

Trends Assessments City of Cambridge New Mobility Blueprint

October 7, 2019



New Mobility Blueprint

Purpose:

The goal of the New Mobility Blueprint is to develop actionable recommendations for policy, programs, and regulations that will help the City implement new mobility options in a way that aligns with and advances existing values and policies.

New Mobility Blueprint

Understand the Present State

Policy Audit

Trends Assessment

Plan for the Future

EV Pilot

Implementation Blueprint

Proposed Regulatory Strategy

Public Engagement Approach



Executive Summary

Preparing for the future of mobility requires a thorough understanding of the current mobility ecosystem. The New Mobility Blueprint Trends Assessment identifies current trends for existing modes in Cambridge. The goal is to identify barriers and opportunities to prepare the City for a better and cleaner transportation future.

Introduction

With this Trends Assessment, we identify barriers and opportunities that would allow Cambridge to shape how new mobility options are implemented, in order to strive towards and prepare for an improved, safer, more equitable transportation experience.

We take a people-centric approach to the New Mobility Blueprint, with a key emphasis on people journeys. The goal was to understand trends at both a high-level and detailed scale—for specific modes, as well as for the transportation ecosystem in its entirety—in order to better understand and identify changes over time.

The assessment relied on datasets including the American Community Survey (ACS), data from the City of Cambridge, anonymized GPS data, and others.





People Journeys

People Journeys

Commuting Patterns

Modes Assessment

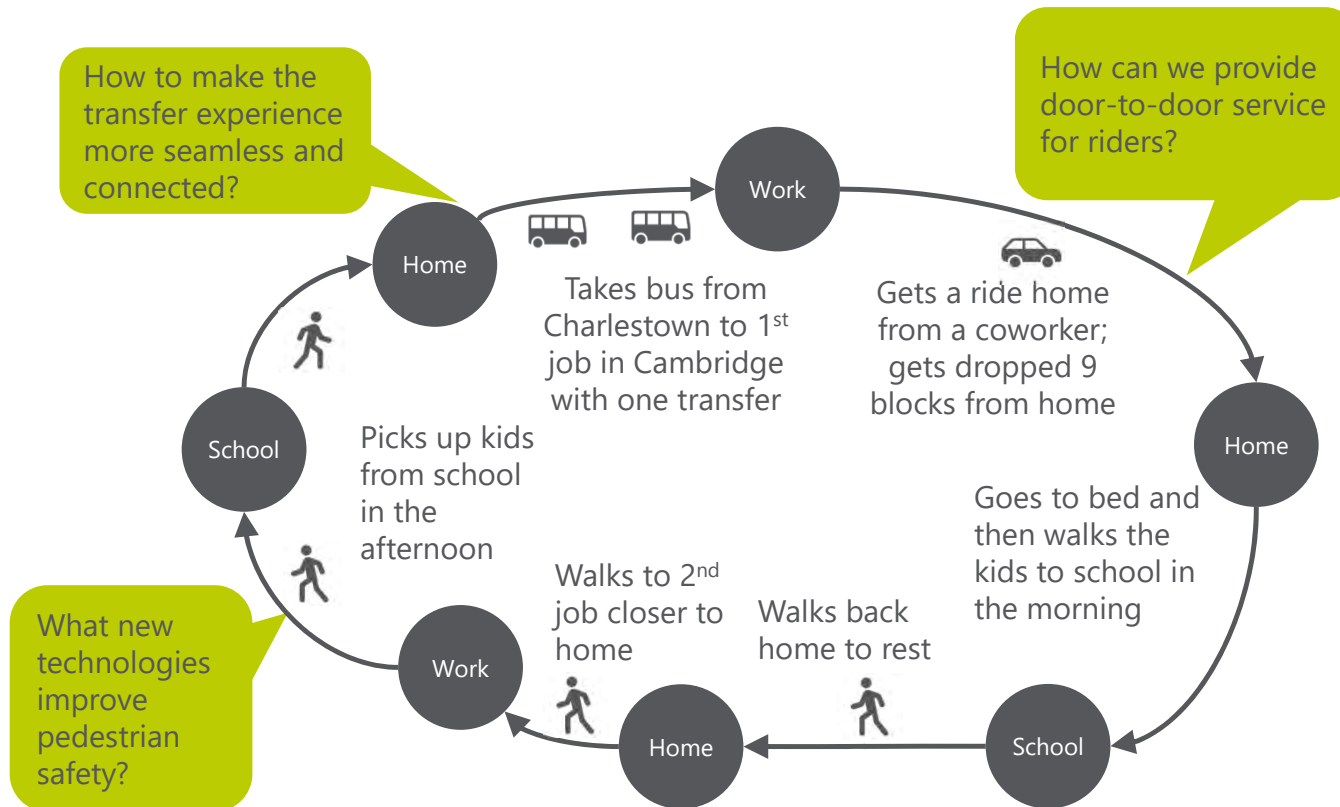
Traffic/Crashes

People Journeys

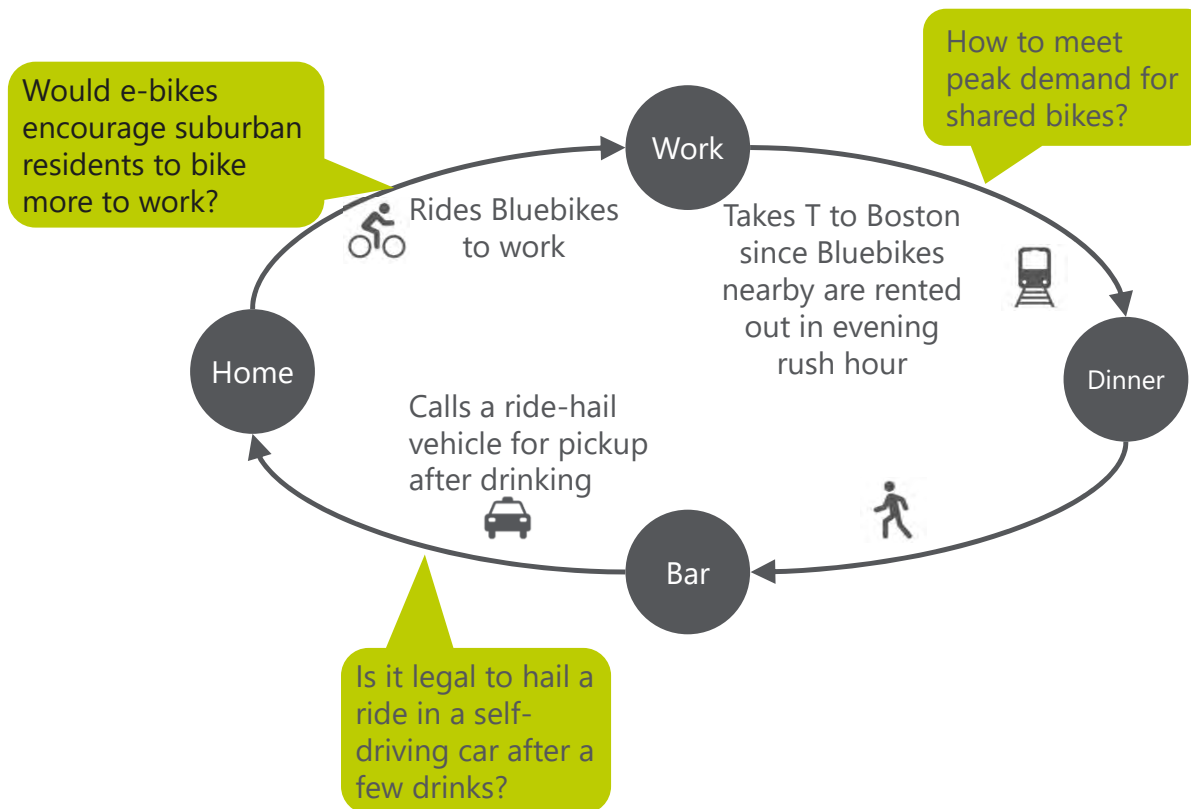


The City of Cambridge is focused on helping people move around efficiently, safely, and equitably. Six scenarios represent a sample of the daily choices people make using transportation options currently available, to ground future policy discussions in the human experience.

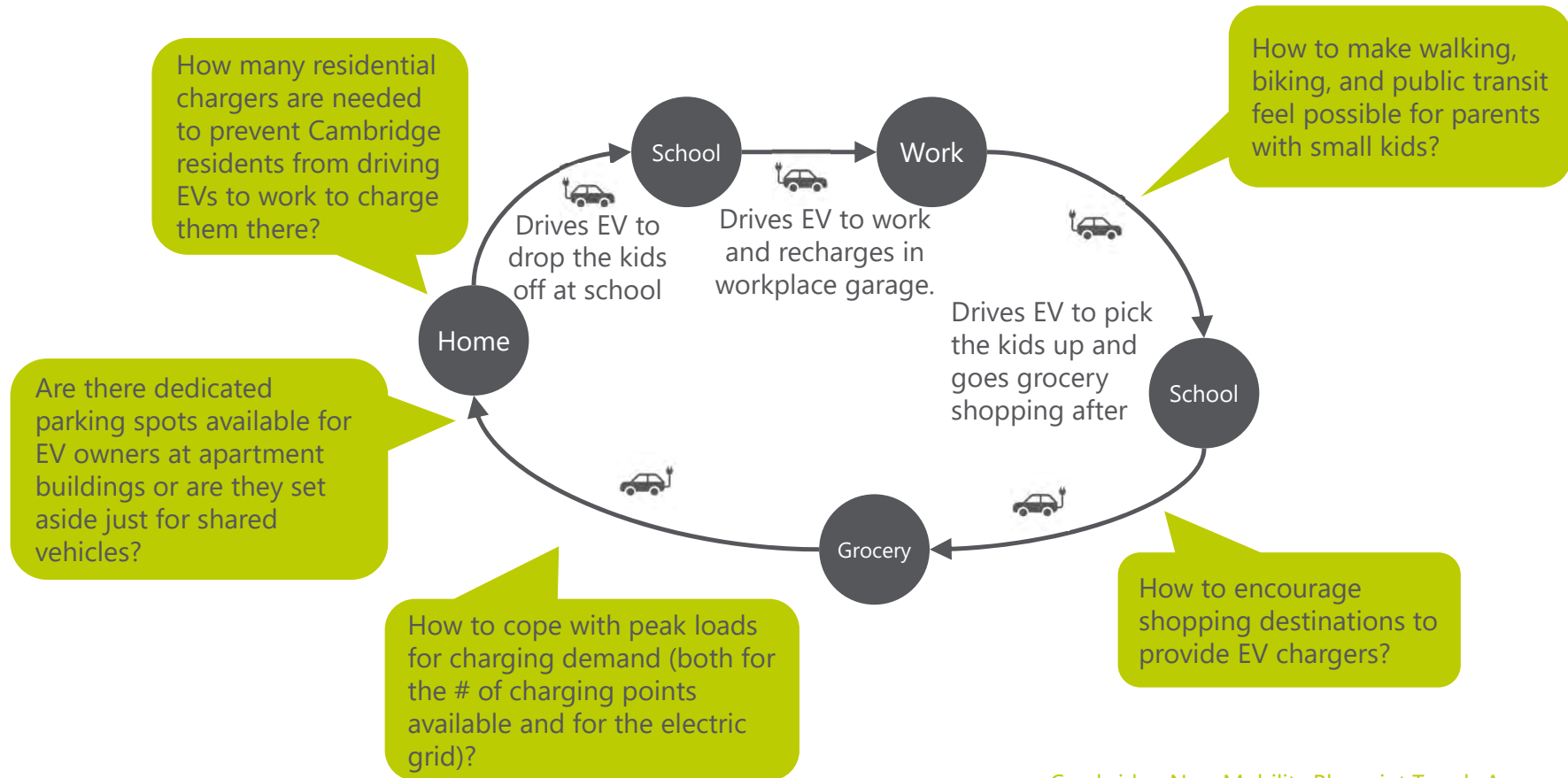
Scenario 1 – Restaurant Worker



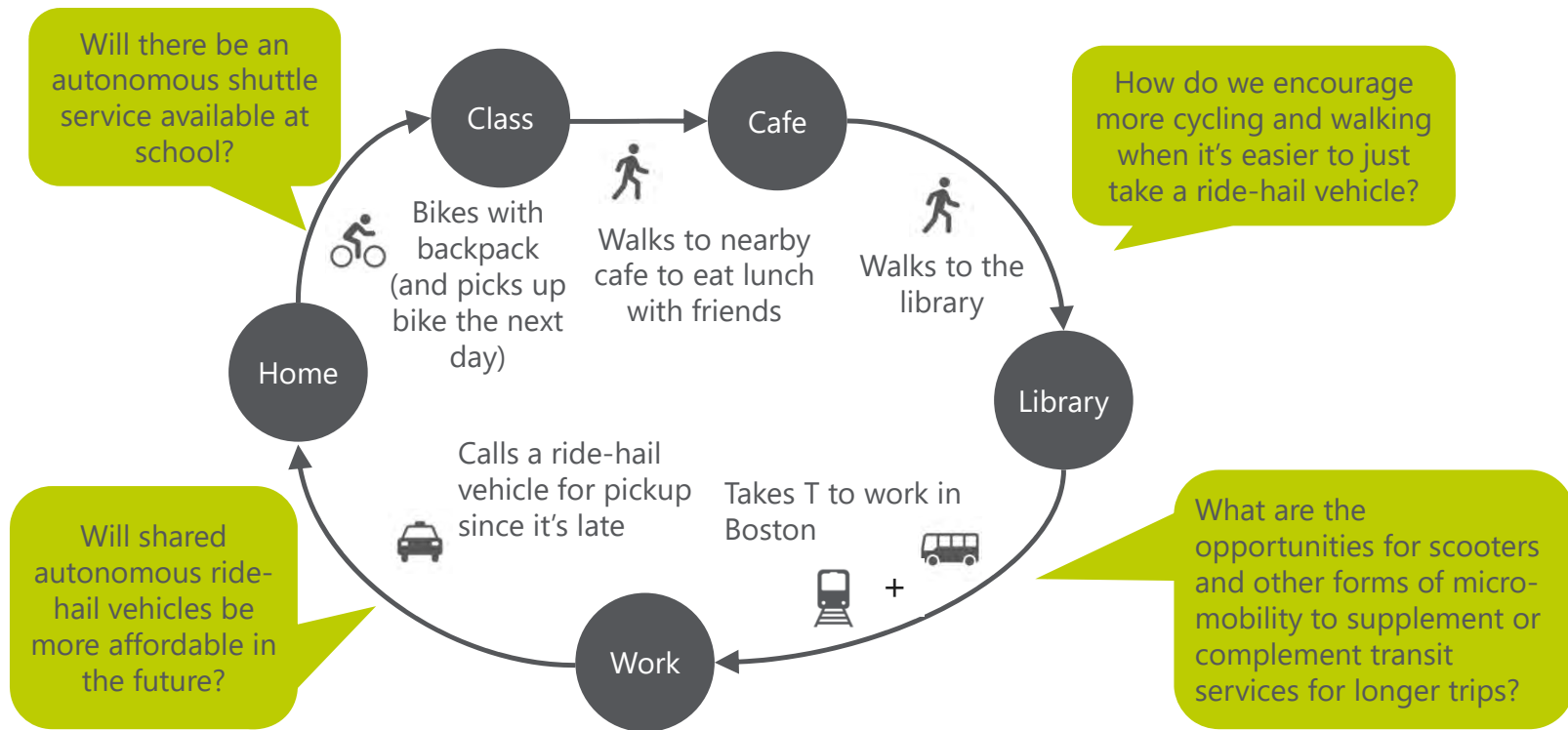
Scenario 2 – Young Biotech Worker



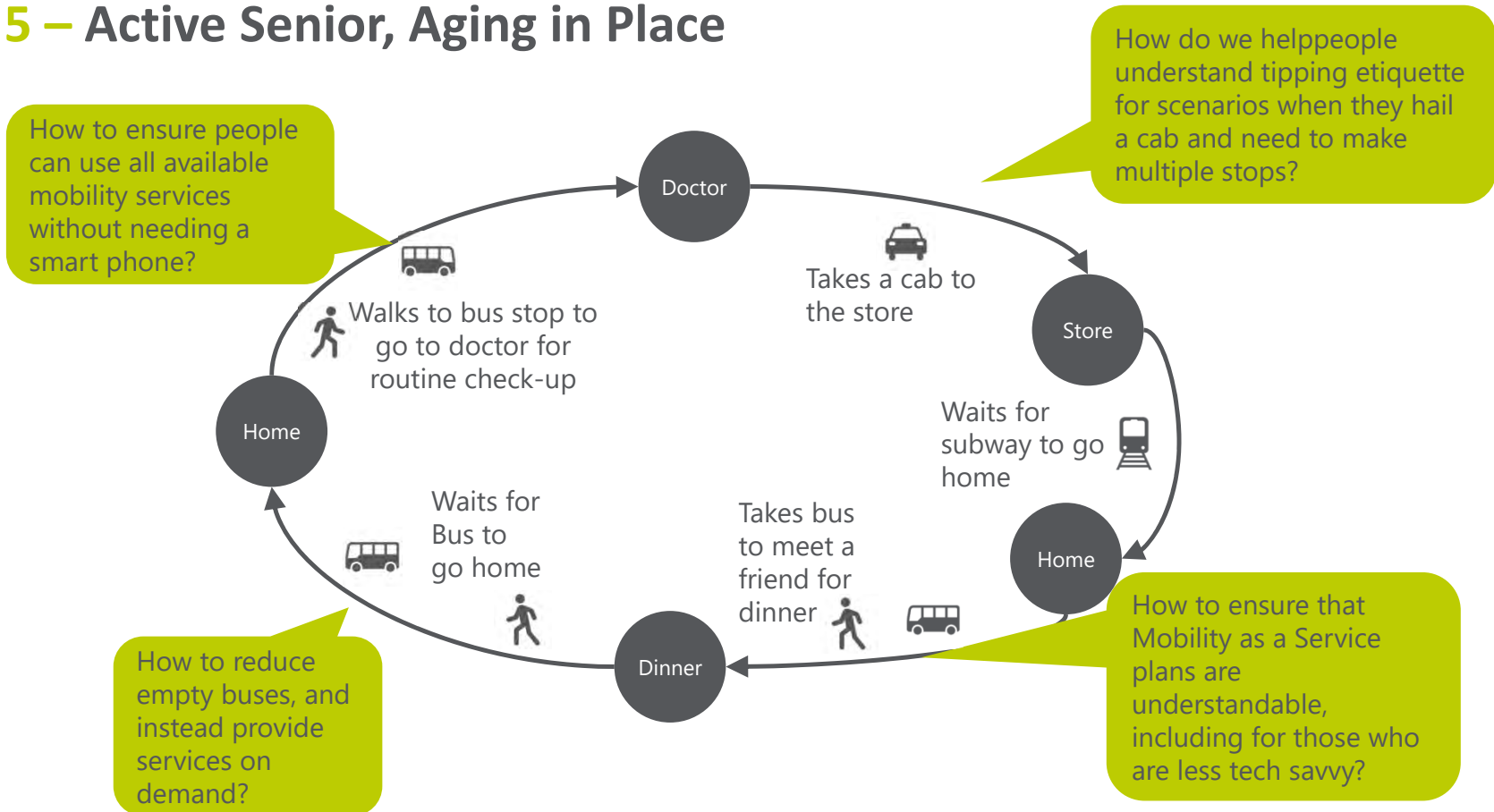
Scenario 3 – Working Parent/Caregiver with Kids



Scenario 4 – High School Student



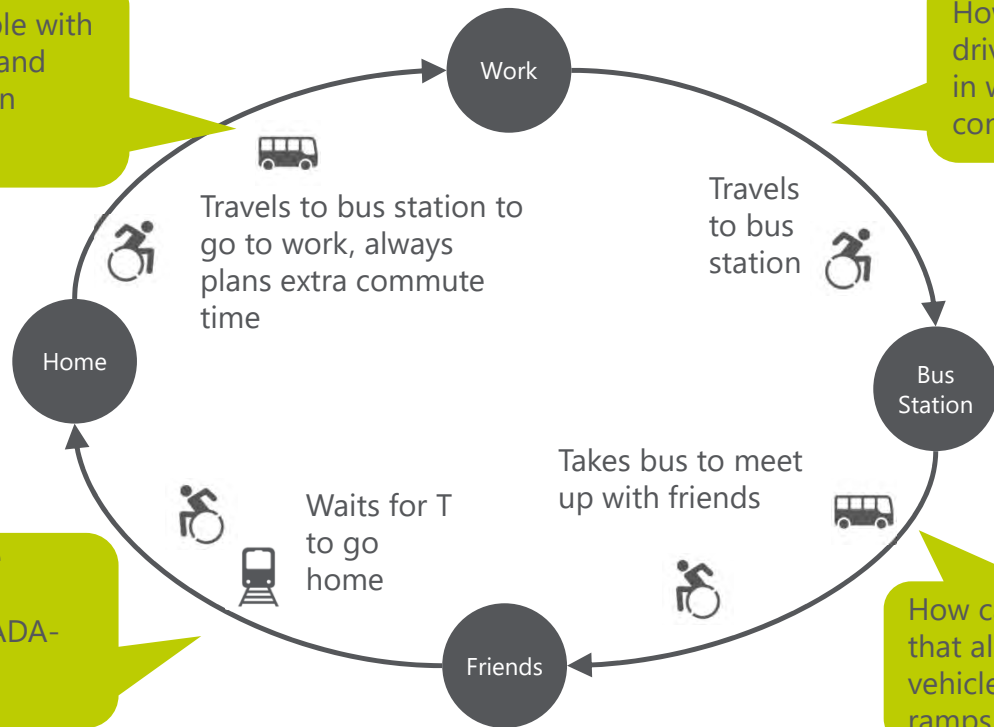
Scenario 5 – Active Senior, Aging in Place



Scenario 6 – Person with Mobility Impairment

How can we make sure that people with disabilities enjoy equal flexibility and spontaneity in their transportation options?

How can we ensure that bus drivers stop to pick up people in wheelchairs and that ramps consistently work properly?



How can we increase the number of ADA-compliant stations?

How can we ensure that all ride-hail vehicles have fold out ramps and lifts?



Commuting **Patterns**

Commute Statistics

On average, 15% of daily trips taken nationally are for commuting purposes.

About 24% of Cambridge residents commute to work by walking, and 7% of Cambridge residents commute to work by bike.

The national average across medium-sized cities for commuting by walking is 3%, while commuting by bike is 0.9%.

Over the past three decades, more people commuted by sustainable modes (walking, bike, and transit) and fewer by car (single occupancy vehicle and carpool). More people also worked from home.

People who work in Cambridge but don't live in Cambridge are more dependent on single occupancy vehicles (SOV). This can be observed in the difference between the higher rate of workforce SOV trips, compared to that of the local labor force.

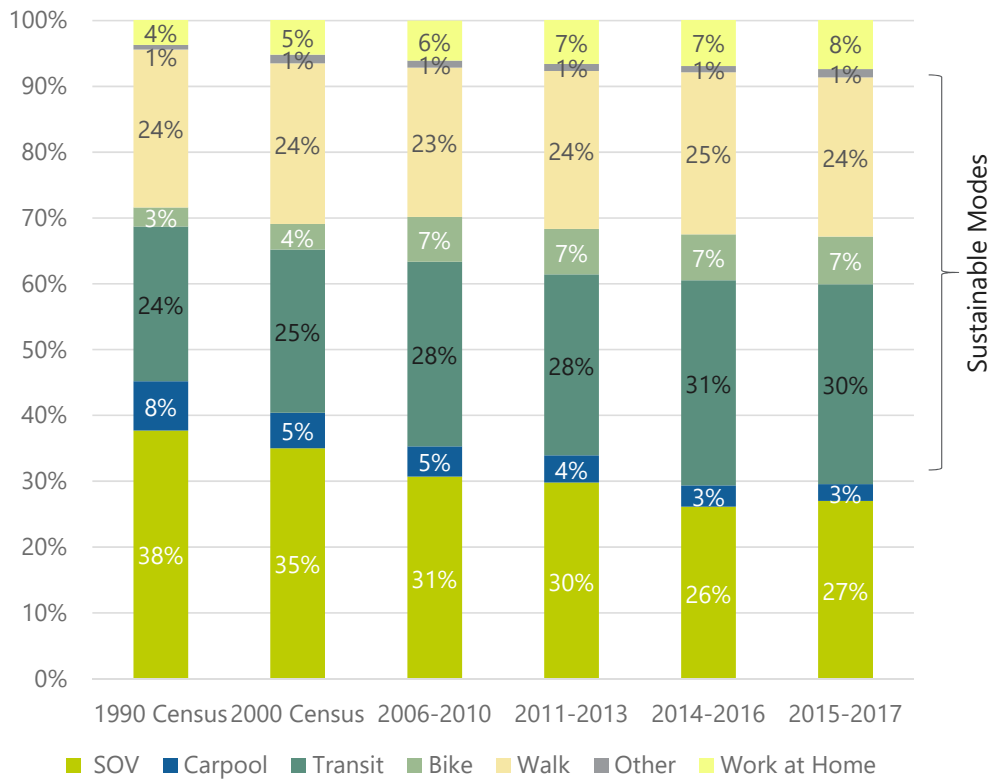
Data Source:

American Community Survey (ACS) Data;

*Bicycling and Walking to Work in the United States: 2008-2012 by US
Census Bureau*

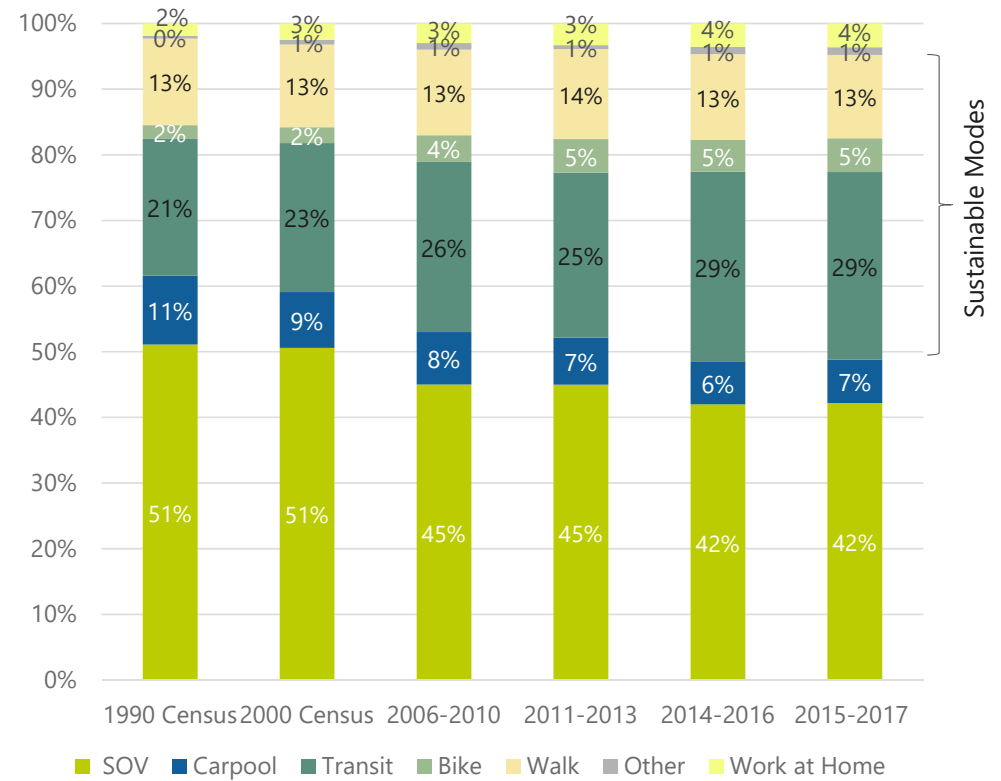
US Bureau of Transportation Statistics

How Cambridge Residents Commute to Work

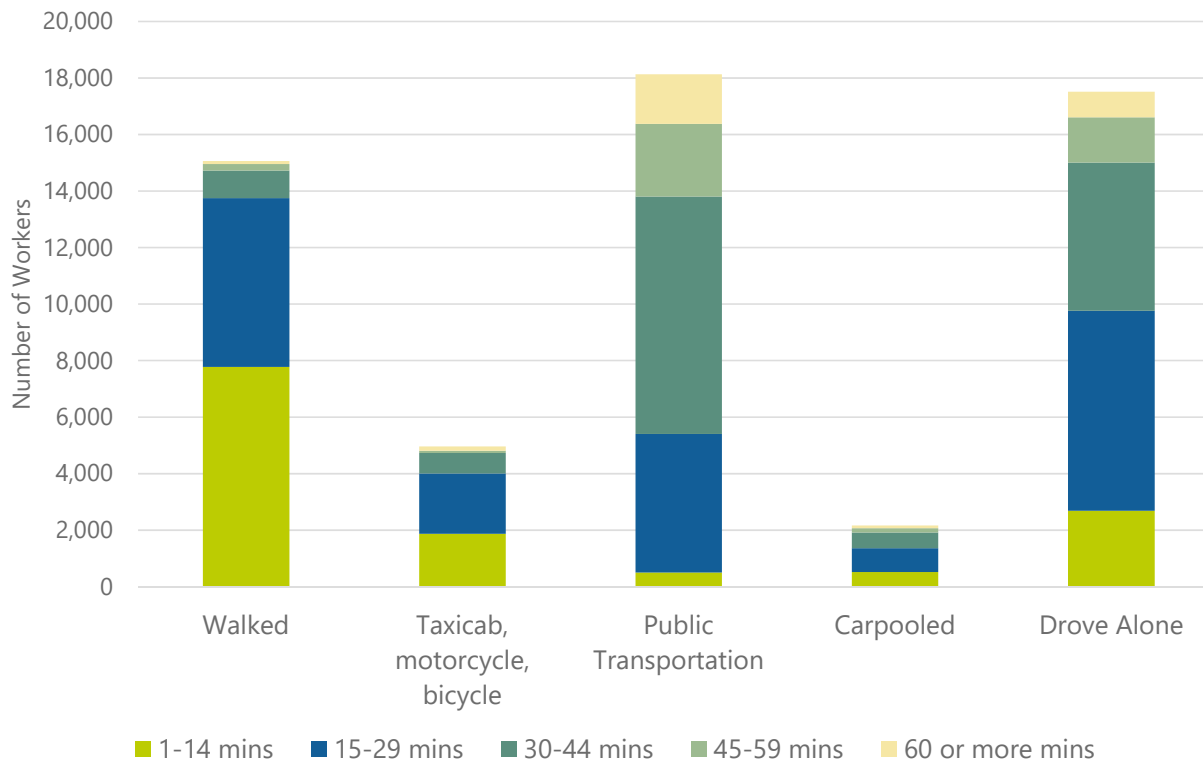


Data Source: American Community Survey

How People Commute to work in Cambridge



Commute Time by Mode for Cambridge Residents

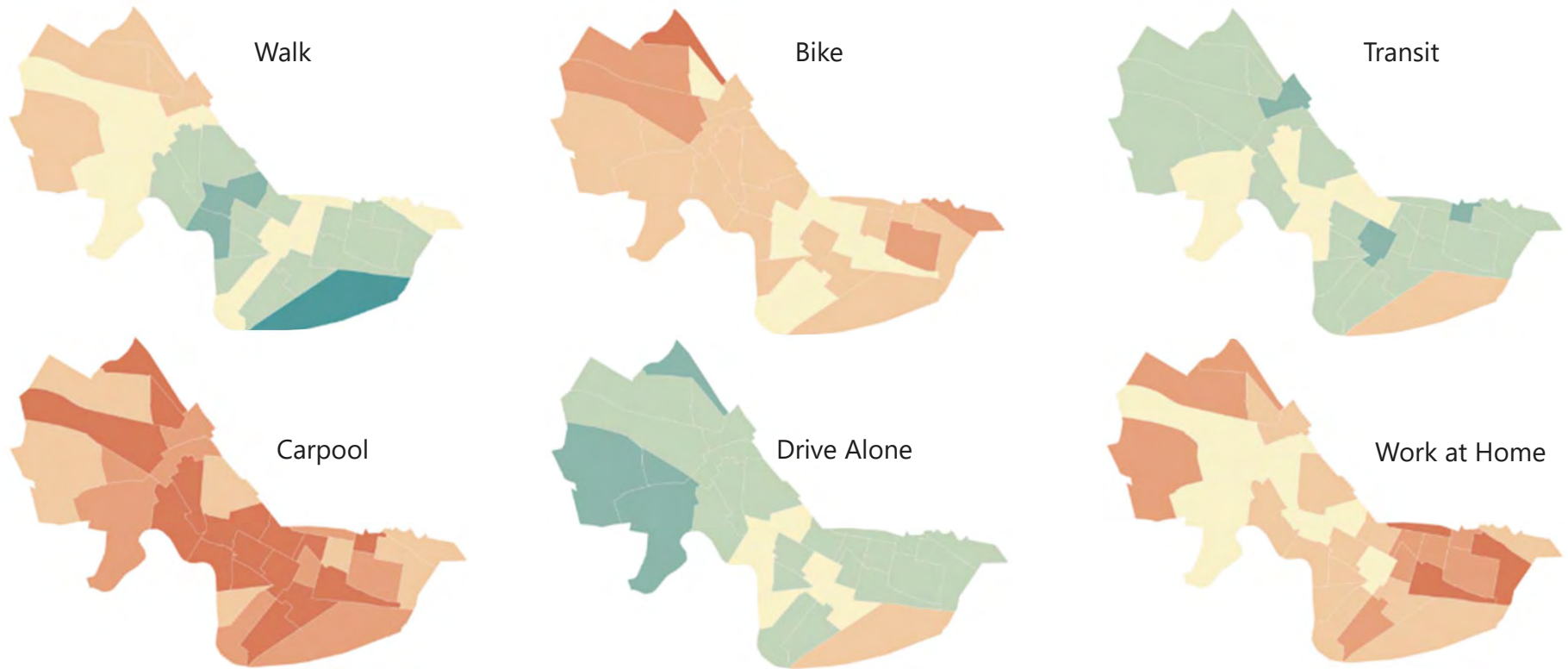
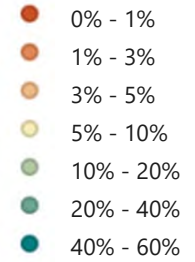


More than 80% of workers living in Cambridge who commute by bike or walk to work have a commute of less than 30 minutes.

The average commute time in Cambridge is 23.7 minutes, compared to 25.4 minutes nationally.

Data Source: 2015-2017 ACS average

How Cambridge Residents Commute to Work, by Mode Percentages



Data Source: 2015-2017 ACS average

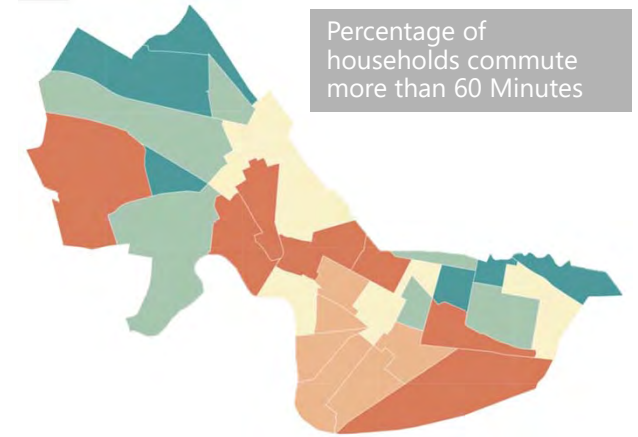
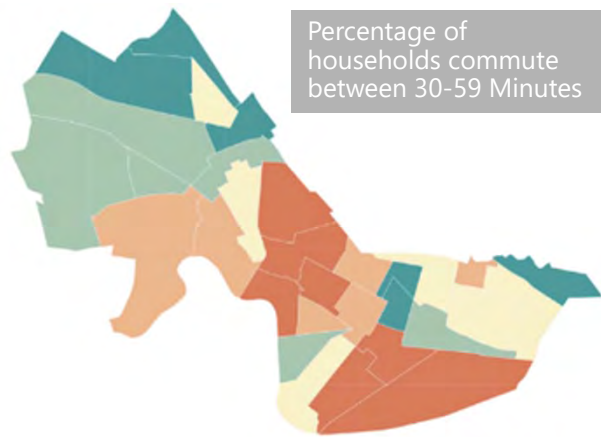
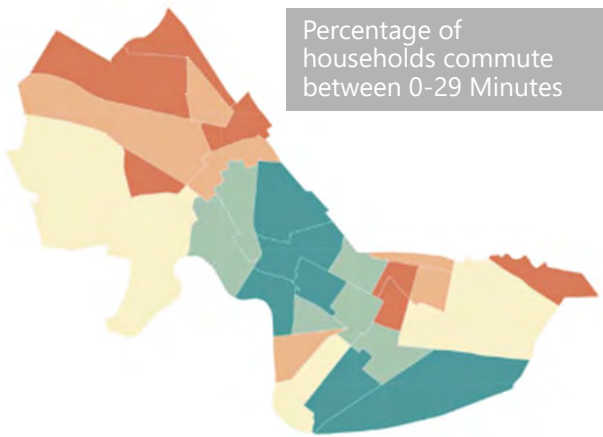
How Long it Takes Cambridge Residents to Commute to Work, by Percentage

The dark green areas have more people with commutes within the specified duration.

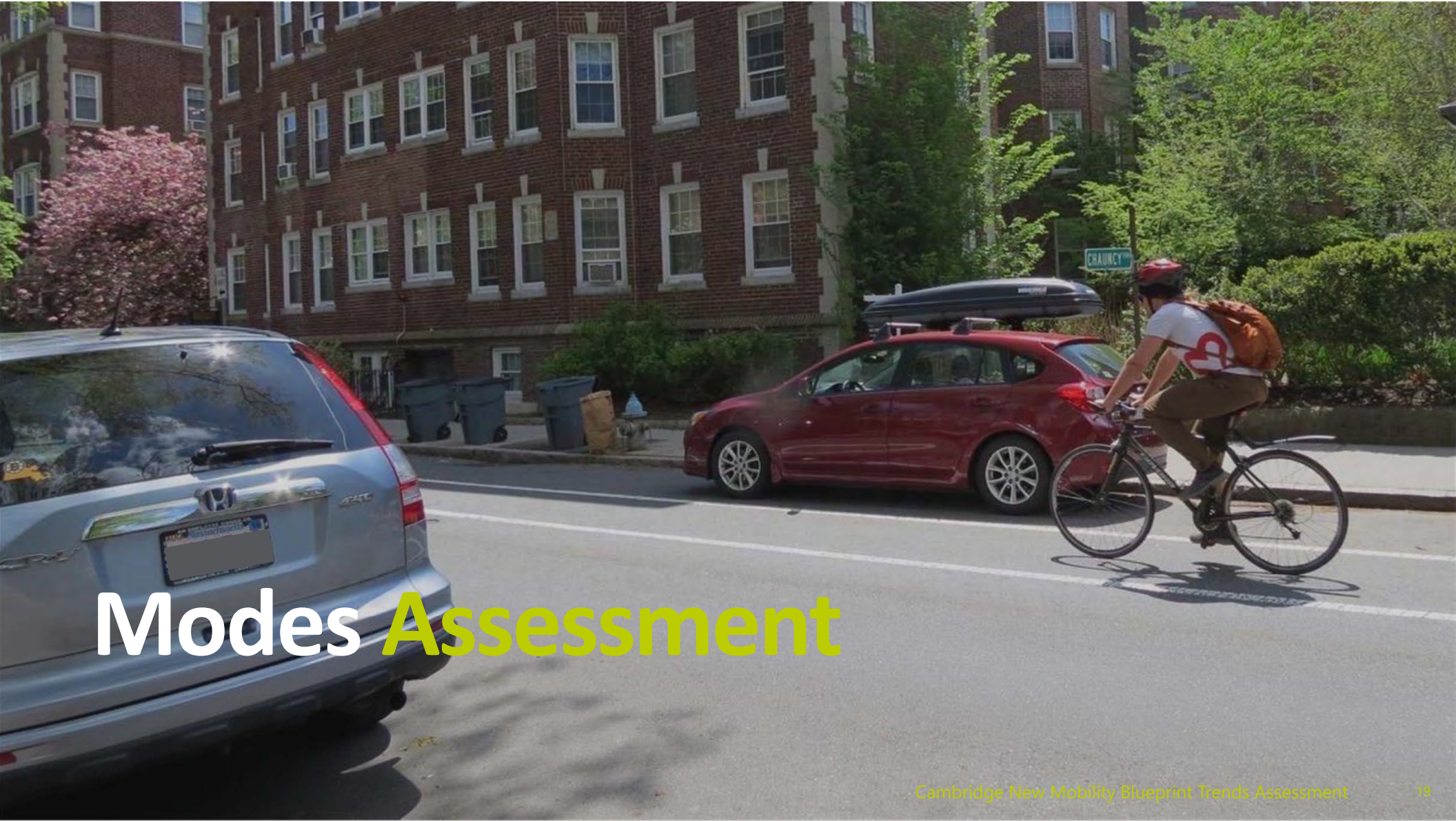
- 70% - 80%, Ranked Top 20 Percentiles
- 60% - 69%, Ranked 20-40 Percentiles
- 56% - 59%, Ranked 40-60 Percentiles
- 54% - 55%, Ranked 60-80 Percentiles
- 37% - 53%, Ranked Last 20 Percentiles

- 42% - 54%, Ranked Top 20 Percentiles
- 40% - 41%, Ranked 20-40 Percentiles
- 37% - 39%, Ranked 40-60 Percentiles
- 32% - 36%, Ranked 60-80 Percentiles
- 17% - 31%, Ranked Last 20 Percentiles

- 7.0% - 10%, Ranked Top 20 Percentiles
- 5.6% - 6.9%, Ranked 20-40 Percentiles
- 4.2% - 5.5%, Ranked 40-60 Percentiles
- 3.6% - 4.1%, Ranked 60-80 Percentiles
- 1.7% - 3.5%, Ranked Last 20 Percentiles



Data Source: 2015-2017 ACS average



Modes **Assessment**

People Journeys

Commuting Patterns

Modes Assessment

Traffic/Crashes

Walk

Bike

Micro-mobility

Transit

RHV

EV

Automobile

Catalog of Modes

Pedestrian



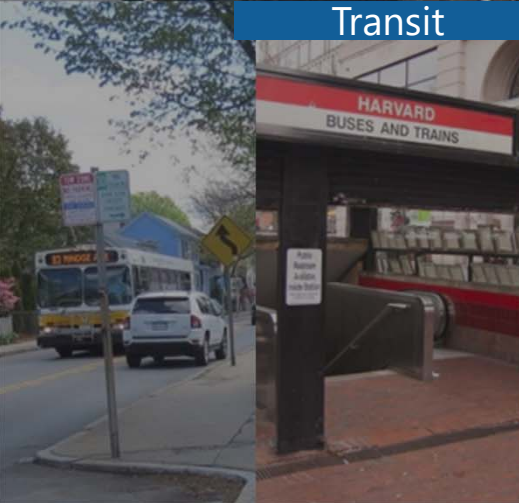
Bike



Micro-Mobility



Transit



Ride-Hail Vehicle



Electric Vehicle



Other Vehicles



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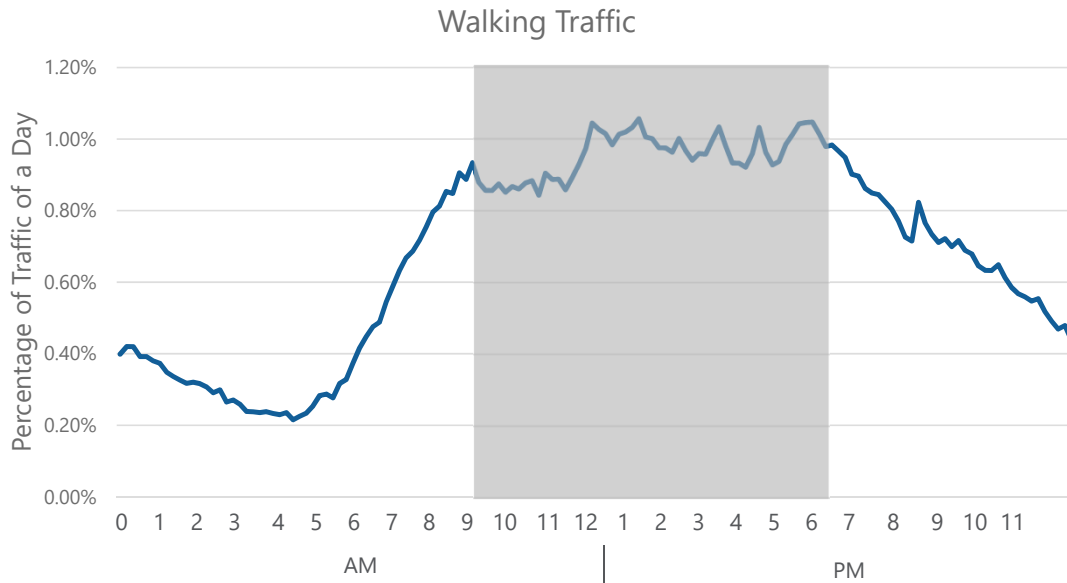
Walk



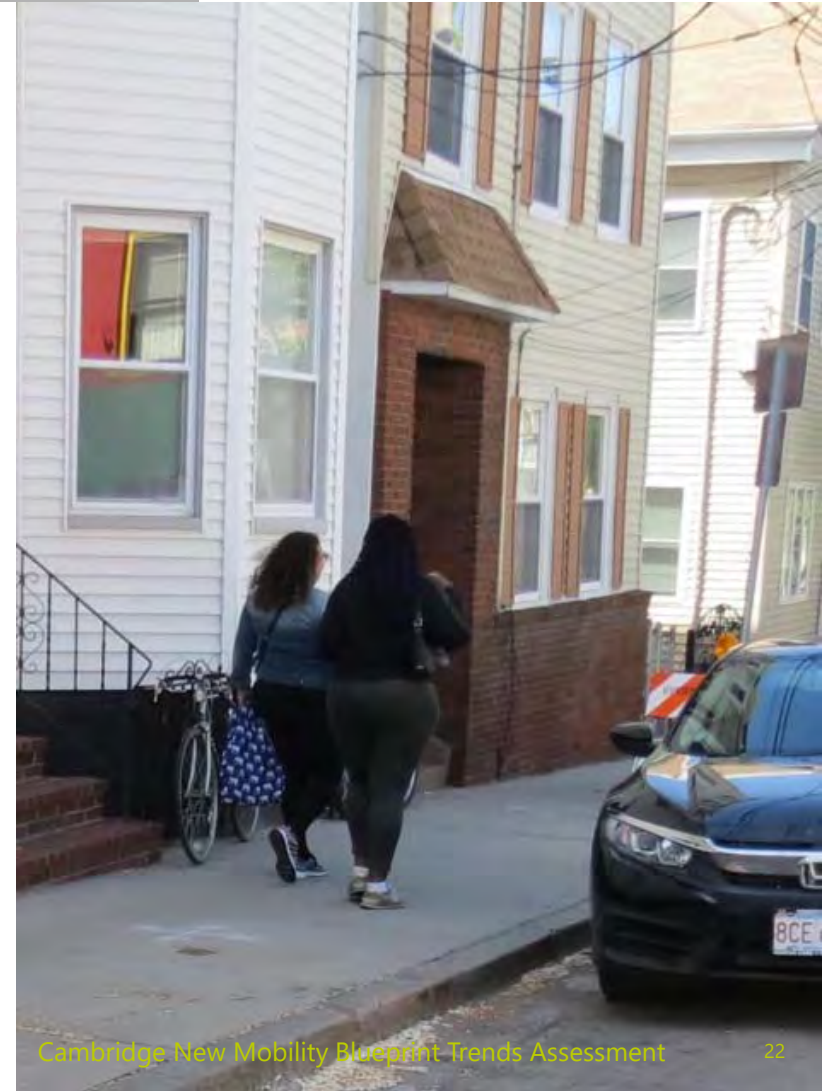
Cambridge New Mobility Blueprint Trends Assessment

Walking Patterns

Half of walking traffic takes place between the hours of 9:00 AM and 5:30 PM. The lowest point of activity is around 4:30 AM.



Data Source: Anonymized GPS Data

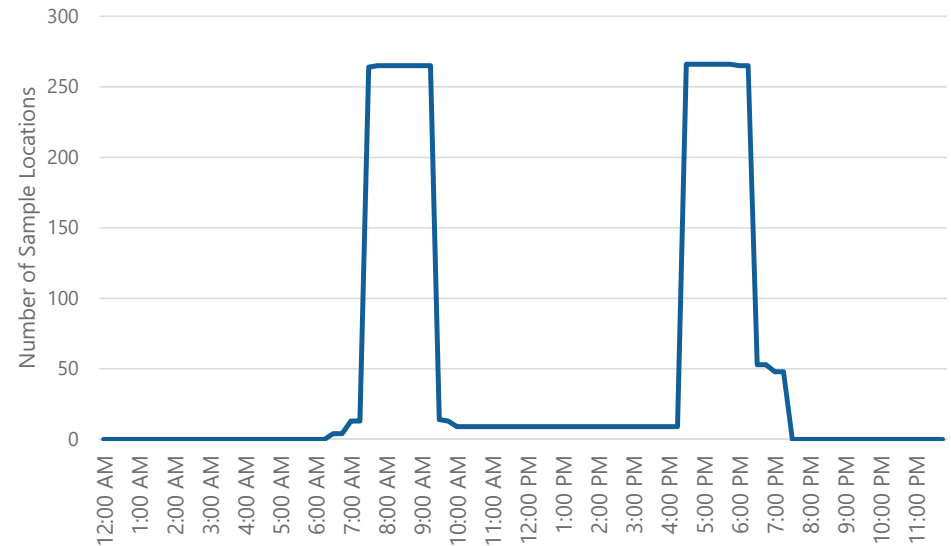


Walking – Traffic Impact Studies

Average TIS Pedestrian Count by 15-Minute Intervals Across Sample Locations



Number of Samples by Collection Time



TIS counts were conducted manually at various locations across the City of Cambridge at predetermined times. It's worth noting that the drop in pedestrian counts during non-commute hours reflects collection hours.

Data Source: 2019 City of Cambridge Traffic Impact Studies

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Bike

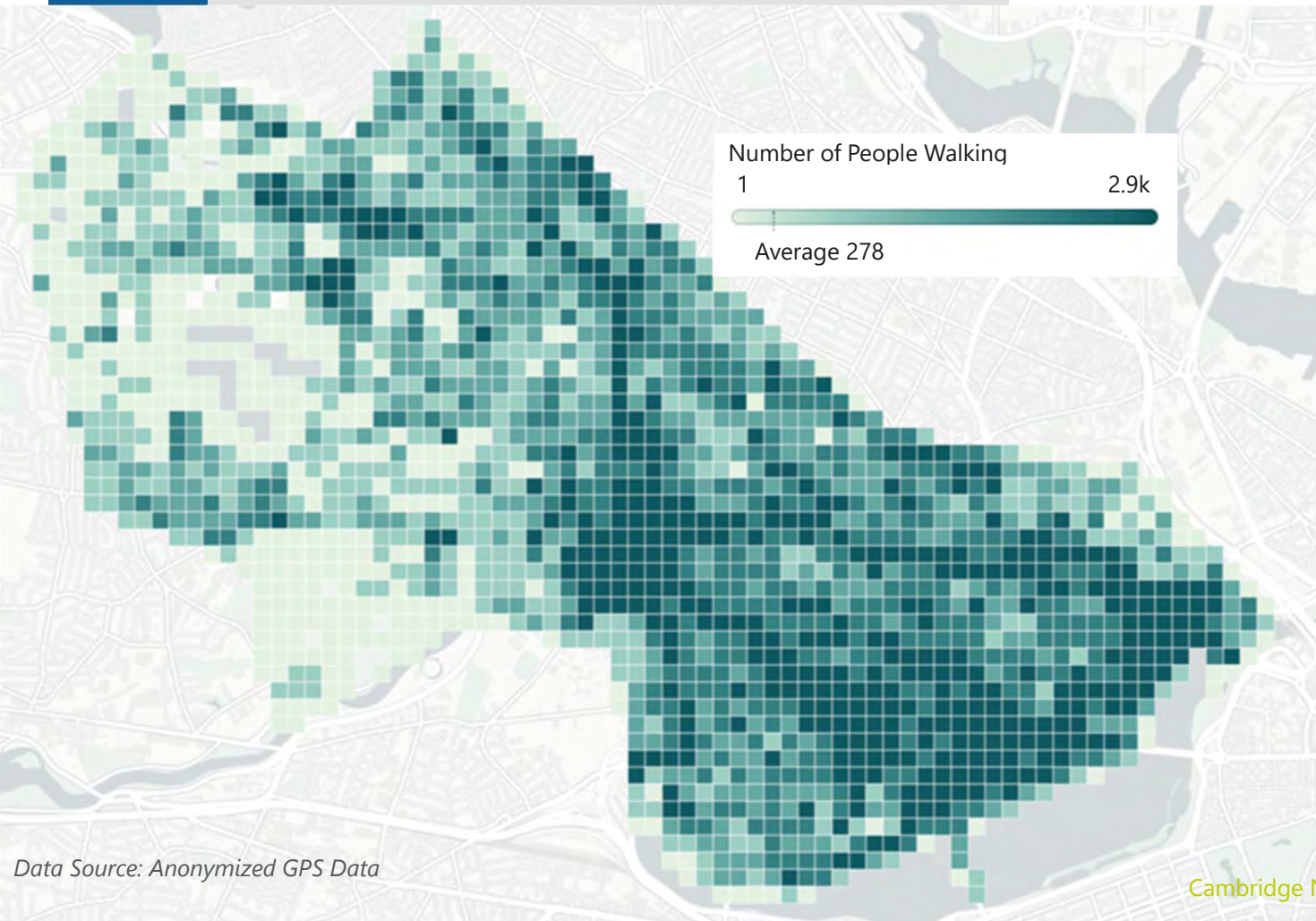
Micro-mobility

Transit

RHV

EV

Automobile



Areas with the Highest Walking Activity in Cambridge

Cell colors represent daily average walking counts across the city.

Since GPS data encompasses just a portion of the population, this map is not a visualization of all walking activity. Rather, it depicts the distribution of people walking across Cambridge.

Data Source: Anonymized GPS Data

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Bike



Bluebikes Usage Trends

34.6% more Bluebikes trips in 2018 than in 2017

Bluebikes is the public bikeshare program owned by the cities of Cambridge, Boston, Brookline, Somerville and Everett.

Bluebikes ridership has increased steadily since 2011. Trips made in Cambridge represent 49% of the cumulative 2017-2018 total in the Metro Boston area. The growth rate for ridership in Cambridge has been slightly higher than that of other participating communities since the start of the program.

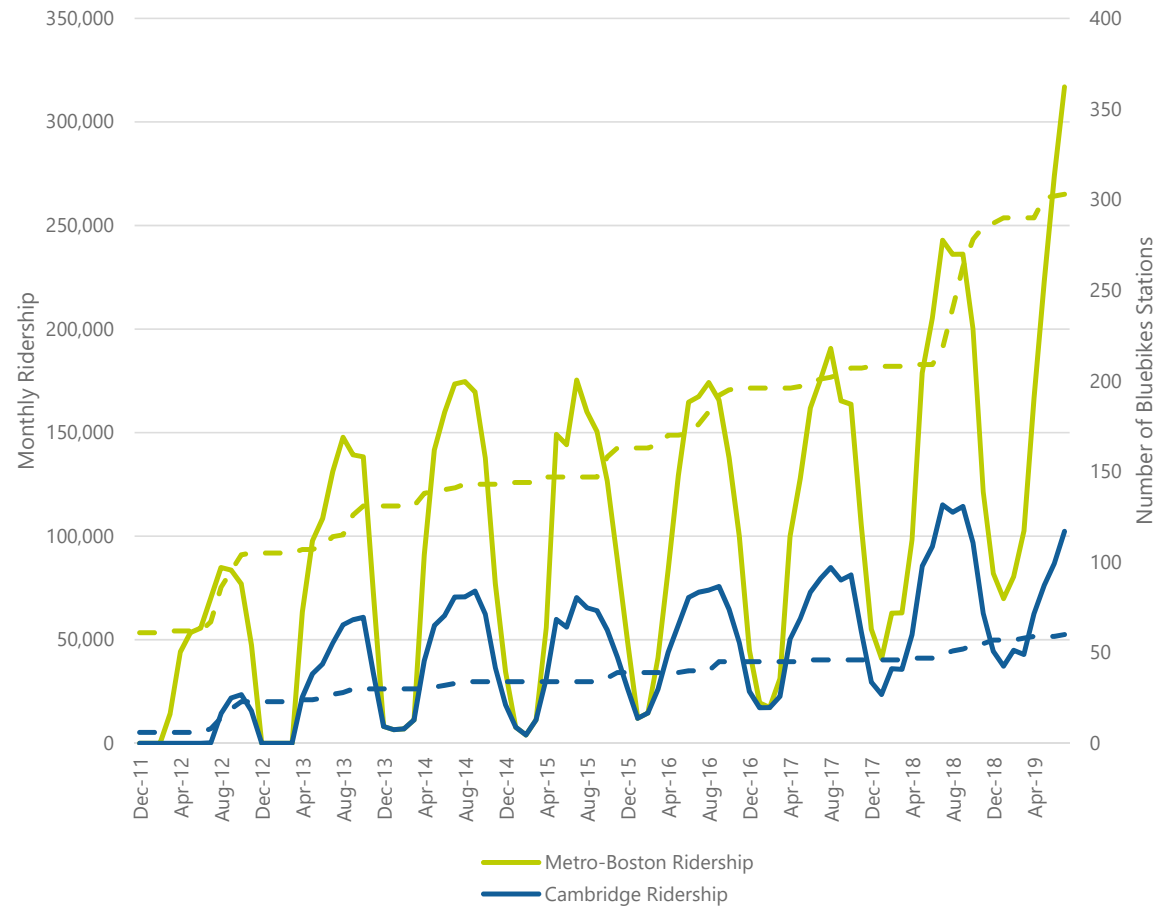
In 2018, there were 873,255 trips in Cambridge, which was a 34.6% increase in trips from the year prior.

Bluebikes ridership has strong seasonal patterns. Most trips are taken between the months of July and October, at a rate approximately 3.5 times higher than the number of trips taken between December and March.

Bluebikes service in Cambridge started in July 2012, with winter operations beginning in late 2013.

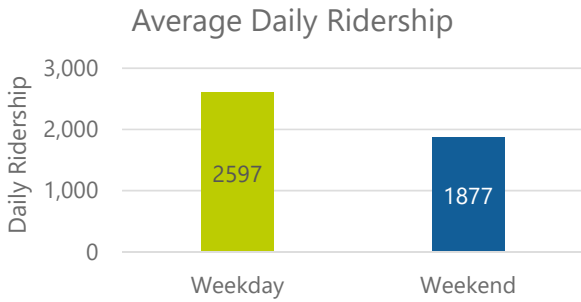
Data Source: Bluebikes All Riders Dataset

Growth of Bluebikes Ridership and Number of Stations

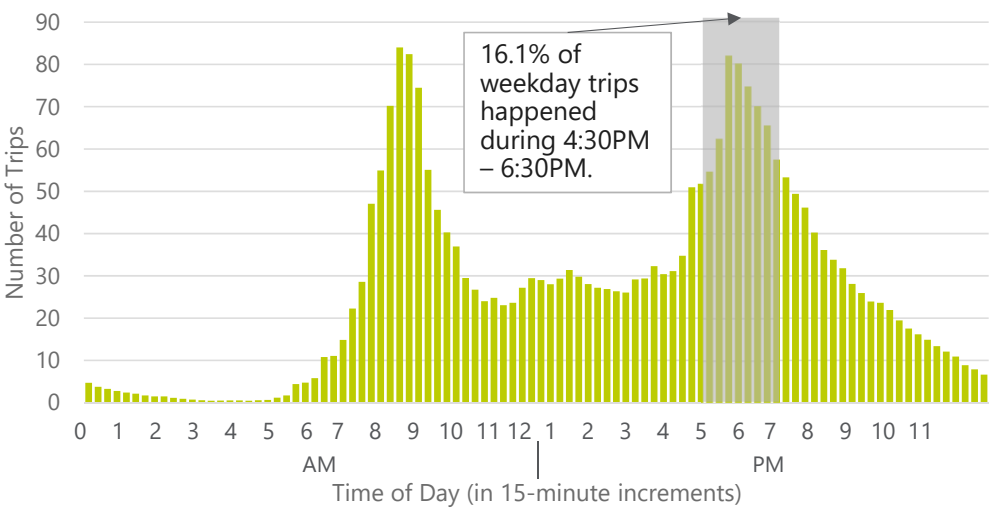


Bluebikes Daily Trends—2018

35.9% of Bluebikes trips on weekdays in 2018 were during morning and evening rush hours.

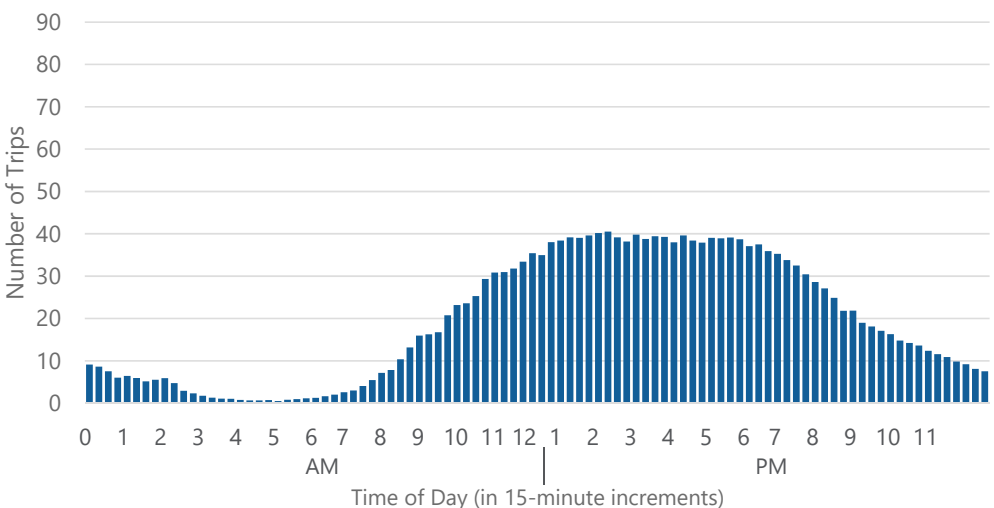


Average Number of Weekday Trips per hour in Cambridge



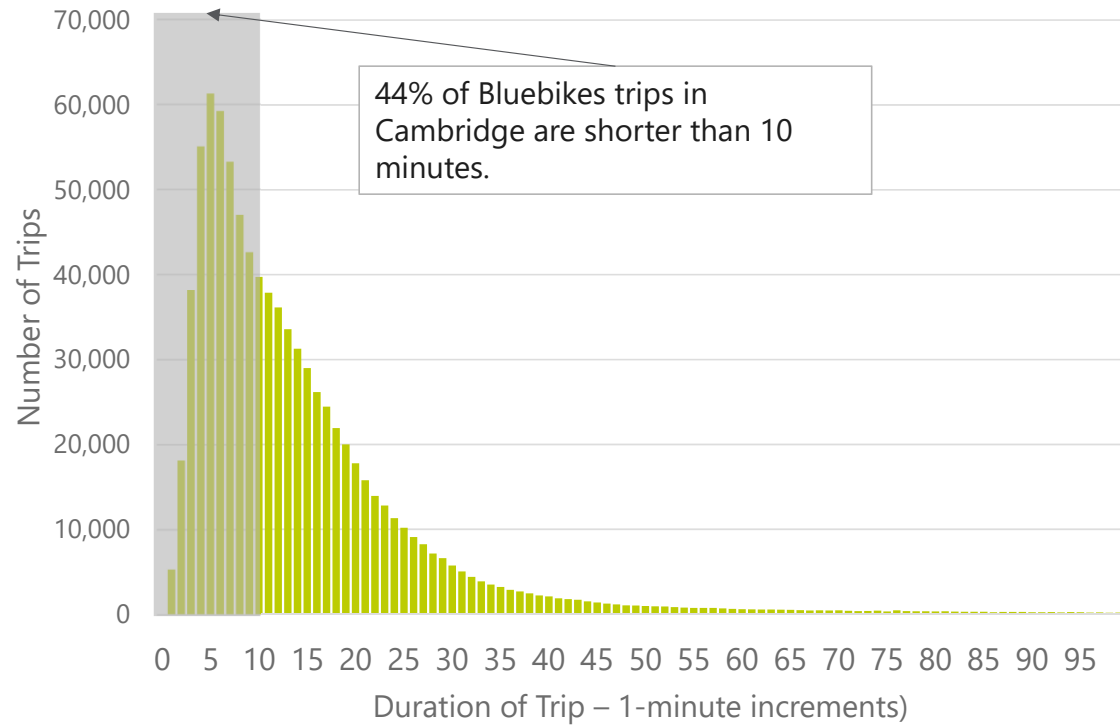
Data Source: 2018 Bluebikes All Riders Dataset—Cambridge only

Average Number of Weekend Trips per hour in Cambridge



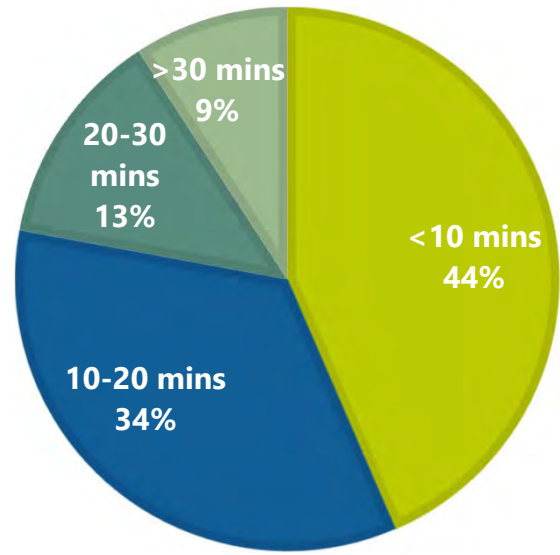
Bluebikes Trip Duration—2018

Bluebikes Trip Duration in Cambridge



Data Source: Bluebikes All Riders Dataset

Percent of Bluebikes Trips in Cambridge



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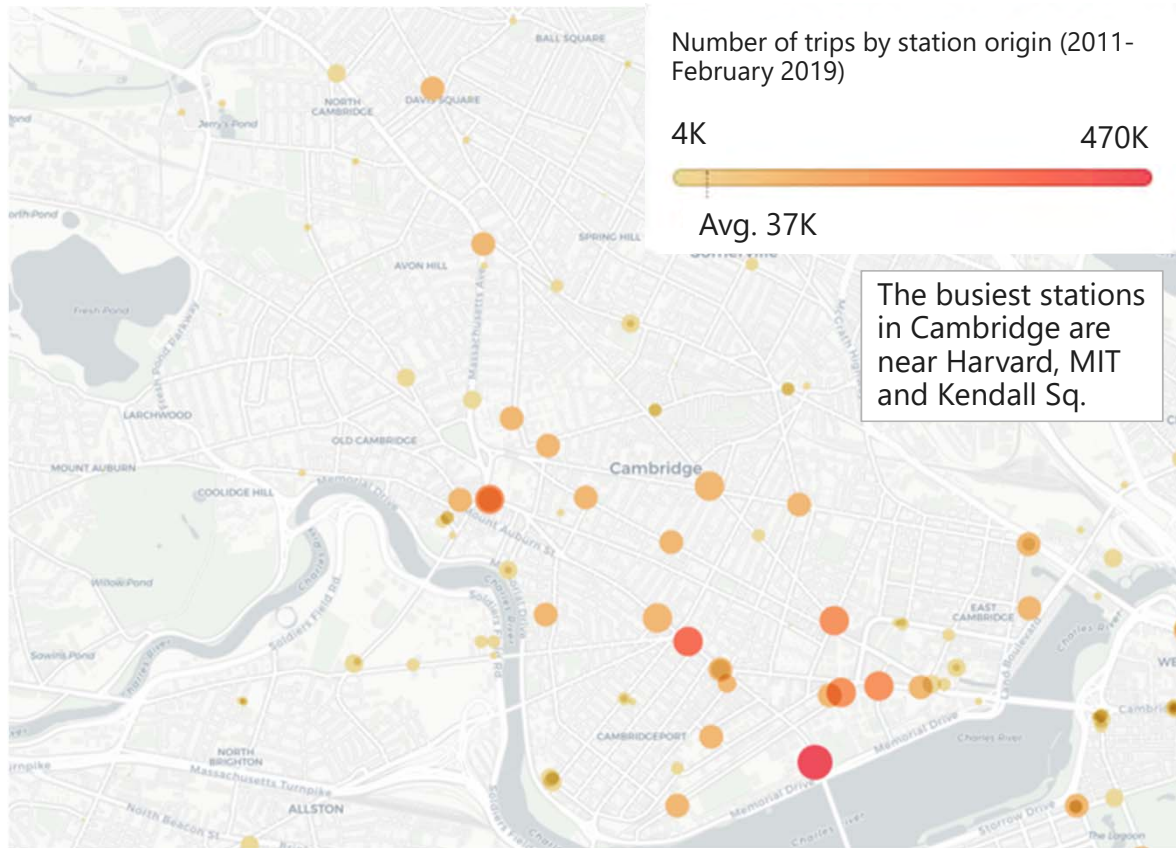
Transit

RHV

EV

Automobile

Bluebikes Station Use

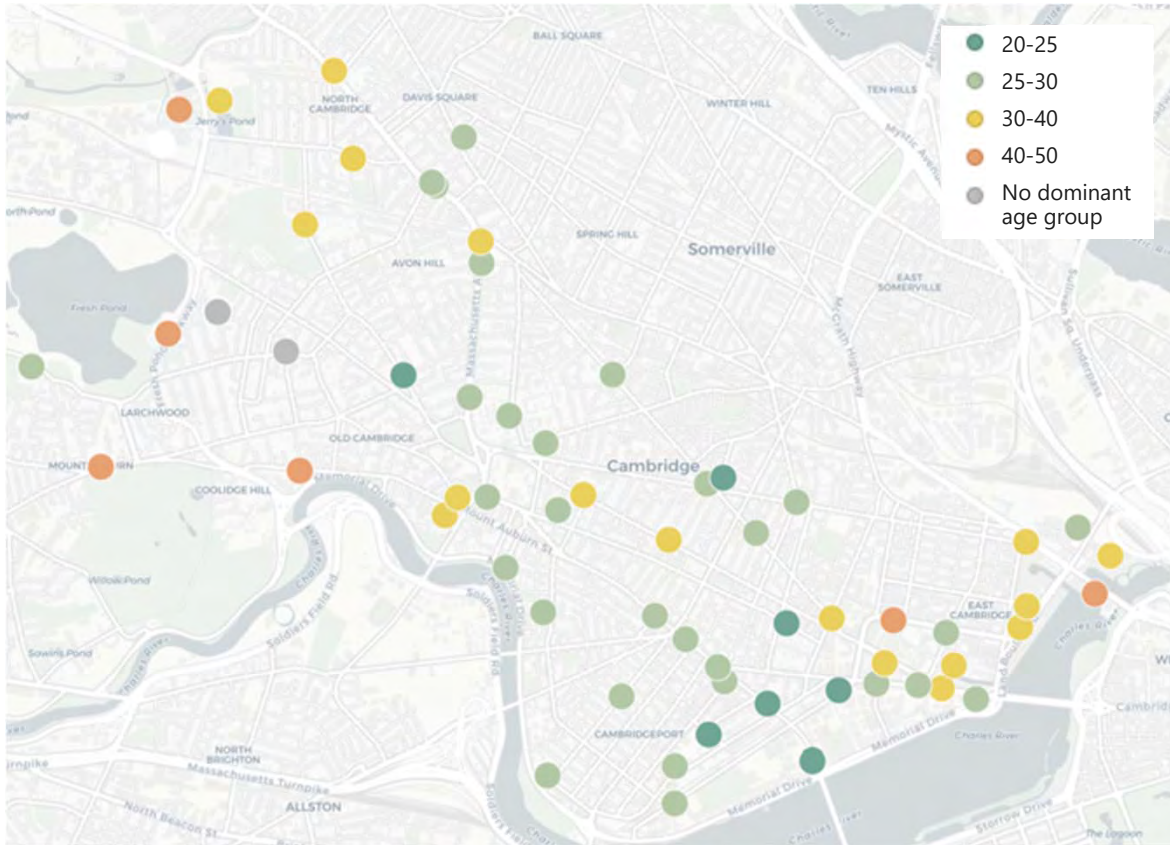


Data Source: Bluebikes All Riders Dataset



Cambridge New Mobility Blueprint Trends Assessment

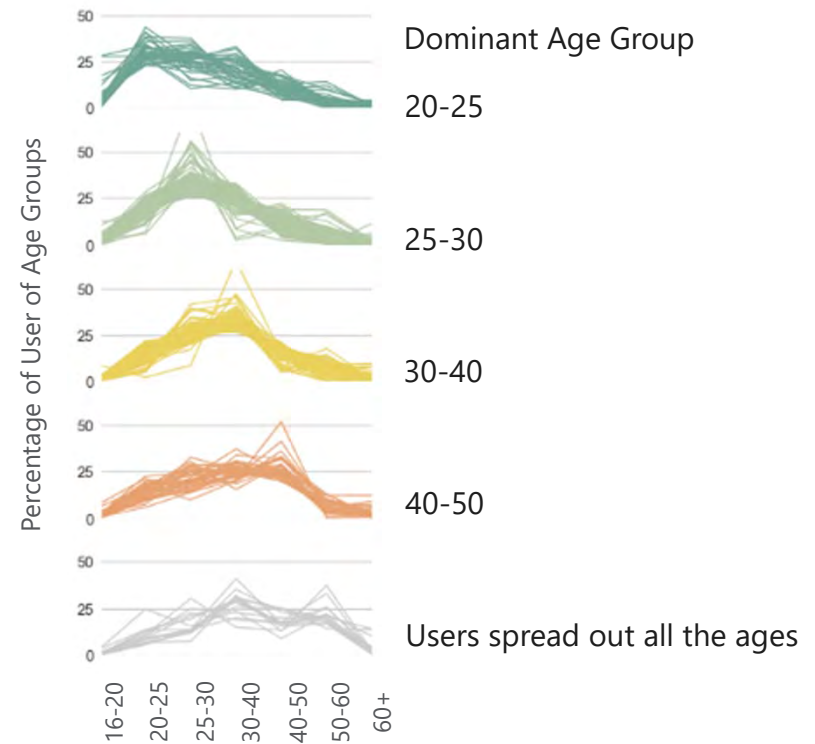
Age of Bluebikes Riders



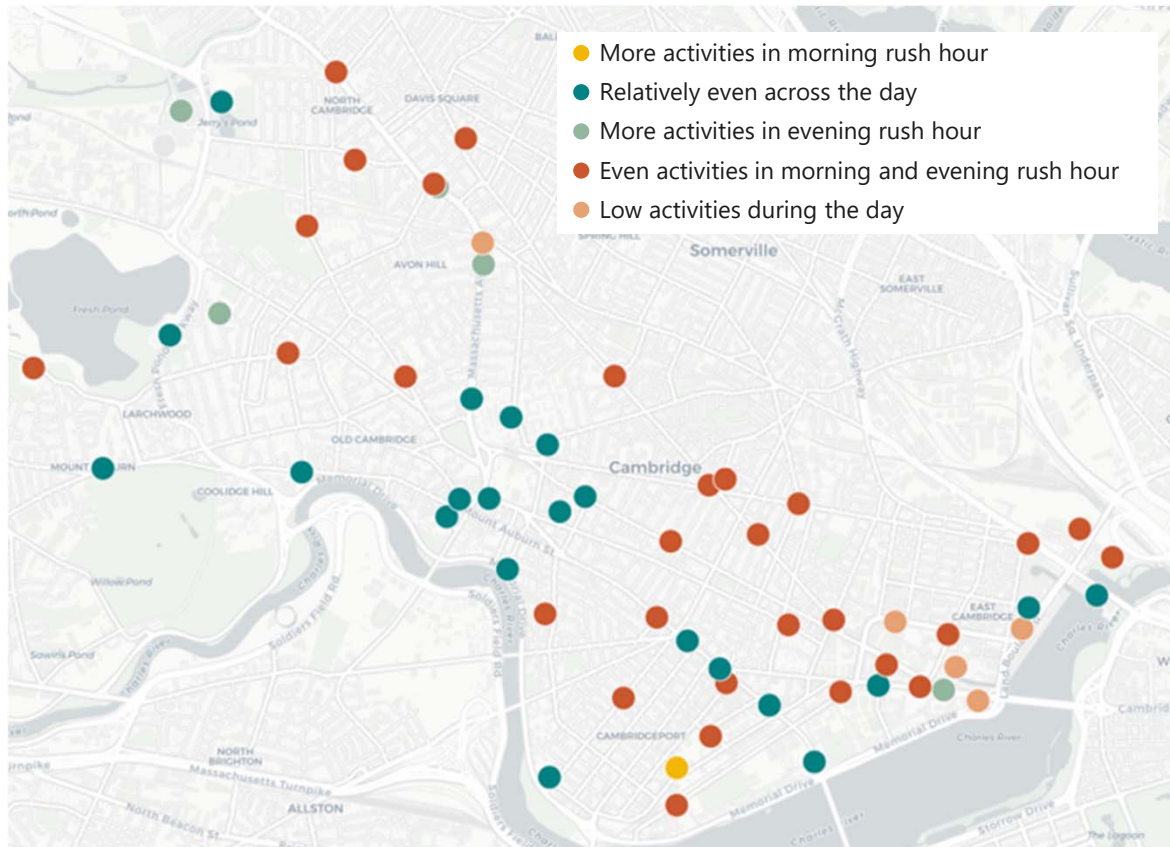
Data Source: Bluebikes All Riders Data

Bluebikes stations near Harvard and MIT have more users that are 20 to 30 years old.

Stations in East Cambridge near Kendall Square have more users between the ages of 30 and 50 years old.



Bluebikes Station Usage: Time of Day

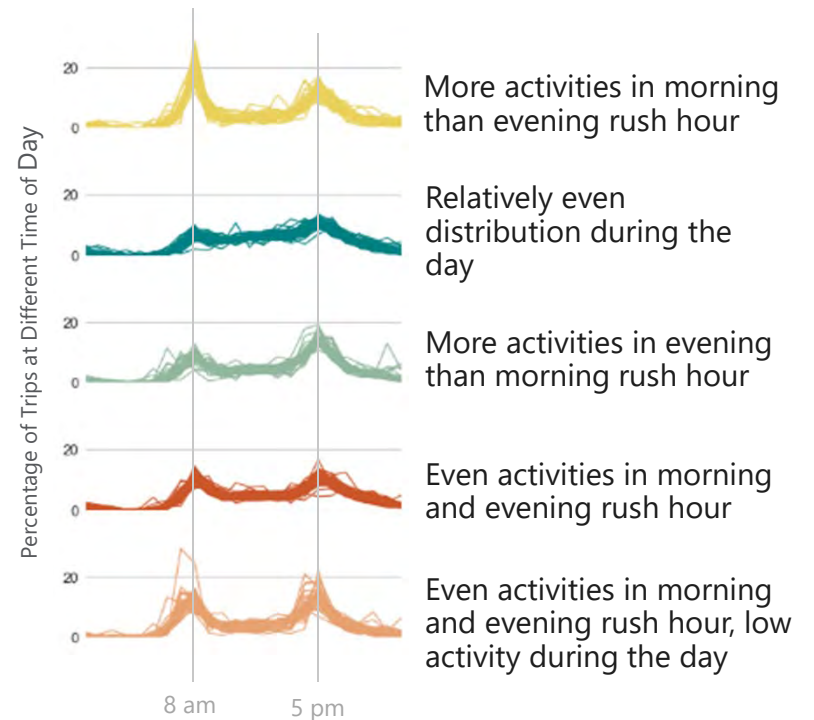


Data Source: Bluebikes All Riders Data

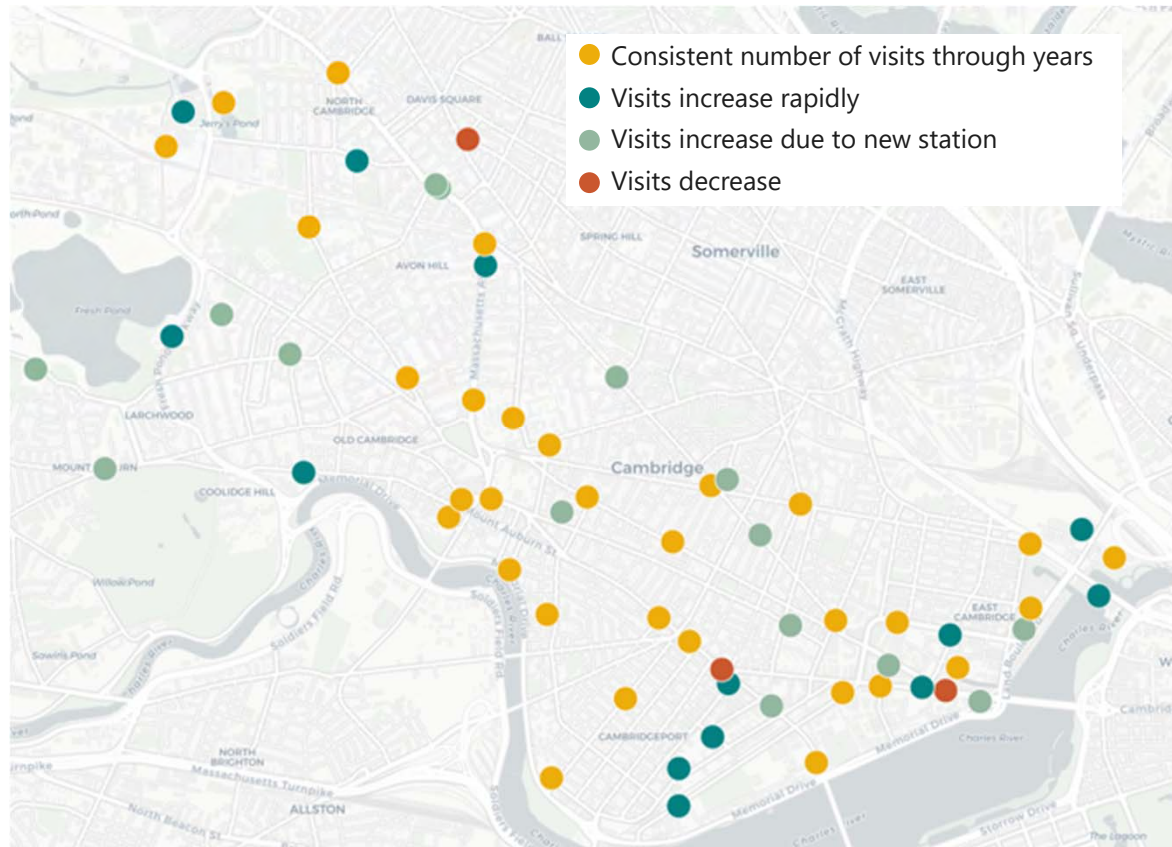
Bluebikes near Harvard and MIT have relatively even distribution of activities during the day.

Bikes near Kendall Square are mostly used during morning and evening rush hours with low usage during the day.

Temporal Distribution of Bluebikes usage

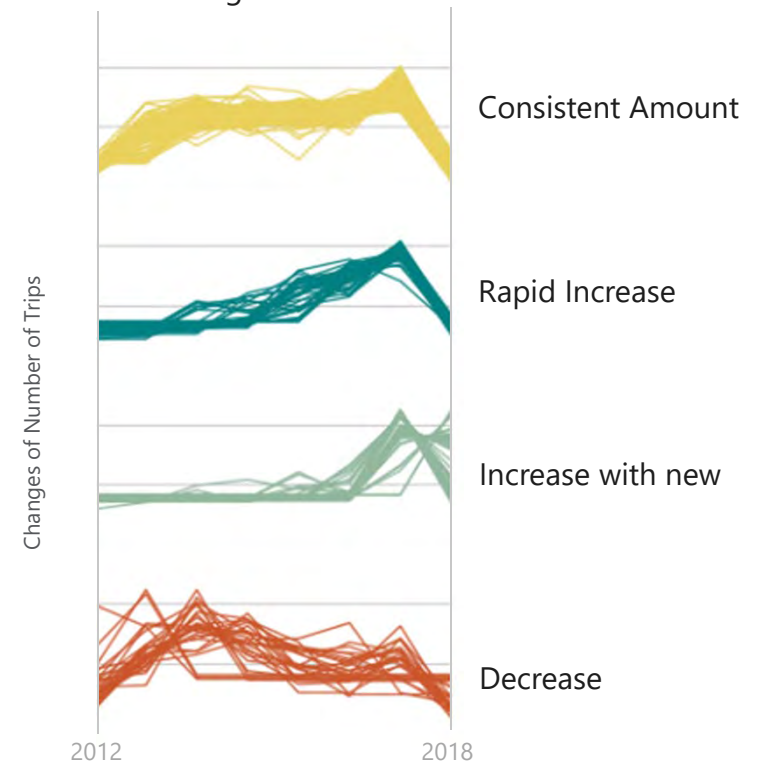


Bluebikes Station Usage 2012-2018

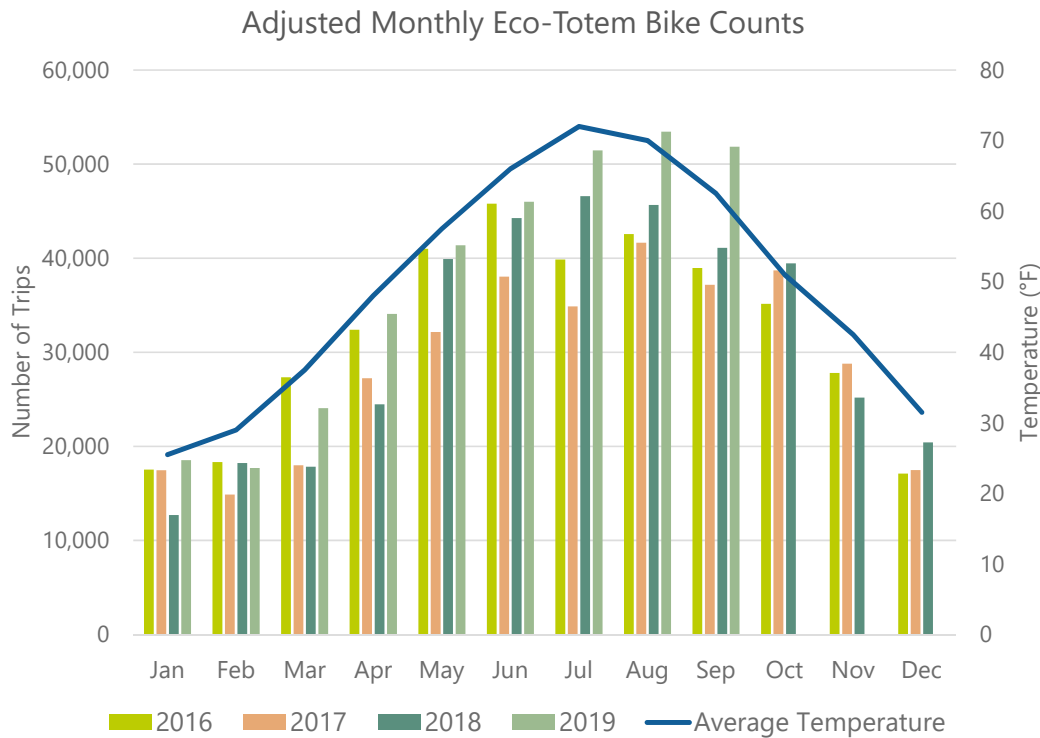


Data Source: Bluebikes All Riders Data

Most Bluebikes stations have had similar usage over their years of operation. While some have enjoyed increased usage, very few stations have seen decreased usage.



Eco-Totem Bike Counts Trend



Biking activity on Broadway in Kendall Square has been steady since 2016.

Seasonal patterns strongly correlate with temperature.

A permanent bicycle counter, the Eco-Totem, is installed on Broadway, between Third Street and Ames Street in Kendall Square. Because it counts only cyclists traveling in the bike lane and not those outside it, its data output requires adjustment. The City conducted counts using pneumatic tube technology for 48 hours on July 18 and 19, 2017, and manual counts at one-hour intervals across various times of day on six weekdays between July and September 2016. Additional manual verification counts were performed between July and September 2018.

Data Source: Anonymized GPS Data, 2016 Cambridge Biennial Manual Bike Counts, Adjusted Eco-Totem Bike Counts

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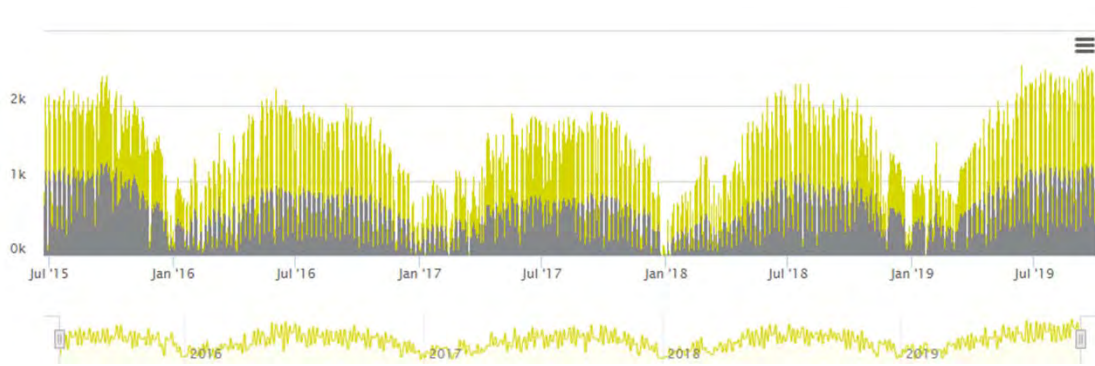
Transit

RHV

EV

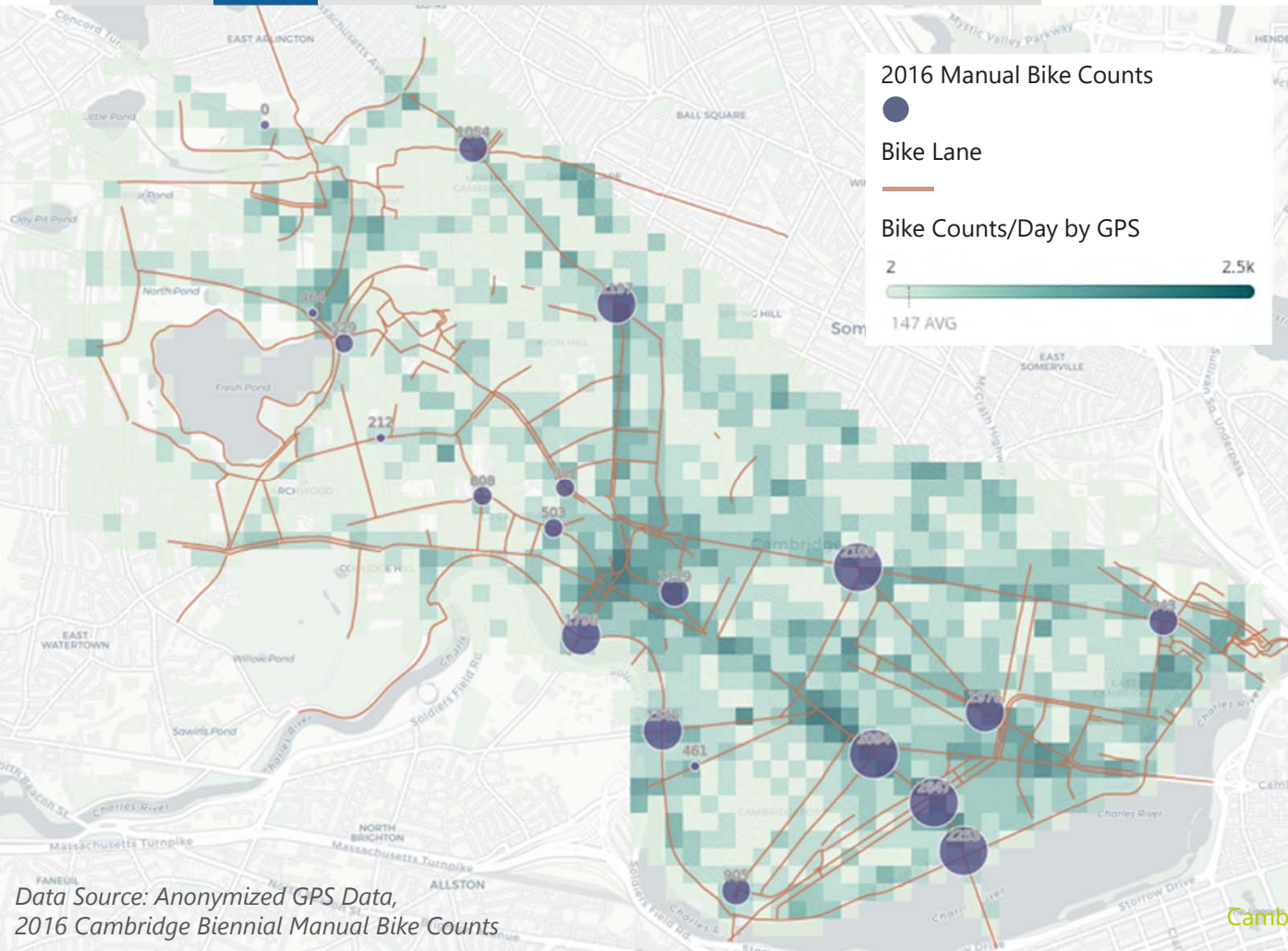
Automobile

Eco-Totem Bike Counts Trend



The year-to-year overview clearly shows patterns that reflect the reconstruction of the Longfellow Bridge, which is the origin/destination of many people being counted by the Eco-totem. Patterns show a decline in ridership for the time that the Longfellow Bridge was under construction, and not very accessible to people bicycling, and a sharp rise in ridership after the reopening of the Longfellow Bridge in May 2019.

Data Source: Eco-Totem Bike Counts, Unadjusted



Bike Traffic in Cambridge

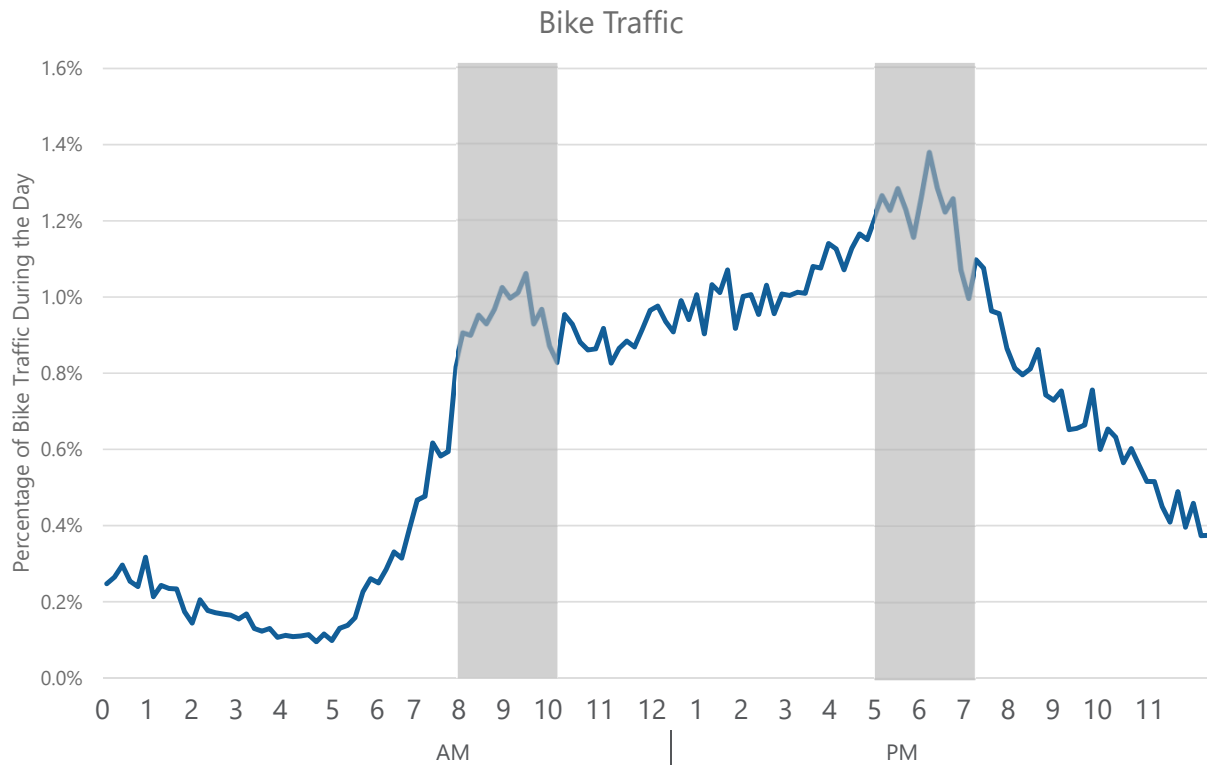
The color of each cell represents daily average bicycle trips distributed across the city. The darker the colored cell, the more daily bicycle trips.

In order to conduct a representative analysis of biking in Cambridge, we compared GPS data, which encompasses the activity of just a subset of the overall population, with bike traffic counts from the 2016 Cambridge Study. The 2016 study, in which bikes were manually counted at 20 locations across the City, showed strong correlation with the GPS data. This correlation indicates that the GPS data is a highly representative subset of bike traffic in Cambridge.

The blue circles on the map show the manual bike counts from the 2016 study. Overall, GPS data captured about a third of biking activities in Cambridge, which is significant for understanding bike traffic flow in the city.

Data Source: Anonymized GPS Data, 2016 Cambridge Biennial Manual Bike Counts

Bike Traffic in Cambridge



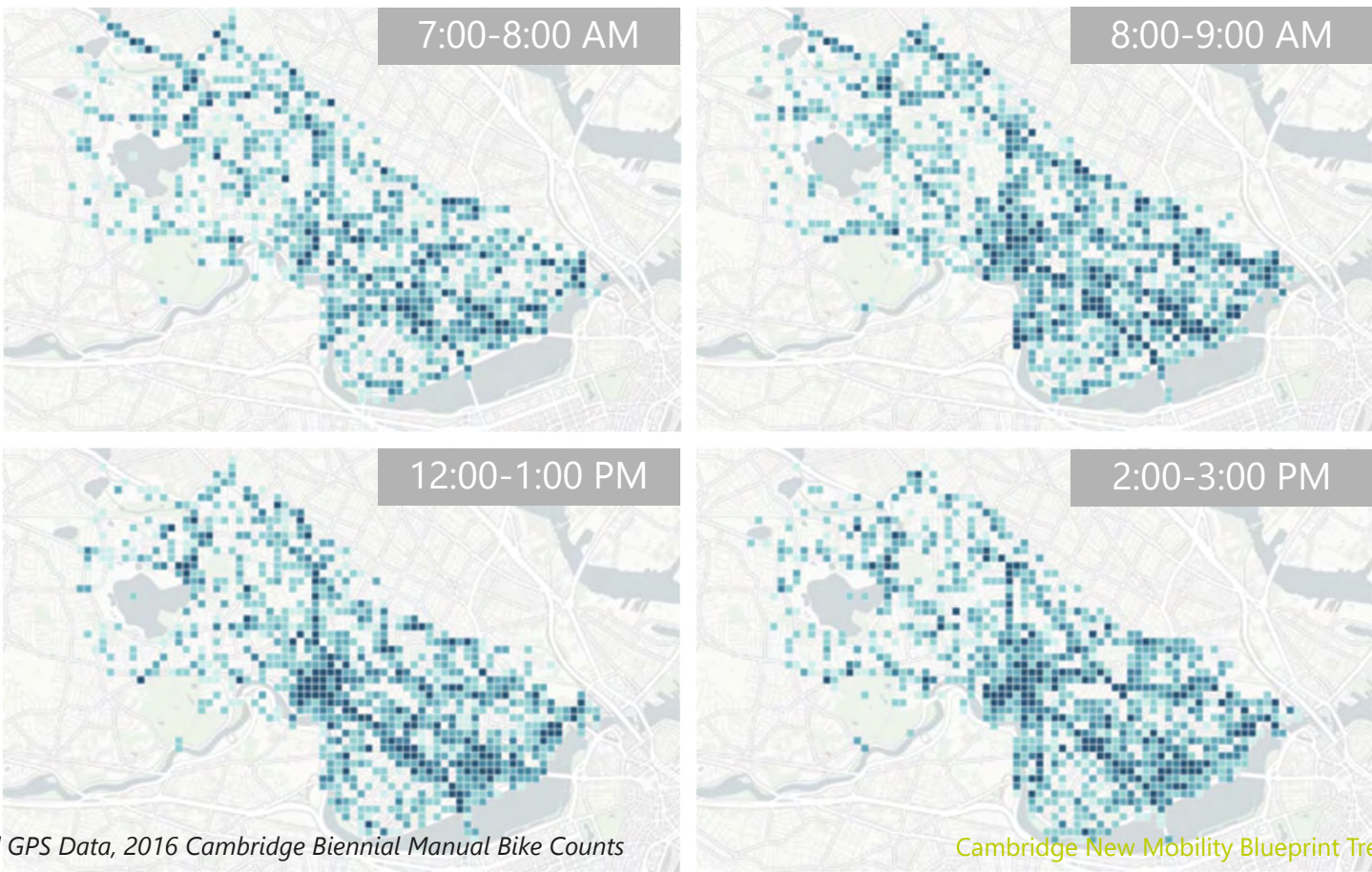
About 26% of biking activity in Cambridge takes place during morning and evening rush hours.

About 11% of daily bike traffic occurs during morning rush hour (7:30-9:30 AM)

About 15% of daily bike traffic occurs during evening rush hour (4:30-6:30 PM)

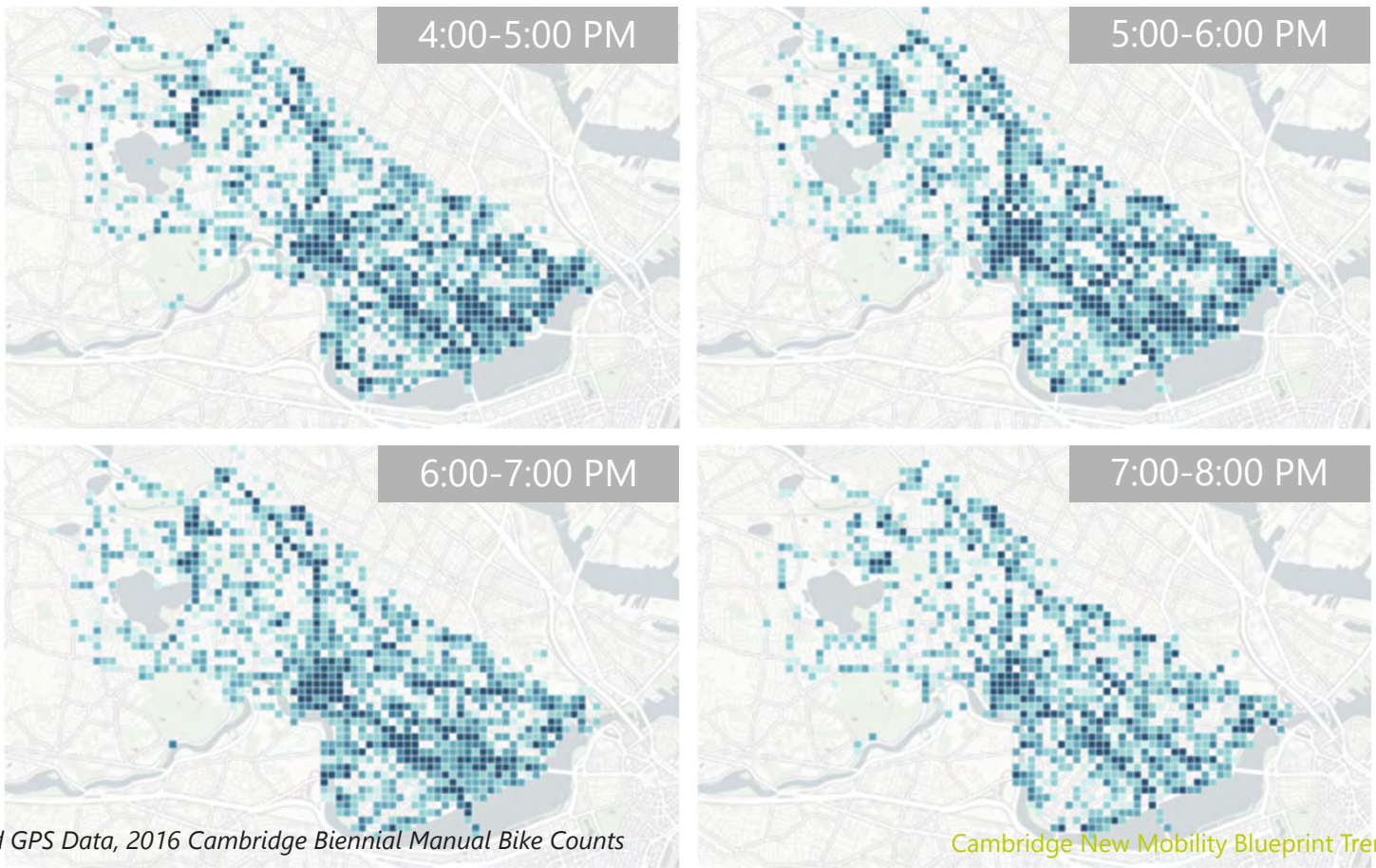
Data Source: Anonymized GPS Data, 2016 Cambridge Biennial Manual Bike Counts

Bike Activity in Cambridge



Data Source: Anonymized GPS Data, 2016 Cambridge Biennial Manual Bike Counts

Bike Activity in Cambridge



Data Source: Anonymized GPS Data, 2016 Cambridge Biennial Manual Bike Counts

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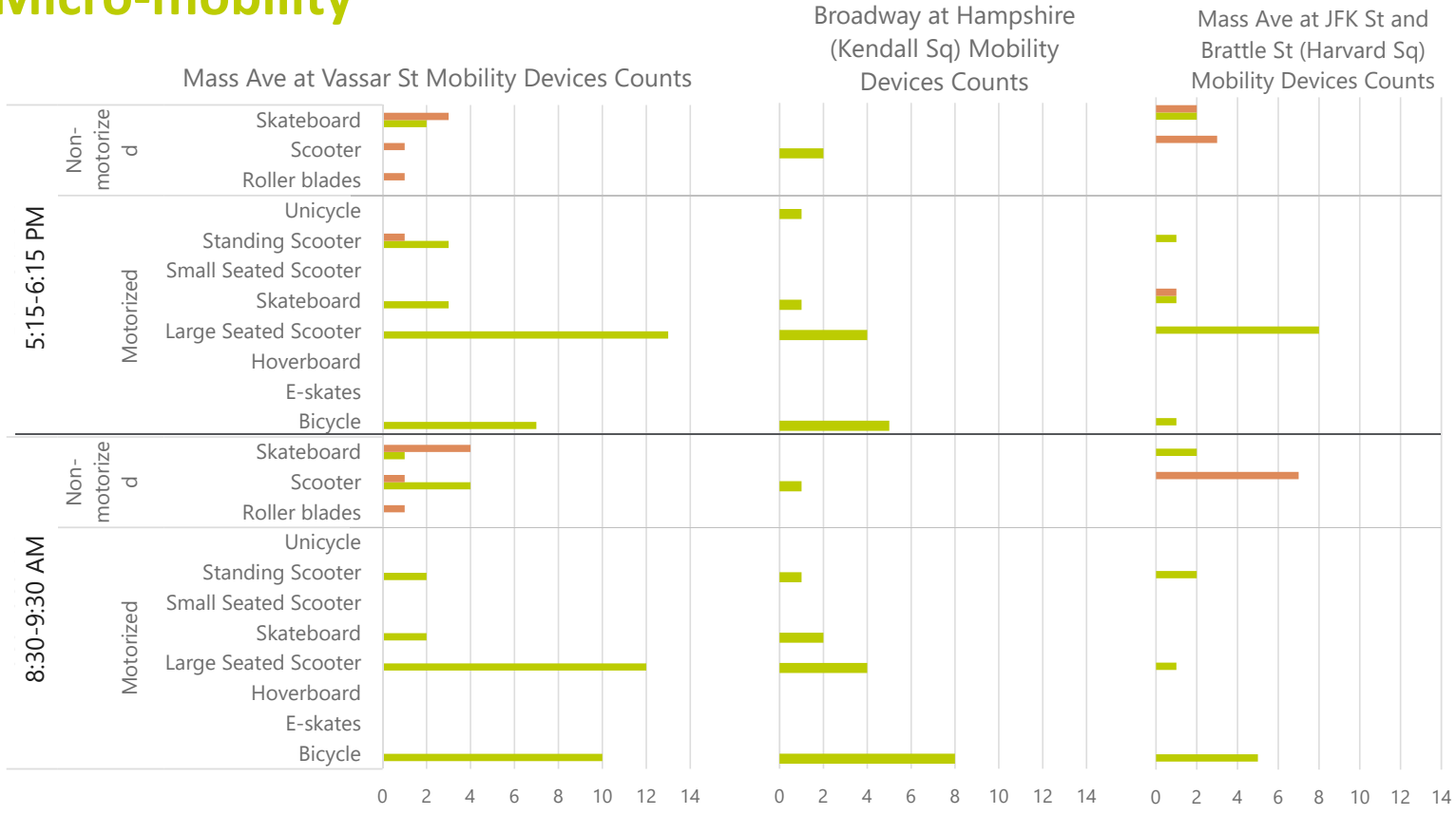
EV

Automobile

Micro-mobility



Micro-mobility



Data Source: 2018 Cambridge mobility device manual counts

■ On Sidewalk
■ On Street

“At the end of 2018, over 85,000 e-scooters were available for public use in about 100 U.S. cities.”

-- Shared Micromobility in the US: 2018 by NACTO

State legislation is currently pending that will allow municipalities to permit scooter share programs. A regional pilot is planned for spring 2020.

On the evening of October 3, 2018 and during the morning hours of October 4, 2018, the City manually counted mobility devices (excluding non-motorized bicycles, which are the subject of biennial bicycle counts) at three locations-

1. Broadway at Hampshire (Kendall Square)
2. Massachusetts Ave at JFK St and Brattle St (Harvard Square)
3. Massachusetts Ave at Vassar St

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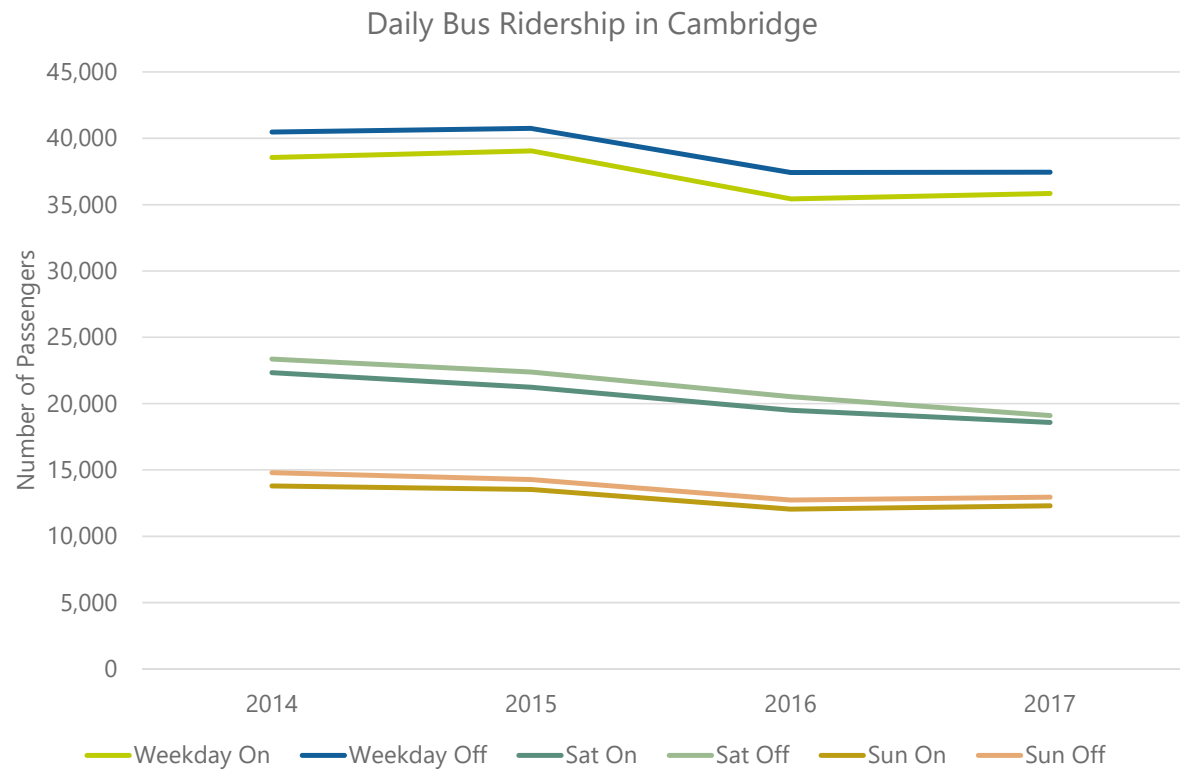


Annual Bus Ridership

“Overall, the MBTA has seen its ridership decline over the past 5 years, especially on its bus services and during off-peak times. Even during peak times, ridership is not growing as much as would be expected in a time of regional population and employment growth, indicating that transit is losing market share. The level and rate of decline, however, is not uniform: ridership on the Blue Line, much of the Commuter Rail system, and certain bus routes has grown over this time period.”

“Bus farebox interactions have dropped by about 8% during peak (weekday), and 10% off-peak (weekday).”

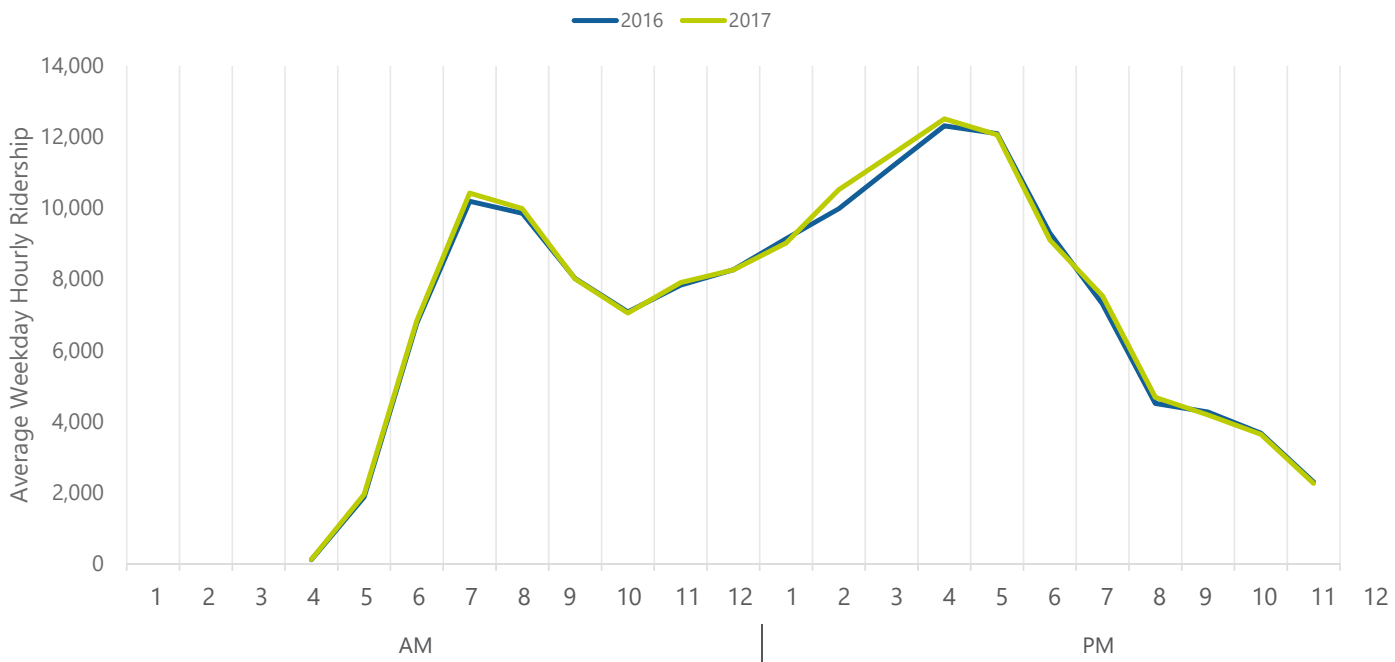
-- MBTA, 2019, A Neighborhood-Level Analysis of Changes in MBTA Bus Ridership



Data Source: MBTA data via the Community Development Department

Hourly Ridership of Buses Crossing Cambridge

Weekday Hourly Ridership of Buses Crossing Cambridge (2016-2017)



Data Source: MBTA data

Typical Daily Subway Ridership

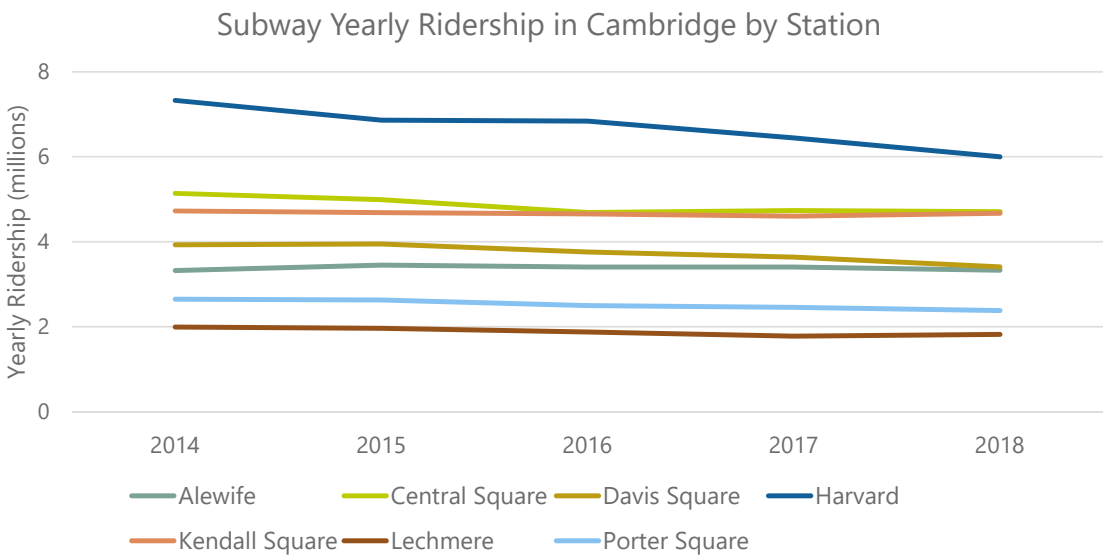
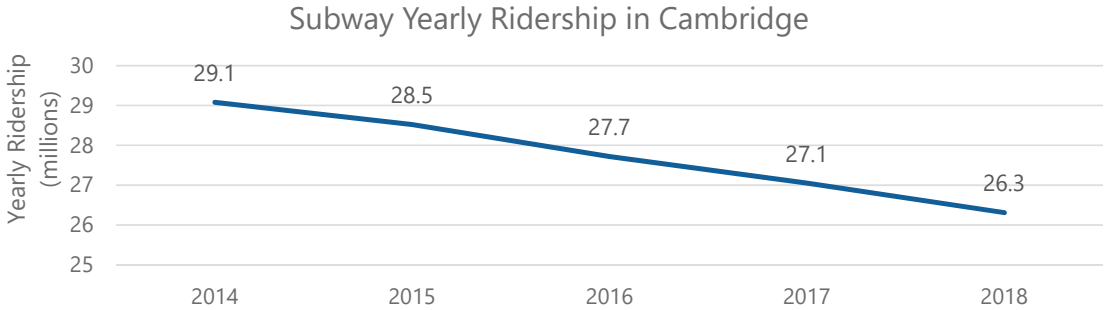
The MBTA's rapid transit ridership is declining in Cambridge and other parts of the Greater Boston area.

Subway ridership has been declining since 2014, except during weekday rush hours.

"Most of the decline is attributed to weekend and off-peak travel times.... The numbers refer to rides and not necessarily passengers. Some riders may still be using the T, just not as much."

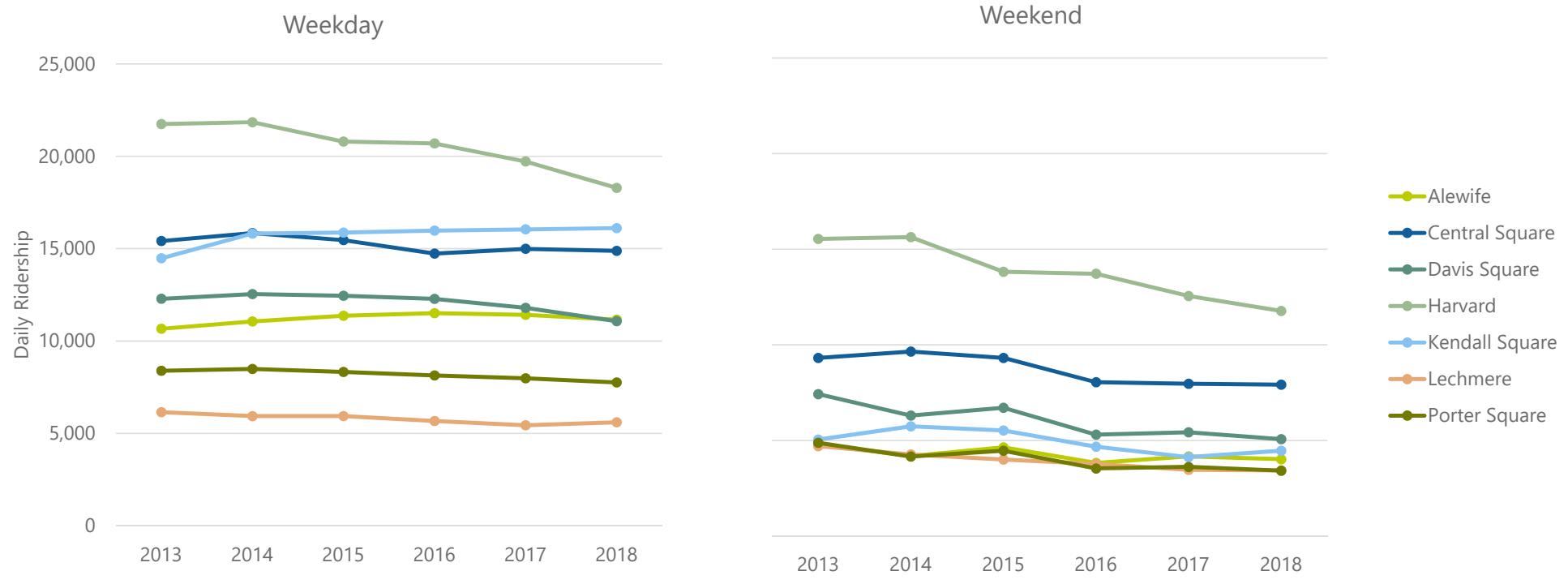
-- T's declining ridership: Why and where, Boston Globe

Fare increases, availability of ride-hail vehicles, and relatively cheap gas may have contributed to the decline in ridership.



Data Source: MBTA data via the Community Development Department

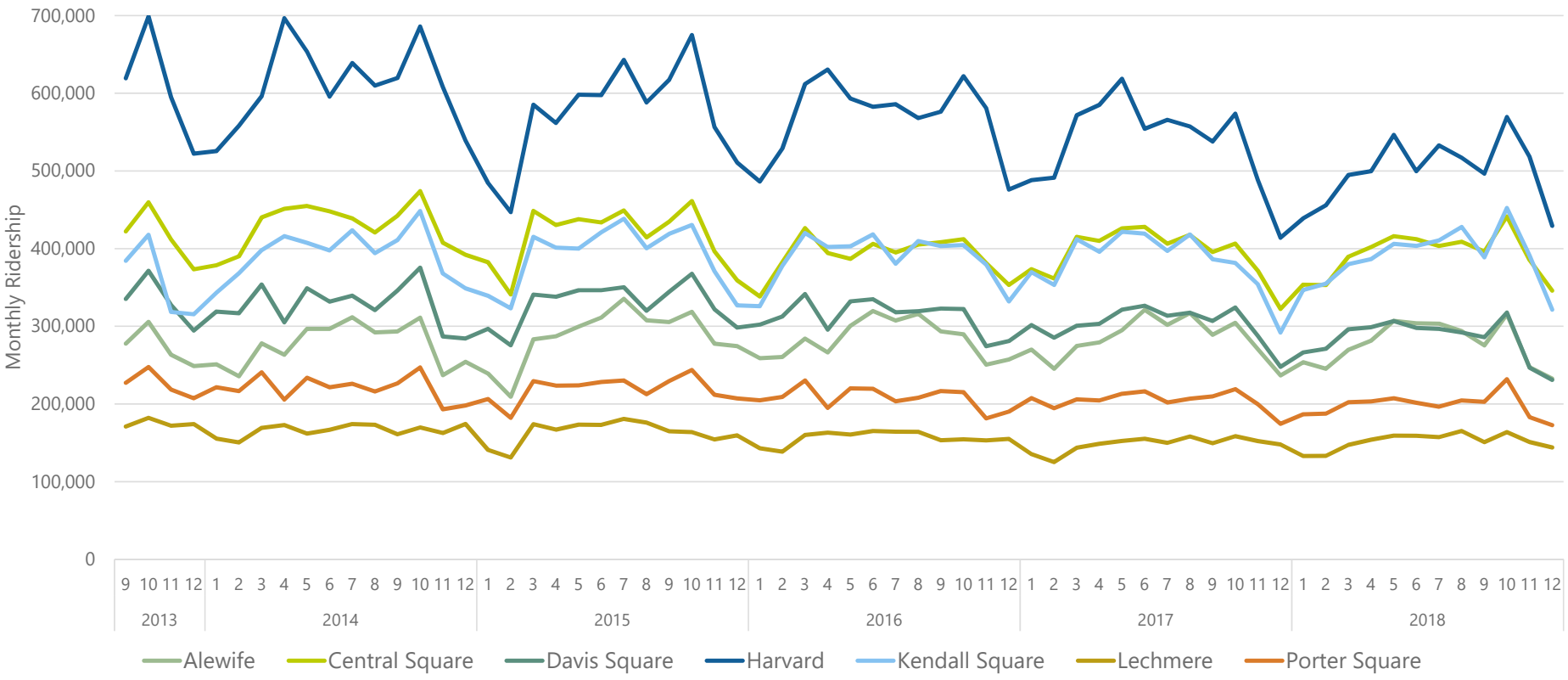
Subway Daily Average Ridership by Year



Data Source: MBTA data via the Community Development Department

Monthly Subway Ridership

Strong seasonal pattern in winter. Ridership drops during the summer at Harvard, but not as much at other stations.

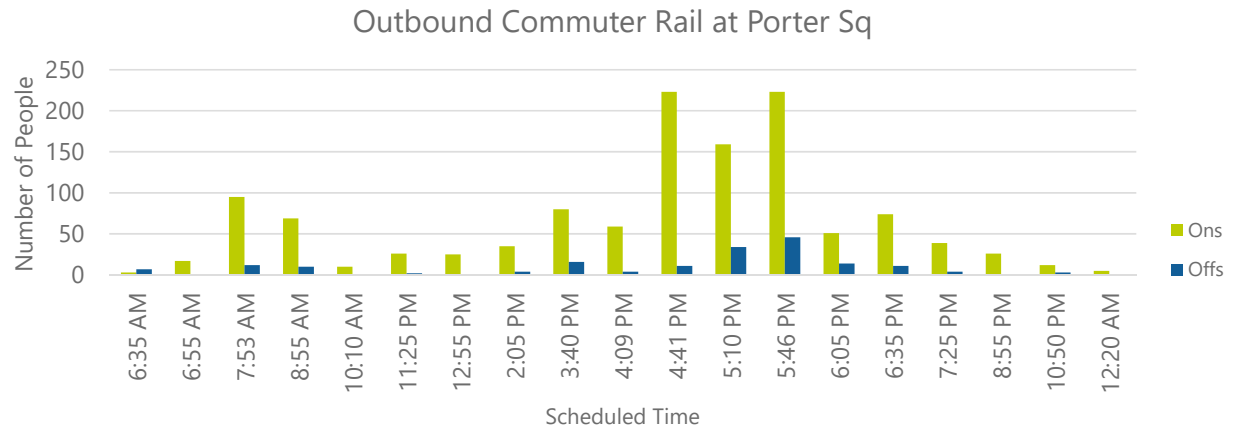
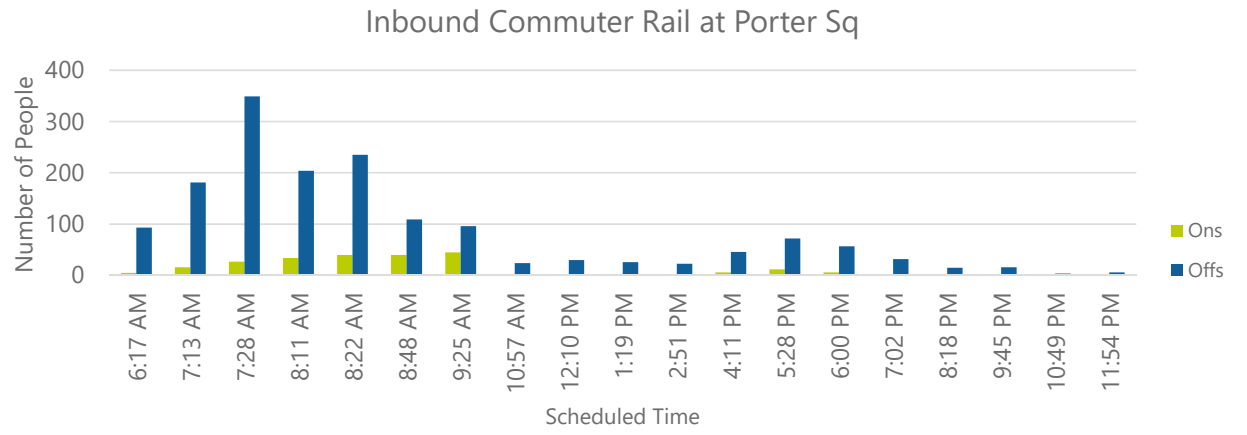


Data Source: MBTA data via the Community Development Department

Commuter Rail

People travelling inbound on the commuter rail from Porter Square in the morning and to Porter Square in the evening likely work around the North Station area in Boston.

People travelling outbound from Porter Square in the morning are generally commuting to work in the Waltham or Concord areas.



Data Source: MBTA data via the Community Development Department

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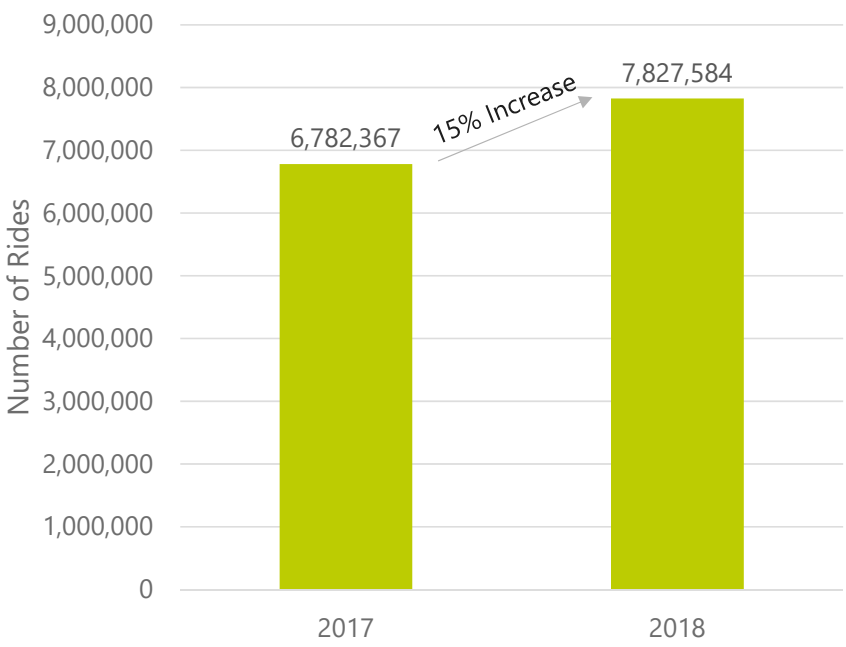
Automobile

Ride-hail Vehicles

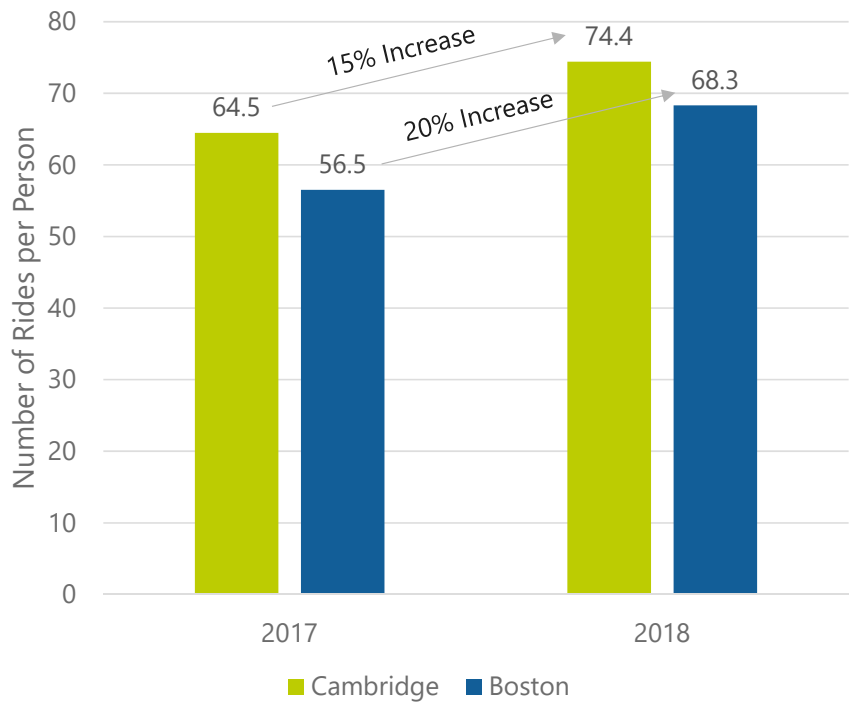


Ride-Hail Vehicles

Annual Rides Starting in Cambridge



Rides/Person Starting in Cambridge



Data Source: MA Department of Public Utilities (DPU), <https://tnc.sites.digital.mass.gov/>

People Journeys

Commuting Patterns

Modes Assessment

Traffic/Crashes

Walk

Bike

Micro-mobility

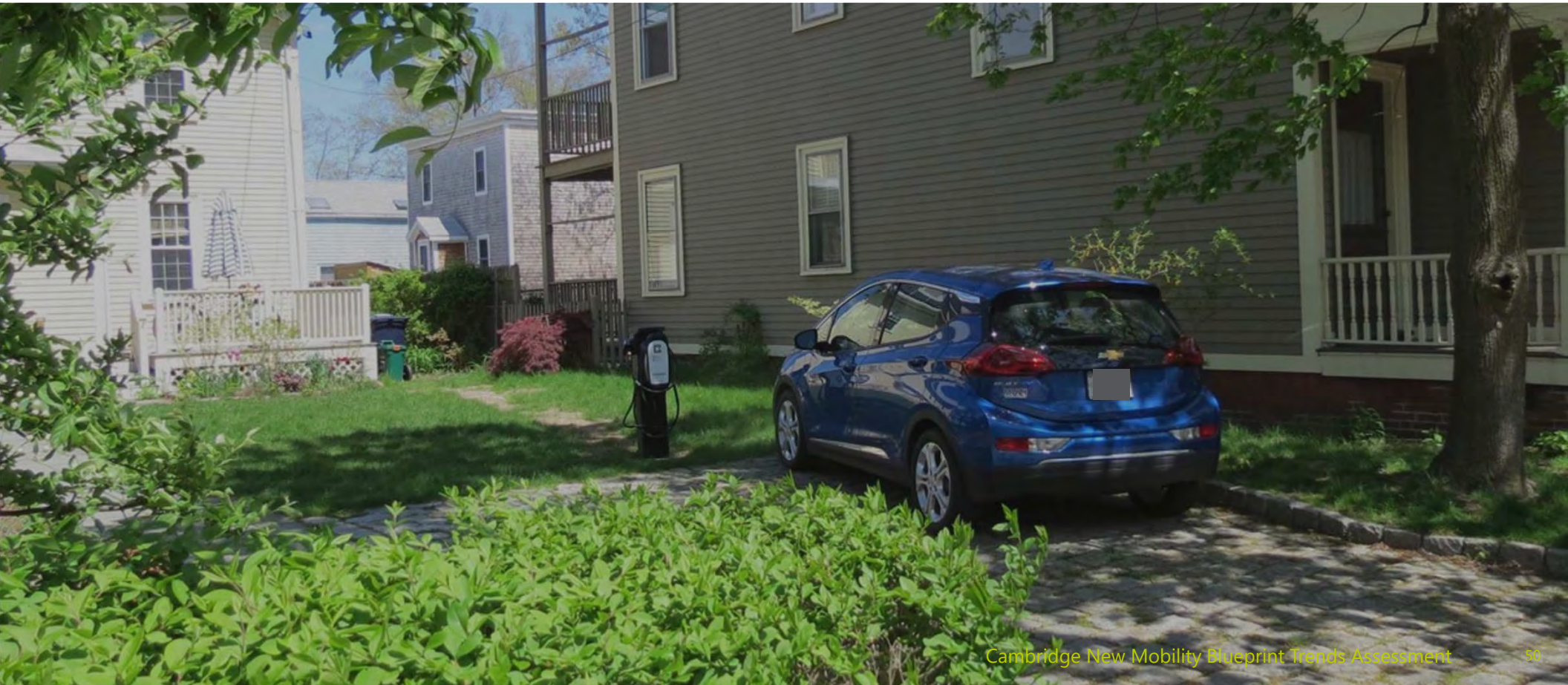
Transit

RHV

EV

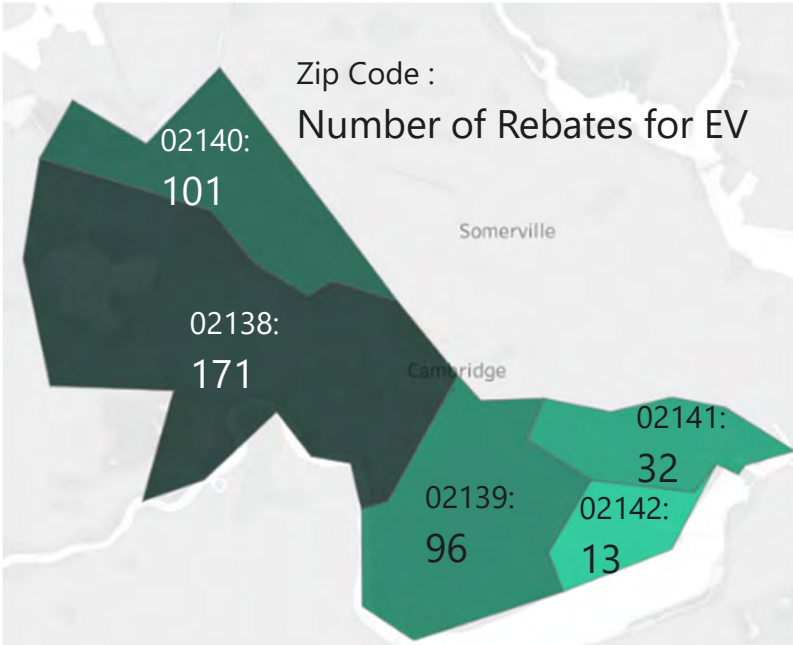
Automobile

Electric Vehicles

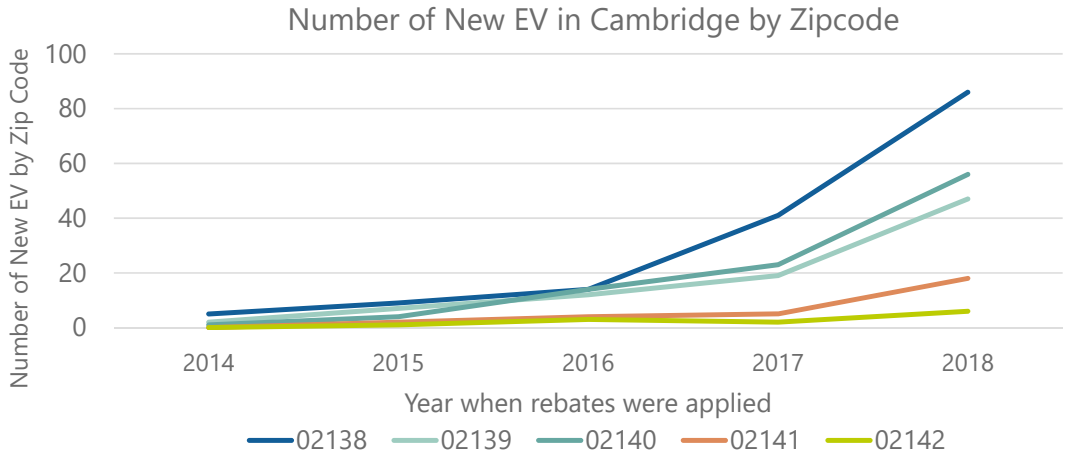
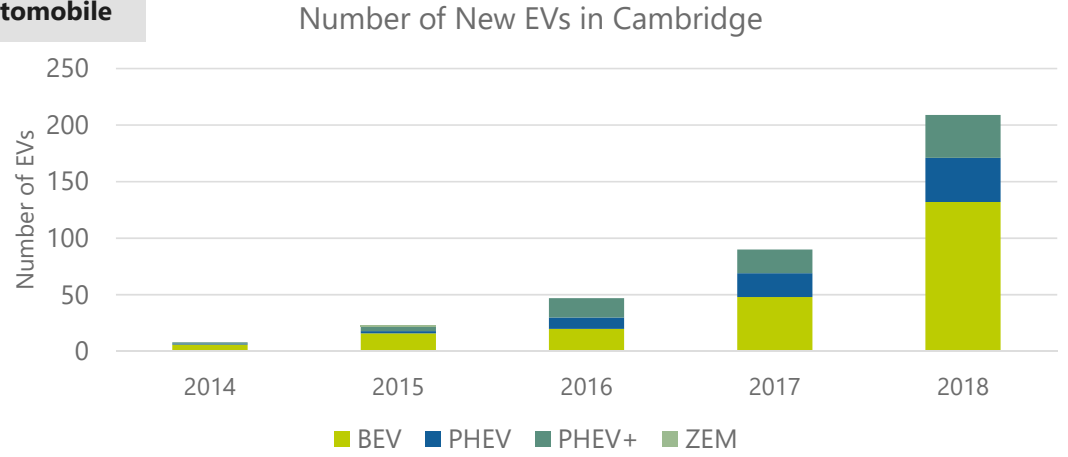


EV Ownership

Cambridge EV ownership is growing at an accelerating rate.



Data Source: MASS DOER EV Rebate Data



| | | | | | | | | | |
|-----------------|------|--------------------|---------|-----|------------------|------------|--|-----------------|--|
| People Journeys | | Commuting Patterns | | | Modes Assessment | | | Traffic/Crashes | |
| Walk | Bike | Micro-mobility | Transit | RHV | EV | Automobile | | | |

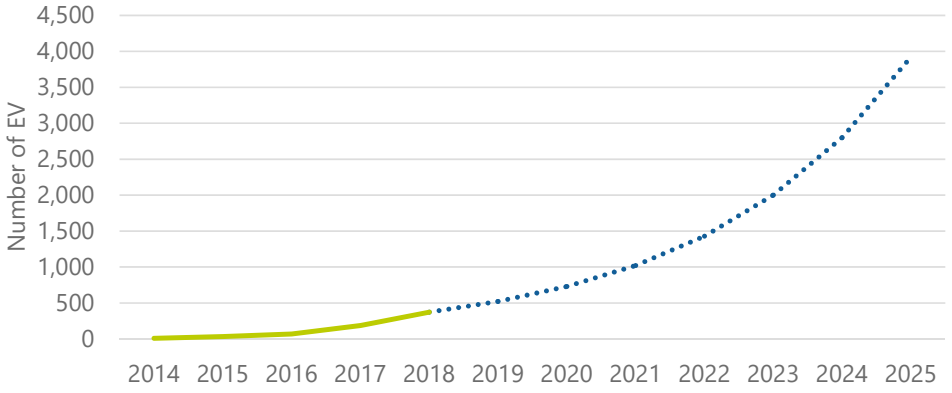
EV Growth

Massachusetts’s zero emission vehicle (ZEV) deployment initiative is aimed at having 300,000 ZEVs in MA by 2025. ZEVs include pure battery-electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hydrogen fuel cell electric vehicles (FCEVs).

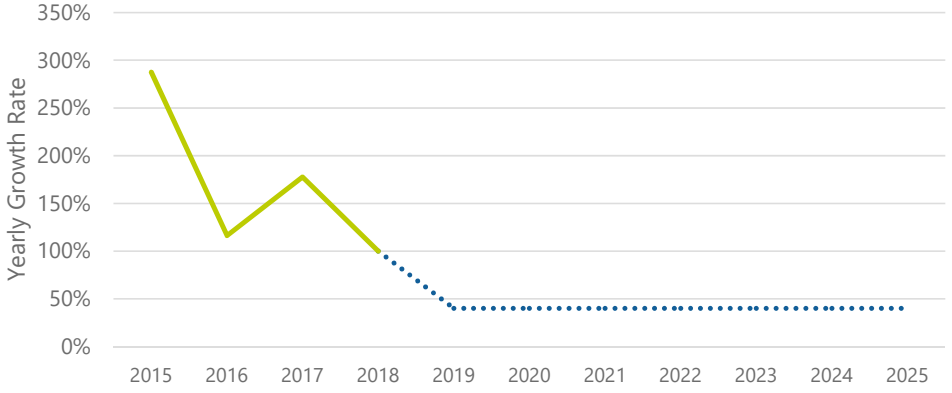
To support and align with the State’s goal of 300,000 EV’s on the road by 2025, Cambridge should proportionally have approximately 4,000 EVs registered (replacing gasoline vehicles) by 2025. If Cambridge maintains yearly EV registration growth rates above 40%, the city will meet this goal in 2025.

Data Source: MA DOER EV Rebate Data

Number of EV in Cambridge



EV Yearly Growth Rate in Cambridge



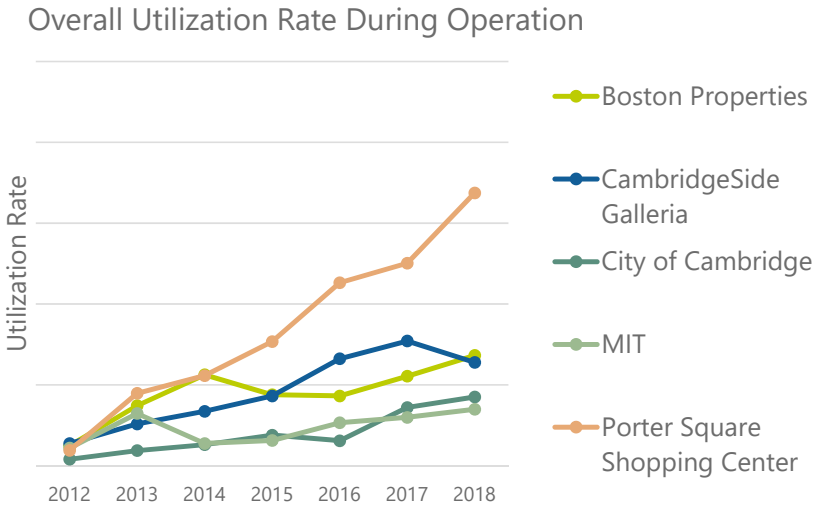
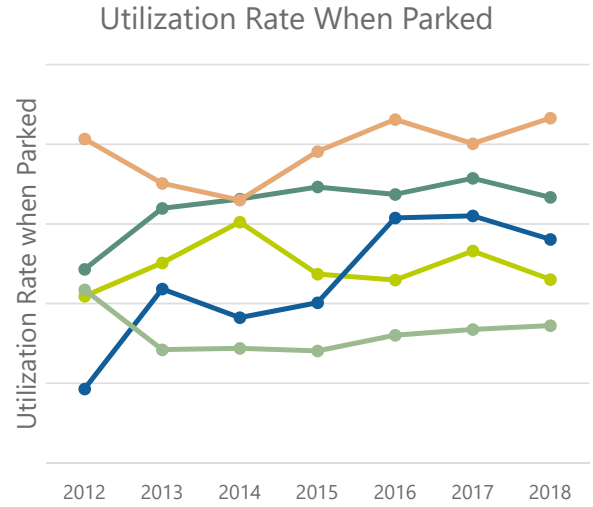
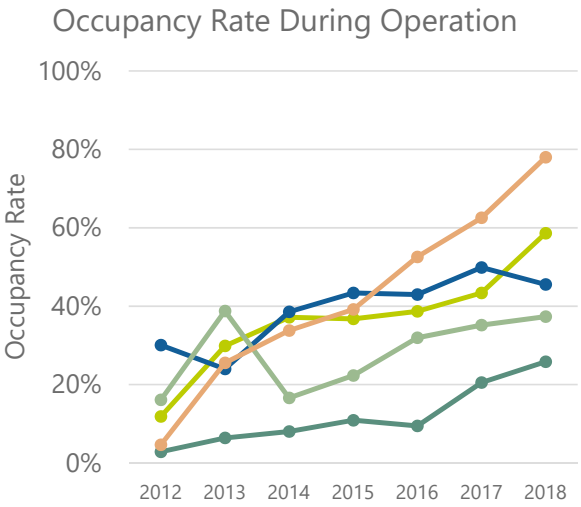
EV Charging Station Usage Trends

In Cambridge, public charger usage is increasing.

Occupancy Rate = Total Time EV Plugged in / Total Time Charging Station in Operation

Utilization Rate When Parked = Time Spent Charging / Total Time EV Plugged in

Utilization Rate During Operation = Time Spent Charging / Total Time Charging Station in Operation



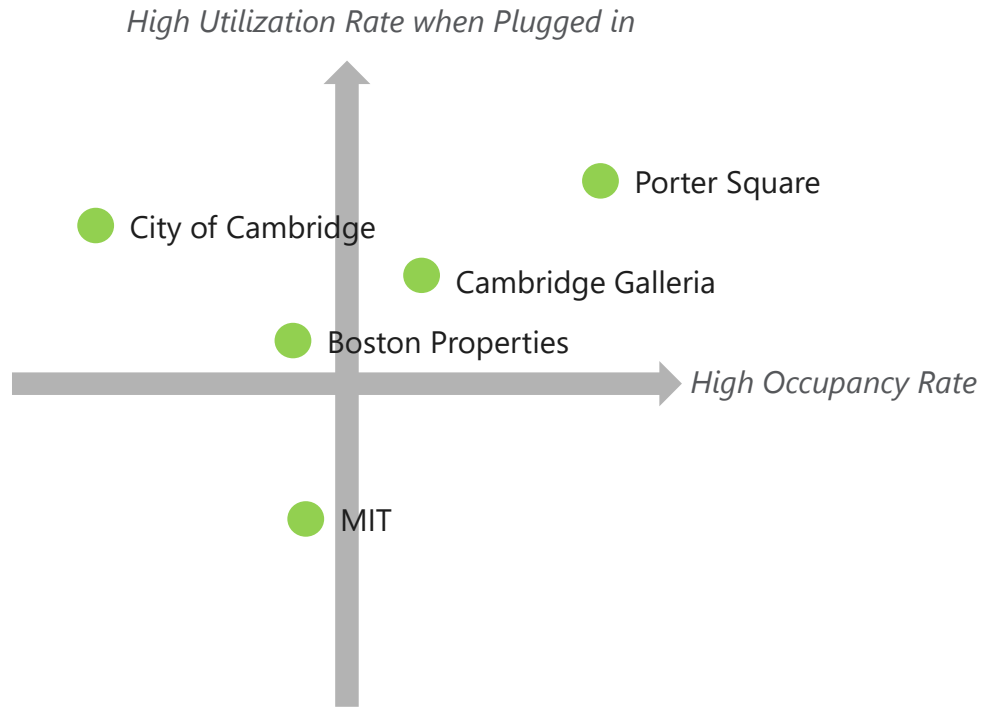
Data Source: City of Cambridge EVSE Data

| | | | | | | | | |
|-----------------|------|--------------------|---------|-----|------------------|------------|-----------------|--|
| People Journeys | | Commuting Patterns | | | Modes Assessment | | Traffic/Crashes | |
| Walk | Bike | Micro-mobility | Transit | RHV | EV | Automobile | | |

EV Charging Station Usage Trends

Of all chargers across the City, the Porter Square charging station has the highest occupancy rate, the best utilization rate when plugged in, and the best overall rate of utilization.

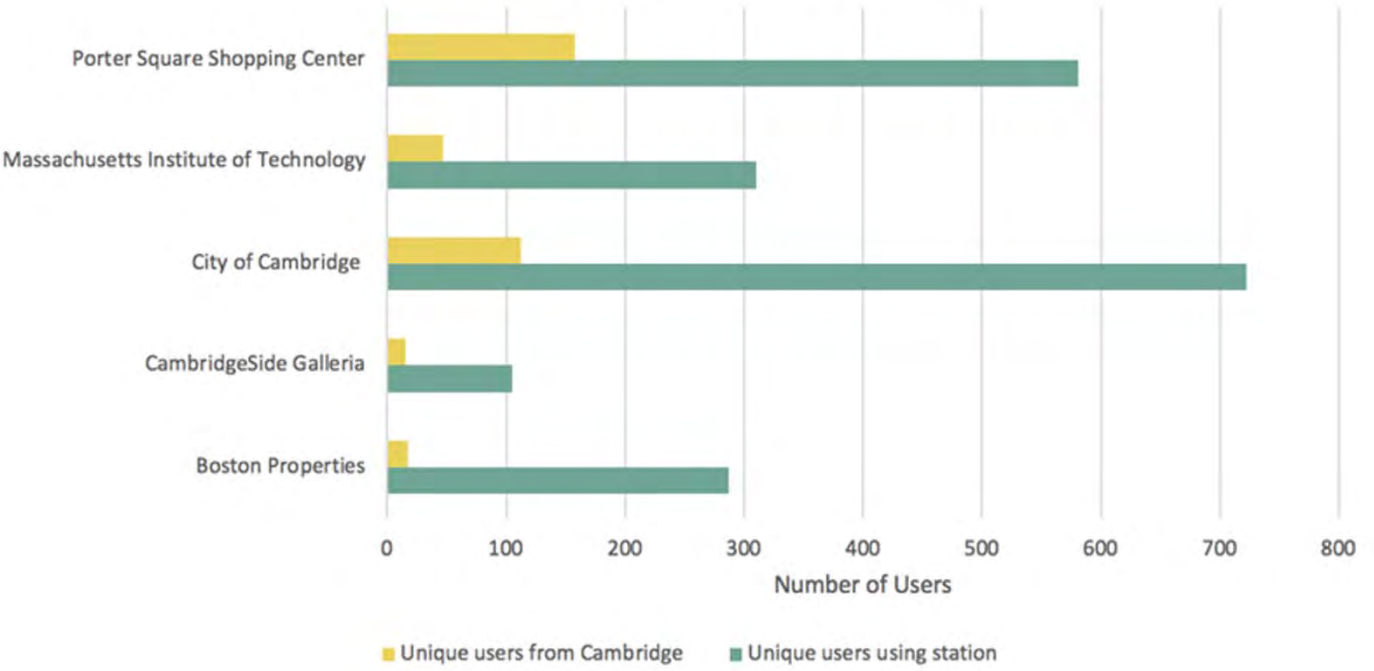
Cambridge Side Galleria operated about 74 days in 2018 from January to April with several maintenance events in between, which negatively impacted its usage.



Data Source: City of Cambridge EVSE Data

EV Charging Station Users Pattern

Number of Unique Users of Each Charging Station in 2018



The Porter Square Shopping Center charging station has the highest charging utilization rate and the highest number of local users.

The City of Cambridge charging station has the largest user base. Most users at this station do not live in Cambridge.

| | Percentage of Users from Cambridge (%) |
|--------------------|--|
| Porter Square | 27.2 |
| MIT | 15.2 |
| City of Cambridge | 15.5 |
| Cambridge Galleria | 14.3 |
| Boston Properties | 5.9 |

Data Source: City of Cambridge EVSE Data

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Automobile



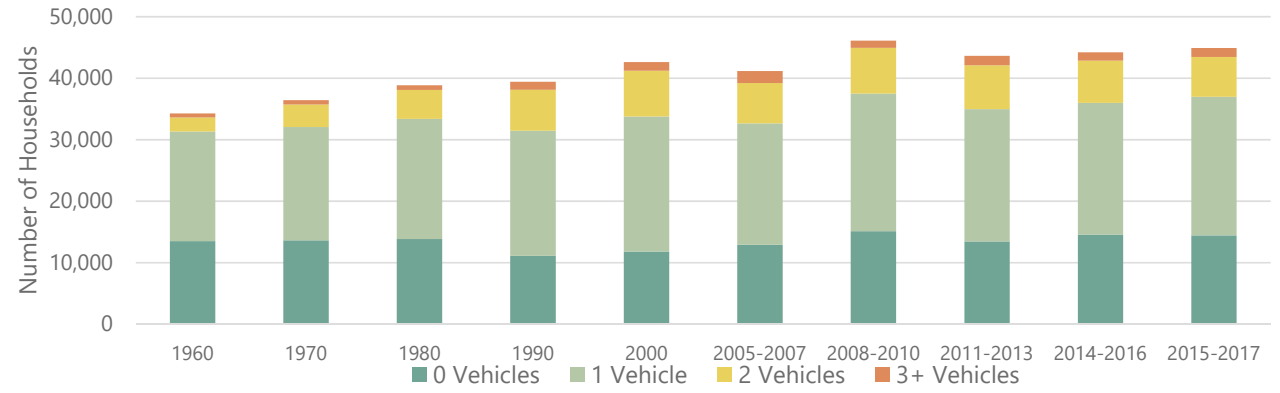
Cambridge New Mobility Blueprint Trends Assessment

Vehicle Ownership

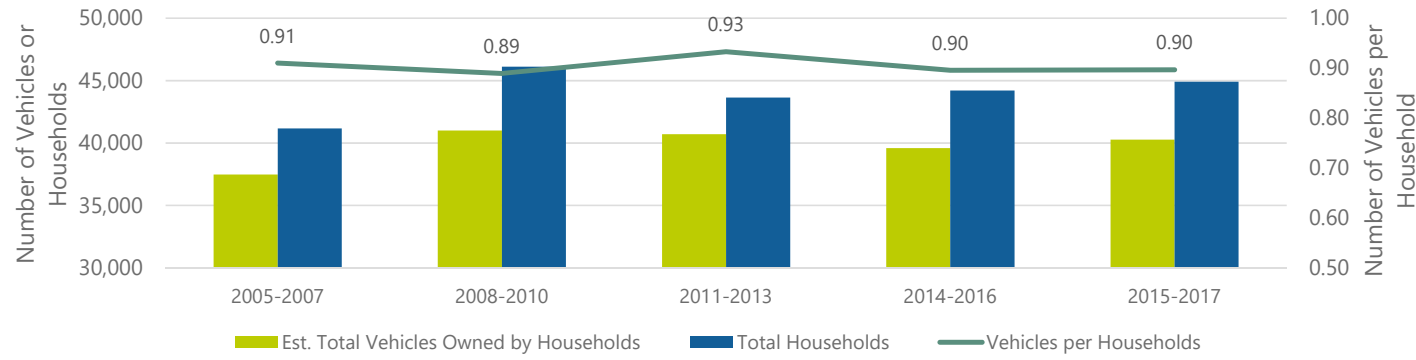
Since 2005, the average number of vehicles owned per household in Cambridge has been approximately 0.9 vehicles.

While the total number of vehicles registered in Cambridge has increased, the % of households that own two or more cars has steadily decreased since 1990.

Vehicle Ownership in Cambridge—ACS Data



Number of Vehicles per Households in Cambridge

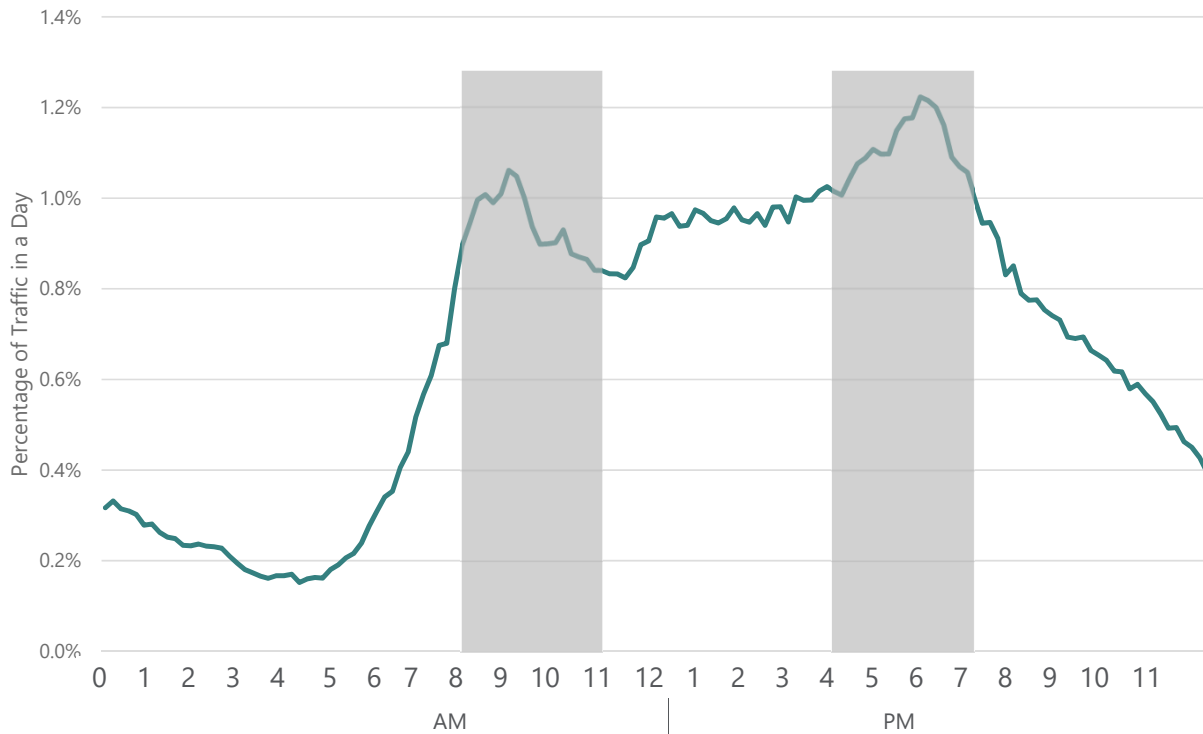


Data Source: 1960,1970, 1980, 1990, 2000 Census, 3-year average ACS from 2005 on, Cambridge RMV Registrations 1996-2018.

Traffic / Crashes



Vehicle Traffic by Time of Day



Evening rush hour lasts longer and has higher traffic intensity than morning rush hour.

About 17% of vehicle traffic happens between 7:30 and 10:30 AM.

About 20% of vehicle traffic happens between 3:30 and 6:30 PM.

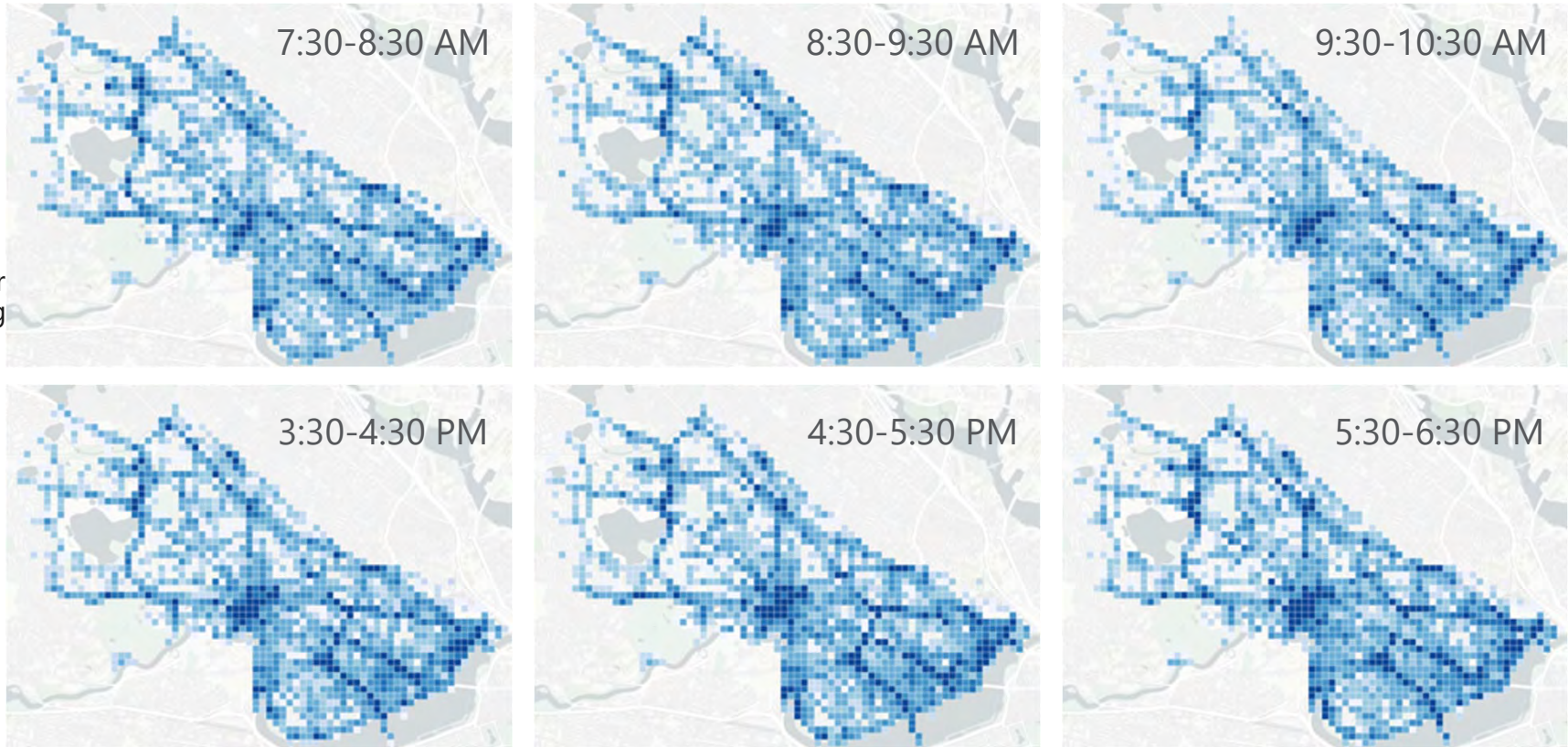
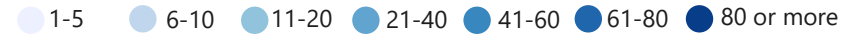
Distribution of Car Traffic

Each map shows the distribution of car traffic at different times of day. Dark blue means the area has more traffic than other parts of the city at the same hour.

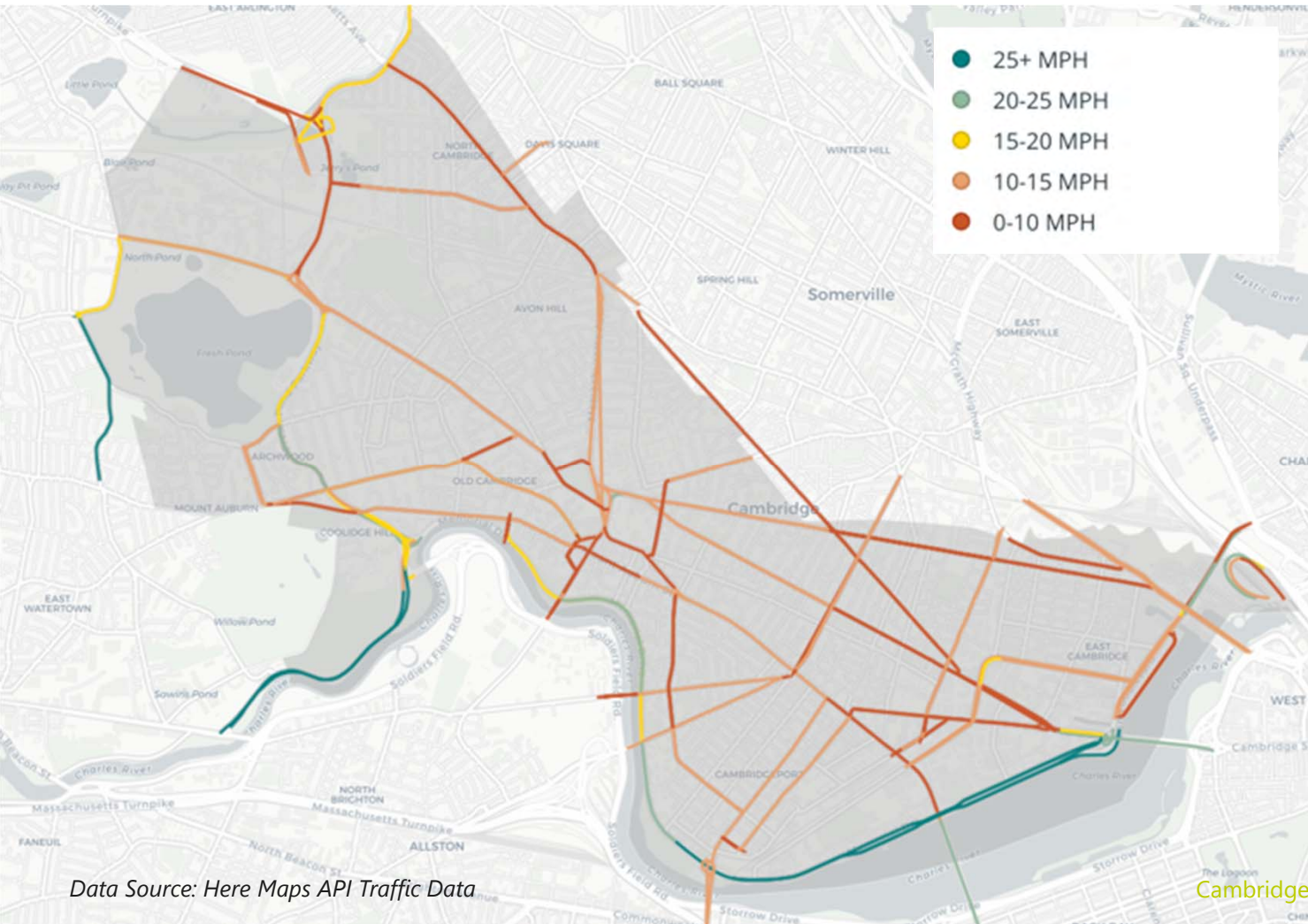
The evening rush hour is busier than morning rush hour.

Traffic is concentrated around Harvard, Lechmere, Kendall Square and Massachusetts Ave. between Central Square and MIT.

Number of Cars Counted by GPS Data

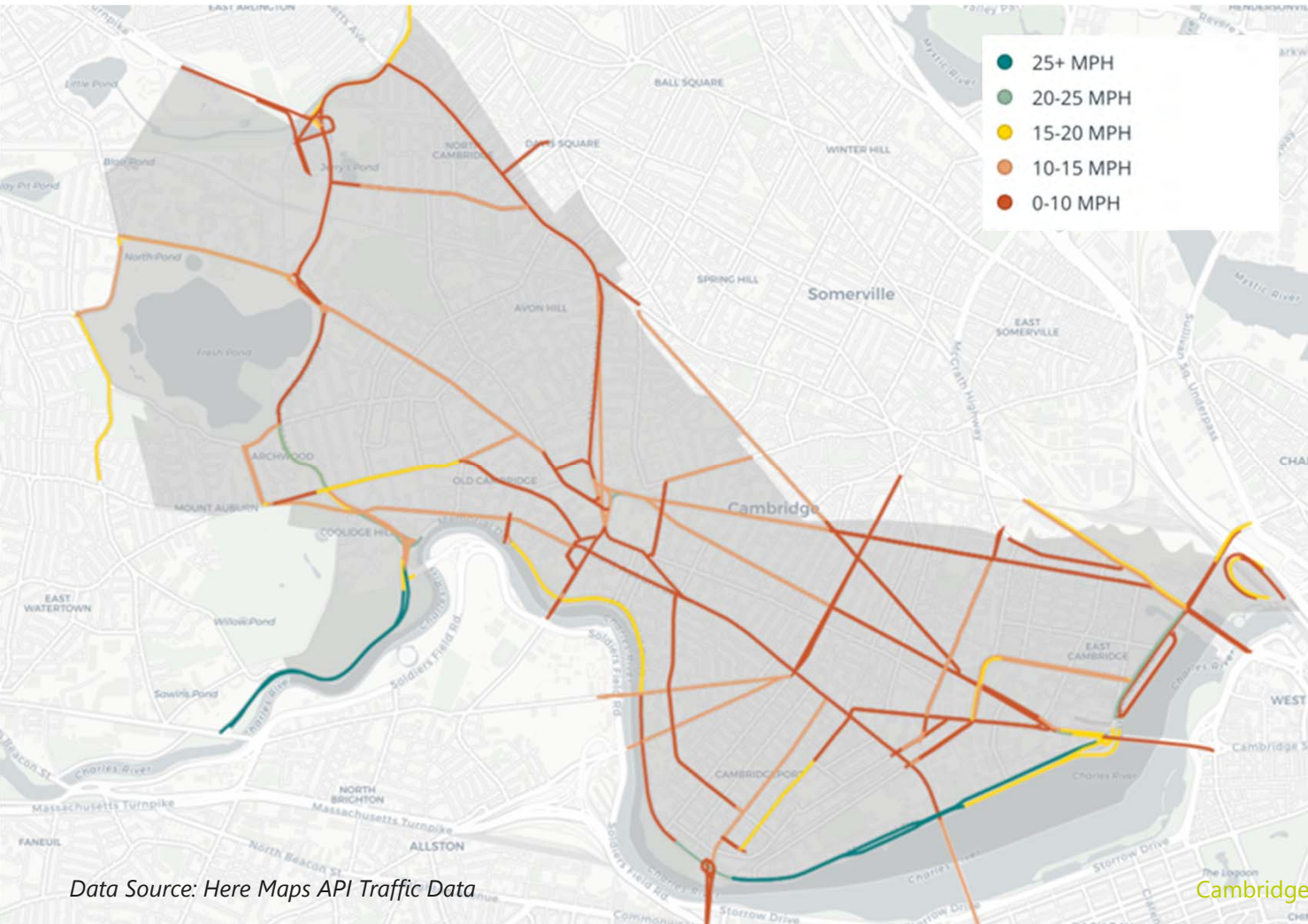


Data Source: Anonymized GPS Data



Average Speed on Traffic on Weekdays at 8 AM

Speed of traffic on major roads within Cambridge is mostly between 5 and 15 MPH.

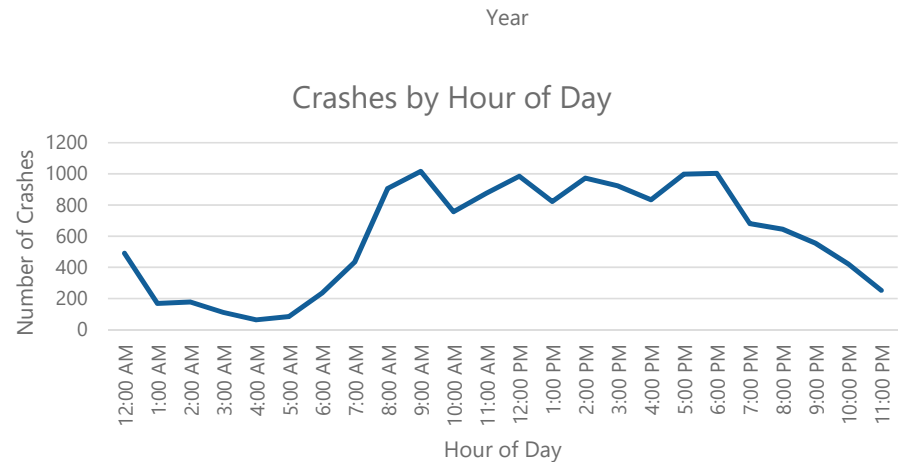
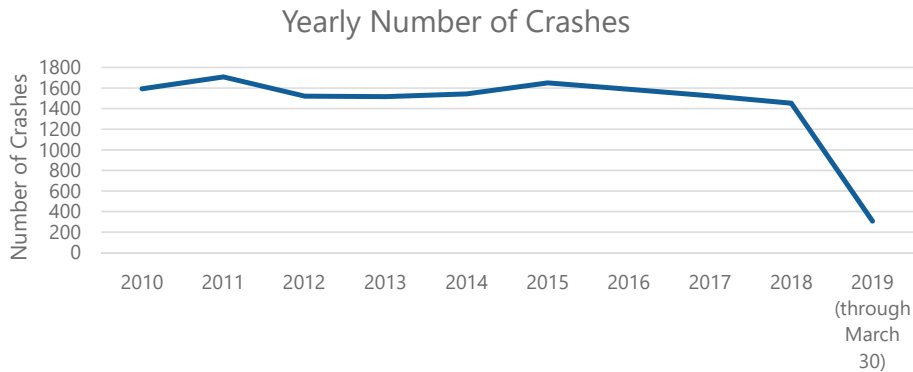


Data Source: Here Maps API Traffic Data

Average Speed on Traffic on Weekdays at 6 PM

Speed of traffic during the evening rush hour is slower than the morning rush hour.

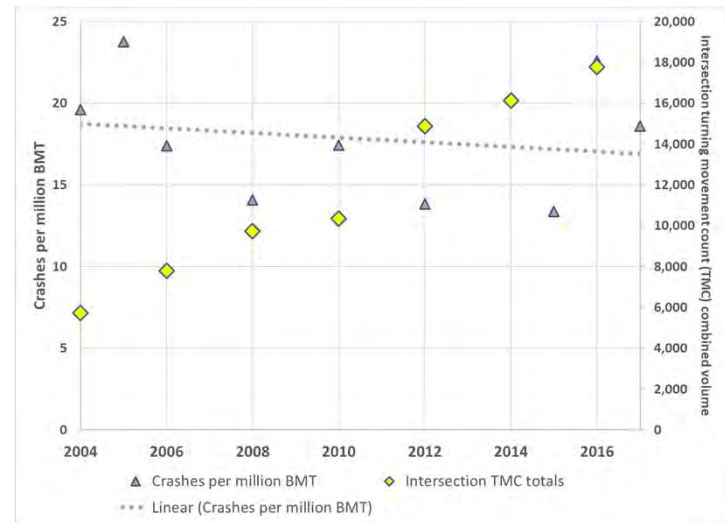
Crashes: 2010-2019



The annual crash count in Cambridge has been relatively consistent, numbering around 1,600 each year. However, since passage of Vision Zero in 2016, the City has enjoyed marginal decreases year over year. Last year, the Police Department reported 1,454 crashes, representing the least for any year included in the data, and a 15% decrease from the City's 2011 peak of 1,708 crashes.

The best way to describe the relative change in the level of safety of travelling by bicycle is with a crash rate. A rate accounts for changes in volume of use.

Crashes per Million Bicycle Miles Traveled (BMT)

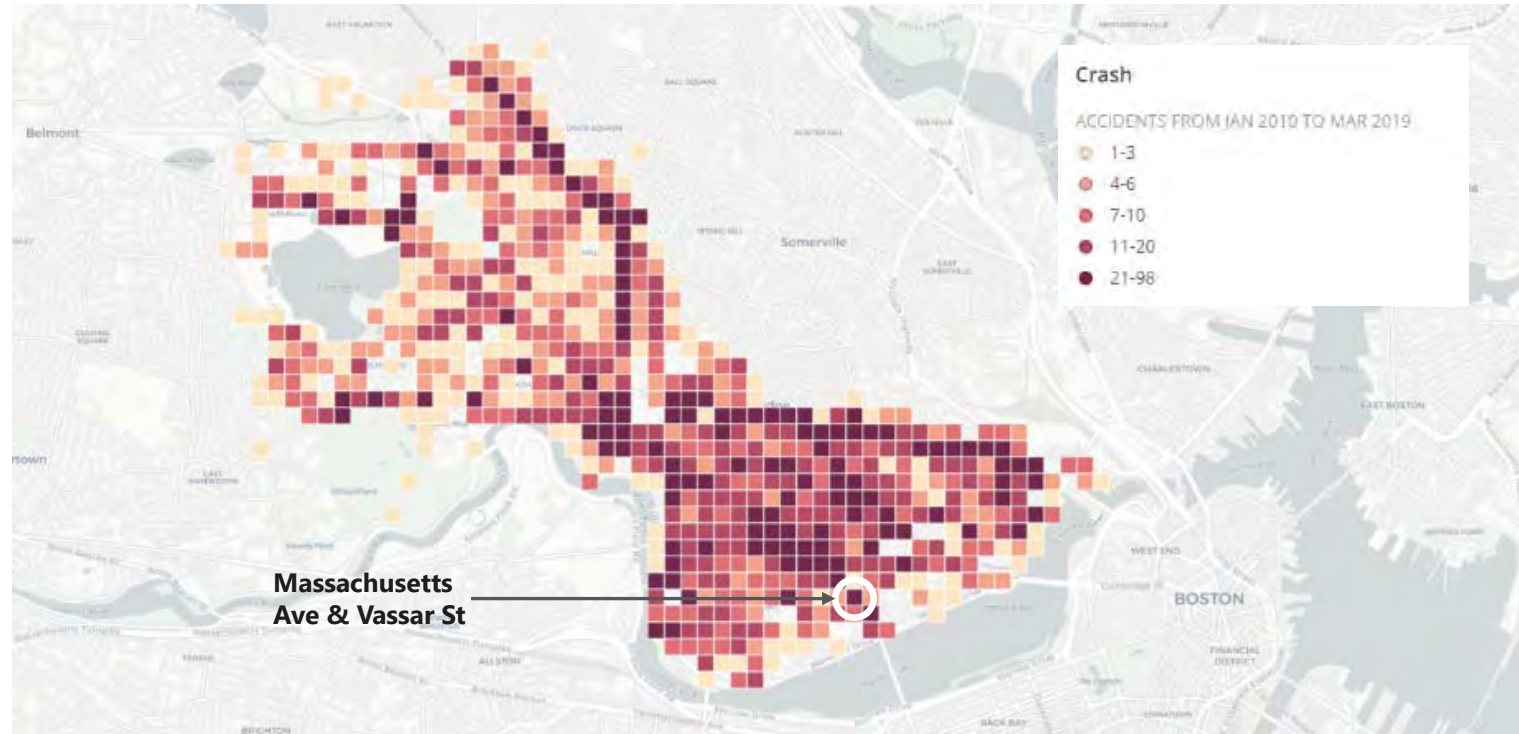


Data Source: Cambridge Police Department Crashes Data 2011- 2019

Heat Map of Crash Locations: 2010 - 2019

The Massachusetts Ave. & Vassar St. intersection is the most dangerous in the City, with more than 90 crashes over more than years.

Much has changed since 2016 when the City adopted Vision Zero (several associated safety improvement projects are currently underway).



Data Source: Cambridge Police Department Crashes Data 2010-2019

Summary of Transportation Trends

| Modes | Trends | Notes |
|-------------------------|--------|---|
| Walking | ↑ | Cambridge, with 24% of residents commuting by walking, ranks first among 178 medium-sized cities in the US. It is 7% higher than the second-ranked city, Berkeley, CA, which has 17% of residents walking to work. |
| Biking | ↑ | Workforce commuting by bike into Cambridge was 7.2% in 2012 (8.2% according to 2017 ACS data), which ranks 4 th among the 178 medium-sized cities in the US in biking commute percentages. Compared to almost all other US cities, Cambridge is a strong performer. Furthermore, it has not yet peaked, especially considered relative to cities like Boulder, CO and Davis, CA. |
| Micro-mobility | ↑ | There is potential for an increase in the use of micro-mobility devices, given that Cambridge has not yet launched a shared scooter program. |
| Transit | → | Both bus and subway ridership is declining, though rush hour trips on the subway have remained mostly flat. |
| RHV | ↑ | Ride-hail vehicle trips have been growing significantly. Cambridge has the highest number of trips per capita in Massachusetts. |
| EV | ↑ | Electric Vehicle adoption in Cambridge is growing faster than in Middlesex County and the State of Massachusetts, overall. |
| All Vehicles | ↑ | With an increase in population, the total number of vehicles will also grow. |
| Vehicles per Households | ↓ | Car ownership per household is about 0.9, which is the national average of 1.8 vehicles per household. The percentage of households without any cars has grown from 28% to 32%. |

Data Source: *Bicycling and Walking to work in the US 2008-2012 by ACS*