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EQUITY-FORWARD PASSENGER ELECTRIC VEHICLES INFRASTRUCTURE PLAN FOR THE CITY OF CINCINNATI

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EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

city of CINCINNATI

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I. BACKGROUND

A. Introduction

The City of Cincinnati ("**City**") is one of the leaders in aggressively pushing toward carbon neutrality goals.[1] The City, *inter alia*, plans to generate 100% of the power it needs from renewable resources, attain 100% EPA Ambient Air Quality Standards, and make all city facilities, fleets, and operations net carbon neutral by 2035.[2] The latest testament to the City's commitment has been the public announcement of the City becoming carbon neutral by 2050, with a near-term goal of reducing carbon emissions by half by 2030.[3]

Transportation accounts for approximately 30% of the City's emissions.[4] Therefore, it is critical to transition to cleaner vehicles for the City's climate goals to be met. Electric Vehicles ("**EVs**") are at the forefront of this transition, presenting themselves as a sustainable, long-term solution to mobility needs. EVs are nearly three times more efficient than gasoline-powered vehicles (or internal combustion engine vehicles ("**ICEs**")) and are quieter and smoother to operate.[5] ICEs are a driver of air pollution and respiratory conditions such as asthma that disproportionately impact low-income households.[6] On the other hand, EVs have zero tailpipe emissions[7] and require less maintenance than ICEs.[8] Recent research on non-luxury used EVs shows that, besides their environmental benefits, these cars are cheaper to own and operate than used ICEs.[9] Some estimates suggest that EVs could save up to USD 10,000 in their lifetime.[10] With gas prices rising to unprecedented levels, EVs are increasingly being viewed as a more appealing option compared to ICEs.[11]

To bolster the adoption of EVs, the White House has set a target to have half of all new passenger vehicles sold in 2030 across the country be zero-

[1] National Resources Defense Council, Sarah Stankorb, How Cincinnati Is Punching Above Its Weight in the Climate Fight, October 24, 2019, available at https://www.nrdc.org/stories/how-cincinnati-punching-above-its-weight-climate-fight.
[2] City of Cincinnati, 2018 Green Cincinnati Plan, adopted May 2018, available at https://www.cincinnati-oh.gov/sites/oes/assets/File/2018%20Green%20Cincinnati%20Plan(1).pdf (hereinafter "**2018 Green Cincinnati Plan**").
[3] City of Cincinnati, 2023 Green Cincinnati Plan Kickoff Meeting, available at https://archive.org/details/2023-green-cincinnati-plan-kickoff-meeting-5-31-22.
[4] City of Cincinnati, Greenhouse Gas Emissions Inventory and Analysis, 2015, available at https://www.cincinnati-oh.gov/oes/climate/2015-greenhouse-gas-emissions-inventory-pdf/.
[5] US Department of Energy, All-Electric Vehicles, available at https://www.fueleconomy.gov/feg/evtech.shtml.
[6] Bloomberg Cities Network, 4 ways U.S. cities are accelerating the switch to electric vehicles, June 2022, available at https://bloombergcities.jhu.edu/news/4-ways-us-cities-are-accelerating-switch-electric-vehicles.
[7] US Department of Energy, Electric Vehicle Benefits and Considerations, available at https://afdc.energy.gov/fuels/electricity_benefits.html.
[8] US Department of Energy, All-Electric Vehicles, available at https://www.fueleconomy.gov/feg/evtech.shtml.
[9] Energy Innovation, Used Electric Vehicles deliver consumer savings over Gas cars, June 2021, available at https://energyinnovation.org/publication/used-electric-vehicles-deliver-consumer-saving-over-gas-cars/.
[10] Chris Harto, Electric Vehicle Ownership Costs: Today's Electric Vehicles Offer Big Savings for Consumers, 2020, available at https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf.
[11] The New York Times, As Gas Prices Went Up, So Did the Hunt for Electric Vehicles, April 2022, available at https://www.nytimes.com/2022/04/08/climate/gas-prices-electric-vehicles.html.

emissions vehicles ("**ZEVs**") (including battery electric, plug-in hybrid electric, or fuel cell electric vehicles).[12] This is further supported by the Bipartisan Infrastructure Law ("**BIL**"), which proposes to make historic investments of USD 7.5 billion to establish an EV charging infrastructure with a goal of deploying 500,000 fast chargers across the country by 2030.[13] The majority of this funding will be allocated to the National Electric Vehicle Infrastructure Formula Program ("**NEVI Plan**") to strategically deploy EV charging infrastructure in designated Alternative Fuel Corridors, particularly along the Interstate Highway System.[14] The remaining funds will be evenly allocated to corridor charging (USD 1.25 billion) and community charging (USD 1.25 billion).[15] Moreover, the White House has mandated that 40 percent of the overall benefits of federal investments in climate and clean energy, including sustainable transportation, must flow to disadvantaged communities ("**Justice40 Initiative**").[16]

The public investment in the EV charging infrastructure will shape the mobility options of communities for decades to come, and the City will need to ensure that the transition to EVs benefits all communities. Presently, EV buyers are mostly male, high-income, highly educated, homeowners with multiple vehicles in their household and have access to charging at home.[17] Low-income and disadvantaged communities that are residents of multi-family housing units ("**MFHs**")/ multi-unit dwellings ("**MUDs**") have disproportionately low EV adoption rates.[18] The lack of at-home charging is the most significant barrier to adopting EVs in these communities.[19] Without the necessary public EV charging infrastructure, these communities are likely to lose out on the benefits of vehicle electrification.[20] Therefore, the City should put the needs of low-income and disadvantaged communities at the forefront and channel investments to provide reliable, affordable, convenient EV charging options to communities that need them the most.

This Report, building upon the 2021 Climate Equity Indicators Report [21] and the 2022 Request for Information on Sources of Electric Vehicle Charging at

[12] The White House, President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks (August 5, 2021), available at https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/.

[13] Infrastructure Investment and Jobs Act, 2021.

[14] Bipartisan Infrastructure Law, National Electric Vehicle Infrastructure Formula Program Guidance, February 10, 2022, available at https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/90d_nevi_formula_program_guidance.pdf (hereinafter "**NEVI Program Guidance, 2022**").

[15] NEVI Program Guidance, p. 4.

[16] The White House, Executive Order on Tackling the Climate Crisis at Home and Abroad, January 27, 2021, available at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

[17] Scott Hardman, et. al., A perspective on equity in the transition to electric vehicle, MIT Science Policy Review, August 2021, available at https://sciencepolicyreview.org/wp-content/uploads/securepdfs/2021/08/A_perspective_on_equity_in_the_transition_to_electric_vehicles.pdf (hereinafter "**MIT, Perspective on Equity, 2021**").

[18] Forth, Jeff Allen and Geoff Gibson, Centering Equity in Charging Investments to Accelerate Electrification, June 2022, available at https://forthmobility.org/storage/app/media/Reports/Equity%20in%20Charging%20Investments%201.pdf. (hereinafter "**Forth, Centering Equity, 2022**").

[19] Climate Change and Business Research Initiative, Driving Equity, May 2022, available at https://www.law.berkeley.edu/wp-content/uploads/2022/04/Driving-Equity-May-2022.pdf (hereinafter "**Driving Equity Report, 2022**"); Forth, Centering Equity, 2022.

[20] Peter Huether, Siting Electric Vehicle Supply Equipment (EVSE) with Equity in Mind, ACEEE White Paper, April 2021, available at https://www.aceee.org/sites/default/files/pdfs/siting_evse_with_equity_final_3-30-21.pdf (hereinafter "**ACEEE, Siting EVSE Equity, 2021**").

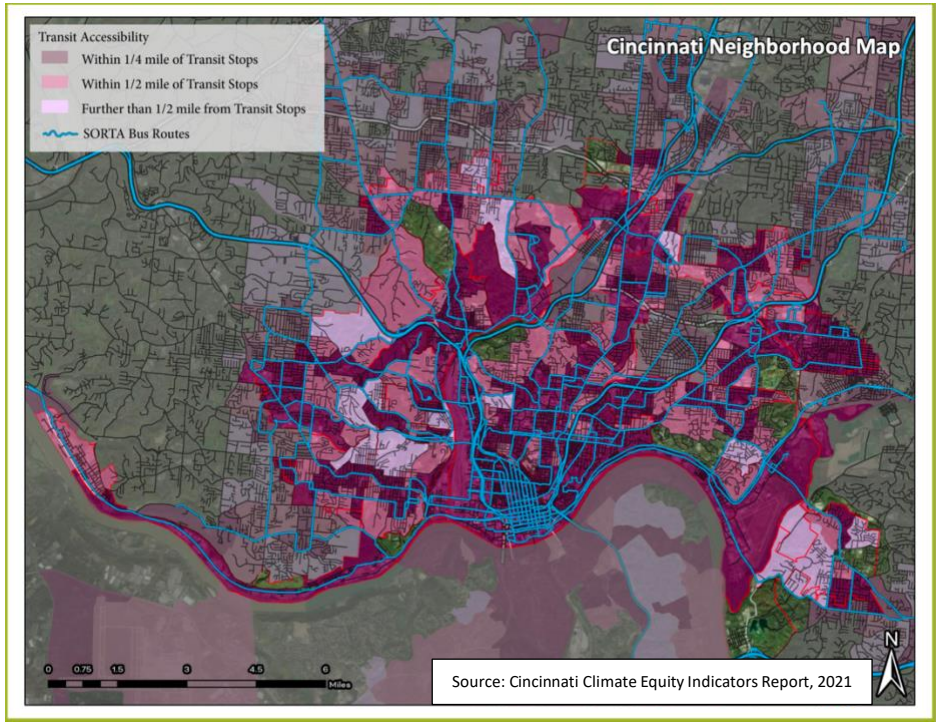
[21] City of Cincinnati, Cincinnati Climate Equity Indicators Report, 2021, available at https://www.cincinnati-oh.gov/sites/oes/assets/File/Climate%20Equity%20Indicators%20Report_2021.pdf (hereinafter "**Cincinnati Climate Equity Indicators Report, 2021**").

Scale,[22] seeks to explore opportunities to deploy EV charging infrastructure in the City with equity and climate justice as cornerstone principles.

In this report, "electric vehicles" and "EVs" refer to light-duty battery-electric vehicles and plug-in hybrids. Further, this Report focuses on private passenger vehicles – we did not consider other mobility options (car sharing, autonomous vehicles, walking, micro-mobility, transit, etc.), which are equally critical for an equitable and sustainable future.

B. Mobility needs of low-income communities in the City

Private automobiles are the dominant mode of transportation for City residents. Over 80% of commuters use personal passenger vehicles.[23] This statistic does not change even for neighborhoods that have been identified by the Department of Energy ("**DOE**") as disadvantaged communities ("**DACs**").[24] Correspondingly, only 0.2% of daily trips utilize public transit.[25] This is correlated to the disproportionate accessibility to transit services across neighborhoods.



The City is taking various steps to make mobility equitable, resilient, and sustainable. For instance, the launch of the Red Bike program, the Cincinnati Bell Connector, increasing funding for public transit, improving bike and pedestrian safety, etc. The City plans to increase the passenger miles traveled via public transit by 25% by 2035 and double the number of bicycle lanes.[26]

However, in addition to the abovementioned programs, the City needs to ensure that certain sections of the community are not prevented from adopting cleaner vehicle technologies such as EVs, owing to the lack of necessary charging infrastructure. It is understood that, given the nascent stage of the EV market and the high upfront cost of owning an EV, the adoption of these vehicles is presently difficult in low-income communities. However, as the second-hand market develops and new EV prices fall, EV adoption will likely pick up in low- and middle-income communities, provided

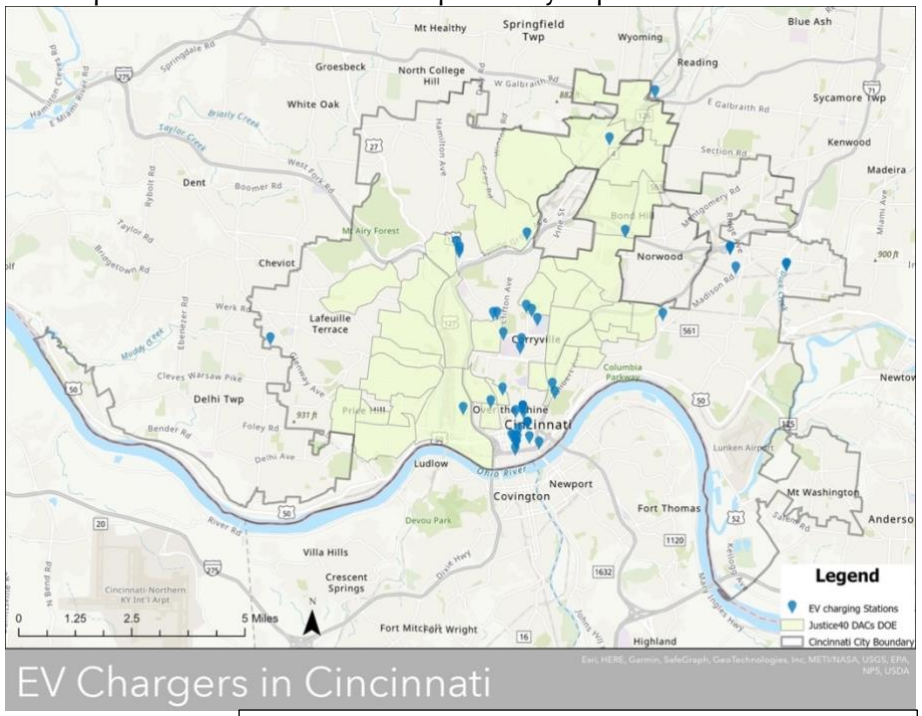
[22] City of Cincinnati, Request for Information, Electric Vehicle Charging at Scale, 2022, available at https://www.cincinnati-oh.gov/noncms/cmgr/business-opportunities/.
[23] Data provided by Replica: Replica Places Model, Spring 2021, Great Lakes Megaregion.
[24] Data provided by Replica: Replica Places Model, Spring 2021, Great Lakes Megaregion; Department of Energy, Energy Justice Mapping Tool - Disadvantaged Communities Reporter, available at https://energyjustice.egs.anl.gov/.
[25] Data provided by Replica: Replica Places Model, Spring 2021, Great Lakes Megaregion.
[26] 2018 Green Cincinnati Plan, p. 202-231.

necessary charging infrastructure is available.[27] Given the benefits of owning an EV, it is incumbent upon the City to ensure the necessary public EV charging infrastructure is in place, particularly for low-income residents of MFHs that do not have a garage or a driveway to charge their EVs at home, renters and those using on-street parking.

It is pertinent to mention here that the policies and programs to encourage the adoption of EVs must be accompanied by improvements to transit and other mobility solutions, as private cars will likely remain beyond the reach of many residents.

a. Defining equitable deployment for EV charging infrastructure

It is estimated that as many as 1.2 million public EV chargers will be required to support the federal target of ZEVs representing half of all vehicles sold by 2030.[28] In a future where every car is electric, the most optimistic prediction is that 25% of EV owners would lack access to home charging.[29] The public investment to meet these needs should address the US's long history of exclusionary transportation policy.[30] Public investment in EV charging infrastructure in the urban landscape should facilitate access to those facing the most significant barriers to charging. For this purpose, equity refers to treating like people alike, and equitable access to EV charging means access to the necessary EV infrastructure to support the use of an EV by all.[31] Therefore, the focus of City planning should be on residents who are currently excluded from easy access to charging. Such exclusion is presently driven by the inability of some individuals to charge at home, the high upfront cost of owning an EV, and the lack of investments by private companies in deploying EV chargers in low-income communities (usually characterized as 'charging deserts').[32] In short, the current EV charging infrastructure



EV Chargers in Cincinnati

Source: DOE Alternate Fuel Data Center, https://afdc.energy.gov/; DOE DACs Reporter Tool, https://energyjustice.egs.anl.gov/.

[27] ACEEE, Siting EVSE Equity, 2021.
[28] McKinsey, EV Charging Infrastructure, 2022.
[29] Yanbo Ge, There's No Place Like Home: Residential Parking, Electrical Access, and Implications for the Future of Electric Vehicle Charging Infrastructure, National Renewable Energy Laboratory, 2021, available at https://www.nrel.gov/docs/fy22osti/81065.pdf.
[30] Forth, Centering Equity, 2022; ACEEE, Siting EVSE Equity, 2021.
[31] Forth, Centering Equity, 2022.
[32] Forth, Centering Equity, 2022.

is not equitably dispersed,[33] and active policy interventions are required to ensure an equitable EV adoption.

For deployment of equitable EV infrastructure, the following parameters noted by the US Department of Transportation are important to consider:

- Financial accessibility of EV ownership and access to the benefits of EV charging infrastructure;
- Geographic coverage of EV charging infrastructure, e.g., EV charging deserts with gaps in coverage;
- Variations in at-home charging capabilities, e.g., for renters, residents in multi-unit dwellings, or residents without dedicated parking;
- Accessibility of EV charging equipment for those with disabilities;
- The emergence of State and utility commission-level requirements that utilities plan EV infrastructure in underserved areas, low-income neighborhoods, and communities of color;
- Eligibility for and access to investment opportunities for EV infrastructure; and
- Access to EV-related training and employment opportunities through electric vehicle supply equipment ("**EVSE**") installation and maintenance.[34]

In addition, during the planning process, meaningful community engagement is critical. This includes placing decision-making power in the hands of the local community with respect to the policy measures proposed to facilitate access to transportation facilities. These considerations are elaborated more in "*Section V. Public Engagement Process*" of this report.

In this report, low-income households include underrepresented communities, communities of color (which include Black or African American, Native Americans, Hispanic or Latino, Native Hawai'ians, and Other Pacific Islanders), and other disadvantaged communities that have historically been disadvantaged by the transportation system or are disproportionately burdened by harmful by-products of transportation.

C. Issues with the EV transition in low-income communities

This subsection highlights some of the main technical, social, and economic barriers to the EV transition in low-income communities.

a. <u>The high upfront cost of buying an EV</u>

The average upfront cost of owning an EV is USD 10,000 more than the industry average.[35] Governmental and utility incentives can help mitigate some

[33] MIT, Perspective on Equity, 2021.
[34] US Department of Transportation, Equity Considerations in EV Infrastructure Planning, available at https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-planning/equity-considerations.
[35] National Resources Defense Council, Electric vs. Gas Cars: Is It Cheaper to Drive an EV?, May 25, 2022, available at https://www.nrdc.org/stories/electric-vs-gas-it-cheaper-drive-ev.

of these costs. Individuals can take advantage of up to USD 7,500 in federal tax credits under the Plug-In Electric Drive Vehicle Credit program when purchasing new qualified EVs.[36] The recently passed Inflation Reduction Act also offers a credit on used EVs of up to USD 4,000 or the amount equal to 30 percent of the sale price of such vehicle, whichever is lesser.[37] Some states, like California, New York, Colorado, etc., have further incentives that promote the adoption of EVs as part of their carbon emission reduction strategies.[38] Some of these programs also target the adoption of new EVs or used EVs in low-income communities.[39]

However, Ohio has yet to follow suit. No additional benefits or tax incentives are provided for buying EVs at the state level, except for exemption from emission testing after a one-time verification inspection for passenger class EVs.[40] Studies show that high-income buyers will purchase EVs even in the absence of any incentives.[41] On the other hand, low-income communities rely highly on these incentives to make their purchase decisions.[42] This reinforces the importance of governmental financial support in EV adoption across all communities.

b. The inability of low-income communities to charge at homes

Presently, over 80% of EV charging occurs at home – primarily in single-family houses with dedicated parking spots.[43] Nearly half of US consumers indicate that charging is one of their top concerns when buying EVs.[44] In other research, 70% of the respondents who did not own an EV said the areas near their homes lacked chargers.[45] This is mainly a concern for those who might have to rely exclusively on public chargers to charge their EVs. Low-income communities are likely to fall into this bucket. These communities often live in MFHs without a driveway or garage.[46] Similarly, rental housing tenants

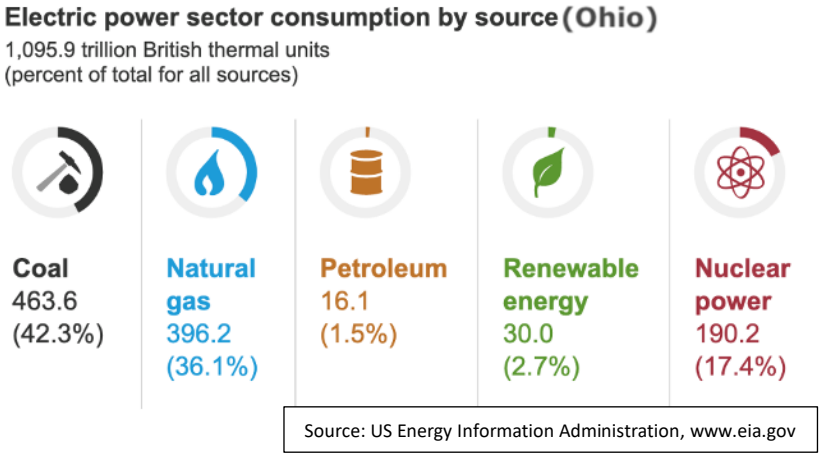
[36] Section 30D, Internal Revenue Code, 1986.
[37] Section 25E, Inflation Reduction Act, 2022.
[38] Plug In America, State Incentives Tool, available at https://pluginamerica.org/why-go-plug-in/state-federal-incentives/.
[39] ACEEE, Siting EVSE Equity, 2021.
[40] US Department of Energy, Ohio Laws and Incentives, available at https://afdc.energy.gov/laws/all?state=OH#State%20Incentives.
[41] S. Hardman, et. al., Comparing high-end and low-end early adopters of battery electric vehicles. *Transportation Research Part A: Policy and Practice* 88, 40–57, 2016.
[42] A. Jenn, et. al., An in-depth examination of electric vehicle incentives: consumer heterogeneity and changing response over time, Transportation Research Part A: Policy and Practice 132, 97–109 (2020).
[43] National Renewable Energy Laboratory, Incorporating Residential Smart Electric Vehicle Charging in Home Energy Management Systems, April 2021, available at https://www.nrel.gov/docs/fy21osti/78540.pdf.
[44] McKinsey Center for Future Mobility, The road ahead for e-mobility, available at https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/the%20road%20ahead%20for%20e%20mobility/the-road-ahead-for-e-mobility-vf.pdf.
[45] McKinsey & Co., Philipp Kampshoff, *et al*., Building the electric-vehicle charging infrastructure America needs, April 18, 2022, available at https://www.mckinsey.com/industries/public-and-social-sector/our-insights/building-the-electric-vehicle-charging-infrastructure-america-needs (hereinafter "**McKinsey 2022, EV Charging Infrastructure**").
[46] Forth, Centering Equity, 2022.

also face a significant barrier to accessing EV chargers.

EV drivers from these communities will have to rely on multiple forms of public charging infrastructure to meet their charging needs. Private companies usually deploy chargers in areas with high EV density and hence, are less likely to invest in public charging infrastructure in communities with low EV uptake.[47] Consequently, the role of public and nonprofit investment in deploying chargers in such communities becomes critical for an equitable EV transition.

c. <u>High cost of charging using public chargers</u>

The high cost of charging that consumers end up paying at public chargers is another major concern. EV owners with at-home charging can charge their vehicles at night when the electricity rates per kilowatt-Hour (**"kWh"**) are low. However, EV drivers who primarily rely on public charging typically charge their vehicles in the daytime, when the electricity rates per kWh are usually high. Public charging costs five to ten times more per kWh than charging an EV at home in some cases.[48] As a result, these exorbitant charging costs prevent low-income communities, with no at-home charging access, from purchasing EVs. Therefore, in addition to making EV charging available to these communities, the City should also take into consideration the cost of charging at these facilities, particularly for low-income communities that rely solely on these chargers for their charging needs.



d. <u>Grid constraints</u>

EVs are not truly clean unless the grid powering them is clean, i.e., powered by renewable energy sources. Ohio has a larger proportion of coal-fired power plants than the national average, which means that electric vehicles charged in Ohio have a higher CO_2 footprint than the national average.[49] The City's move toward a greater mix of renewable sources will potentially address this issue.[50] However, it is pertinent to note that even after accounting for the electricity emissions, research shows that an EV is typically responsible for lower levels of greenhouse gases than average new ICE vehicle.[51]

[47] ACEEE, Siting EVSE Equity, 2021.
[48] McKinsey, EV Charging Infrastructure, 2022.
[49] 2018 Green Cincinnati Plan, p. 212.
[50] 2018 Green Cincinnati Plan, p. 97.
[51] Union of Concerned Scientists, Driving Cleaner Electric Cars and Pickups Beat Gasoline on Lifetime Global Warming Emissions, July 2022, available at

More importantly, there may be locations in the City where the existing power grid may not be equipped to handle the energy load due to the addition of the fast-charging EV network during peak hours.[52] At the time of this report, the energy load capacity data across neighborhoods is not available to the City. Duke Energy will have to collaborate closely with the City to identify any such constraints before deploying the public EV charging network.

D. Considerations for deploying public charging network for EVs

As cities across the country plan to meet the expected demand for EV chargers, the following are some key considerations for EV chargers deployment.

a. Equitable distribution

Most for-profit EV charging companies model their deployment of EV charging infrastructure on current and projected EV density in an area, thereby usually excluding low-income and disadvantaged communities where EV adoption is low. As a result, public and non-profit investment is vital to ensure that disadvantaged communities are not left out.[53] As government entities plan for a massive investment in deploying EV charging infrastructure, it is necessary to consider "*how benefits and burdens vary for and are distributed across specific populations, including users of differing race and ethnicity, gender, physical and cognitive ability, age, education, income level, and language*".[54]

The various facets of equity can be classified into four categories:[55]

- Procedural Equity: inclusive, accessible, authentic engagement and representation in the process to develop or implement programs or policies.
- Distributional Equity: programs and policies result in fair distributions of benefits and burdens across all segments of a community, prioritizing those with the highest need.
- Structural Equity: decision-makers institutionalize accountability; decisions are made with a recognition of the historical, cultural, and institutional dynamics and structures that have routinely advantaged privileged groups in society and resulted in a chronic, cumulative disadvantage for subordinated groups.
- Transgenerational Equity: decisions consider generational impacts and do not result in unfair burdens on future generations.

https://www.ucsusa.org/sites/default/files/2022-07/driving-cleaner-report_0.pdf.

[52] McKinsey, EV Charging Infrastructure, 2022.

[53] Driving Equity Report, 2022.

[54] US Department of Transportation, Equity Considerations in EV Infrastructure Planning, available at https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-planning/equity-considerations.

[55] Urban Sustainability Directors Network, Equity in Sustainability: An Equity Scan of Local Government Sustainability Programs, 2014, available at https://www.usdn.org/uploads/cms/documents/usdn_equity_scan_sept_2014_final.pdf.

An important consideration for deploying the EV chargers is the location of MFHs. People living in MFHs, e.g., apartment complexes or condominiums, rarely have access to dedicated parking and, as a result, at-home charging.[56] Therefore, providing these communities, particularly those that are also low-income communities, with EV charging options in publicly accessible locations is a central consideration for equitable deployment.

b. Economical to use

The low-income communities without access to at-home charging do not enjoy the same benefits of owning an EV compared to those with at-home charging. EV owners who charge their vehicles at home can save up to 60% on fuel charges compared to ICE vehicles.[57] However, these savings decrease considerably if there is a significant reliance on public chargers for the charging needs.[58] And in some cases, it can also lead to higher fueling costs per mile compared to ICEs.[59] This is due to the difference between charging at home at night when the electricity rates per kWh are low and charging at public chargers during the daytime when the electricity rates per kWh are usually high. Therefore, any public investment in EV charging infrastructure targeting low-income and MFHs needs to make the necessary accommodations to ensure that charging at these service locations is economical, if not at par with at-home charging.

c. Appealing to use

The customer experience of public charging is often underwhelming. A McKinsey customer survey noted speed, cost, availability, and safety of charging locations as the main shortcomings of public charging.[60] Some concerns around the unreliability of mobile apps for locating the chargers, user-unfriendly payment options, and unhelpful customer services were also highlighted.[61] These concerns have also been echoed in Plug In America Survey Report 2022.[62] One major issue this report highlighted was public chargers being broken or non-functional.[63] Consequently, planning for a public EV charging

[56] Smart Columbus Case Study, Smart Columbus Kickstarts EV Charging Deployments at Multi-Unit Dwellings, 2018, available at https://d2rfd3nxvhnf29.cloudfront.net/legacy/uploadedfiles/playbook-assets/electric-vehicle-charging/mud-case-study-final.pdf.
[57] Consumer Reports, Electric Vehicle Ownership Costs, 2020, available at https://advocacy.consumerreports.org/wp-content/uploads/2020/10/EV-Ownership-Cost-Final-Report-1.pdf.
[58] Borlaug, Brennan, et al., Levelized cost of charging electric vehicles in the United States, Joule 4.7 (2020), 1470-1485, available at https://www.sciencedirect.com/science/article/pii/S2542435120302312#bib13.
[59] Hardman, Scott, et al., A perspective on equity in the transition to electric vehicles, MIT Science Policy Review 2 (2021): 46-54, available at https://sciencepolicyreview.org/2021/08/equity-transition-electric-vehicles/.
[60] McKinsey, EV Charging Infrastructure, 2022.
[61] McKinsey, EV Charging Infrastructure, 2022.
[62] Plug In America, The Expanding EV Market: Observations in a year of growth, February 2022, available at https://pluginamerica.org/wp-content/uploads/2022/03/2022-PIA-Survey-Report.pdf.
[63] Plug In America, The Expanding EV Market: Observations in a year of growth, February 2022, available at https://pluginamerica.org/wp-content/uploads/2022/03/2022-PIA-Survey-Report.pdf.

network should also consider the proposed services' reliability, safety, and user-friendliness.

d. Other Considerations

The EV charging stations need to meet the requirements of people with disabilities to ensure that charging stations are accessible to all EV drivers. It is also critical that public chargers use the standard plugs and connectors for an accessible and open public EV charging network.

II. MODELING AND ANALYSIS

This section identifies suitable City properties for the deployment of EV chargers in low-income and in the vicinity of MFH units. For this purpose, we first assess the learnings about different neighborhoods in Cincinnati using the *2021 Climate Equity Indicators Report*. This data is used in conjunction with data from the US Department of Energy, Energy Justice Mapping Tool - Disadvantaged Communities Reporter ("**DOE DACs Reporter**") to identify the disadvantaged communities in Cincinnati where investment in EV charging infrastructure should be prioritized. Finally, we identify City-owned properties in the vicinity of densely populated MFHs in DACs to identify potential sites for deploying EV chargers.

Note: The findings in this section are preliminary as the data about energy configurations from Duke Energy, suitable space available on properties, etc., in identified locations is not available at the time of this report. However, these findings provide the platform for the public engagement and local knowledge integration process to kick off based on the locations identified in different neighborhoods.

A. Identifying disadvantaged communities in the City of Cincinnati for prioritizing investments

For the purposes of identifying suitable sites for deploying EV charging infrastructure, the density of MFHs in census tracts with low-income and DACs were considered. Below is a brief overview of the tools used for this purpose.

a. Cincinnati Climate Equity Indicators report

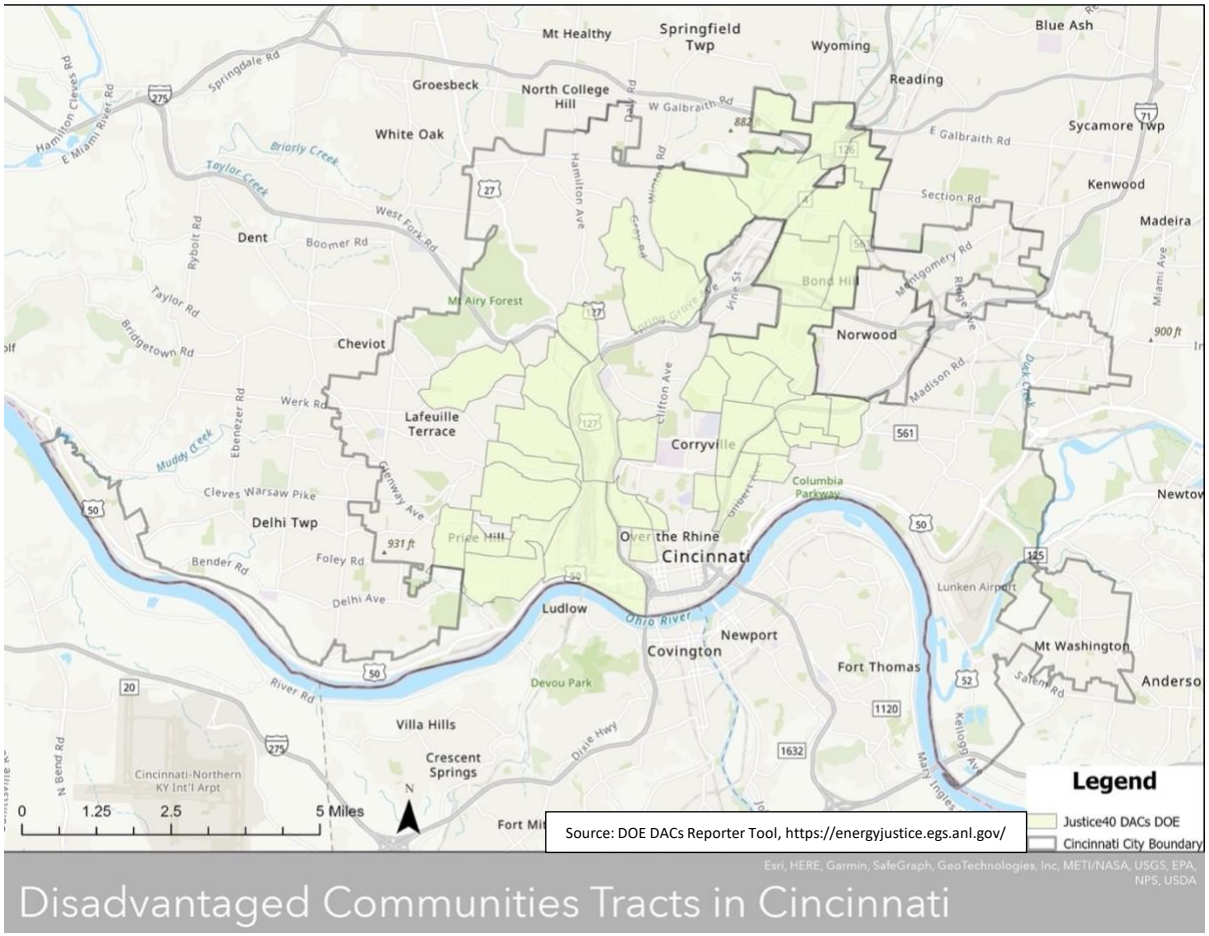
The Office of Environment & Sustainability, City of Cincinnati, together with the University of Cincinnati, Green Umbrella, Groundwork Ohio River Valley, and Adaptation International, released a report titled the *Cincinnati's Climate Equity Indicators Report, 2021*[64] to understand the ways the climate crisis will impact government operations, quality of life for residents of Cincinnati, and what actions are necessary to reduce these impacts.[65] The *Climate Equity Indicators Report* highlights the climate vulnerabilities of each neighborhood in Cincinnati by compiling a wide range of demographic, environmental, health outcome, economic, and planning indicators.[66] We considered the findings in the *Climate Equity Indicators Report* to identify the areas of interest.

b. EPA DACs Reporter tool and CEJST tool

The EPA DACs Reporter tool identifies census tracts that the U.S. Department of Energy has categorized as DACs pursuant to Executive Order 14008 -

[64] Cincinnati Climate Equity Indicators Report, 2021.
[65] Cincinnati Climate Equity Indicators Report, 2021.
[66] Cincinnati Climate Equity Indicators Report, 2021.

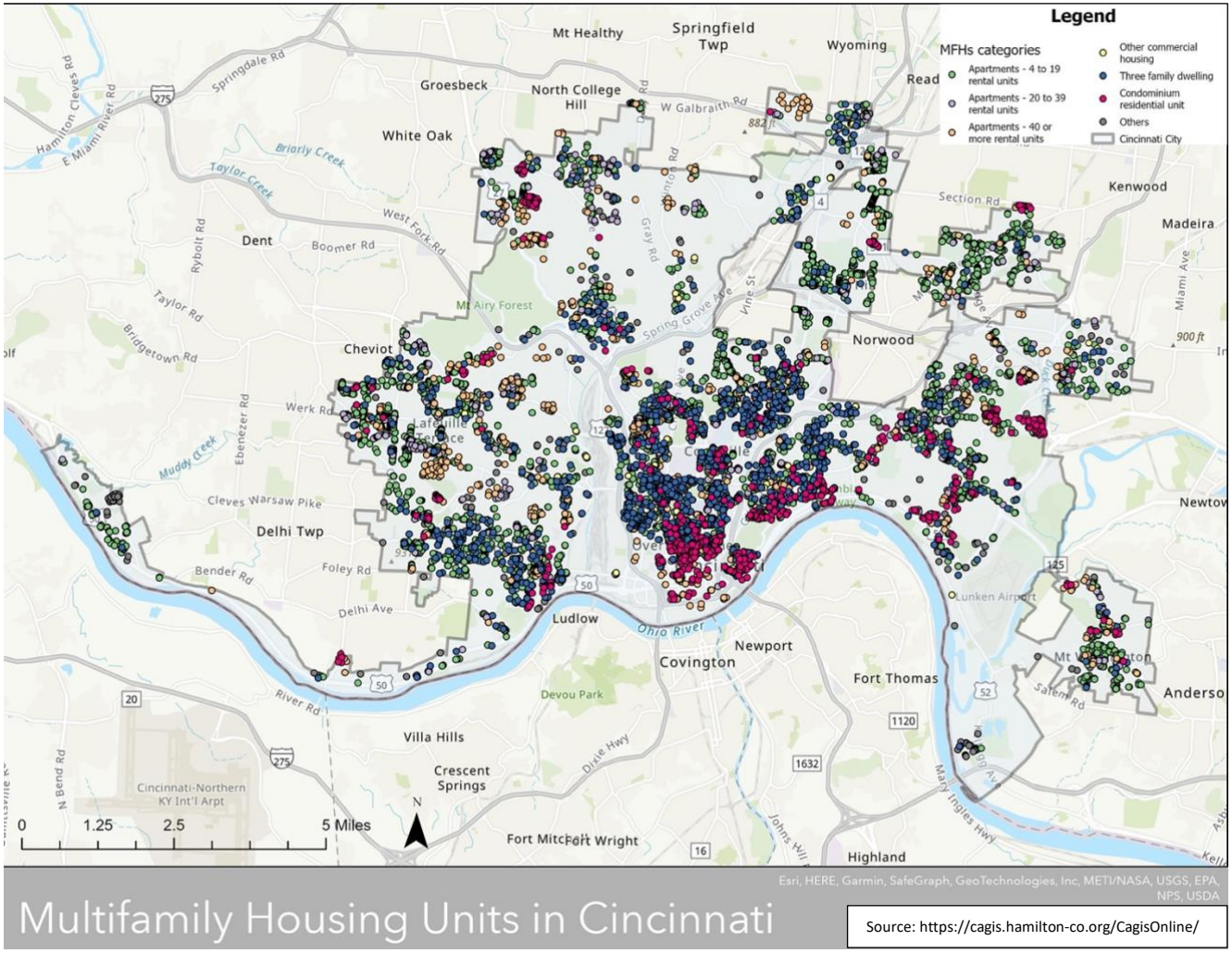
Tackling the Climate Crisis at Home and Abroad.[67] Climate and Economic Justice Screening Tool (**"CEJST"**) does a similar job; however, it is in the Beta stage currently.[68] In this Report, given the overlaps in our findings in *Climate Equity Indicators Report* and DOE DACs Reporter, we used the DOE DACs Reporter Tool to identify the DAC tracts with low-income and disadvantaged communities for prioritizing the deployment of EV chargers.



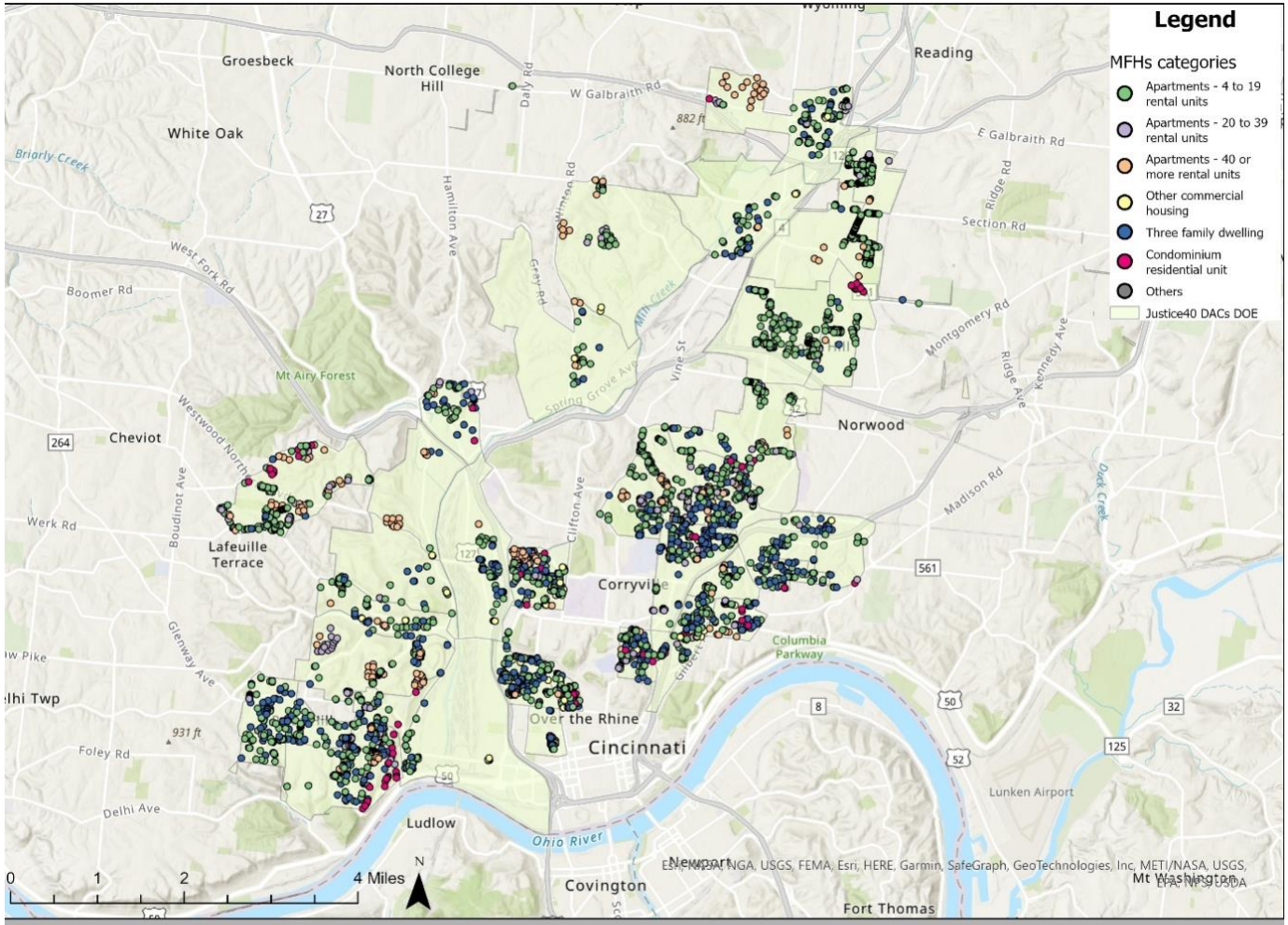
[67] The White House, Executive Order on Tackling the Climate Crisis at Home and Abroad, January 27, 2021, available at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.
[68] Climate and Economic Justice Screening Tool, available at https://screeningtool.geoplatform.gov/en/methodology.

c. Multi-family housing units located in DACs

We thereafter identified the location of MFHs in the City.



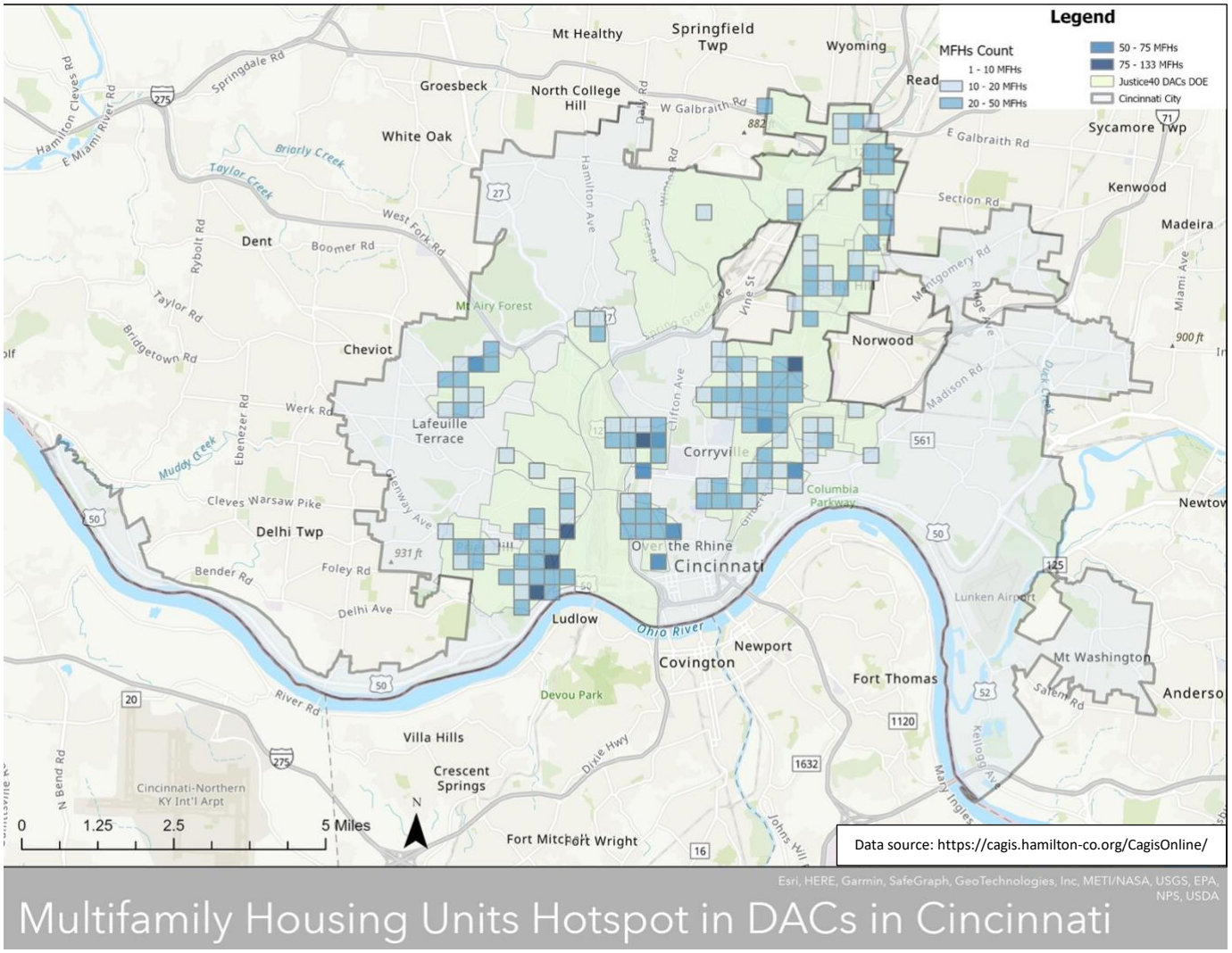
We further narrowed down our focus to MFHs in DACs. The map below presents the location of MFHs in the DACs tracts.



Multifamily Housing Units in DACs Cincinnati

Source: https://cagis.hamilton-co.org/CagisOnline/

The map below presents the hotspot/density of MFHs in the DACs.



B. Suitable locations in the city to deploy the chargers equitably

We examined the DACs and density of MFHs to identify suitable city-owned properties in the vicinity of these hotspots for the deployment of EV infrastructure.[69] Based on the analysis, the following are the neighborhoods in the City for prioritizing investments in the deployment of EV charging infrastructure.

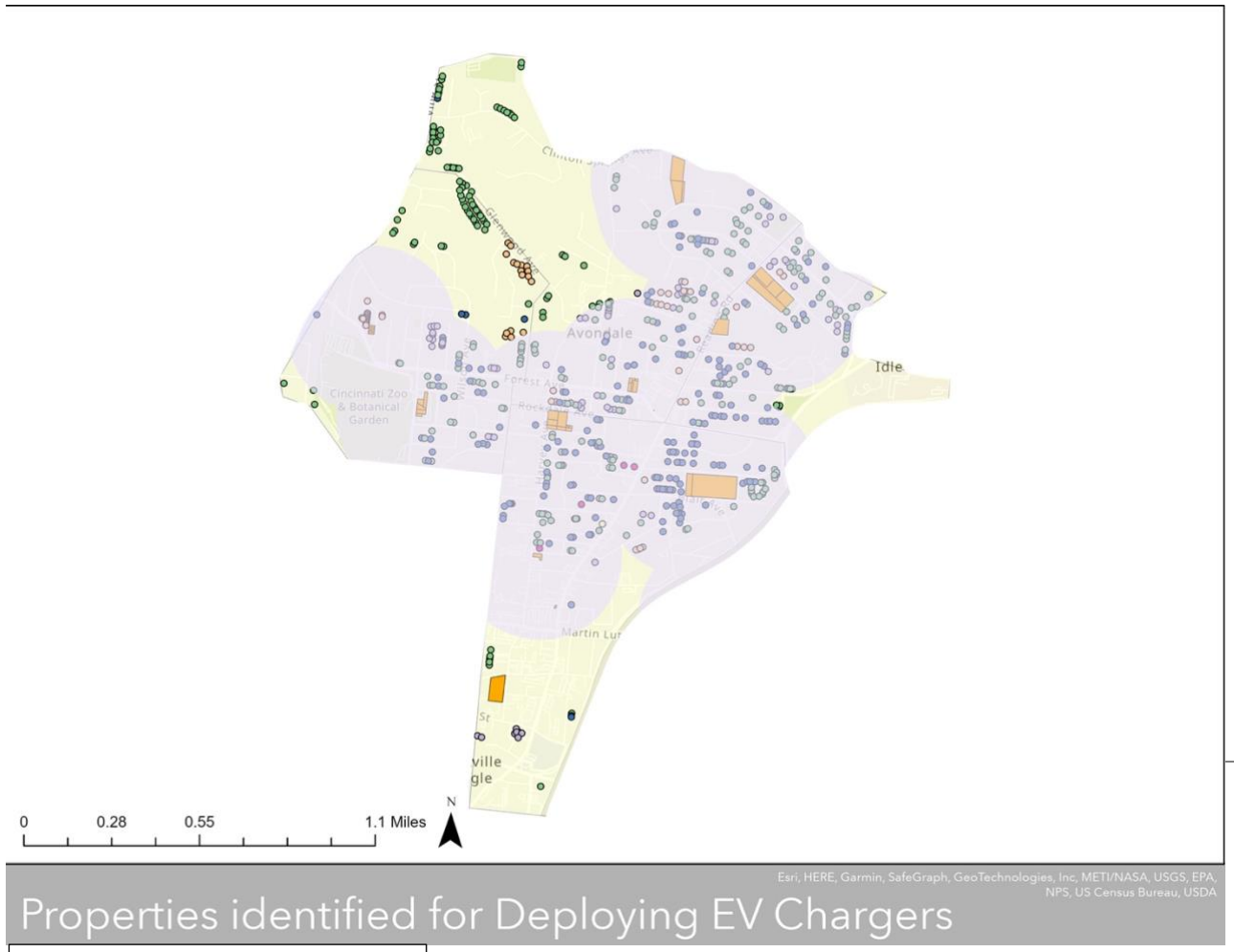
1. Avondale
2. Bond Hill
3. Camp Washington
4. CUF
5. East Price Hill
6. Evanston
7. Hartwell
8. Lower Price Hill
9. Mt. Auburn
10. Over-the-Rhine
11. Roselawn
12. Sedamsville
13. South Fairmont
14. Walnut Hills
15. West End
16. West Price Hill
17. Westwood

In the following pages, we have identified in each eligible neighborhood the City-owned properties that may be suitable for deploying EV chargers.

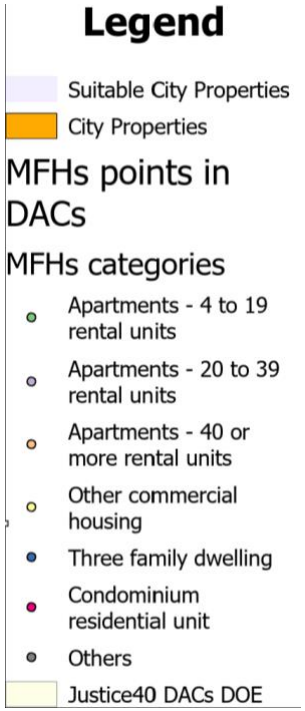
Please note that Suitable City Properties in the following pages mean City-owned properties which have more than 20 MFHs in a radius of 0.25 miles and have no EV chargers installed in their vicinity.

[69] *We identified City-owned properties which had more than 20 MFHs in radius of 0.25 miles. We thereafter eliminated city-owned properties which already had EV chargers installed in their vicinity.*

AVONDALE

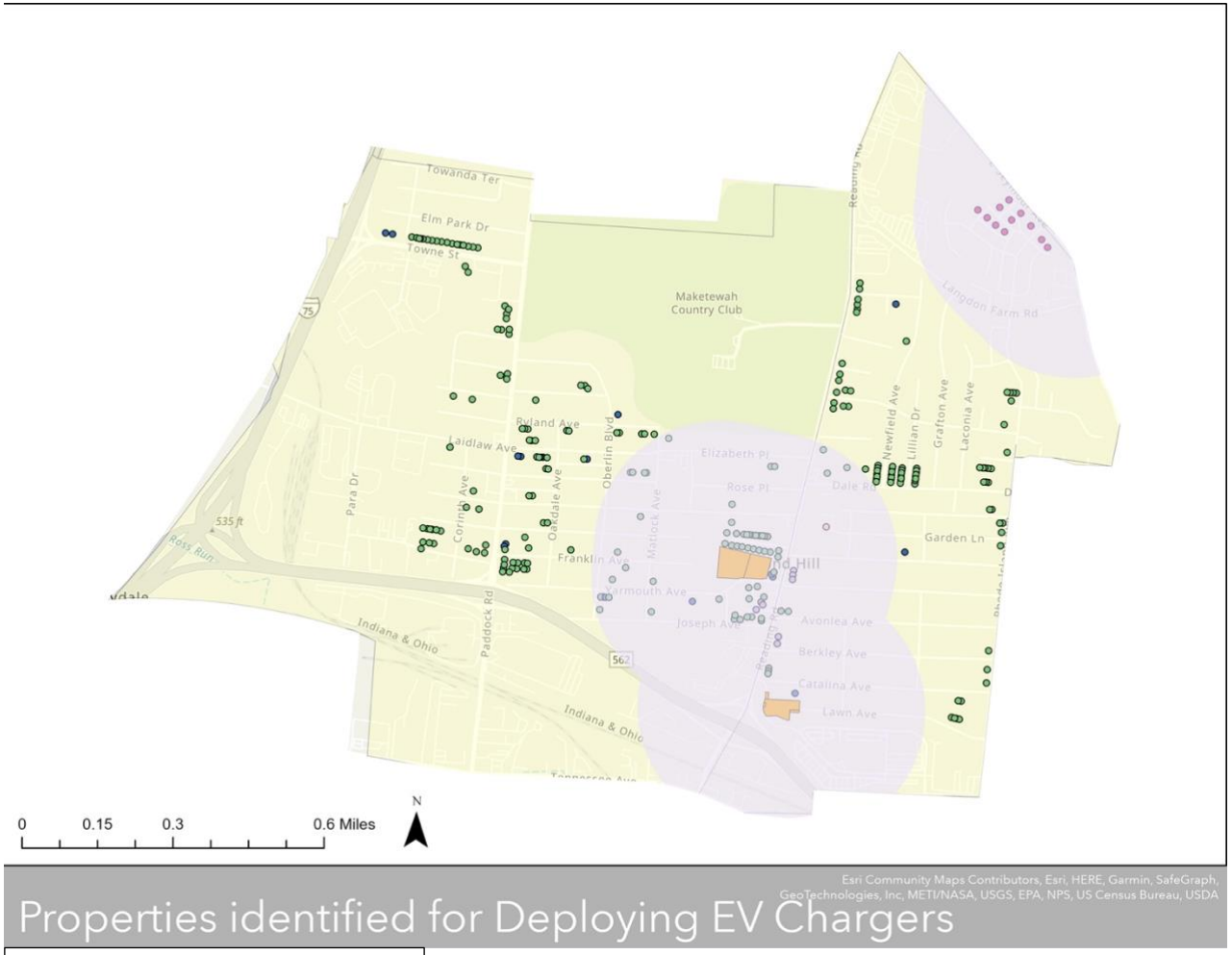


Data source: https://cagis.hamilton-co.org/CagisOnline/



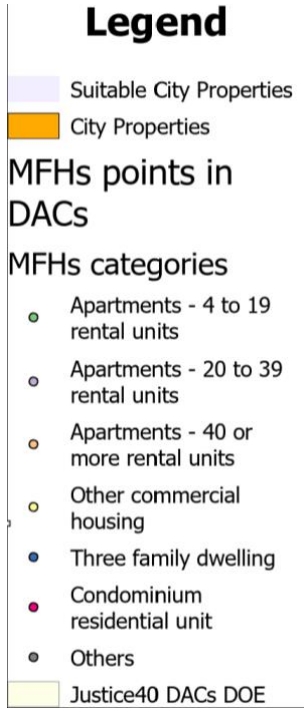
S. No.	*Identified Properties in Avondale*
1.	Jewish Hospital Parking
2.	Avondale Recreation Center
3.	Harvey & Rockdale Playground
4.	Dury Avenue Playground
5.	Forest & Irving Playground
6.	Avondale Town Center
7.	Martin Luther King Park
8.	North Avondale Playground

BOND HILL



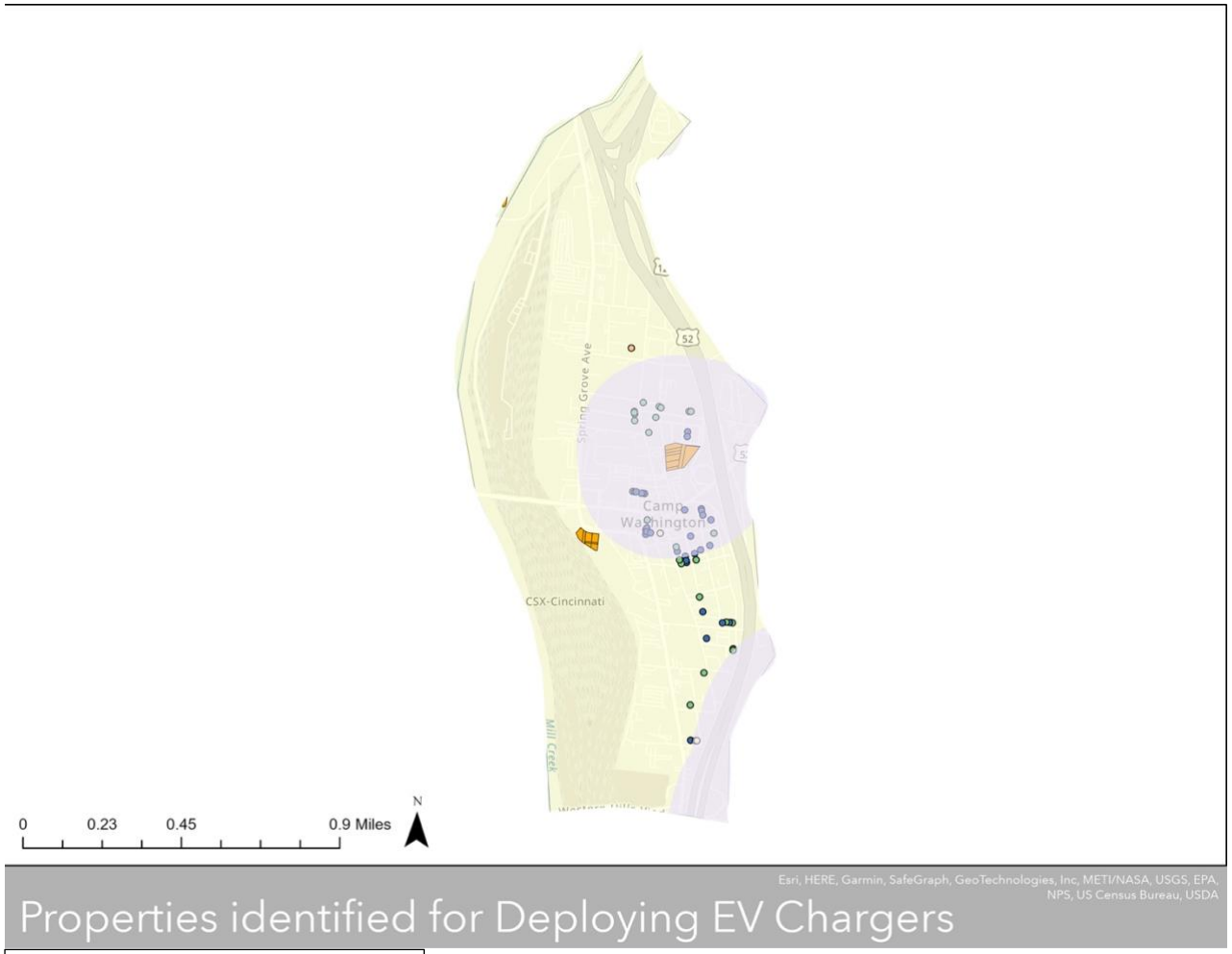
Properties identified for Deploying EV Chargers

Data source: https://cagis.hamilton-co.org/CagisOnline/



S. No.	*Identified Properties in Bond Hill*
1.	Bond Hill Playground
2.	Lawn Avenue Nature Centre

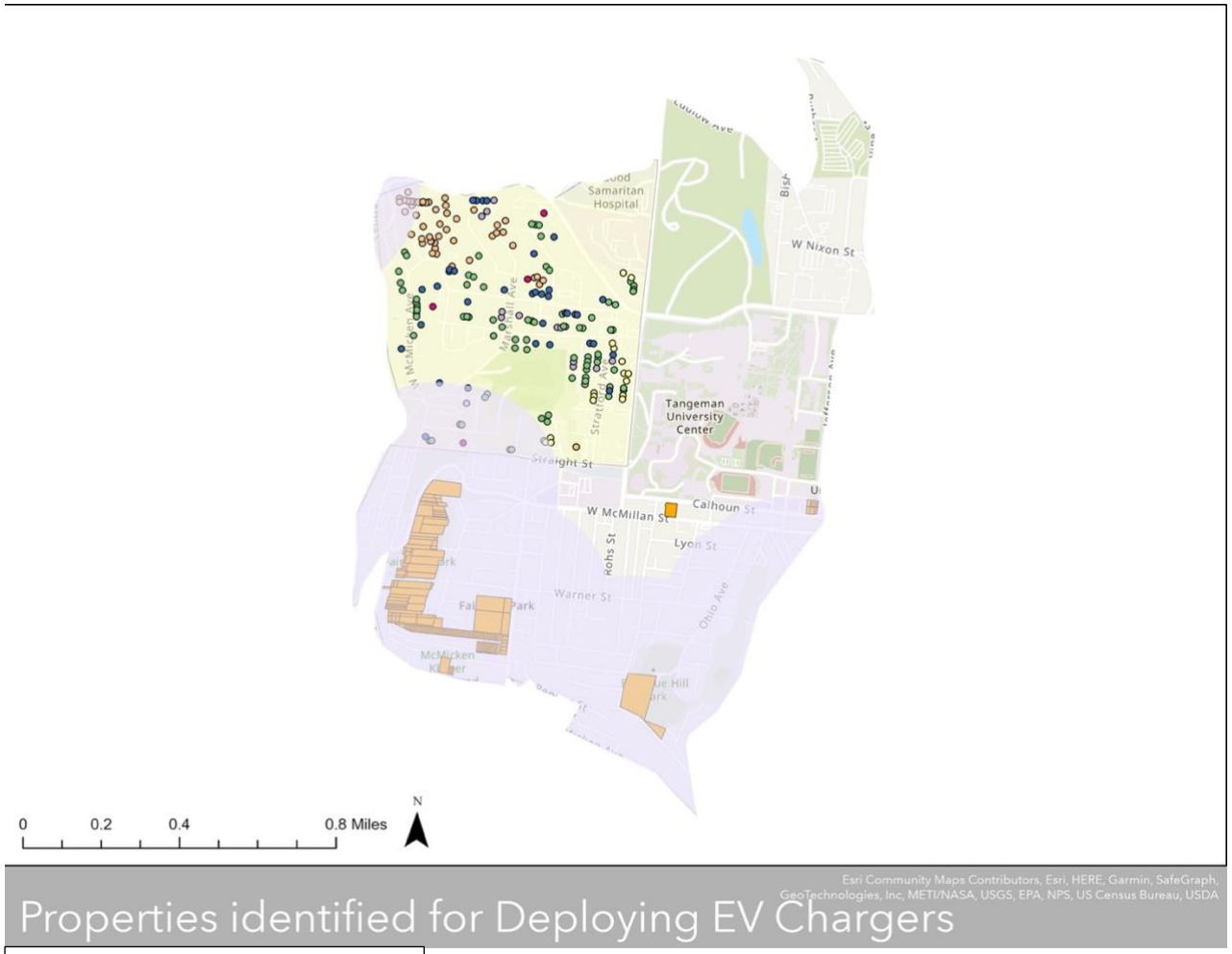
CAMP WASHINGTON



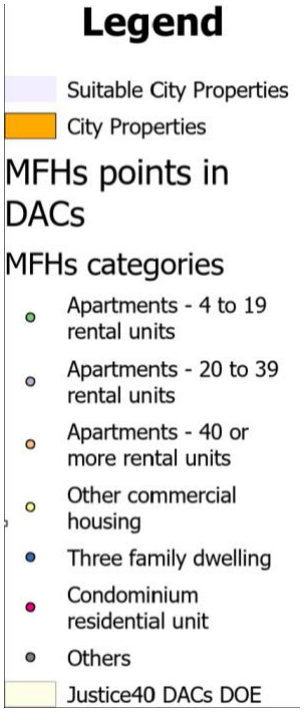
Data source: https://cagis.hamilton-co.org/CagisOnline/

S. No.	*Identified Properties in Camp Washington*
1.	Camp Washington Recreation Complex

CUF

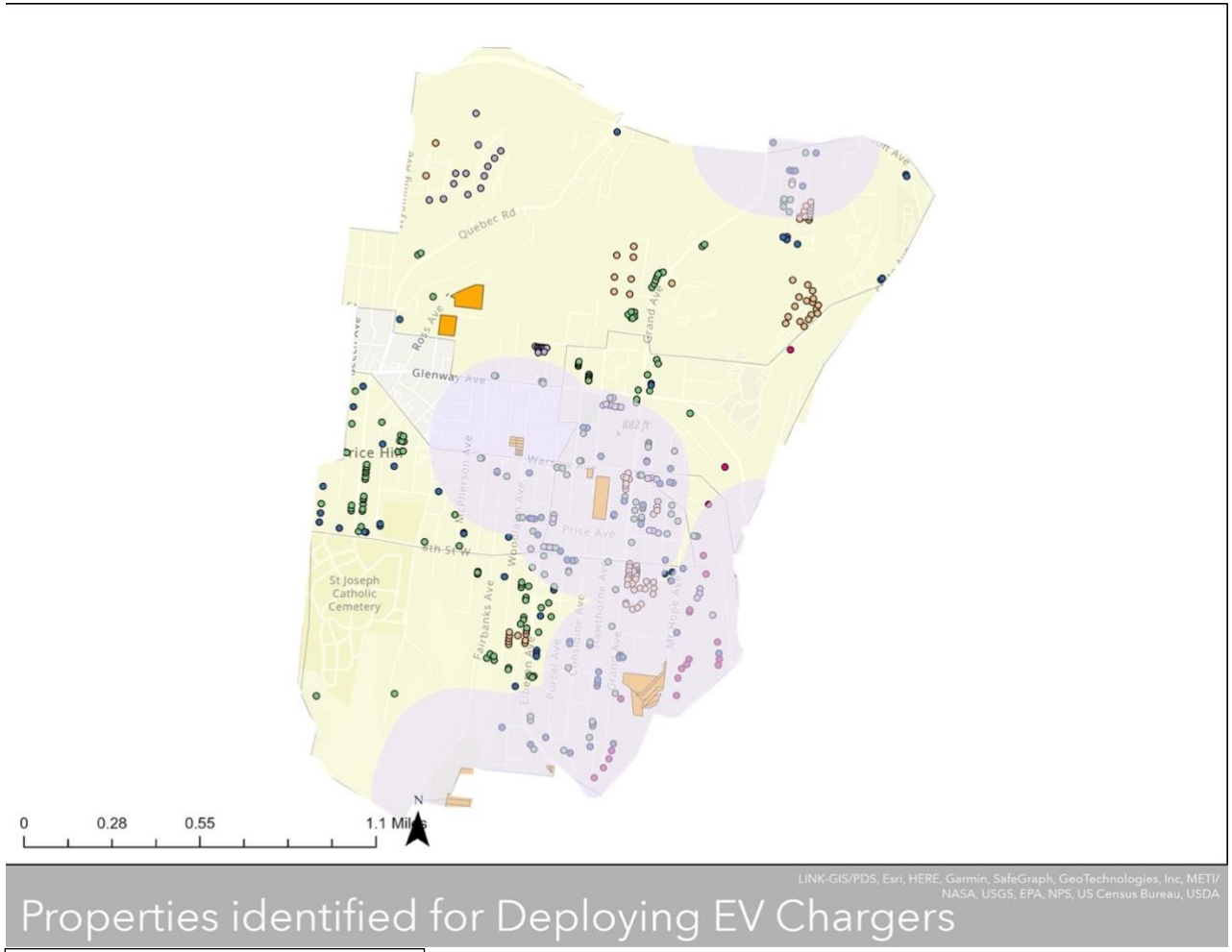


Data source: https://cagis.hamilton-co.org/CagisOnline/

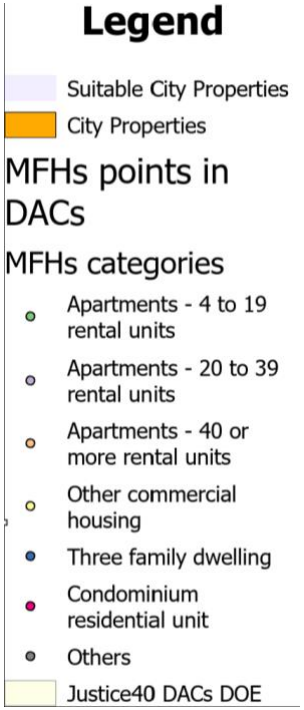


S. No.	*Identified Properties in CUF*
1.	Bellevue Hill Park
2.	Mohawk Park
3.	Fairview Park
4.	Fairview Park - Mcmillan Street
5.	Fairview Playground

EAST PRICE HILL

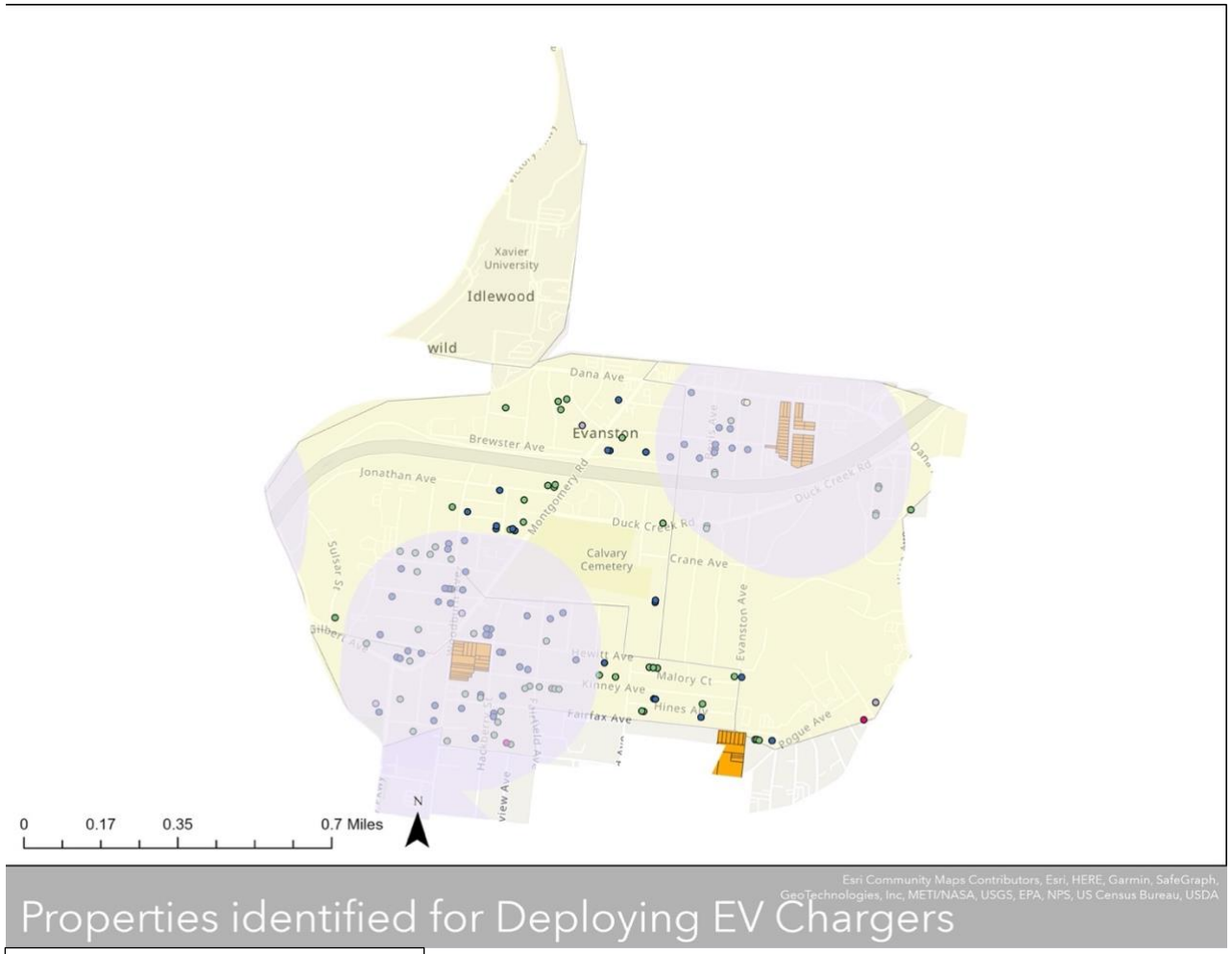


Data source: https://cagis.hamilton-co.org/CagisOnline/



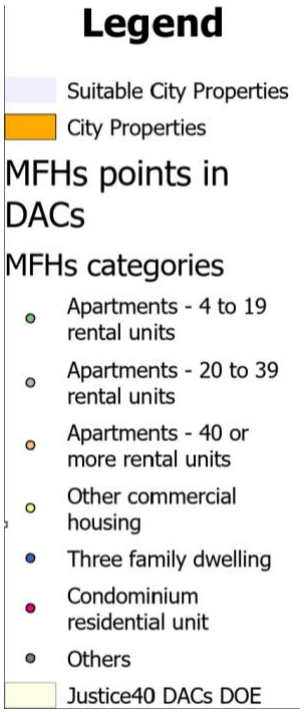
S. No.	*Identified Properties in East Price Hill*
1.	Mt. Echo Park
2.	Harry Olden Playfield
3.	Price Hill Park – Green Space
4.	Price Hill Recreation Center

EVANSTON



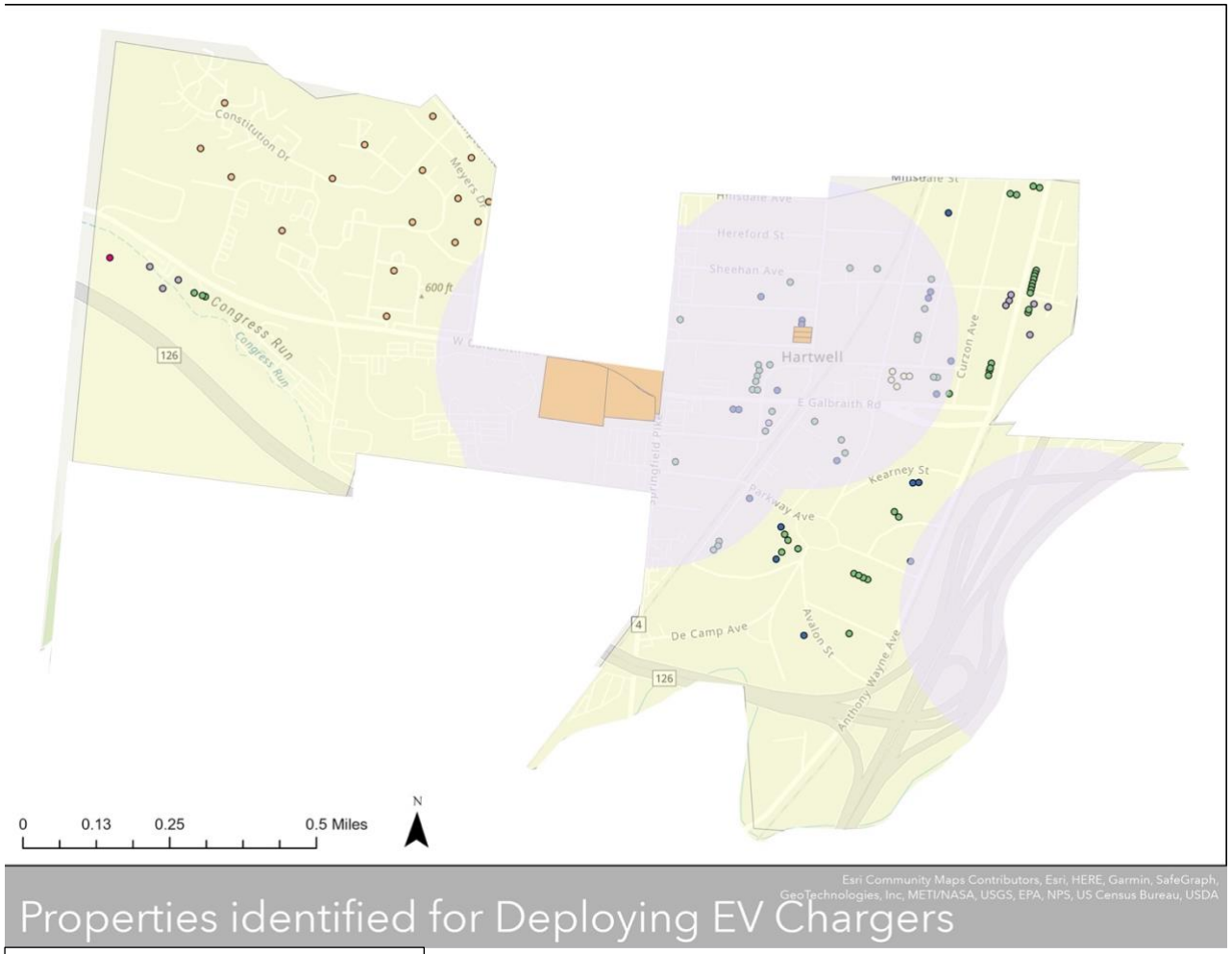
Properties identified for Deploying EV Chargers

Data source: https://cagis.hamilton-co.org/CagisOnline/

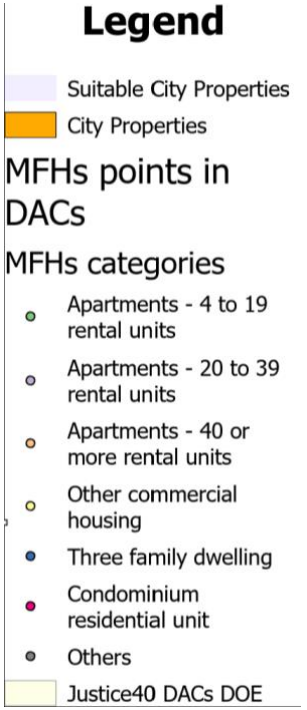


S. No.	*Identified Properties in Evanston*
1.	Evanston Rec Center/Playfield
2.	Evanston Athletic Field
3.	Evanston Park

HARTWELL

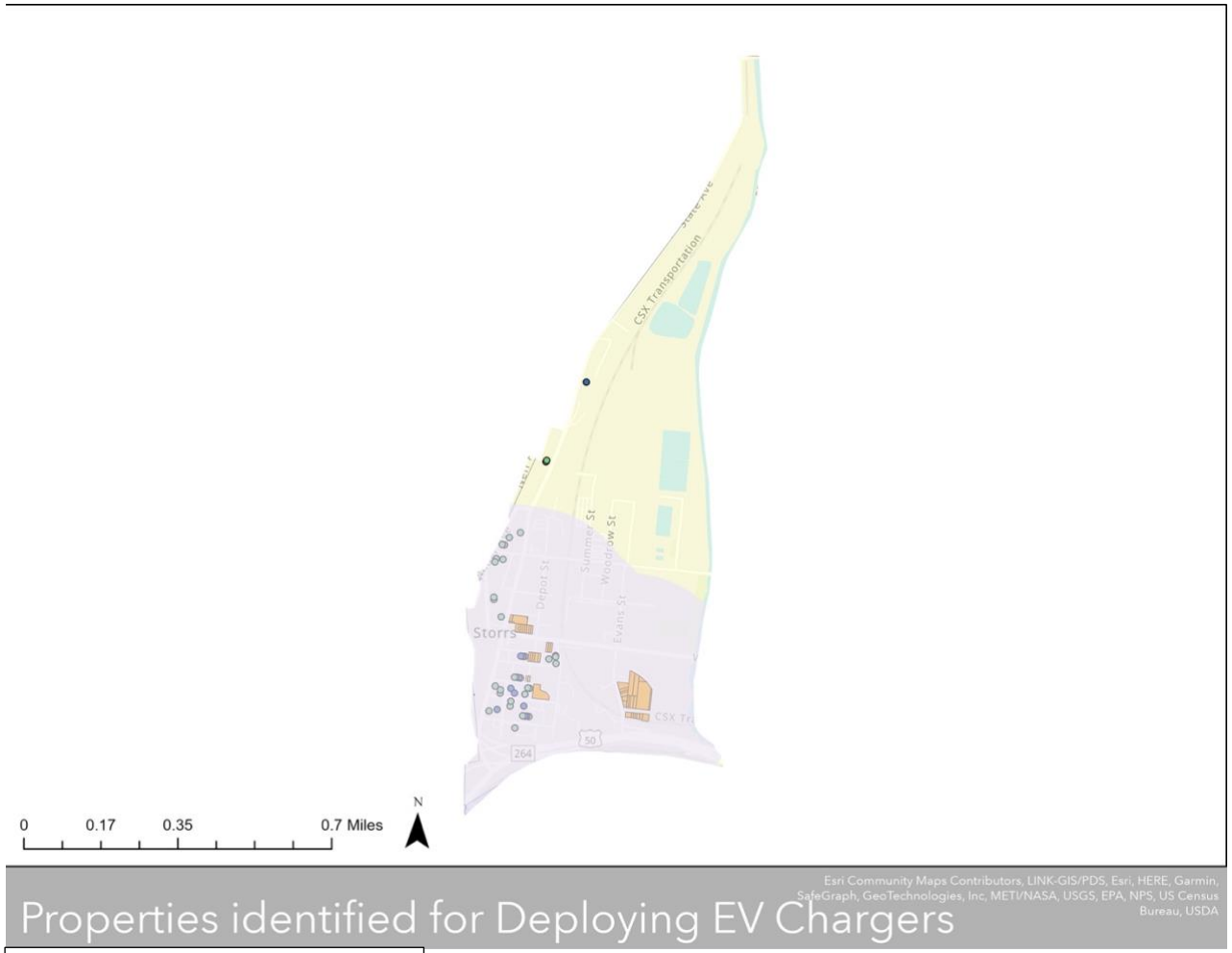


Data source: https://cagis.hamilton-co.org/CagisOnline/



S. No.	*Identified Properties in Hartwell*
1.	Hartwell Playground
2.	Hartwell Recreation Center

LOWER PRICE HILL



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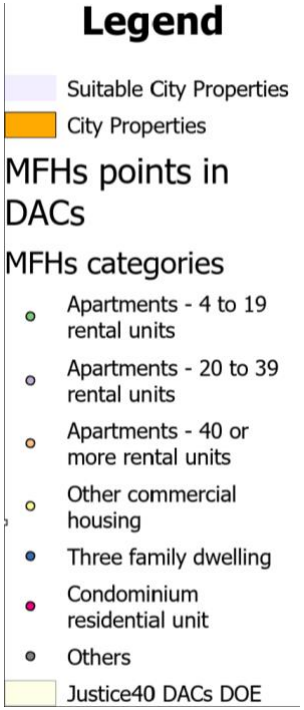
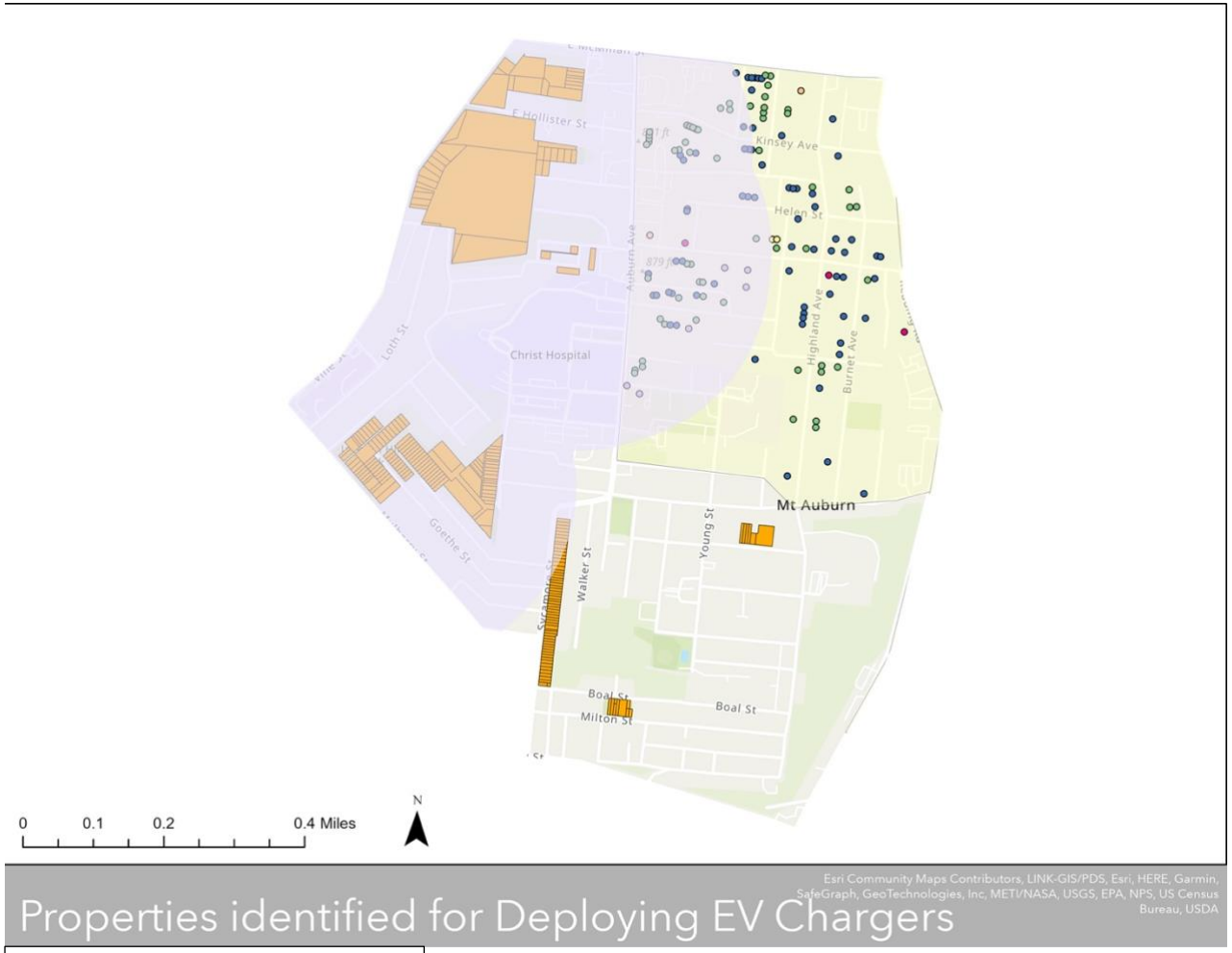


S. No.	*Identified Properties in Lower Price Hill*
1.	Evans St Ballfield
2.	Lower Price Hill TOT Lot
3.	Oyler Pool House (Cons W/Row)
4.	Lower Price Hill Health Clinic

MT AUBURN



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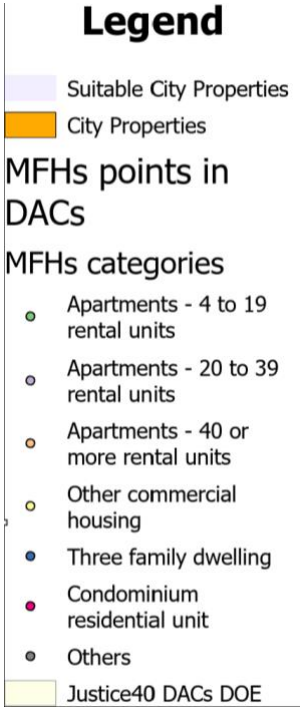
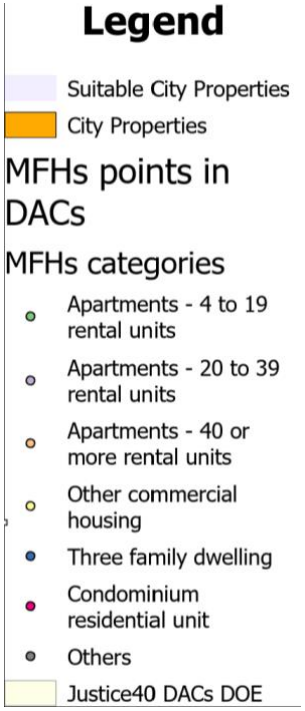


S. No.	*Identified Properties in Mt. Auburn*
1.	Inwood Park
2.	Jackson Hill Park

OVER-THE-RHINE

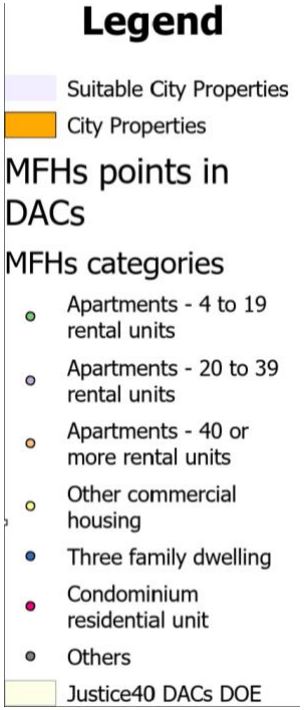
Properties identified for Deploying EV Chargers

Data source: https://cagis.hamilton-co.org/CagisOnline/



S. No.	*Identified Properties in Over-the-Rhine*
1.	Parking Lot
2.	Hanna Playground

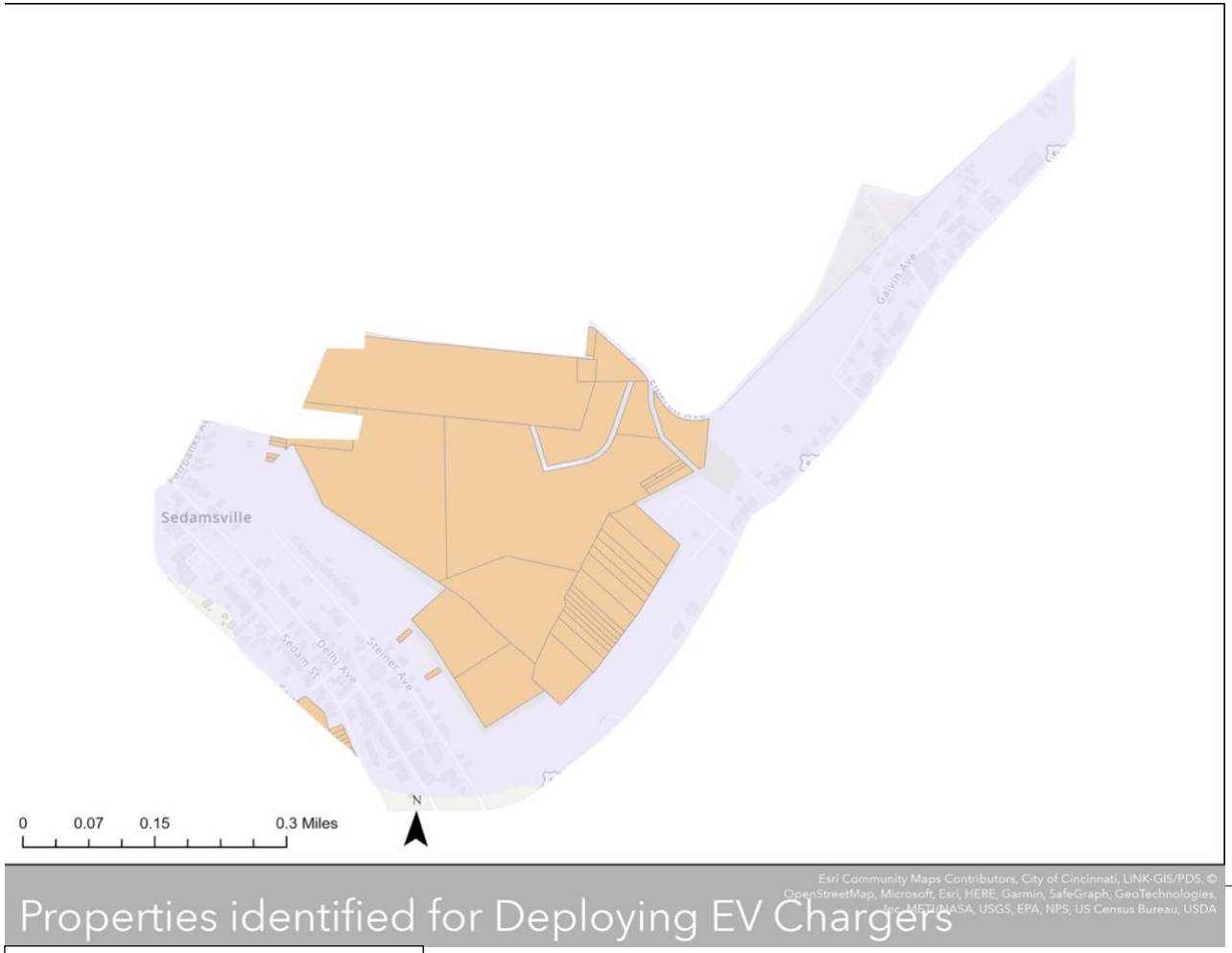
ROSELAWN



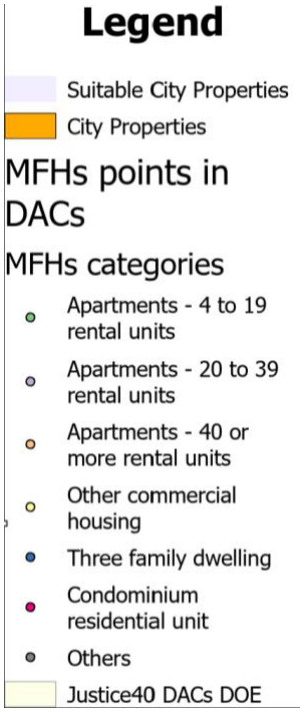
S. No.	*Identified Properties in Roselawn*
1.	Roselawn Parking
2.	Roselawn Park
3.	Dawn Avenue Play Field

Data source: https://cagis.hamilton-co.org/CagisOnline/

SEDAMSVILLE

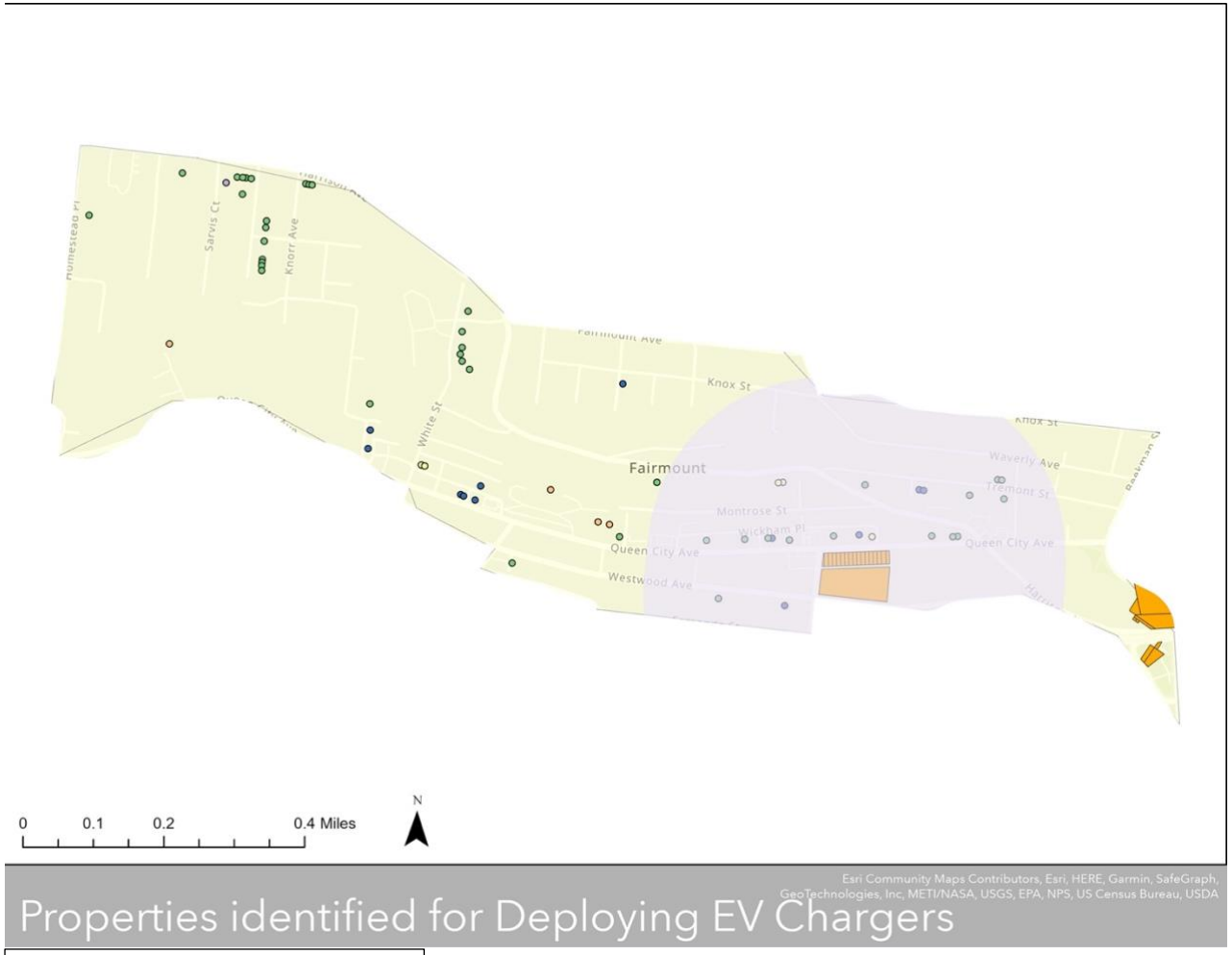


Data source: https://cagis.hamilton-co.org/CagisOnline/



S. No.	*Identified Properties in Sedamsville*
1.	Mt. Echo Park

SOUTH FAIRMONT



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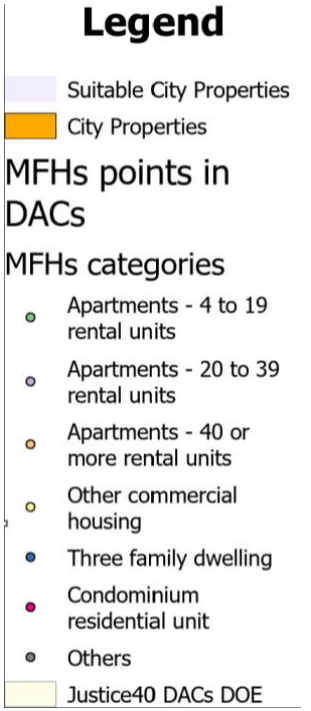
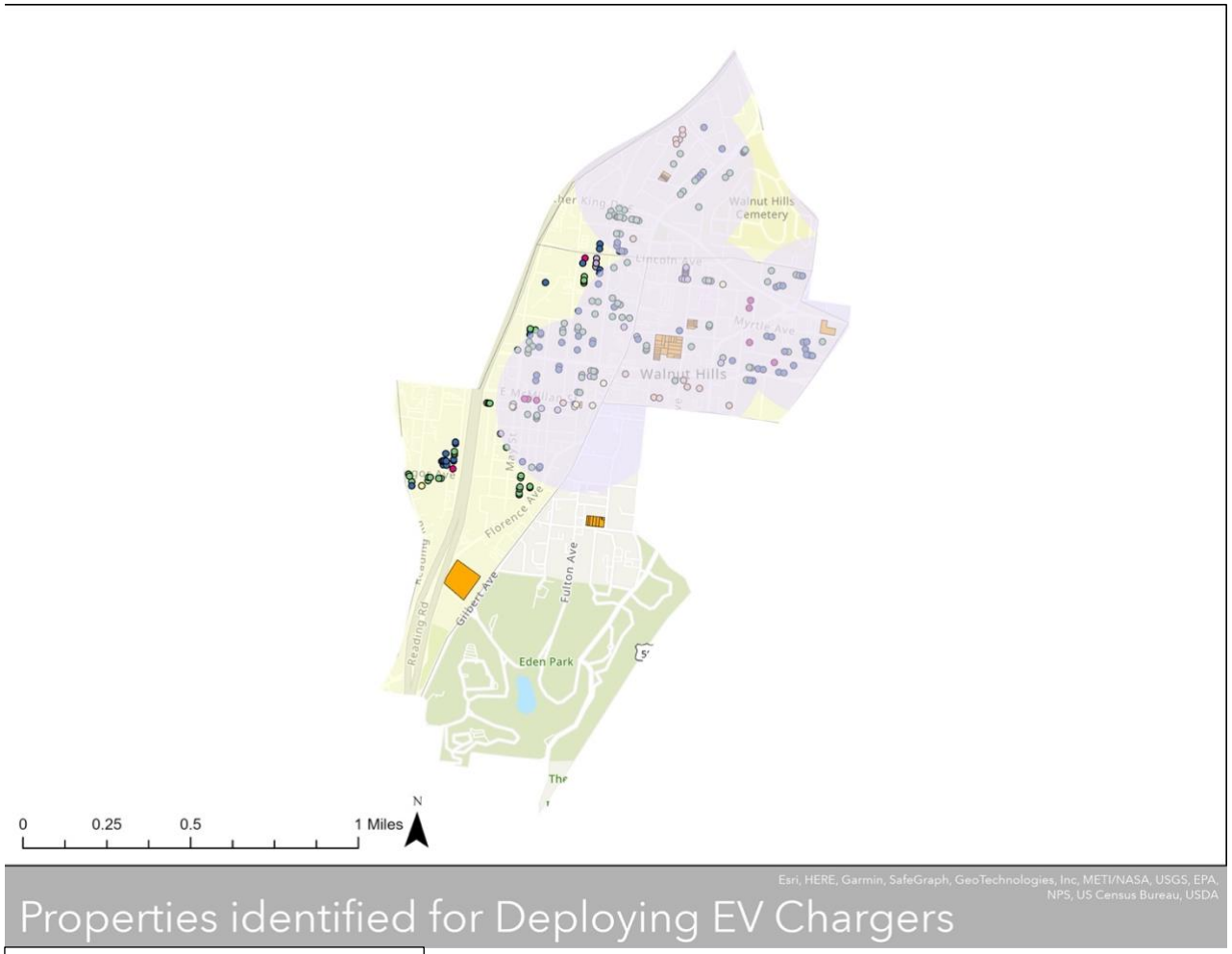


S. No.	*Identified Properties in South Fairmont*
1.	South Fairmount Athletic Field
2.	South Fairmount Pool House

WALNUT HILLS



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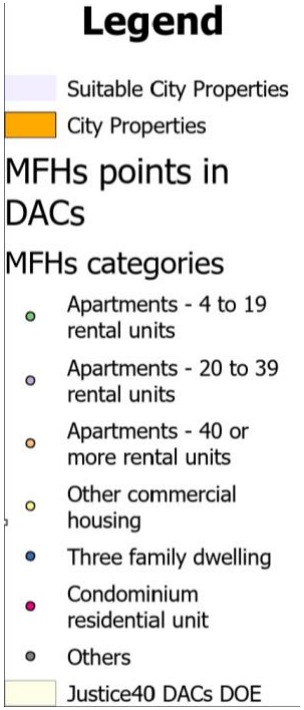
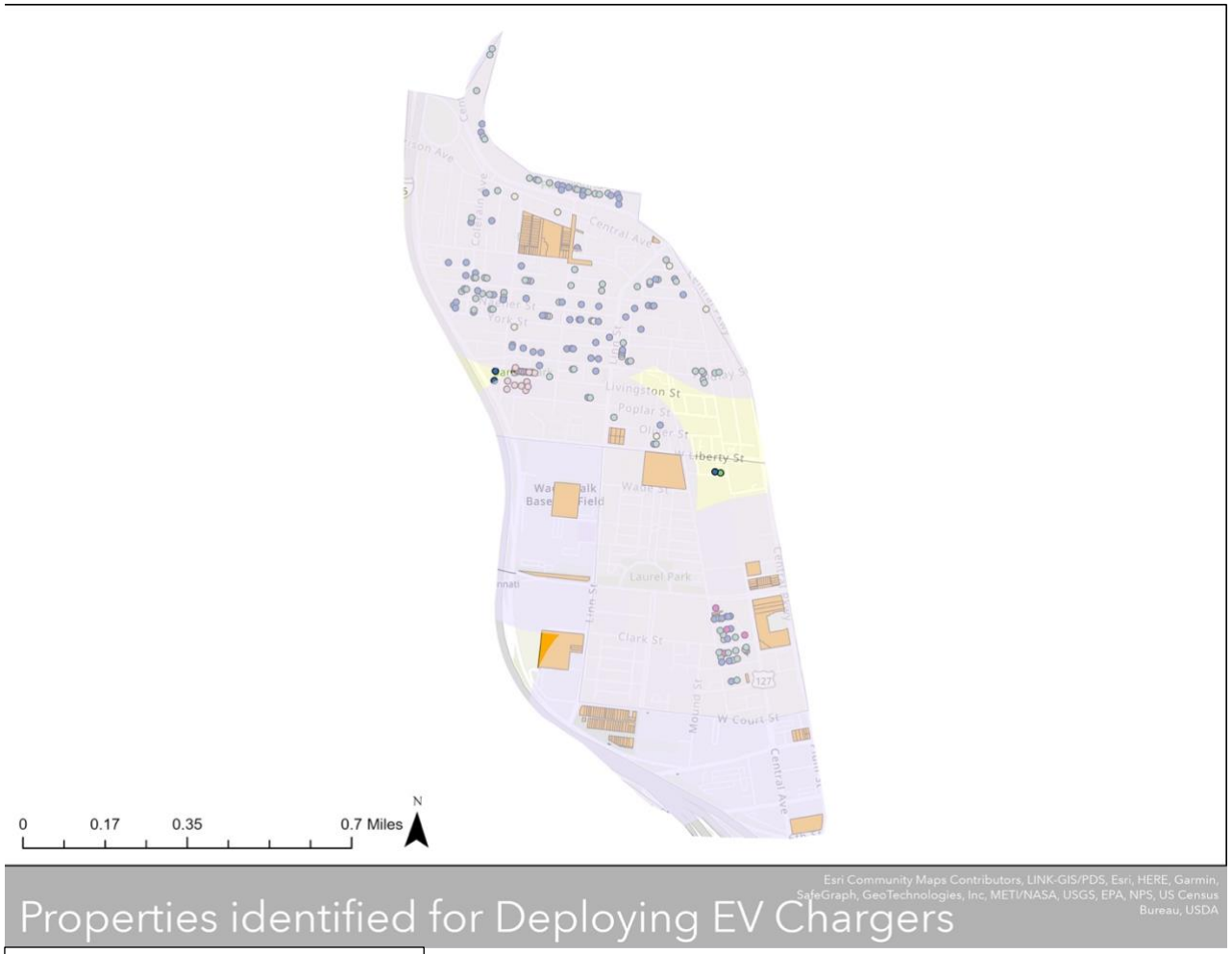
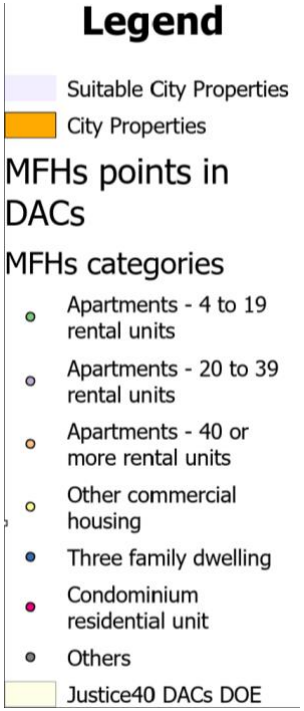


S. No.	*Identified Properties in Walnut Hills*
1.	Lane Seminary Playfield
2.	Bush Rec Center
3.	Mathers Play Area
4.	Desales Corner Parking
5.	Parking Lot - Sw Quadrant Business Redevelop

WEST END

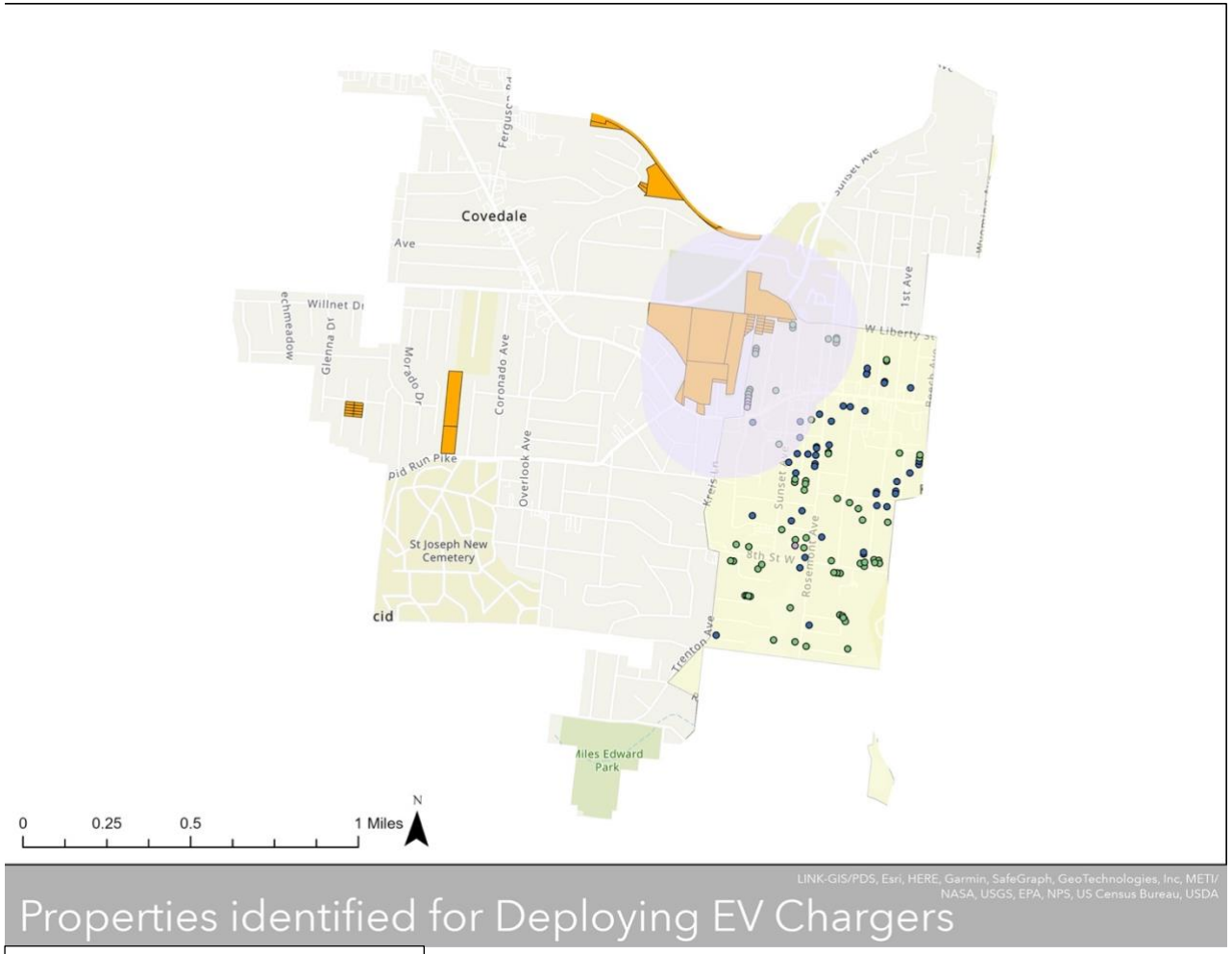


Data source: https://cagis.hamilton-co.org/CagisOnline/



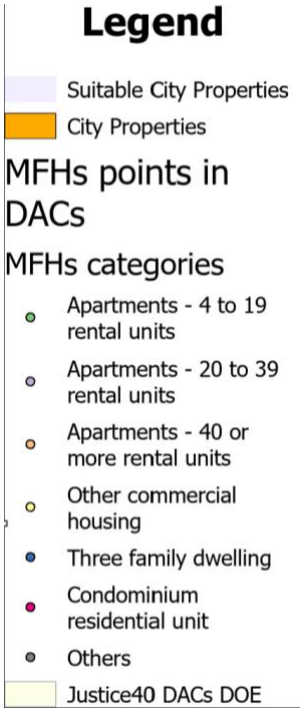
S. No.	*Identified Properties in West End*
1.	Dyre Park
2.	Mohawk Park
3.	Betts Longworth Parking
4.	Town Center Parking Garage
5.	City Parking Lot
6.	Cinti Recreation Comm (Par 2 & 4)
7.	Queensgate Playground

WEST PRICE HILL



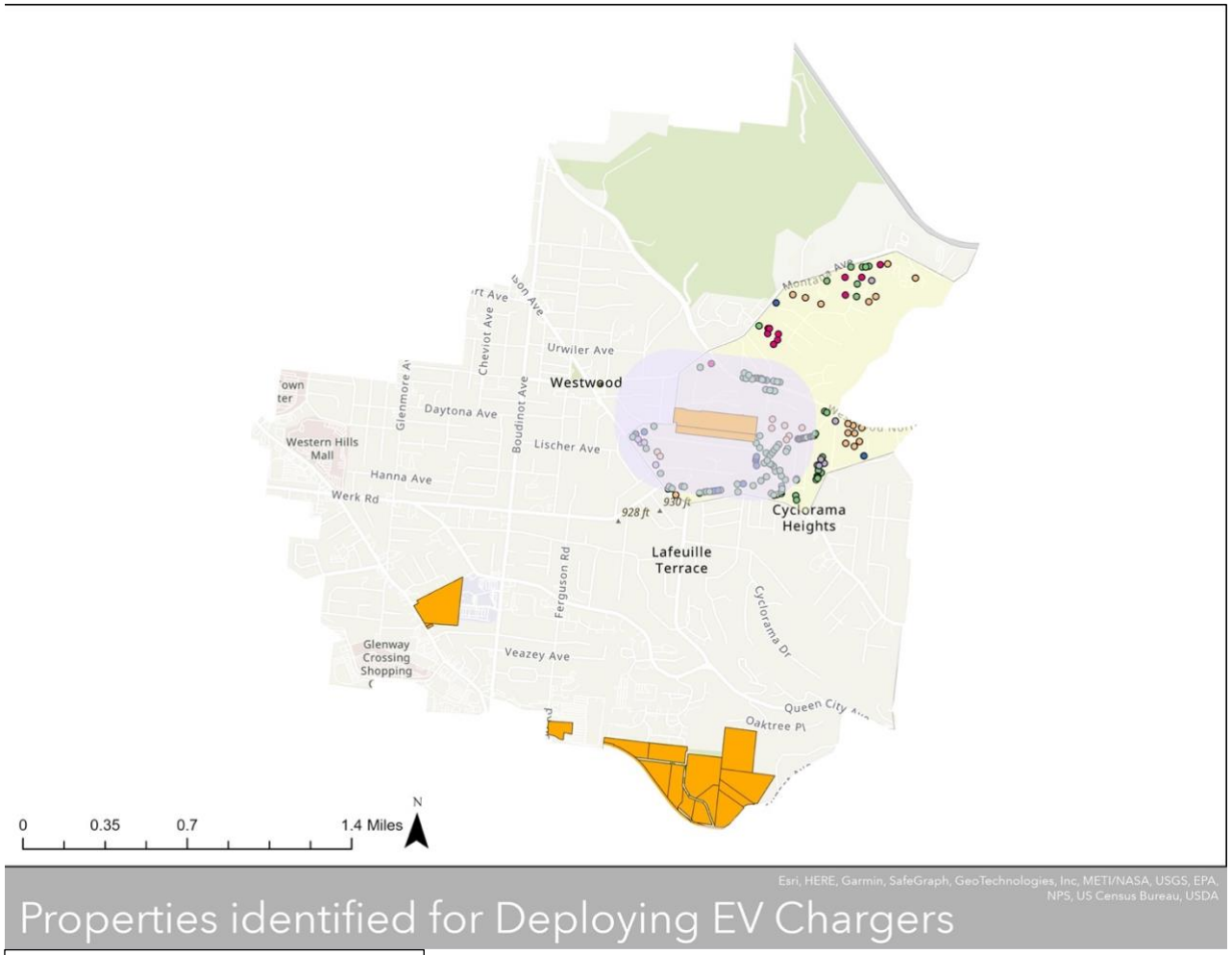
Properties identified for Deploying EV Chargers

Data source: https://cagis.hamilton-co.org/CagisOnline/

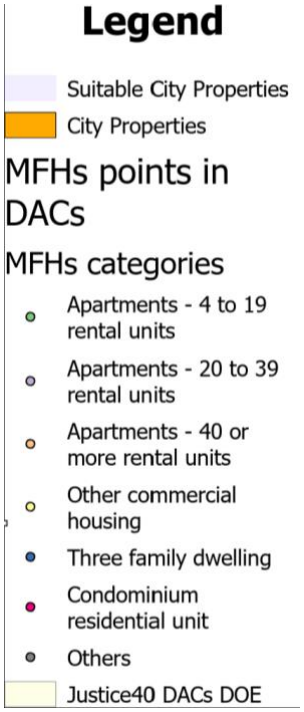


S. No.	*Identified Properties in West Price Hill*
1.	Rapid Run Park & Parkway

WESTWOOD



Data source: https://cagis.hamilton-co.org/CagisOnline/



S. No.	*Identified Properties in Westwood*
1.	Ryan Memorial Playground

III. RECOMMENDATIONS

Based on the issues, considerations, and analysis highlighted above, the following are the key recommendations for the equitable deployment of public EV chargers in the City.

A. The City should leverage its properties to provide access to EV charging in disadvantaged communities.

Given the importance of near-home charging solutions for DACs and residents of MFHs, the City should use its existing property assets to install EV chargers in these communities. The analysis above helps kickstart this process by identifying the equity gaps in the present EV charging infrastructure across the city and identifying City-owned locations for prioritizing investments in EV infrastructure. However, this is only the first step. The involvement of Duke Energy, local communities, and other interested stakeholders will be critical to finalizing the implementation strategy. For information on the next steps, please see "*Section V. Public Engagement Process*" of this report.

Other innovative methods could also be explored in areas where there is a high density of low-income MFHs but no suitable city-owned assets. For instance, the City may explore multi-use parking arrangements with the owners of non-residential parking lots (e.g., places of worship, workplaces, retail locations, etc.) to install EV chargers, where visitors/customers/employees could use the parking space during the day, and residents residing near these places could use these spaces during the night – when these parking spaces are otherwise vacant. This model may be particularly useful in the long run as the EV market evolves and profitable business models emerge.

This approach will be consistent with the Federal Justice 40 program. The Justice 40 program mandates that 40 percent of the overall benefits of certain federal investments must flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution.[70] While this requirement only applies to federal investments, such as the NEVI Plan, the Federal community charging grant, etc., the City should adhere to this threshold for all EV infrastructure investments irrespective of the funding source. This commitment is necessitated owing to the fact that these communities will otherwise be excluded from the EV transition due to a lack of at-home charging facilities and the absence of publicly accessible EV charging options in areas where they reside or work.

B. The City should explore ways to make EV charging affordable for disadvantaged communities.

In order for the EV charging infrastructure to be truly equitable, the City must not only provide access to the EV chargers where they are most required but also ensure that the cost of EV charging at these facilities is at par with at-home charging. Public charging is significantly more expensive than at-

[70] The White House, Justice40: A Whole-Of-Government Initiative, available at https://www.whitehouse.gov/environmentaljustice/justice40/#:~:text=What%20is%20the%20Justice40%20Initiative,underserved%2C%20and%20overburdened%20by%20pollution.

home charging. Therefore, appropriate strategies are needed to subsidize the cost of charging for those EV drivers who will exclusively rely on public charging. Otherwise, the economic benefits of owning an EV will not flow to these drivers, thereby hindering the adoption of EVs in these communities.

The City should explore a public-private partnership ("**PPP**") model for installing the EV chargers in identified locations. However, it is likely that the rate of utilization of these chargers will be low in the beginning. Given that the private player will be unable to recoup the investment owing to the lower rate of utilization, the City may need to provide subsidies to ensure that the model is both economically sustainable and equitable for low-income and disadvantaged communities. To facilitate this, the City may have to sign an offtake agreement with private players to purchase a set amount of charging services. It is further recommended that the City should retain control over setting the pricing policies of the installed chargers through the PPP model or otherwise.

The City should provide charging services at city-controlled public chargers at a price that is at least 10% lower than other public chargers (owned by for-profit service providers) for all users. In addition, the City should institute a subsidy program for low-income EV drivers who will avail the charging facilities at the city-controlled public chargers. One way to institute this is by administering a universal fueling payment card with subsidized rates for lower-income drivers.[71] This could be facilitated through the Electronic Benefit Transfer (EBT) cards used to distribute welfare cash benefits.[72] The City could work with private partners to manage this program. EV dealerships could distribute these cards and set up accounts linked to vehicles at the point of purchase.[73] The subsidies could be distributed as a monthly charging balance (in kWh), with the flexibility for cardholders to charge their vehicles at any public charging station on the subsidized rate until they exhaust their charging balance. The City could also extend these subsidized rates across all public EV chargers in the City, irrespective of whether chargers are controlled by the City or not.

C. The City should work with Duke Energy to explore the potential of installing EV Chargers on curbsides

Many cities across the country are partnering with utilities to install chargers on curbsides (curbside pole-mounted chargers) or by attaching the EV chargers to the ground (curbside ground-mounted chargers).[74] This approach has been tried and tested in European countries.[75] It has tremendous potential for providing access to EV charging to low-income communities where the renter population does not have a garage or dedicated off-street

[71] Driving Equity Report, 2022.
[72] Driving Equity Report, 2022.
[73] Driving Equity Report, 2022.
[74] Bradley Berman, LA adds hundreds of EV chargers to streetlights, giving renters a place to plug in, November, 2019, available at https://electrek.co/2019/11/13/la-adds-hundreds-of-ev-chargers-to-streetlights-giving-renters-a-place-to-plug-in/; City of Melrose, City of Melrose Introduces Innovative Electric Vehicle Charger Program, April 22, 2021, available at https://www.cityofmelrose.org/home/news/city-melrose-introduces-innovative-electric-vehicle-charger-program; City of Cambridge, EV Charging Infrastructure, available at https://www.cambridgema.gov/-/media/Files/CDD/Transportation/EV/evpilotpublicmeeting20220112.pdf.
[75] Fred Lambert, London is installing electric car charging stations inside lamp posts for street charging, November, 2017, available at https://electrek.co/2017/11/14/london-electric-car-charging-stations-lamp-posts-street/.

parking due to its comparative ease of installation using the existing electrical circuitry and real estate availability.[76] The locations for installing these chargers will need to be strategically decided so that the installation does not interfere with other City initiatives such as tree planting, bike lanes, etc.[77] New York,[78] Los Angeles, Seattle[79], etc., have installed hundreds of chargers on curbsides with great success.

Further, such installations could be supplemented with appropriate policies and restrictions such that these chargers serve the residents instead of visitors. For instance, the City could restrict the usage of these chargers exclusively for local residents from 6 p.m. to 6 a.m. These chargers could otherwise be available for anyone during the daytime hours on a first come, first serve basis. The City may have to institute special EV curbside parking permits in neighborhoods to facilitate this. The City could further explore the option of partnering with third-party vendors who could help offset the upfront cost of installing the EV chargers, as done by some cities.[80]

It is pertinent to note here that the curbside charging locations may be more suitable for installing Level 2 chargers due to the practical challenges of deploying DC Fast Chargers in these locations.

D. Deployment of chargers at workplaces and locations where members of disadvantaged communities go to work.

The US Department of Energy reports that an employee with access to workplace charging is six times more likely than the average worker to drive an EV.[81] Moreover, the NEVI program guidance clarifies that the Justice40 initiative sets the goal of at least 40% of allocating the benefits of federal investments in climate and clean energy infrastructure to DACs, but it does not mean "*that 40% of all charging infrastructure funded under this program must be located in disadvantaged communities*."[82]

The City could explore the data to understand where the residents of DACs and MFHs work and use this information to kickstart a conversation with the corporate players to encourage them to install EV chargers at the workplace. This can potentially offset the need for more public chargers, provide reliable charging options, and utilize vehicles' parked time.

E. The City should adopt policies and legislation for EV uptake and charging infrastructure.

[76] LADWP's Electric Vehicle Charger installed on Power Pole in Watts Likely the First in the Country, available at https://www.ladwpnews.com/ladwps-electric-vehicle-charger-installed-on-power-pole-in-watts-likely-the-first-in-the-country/.
[77] The Urban Sustainability Directors Network, Electric Vehicle Charging Access for Renters: A Guide to Questions, Strategies, and Possible Next Steps, https://www.somervillema.gov/sites/default/files/USDN_EVChargingAccess_UpdatedReport_Final11.18.20.pdf.
[78] https://www.coned.com/en/our-energy-future/our-energy-vision/where-we-are-going/nyc-public-charging.
[79] https://www.seattle.gov/transportation/projects-and-programs/programs/new-mobility-program/electric-vehicle-charging-in-the-public-right-of-way.
[80] City of Sacramento, Curbside Charging, available at http://www.cityofsacramento.org/Public-Works/Electric-Vehicle-Initiatives/Curbside-Charging.
[81] US Department of Energy, Workplace Charging Challenge, 2016, available at https://www.energy.gov/sites/prod/files/2017/01/f34/WPCC_2016%20Annual%20Progress%20Report.pdf.
[82] NEVI Program Guidance, 2022.

Presently, the City is in the process of revising the Green Cincinnati Plan.[83] Given the urgency to reduce greenhouse gas emissions and air quality concerns, the City should set ambitious targets for the much greater adoption of EVs. The City may set a target of 7% of all new passenger car purchases by city residents to be EVs by 2025, 25% by 2030, 50% by 2040, and 100% by 2050. The City may also consider becoming a signatory to the C40 Cities Green and Healthy Streets initiative to benefit from the collective expertise of other signatory cities.[84]

Furthermore, the City should consider adopting the following laws to nudge EV adoption:

a. *The City should mandate all new constructions to be EV ready*: Retrofitting significantly increases the cost of installation of EV chargers; however, doing so up front adds less than 0.2 percent to construction costs.[85] Therefore, the City should adopt a law requiring 20% of parking spaces in all new commercial and MFHs to be EV-ready (conduit, wiring, and electrical capacity). The City should also mandate that all new parking facilities equip 25% of parking with access to EV charging. These mandates should also apply to any existing building renovations.

b. *The City should pass the 'Right to Charge' law for renters to install charging stations*: The City should adopt a law that allows renters to install charging stations at their rented properties easily. The City should create a framework for tenants to request permission from their landlord to install EV chargers at their designated parking space. The landlords shall be therein obligated to accede and shall not be allowed to deny such request unreasonably. If the installation of the chargers is not possible in the designated spot, renters with EVs should be allowed to request a new site where EV charger installation is reasonable.

Please see the "*Appendix*" for more policy options and best practices for nudging the adoption of EVs.

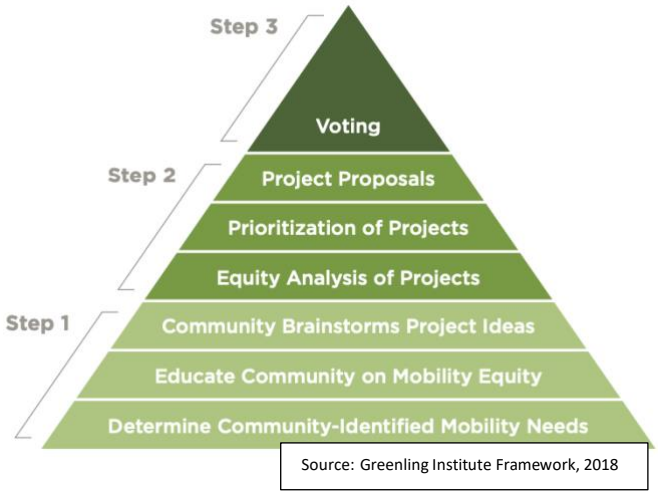
[83] City of Cincinnati, 2023 Green Cincinnati Plan Kickoff Meeting, available at https://archive.org/details/2023-green-cincinnati-plan-kickoff-meeting-5-31-22.
[84] C40 Cities, Green & Healthy Streets program, available at https://www.c40.org/what-we-do/scaling-up-climate-action/transportation/green-and-healthy-streets/.
[85] Energy Solutions, Plug-In Electric Vehicle Infrastructure Cost-Effectiveness Report for San Francisco, 2016 available at http://evchargingpros.com/wp-content/uploads/2017/04/City-of-SF-PEV-Infrastructure-Cost-Effectiveness-Report-2016.pdf.

IV. PUBLIC ENGAGEMENT PROCESS

The analysis in this Report identifying the properties in the City for deploying EV chargers should be followed by meaningful outreach, education, and engagement with the communities which will use these chargers. Process equity, i.e., the engagement of local disadvantaged communities in decision-making, is critical for any equitable outcome. The City should therefore undertake meaningful engagement with the communities before finalizing where to channel the investments.

Greenling Institute's Mobility Equity Framework delineates procedural steps to incorporate equity in transportation policymaking and make it work for all communities.[86] The three-step procedure suggested by the Greenling Institute's Framework is highlighted below:

1. Identify the mobility needs of a specific low-income community of color.
2. Conduct a mobility equity analysis to prioritize transportation modes that best meet those needs while maximizing benefits and minimizing burdens.
3. Place decision-making power in the hands of the local community.[87]



Source: Greenling Institute Framework, 2018

Building on the above, the City should first assess the transportation needs of the communities both in the present and the future by conducting a meaningful outreach and education campaign in all the 17 neighborhoods identified above for channelizing investments. The City should sensitize the communities about the different mobility options at this stage and emphasize how the investments that are being made today (in EV charging infrastructure) will shape the future mobility options for decades to come. For this purpose, the City may partner with local, trusted organizations representing disadvantaged community members in conjunction with technical EV experts. This effort shall then be followed by equity analysis. The Greenling Institute's Framework prescribes 12 mobility indicators to assess if the project increases access to mobility, reduces air pollution, and enhances economic opportunity.

The final step in this process is to present to the communities the City-owned properties that could be potential sites for installation of the EV chargers (plus any other properties/places they identify during the public engagement process). And after that, placing the power in the hands of these

[86] Hana Creger, *et al.*, Mobility Equity Framework, Greenling Institute, 2018, available at https://greenlining.org/wp-content/uploads/2018/03/Mobility-Equity-Framework-Final.pdf (hereinafter, "**Greenling Institute Framework, 2018**").
[87] Greenling Institute Framework, 2018.

communities to decide which of these properties will be best suited for them.

The public investments could be potentially wasted if chargers are installed where they are not needed or are otherwise not an optimal location for installation. Therefore, the City must follow a thorough public engagement process outlined above to ensure the investments benefit the disadvantaged communities. This should be further followed by robust data collection at the implementation stage and the development of crucial progress metrics to measure the project's success.

V. CONCLUSION

The transition to EVs presents a unique opportunity for the City to reduce carbon emissions, improve air quality, and achieve environmental justice. This Report identifies the gaps in the present EV infrastructure in the City. It also delineates the possible steps the City could undertake to ensure that the EVs are accessible to all, particularly for low-income and disadvantaged communities. For the success of this project, a participatory approach to decision-making is necessary, and the voices of disadvantaged communities must be incorporated in both the ideation and implementation of this project to avoid misplacing public investment.

Making the transition to EVs possible for all communities aligns strongly with the City's climate and clean air goals. However, this shall be supplemented by continued efforts to shift mobility to more sustainable modes like transit, biking, pedestrian travel, car sharing, etc. Only with concerted efforts from all directions will the City and its residents be able to achieve the vision of a carbon-neutral Cincinnati by 2050.

Appendix

Below is a list of policy options and best practices for nudging the adoption of EVs in the City of Cincinnati:

1. Given that at-home charging will remain a critical component of EV charging infrastructure, the City should, in collaboration with Duke Energy, explore options of providing incentives to consumers wanting to install EV chargers in their homes. Duke Energy is running incentives in other states,[88] as are many other utilities across the country.[89] However, no such incentives are presently being offered to the residents of Cincinnati.

2. The City should encourage Duke Energy to adjust the cost of electric infrastructure upgrades needed (land assessment, connecting to the grid through digging distribution wires, substations, transformers, and installing the charging unit, etc.) to install EV chargers at their end and not pass it on to customers.[90] Duke Energy is currently running programs to offset some of the cost of make-ready EV sites in other states like North Carolina and Florida,[91] as are many other utilities across the country. [92] Similar or better schemes should also be introduced in Cincinnati, which will considerably reduce the burden on EV drivers.

3. Research indicates that low-income communities are more dependent on incentives for purchasing EVs.[93] The City should also explore the possibility of providing incentives to new and used EV car buyers from these communities for equitable EV adoption. For instance, the Replace Your Ride (RYR) program in the Greater Los Angeles area allows buyers to scrap their old polluting vehicles and provides cost reduction of up to $9,500 to upgrade their car to a hybrid or an EV or get vouchers for carsharing or public transit.[94] Similarly, The Clean Cars 4 All Program, with stricter income caps, more progressive rebate amounts, and greater availability to used car buyers, increased rebate allocation in disadvantaged, lower income, lower education, and Hispanic communities.[95] Given the limited incentives in the State of Ohio to purchase EVs, the City will have to step up to ensure that the buyers are encouraged to switch to EVs. The City could introduce this policy with inbuilt checks to ensure it benefits low-income communities, i.e., by having an income cap, increased rebates for lower-income car buyers, and a vehicle purchase price cap.

[88] Duke Energy, Park & Plug program in North Carolina, available at https://www.duke-energy.com/business/products/park-and-plug.
[89] ACEEE, Siting EVSE Equity, 2021.
[90] Electric Rule 29, Pacific Gas and Electric Company.
[91] Duke Energy, EV Charger Prep Credit, available at https://www.duke-energy.com/home/products/ev-complete/charger-prep-credit.
[92] ACEEE, Siting EVSE Equity, 2021.
[93] Zhang, Y., Qian, Z. S., Sprei, F. & Li, B. The impact of car specifications, prices and incentives for battery electric vehicles in Norway: Choices of heterogeneous consumers. Transportation Research Part C: Emerging Technologies 69, 386–401 (2016). Online: http://dx.doi.org/10.1016/j. trc.2016.06.014., Jenn, A., Lee, J. H., Hardman, S. & Tal, G. An in-depth examination of electric vehicle incentives: consumer heterogeneity and changing response over time. Transportation Research Part A: Policy and Practice 132, 97–109 (2020).
[94] South Coast AQMD, Replace Your Ride program, available at http://www.aqmd.gov/home/programs/community/community-detail?title=ryr.
[95] Ju, Y., Cushing, L. J. & Morello-Frosch, R. An equity analysis of clean vehicle rebate programs in California. *Climatic Change* 162, 2087–2105 (2020).

4. The City already has a policy that waives parking fees for all EVs at city-owned locations and meters.[96] The City could further enact laws to designate select parking spots exclusively for EVs and penalize ICEs should they use designated EV spaces.

5. Raising awareness about available programs and incentives in disadvantaged communities is critical. The City should institute programs to educate the public about EVs and the various benefits that the consumers can avail themselves of when they consider buying EVs.

6. The City should take active steps to simplify and enhance the charging experience. The City should ensure that the sites selected for deployment of EV chargers are safe. In addition, the City should require all EV charger operators to charge the consumers on a per kWh basis instead of a per-minute basis. The City should also require all new public charging stations to offer chip card readers for payment and a computing display to indicate the unit price in whole cents.

7. The City should enter into long-term contracts with the private players who will own and/or operate the chargers to ensure continuity and consistency in user experience. The City should also mandate minimum uptime requirements, i.e., a minimum percentage of the hours in a year that each charger must be functional, maintenance, and repair obligations (stipulating a time to initiate repairs from the notification of a charger being non-functional), etc. to enhance user experience. The City should also ensure that the public charging network is based on open communication standards and protocol.

[96] City of Cincinnati, Free Parking For All-Electric Vehicles, available at https://www.cincinnati-oh.gov/oes/mobility/electric-vehicle-free-parking/.