department should also develop their own EV-related procedures and train personnel to follow them. Finally, if there is a community safety plan, it could be updated to include EV policies into it.

RECOMMENDATIONS SUMMARY

Current & Future Demand

Understand the current and future needs for EV charging stations in Greenfield.

- Observe the EVCS market in the next 5-10 years in Greenfield and pay attention to the locations where the private market is not providing affordable EV charging.
- Use the results of scenario planning and the recommended list of sites suitable for EVCS in conjunction with the recommended priority areas for EVCS to encourage deployment of EVCS where it will be most needed.
- Incentivize and/or encourage EV readiness for new construction or existing developments, especially multi-family and certain retail commercial developments.
- Consider providing EVCS in the areas with the highest possibility of barriers to accessing at-home affordable charging, like existing multi-family developments, areas with high rental rates, old housing stock, and housing with no garages.

Government Policies

The City of Greenfield will be mindful about policies that could encourage EV market growth while also provide for safe EV charging integration.

Planning and Building Permitting

- Amend Greenfield UDO with EVCS-related standards.
- Pay attention to the changes to the Indiana Electric Code in the near future.
- Develop a clear planning, building permit, and inspections processes of EVCS projects.
- Train staff on municipal EVCS permitting and inspection procedures.

Safety and Training

- Support public safety staff and first responders in safely managing incidents involving EVs and EVCSs. See recommendations from NFPA.
- Provide professional hands-on training of EVs and EVCSs for appropriate first responders and public safety personnel.
- Adopt standard operating procedures for emergency incidents involving EVs and EVCSs.
- Advise local tow truck operators/storage facility owners to be trained on safety requirements for loading, hauling, and storage of EVs, post incident.
- Integrate transportation electrification considerations into community safety plans.

Electric Utility

- Coordinate with the planning and building departments on reviewing EVCS projects.
- Consider establishing a time-of-use rate to shave the demand peaks.
- Consider whether the existing utility and light poles could be equipped with Level 2 charging.

Possible Host Sites

Determine locations throughout Greenfield which could potentially host EV charging stations.

- Determine whether the city would like to install EVCS at certain publicly-owned sites or in ROW.
- Determine whether the city would like to partner on some privately-owned sites that could deploy publicly-accessible EV charging.
- Determine criteria for partnerships - public private partnerships required for some grants.
- Government-led projects can provide an example of how to provide ADA-accessible EV charging.

Grants & Funding

Identify funding sources for EV charging station installation and compile data for grant application readiness.

- Should the city decide on the kinds of EVCS projects that it would like to lead or support, review available grants for EVCS to see if the projects would be eligible for those grants.
- In addition to grant-specific requirements, most EV grants that originate from federal sources will need to meet federal EVCS minimum standards. Ensure that the sites, EVSE, and partners can meet those standards.
- Some grants allow using a small portion of the funds for training workforce to operate and maintain EVCS. Make sure to include such trainings to provide long-term support for the projects.

Public Support

Develop educational materials to inform Greenfield residents about EVs and constructing charging stations to meet market demand.

- Devote a website page to EVCS to show the city's commitment to EV readiness and provide educational resources.
- Provide access to this plan and EV FAQ pages to the public.
- Provide EV and EVCS safety information to consumers after reviewing them with the public safety staff.
- Should the city install its own EVCS, inform the public about its availability.
- Develop communication channels that the public may use to communicate their need for installing EVCS near their place of living.

CHAPTER TAKEAWAYS

- *Several Greenfield sites could be suitable for EVCS installation with some improvements. The preliminary site assessments are presented in this chapter.*
- *The City of Greenfield can be eligible to apply for several grants for EVCS. This chapter goes over those grants and the most important details to pay attention to.*
- *Most EVCS development happens on privately-owned sites. It is important for the city to encourage EVCS development by streamlining its permitting procedures, while also ensuring safe deployment. Establishing clear policies and permitting processes for reviewing and inspecting EVCS helps with this goal. This chapter and Appendix C gather examples of development standards for Greenfield to consider.*
- *Greenfield Power and Light can consider utility rate programs that would encourage people and organizations to charge at off-peak times to manage the grid load.*
- *Public Safety EV-related training are available to prepare city's first responders and other public safety personnel for addressing EV accidents.*
- *The chapter concludes with a list of recommendations for each plan goal.*

REFERENCES

1. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. *2018 Electric Vehicle Charger Selection Guide*.
2. U.S. Department of Energy. Federal Energy Management Program. *Federal Workplace Charging Program Guide*. Link: https://www.energy.gov/femp/federal-workplace-charging-program-guide.
3. U.S. Department of Energy. *Grid Resilience and innovation Partnership (GRIP) Program*. Link: https://www.energy.gov/gdo/grid-resilience-and-innovation-partnerships-grip-program.
4. IRS. *Credits for New Electric Vehicles Purchased in 2022 or Before*. Link: https://www.irs.gov/credits-deductions/credits-for-new-electric-vehicles-purchased-in-2022-or-before.
5. IRS. *Residential Clean Energy Credit.* Link: https://www.irs.gov/credits-deductions/residential-clean-energy-credit.
6. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. *Alternative Fuel Infrastructure Tax Credit*. Link: https://afdc.energy.gov/laws/10513.
7. The White House. February 15, 2023. *FACT SHEET: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicle Chargers.* Link: https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/.
8. U.S. Department of Energy. November 18, 2022. *Biden-Harris Administration Announces $13 Billion To Modernize And Expand America's Power Grid.* Link: https://www.energy.gov/articles/biden-harris-administration-announces-13-billion-modernize-and-expand-americas-power-grid.
9. U.S. Department of Transportation. FHWA. April 22, 2022. *Report: Federal Funding is Available for Electric Vehicle Charging Infrastructure on the National Highway System.*
10. Indianapolis Metropolitan Planning Organization. *IMPO Funding Guide*.
11. Indiana Department of Transportation. *INDOT Electric Vehicle Infrastructure Plan 2023.* Link: https://www.in.gov/indot/current-programs/innovative-programs/electric-vehicle-charging-infrastructure-network/#tab-598333-Deployment_Plan_and_Maps.
12. U.S. Department of Transportation. FHWA. *Charging and Fueling Infrastructure Discretionary Grant Program*. Link: https://www.fhwa.dot.gov/environment/cfi/.
13. Federal Register. February 28, 2023. *National Electric Vehicle Infrastructure Standards and Requirements.* Link: https://www.federalregister.gov/documents/2023/02/28/2023-03500/national-electric-vehicle-infrastructure-standards-and-requirements.
14. US Environmental Protection Agency. *Workforce Development and Training Resources. General Electric Vehicle and Electric Vehicle Supply Equipment Training*. Link: https://www.epa.gov/cleanschoolbus/workforce-development-and-training-resources.
15. PGE. April 21, 2021. *Daimler Trucks North America, Portland General Electric open first-of-its-kind heavy-duty electric truck charging site*. Link: https://portlandgeneral.com/news/2021-04-21-daimler-portland-general-electric-open-electric-charging-site.
16. Daimler Truck North America. April 21, 2021. Daimler Trucks North America, *Portland General Electric open first-of-its-kind heavy-duty electric truck charging site.* Link: https://northamerica.daimlertruck.com/PressDetail/daimler-trucks-north-america-portland-general-2021-04-21/.
17. Indiana Department of Homeland Security. Indiana Electric Code Update Committee. September 28, 2022. *Summary of Proposed Amendments to the 2020 National Electric Code*. Link: https://www.in.gov/dhs/boards-and-commissions/indiana-electrical-code-update-committee/.
18. U.S. Access Board. July 17, 2023. *Design Recommendations for Accessible Electric Vehicle Charging Stations*. Link: https://www.access-board.gov/tad/ev/.

19. McKinsey & Company. April 18, 2022. ***Building the electric vehicle charging infrastructure America needs.*** Link: https://www.mckinsey.com/industries/public-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs
20. U.S. Department of Energy. Office of Electricity. ***Planning Considerations for Electric Vehicles in Indiana***.
21. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite***. Link: https://afdc.energy.gov/evi-pro-lite.
22. National Fire Protection Association. ***Electric Vehicle Safety Online Training***. Link: https://www.nfpa.org/for-professionals/training-for-me/alternative-fuel-vehicles-training/electric-vehicles?l=70.
23. AES Indiana. ***EV Rates***. Link: https://www.aesindiana.com/ev-rates.
24. Indiana Michigan Power. ***Charge at Home in Indiana***. Link: https://www.indianamichiganpower.com/clean-energy/electric-cars/charge-at-home-indiana.
25. U.S. Department of Energy. Office of Electricity. October 2021. ***Report: An EV Future: Navigating the Transition.*** Link: https://smartgrid.gov/files/documents/An_EV_future_10.21.21_FINAL.pdf

A | APPENDIX: MARKET AND CENSUS DATA

Electric Vehicle and EV Charging Statistics, US and Indiana

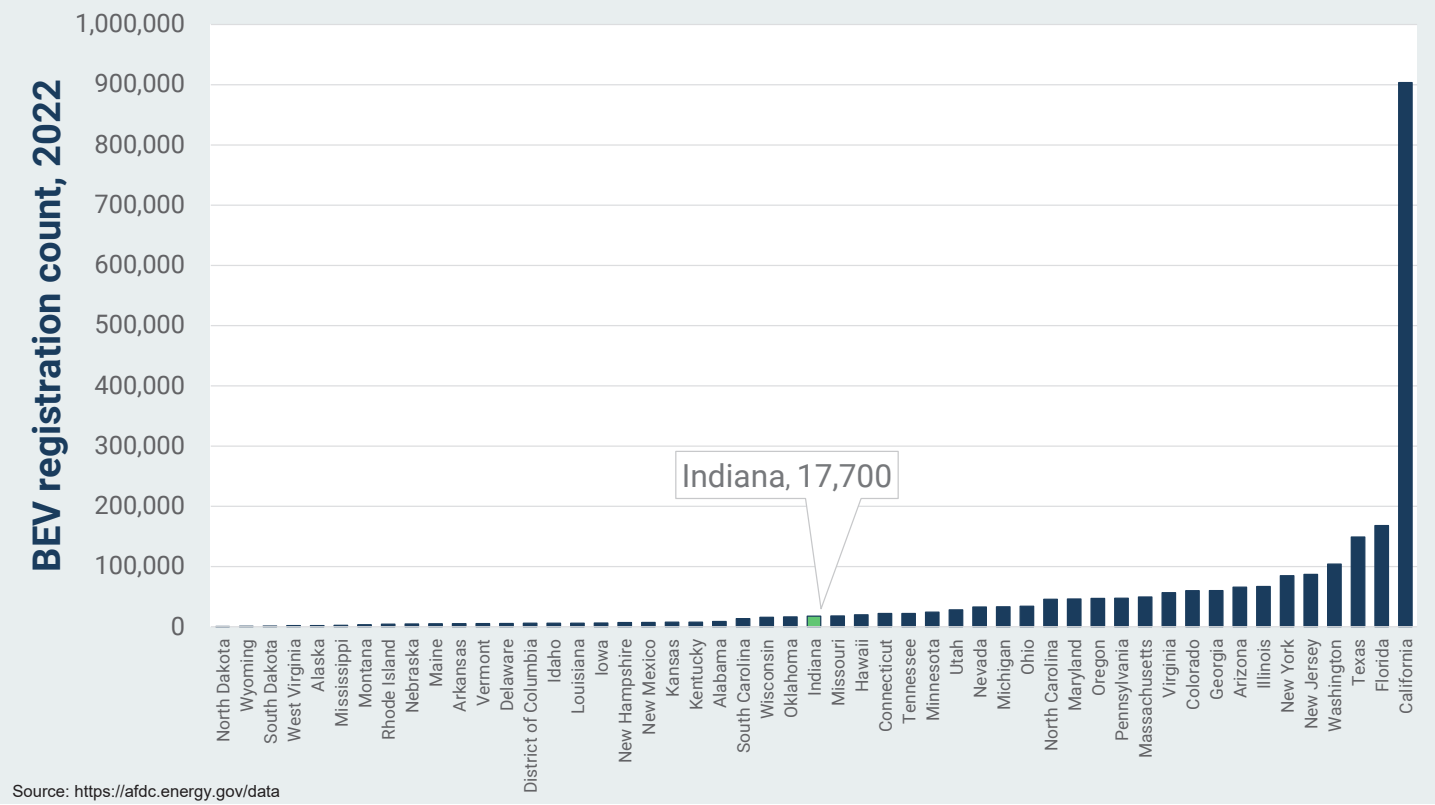


Figure A.1 Registered Battery Electric Vehicles in the US by State, 2022. Source: 1.

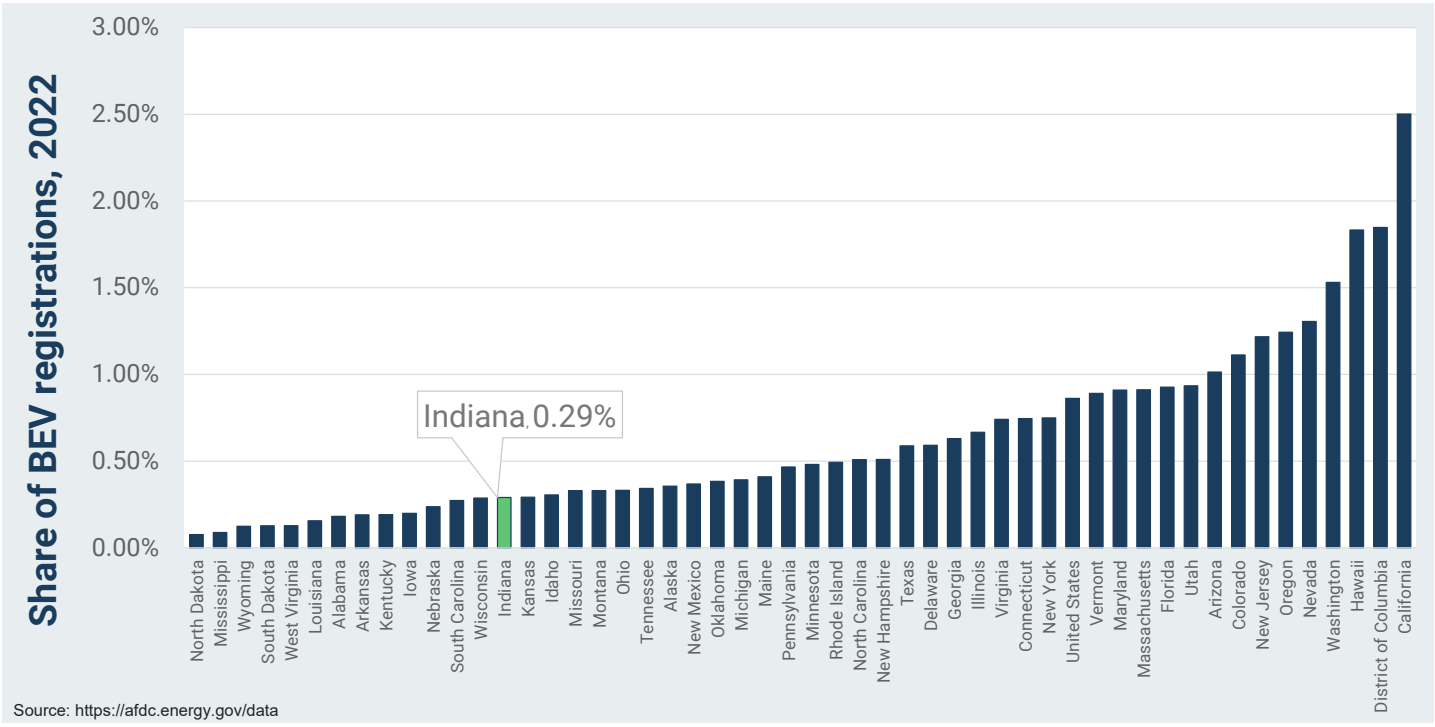


Figure A.2 Share of Registered Battery Electric Vehicles among all Vehicles in the US by State, 2022. Source: 1.

Indiana ranks 26th in total number of BEVs registered and 37th in BEV share among all vehicles registered.

In the past decade (2012-2022), the number of EV charging stations increased almost 9-fold (or +860%). Also, the share of EV charging stations among other alternative fuel stations increased from 9 % in 2010 to 84 % in 2022 making it a clear leader among the alternative fuels.

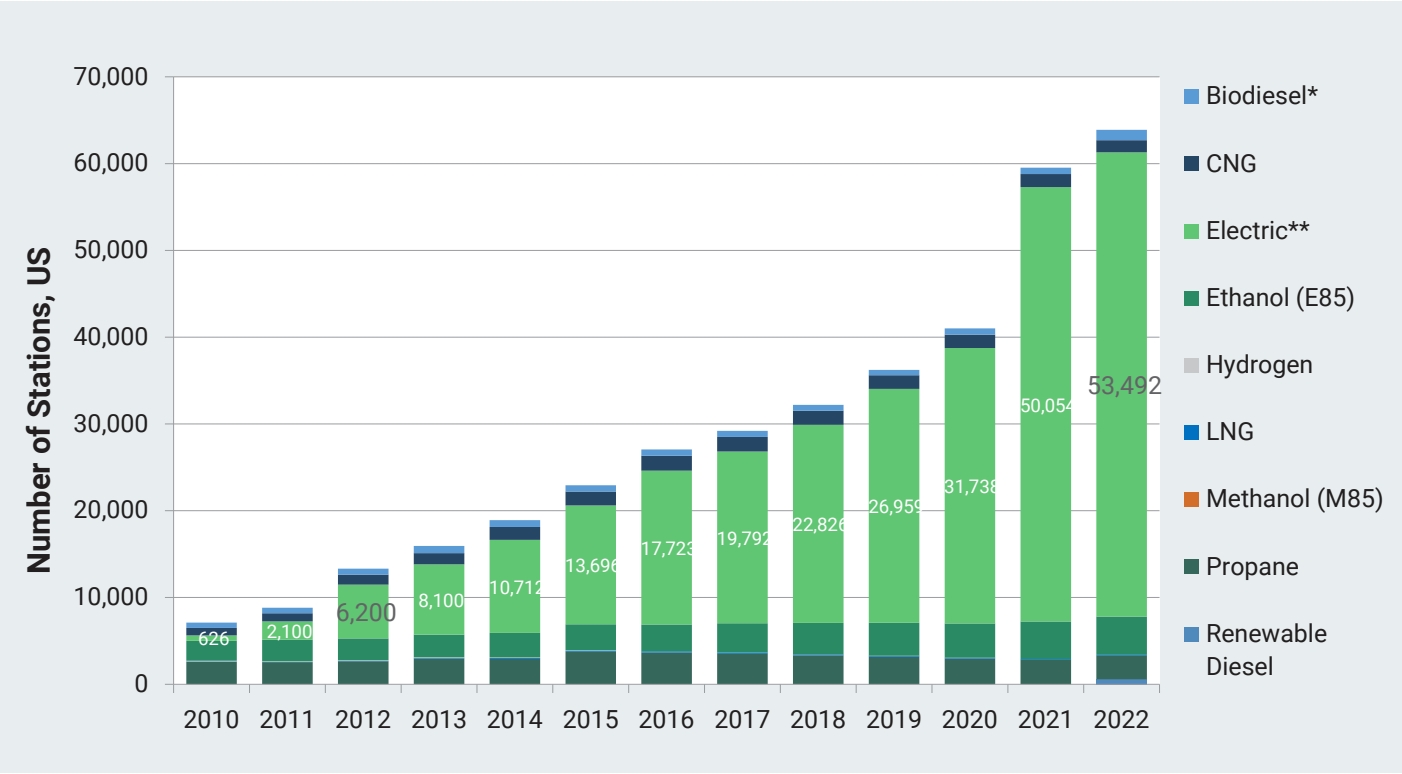


Figure A.3 Number of Alternative Fuel Stations in the US, 2010-2022. Source: 1.

In the past decade (2011-2021), the average battery range increased by about 350%, while the maximum range increased 4-fold.

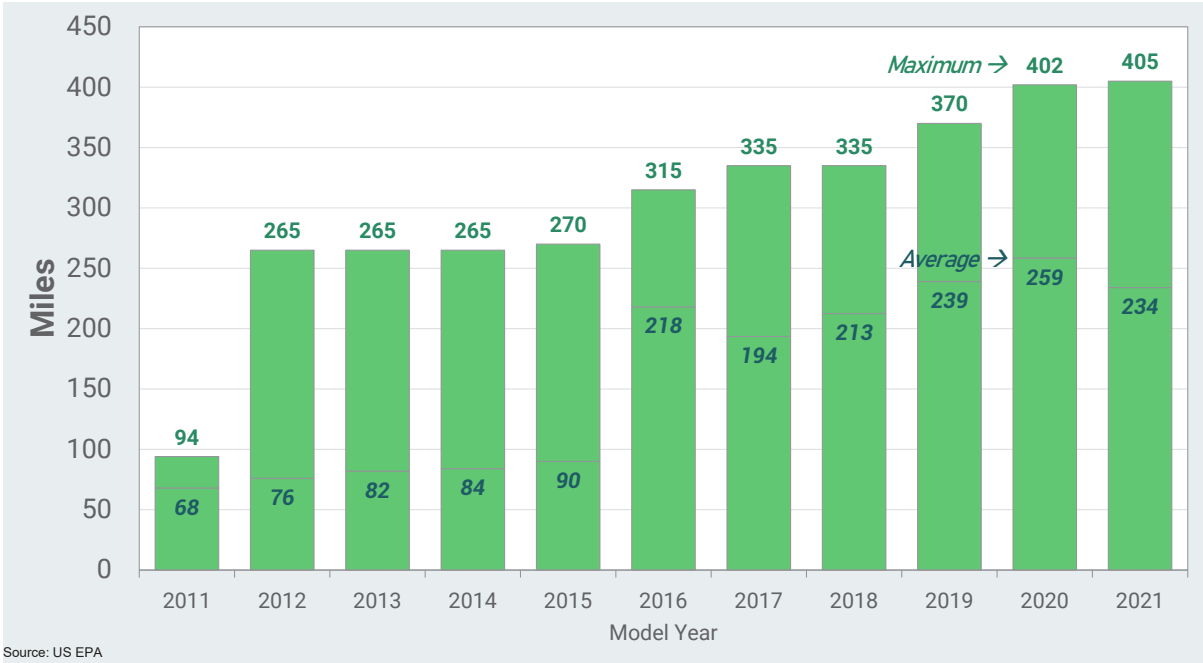


Figure A.4 BEV Battery Range Change between 2010 and 2021. Source: 2.

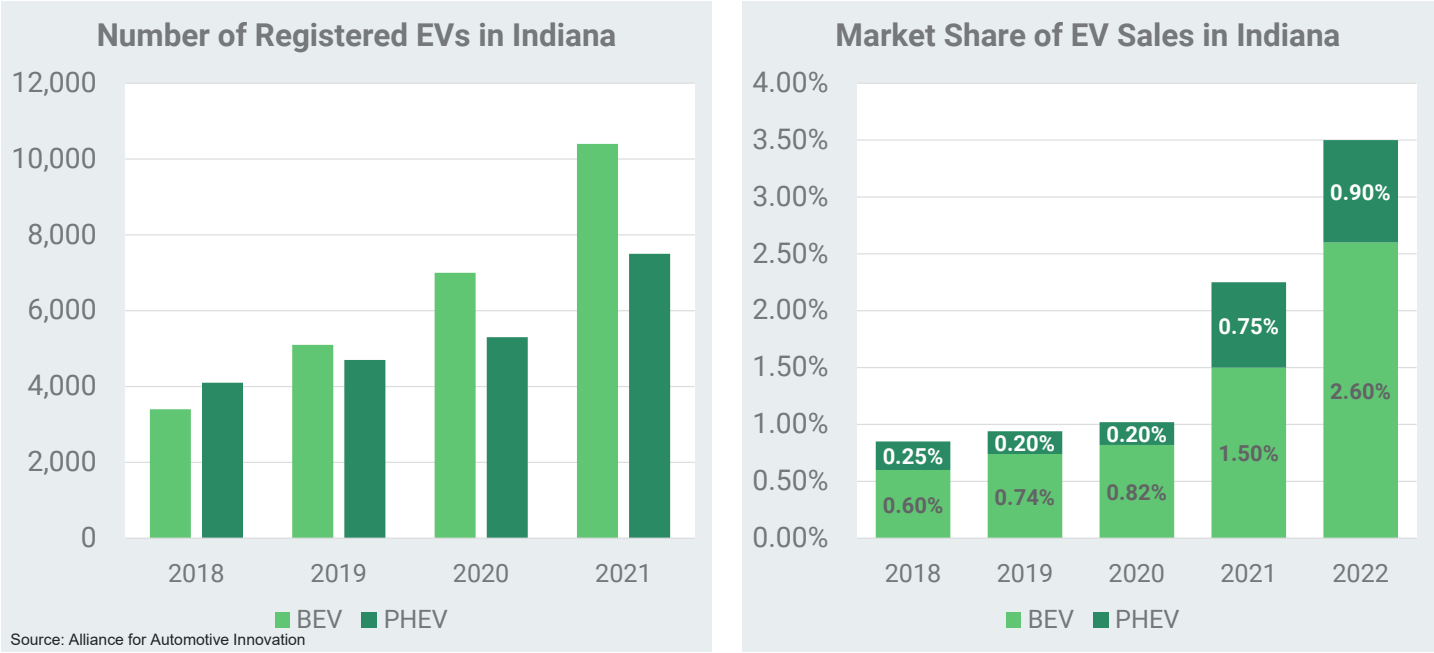


Figure A.5 Growth of Registered EVs and Market Share of sold EVs in Indiana, 2018-2022. Source: 3.

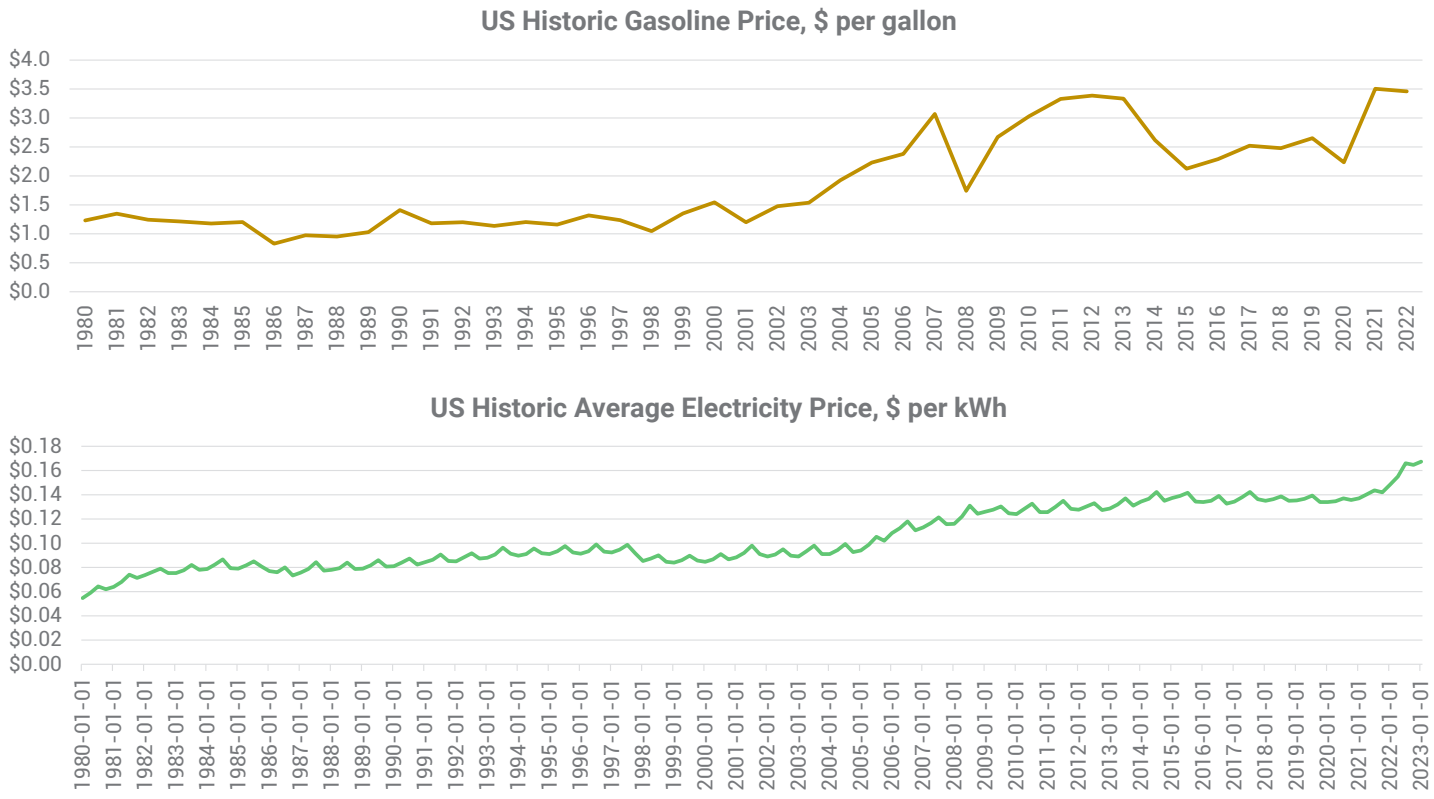


Figure A.6 US Historic Gasoline and Electricity Prices, 1980-2022. Sources: 4, 5.

Greenfield Census Data

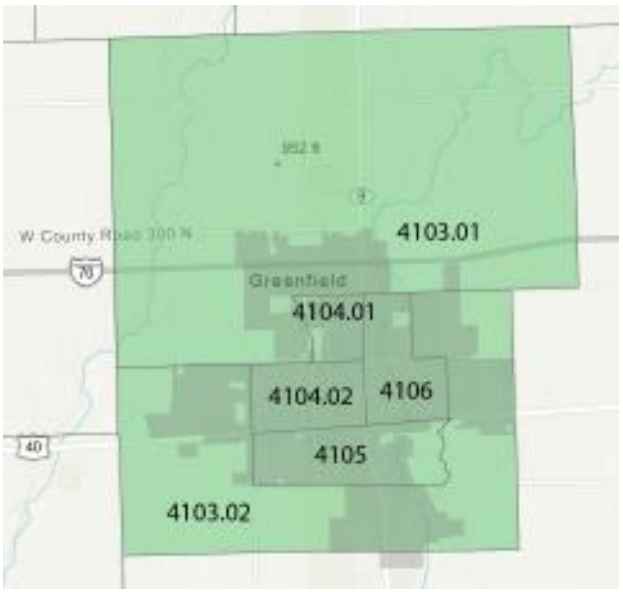


Figure A.7 Greenfield Census Tracts. Map source: Esri basemap 2023.

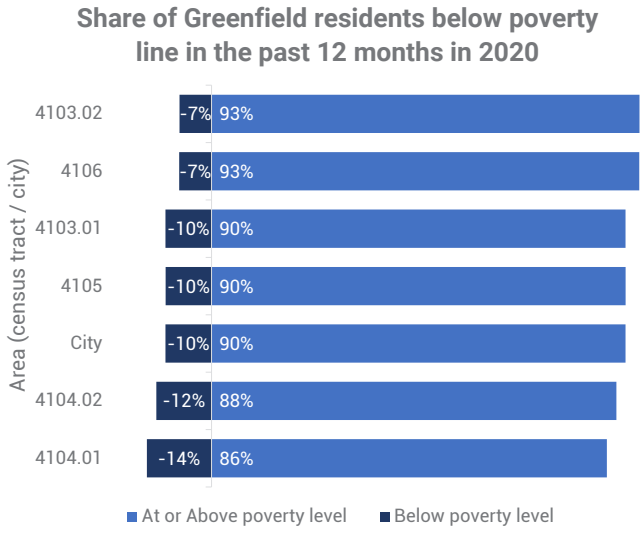


Figure A.8 Share of Greenfield residents living below poverty line in 2020. Source: 7.

MEANS OF TRANSPORTATION TO WORK	Census Tract 4103.01		Census Tract 4103.02		Census Tract 4104.01		Census Tract 4104.02		Census Tract 4105		Census Tract 4106		Greenfield City	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Total	2,486		3,626		1,012		2,462		1,608		2,591		10,796	
Car, truck, or van - drove alone:	2,165	87%	3,344	92%	897	89%	1,968	80%	1,436	89%	2,209	85%	9,481	88%
Car, truck, or van - carpooled:	205	8%	97	3%	54	5%	177	7%	135	8%	228	9%	702	7%
Public transportation (excluding taxicab):	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Walked:	0	0%	26	1%	0	0%	28	1%	12	1%	38	1%	78	1%
Taxicab, motorcycle, bicycle, or other means:	2	0%	0	0%	50	5%	4	0%	0	0%	12	0%	68	1%
Worked from home	114	5%	159	4%	11	1%	285	12%	25	2%	104	4%	467	4%
Car		95%		95%		94%		87%		98%		94%		94%
Worked from home		5%		4%		1%		12%		2%		4%		4%
Other		0%		1%		5%		1%		1%		2%		1%

Table A.1 Means of Transportation to Work in Greenfield in 2020. Source: 6.

Greenfield Census Data

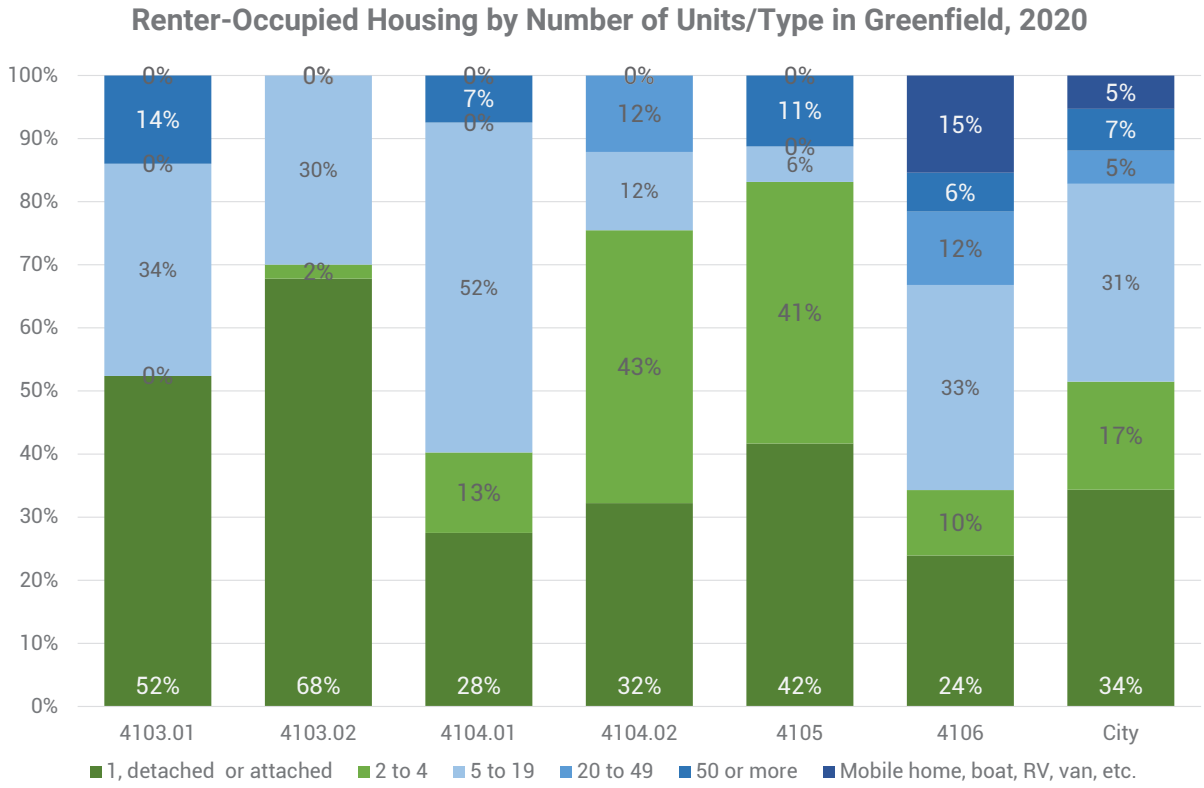


Figure A.9 School sites. Source: 8.

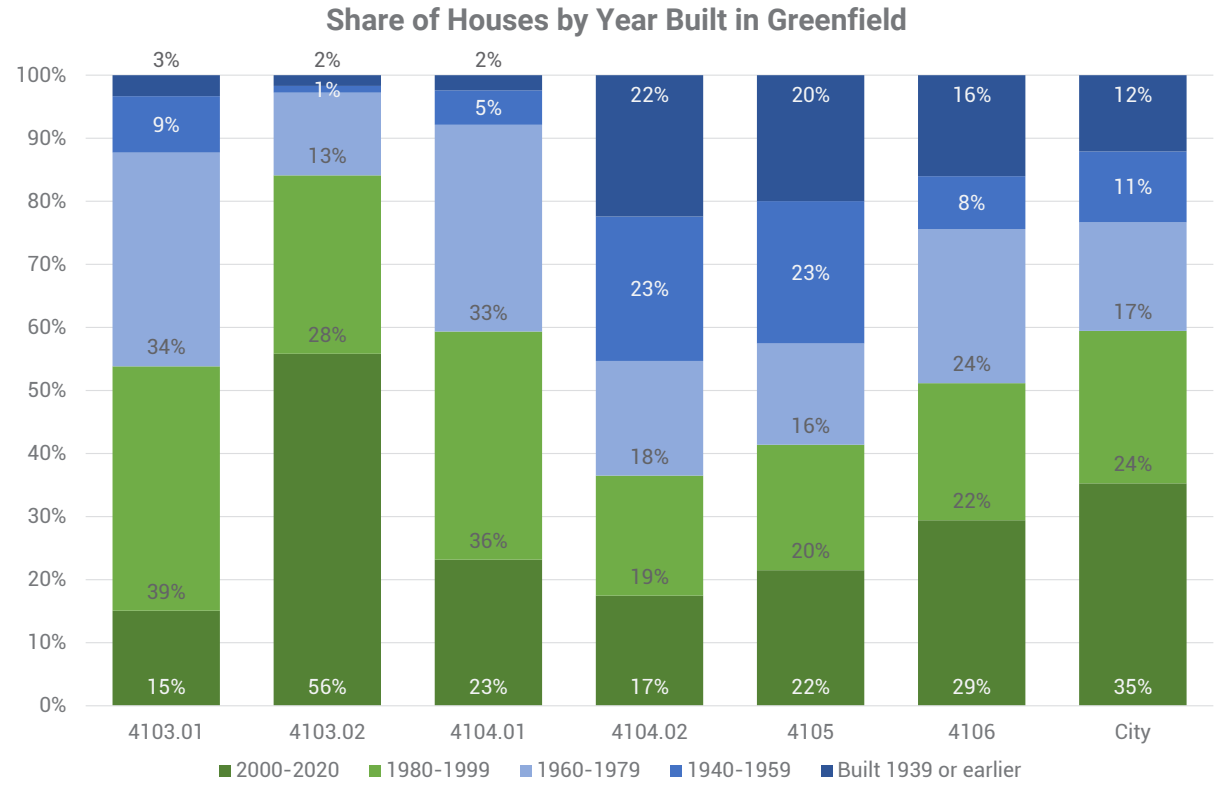


Figure A.10 School sites. Source: 9.

REFERENCES

1. U.S. Department of Energy. Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Maps and Data***. Link: https://afdc.energy.gov/data.
2. U.S. Department of Energy and U.S. Environmental Protection Agency. ***EV Battery Range data***. Link: https://fueleconomy.gov/
3. Alliance for Automotive Innovation. ***EV Sales Dashboard***. Link: https://www.autosinnovate.org/EVDashboard.
4. Federal Reserve Economic Data, Federal Reserve Bank of St. Louis. APU000072610: ***Average Price: Electricity per Kilowatt-Hour in U.S. City Average, U.S. Dollars, Quarterly, Not Seasonally Adjusted***. Link: https://fred.stlouisfed.org.
5. Federal Reserve Economic Data, Federal Reserve Bank of St. Louis. APU00007471A: ***Gasoline, all types, per gallon in U.S. city, 1980-2023***. Link: https://fred.stlouisfed.org.
6. U.S. Census Bureau. "MEANS OF TRANSPORTATION TO WORK BY POVERTY STATUS IN THE PAST 12 MONTHS." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B08122, 2020.
7. U.S. Census Bureau. "POVERTY STATUS IN THE PAST 12 MONTHS BY SEX BY AGE." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B17001, 2020.
8. U.S. Census Bureau. "TENURE BY YEAR STRUCTURE BUILT BY UNITS IN STRUCTURE." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B25127, 2020.
9. U.S. Census Bureau. "YEAR STRUCTURE BUILT." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B25034, 2020.

B | APPENDIX: METHODOLOGIES

SITE ANALYSIS

A six-step methodology was developed to identify potential sites for EV charging stations around Greenfield.

1. Identify trip types
2. Identify land uses corresponding to the trip types
3. Identify relevant parcels using land use codes from the Indiana Departement of Local Government Finance
4. Examine parking area around each identified parcel
5. Compare selected parcels with steering committee and public pop-up input and finalize list
6. Conduct an equity analysis to ensure potential sites are near residents of all income levels

1. IDENTIFY TRIP TYPES

- Commute Trips
- Regional Through Trips
- Retail & Recreation
- Overnight Stays

2. LAND USES

- Schools
- Parks & Recreation
- Shopping centers
- Healthcare
- Hotels
- Apartments & High Density Residential
- Employment Centers

3. LAND USE TYPE MAPS

Next, land use codes from the Indiana Property Tax Management System Code were cross-referenced with parcel data for the City of Greenfield. The next several pages show where each of these land use types are located in Greenfield.

SCHOOLS

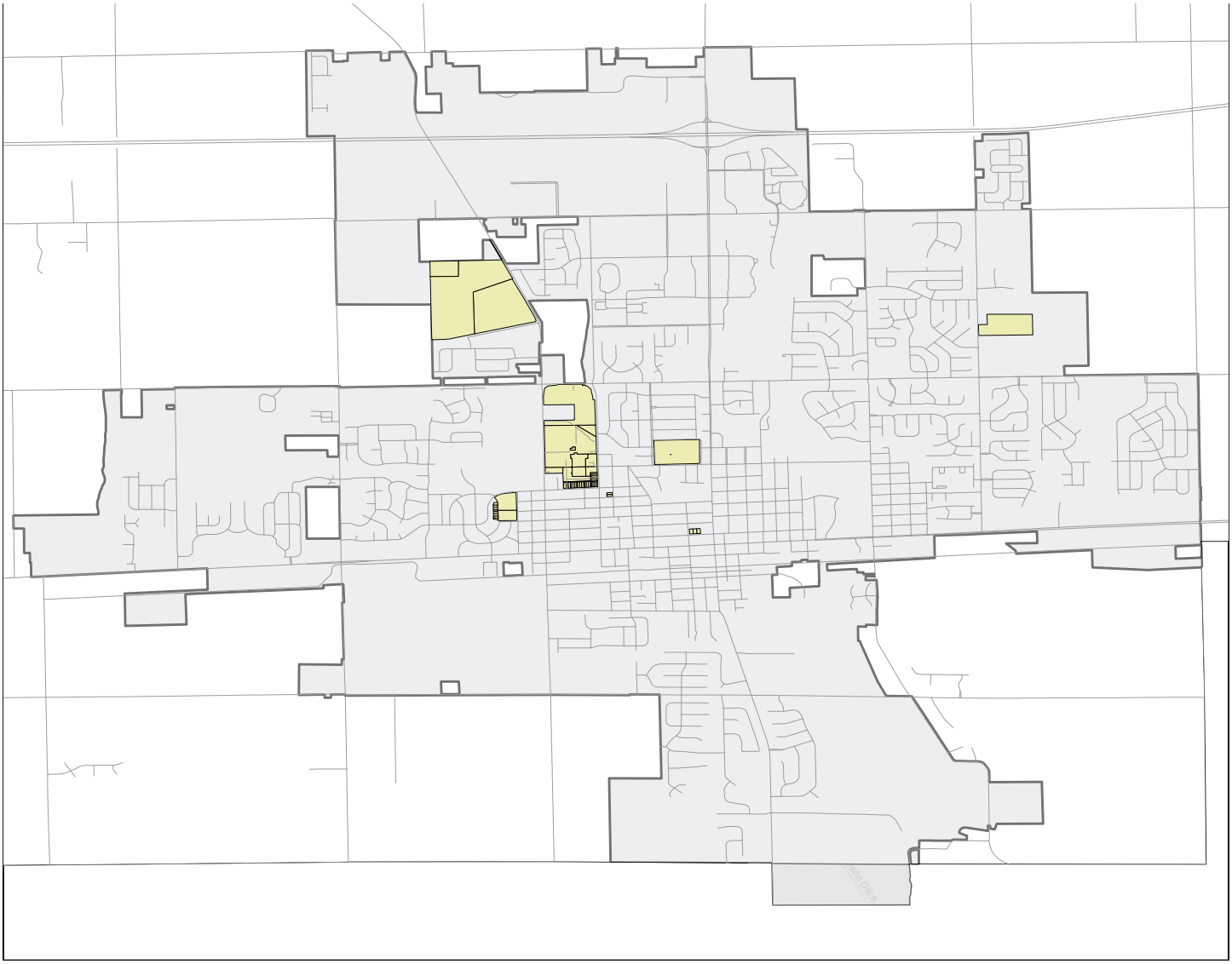


Figure B.1 School sites. Source: 1

PARKS AND RECREATION

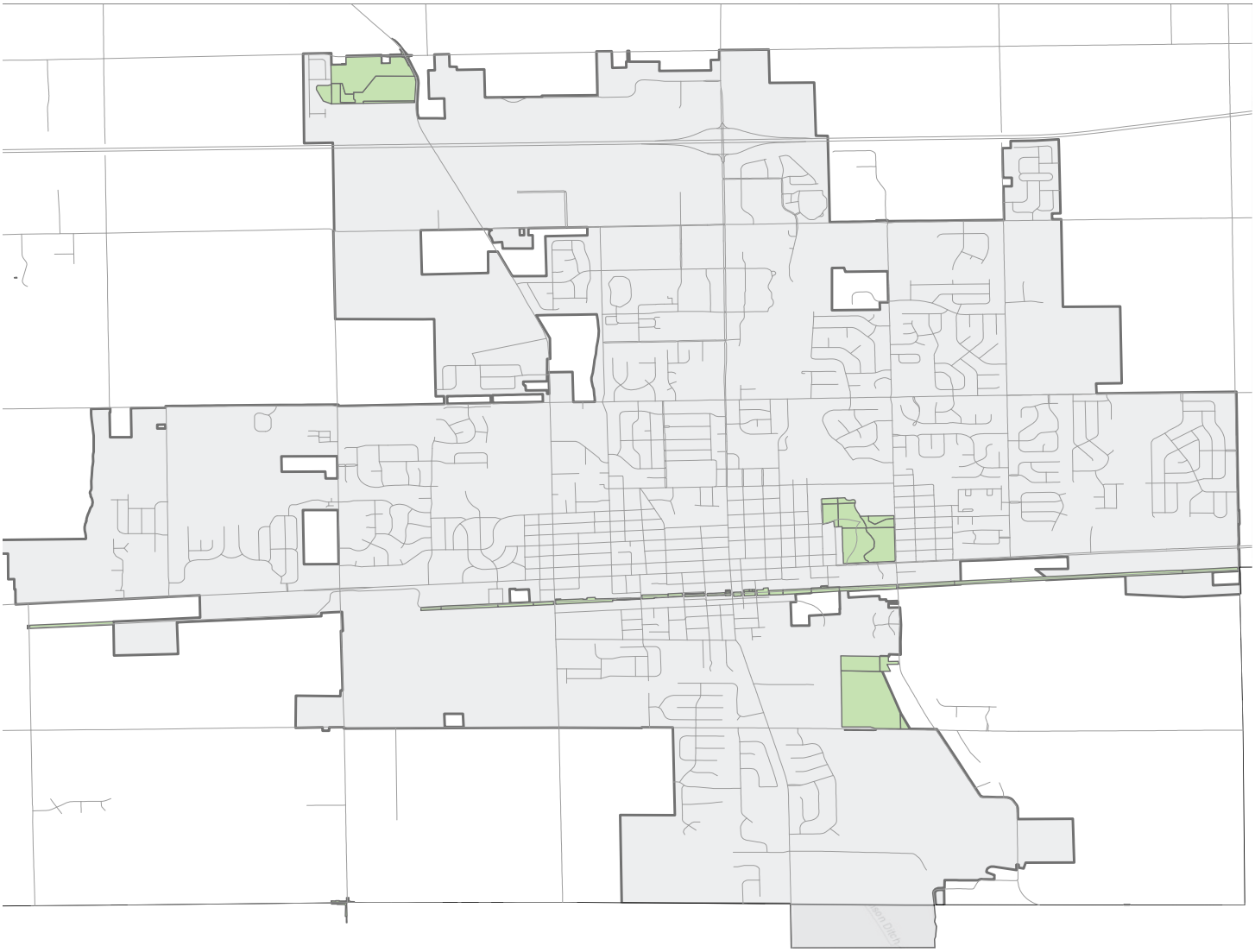


Figure B.2 Park sites. Source: 1

SHOPPING CENTERS

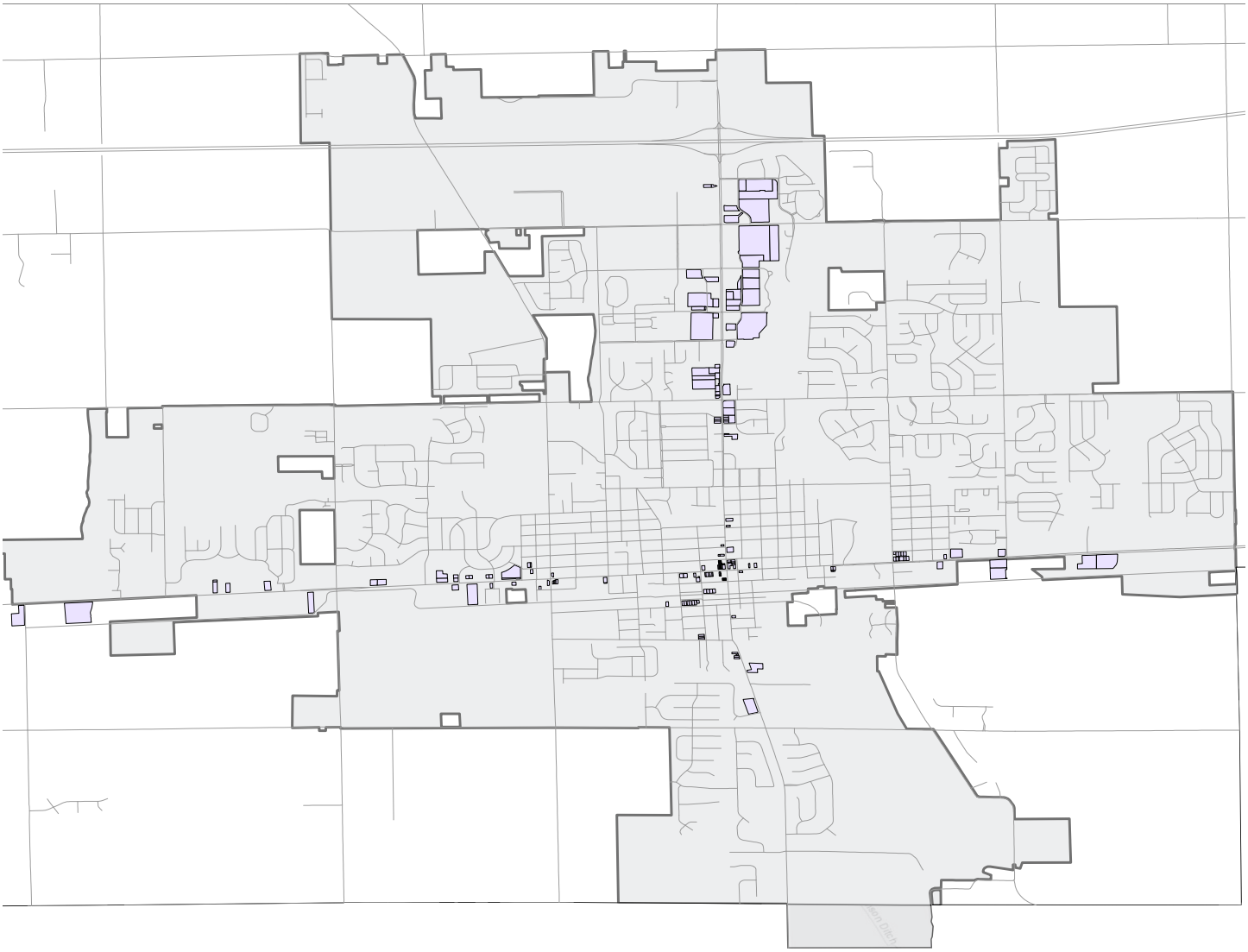


Figure B.3 Shopping center sites. Source: 1

HEALTHCARE

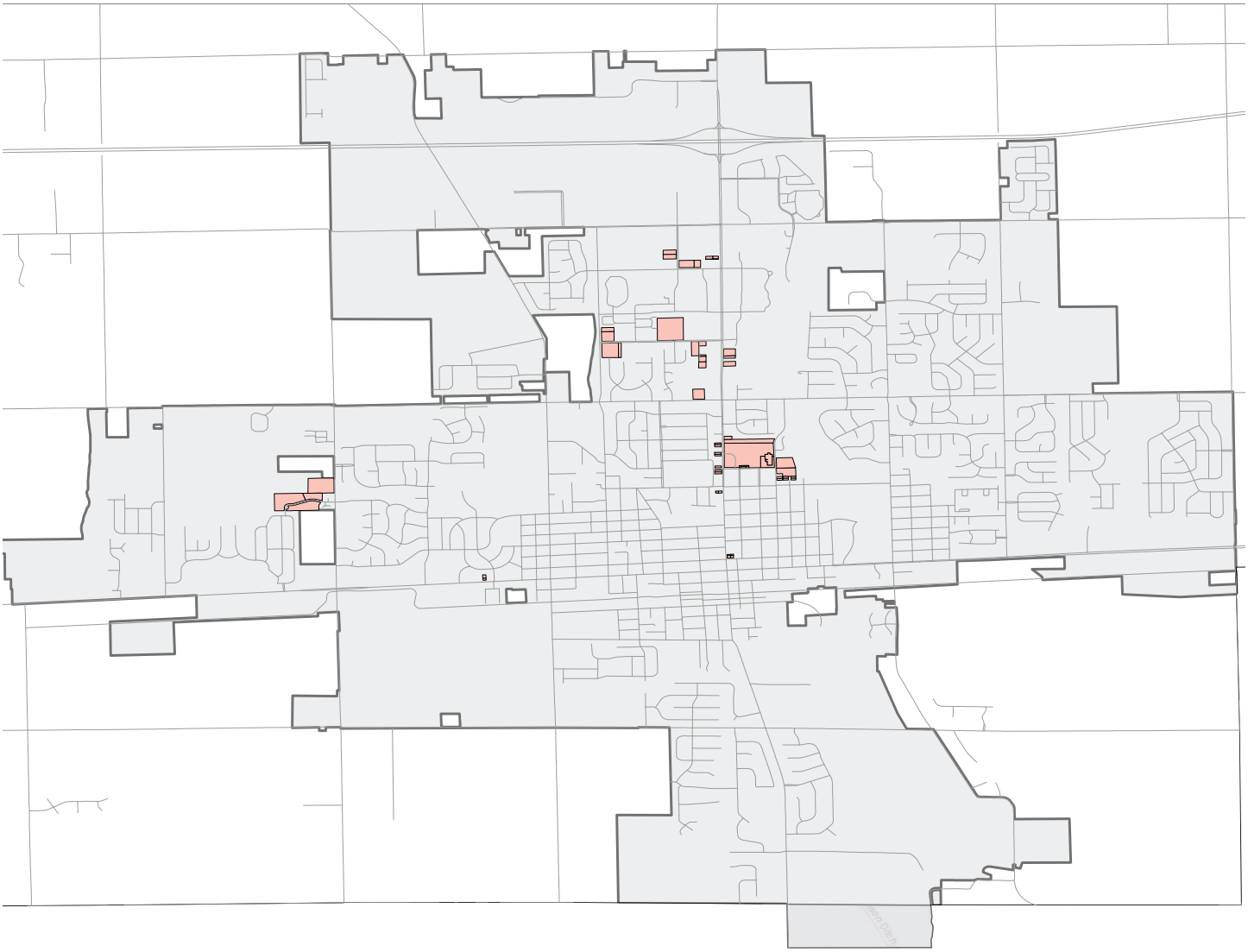


Figure B.4 Healthcare sites. Source: 1

HOTELS

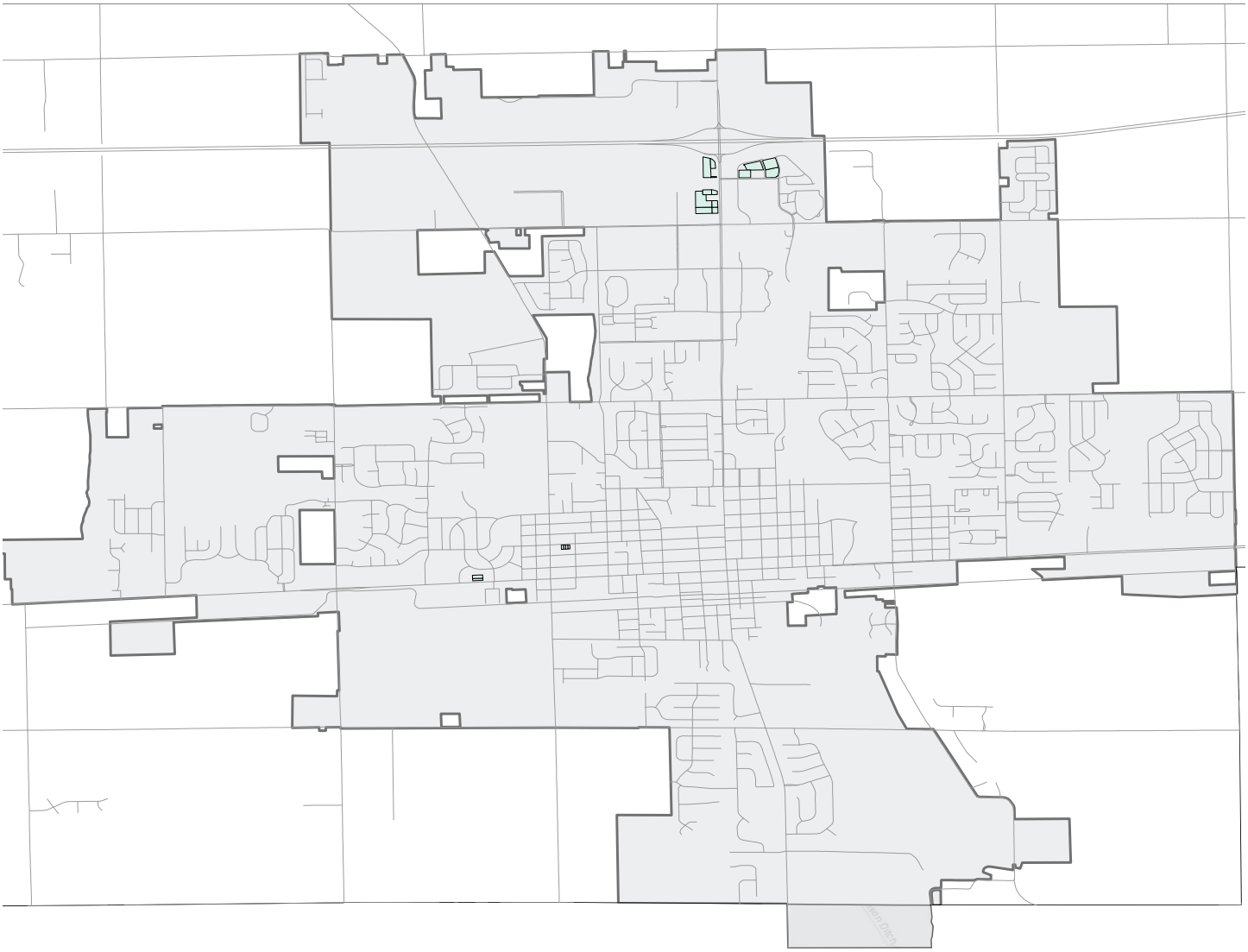


Figure B.5 Hotel sites. Source: 1

APARTMENTS & HIGH-DENSITY RESIDENTIAL

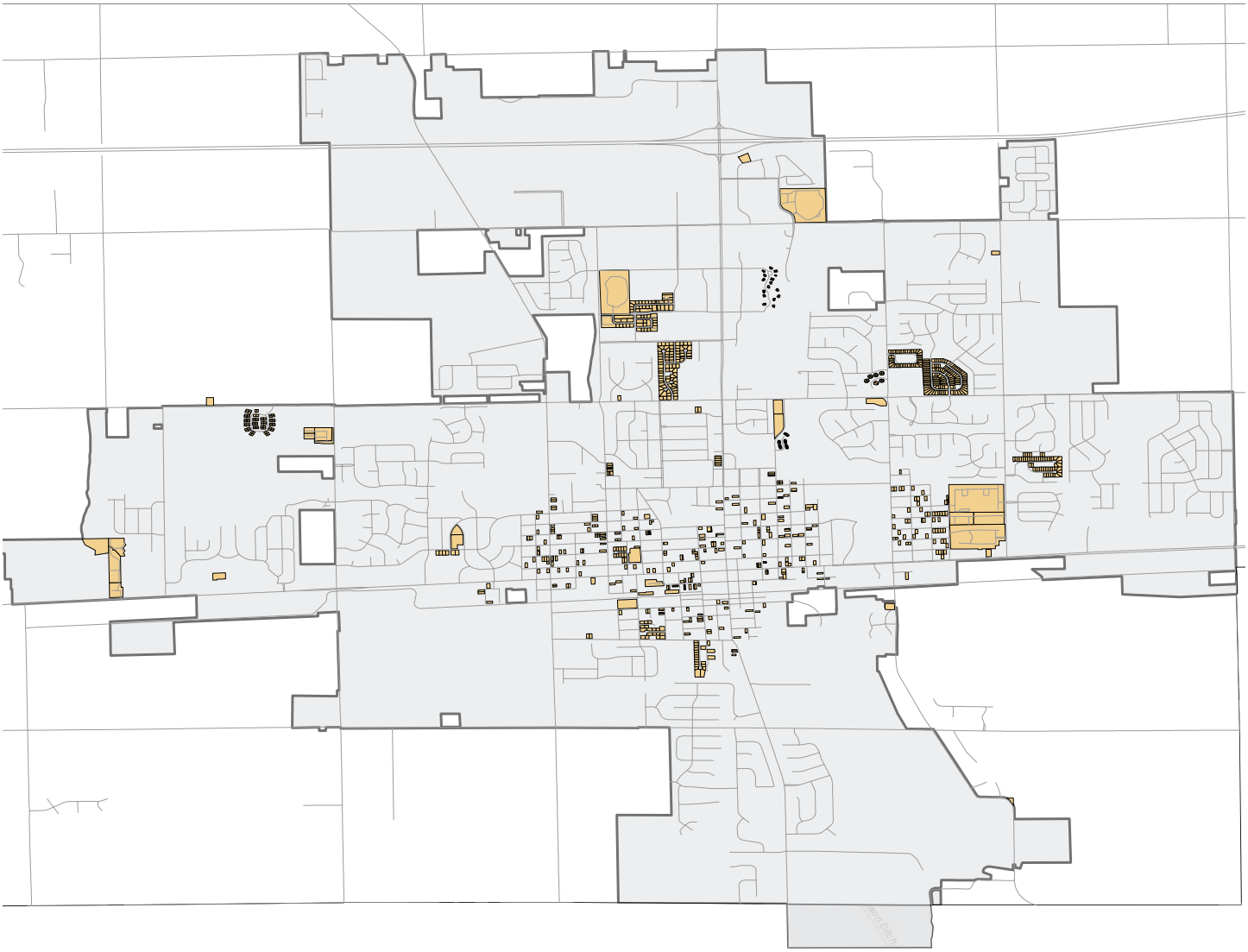
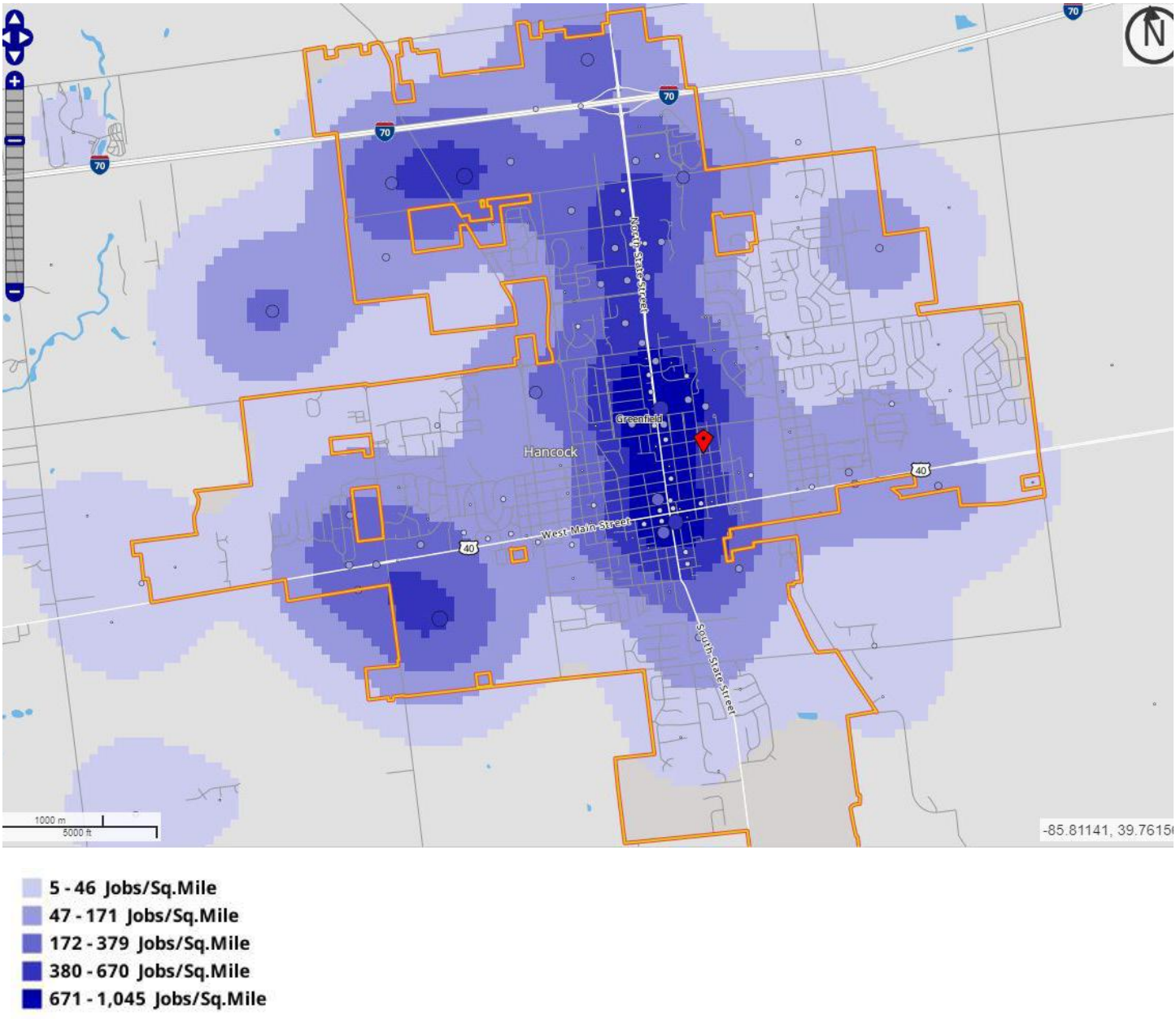


Figure B.6 Apartments and high density residential sites.
Source: 1

EMPLOYMENT CENTERS

To uncover the employment centers within Greenfield, we examined data from the Longitudinal Employer-Household Dynamics (LEHD) program using the OnTheMap tool from the US Census Bureau. The map shows where people are traveling to work in Greenfield. The high concentrations of workers along State Street and Main Street aligns with the analysis of the other six types of parcels. The only additional information uncovered were the industrial facilities in the Northwest area of the city. However, any charging stations here would not be open to the public and likely only accessible by employees and visitors of these facilities.

Figure B.7 Number of jobs per square mile in Greenfield. Source: 2



4. EXAMINE PARCEL INFO

We performed a high-level look using Google Maps to determine whether the parcels indentified in Step 3 had adequate parking to house an EV charging station.

Figure B.8 Example of a high density neighborhood. Source: Google Maps, Accessed November 2023.

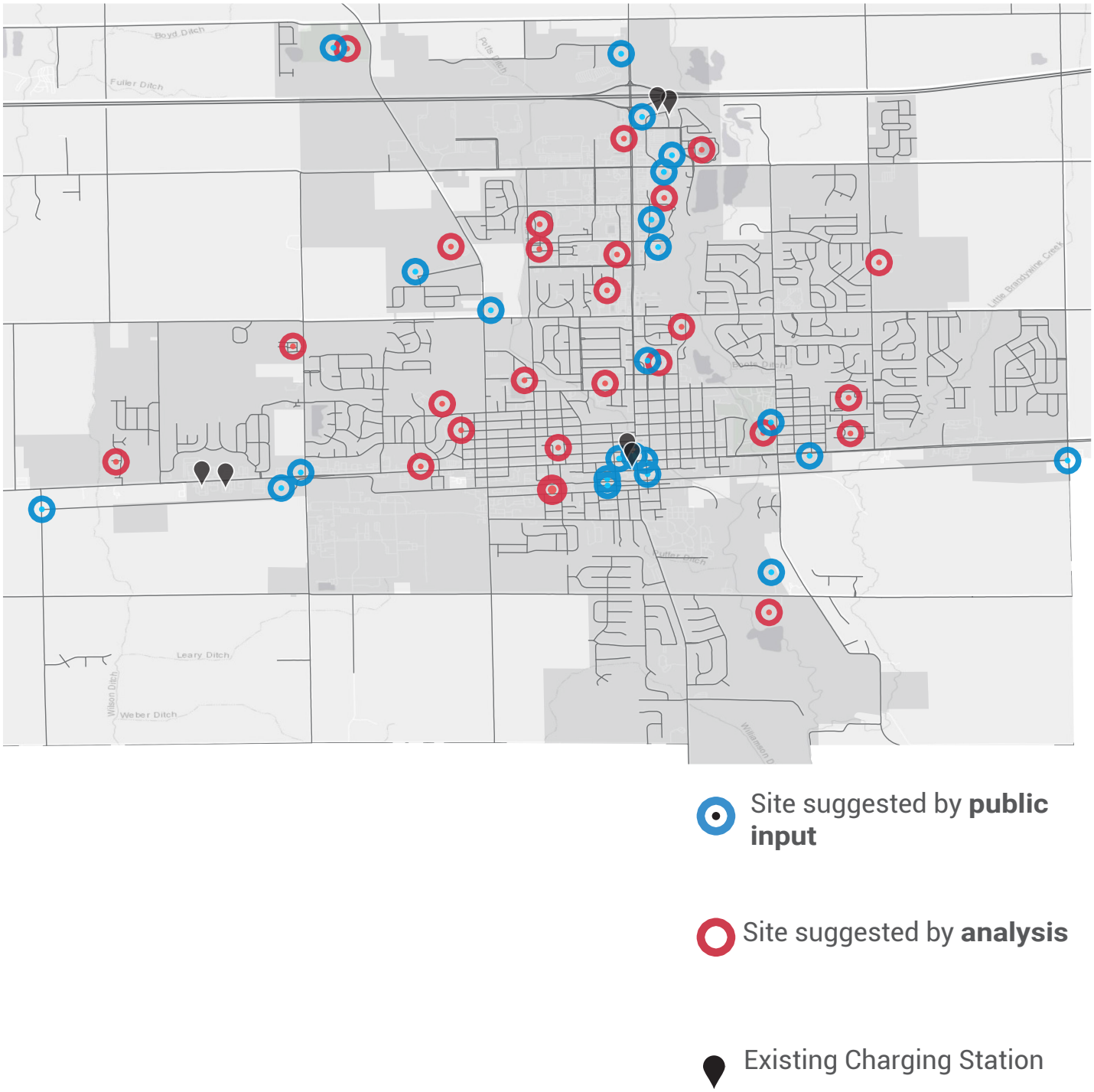
The neighborhood at the right provides an illustrative example. This area showed up on the Apartments & High Density Residential parcel map because each structure is a duplex or multi-family dwelling. However, each property has its own driveway and there is no central location in the neighborhood where an EV owner could park and charge without obstructing the narrow local streets. Therefore, we removed this location from the list. But it is less than a mile from the potential location at the Green Meadows Shopping Center.

5. OVERLAY WITH ENGAGEMENT

Once we came up with the final list of parcels, we overlaid them with locations from the summer pop-up events and the first steerting committee meeting.

Some locations showed up in both lists - this can be seen where red and blue dots overlap.

Figure B.9 Potential site locations from data analysis and public engagement



6. EQUITY ANALYSIS

Income and poverty statistics from the US Census Bureau at the Census Block Group level were examined to determine if the land use analysis had been equitably distributed across the city. The data below is from the 2021 American Community Survey which is the most recent available information at the block group level.

NOTE: 4104.02, Block Group 3 is below the Census Bureau threshold for reporting of median income.

Table B.1 Income in the past 12 months below poverty level in Greenfield per census block group. Data sources: 3, 4

CENSUS TRACT	BLOCK GROUP	POPULATION	MARGIN OF ERROR	INCOME IN THE PAST 12 MONTHS BELOW POVERTY LEVEL	MARGIN OF ERROR	MEDIAN HOUSEHOLD INCOME	MARGIN OF ERROR
4103.01	1	1,817	485	345	290	71,914	11,773
4103.01	2	1,668	476	196	113	61,768	25,758
4103.01	3	962	366	0	12	66,250	41,968
4103.02	1	2,826	780	278	344	64,797	14,459
4103.02	2	1,708	697	19	31	93,313	15,734
4103.02	3	3,812	886	167	155	92,813	30,310
4104.01	1	1,878	208	67	57	48,003	9,522
4104.02	1	794	369	0	12	65,500	61,696
4104.02	2	2,323	526	16	26	100,786	6,492
4104.02	3	508	233	115	104	-	**
4104.02	4	1,148	415	41	62	71,304	35,421
4105.00	1	2,193	333	232	112	53,598	14,000
4105.00	2	668	346	18	19	68,561	18,701
4106.00	1	2,054	462	16	30	62,326	11,414
4106.00	2	1,266	435	35	57	50,451	6,403
4106.00	3	1,186	383	127	208	72,522	10,492
4106.00	4	720	370	0	12	61,724	49,017

SCENARIO METHODOLOGY

The main goal for "Charging Greenfield" plan is to prepare Greenfield for transitioning to EVs by understanding what the market may do in the next 5-10 years. To reach the goal of the study, the following questions need answers:

- How many EVs will be there in Greenfield?
- What type of charging infrastructure will be needed, how many and where?
- When should the charging infrastructure be installed?

These are "market" type of questions. The answers to these questions lie in predicting the future and making some estimates. The EV market has been on the rapid rise in the US and worldwide, and the rise has been happening a lot faster than any past forecasts. The EV market is growing with some places in the US that have been ahead in EV adoption in comparison to Hancock County, IN.

Since it has been difficult even for the global experts to make precise predictions about the future of the EV market, the scenario planning approach was chosen to provide Greenfield with several paths forward for what could happen in the future with EV market to prepare the city for a variety of scenarios. The results of the scenarios can be used by various actors within the city to participate in creating a city-wide charging network, monitor if the network is enough to serve the needs of all residents, and then make adjustments accordingly.

Scenario results give an idea of goals for all the charging network participants. The city can see how many chargers the market can take care of and how many chargers the government organizations could provide. Right now, if a retail business approached the city of Greenfield and asked "How many charging stations and of what kind should I add to my business?", no-one would know the answer. However, with scenarios, the city could respond, "It looks like in the next 5-10 years, Greenfield may need "X" amount of Level 2 chargers by retail businesses." If a city park decides to install some charging, one can look at the breakdown of public level 2 and DCFC charging to see the number of chargers that could be provided by "recreational centers" and on-street parking (for trail areas close to the streets) and find that number.

EVI PRO LITE TOOL

EVI-Pro Lite estimation tool was used to find the number and kind of chargers for several scenarios (5). This tool was created by the federal energy and transportation agencies to help the U.S. states and metropolitan areas to estimate their charging needs. The tool asks to choose either a state or a metropolitan area and then a number of light-duty BEVs to support. Other inputs that can be tweaked in this tool are:

- Share of people that have access to home charging;
- % of vehicle types in the mix (sedans, SUVs, vans, & pick-up trucks);
- % of plug-in hybrids that the charging network would support; and
- Extent to which the network would support plug-in hybrids (full, partial, none).

EVI PRO LITE INPUTS

Geographic Area

The first input is the geographic area, which can be either a state or a metropolitan area. Hancock County is lumped in with over a dozen counties included into Indy-Carmel-Anderson metro area, so it would be hard to decipher Hancock County's specific situation from using this area. There are only three metro areas in Indiana in the EVI-Pro Lite tool that are small enough to make an estimate about Hancock County: Kokomo, Muncie, and Columbus. After looking at population and BEV registration numbers for the counties where these metro areas are located (Table B.2), it was determined that *Columbus* area (Bartholomew County) would fit the best.

Inputs that remained as recommended by the tool

Vehicle mix, share of PHEV to support and extent of support of PHEV. Changing the ratios of these numbers doesn't significantly change any results, so they were left as recommended for a specific area. For example changing PHEV percentage from 40 % to 1 % or 90 % changes the total number of resulting ports by +/-1%.

Table B.2 Comparison of BEV registration rates among top 20 Indiana counties, 2018-2023 (Data source: 7)

Top 20 IN counties by number of BEVs registered 2018-2023	Share of registered BEVs among all vehicles						2023 difference between county and IN rate	Change				
	2018	2019	2020	2021	2022	2023		18-19	19-20	20-21	21-22	22-23
Indiana overall	**0.05%**	**0.08%**	**0.11%**	**0.16%**	**0.25%**	**0.34%**		60.00%	37.50%	45.45%	56.25%	36.00%
Hamilton	0.20%	0.31%	**0.43%**	**0.65%**	**0.90%**	**1.28%**	0.94%	55.00%	38.71%	50.00%	39.53%	42.22%
Marion	0.11%	0.13%	0.18%	0.22%	**0.35%**	**0.46%**	0.12%	18.18%	38.46%	22.22%	59.09%	31.43%
Lake	0.04%	0.06%	0.10%	0.15%	0.27%	**0.36%**	0.02%	50.00%	66.67%	50.00%	80.00%	33.33%
Allen	0.05%	0.07%	0.10%	0.17%	0.26%	**0.36%**	0.02%	40.00%	42.86%	70.00%	52.94%	38.46%
Saint Joseph	0.06%	0.08%	0.10%	0.17%	0.24%	**0.35%**	0.01%	33.33%	25.00%	70.00%	41.18%	45.83%
Porter	0.08%	0.11%	0.15%	0.23%	**0.33%**	**0.47%**	0.13%	37.50%	36.36%	53.33%	43.48%	42.42%
Hendricks	0.06%	0.10%	0.14%	0.21%	0.31%	**0.47%**	0.13%	66.67%	40.00%	50.00%	47.62%	51.61%
Boone	0.17%	0.27%	**0.37%**	**0.47%**	**0.75%**	**1.01%**	0.67%	58.82%	37.04%	27.03%	59.57%	34.67%
Tippecanoe	0.08%	0.11%	0.17%	0.23%	**0.36%**	**0.36%**	0.02%	37.50%	54.55%	35.29%	56.52%	0.00%
Monroe	0.10%	0.16%	0.24%	**0.35%**	**0.48%**	**0.70%**	0.36%	60.00%	50.00%	45.83%	37.14%	45.83%
Johnson	0.04%	0.06%	0.09%	0.17%	0.29%	**0.44%**	0.10%	50.00%	50.00%	88.89%	70.59%	51.72%
Elkhart	0.04%	0.05%	0.06%	0.10%	0.14%	0.20%	-0.14%	25.00%	20.00%	66.67%	40.00%	42.86%
Vanderburgh	0.03%	0.04%	0.07%	0.10%	0.15%	0.21%	-0.13%	33.33%	75.00%	42.86%	50.00%	40.00%
Clark	0.03%	0.05%	0.07%	0.14%	0.22%	0.31%	-0.03%	66.67%	40.00%	100.00%	57.14%	40.91%
Floyd	0.06%	0.09%	0.12%	0.20%	0.27%	**0.37%**	0.03%	50.00%	33.33%	66.67%	35.00%	37.04%
Bartholomew	0.05%	0.08%	0.12%	0.16%	0.27%	**0.38%**	0.04%	60.00%	50.00%	33.33%	68.75%	40.74%
Hancock	0.05%	0.07%	0.10%	0.14%	0.23%	**0.32%**	-0.02%	40.00%	42.86%	40.00%	64.29%	39.13%
LaPorte	0.03%	0.06%	0.08%	0.11%	0.16%	0.22%	-0.12%	100.00%	33.33%	37.50%	45.45%	37.50%
Vigo	0.03%	0.05%	0.07%	0.10%	0.15%	0.23%	-0.11%	66.67%	40.00%	42.86%	50.00%	53.33%

Share of people having access to home charging

- 61 % is homeowner's rate in Greenfield citywide (6). Figure B.10 shows homeowner rates per census tract. Greenfield public engagement events results: about 64 % of the respondents have access to home charging.
- 75 % is the share of single family housing among all dwelling types in Greenfield (6). Figure B.11 shows this share per census tract.

As EVs become more affordable, it is important to be aware of the barriers to at-home charging. The shares above were used to create two versions of each scenario to show the increased need for EV charging ports when the levels of at-home charging are lower.

Number of BEVs to support

Figure B.10 Homeowner's rate per census tract. Source: 2021 ACS (6). Map source: Esri basemap 2023.

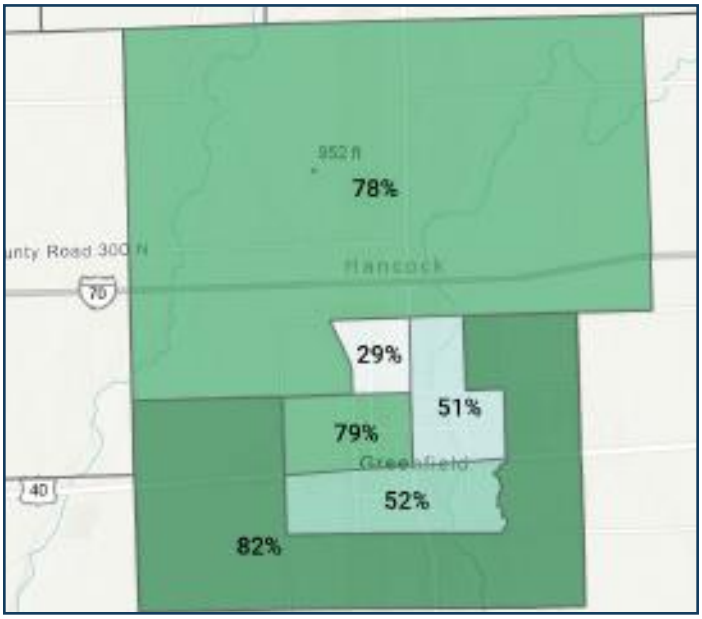
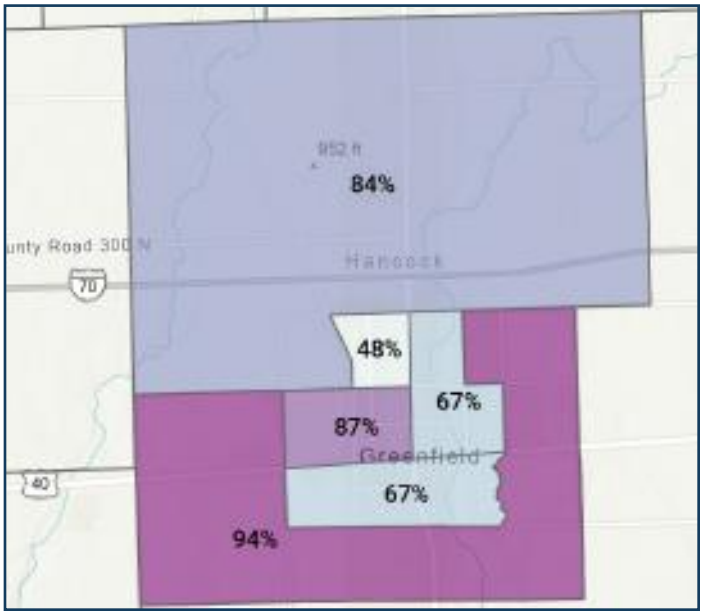


Figure B.11 Single-family housing share per census tract. Source: 2021 ACS (6). Map source: Esri basemap 2023.



EVI-Pro lite tool requires the minimum input to be at least 1 % of BEVs of all light-duty vehicles. For Columbus, it is 700 BEVs. 700 vehicles became the minimum scenario and through other projections explained here after the scenario results, it became a 5-year benchmark scenario for Greenfield.

The choice of BEV numbers and corresponding scenarios is based on the projected number of BEVs that may be reached in Greenfield in 5-10 years (explained in detail further down).

- Greenfield may reach 700 BEVs between 2028 and 2030, or in 5 years. This is the 1st scenario.
- Greenfield may reach 2000 BEVs between 2031-2033, or in 10 years. This is a "10-year average" scenario.
- Greenfield may reach 4000 BEVs by 2033 in a more optimistic scenario. This is a "10-year optimistic" scenario.
- EVI-Pro Lite tool also gives this statistic: *"Based on NREL national electric vehicle infrastructure needs assessment, 12 % of light-duty vehicles on the road could be plug-in electric vehicles by 2030."* The projections show that this registration rate may be reached in Greenfield between 2032 and 2035. The "10 year optimistic" scenario accounts for it.

Table B.3 shows the resulting number of charging ports that would be necessary to service a given number of BEVs under two rates of access to at-home charging: 61 % and 75 %.

Share of charging port types

The tool gives a summary of the share that each type of charger would constitute within the mix of chargers.

	Share of charging port types	
	61 % access	**75 % access**
Single Family	84 %	90 %
Level 2, private	6%	4 %
Level 2, public	9%	6 %
DCFC, public	1%	1 %

These shares correspond with what other market predictions that the majority of charging stations are going to be private and that the share of DCFC charging in the total number of chargers is going to be low. Also, the shares above show that if access to home charging is low, then the share of single family is also lower and more Level 2 chargers (private and public) are needed.

SCENARIO RESULTS

Table B.3 Number and Kind of Charging Ports for Three EV Adoption Scenarios

		2028-2030 5YR 700 BEV		2031-2033 10 YR AVG 2000 BEV		2033 10 YR OPT 4000 BEV	
	PERCENT OF DRIVERS WITH ACCESS TO HOME CHARGING	61 %	75 %	61 %	75 %	61 %	75 %
Private	Single Family (level 1)	138	170	385	473	770	946
	Singel Family (level 2)	279	341	777	955	1553	1909
	Level 2 (e.g., workplace)	30	22	78	56	159	111
	Total Private	447	533	1240	1484	2482	2966
Public	Level 2	46	33	120	94	247	194
	DCFC	6	6	15	12	31	25
	Total public	52	39	135	106	278	219

BREAKDOWN OF PUBLIC CHARGING PORTS BY USE

Table B.4 further breaks down PUBLIC Level 2 and DCFC charging ports by use. At this point, the market has a good idea as to where the chargers can be used often enough that pairing the use with a certain speed or level of charging makes sense. This is useful to know to approximate how many publically accessible charging ports to install in Greenfield in the future.

Table B.4 Number and Kind of Charging Ports per Use of Publicly Accessible Charging for Three EV Adoption Scenarios

	2028-2030 5YR 700 BEV		2031-2033 10 YR AVG 2000 BEV		2033 10 YR OPT 4000 BEV	
PERCENT OF DRIVERS WITH ACCESS TO HOME CHARGING	**61 %**	**75 %**	**61 %**	**75 %**	**61 %**	**75 %**
LEVEL 2	**46**	**33**	**120**	**94**	**247**	**194**
Retail	8	6	24	16	46	31
Rec Center (parks, libraries, museums, bars, movies, exercise)	4	2	8	6	19	15
Healthcare Facility (hospitals, dental, therapy, etc.)	6	4	15	10	30	22
Education Facility	4	1	9	7	20	12
Community Center (religious & community gatherings)	4	3	9	6	19	15
Transportation Facility	3	2	9	8	20	17
Neighborhood (on-street)	5	7	14	17	28	37
Office (publicly accessible)	12	8	32	24	65	45
DCFC	**6**	**6**	**15**	**12**	**31**	**25**
Retail, 150 kW	3	3	6	4	11	10
Retail, 250 kW	1	1	3	2	6	4
Retail, 350 kW+	0	0	2	2	5	3
Rec Center, 150 kW	2	2	2	2	5	4
Rec Center, 250 kW	0	0	1	1	2	2
Rec Center, 350 kW+	0	0	1	1	2	2

NUMBER OF BEVS & TIMELINE

How to choose the right number of BEVs and find out the approximate timeline of the BEVs adoption in Greenfield? There are no specific BEV statistics available for Greenfield, so certain proxy-numbers were found and then used together with the numbers that are available for Greenfield.

Methodology for finding the number of total vehicles in Greenfield during 2024-2033

There are no numbers of exact vehicle registrations for Greenfield. However, these numbers are available for Hancock County and can be used to approximate the number of vehicles in Greenfield.

It was observed that the number of registered vehicles in Hancock County is about 5 % larger than its population, so this 5 % increase was used to arrive at the total number of vehicles in Greenfield. Population numbers were estimated for Greenfield to grow about 1.4% annually, which is the average annual growth rate that helped Greenfield arrive from its 2010 to 2020 population per 2010 and 2020 Decennial Census results (8).

Methodology for finding the number of BEVs in Greenfield during 2024-2033

Hancock County existing and projected BEV registration shares were used to find the number of BEVs in Greenfield. In order to project county's BEV registration share into the next decade, the existing BEV shares of the Indiana counties and the U.S. states that are ahead of Hancock County in EV adoption were used.

A few places that are ahead of Hancock County in their BEV registration shares are: the USA, states of Arizona and Washington, King County (WA) (highest BEV share among Washington counties), and the following Indiana counties that are 3-4 years ahead: Hamilton, Boone, and Monroe. AZ and WA are similar in population to Indiana. By population, WA ranks 13th, AZ ranks 14th, and IN ranks 17th in 2022. Meanwhile, by 2022 BEV numbers, WA ranks 4th, AZ ranks 9th and IN ranks 37th (see Appendix A). See comparison of the registration rates in Table B.5.

The shares of BEV registration were analyzed as to how much they have been growing every year to see if there is a certain pattern that we could use for our projections. Table B.6 shows the growth rate of the share.

The patterns are a little uneven, but some general trends can be observed:

- BEV registration rates are going up everywhere, but the rate of their growth varies, even on year-by-year basis.
- When BEV registration rates are low (less than 0.5%), the growth rate typically looks high: 50 %.
- When BEV registration rates start climbing up, the growth rate starts slowing down.
    - For example, Indiana's average growth rate of the BEV share is 47 %, Hancock's county's is 45 %, but the growth rate in Indiana counties that are ahead in their BEV numbers (Hamilton, Boone and Monroe) range between 40-43%. Since future growth of BEV in Hancock County may start following these counties, 40-43% seems like a good locally-based growth rate to consider.
    - State of Washington ranks 4th among the US states by the number of BEVs and has already

Table B.5 Share of registered BEV among all vehicle for the US, Indiana, select Indiana counties and US states (Data sources: 7, 9, 10, 11)

	2018	2019	2020	2021	2022	2023
Indiana	0.05%	0.08%	0.11%	0.16%	0.25%	0.34%
Hamilton Co, IN	0.20%	0.31%	0.43%	0.65%	0.90%	1.28%
Boone Co, IN	0.17%	0.27%	0.37%	0.47%	0.75%	1.01%
Monroe Co, IN	0.10%	0.16%	0.24%	0.35%	0.48%	0.70%
Hancock Co, IN	0.05%	0.07%	0.10%	0.14%	0.23%	**0.32%**
United States	0.21%	0.28%	0.37%	0.52%	0.86%	
Washington	0.40%	0.53%	0.68%	0.83%	1.31%	
King Co, WA	1.19%	1.70%	2.15%	2.57%	3.33%	4.47%
Arizona	0.22%	0.33%	0.48%	0.67%	1.01%	

Green highlight: higher than Hancock's 2023 BEV rate of 0.32 %.
Yellow highlight: BEV rate higher than 1 % (the rate of BEV growth slows down after 1 %).

Table B.6 Growth rate of the share of registered BEV among all vehicle for the US, Indiana, select Indiana counties and US states. (Data sources: 7, 9, 10, 11)

Share growth rate	2018	2019	2020	2021	2022	2023	Average	Average over 0.32%
Indiana		60%	38%	45%	56%	36%	47%	
Hamilton Co, IN		55%	39%	50%	40%	42%	45%	43%
Boone Co, IN		59%	37%	27%	60%	35%	43%	40%
Monroe Co, IN		60%	50%	46%	37%	46%	48%	43%
Hancock Co, IN		40%	43%	40%	64%	39%	45%	
United States		33%	32%	41%	65%		43%	46%
Washington		33%	28%	22%	58%		35%	35%
King Co, WA		43%	26%	20%	30%	34%	31%	31%
Arizona		50%	45%	40%	51%		46%	46%

reached 1.31% BEV registration rate. Its BEV rate over the last 5 years has been growing at about 35 % (2018-2022). 5 years before that, the annual BEV growth rate was about 60% (2013-2017).

- King County, WA has the highest BEV registration rate: 4.47 % at the beginning of 2023. The growth of its BEV share is at 31 % annually (2017-2023).

- Arizona has been ahead of Hancock County's rate and its BEV rate has still been growing at a rate of 46 %.
- US is showing a similar rate of growth to AZ, but US is a mixture of all regions no matter where they are in their BEV journey: 46%.
- Hancock County's BEV registrations are growing at a rate very similar to Indiana's: 45 % and 47%.

With decreasing EV prices and an improved charging network, people may start buying EVs at a higher rate in the future. Most market predictions about EVs have been lower than what actually happened, so scenarios that are more optimistic than the past experiences can hold true. Due to this constant more positive outcome in BEV adoption, a more positive growth rate can be added to the projections.

Projected Greenfield BEV Shares in the Next Decade

Based on the observations above, a few BEV growth rates were chosen for Greenfield to shape four projections of BEV growth:

1. *Projection A*: BEV adoption grows slow at 35 % during the next 10 years (2024-2033). This rate is lower than any rates observed in most America so far.
2. *Projection B*: BEV has a staggered growth: 42 % during 2024-2028 and 30 % during 2029-2033. This is a combination of the growth rate of Indiana counties that are 3-4 years ahead and Washington's top BEV county experience that is a decade ahead of Hancock County in BEV share.
3. *Projection C:* BEV is growing at the current Hancock County's rate of 45 % during 2024-2033. Also the average BEV growth rate in Indiana and the US now are 47% and 46%, which are close to the chosen rate in this projection.
4. *Projection D*: BEV is growing at a more optimistic rate of 50 % during 2024-2033.

Greenfield BEV Numbers

Projected number of total vehicles was multiplied by the projected BEV shares from all 4 projections. Table B.6 show the projected number of BEVs based on the four projections described above.

Final Chosen Scenarios

The following patterns are observed in the projection tables:

- In **5-7 years, 700 BEVs** may be reached according to all projected scenarios. That's the 1st scenario.
- In **10 years, 2000 BEVs** may be reached according to all scenarios. That's the 2nd scenario.
- In **10 years, 4000 BEVs** may be reached if Greenfield's BEV keeps growing at a 45% rate like it does now. That's the 3rd scenario. In the most optimistic scenario, 4000 BEVs are reached in 9 years.

So, the final choice of scenarios is based on the projected number of BEVs that may be reached in Greenfield in 5-10 years.

Table B.7 Projections for Greenfield: total number of vehicles and BEVs during 2024-2033 (Data sources: 7, 12)

GREENFIELD ESTIMATES

Population increase +1.4% annually	Known						Projected									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Number of vehicles +5 % over population (similar to Hancock County)							27,311	27,693	28,081	28,474	28,872	29,277	29,687	30,102	30,524	30,951
Greenfield population	21,871	22,160	23,488	23,024	25,651	25,651	26,010	26,374	26,743	27,118	27,498	27,883	28,273	28,669	29,070	29,477

PROJECTION A: Low growth rate of 35%

2024-2033: + 35 %	Known						Projected									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hancock Co, BEV share	0.05%	0.07%	0.10%	0.14%	0.23%	0.32%	0.43%	0.58%	0.79%	1.06%	1.43%	1.94%	2.62%	3.53%	4.77%	6.43%
Greenfield, projected # of BEVs							118	162	221	303	414	567	**776**	1,063	1,455	**1,991**

PROJECTION B: Staggered growth rate

2024-2028: + 42 %	Known						Projected									
2029-2033: +30 %	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hancock Co, BEV share	0.05%	0.07%	0.10%	0.14%	0.23%	0.32%	0.45%	0.65%	0.92%	1.30%	1.85%	2.40%	3.12%	4.06%	5.28%	6.86%
Greenfield, projected # of BEVs							124	179	257	370	533	**703**	927	1,222	1,611	**2,123**

PROJECTION C: Hancock's current BEV growth rate at 45 %

2024-2033: + 45 %	Known						Projected									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hancock Co, BEV share	0.05%	0.07%	0.10%	0.14%	0.23%	0.32%	0.46%	0.67%	0.98%	1.41%	2.05%	2.97%	4.31%	6.25%	9.07%	13.15%
Greenfield, projected # of BEVs							127	186	274	403	**592**	**871**	1,280	**1,882**	2,768	**4,069**

PROJECTION D: High BEV growth rate of +50%

2024-2033: + 50 %	Known						Projected									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Hancock Co, BEV share	0.05%	0.07%	0.10%	0.14%	0.23%	0.32%	0.48%	0.72%	1.08%	1.62%	2.43%	3.65%	5.47%	8.20%	12.30%	18.45%
Greenfield, projected # of BEVs							131	199	303	461	**702**	1,067	**1,623**	**2,469**	3,755	**5,711**

REFERENCES

1. Parcel Boundaries of Indiana 2022: Parcel boundaries maintained by County Agencies in Indiana, (Indiana Geographic Information Office, File Geodatabase, Polygon Feature Class), 20221109.
2. U.S. Census Bureau. (2023). LEHD Origin-Destination Employment Statistics Data (2002-2021) [computer file]. Washington, DC: U.S. Census Bureau, Longitudinal-Employer Household Dynamics Program [distributor], accessed on 20230901 at https://lehd.ces.census.gov/data/#lodes. LODES 8.1 [version]
3. U.S. Census Bureau. "POVERTY STATUS IN THE PAST 12 MONTHS OF PEOPLE IN HOUSING UNITS." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B17101, 2021, . Accessed on November 1, 2023.
4. U.S. Census Bureau. "MEDIAN HOUSEHOLD INCOME IN THE PAST 12 MONTHS (IN 2021 INFLATION-ADJUSTED DOLLARS)." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B19013, 2021, . Accessed on November 1, 2023.
5. U.S. Department of Energy. Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite***. Link: https://afdc.energy.gov/evi-pro-lite..
6. U.S. Census Bureau. "HOUSEHOLD AND FAMILIES." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table S1101, 2021
7. Indiana Office of Energy Development. ***Indiana Vehicle Fuel Dashboard***. Link: https://www.in.gov/oed/resources-and-information-center/vehicle-fuel-dashboard/.
8. U.S. Census Bureau. "TOTAL POPULATION." Decennial Census, DEC Demographic and Housing Characteristics, Table P1, 2010, 2020. Greenfield city, Hancock County, IN
9. U.S. Department of Energy. Energy Efficiency & Renewable Energy. Alternative Fuels Data Center. ***Vehicle registration counts by state***. Link: **https://afdc.energy.gov/vehicle-registration.**
10. FHWA, Highway Statistics Series, State Motor-Vehicle Registrations, 2018-2021. Link: https://www.fhwa.dot.gov/policyinformation/statistics.cfm.
11. State of Washington Data. ***Electric Vehicle Registration Activity by Year.*** King County, WA, 2018-2023. Link: https://data.wa.gov/Transportation/Electric-Vehicle-Registration-Activity-by-Year/tak8-xdcp
12. U.S. Census Bureau. "ACS Demographic and Housing Estimates." American Community Survey, ACS 5-Year Estimates Data Profiles, Table DP05, 2018-2022. Greenfield city, Hancock County, IN.

C | APPENDIX: ORDINANCE EXAMPLES

GREENFIELD UDO RECOMMENDATIONS

This Appendix lists places in Greenfield's UDO that can include EVCS standards, provides additional comments to consider when deciding on regulations and provides examples of some standards from other jurisdictions. Table C.1 below lists places in the UDO that can be updated to provide EVCS-specific standards.

Table C.1. UDO Sections to Pay Attention to for EVCS Updates

UDO SECTION	TITLE	RECOMMENDATION
Appendix A	Definitions	Add definitions of the EVCS use and other terms.
155.007	Table of Uses	Update the table to show where EVCS is permitted as an accessory or primary use.
155.039	Setbacks, encroachments	Review these standards, evaluate how the regulations can apply to various EVCS and whether any amendments specific to EVCS are needed.
155.050	Accessory Structures and Uses	If EVCS-specific standards are warranted, add "EVCS accessory" use here and list the standards (e.g., 155.050.8 "Accessory EVCS"). Add at-home charging to the list of items exempt from permitting in 155.050.2.A.
155.063	Landscaping	Review to see if EVCS-specific standards should be added.
155.064	Fences and Screening	Review to see if EVCS-specific standards should be added, like adding screening utility equipment that serves EV chargers to the list in section 155.064.1.
155.065	Signs	Review to see if EVCS-specific standards should be added. They could be similar to gas pump station sign requirements (155.065.14)
155.066	Off-street Parking	Review to add EVCS-specific standards: update required EVCS spots, ADA EV parking spot dimensions, etc.
155.094	Conditional Uses	Should there be a need to establish certain EVCS as a Conditional Use in some zoning districts, update this section to add EVCS-specific criteria for Conditional Use review.

Considerations when Defining EVCS Use

Due to the evolving nature of the EV charging station use and design, it may be necessary to differentiate among the categories of EV charging stations depending on certain characteristics of the use (1):

- *Intensity of the Use.* The number and kind of chargers and corresponding utility infrastructure installed on site creates a different visual impact and trip generation. A public charging station that has two Level 2 chargers and one DCFC charger with some utility equipment installed in the landscape buffer area might not create as much of a visual impact as a private EV semi-truck fleet charging station with a bank of a dozen of DCFC chargers and corresponding utility equipment. The first setup may not require any additional development standards, while the second may warrant screening standards for the utility equipment and some other visual adjustments like additional landscaping.
- *Public Access of the Use*. Publicly accessible charging stations lead to a larger trip generation than private charging. Examples of private charging are at-home charging, at-work charging restricted only to the employees, or charging restricted only to the customers of a business.
- *Payment for the Use*. Some zoning codes differentiate between similar land uses based on whether an activity is paid for or not. For example, an agricultural farm could be simply a permitted farm use not needing any approvals. However, once a portion of that farm is used to accept public to view a portion of the farm for a fee, it could be classified as an '"event venue" and be treated differently by the zoning code.

DEFINITIONS EXAMPLES

Electric Vehicle (EV)

An ELECTRIC VEHICLE (EV) is defined as a motor vehicle that uses one or more electric motors for propulsion. Onboard batteries provide electricity for propulsion, which can be charged using Electric Vehicle Supply Equipment (EVSE). (City of Columbus, OH, Zoning Ordinance (2))

ELECTRIC VEHICLE. EV means any motor vehicle that is licensed and registered for operation on public and private highways, roads, and streets, and that operates either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board via a battery for motive purpose. Electric Vehicle does not include an electric bicycle. Electric Vehicle includes:

1. A battery electric vehicle; and
2. A plug-in hybrid electric vehicle.

(City of Madison, WI, Zoning Ordinance (3))

ELECTRIC VEHICLE. Any vehicle that is licensed and registered for operation on public and private highways, roads, and streets; either partially or exclusively, on electrical energy from the grid, or an off-board source, that is stored on-board via a battery to propel the vehicle. (City of Chicago, IL, Zoning Ordinance (4))

ELECTRIC VEHICLE. An automotive-type vehicle for on-road use primarily powered by an electric motor that draws current from an onboard battery charged through a building electrical service, electric vehicle supply equipment (EVSE), or another source of electric current. (2021 International Building Code (5))

Electric Vehicle Supply Equipment (EVSE)

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). EVSE are the conductors, including the ungrounded, grounded, and equipment grounding conductors, and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the electric vehicle.(City of Madison, WI, Zoning Ordinance (3))

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The apparatus installed specifically for the purpose of transferring energy between the premises wiring and the Electric Vehicle. (2021 International Building Code (5))

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded and equipment grounding conductors and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets or apparatus installed specifically for the purposes of transferring energy between the premises wiring and the EV. (2022 California Green Building Standards Code (6))

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The equipment, as defined by the National Electrical Code and adopted in Section 14E-6-625 of the Municipal Code of Chicago, that includes the conductors, including the ungrounded, grounded, and equipment grounding conductors, and the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and an electric vehicle.(City of Chicago, IL, Zoning Ordinance (4))

Electric Vehicle Charging Station (EVCS)

ELECTRIC VEHICLE CHARGING STATION. One or more electric vehicle charging spaces served by electric vehicle charger(s) or other charging equipment allowing charging of electric vehicles. (2022 California Green Building Standards Code (6))

ELECTRIC VEHICLE CHARGING STATION. A parking space, or parking spaces, that is, or are, equipped with and served by electric vehicle supply equipment for the purpose of transferring electric energy to a battery or other energy storage device in an electric vehicle. The terms Level l, 2, and 3 charging stations are the most common electric vehicle charging levels, and include the following specifications:

1. Level l is considered slow charging and operates on a 15 to 20 amp breaker on a 120 volt AC circuit.
2. Level 2 is considered medium charging and operates on a 40 to 100 amp breaker on a 208 or 240 volt AC circuit.
3. Level 3 is considered “fast” or “rapid” charging and typically operates on a 60 amp or higher breaker on a 480 volt or higher three phase circuit with special grounding equipment. Level 3 stations are primarily for commercial and public

applications and are typically characterized by industrial grade electrical outlets that allow for faster recharging of electric vehicles.

(City of Madison, WI, Zoning Ordinance (3))

Electric Vehicle Charging Facility

Electric Vehicle Charging Facility. A facility where electricity is provided directly to the public on the premises for purposes of charging electric vehicles at one or more electric vehicle charging stations. An Electric Vehicle Charging Facility may also retail minor accessories but may not provide other types of vehicle fuel, such as gasoline. (City of Madison, WI. Zoning Ordinance (3))

EV-Capable Space

EV-CAPABLE SPACE. A dedicated parking space with electrical panel capacity and space for a branch circuit dedicated to the EV parking space that is not less than 40-ampere and 208/240-volt and equipped with raceways, both underground and surface mounted, to enable the future installation of electric vehicle supply equipment. For two adjacent EV-Capable spaces, a single branch circuit is permitted. (2021 International Building Code (5))

EV-CAPABLE SPACE. A vehicle space with electric panel space and load capacity to support a branch circuit and necessary raceways, both underground and/or surface mounted, to support EV charging. (2022 California Green Building Standards Code) (6)

EV Capable: These parking spaces provide dedicated conduit from the planned location of a breaker or sub panel expansion to the EV Capable parking spaces. (City of Columbus, OH, Zoning Ordinance (2))

EV-Ready Space

EV Ready Space means a designated parking space which is provided with electrical panel capacity and space to support a minimum 40-ampere, 208/240-volt branch circuit, and the installation of raceways, both underground and surface mounted, to support the future installation of EVSE to serve the parking space. (City of Madison, WI, Zoning Ordinance (3))

EV Ready: These parking spaces provide dedicated electrical panel capacity, conduit, and wiring installed with termination at an outlet to the EV Ready parking space. (City of Columbus, OH, Zoning Ordinance (2))

EVSE-Ready Space. A parking space having electric vehicle supply equipment infrastructure installed so as to provide conduit and wiring for a 40-ampere, 208- or 240-volt dedicated branch circuit terminating at a receptacle or junction box within 3 feet of the parking space. For two adjacent parking spaces, a single branch circuit is allowed. The electrical panel directory and receptacle or junction box must both be permanently marked “For future electric vehicle supply equipment". (City of Chicago, IL, Zoning Ordinance (4))

EV-READY SPACE. A designated parking space which is provided with a dedicated branch circuit that is not less than 40-ampere and 208/240-volt assigned for electric vehicle supply equipment terminating in a receptacle or junction box located in close proximity to the proposed location of the EV parking space. For two adjacent EV-Ready spaces, a single branch circuit is permitted. (2021 International Building Code (5))

EV-READY SPACE. A vehicle space which is provided with a branch circuit; any necessary raceways, both underground and/or surface mounted; to accommodate EV charging, terminating in a receptacle or a charger. (2022 California Green Building Standards Code (6))

EV-Installed Space

EV Installed Space means a parking space that is served by an electric vehicle charging station, at a minimum of Level 2. (City of Madison, WI, Zoning Ordinance (3))

EVSE-Installed Space. A parking space having such electric vehicle supply equipment infrastructure installed so as to be an EVSE-ready space and with electric vehicle supply equipment installed within 3 feet of the parking space. (City of Chicago, IL, Zoning Ordinance (4))

Electric Vehicle Supply Equipment (EVSE Installed): These parking spaces provide dedicated panel capacity, conduit, and EVSE Installed, as defined by rules promulgated under this chapter. (City of Columbus, OH, Zoning Ordinance (2))

PARKING REQUIREMENTS

The most common land use requirement related to EVCS are the amount of required parking spaces for charging. Due to that, most EVCS zoning standards will be found in the "Parking and Loading" sections of the zoning codes. The development standards typically include:

- What kinds of developments are required to provide EVCS;
- Minimum number of EVCS to be provided;
- Minimum number of ADA EVCS parking spaces;
- EVCS design standards.

WHEN TO REQUIRE EVCS?

Places vary greatly in their requirements for minimum EVCS installations depending on whether there is an increase in EV drivers, presence of sustainability initiatives related to climate change and reducing air pollution, or understanding that some uses must provide charging in the future like multi-family developments (7).

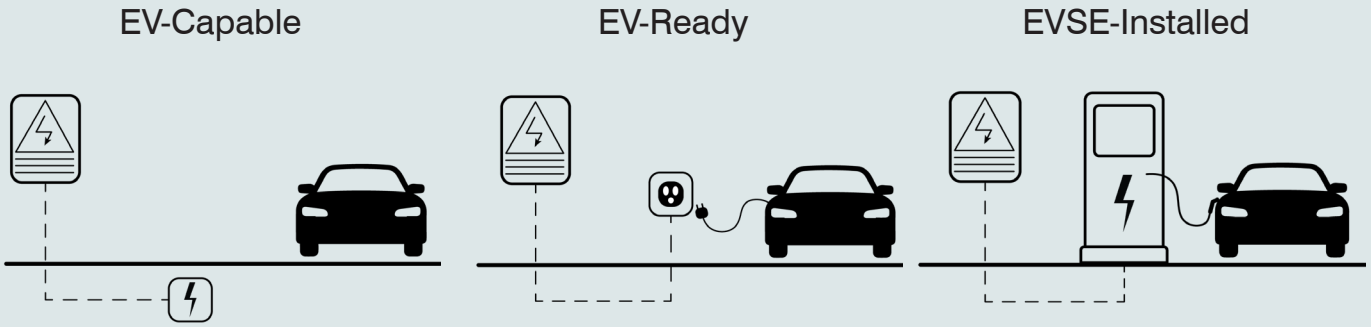
It is difficult to predict the number of spots to devote to EV charging at the moment and require that amount. However, it is also costly to install additional electric infrastructure and repave parking lots to add a few more chargers in the future when the market produces a higher demand for EV charging.

Some require a specific number of EV chargers installed per number of new parking spaces. Others instead ask to provide infrastructure for EVCS expansion. A common strategy appearing in land use policies recommends to define three levels of readiness of a parking spot for charging: EV-capable, EV-ready, and EVSE-installed.

Figure C.1 provides explanation and demonstration of what these terms mean. In essence, they are different stages of a potential spot for charging to be used or converted into an EV charging space. Some local zoning ordinances use all three terms, while others use only two: EV-ready and EV-installed.

Note that in some jurisdictions, the *building code* regulates the number and kind of parking spaces to be EV-Ready or EV-Capable. Examples of their definitions is given on the previous pages from the International Building Code. These standards sometimes read a little different than the zoning ones.

Figure C.1 EV terms for parking spaces (Data source: 1)



EV Capable means the installation of electrical panel capacity with a dedicated branch circuit and a continuous conduit from the panel to the future EV parking spot(s).

This is the lowest cost of readiness for future EVSE installation and is long-term "insurance" for cost-effective expansion of EV charging.

EV-Ready means the installation of electrical panel capacity and raceway with conduit to terminate in a junction box or 240-volt charging outlet.

If wiring is terminated at an outlet, EV Ready enables charging with onboard vehicle charger. It also provides for a space to connect a Level 2 charger.

Electric Vehicle Supply Equipment (EVSE) Installed means the installation of electric panel, conduit, and an EV charger (Level 2 or DCFC).

This enables immediate charging.

Development-specific situations that can trigger the minimum EVCS provisions:

- Any new development that provides "x" amount of parking spaces or "X" sq.ft of parking area;
- Any new development for specific types of uses;
- Any redevelopment that changes the parking lot and makes the parking lot reach a certain number of parking spaces.
- Application date. In anticipation of changing EV market conditions, several jurisdictions require different levels of EVCS ready/installed depending on the application date.

LANGUAGE EXAMPLES

City of Bloomington, IN,,Zoning Ordinance (8)

"Parking areas with 50 or more parking spaces shall provide a minimum of one parking space dedicated to electric vehicles for every 25 parking spaces provided on site."

City of Madison, WI, Zoning Ordinance (3)

"Electric Vehicle Charging Station Requirements. Parking facilities shall be designed and built to meet the following requirements:

1.Applicability. The requirements of this subdivision shall apply to any new parking facility, or to any parking facility that is expanded by 10,000 square feet, as measured in parking spaces being created after January 1, 2021. A parking facility may be maintained or reconstructed without triggering the requirements of this subdivision. However, where more than 10,000 square feet of the paving and base in place on January 1, 2021 is removed from an existing parking lot and new paving and base is installed, these requirements shall apply."

City of Lakewood, CO, Zoning Ordinance (9)

"Developments that meet the following conditions must follow the standards in this section *[EVCS development standards section]*.

1. New development with more than 10 off-street parking spaces; and

2. The development includes one or more of the uses identified in Table 17.8.5."

2022 California Green Buildings Code (6)

"New construction shall comply with Sections ... *[multi-family & commercial developments]* to facilitate future installation and use of EV chargers."

City of Chicago, IL, Zoning Code (4)

"17-10-1011 Electric Vehicle Supply Equipment. This section shall apply to building permit applications for *a new construction* building project that includes accessory parking or non-accessory parking as described in this section.

17-10-1011-A Residential Buildings.

1. Where the first building permit application for the project is submitted after October 31, 2020, and before November 1, 2023, new construction of a multi-unit residential building containing five or more dwelling units where on-site parking is provided shall include equipment so that at least 20 percent, and no less than one, of the parking spaces are either EVSE-ready spaces or EVSE-installed spaces.

2. Where the first building permit application for the project is submitted on or after November 1, 2023, new construction of a residential building intended for household living with accessory parking provided shall include equipment so that 100 percent of the accessory parking spaces serving dwelling units, 20 percent of the accessory parking spaces serving other than dwelling units, and 20 percent of the non-accessory parking spaces are either EVSE-ready spaces or EVSE-installed spaces.

3. Where the first building permit application for the project is submitted on or after November 1, 2023, new construction of a residential building intended for group living or lodging with accessory parking provided shall include equipment so that 20 percent of parking spaces are either EVSE-ready spaces or EVSE-installed spaces.

17-10-1011-B Nonresidential Buildings. Where the first building permit application for the project is submitted after October 31, 2020, new construction of a building other than a residential building, with 30 or more parking spaces provided shall include equipment so that at least 20 percent of the parking spaces are either EVSE-ready spaces or EVSE-installed spaces."

EXCEPTIONS FROM EVCS REQUIREMENT EXAMPLE

2022 California Green Buildings Code (6)

"One a case-by-case basis, where the local enforcing agency has determined that EV charging and infrastructure are not feasible based upon one or more of the following conditions:

1. Where there is no local power supply or the local utility is unable to supply adequate power.
2. Where there is evidence suitable to the local enforcement agency substantiating that additional local utility infrastructure design requirements, directly related to the implementation of Section ... , may adversely impact the construction cost of the project."

City of Chicago, IL, Building Code (4)

"...Provided, however, nothing in this section shall be construed to require creation of EVSE-ready spaces or EVSE-installed spaces if the only feasible way to create such spaces would necessitate excavation of an existing surface lot or other parking facility to install the necessary conduit and wiring."

MINIMUM NUMBER OF EVCS

City of Middletown, CT, Zoning Code (7)

"Any new development that requires 25 or more parking spaces, as calculated by Section 40.04 of these regulations, shall have a minimum of 1 charging space or 3% of the total number of spaces allocated to Electric Vehicles (EVs) (whichever is greater) and must have a Level 2 or 3 charging station/connection per EV parking space."

Places that require a percentage of EV-ready and EV-installed spaces:

- City of Madison, WI
- City of Columbus, OH
- City of Lakewood, CO
- City of Chicago, IL
- City of Honolulu, HI
- City of St. Louis, MO

Places that differentiate the number of required EVCS spaces based on the use type (multi-family, some commercial, exempted uses, etc.):

- City of Madison, WI
- City of Columbus, OH
- City of Lakewood, CO
- City of St. Louis, MO

MINIMUM NUMBER OF ADA EVCS

City of Chicago, IL, Zoning Code (4)

Minimum number of ADA-accessible charging stations shall be provided based on the number of EV-ready and/or EV-installed required spaces:

- 1-50 -> 1 ADA space;
- 51-75 -> 2 ADA spaces;
- 76-100 -> 3 ADA spaces;
- 100+ -> 3 + 1 additional space per 60 EV-installed required spaces.

City of Madison, WI, Zoning Ordinance (3)

Minimum number of ADA-accessible charging stations shall be provided based on the number of EV-INSTALLED required spaces:

- 0-2 -> 0 ADA spaces;
- 3-50 -> 1 ADA space;
- 51-100 -> 2 ADA spaces;
- 100+ -> 3 + 1 additional space per 50 EV-installed required spaces.

ADA EVCS DESIGN REQUIREMENTS

City of Columbus, OH, Zoning Ordinance (2)

"Accessibility.

1.A minimum of one (1) EVSE Installed space must be located adjacent to an Americans with Disabilities Act (ADA) Accessibility designated space to provide access to the charging station.

2.The EVSE Installed accessible spaces must comply with ADA Guidelines referenced in Section 3312.31 Parking space for ADA compliance.

3.The EVSE Installed accessible spaces shall have all relevant parts located within accessible reach, and in a barrier-free access aisle for the user to move freely between the EVSE and the EV."

Image sources: 10, 11

EVCS OTHER DESIGN STANDARDS EXAMPLES

City of Portland, OR, Zoning Ordinance (12)

"Electric vehicle chargers in parking areas. Electric vehicle chargers, accessory equipment, and protective curbs, tire stops, bollards or other barriers needed to protect the charger or accessory equipment, may be located within parking areas, or adjacent to parking areas, subject to the following:

1. The chargers, accessory equipment, and protective barriers cannot be located more than 2 feet into required perimeter landscaping areas; and

2. The accessory equipment may be located anywhere on site but must be screened from the street and adjacent residential zones by walls, fences, or vegetation. Screening must comply with at least the L2 or F2 standards of Chapter 33.248, Landscaping and Screening, and be tall enough to screen the equipment."

City of Bloomington, IN, Zoning Ordinance (8)

"The electric vehicle parking space shall be:

- Located on the same lot as the principal use;
- Signed in a clear and conspicuous manner, such as special pavement marking or signage, indicating exclusive availability to electric vehicles; and
- Outfitted with a standard electric vehicle charging station."

City of Columbus, OH, Zoning Ordinance (2)

"Design.

1.Charging equipment must be mounted on the wall or on a structure adjacent to the EV parking space.

2.No charging devices may be placed within the dimensions of a space.

3.When cords and connectors are not in use, retraction devices or locations for storage shall be located sufficiently above the pedestrian surface and the parking lot as to reduce conflicts with pedestrians and vehicle maneuvering.

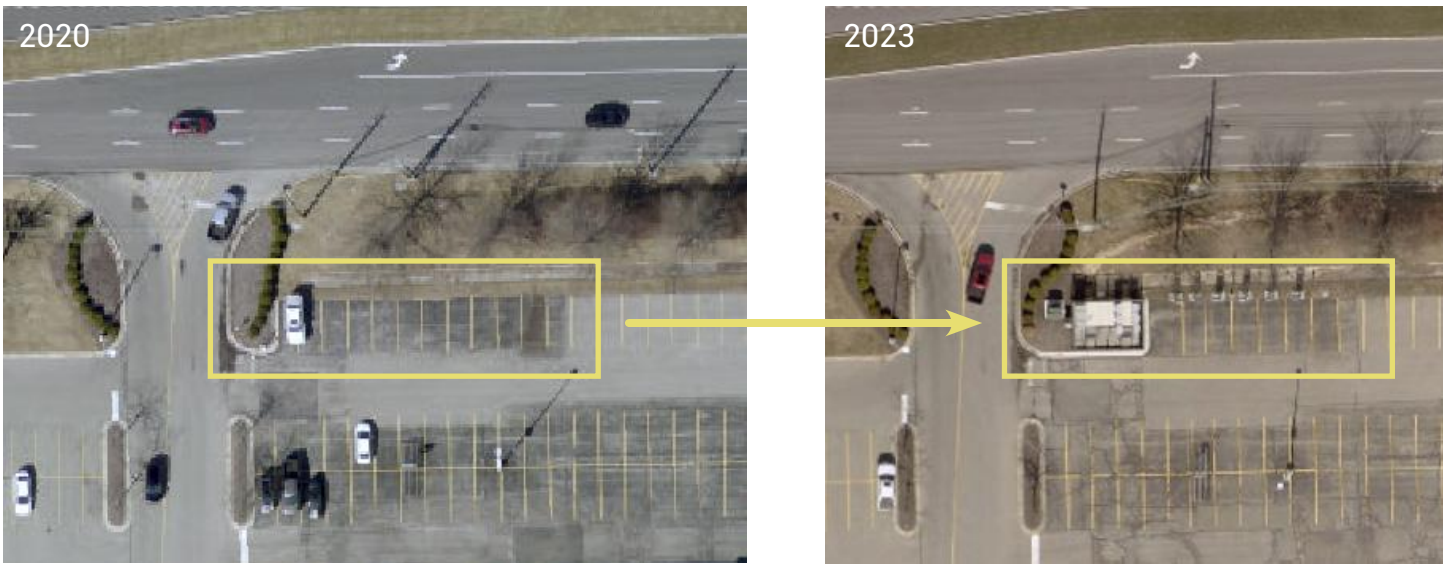
4.Cords, cables, and connector equipment shall not extend across the path of travel in any sidewalk.

5.Equipment mounted on structures such as pedestals, lighting posts, bollards, or other devices shall be located in a manner that does not impede pedestrian, bicycle, or transit travel.

6.Upon a showing of good cause, alternative designs may be approved by the Director or their designee.

7.Per rules adopted by the Director, screening shall be required for charging stations and/or related mechanical equipment such as transformers in excess of 60 inches in height and 30 square feet consistent with screening requirements in Section 3321.11 Screening of mechanical systems."

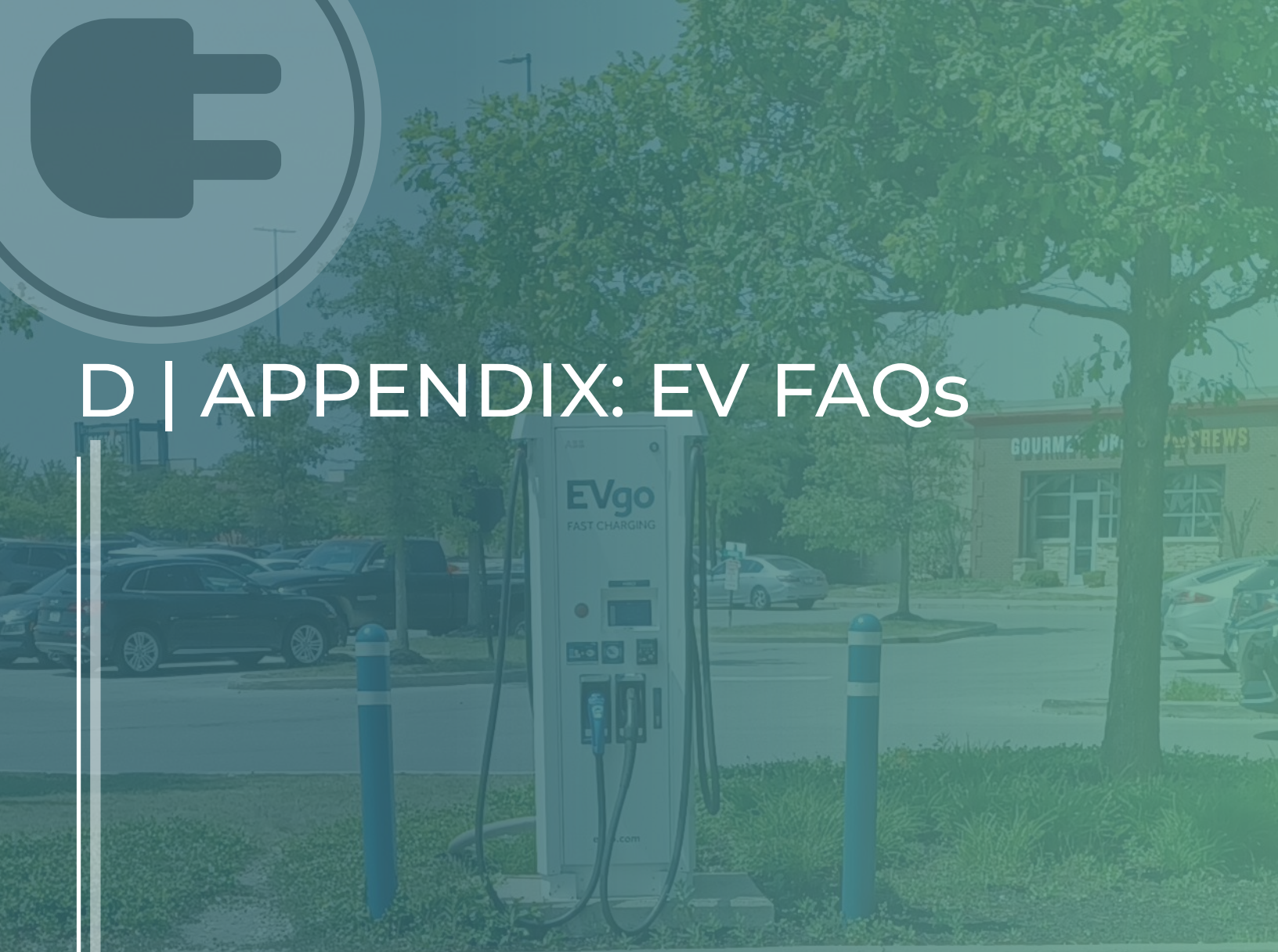
Figure C.2 Meijer, Indianapolis (8375 E 96th Street) Conversion of parking spaces to EV DCFC charging spaces (Map source: 13)



REFERENCES

1. American Planning Association. October 2022. ***Preparing for the Electric Vehicle Surge***. Zoning Practice, Vol. 39, No. 10
2. City of Columbus, OH, Zoning Code. Link: https://library.municode.com/oh/columbus/codes/code_of_ordinances?nodeId=TIT33ZOCO.
3. City of Madison, WI, Zoning Ordinance. Link: https://library.municode.com/wi/madison/codes/code_of_ordinances?nodeId=COORMAWIVOIICH20--31_CH28ZOCOOR
4. City of Chicago, IL, Zoning Ordinance. Link: https://codelibrary.amlegal.com/codes/chicago/latest/chicagozoning_il/0-0-0-48006.
5. ICC. 2021 Building Code Amendments for Electric Vehicle Charging. Link: https://codes.iccsafe.org/content/ICCEVBCSGGR2021P1/building-code-amendments-for-electric-vehicle-charging.
6. ICC. 2022 California Green Building Standards Code, Title 24, Part 11. Link: https://codes.iccsafe.org/content/CAGBC2022P1.
7. Great Plains Institute. June 2019. ***Summary of Best Practices on Electric Vehicle Ordinances***. Link: https://www.betterenergy.org/wp-content/uploads/2019/06/GPI_EV_Ordinance_Summary_web.pdf.
8. City of Bloomington, IN, Zoning Ordinance. Link: https://bloomington.in.gov/planning/udo.
9. City of Lakewood, CO, Zoning Ordinance. Link: https://www.lakewood.org/Government/Departments/Planning/Lakewood-Zoning-Ordinance.
10. EV spot image link: https://grabcad.com/groups/electric-vehicles.
11. ADA spot image link: https://en.wikipedia.org/wiki/International_Symbol_of_Access.
12. City of Portland, OR, Zoning Ordinance. Link: https://efiles.portlandoregon.gov/record/16473799.
13. City of Indianapolis. Zoning Map. Link: https://maps.indy.gov/Zoning/

D | APPENDIX: EV FAQs



WHAT IS AN ELECTRIC VEHICLE?

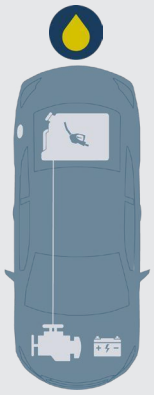
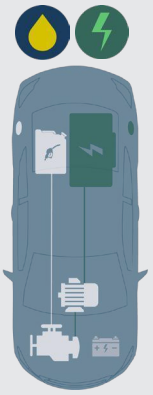
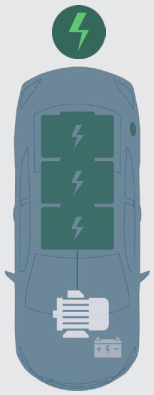
An Electric Vehicle (EV) is an automobile or other motorized vehicle that is powered by a rechargeable battery. There are two types of EVs: an all-electric (battery) EV (BEV) and a plug-in hybrid (PHEV). BEVs use only the battery to power the vehicle. PHEVs have a battery and an internal-combustion engine that can power the vehicle.

BEVs average battery range is around 260 miles (with the highest being at about 400 miles as of 2023 (1). Given that the average resident in the United States travels around 30 miles a day (2), a BEV lasts about a week on a single charge. A PHEVs battery has capacity to power the vehicle for up to 60 miles during a single trip before switching to gasoline power after the battery is depleted. Most models can also recharge the battery from the internal combustion engine while driving.

HOW IS AN ELECTRIC VEHICLE DIFFERENT FROM A HYBRID?

A Hybrid vehicle, unlike a Plug-in Hybrid vehicle, cannot be charged. A Hybrid vehicle has a battery that helps the car operate more efficiently than a non-hybrid vehicle, but it still uses gasoline as a fuel. A Hybrid car benefits from the technologies that EVs use to capture some of the energy and put it back into the battery.

See the table below for the main differences between a conventional gasoline car, a hybrid, a plug-in hybrid, and a battery electric vehicle.

	ICE INTERNAL COMBUSTION ENGINE	HEV HYBRID VEHICLE	PHEV PLUG-IN ELECTRIC VEHICLE	BEV BATTERY ELECTRIC VEHICLE
Source of Energy				
Consumption				
Tailpipe Emissions				**no emissions** 

WHAT ARE THE BENEFITS OF ELECTRIC VEHICLES?

$1/gallon
avg. cost to charge an EV

Cheaper Drive

EV drivers pay the equivalent of $1/gallon to drive the same distance as a gallon of gas in a conventional car (3).

Reliable Electricity Price

Since the price of electricity remains a lot more stable and predictable than the price of gasoline, EV drivers are not at the mercy of rapid oil price changes.

Less Noise

With the noises of a car engine removed, the EVs are mostly silent at any speed.

Braking Gives Energy Back

When pushing the brakes in the all-electric car, the energy goes back into the battery, which extends the battery range. This technology also reduces the amount of wear and tear on the brake pads and rotors.

Better for Air Quality and Smell

BEVs produce zero tailpipe emissions and PHEVs produce zero tailpipe emissions when they run on battery. This can significantly reduce local air pollution and the unpleasant smell from car exhaust and oil.

Better for the Environment

While gasoline can only be produced from oil, electricity can be produced using cleaner energy sources, reducing the amount of emissions that would come from charging the vehicle.

Better Handling in Poor Weather Conditions

EVs generally have a lower center of gravity from the battery being placed under the floor, which helps the vehicle handle poor weather conditions and be less likely to roll over.

Modern Technology

All EVs come with a digital dashboard showing the current battery range, battery use efficiency in real time, and other car statistics. Not only can an EV be pre-heated or started remotely through an app, but drivers can start and stop the charge flowing to the battery too.

Battery Range

Most cars can travel between 300-500 miles on a full tank of gas before needing to refuel. (4) This varies based on the volume of the gas tank, fuel efficiently (miles per gallon), and driving conditions such as temperature and city vs. highway driving.

EV technology has evolved quickly and is catching up quickly. Most EVs today can travel 200-300 miles before needing a charge under similar conditions. (4)

WHAT IS THE COST OF OWNING AN EV?

$

With a larger number of EV models, types, and prices available, EVs are becoming more attractive to the buyers. Also, EVs have certain cost savings that the conventional cars don't have. Let's break down the costs related to purchasing and owning an EV.

≈/+

Car Price

The cost of new mid-size and luxury EVs has reached parity with comparable new models of gas-powered cars. Also, with over 400 sedans, SUVs, and truck EV models on the market, today's new EV will be a much cheaper used EV tomorrow.

\-

Tax Credits

Many EVs and hybrids made after 2010 are eligible for up to $7,500 in federal tax credits (5). Starting in the 2023 tax cycle, people can also apply for a federal tax credit for installing a home EV charger (30 % and up to $1,000). This credit will be in place until 2032 and then the % will decrease to 26% in 2033 and 22% in 2034 (6).

\-

"Fuel" Price

The cost of charging an EV in Indiana is equivalent to about $1/gallon of gasoline for the same distance traveled (3). The price of charging an EV at a public charging station, especially at the fast (DCFC) charging station may be higher mainly due to the convenience of faster charging.

The last time when gasoline cost in the US was below $1/gallon was before 1980s and for a brief period of 1986-1988 during the oil bust period. Even with the recent developments in oil extraction technologies in the US, the cheapest gasoline price the market reached was $2.14/gallon in 2016 (Appendix A).

\-

Maintenance Costs

EVs have a lot less moving parts to maintain, so the long-term cost of maintenance may be lower for EVs than for gas-powered vehicles (7). Check out the comparison list of the routine items to maintain in an all-electric vs gas-powered vehicle on the next page.

\+

Insurance

On average, the annual cost of car insurance for EV is $100 or 5 % more than that of a gas-powered car (8). The higher cost is mostly due to a slightly higher price for EV parts and the need for technicians who specialize in EV repairs. With more EVs on the market and more people trained, the cost of the insurance will likely go down.

≈/-

State EV Fee

Indiana requires an annual $214 fee for EVs and $72 for hybrids as a replacement for the gasoline tax (9). When people fuel their cars with gasoline in Indiana, they pay a tax of $0.34 cents/gallon. This money is used for road projects in the state. Since EVs do not use gasoline and hybrids use only some, the state created this fee to ensure that all car drivers contribute to the road fund.

WHAT IS THE DIFFERENCE IN MAINTAINING AN EV VS GAS-POWERED CAR?

Thanks to fewer fluids and moving parts, an all-electric EV is a lot easier to maintain than a gas-powered vehicle. Here is a quick breakdown of BEV vs. gas vehicle routine maintenance.

REQUIRED MAINTENANCE	EV	GAS
Oil Change		√
Engine Oil		√
Spark Plugs		√
Engine Air Filter		√
Exhaust		√
Fuel Filter		√
Hoses		√
Check/Change Belts		√
Brakes & Rotors		√
Cabin Air Filter	√	√
Brake Fluid	√	√
Coolant	√	√
Steering Alignment	√	√
Rotate & Balance Tires	√	√
Power Steering Fluid	√	√
Windshield Washer Fluid	√	√

BATTERY MAINTENANCE TIPS

Like gas-powered engines, the battery will eventually wear out. While there is no comprehensive data on the actual battery lifetime of EVs, most EVs sold today have an 8-year (or 100,000 miles) battery warranty. To slow the process of wearing the battery out, use these tips.

OPTIMAL BATTERY CHARGE

Try to keep the battery charged around 40–80%. Lithium ion batteries last longest when they aren't always fully charged to 100% (10).

OPTIMAL TEMPERATURE

Limit the battery's exposure to extreme temperatures. The further the temperature gets away from the optimal 60–80˚, the more battery performance drops. (11)

PRE-HEAT/PRE-COOL AT HOME

Use home charging for pre-heating or pre-cooling. If you pre-heat or pre-cool the vehicle while it's plugged into your home charger, then you won't be using the battery for pre-heating/cooling (11).

SLOW CHARGING IS BETTER

Try to use slower charging when possible. Fast charging brings convenience, but slower charging is easier on the battery and prolongs its life (10).

WHAT WILL CHARGING AN EV AT HOME DO TO MY ELECTRICITY?

EVs can be charged at home by plugging them into a regular 110v or 220v outlet. The charging cable is provided with the vehicle. This is called Level 1 charging and it is similar to plugging in a typical house appliance. This charge will be slow, which is good for the battery and for the house electricity, but it may be less convenient.

If you'd like faster charging, you can buy a Level 2 at-home charger starting from $300 and for an average price of $600. A level 2 at-home charger typically uses the power similar to an electric water heater. EVs with larger batteries like Ford F-150 Lightning may use similar amounts of electricity as an HVAC system, but only during the charging time.

The power draw for an EV is limited by either the electric vehicle supply equipment (EVSE) or the vehicle's on-board charger which limits the rate of electricity the vehicle can accept. Many first-generation plug-in vehicles have on-board chargers limited to 3,600 watts, similar to the power draw for a typical home air conditioning system, while newer electric vehicles have increased on-board charging rates (12).

It is important to consult with an electrician to determine whether your house electric panel and wiring is capable of adding another appliance like a Level 2 charger.

CAN THE GRID HANDLE EVS?

In short, yes it can, but future adjustments will be needed.

Total Electricity Demand

Addition of Level 1 and 2 charging is like adding another household appliance. Images below show how EV charging at Level 2 compares to other house appliances. It is estimated that the future additional U.S. electricity supply would need to increase by 9-10 % if EV adoption rate increased to 50 % (13, 14).

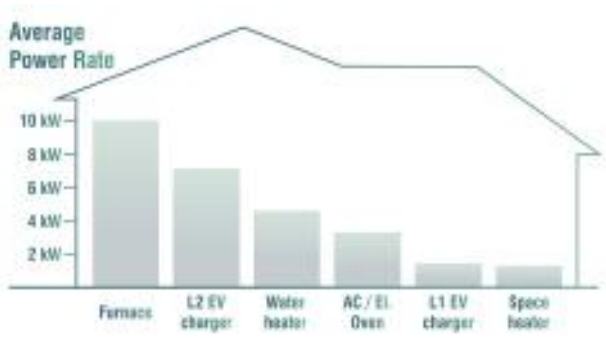
Peak and Off-Peak Demand

The biggest demand on the grid is at times when people come home from work or school in the evening and turn on their appliances all at once (electric stove, TV, PlayStation, etc.) (15). There is a sudden increase in demand for electricity. This time is called “peak” load. Charging during off-peak times like at night or at work can also help reduce the demand.

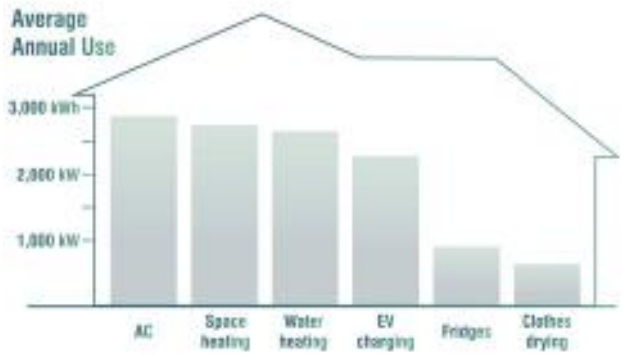
Future Technology

Fast chargers can draw a lot of energy at a given point. The faster they are, the more power they need. Due to this, fast charger installers should check with the local utility to learn where the grid infrastructure can provide the needed output.

Also, there are technologies and strategies being developed right now that can help integrate fast charging into the grid properly and help utilities manage the load. The transition to EVs is likely to be slow enough that the utilities can find the right tools and policies to manage the grid.



Data source: 12



Data source: 16

HOW DO I CHARGE AN ELECTRIC VEHICLE (EV)?

Charging an electric vehicle is as simple as pumping gas!

Each EV has an opening similar to a gas cap (See the photo to the right). The charging head gets plugged in, the same as a gasoline nozzle. Make sure to listen for the CLICK to know its fully attached.

Every EV comes with a power cord so drivers are never left stranded without a way to charge.

HOW DO I FIND A PLACE TO CHARGE?

4 Largest

Charging Networks in

INDIANA

TESLA

electrify america

EVgo

chargepoint

PlugShare

"[This] is a community based tool that guides users to public charging locations throughout the world. Available for iOS, Apple Watch, Android, and on the web" Plugshare.com

This Free-To-Use App displays EV charging stations across all charging networks on a Google-powered map.

Each charging network also has its own app to show the location of charging stations and to be able to pay for charging and use the station.

NOTE: *Charging stations can be non-networked*

WHAT ARE THE DIFFERENT KINDS OF CHARGING STATIONS?

LEVEL 1

Charging Port: Grounded Wall Outlet

24-36 Hours
Empty to Full Charge

HOME, WORK
Charging Locations

COST TO CHARGE
About the same as running an air conditioning unit for 6 hours *(Source: DOE)*

LEVEL 2

Charging Port: J1772

6-8 Hours
Empty to Full Charge

HOME, WORK, SHOPS
Charging Locations

COST TO CHARGE
- At home: same as Level 1
- Away from home: $0.20-0.60/kWh + $2-6 flat station fee

(Source: PlugShare)

DC FAST CHARGING

30-40 Minutes
0% to 80+% Charge

SHOPS, REST STOPS
Charging Locations

COST TO CHARGE
$0.40-0.60/kWh + $1-3 flat station fee
(Source: PlugShare)

Charging Ports

FREQUENTLY ASKED QUESTIONS

How much does it cost to buy an EV?

EV Sedans can cost anywhere from $35,000-$125,000 MSRP. (DOE-AFDC)

A Federal tax credits up to $7,500 is available for many EV models. (Source: FuelEconomy.gov)

Cost parity in mid-sized and luxury cars was reached. (Source: DOE-AFDC)

Used EVs in the area can be found starting at $8,000 and higher. (Source: Edmunds.com)

Are EVs safe?

Yes - the battery pack is in the back of the car which makes EVs much less likely to roll over than conventional vehicles. (DOE)

The battery and electrical systems are much less flammable than gasoline and the combustion engines in a conventional car.

Only 0.025% of car fires every year are from EVs. (NTSB)

Why is the City getting involved with EVs?

EV adoption is slow when there are few places to charge them.

The city can access grant money to pay for installing charging stations even if private sector business owners are the ones who will be operating and maintaining the station.

This way people who wish to try out an EV or a plug-in hybrid can have somewhere to charge locally instead of having to drive to Indianapolis or elsewhere to fuel their vehicle.

Will my electric bill increase if I charge my EV at home?

There is little impact on your electric bill, because charging an EV at home is the equivalent of running a window AC unit for 6 hours (Source: US DOE).

Who pays for installing charging stations?

Property owners generally pay for the installation. This can be a private business owner, a landlord, or a government agency. Governments and private-sector landowners can also form partnerships to access grants and loans to help pay for the installation.

Where can I learn more about EVs?

Scan the QR code below!

REFERENCES

1. U.S. Department of Energy and U.S. Environmental Protection Agency. ***EV Battery Range data***. Link: https://fueleconomy.gov/
2. U.S. Department of Transportation. Bureau of Transportation Statistics. May 31, 2017. ***National Household Travel Survey Daily Travel Quick Facts***. Link: https://www.bts.gov/statistical-products/surveys/national-household-travel-survey-daily-travel-quick-facts
3. AES Indiana. ***Plug into big savings.*** Link: https://aesindiana.trymotor.com/estimator/cost.
4. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. Fuel Economy website. Link: https://fueleconomy.gov/.
5. IRS. ***Credits for New Electric Vehicles Purchased in 2022 or Before***. Link: https://www.irs.gov/credits-deductions/credits-for-new-electric-vehicles-purchased-in-2022-or-before.
6. IRS. ***Residential Clean Energy Credit.*** Link: https://www.irs.gov/credits-deductions/residential-clean-energy-credit.
7. AAA. ***True Cost of Electric Vehicles.*** Link: https://www.aaa.com/autorepair/articles/true-cost-of-ev.
8. Forbes. January 4, 2023. ***Electric Car Insurance: Why it costs more.*** Link: https://www.forbes.com/advisor/car-insurance/electric-vehicle/.
9. Indiana Public Radio. May 30, 2023. ***Gas tax, electric and hybrid fee increases coming soon***. Link: https://indianapublicradio.org/news/2023/05/gas-tax-electric-and-hybrid-fee-increases-coming-soon/
10. Battery University. ***BU-808: How to Prolong Lithium-based Batteries.*** Link: https://batteryuniversity.com/article/bu-808-how-to-prolong-lithium-based-batteries
11. Geotab. February 6, 2023. ***To what degree does temperature impact EV range?*** Link: https://www.geotab.com/blog/ev-range/.
12. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. September 18, 2017. Electric vehicle charging at home typically draws less than half the power of an electric furnace. Link: https://www.energy.gov/eere/vehicles/articles/fact-995-september-18-2017-electric-vehicle-charging-home-typically-draws.
13. PWC. EV charging growth: How can power and utilities prepare? Link: https://www.pwc.com/us/en/industries/energy-utilities-resources/library/ev-charging-power-and-utilities.html.
14. McKinsey & Company. April 18, 2022. ***Building the electric vehicle charging infrastructure America needs.*** Link:https://www.mckinsey.com/industries/public-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs.
15. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. ***Electricity Production and Distribution. EVs and Electricity Infrastructure Capacity***. Link: https://afdc.energy.gov/fuels/electricity_production.html.
16. U.S. Department of Energy. Office of Energy Efficiency & Renewable Energy. September 11, 2023. ***Electric Vehicle Charging consumed less energy than water heating in a typical U.S. household in 2020***. Link: https://www.energy.gov/eere/vehicles/articles/fotw-1307-september-11-2023-electric-vehicle-charging-consumed-less-energy.