

# Residential EV Charging Pilot City of Cambridge New Mobility Blueprint

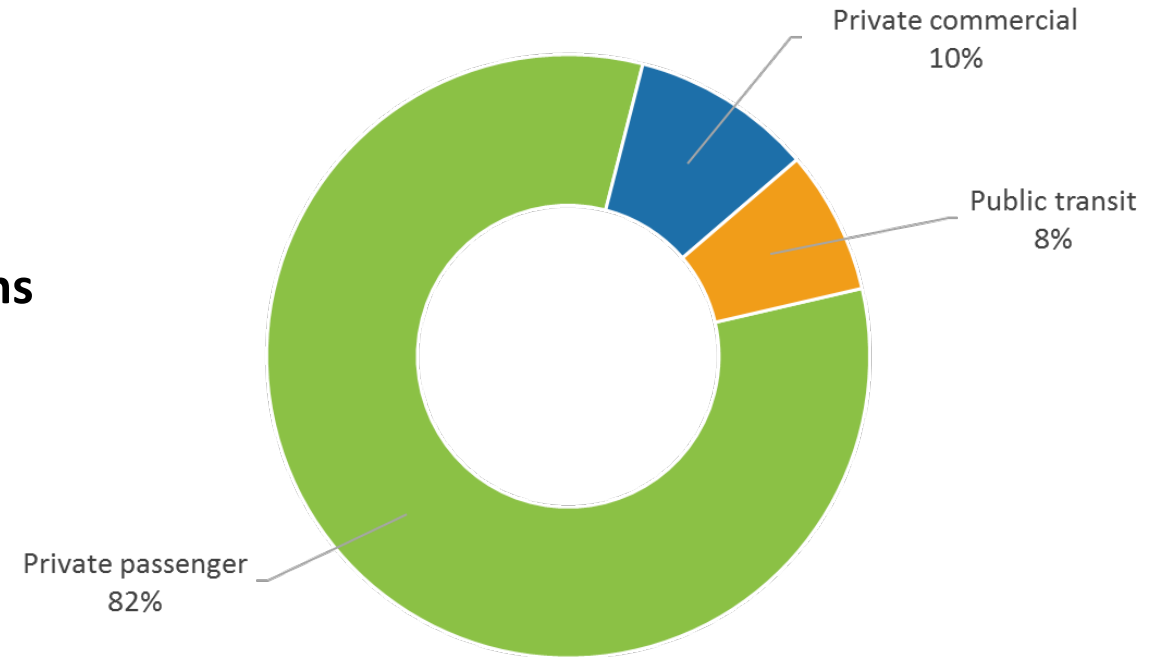
October 16, 2019



# Greenhouse Gas (GHG) Emissions

Transportation accounts for...

- 29% of U.S. emissions
- 43% of MA emissions
- 11% of Cambridge emissions\*
- **82% of Cambridge transportation sector emissions are from private passenger vehicles**



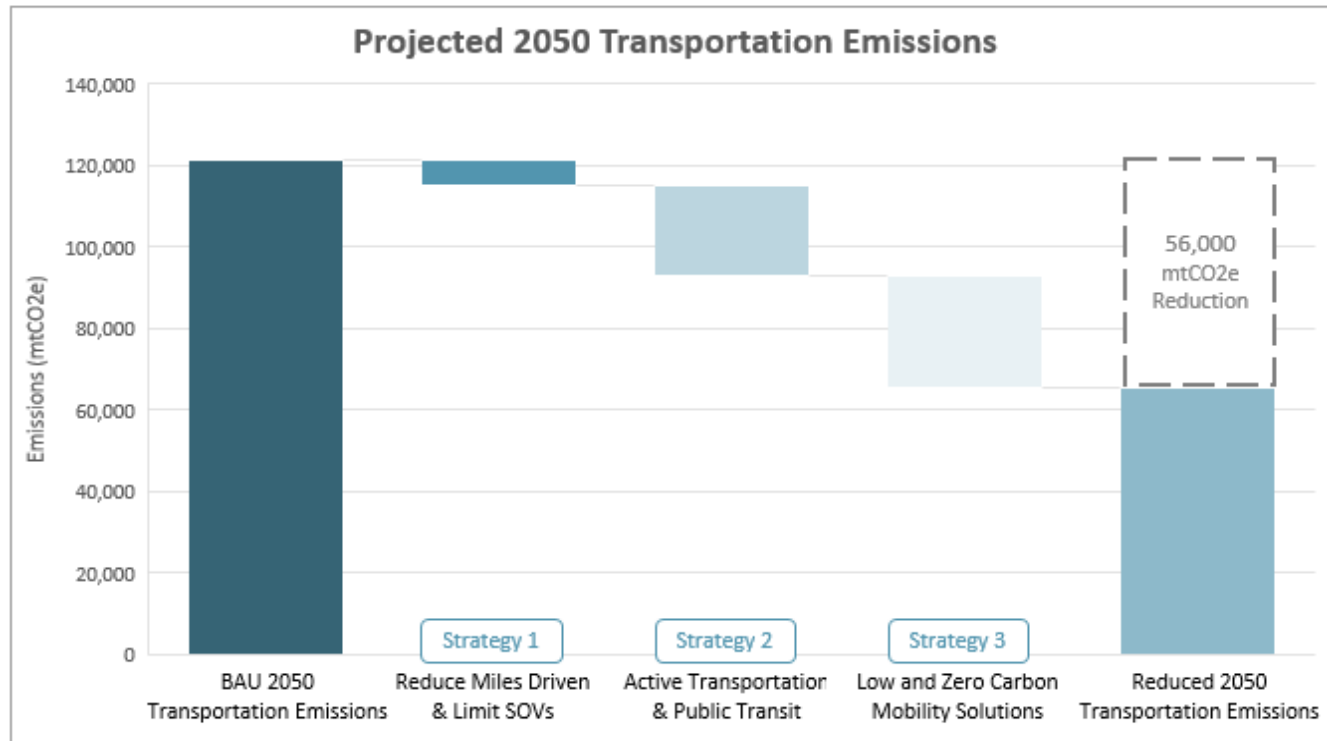
\*Includes: vehicles registered in Cambridge, a portion of public transit emissions

\*Doesn't include: emissions generated from trips starting outside and ending in the City, emissions from trips made through the City.

While not easily measured, the City should continue to use available policy levers to reduce and electrify trips starting outside and ending in the City, and trips through the City.

# Transportation Sector Strategies

- Mode shift alone is unlikely to achieve net zero emissions by 2050.
- Electrification of the transportation sector remains a key strategy to reduce emissions.



## Key Assumptions for projected emissions

### Commute Mode Shift by 2050

- Biking 13% to 20%
- Rail 14% to 25%
- Bus 10% to 20%
- Passenger vehicle 48% to 25%

### Passenger % of Sales by 2050

- Plug in electric vehicles .5% to 78%
- Hybrid electric vehicle .5% to 2%

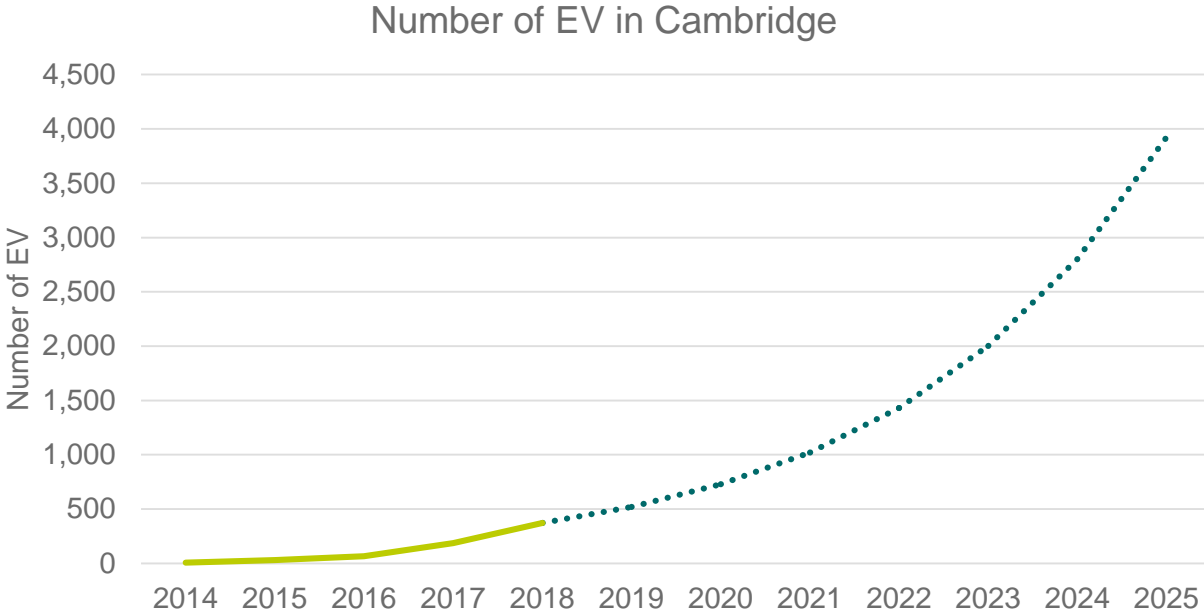
### Grid by 2050

- RGGI & RPS by 2030
- Same trajectory 2030-2050

# Automobile EV Growth

The State goal is to have 300,000 EVs on the road by 2025.

- For Cambridge to contribute proportionally to the State goal, it should have ~4000 EV by 2025.
- Barriers to EV ownership need to be addressed to accelerate EV adoption beyond the early adopters



Data Source: MA DOER EV Rebate Data

# EV Barriers

## Range Anxiety

- *99% of trips are under 70 miles, most EVs have 100+ miles of range*

## Cost

- *Incentives bring EVs in line with average new vehicle MSRPs*
- *Used market is growing*

## Technology Uncertainty

- *Lease options alleviate fear of being locked in*

## Access to EV Charging

- ***Primary at home charging for “garage free”***
- *Secondary transportation corridors and workplace charging*







**80%**

**of charging is  
expected to take  
place at home**

**20%**

**Public charging**

- retail/commercial lots
- transportation corridors
- Workplace charging
- Level 2 and Level 3



# 80%

of residents don't  
have an "at home"  
EV charging  
solution

## 80% of registered vehicles use on-street parking

Passenger vehicles registered in Cambridge ~41,000  
Resident on-street parking stickers issued ~33,000

## 80% of housing units are in 3+ unit multifamily buildings

Type of Housing <sup>1</sup>	ALL UNITS	
	Count	Percent of Total
Single Family	3,780	7.2%
Two Family	6,976	13.2%
Three Family	6,216	11.8%
4 to 6 Units	5,019	9.5%
7 to 25 Units	6,259	11.8%
26 to 50 Units	3,995	7.6%
51 to 100 Units	5,659	10.7%
Over 100 Units	14,918	28.2%
<b>Total Units</b>	<b>52,822</b>	<b>100%</b>

# Access to EV Charging

## City Actions To Date

### 2012 – DOER Grant Funding

- Installed 8 publicly accessible EV charging stations in highly visible, commercial areas
  - 3 were in municipal owned parking lots
  - 5 were in privately owned public retail or workplace parking
- 147 Hampshire St.
  - First St. Garage
  - Bishop Allen St., Lot #5
  - Porter Square Shopping Center
  - Cambridgeside Galleria
  - Boston Properties West Garage
  - MIT garage, Brookline St.
  - MIT garage, Vassar St.

### 2019 – City and Utility Funding

- \$100,000 in City capital funds to expand the public EV charging network
  - Eversource Makeready funds made available to cover electrical work up to the EV charging station
  - Combining these funding sources, the City is installing EV charging stations in 7 municipal parking lots
- 375 Green St.
  - 420 Green St.
  - 7 Warren St.
  - 99 Sherman St.
  - 73 Sherman St.
  - 177 Garden St.
  - 341 Rindge Ave



# Access to EV charging

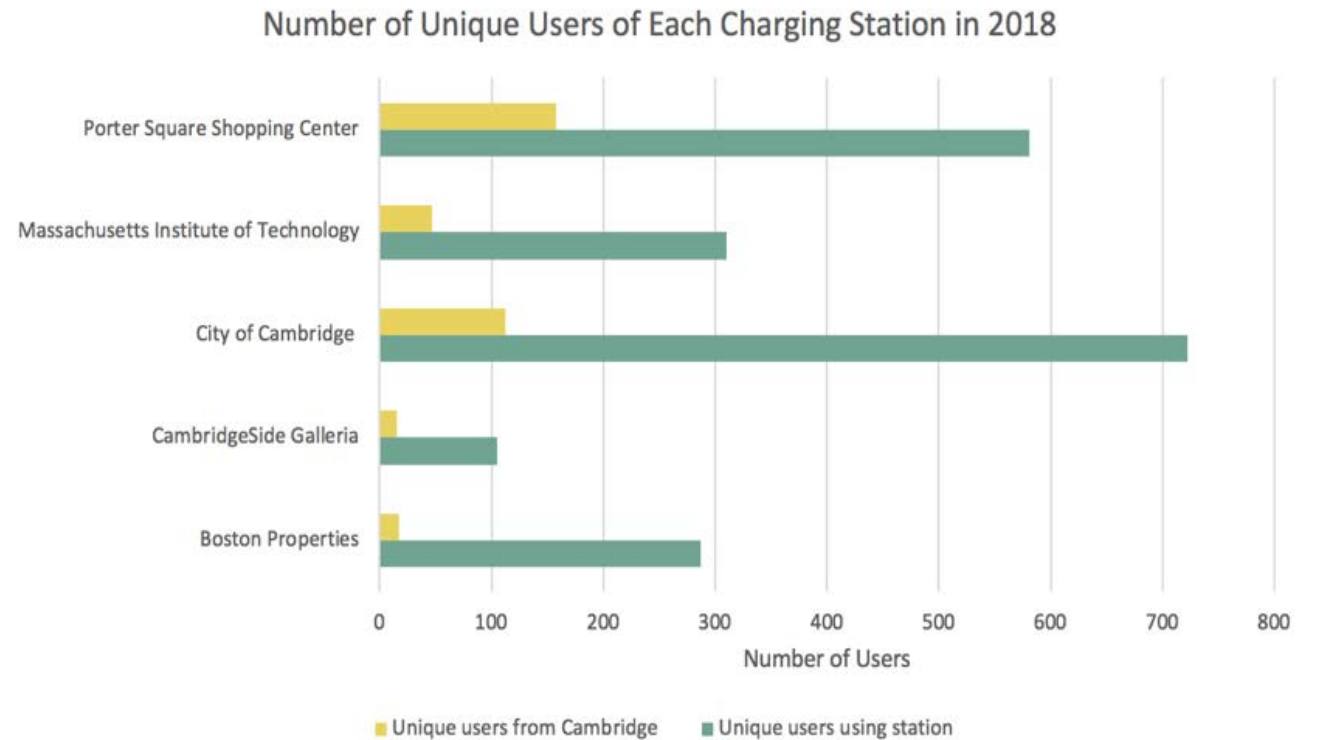
Most public EV charging stations do not provide “at home like” charging.

- Charging at EVSE in commercial lots can be prohibitively expensive as a primary source of charging due to hourly parking fees
  - First St. garage costs \$2.00per hour
  - Kendall Center garage costs \$31.00 for 3 hours
- Time limits and hours of access limit ability to get a charge



# Access to EV Charging

- Chargers are open to the general public. Residents “compete” with visitors for use of EV charging stations.
- EV charging locations are not convenient or close enough to home for overnight charging





# New Mobility Blueprint

## New Mobility Blueprint

### Understand the Present State

Policy Audit

Trends Assessment

### Plan for the Future

Residential  
EV Charging Pilot

Implementation Blueprint

Proposed Regulatory  
Strategy

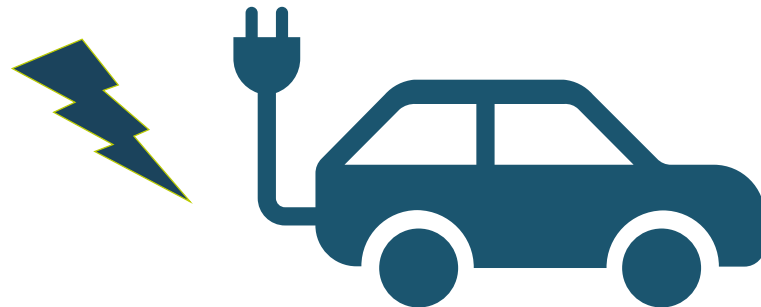
Public Engagement  
Approach

## Residential EV Charging Pilot Goal

The City of Cambridge aims to be carbon neutral by 2050.

Emissions from vehicles registered in Cambridge equate to approximately 92% of Cambridge's transportation emissions. Transitioning these vehicles from gasoline to electric is an important strategy for reducing emissions.

However, a significant barrier to EV adoption in Cambridge is the lack of "at home" charging, which is expected to be the primary source of charging for EV owners. Recommendations to expand the EVSE network are needed to support EV adoption in a way that's equitable across The City.





# Pilot Design Methodology

## 1. Analyze EV Charging Use Case



### Use Case

- Cambridge resident
- Current car owner
- No access to EV charging (no driveway)
- Relies on car for commute and/or for personal travel

### Parking Type

*Private off-street*

*Parking lots*

*Workplace*

**Curbside**  
*Pilot focus*



## 2. Select Two Neighborhoods

- Agassiz
- Area 2/MIT
- Cambridge Highlands
- Cambridgeport
- East Cambridge
- Mid-Cambridge
- Neighborhood 9
- North Cambridge
- Riverside
- Strawberry Hill
- The Port
- Wellington-Harrington
- West Cambridge



### Utility Score

- % residential lots with driveways
- # residents per driveway
- # permits per acre
- % households with 2+ cars

### Equity Score

- Household median income
- Affordable housing
- EJ community

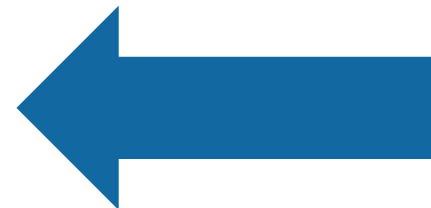


Select two neighborhoods to move forward with EV Pilot



## 4. Implement Pilot

- Implement pilot
- Monitoring & Evaluation
- Determine next steps for - EVSE network expansion



## 3. Evaluate EV Charging Design

### Constraints Based Analysis

- Clearances
- ADA
- Curb cuts/tress/street infrastructure etc.

### Evaluate EVSE Solutions

- EVSE Configuration
- Hardware/software products
- Ownership/partnership models
- Parking policies, regulations
- Use fees

# EV Charging Use Case



## BEV (Battery Electric Vehicle)

- Drivers must use charging infrastructure to fuel their car
- Home charging is expected to meet 80% of charging needs
- Drivers are less likely to switch to a BEV if they live in a one car household and/or they do not have reliable and convenient charging



## Plug-in Hybrid Electric Vehicle (PHEV)

- Drivers can meet most of their daily driving needs on electric, but have gasoline as backup
- Drivers charge when possible but will not go out of their way to charge
- Drivers are more likely to switch to Plug-in hybrid, rather than a BEV, if they live in a one car household and/or they do not have reliable and convenient charging



# EV Charging Use Case



Battery Electric Vehicle

118 miles

1.3

23.6

5.9

1.0

Average vehicle range\*

Number of charges needed per week\*\*

Level 1: Time for full charge

Level 2: Time for full charge

Level 3: Time for full charge



Plug-In Hybrid Vehicle

30 miles

5.0

6.0

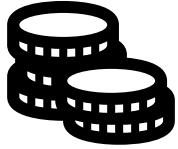
1.5

.3

\* From 2018 US EVs on the market, subtracting Tesla Model S and Model X

\*\* based on the average daily VMT for vehicles registered in Cambridge of 21.5 miles per day, and assuming the average battery is fully drained before being fully charged. average daily VMT data source is the MAPC's Massachusetts Vehicle Census data used for the Community GHG Inventory. Weekday VMT is not available separate from weekend VMT.

# Utility and Equity Scoring



*Utility score for EV charging is evaluated for each neighborhood based on the existing driveway and parking data in each neighborhood. Higher utility score includes a higher number of residential lots without driveways, greater number of residents per driveway, higher number of vehicles per household, and greater number of parking permits per acre.*

- 1 = Lower utility for public residential EVSE usage than other neighborhoods
- 3 = Higher utility for public residential EVSE usage than other neighborhoods



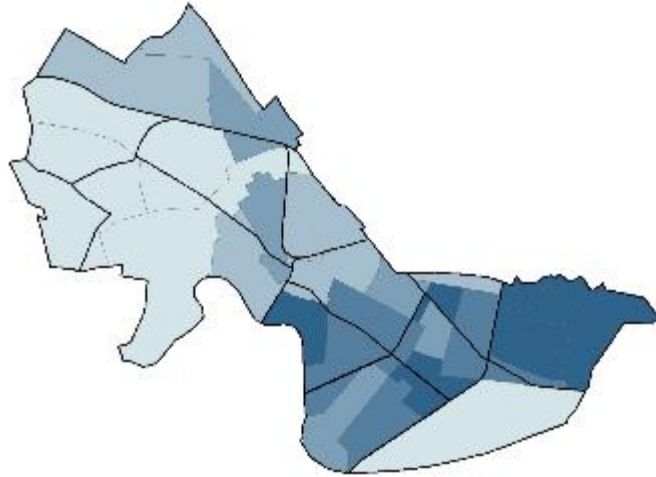
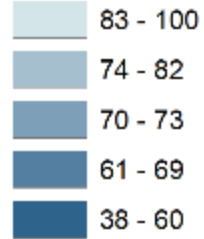
*Equity score is evaluated based on the median income levels in the census areas.*

- 1 = Higher household income compared to other census tracts
- 3 = Lower household income compared to other census tracts

# Utility Scoring - Existing Driving and Parking Data

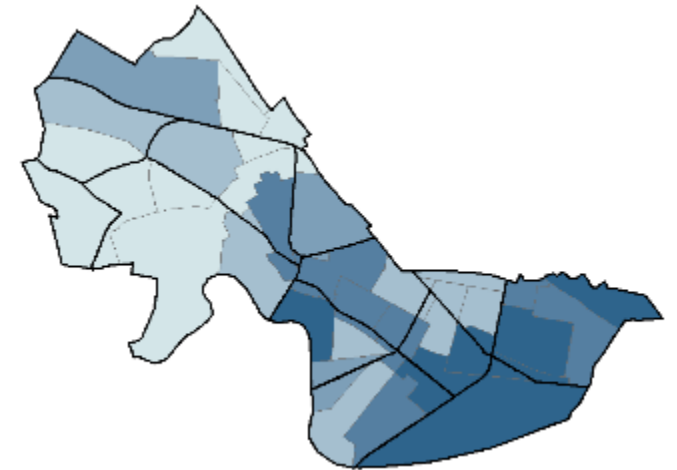
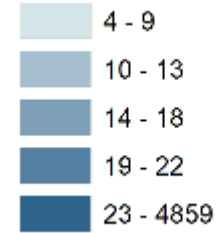
## Percent of residential lots with driveways

Darker areas have lower percent of residential lots with driveways



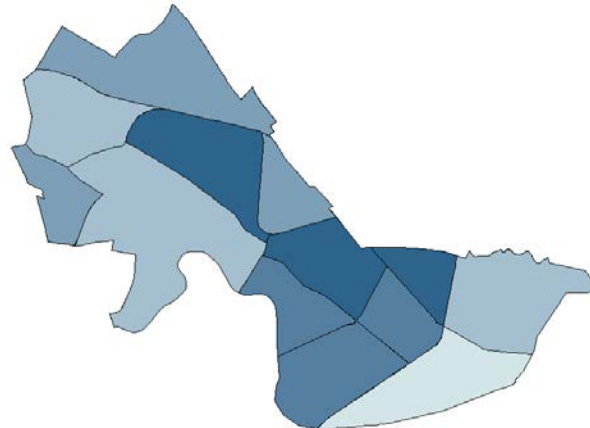
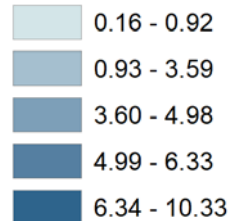
## Number of residents per driveway

Darker areas have more residents per driveway



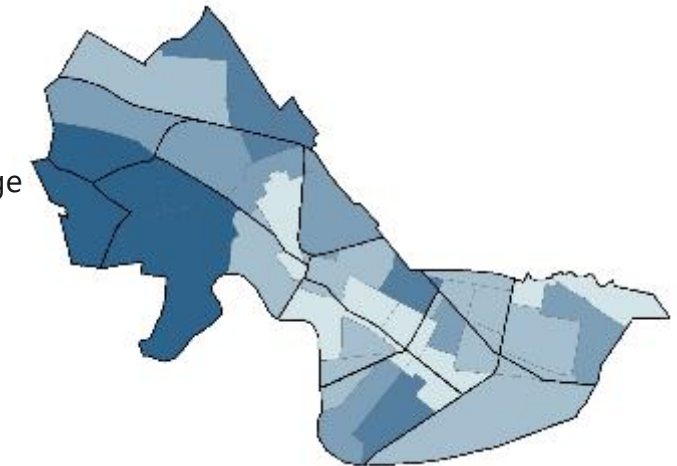
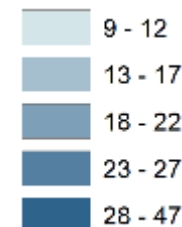
## Number of resident parking permits per acre

Darker areas have more parking permits per acre



## Percent of households with 2+ vehicles

Darker areas have a higher percentage of households with 2+ vehicles  
Assume targeting households with less than 2 vehicles (lighter areas)

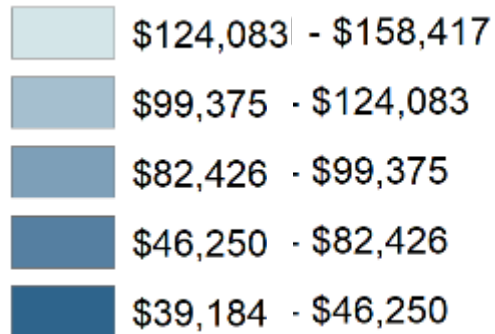
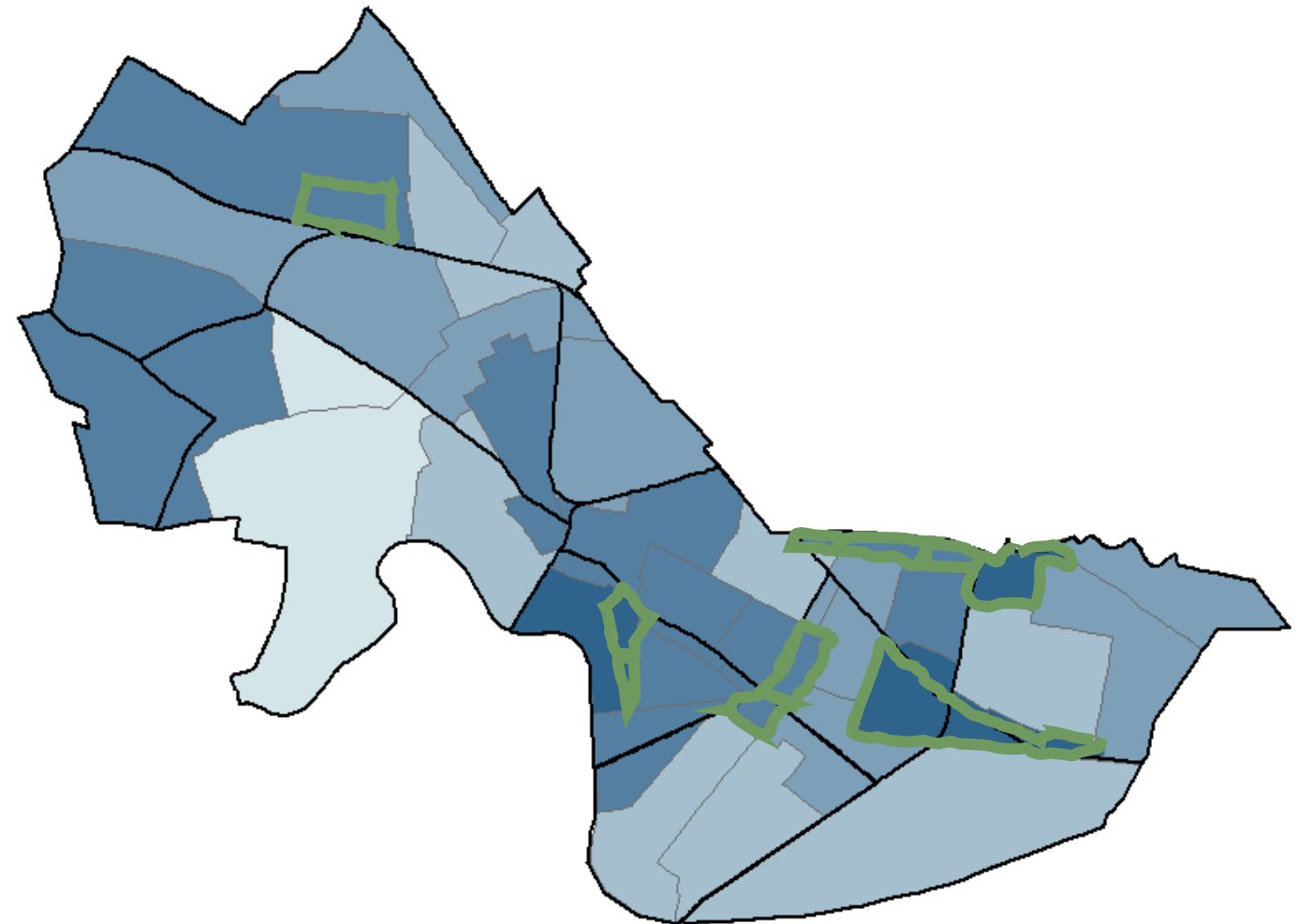


Data from 2010 Census and City of Cambridge GIS Database



# Equity Scoring - Household Income Distribution in Cambridge

- Darker areas have a lower household median income than lighter areas; affordable housing is also accounted for in siting selection.
- Green highlighted areas represent State of Massachusetts Environmental Justice Communities.



# Neighborhood Selection Scoring Summary

*Below is the scoring matrix using raw cost effectiveness and equity scores. Weights can be applied to the scores based on importance. Higher score is more suitable for this pilot.*

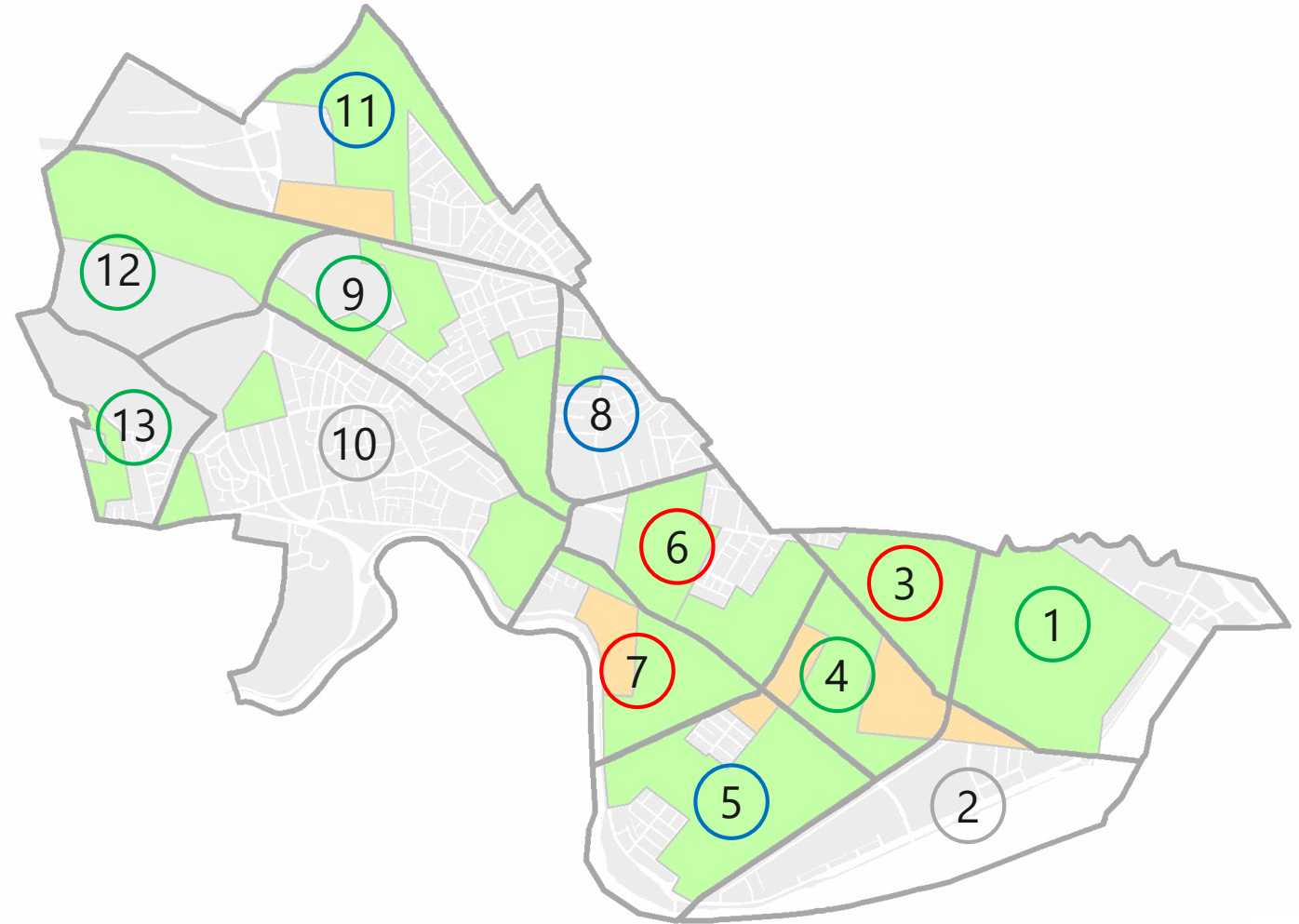
	Utility Score	Equity Score	Total Score
Agassiz	2	2	4
Area 2/MIT	1	1	2
Cambridge Highlands	2	3	5
Cambridgeport	3	1	4
East Cambridge	3	2	5
Mid-Cambridge	3	3	6
Neighborhood 9	3	2	5
North Cambridge	2	2	4
Riverside	3	3	6
Strawberry Hill	2	3	5
The Port	3	2	5
Wellington-Harrington	3	3	6
West Cambridge	1	1	2

# Equity Scoring – Environmental Justice Communities

## Legend

- 6 Neighborhood Score
- 5 Neighborhood Score
- 4 Neighborhood Score
- ≤3 Neighborhood Score

- 1 Factor
- 2-3 Factor



## List of Neighborhood Names

1 East Cambridge	8 Agassiz
2 Area 2/MIT	9 Neighborhood Nine
3 Wellington-Harrington	10 West Cambridge
4 The Port	11 North Cambridge
5 Cambridgeport	12 Cambridge Highlands
6 Mid-Cambridge	13 Strawberry Hill
7 Riverside	

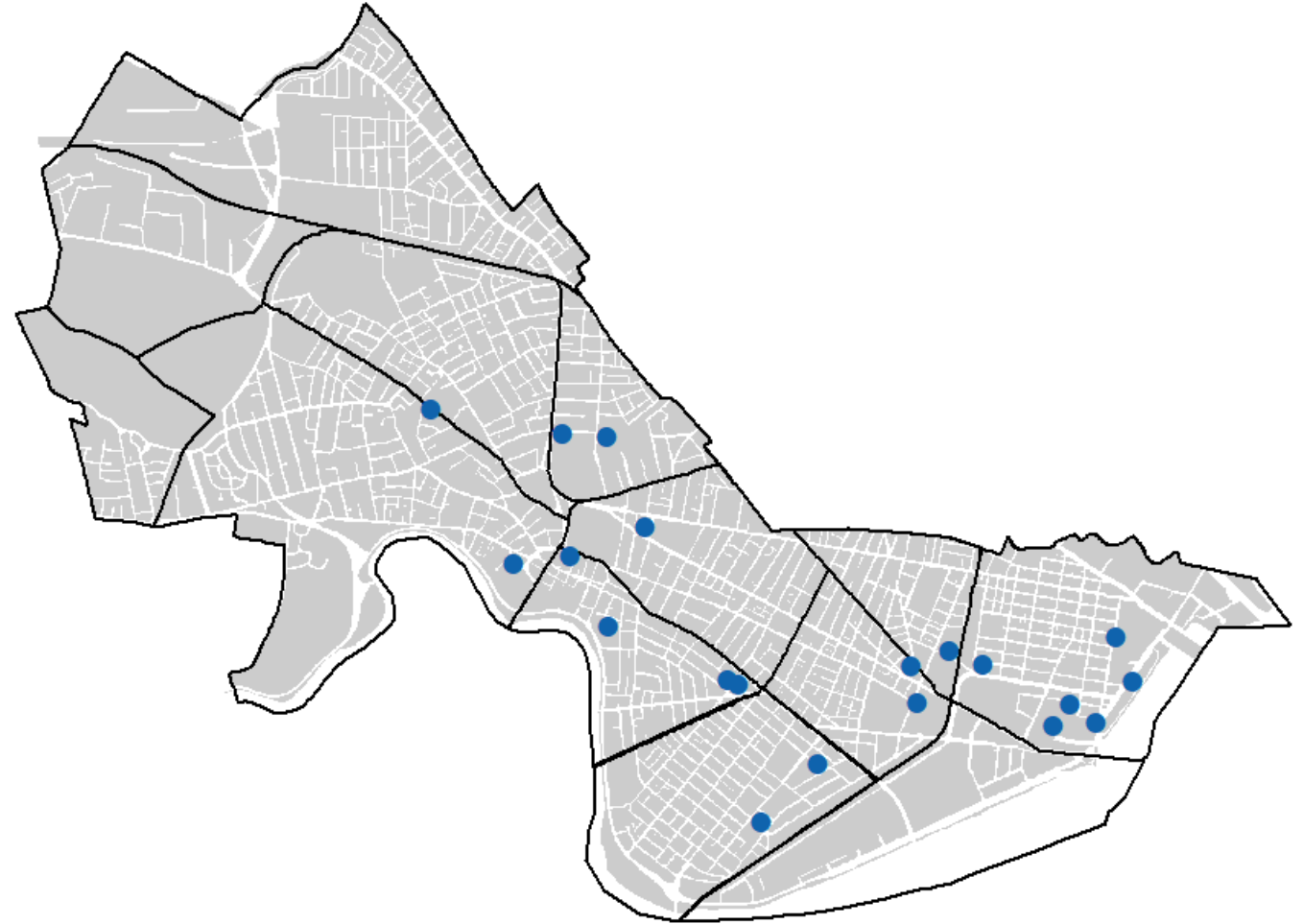


# Current Public EVSE

- In addition to scoring neighborhoods, consider where public EVSE is currently located,
- Concentrating EVSE may be beneficial, as it can help to create a stronger network effect in a neighborhood.
- Installing more EVSE in neighborhoods that already have some EVSE stations could trigger concerns about the distribution of benefits.
- It is important to note that existing public EVSE does not meet the use case this pilot is solving for, as many public EVSE has parking restrictions or additional costs that make it dissimilar from “at home” charging.

## Legend


- Current public EVSE

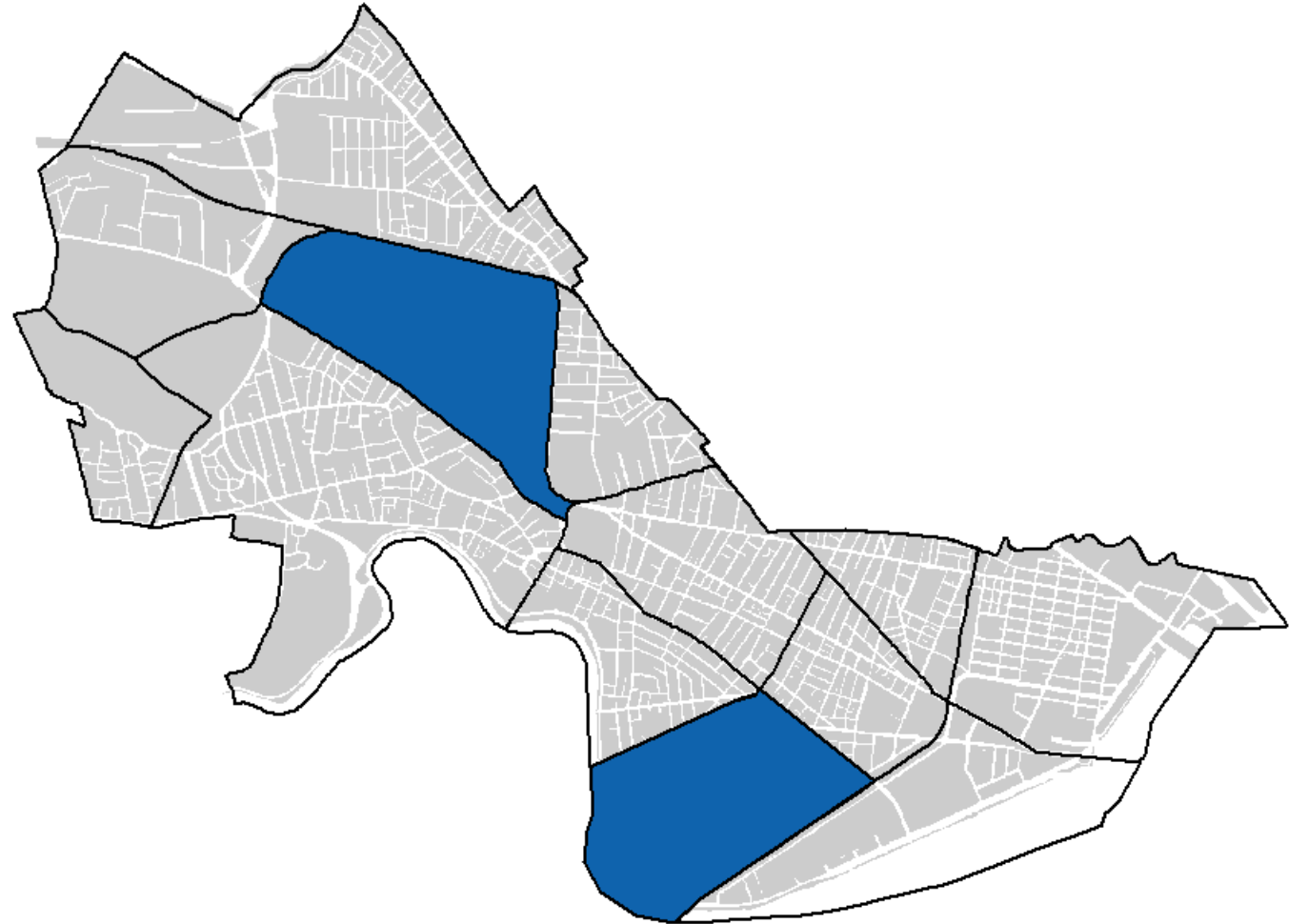


# Additional Considerations

- Highlighted neighborhoods had the most EVSE installation requests
- Meetings with DPW and Traffic and Parking provide insights into street level constraints and opportunities
  - Places where the City owns light poles for pole mounted options
  - Avoid streets slated for bike facilities
  - Avoid areas where residential parking is tight

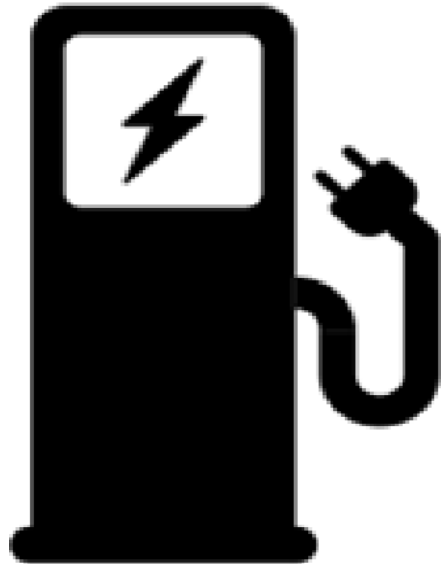
## Legend

-  Neighborhood with a high # of EV Charging Station Requests



# EV Charging Overview

There are three main types of EV charging; Level 1, Level 2, and Level 3/DC fast charging. Each charging type has different equipment, power requirements, and charging speeds. Pros and cons of the different charging types are explored below.



## Level 1 chargers

SAEJ1772 charge ports,  
120V outlet

4-6 miles of range per 1 hour of charging.

## Level 2 chargers

SAEJ1772 charge ports  
240 V outlet

10-25 miles of range per 1 hour of  
charging.

## Level 3 DC fast chargers

SAEJ1772 Combo, CHAdeMO, or Tesla  
ports, 480 V plug

75 – 270 miles of range per hour of  
charging

Pros	Cons/Challenges
<ul style="list-style-type: none"> <li>• Best energy management option</li> <li>• Low cost equipment</li> <li>• No electrical upgrades needed</li> <li>• Minimal space needed for EVSE</li> </ul>	<ul style="list-style-type: none"> <li>• Slowest charging time</li> </ul>
<ul style="list-style-type: none"> <li>• Moderate energy management</li> <li>• Basic equipment is low cost</li> <li>• Minimal electrical upgrades needed</li> <li>• Small amount of space needed for EVSE relative to level 3</li> <li>• Faster charging than level 1</li> </ul>	<ul style="list-style-type: none"> <li>• Faster charging time compared to level 1</li> <li>• Public EVSE equipment and installation costs are \$10,000 +</li> </ul>
<ul style="list-style-type: none"> <li>• Fastest charging time (30 mins to ~1 hour)</li> </ul>	<ul style="list-style-type: none"> <li>• EVSE equipment and installation can cost \$40,000+</li> <li>• High utility demand charges</li> <li>• A lot of space needed for EVSE</li> <li>• Different charge ports than for level 1 and level 2.</li> <li>• Not all car models available in the market can accept a Level 3 charge</li> </ul>



# EV Charging Pilot Design

*There are many hardware, software, and service features to consider when selecting an EVSE vendor.. Considerations may change depending on field conditions, and whether Level 1, Level 2, or Level 3 charging is used.*

## Primary Considerations

*Features to be evaluated, and included as specifications in RFP for pilot implementation*

- Charging speed/level
- Number of stations/ports
- Open vs. closed charging
  - Open charging allows EV charging stations and central management systems from different vendors to communicate with each other*
- Payment platforms
- Cable management
- Accessibility (ADA) and safety

## Additional Considerations

*Features to be evaluated more closely during pilot evaluation, and may be added to specifications for future network expansion*

- Warranty and maintenance
- Connection to power utility (demand pricing/V2G)
- Branding or advertising space
- Other ownership/partnership models

# Introduction to Ownership Models

*Two basic models are being investigated for ownership and operation over the lifecycle of the EVSE*

Model Type	Overview
<p>In-House Model</p>	<ul style="list-style-type: none"> <li>Set up a new, fully-resourced in-house partnership to manage the installation and day-to-day management of EVSE in residential areas across Cambridge.</li> </ul>
<p>Outsourced Model</p>	<ul style="list-style-type: none"> <li>Set up a contract for the EVSE installation and associated maintenance responsibilities by a Delivery Partner; City selects Delivery Partner and manages the contract</li> <li>Delivery Partner is responsible for EVSE installation and associated subcontracts</li> </ul> <p><u>Option 1: Contract-only solution</u></p> <ul style="list-style-type: none"> <li>The Delivery Partner is paid contractually by the City only and will be responsible for installation, management and day-to-day functioning of the EVSE network in locations for charging infrastructure identified by The City.</li> </ul> <p><u>Option 2: Profit sharing solution</u></p> <ul style="list-style-type: none"> <li>The Delivery Partner has more control than Option 1. The City is paid by the delivery partner for leased station land, with permissible locations for charging infrastructure stipulated in advance by The City. The Delivery Partner manages costs and keeps revenue.</li> </ul>

# Constraints Overview

*Below are the minimum clearances initially proposed for siting EVSE. In addition, installation priorities should be considered after meeting all minimum clearances. Depending on the vendor selected, the siting constraints may change.*

## Minimum Clearances

- 5'** minimum clear path of travel (ADA) on sidewalk
- 5'** from a building entrance
- 5'** from a curb cut
- 5'** minimum from sign and legal furniture
- 5'-6'** minimum distance from underground utilities
- 8'** preferred clear path of travel on sidewalk
- 10'** from the trunk of a street tree or 5' from the edge of a tree pit
- 10'** clearance from corner
- 15'** from the open side of a T-stop entrance or bus stop
- 15'** from fire hydrant
- 18"** minimum setback from curb and siting in the amenity strip
- 25'** clearance from the main entrance of a major building, school, or hospital

## Installation Priorities

- *Residential only parking spots*
- *Not metered parking spots*
- Proximity to an electric panel
- Cellular network availability
- ADA compliance
- Driver's side (left-hand) installations for safety on one-way roads
- Installations in the first legal parking space after the intersection
- Maximum station visibility for safety
- Opportunities to minimize visual clutter
- Away from low point/ponding areas
- 6" curb height



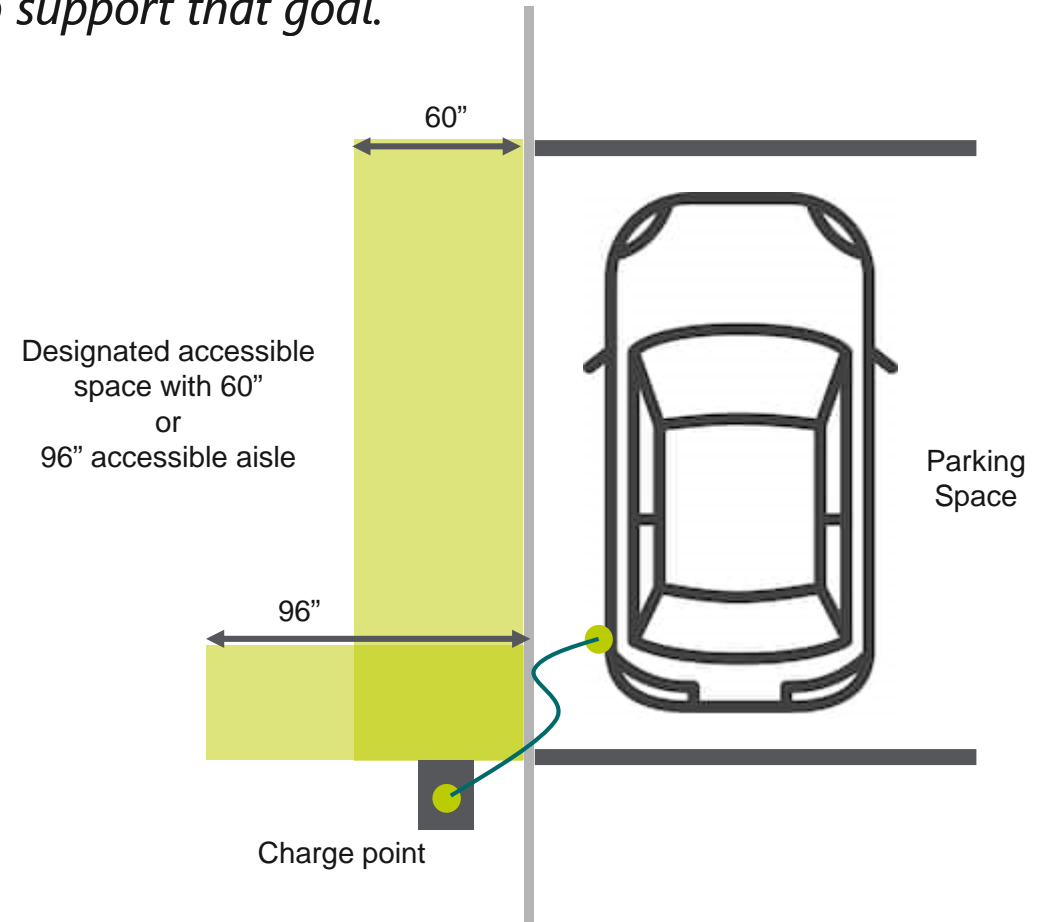
# ADA Accessibility

*The ADA does not provide design standards for parking spaces with charging stations but has developed best practices for installing ADA-compliant charging stations. The City should decide on goals for providing ADA compliant EV charging and develop its own best practices to support that goal.*

## Best Practices

- Parking spaces meet ADA street parking requirements
- Charging equipment does not encroach parking space, pedestrian paths, or accessible isles.

*Clearance standards will be developed for EV chargers, similar to City efforts for bike parking.*



*Clearance standards will be developed for EV chargers, similar to City efforts for bike parking. (City of Cambridge Bicycle Parking Guide)*

# Next Steps

## 1. Analyze EV Charging Use Case



## 2. Select Two Neighborhoods

- a. A detailed constraints based analysis will be completed for Neighborhood 9, and selected areas of Cambridgeport and The Port.

## 3. Evaluate EV Charging Design

- a. Finalize siting considerations for EVSE with other City stakeholders
- b. Coordinate with Eversource on suitable locations for EVSE
- c. Conduct vendor and partnership analysis
- d. Perform detailed desktop constraints analysis on the two selected neighborhoods
- e. Evaluate policies and use fees for the pilot

## 4. Implement Pilot

- a. Community outreach/public process