Data Infographics for CTfastrak and the Hartford Line Survey

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This report examines some of the economic and real estate impacts of Connecticut's CTfastrak and Hartford Line transit systems through a multi-phase, data-driven study. Findings reveal evidence that proximity to transit stations is associated with increased property values, higher property tax revenues, reduced residential and commercial vacancies, and enhanced transit-oriented development (TOD). The research utilizes GIS mapping, causal analysis, and infographic visualization to assess changes in real estate markets and municipal development. CTfastrak shows particularly strong gains due to its earlier launch and novelty as a Bus Rapid Transit system. Policy recommendations include expanding TOD zoning, incentivizing private investment, ensuring housing affordability, and enhancing data monitoring. With recent federal funding to expand the Hartford Line, these insights are timely and critical for guiding future infrastructure investment and urban and regional planning efforts. The study highlights how integrated transportation planning can promote sustainable growth, improve mobility, and deliver broad economic benefits across Connecticut communities.</td></tr>
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METRIC CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
LENGTH				
in	inches	25.4	millimeters	Mm
ft	feet	0.305	meters	M
yd	yards	0.914	meters	M
mi	miles	1.61	kilometers	Km
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	Ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	G
lb	pounds	0.454	kilograms	Kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
ºF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	ºC
ILLUMINATION				
fc	foot-candles	10.76	lux	Lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

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Executive Summary

The Connecticut Department of Transportation (CT DOT), in partnership with the Federal Highway Administration (FHWA), commissioned a multi-phase research initiative to evaluate the effects of two major transit projects—CTfastrak and the Hartford Line—on real estate development and economic growth across several Connecticut municipalities. The University of Connecticut (UCONN) led the data collection and analysis, which culminated in a series of maps, visualizations, and infographics intended to inform policymakers, planners, and the public.

CTfastrak, a Bus Rapid Transit (BRT) system, was launched in March 2015 and serves four municipalities. The Hartford Line, a heavy commuter rail, began operations in June 2018 and spans eleven municipalities. The central research goal of this study was to understand how fixed-guideway transit investments stimulated private real estate development, job accessibility, tax revenue increases, and reduction in commercial and residential vacancies—key elements of Transit-Oriented Development (TOD).

The study tested seven primary hypotheses, which are summarized as follows:

1. Investment in enhanced transit services provides reduced transportation costs to commuters.

2. Property tax revenues from new residential and commercial developments were higher near transit.

3. Real estate sales prices near the stations increased after the opening of the new transit lines.

4. Assessed property values rose near transit stations.

5. Transit proximity was linked to lower rates of residential and commercial vacancy.

6. There has been a surge in constructed and proposed development in the vicinity of transit.

7. Many Connecticut municipalities have changed their zoning near transit stations, to reflect mixed-use and residential growth.

Multiple data sources from previous phases of the research—including over 1,000 GIS maps, Excel pivot tables, and other data—were used to synthesize trends and patterns across space and time to design and create a crisp set of concise infographics.

Major Findings Include:

1. Property Value and Sales Price Increases:

Proximity to transit stations significantly increased residential and commercial property values in many locations. Near CTfastrak, home values were often higher compared to those near the Hartford Line, partly due to a longer study window (2015–2020 vs. 2011–2018). Regression analysis indicated causal effects: homes within 0.75 miles of CTfastrak stations experienced a 17.5% price increase, while condominiums saw a 10% increase.

2. Cost Savings for Commuters:

Commuting via transit saved many households significantly on transportation costs because commuting costs associated with car ownership were roughly twice those of using transit.

3. Tax Revenue Trends:

Property tax revenues rose near transit, especially in New Britain, West Hartford, Enfield, and Windsor Locks. Rising assessed values led to higher tax revenues in many areas near both transit systems.

4. Vacancy Trends:

Residential vacancies declined substantially near CTfastrak stations between 2015–2020, aligning with a statewide vacancy drop of 66%. The Hartford Line showed mixed results, possibly due to timing and slower absorption of new housing in some rapidly expanding areas like Meriden.

5. Planned and Proposed Developments:

New Haven, Meriden, and Hartford all saw extensive increases in development around Hartford Line stations. New Britain and Hartford experienced consistent or increased proposed development near CTfastrak stations. West Hartford saw early growth in the planning stages of CTfastrak, followed by a temporary decline in new developments in 2015-2020.

6. Zoning Shifts:

West Hartford and Hartford have both implemented zoning changes, with shifts toward mixed-use zoning near CTfastrak stations. Other municipalities had limited evidence of zoning adjustments, though more data is needed to assess long-term trends, particularly for the Hartford Line.

Policy Implications:

This research provides evidence that transit investments can support real estate investment and broader economic growth, reduces transportation costs for households, enhances local tax bases, and can lead to greater land use efficiency. With Connecticut recently receiving $105 million in federal funding to expand Hartford Line service, the findings of this study are particularly timely. The insights support future investment in TOD strategies and reinforce the benefits of continued and expanded transit services in Connecticut.

1 Background

1.1 Introduction

A research team at the University of Connecticut has been analyzing the baseline conditions of real estate markets, and the subsequent evolution of real estate in the station areas near relatively new transit lines. CTfastrak is a bus rapid transit (BRT) service in four Connecticut municipalities operated by CT Transit since March 2015. The Hartford Line heavy commuter rail has been operating in central Connecticut since June 2018. The Connecticut Department of Transportation (CT DOT) and the Federal Highway Administration (FHWA) have funded 3 phases of the study on these transit initiatives, and this research effort has been overseen by the CT DOT Department's Bureau of Policy and Planning, Research Unit. Several reports have been produced to date, including two for CTfastrak (one for Phase 1 and another for Phase 2), and one for the Hartford Line (one report for Phase 1). In addition, a visualization tool using ArcGIS StoryMaps ® has been developed to demonstrate the real estate conditions for the two CTfastrak phases. Each of the above-described reports has generated several hundred aerial photos superimposed on thematic maps, which are available in separate geodatabases.

This multi-year study has examined how investments in fixed-guideway transit systems influence private real estate investment development. It focuses on how this development contributed to the essentials needed for business location and expansion in the state, access to job opportunities, increased tax revenues, and expanded housing options for residents.

CT DOT has requested this information as a public information tool to allow the general public and elected officials to better understand the benefits of the state's investment in public transportation. While there is a wealth of information developed by the UCONN team, CT DOT indicated they could benefit further from a user-friendly compilation of the information in visualization format. Finally, CT DOT has indicated interest in having a real estate related brochure for each of the CTfastrak and the Hartford Line, to demonstrate the substantial financial and community benefits of a collaborative approach to Transit Oriented Development (TOD) between the municipalities and the CT DOT. This report develops a set of infographics that can support CT DOT with its marketing, presentations, and future decision making related to these two transit lines.

1.2 Staging of Study

This section describes the various phases and stages of the CT***fastrak*** and Hartford Line studies.

Staging of the CT*fastrak* Studies: Phase 1, 2, and 3

CT*fastrak* Phase 1. Phase 1 of the CT***fastrak*** project, which was completed in October 2017, collected data for the following period:

Phase 1: **Pre-2015 (baseline conditions)**: The time period leading up to the start of CT***fastrak*** service.

- Over 500 GIS maps, many of which were superimposed on aerial photography, were developed and placed in a geospatial database for later use in Phase 2.

CT*fastrak* Phase 2. Phase 2 of the CT***fastrak*** project was a follow-up of Phase 1, to update the data as described below, and then statistical analyses were performed to determine the causal relationships between CT***fastrak*** and various real estate variables. Phase 2 covered the following period:

Phase 2: **2015 – 2020:** The period between the start of service on CT***fastrak*** (March 2015) and the 5 year anniversary of the service (March 2020).

- Over 500 GIS maps, many of which were superimposed on aerial photography, were developed. An ArcGIS StoryMap ® was developed based on some of these maps, and is publicly available here: https://gis.cti.uconn.edu/portal/apps/MapSeries/index

CT*fastrak* Phase 3: A later project would collect data for Phase 3. This phase of the research project has not yet begun.

Phase 3: **2020-2025:** The period between the start of the Covid-19 pandemic (March 2020) through March 2025 (10 years after the start of CT***fastrak*** service).

- Staging of the Hartford Line Studies: Phases 1 and 2

Hartford Line Phase 1. Phase 1 of the Hartford Line project was completed in June 2022. It collected data for both Period 1 and Period 2.

Period 1: Pre-2012 (baseline conditions): The time period before the formation of the state's Interagency Workgroup on Transit Oriented Development (TOD).

Period 2: 2012 – 2018: The period between the formation of the Interagency Workgroup on TOD (2012) and the opening of the CTrail Hartford Line in 2018.

- Over 500 GIS maps, many of which were superimposed on aerial photography, were developed and placed in a geospatial database for later use in Phase 2.

Hartford Line Phase 2. A later project (Phase 2) would collect data for Period 3. This phase has not yet begun. This later phase of the project would occur several years after the opening of service to allow sufficient time for development and real estate markets to adjust and respond to the presence of the new rail service.

Period 3: 2018-2023: The period following the opening of the CTrail Hartford Line in June 2018, covering the first 5 years of service (through June 2023).

Study Setting:

Central Connecticut is the setting for both the CTfastrak and the CTrail Hartford Line locations. As shown in the corridor maps on the following pages, the CTfastrak covers Central Connecticut while the Hartford Line spans the entire north-south corridor of the state.

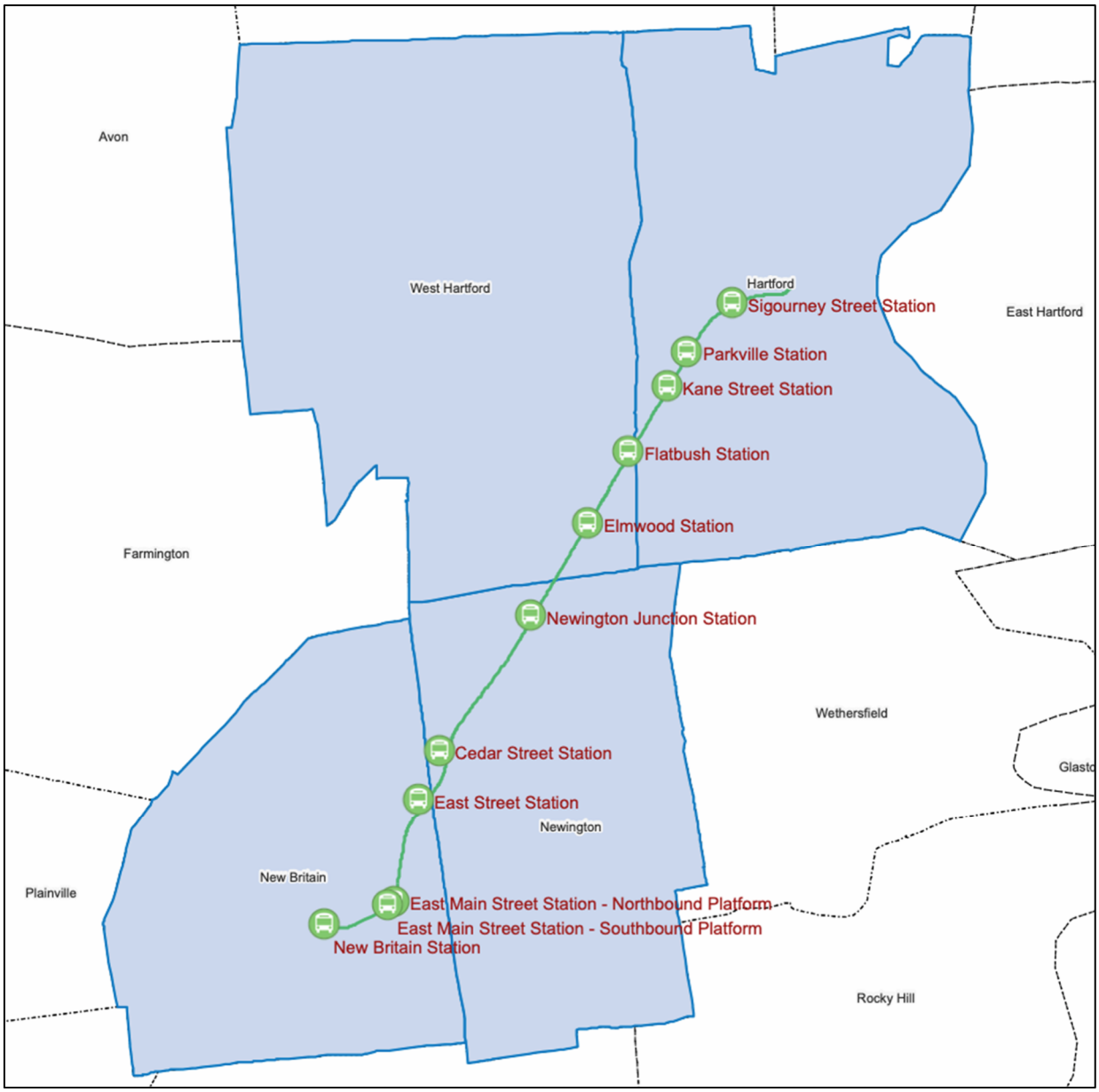

Figure 1 Map of CTfastrak stations

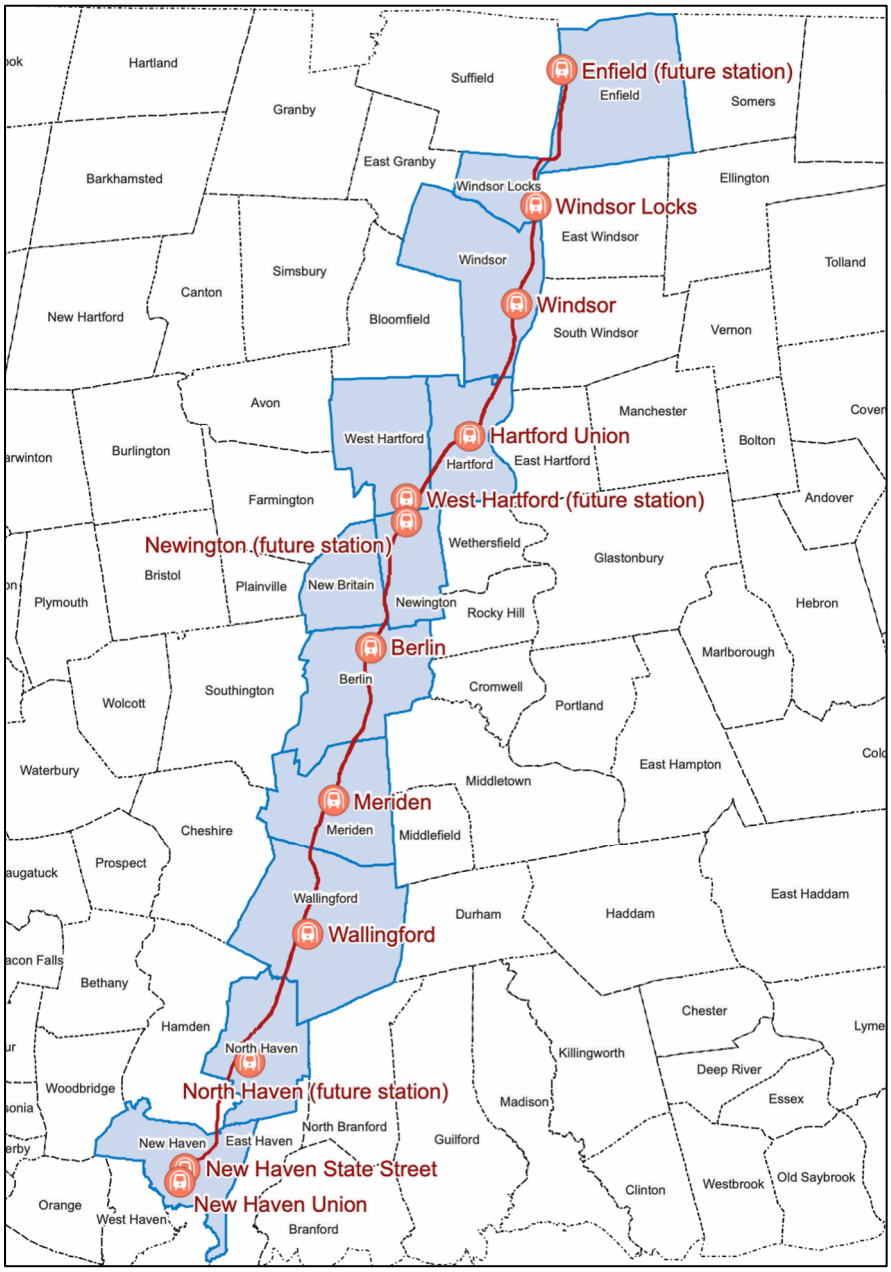

Figure 2 Map of CTrail Hartford Line stations

1.3 Problem Statement

The overall aims of all phases of the Hartford Line study are to measure the impact of the Hartford Line on real estate and urban economic development in the eleven Connecticut municipalities with rail stations; and to compare a baseline condition before construction with the post-construction status of real estate markets near the stations. Phase 1 – consisting of Period 1 and Period 2 - collected data for both periods. Period 1 covered pre-2012 (baseline conditions): the time period before the formation of the State of CT's Interagency Workgroup on TOD. Period 2 covered 2012 – 2018: the period between the formation of the Interagency Workgroup on TOD (2012) and the

opening of the Hartford Line in June of 2018. Several hundred thematic maps were developed, along with a set of Excel pivot tables. Phase 1 of the CT*fastrak* study set the baseline conditions leading up to the start of service in 2015. The CT*fastrak* Phase 2 study covered the first 5 years of service (March 2015-March 2020). Phase 2 of this series of studies found this service has been encouraging TOD along the busway, and it quantified a statistically significant impact on property values. The analyses also included descriptive statistics for many variables across various ranges of distance from the stations in 2015 and 2020, as well as a comprehensive set of over 500 before/after maps superimposed on aerial photography (including property sales values; assessed values; property tax revenues; vacancies; travel costs; and planned/proposed development).

An ArcGIS StoryMap ® visualization tool (https://gis.cti.uconn.edu/portal/apps/MapSeries/index.html?appid=4f407577fd134d598dc45957f12cb44c) was developed in Phase 2 to ease the presentation of comparing each of the two sets of maps for Phase 1 and Phase 2 of the CTfastrak studies.

1.4 Objectives and Benefits

Real estate markets have been growing nationwide in recent years. For a broad range of cities in the U.S. there is evidence that property near transit has appreciated faster and more than in other locations (see, for instance, the APTA Report).

The primary objective of all of the phases of the present study is to develop and test hypotheses regarding the extent of and reasons for investment in fixed-guideway transit influencing private sector real estate investment in Connecticut. The methods of the current phase include the development of infographics to support CT DOT with understanding the primary objective above. There are several hypotheses in common for all 3 prior phases and the current phase, including the following:

Hypothesis 1: Substituting transit for car ownership saved commuters money.

Hypothesis 2: Property tax revenues were higher in neighborhoods near transit.

Hypothesis 3: Proximity to transit stations was associated with higher residential and commercial property values.

Hypothesis 4: Assessed values were higher the closer properties were to transit stations.

Hypothesis 5: There were fewer residential and commercial vacancies near transit stations.

Hypothesis 6: Transit has been associated with additional nearby planned and proposed development.

Hypothesis 7: Zoning changes occurred close to transit stations.

CT DOT requested UCONN's assistance with integrating the products of these past UCONN studies, in order to use the information in their work related to these transit initiatives. This includes development of a set of key figures and select conclusionary data to highlight the positive correlation between transit investment with TOD development and real estate market outcomes.

The communication in this report is in the form of narrative and easy to digest visuals/graphics, with a target audience of municipal staff, legislators, state officials, and the general public.

The other benefits of the completed infographics products include that they enable CT DOT to use the vast array of information from the prior related Hartford Line Phase 1 and CTfastrak Phase 2 projects, to support the goals and mission of the agency. This is accomplished by maximizing the usability and value of the information in the previous phases' reports and products. It also further strengthens the foundation for potential future phases of the CTfastrak and Hartford Line projects and fosters collaboration with municipal planning and economic development efforts focused on TOD.

This project is important and timely for several reasons. First, it is timely because Connecticut recently received $105 million in federal funds (to be supplemented by state funds), in support of the addition of a double track in parts of the current line where there is only a single track. This funding may enable the Hartford Line to run up to 44 daily trips, up from the current 35 daily trips on the Hartford Line (https://www.hartfordbusiness.com/article/105m-upgrade-to-hartford-line-tracks-will-lead-to-more-service). Second, with better ability to offer evidence on how the Hartford Line has been impacting the development and real estate markets around the Connecticut stations, CT DOT may be able to further justify the use of these state and federal funds to enhance service on the rail line. This possibly could support additional federal funding for the Hartford Line in the future. In addition, this project also may be useful to CT DOT in deciding whether and where to further extend future CTfastrak service, based on a better ability to offer supporting evidence on how the current CTfastrak stations have contributed to changes in real estate markets.

2 Tasks, Methodology and Infographics

2.1 Inventory List of Visualizations

2.1.1 Task Description

As part of this project, a series of infographics are developed to effectively communicate key findings and insights. These visuals are designed to enhance understanding of the data, support decision-making, and engage a broad audience.

2.1.2 Inventory

To ensure clarity and ease of reference, an inventory of the infographics created during the project can be viewed below (note that the page numbers in this inventory table are clickable):

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7	Map of CTrail Hartford Line stations
15	Overarching Brochure, CTfastrak
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29	Change in Median Tax Revenue for Residential Properties in Newington (Between Pre-2012 and 2012-2018)
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Page Number in This Report	Infographic Title
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40	Change in Median sales price for residential properties in Hartford between 2011 and 2016-2017
41	Change in Median sales price for residential properties in West Hartford between 2015 and 2016-2020
41	Change in Median sales price for residential properties in New Britain between 2015 and 2016-2020
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Page Number in This Report	Infographic Title
64	Map of the change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2009 and 2015
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Table 1 The Inventory of Infographics

2.2 Over-Arching Infographic Pamphlets

2.2.1 Task Description

For the CTfastrak and Hartford Line studies, a broad, over-arching infographic is developed. Each of these can be used as a separate pamphlet that highlights several different facets of each of these transit lines. While these brochures do not necessarily directly address the 6 hypotheses described

above, they offer CT DOT a tool that can be shared with stakeholders to demonstrate the broad findings and implications of the transit initiatives in the state.

2.2.2 Methodology

Key metrics from four aspects are summarized in these over-arching pamphlets: home value changes, commercial vacancies, percentage of non-car owners, and transportation savings associated with these transit lines.

- **Home Value Increase**: The percentage change in home sales prices between homes located near stations (within 1 mile) and those farther away are calculated. The data are sourced from the final reports of the CTfastrak Phase 2 study (https://rosap.ntl.bts.gov/view/dot/78271) and the CTrail Hartford Line Phase 1 of the study (https://rosap.ntl.bts.gov/view/dot/64687). More specifically:

    - CTfastrak

    The median sales price difference between phase 2 and phase 1 was $35,496, with a 24.21% rise in the areas near stations, and was $29,943 with 14.66% rise in percentage in the areas farther away. So, the rise in median sales price was 9.5% higher near the transit stations.

    - CTrail Hartford Line

    The median sales price difference between period 2 and period 1 was $16,849, with an 11.6% rise in the areas near stations, and the corresponding difference is $13,828 with 7.8% rise in percentage in the areas farther away. So, the rise in median sales price was 3.8% higher near the transit stations.

- **Commercial Vacancies**: The change in total commercial vacancies in census tracts near each particular station is analyzed, by comparing the later phase with the earlier phase for each of the two studies (the CTfastrak and the Hartford Line studies, separately). This change is calculated by dividing the vacancy differences in the two time periods by the total number of vacancies in the earlier phase. The data originate from USPS/HUD tract-level data. The data for the vacancies can be found in the CTfastrak Phase 2 report (https://rosap.ntl.bts.gov/view/dot/78271) and the Hartford Line report (https://rosap.ntl.bts.gov/view/dot/64687).
- The details of these calculations are as follows:
    - CTfastrak

    The number of commercial vacancies in census tracts near each station as shown in this table:

Station	Year:2015	Year:2020
Sigourney Street Station	73	59
Parkville Station	45	39
Kane Street Station	45	39
Flatbush Station	105	83
Elmwood Station	105	83
Newington Junction Station	23	20
Cedar Street Station	23	20
East Street Station	13	9
East Main Street station- Northbound	13	9
East Main Street station- Southbound	11	11
New Britain Station	126	121

Table 2 The number of commercial vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

The same tracts for multiple stations were counted only once (the entries with blue background in Table 2 above), so the percentage change of commercial vacancies between 2015 and 2020 was 100*(342-396) / 396 = -13.6%.

- CTrail Hartford Line

  The number of commercial vacancies in census tracts near each station as shown in the table:

Station	Year:2011	Year:2017
Enfield	33	28
Windsor Locks	38	40
Windsor	10	19
Hartford Union	291	290
West Hartford	117	105
Newington	6	5
Berlin	48	64
Meriden	24	16
Wallingford	148	120
North Haven	28	34
New Haven State Street	233	197
New Haven Union	18	28

Table 3 The number of commercial vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

The corresponding percentage change in commercial vacancies between 2011 and 2017 was 100*(946-994) / 994 = -4.8%.

- **Percentage of Households with Zero Vehicles**: The percentages of households without vehicles within and outside the "transit shed" (the walkable area around transit stations) are obtained from the APTA report (CNT, 2019, page 24), available at: APTA Report.
  The percentage of households with zero vehicles was 29% in the transit shed, and 9% in non-transit areas.

- **Transportation Savings**: The difference in transportation spending between areas within the "transit shed" and those outside of it, is analyzed. The data are also from the APTA report (CNT, 2019, page 24), available at: APTA Report.
  The average annual transportation cost was $13,563 in non-transit areas and $10,292 in transit shed, so the difference of transportation spending was 10,292 – 13,563 =-3,271, which indicates that the car-free households near transit spent approximately $3,200 less on transportation each year.

2.2.3 Infographics

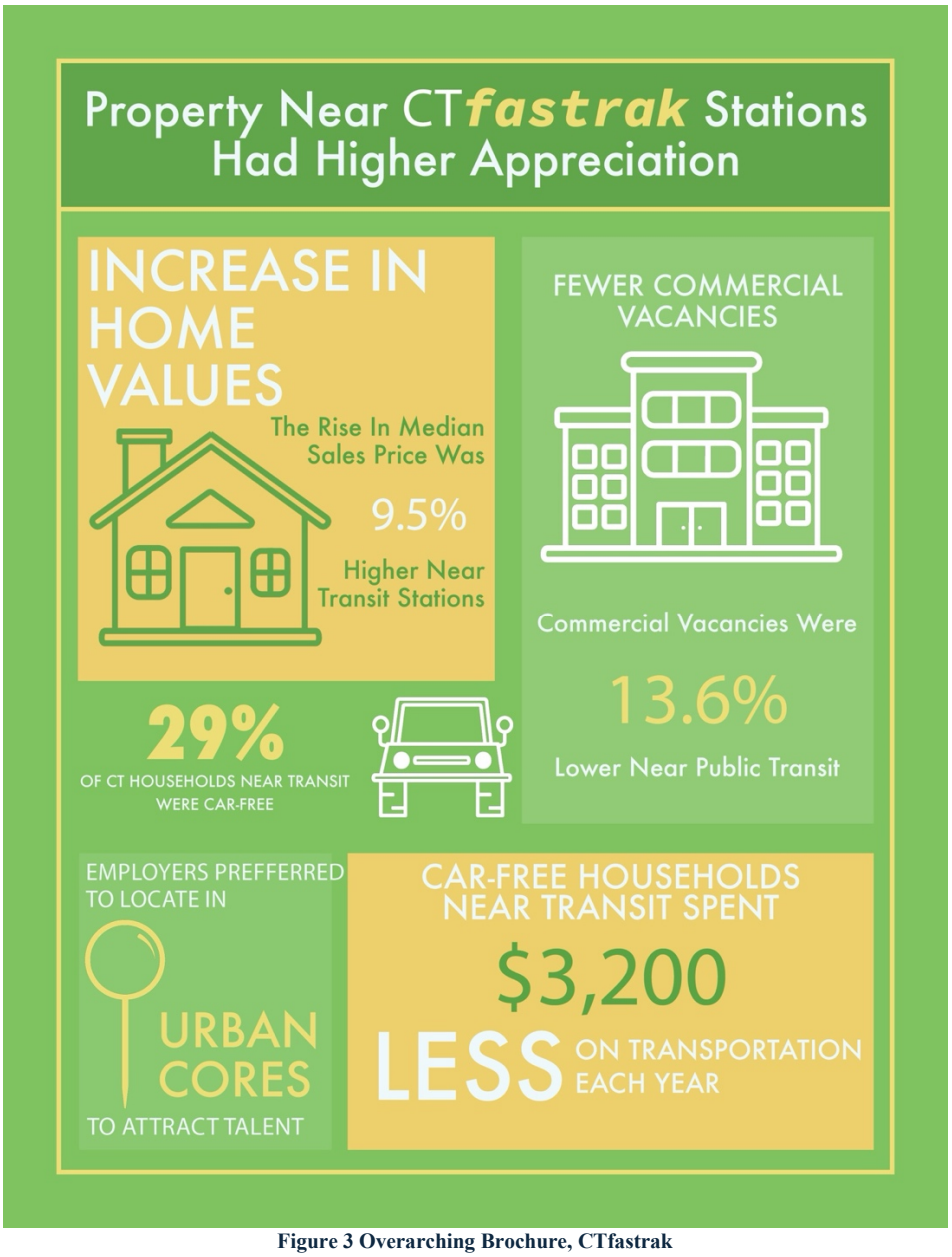

Figure 3 Overarching Brochure, CTfastrak

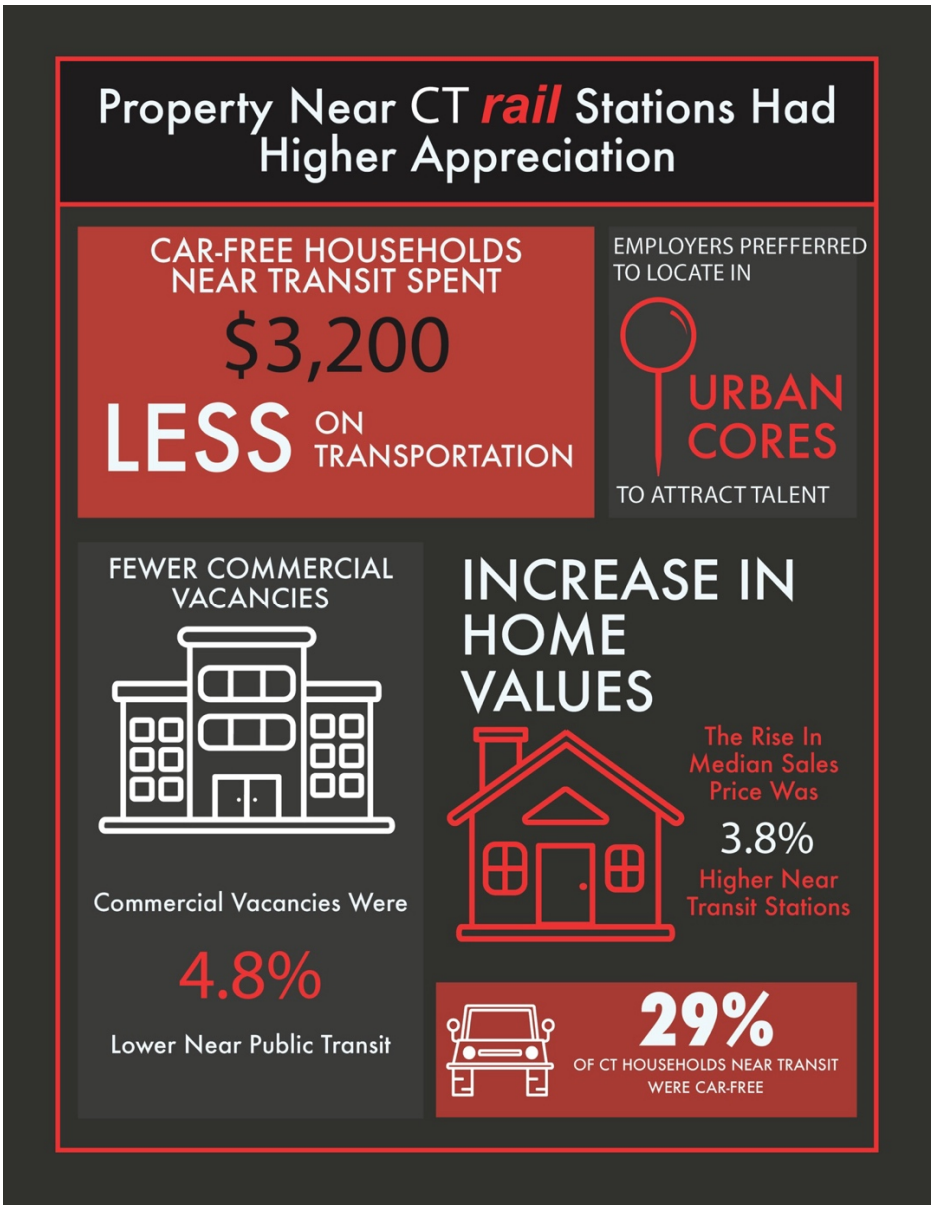

Figure 4 Overarching Brochure, CTrail Hartford Line

2.2.4 Insights

The overall implications from these overarching brochures are that the new transit lines were associated with greater usage of commercial space, higher home values, and less spending on transportation that may have been driven by fewer households owning motor vehicles. This evidence is consistent with whether considering the households near a CTfastrak station or near a Hartford Line station. The implication is that continued transit service would be expected to be associated with additional benefits to homeowners, commercial property owners, and commuters.

It may be of interest that the home value increases near CTfastrak stations were approximately double those near the Hartford Line stations. Part of this explanation is grounded in the fact that the time period under consideration in the CTfastrak analysis (2015-2020) was longer than the

timeframe for the Hartford Line study (2018-2020), so there was a longer length of time for appreciation to accrue. Also, the Hartford Line had existing Amtrak service on the same route, so given the Hartford Line was not establishing completely new commuter rail service on that route, the appreciation in house values may be expected to be less than CTfastrak, which had no service on that route before 2015. Therefore, the bounce from CTfastrak may have been associated with the novelty of service and newly created access to other municipalities for residents who did not own motor vehicles.

2.3 Travel Time and Travel Costs

2.3.1 Task Description

Underlying any changes in real estate values from new commuter services are the access benefits created by new transit. One way to measure access benefits is with travel time changes and travel costs savings. Both the CTfastrak Phase 2 and the Hartford Line study reports include information about the estimated travel time and costs of riding the transit from an example residential location to a landmark location in one of the major cities (Hartford for CTfastrak; and separately, Hartford and New Haven for the Hartford Line). These travel times are compared with the analogous cost of driving and owning an automobile instead of riding transit.

The present study refines these estimates and develops a set of infographics to demonstrate the various components of each trip, along with their associated travel time and monetary costs. It enables understanding the following hypothesis:

Hypothesis 1: Substituting transit for car ownership saved commuters money.

The components of a typical trip included the time to walk from one's residence to the nearest station (assuming no waiting time for the train since passengers can time their walking to the arrival of the next train), time spent riding the transit (which is discounted because commuters can work while riding the transit, based on US DOT guidance), and the walk time from the arrival station to their destination. The commuters' time can be monetized based on the average personal income (per minute) for residents near the station. The per-minute income is multiplied by the trip time to obtain a travel cost estimate. Additional factors, such as the transit fares, the parking costs that are saved, and the costs of owning an automobile that is no longer needed, are considered when developing the travel costs estimates from any particular origin residential address to the destination point.

2.3.2 Infographics

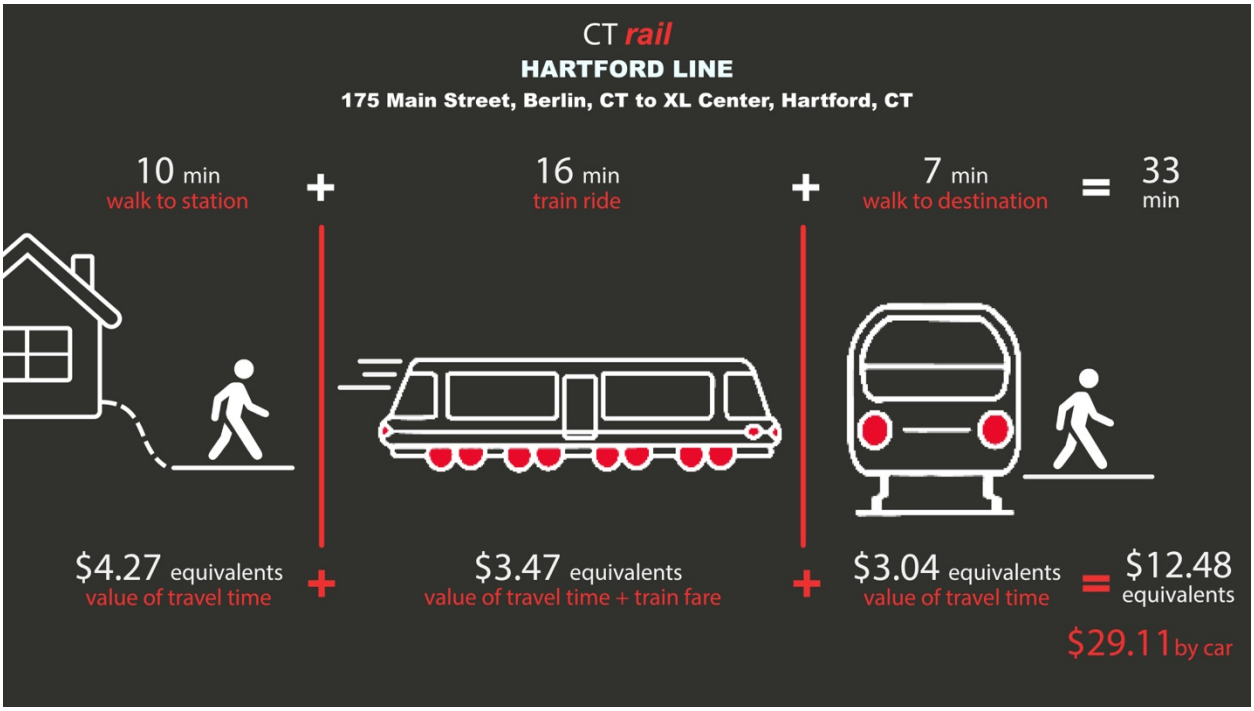

Figure 5 Travel Time and Travel Cost with CTrail Hartford Line from 175 Main Street, Berlin, CT to XL Center, Hartford, CT

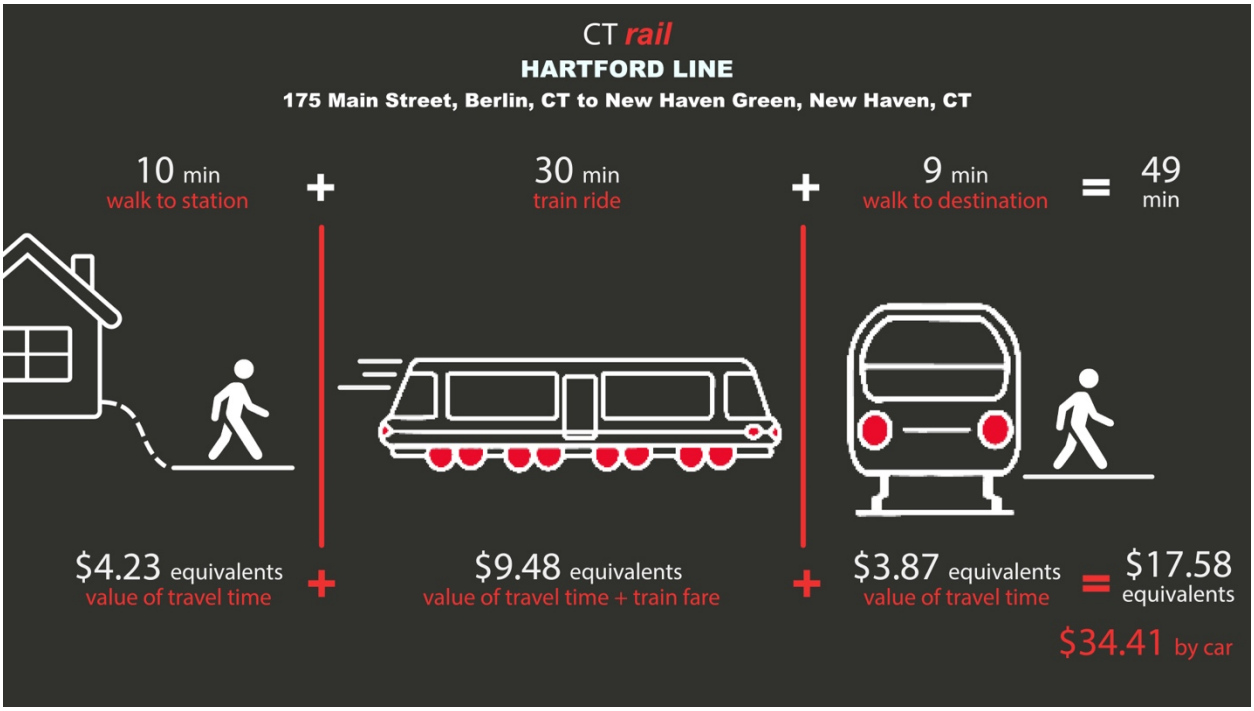

Figure 6 Travel Time and Travel Cost with CTrail Hartford Line from 175 Main Street, Berlin, CT to New Haven Green, New Haven, CT

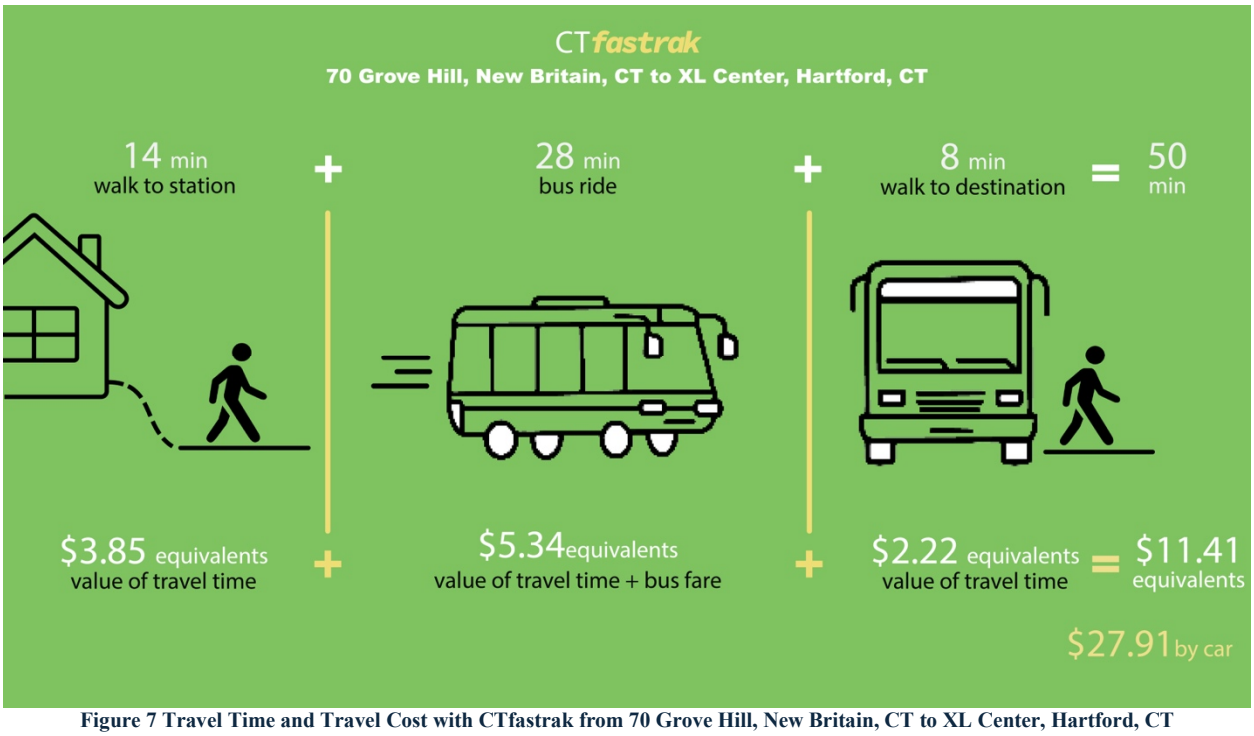

Figure 7 Travel Time and Travel Cost with CTfastrak from 70 Grove Hill, New Britain, CT to XL Center, Hartford, CT

2.3.3 Methodology

Below are the details for calculating travel time and travel costs for the infographics for each of the two studies:

Hartford Line: The data source is the 2019 Census Bureau American Community Survey, specifically the Median Household Income by Census Tract, which averaged $108,250 per year in the census tract for 175 Main Street in Berlin. For this calculation, two working individuals per household are assumed, and the total household income is divided by 2 to estimate individual income. The individual income per minute is $0.43, calculated as follows:

*($108,250/year)/ ((260 workdays/year) * (8 hr/workday) * (60 min/hr)) / 2 = $0.43/minute*

This estimate reflects the income per individual per minute of work based on the average annual household income. The time spent walking to the station was time the individual was not able to work, therefore, the cost of walking from their place of residence to the station is obtained by multiplying the walking time (in minutes) by the per-minute income (in this case, $0.43 per minute). A similar methodology is used to calculate the value of the walk time from the destination train station to the final destination point. The results for these two transportation modes (driving versus transit) are presented in the infographics.

The value of time for the actual train ride is calculated in a similar manner except it is discounted by 50 percent because of the U.S. Department of Transportation's Surface Transportation Factor guidance. This guidance has indicated that since commuters are typically able to be productive during a transit ride, their time riding transit should be discounted. The details of this guidance can

be found here: [Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis]

Travel Periods	Walk from Home to Berlin Station	Train Ride: Berlin Station to Union Station, Hartford	Walk from Union Station to Destination
Cost of Time ($)	• The walk time from home to the nearest station is 9.84 mins (per Google Maps) • Cost = $ 0.43 X 9.84 mins = $4.27	• The commute time is 16 mins • Cost = $ 0.43 X 16 mins = $6.94 • Per the "US DOT Surface Transportation Factor" guidance, the Cost is reduced by 50% • Cost = $6.94 X 50% = **$3.47**	• The walk time from station to XL Center is 7 mins (per Google Maps) • Cost = $ 0.43 X 7 mins = **$3.04**
Train Fare	$0	• It is assumed there are 260 workdays in a full year (after removing weekends), so the average number of workdays a month is 260 / 12 = 21.6 workdays/month. • A monthly pass for this route in 2023 was $73.50. Therefore, the average fare each way was: $73.50/(21.6 x 2) = **$1.70**	$0
Subtotal Cost	**$ 4.27**	**$3.47 + $1.70 = $5.17**	**$3.04**
Total Cost by Train	**$12.48 one-way**		

Table 4 Travel Time and Travel Cost with CTrail Hartford Line from 175 Main Street, Berlin, CT to XL Center, Hartford, CT

Cost of Time ($)	• The one-way average commute time is 18.66 mins (per Google Maps) • Cost = $0.43 * 18.66 = **$8.09**
Parking Fee	• The daily parking fee near the XL Center is $ 8.00 (200 Church Street Garage, as of 2022) • The one-way parking cost is the half of the total fee, so the average one-way parking cost = $8.00 / 2 = **$4**
Cost of Car Ownership	• The cost of car ownership per day is $34.03 (info source: AAA - American Automobile Association, 2018) • The one-way car ownership cost is the half of the total fee, so the cost of car ownership = $34.03 / 2 = **$17.02**
Total Cost by Car	**$29.11 one-way**

Table 5 Travel Cost by Car from 175 Main Street, Berlin, CT to XL Center, Hartford, CT

Travel Periods	Walk from Home to Berlin Station	Train Ride: Berlin Station to Union Station, New Haven	Walk from Union Station to Destination
Cost of Time ($)	• The walk time from home to the nearest station is 9.85 mins (per Google Maps) • Cost = $ 0.43 X 9.85 mins = **$4.23**	• The commute time is 30 mins • Cost = $ 0.43 X 30 mins = $12.9 • Per the "US DOT Surface Transportation Factor" guidance, the Cost is reduced by 50% • Cost = $12.9 X 50% = **$6.45**	• The walk time from station to New Haven Green is 9 mins (per Google Maps) • Cost = $ 0.43 X 9 mins = **$3.87**
Train Fare	$0	• It is assumed there are 260 workdays in a full year (after removing weekends), so the average number of workdays a month is 260 / 12 = 21.6 workdays/month. • A monthly pass for this route in 2023 was $131.25. Therefore, the average fare each way was: $131.25/(21.6 x 2) = **$3.03**	$0
Subtotal Cost	**$ 4.23**	**$6.45 + $3.03 = $9.48**	**$3.87**
Total Cost by Train	**$17.58 one-way**		

Table 6 Travel Time and Travel Cost with CTrail Hartford Line from 175 Main Street, Berlin, CT to New Haven Green, New Haven, CT

Cost of Time ($)	• The one-way average commute time is 35.79 mins (per Google Maps) • Cost = $0.43 * 35.79 mins = **$15.39**
Parking Fee	• The daily parking fee near the New Haven Green is $ 4.00 • The one-way parking cost is the half of the total fee, so the average one-way parking cost = $4.00 / 2 = **$2**
Cost of Car Ownership	• The cost of car ownership per day is $34.03 (info source: AAA - American Automobile Association, 2018) • The one-way car ownership cost is the half of the total fee, so the cost of car ownership = $34.03 / 2 = **$17.02**
Total Cost by Car	**$34.41 one-way**

Table 7 Travel Cost by Car from 175 Main Street, Berlin, CT to New Haven Green, New Haven, CT

CTfastrak: The data source is the U.S. Census Bureau's American Community Survey, Median Personal Income by Census Tract (average of $34,555/year in this Census Tract), 2019. For this start address, the individual income/minute is calculated as $ 0.28 at that address (175 Main Street, Berlin, CT). It is based on ($34,555/year)((260 workdays/year) * (8 hour/workday) * (60 min/hr)) = $0.28/minute. This travel time per minute is applied to the walk time from home to the station, and to the walk time from the Travelers Plaza bus stop to the commuter's final destination in Hartford. For CTfastrak, the final stop on the transit line in Hartford is Sigourney Street, which would be a long walk to the XL Center. Therefore, the analysis below assumes the typical rider(s) took a connecting bus from Sigourney Street to Travelers Plaza, from which point they walked to the XL Center.

For the value of travel time during the bus ride, the U.S. DOT surface transportation factor of 50 percent is applied here to account for the fact that commuters can be somewhat productive while riding the transit. See the documentation for the surface factor here: Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis

Travel Periods	Walk from Home to New Britain Station	Bus Ride: New Britain Station to Travelers Plaza Bus Stop (via Sigourney Street)	Walk from Travelers Plaza Bus Stop to Destination
Cost of Time ($)	• The walk time from home to nearest station is 13.91 mins (per Google Maps) • Cost = $ 0.28 X 13.91 mins = **$3.85**	• The commute time is 28 mins • Cost = $ 0.28 X 28 mins = $7.76 • Per the "US DOT Surface Transportation Factor" guidance, the Cost is reduced by 50% • Cost = $7.76 X 50% = **$3.88**	• The walk time from Travelers Plaza bus stop to the XL Center is approximately 8 mins (per Google Maps) • Cost = $ 0.28 X 8 mins = **$2.22**
Bus Fare	$0	• It is assumed there are 260 workdays in a full year (after removing weekends), so the average number of workdays a month is 260 / 12 = 21.6 workdays/month. • A monthly pass in 2020 was $63. Therefore, the average one-way fare = $63/(21.6 x 2) = **$1.46**	$0
Subtotal Cost	**$3.85**	**$3.88 + $1.46 = $5.34**	**$2.22**
Total Cost by Bus	**$11.41 one-way**		

Table 8 Travel Time and Travel Cost with CTfastrak from 70 Grove Hill, New Britain, CT to XL Center, Hartford, CT

Cost of Time ($)	• The one-way average commute time is 22.79 mins (per Google Maps) • Cost = $0.28 X 22.79 = **$6.31**
Parking Fee	• The daily parking fee near the XL Center is $ 7.50 (200 Church Street Garage, as of 2021: $150/month for 20 workdays) • The one-way parking cost is the half of the total fee, so the one-way average parking cost = $7.50 / 2 = **$3.75**
Cost of Car Ownership	• The cost of car ownership per day is $37.7 (info source: AAA - American Automobile Association, 2019) • The one-way car ownership cost is the half of the total fee, so the cost of car ownership = $35.70 / 2 = **$17.85**
Total Cost by Car	**$27.91 one-way**

Table 9 Travel Cost by Car from 70 Grove Hill, New Britain, CT to XL Center, Hartford, CT

2.3.4 Insights

There are several key insights from these travel time and travel cost analyses. First, on average, the travel cost by car was roughly twice as much as the travel cost from taking the transit. This reduction could result in significant savings in each trip. Part of the cost savings is attributable to the commuter's ability to safely perform some work (even if only reading and replying to texts and e-mails) while riding transit.

These travel cost savings can be one explanation for this study's finding that residential property values were higher near transit. Travel time and cost savings can be considered an amenity, and often the value of such amenities can become capitalized into house prices. Access to transit would be faster for residents with homes that are closer to a transit station. Therefore, homes that were closer to transit stations tended to experience this type of price capitalization to a greater extent than homes far from transit.

A similar argument can be made for commercial properties near transit. Commercial entities located near transit can sometimes end up paying their employees less than they would have if employees had more costly commutes. Commuters with easier commutes often arrive at work with more energy, and faster commutes can leave more time for employees to accomplish their duties. This tends to result in lower compensation required for employees, healthier employees, and therefore commercial entities may have more money left over to pay for the more desirable real estate near transit. These market forces may push up the price of real estate and reduce the vacancy rate for commercial properties near transit stations.

In sum, the hypothesis that substituting transit for car ownership saved commuters money has been validated for a set of specific example property addresses. While it is unclear if this result would hold for homes that were located farther from the transit stations, or at what distance from the stations the switching point would be where these benefits no longer held, there was a clear benefit to those commuters who resided relatively close to transit stations.

2.4 Property Tax Revenues

2.4.1 Task Description

The infographics developed in this task enable testing the hypothesis that transit proximity was associated with higher property tax revenues. Tax revenues can change for several reasons. One reason is that the millage (or tax rate, or mill rate) changed, implying a different rate applied to the assessed value when calculating the tax bill for a property. Also, the assessed values changed over time, so even if the millage rate stayed the same during two periods, a property owner's tax bill could have changed if the assessed value had changed. Finally, a combination of these two forces could have been at play simultaneously, resulting in changes in the tax revenues that would be difficult to predict overall. In sum, the focus of this section is to generate useful information to test the following hypothesis:

Hypothesis 2: Property tax revenues were higher in neighborhoods near transit.

2.4.2 Methodology

The data for this task are obtained from Municipal Assessor Offices in the previous phases of the CTfastrak and Hartford Line studies. Below the key attributes and calculated attributes that are used to calculate the tax revenue change:

- Key Attributes:
    - ✓ Tax Revenue
    - ✓ Property Type
    - ✓ Distance to the Nearest Station
    - ✓ City
- Calculated Attribute:
    - ✓ Distance Category groups properties in four categories based on distance from nearest station (less than 0.75 miles, 0.75-1.0 miles, 1.0-2.0 miles, and beyond 2.0 miles
    - ✓ Distance is based on straight-line distance

The following steps were followed for the analysis:

Data Pre-process:

- Removed unreasonable entries:
    - ✓ Entries with missing sale prices.

- ✓ Transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.

- ✓ Duplicate records to avoid counting the same sale more than once.

- Removed Outliers:

  - ✓ Use a statistical method called the "Z-score" to measure how many standard deviations each data point is from the mean. The threshold is set to 3 standard deviations, which eliminates around 0.27% of data points that are extreme outliers (implausibly high or low values).

- Kept the Paired Data:

  - ✓ Pair each address data point with the same address across different phases to analyze changes over time

The Mill Rates (which was essentially the property tax rate applied to the assessed value to determine the tax payments for each property) can be seen in the tables below.

- CTfastrak:

Municipality	Mill Rates Phase 1 (2015)	Mill Rates Phase 2 (2020)
Hartford	0.0743	0.0743
New Britain	0.0490	0.0505
Newington	0.0358	0.0385
West Hartford	0.0383	0.0410

Table 10 The Mill Rates of Municipalities along CTfastrak

- CTrail Hartford Line:

Municipality	Mill Rates Period 1 (2011 or 2012)	Mill Rates Period 2 (2017 or 2018)
Berlin	0.0288	0.0339
Enfield	0.0239	0.0314
Hartford	0.0743	0.0743
Meriden	0.0347	0.0432
New Haven	0.0389	0.0430
Newington	0.0300	0.0366
North Haven	0.0265	0.0305
Wallingford	0.0260	0.0286
West Hartford	0.0358	0.0410
Windsor	0.0280	0.0324
Windsor Locks	0.0243	0.0267

Table 11 The Mill Rates of Municipalities along CTrail Hartford Line

Note: Tax revenue estimates are calculated based on the median tax revenue from all properties in each municipality. The tax revenues are calculated as the product of the assessed value and the mill rates of each of the properties in each municipality.

*Tax Revenue per Property = Assessed Value * Mill Rates*

Calculation:

For each class of properties (commercial, residential and condo), the calculations were:

- Median of Tax Revenue:

  ✓ Calculate the median (midpoint value) of the tax revenues for the properties in each Distance Category of each town. This provides a general sense of the central tendency of tax revenue.

- Comparison of Median Tax Revenue:

  ✓ Compare the median tax revenue over time to understand how property tax revenue changed:

Median Tax Revenue Change = Later Period Median Tax Revenue in Each Distance Category of Each Town - Previous Period Median Tax Revenue in Each Distance Category of Each Town

- Percentage Change in Tax Revenue:

  ✓ Calculate the percentage change in median tax revenue to assess how much property tax revenues have increased or decreased over time by percentage:

*Median Percentage Change in Tax Revenue = 100 * (Median Tax Revenue Change in Each Distance Category of Each Town) / (Previous Period Median Tax Revenue in Each Distance Category of Each Town)*

2.4.3 Infographics

Various infographics are developed and presented below, including radii graphics showing how tax revenue changes collected varied over time within different distances to the nearest station and the percentage changes in these tax revenues. These provide some support for the hypothesis that proximity to transit stations led to higher property tax revenues.

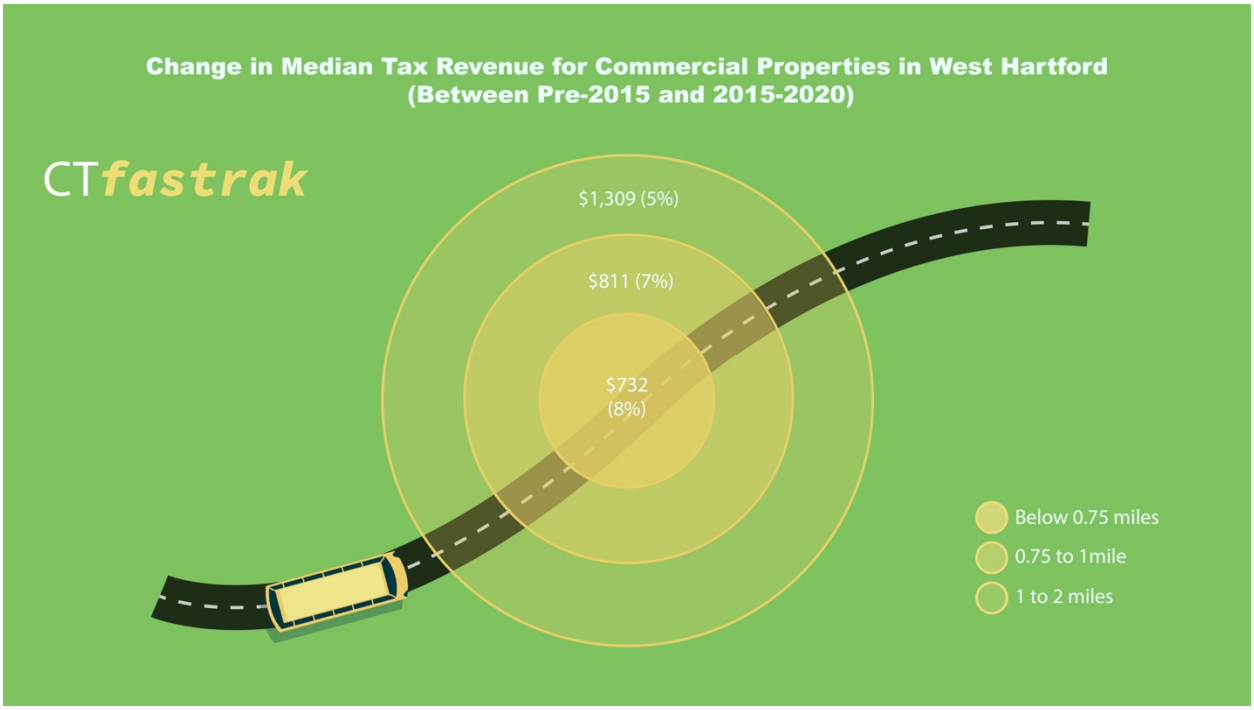

Figure 8 Change in Median Tax Revenue for Commercial Properties in West Hartford (Between Pre-2015 and 2015-2020)

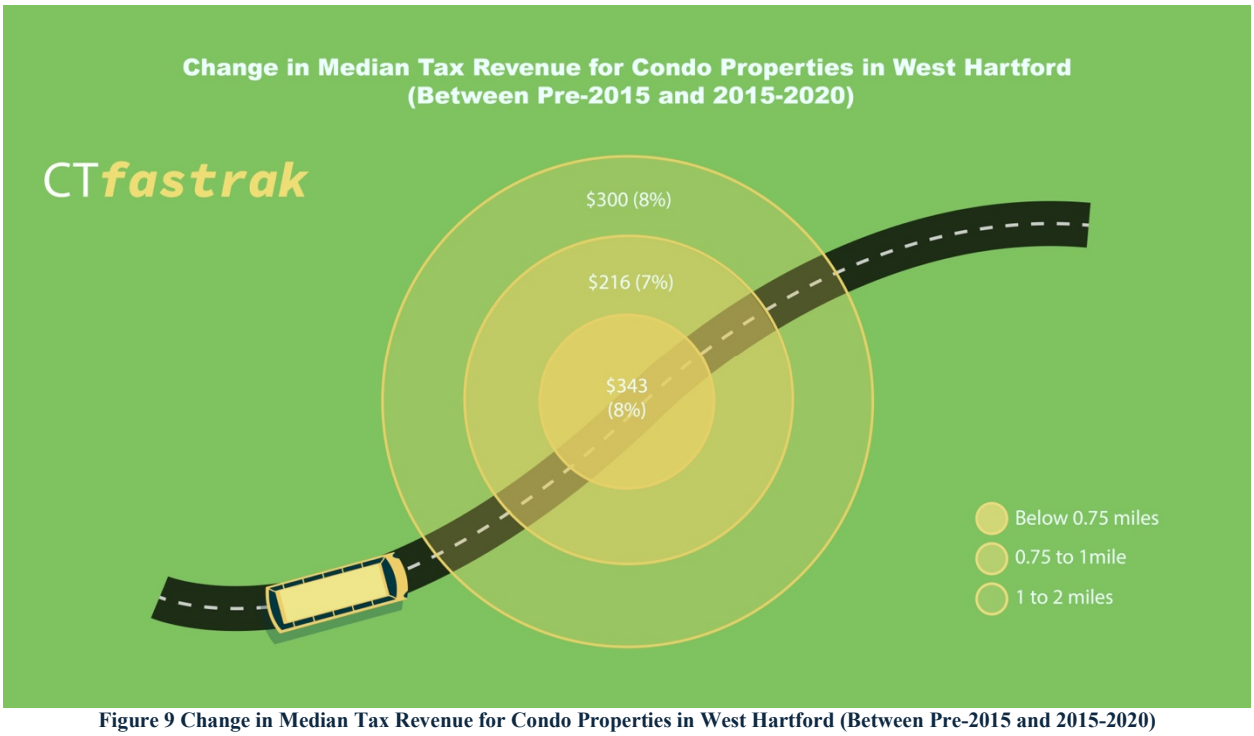

Figure 9 Change in Median Tax Revenue for Condo Properties in West Hartford (Between Pre-2015 and 2015-2020)

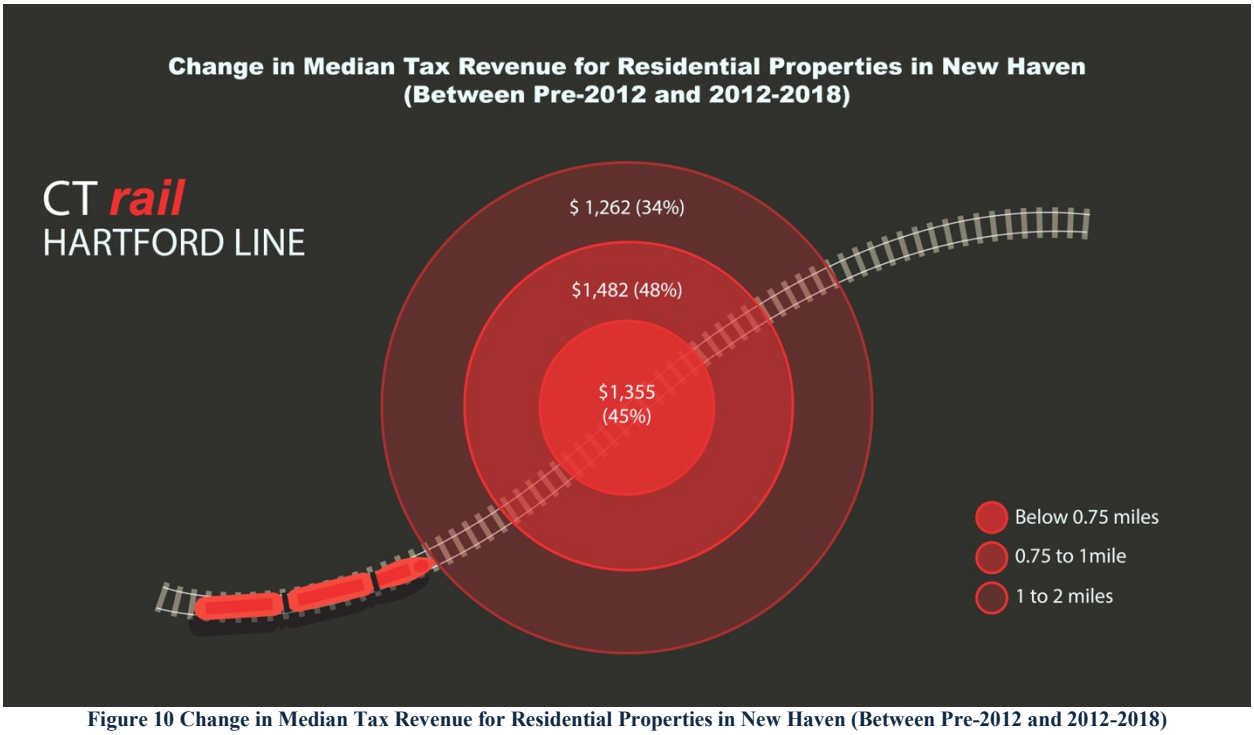

Figure 10 Change in Median Tax Revenue for Residential Properties in New Haven (Between Pre-2012 and 2012-2018)

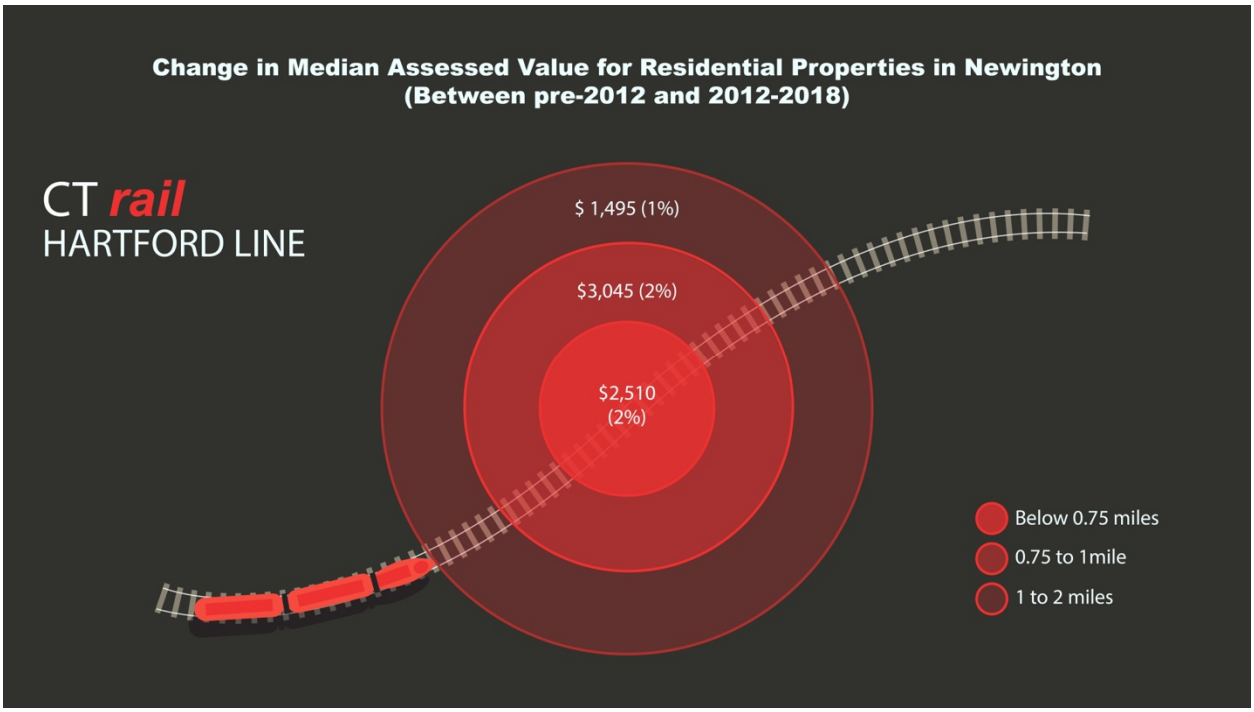

Figure 11 Change in Median Tax Revenue for Residential Properties in Newington (Between Pre-2012 and 2012-2018)

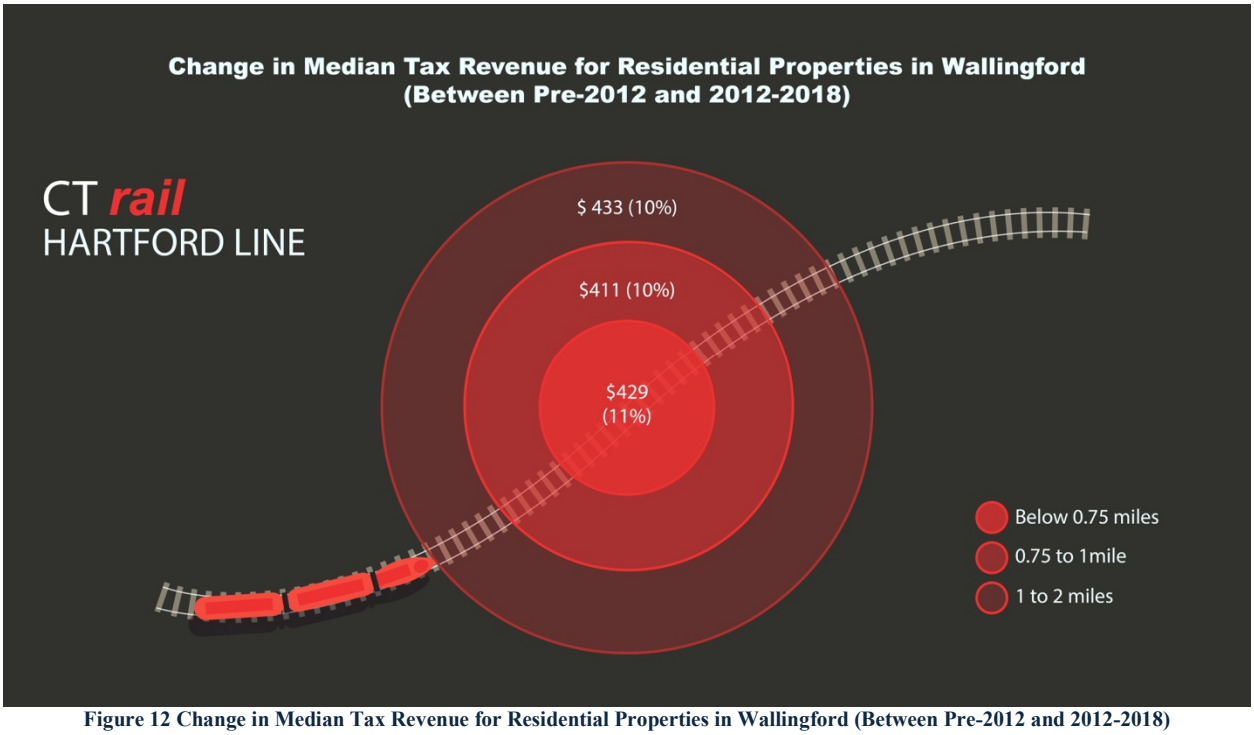

Figure 12 Change in Median Tax Revenue for Residential Properties in Wallingford (Between Pre-2012 and 2012-2018)

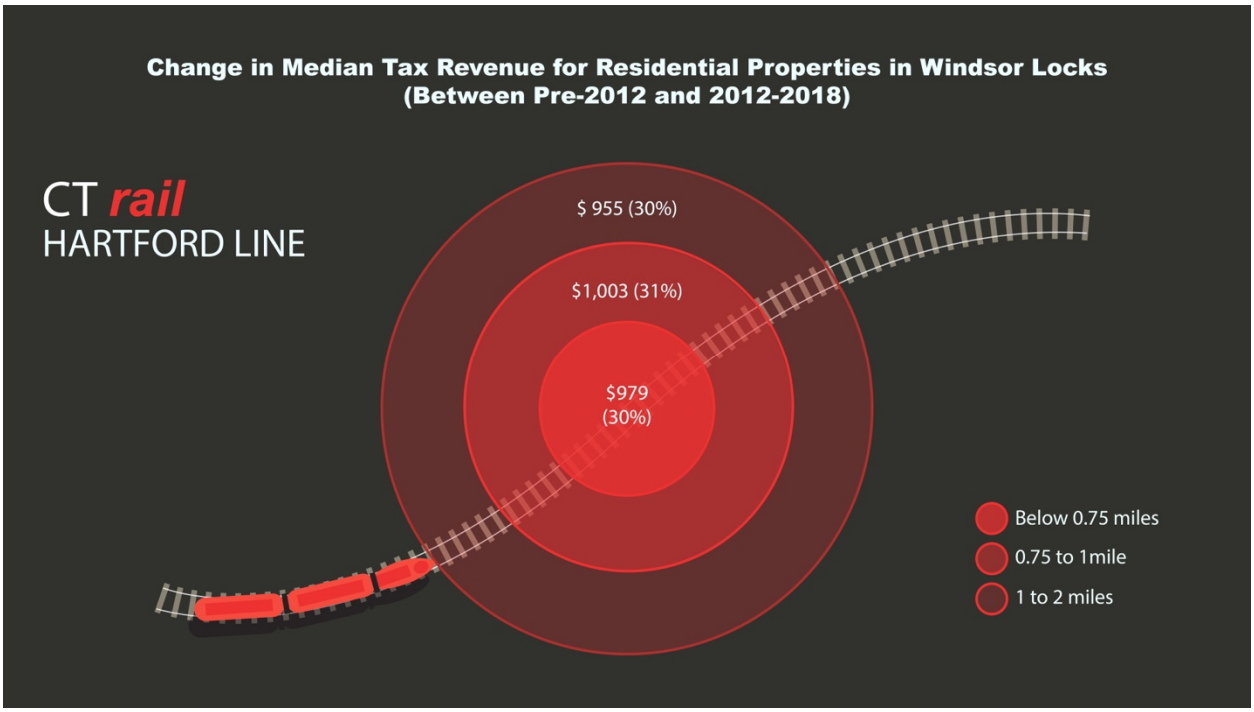

Figure 13 Change in Median Tax Revenue for Residential Properties in Windsor Locks (Between Pre-2012 and 2012-2018)

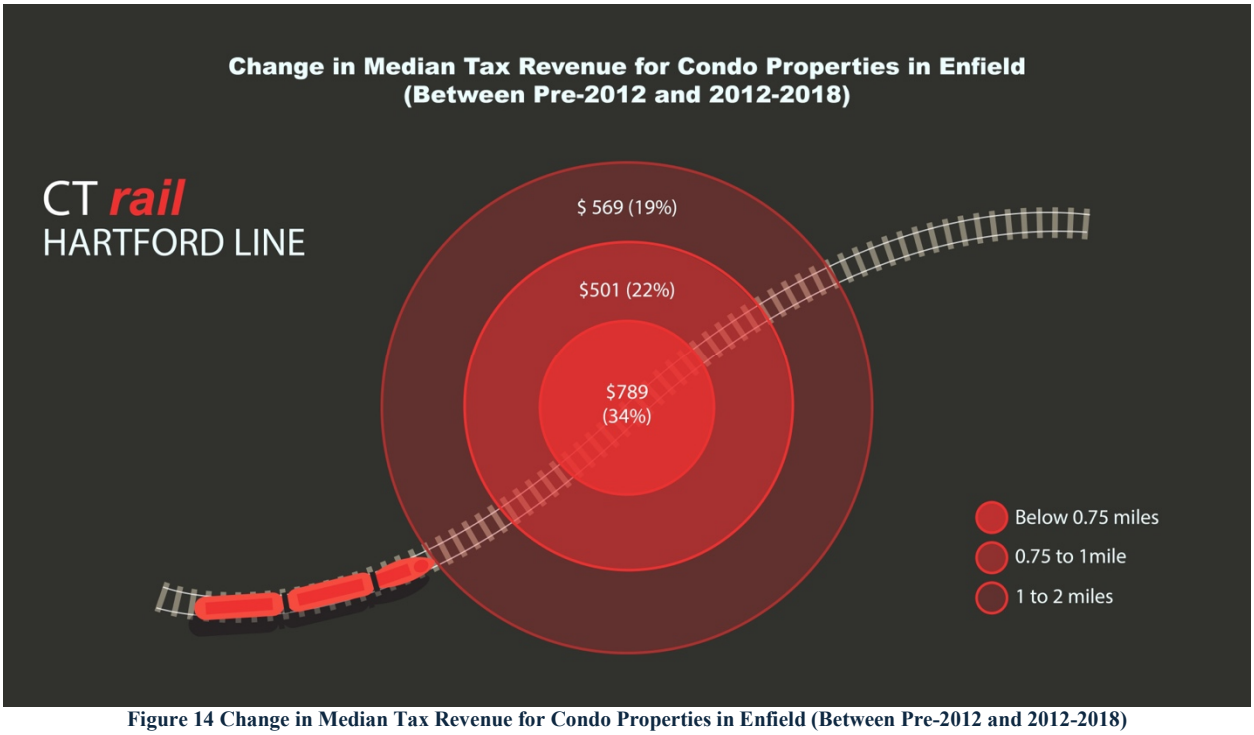

Figure 14 Change in Median Tax Revenue for Condo Properties in Enfield (Between Pre-2012 and 2012-2018)

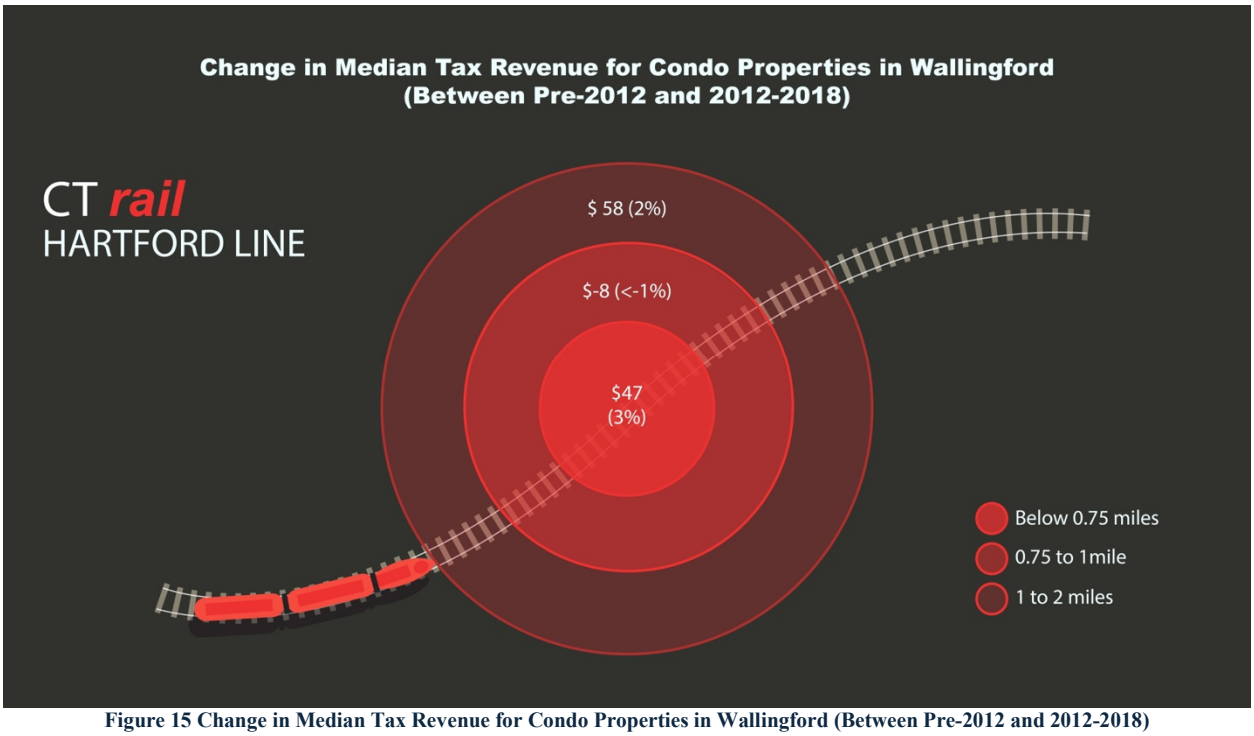

Figure 15 Change in Median Tax Revenue for Condo Properties in Wallingford (Between Pre-2012 and 2012-2018)

2.4.4 Insights

Some insights are apparent from these property tax revenues infographics. New Britain, Newington, and West Hartford experienced an increase in their millage rates between phase 1 and phase 2 of the study. Hartford did not change its mill rate. Therefore, some rise in tax revenues would be expected if the assessed values in the former municipalities were steady on average during the same time periods. The infographic above for tax revenues in West Hartford shows a slight increase near the CTfastrak station, while the infographic in a later section of this report demonstrates that assessed values also rose slightly during the first five years of service. Taken together, the higher mill rate and the higher assessed values imply one should have expected higher tax revenues in West Hartford near the station over this time period. In other words, these findings are consistent with expectations.

Similar analyses can be done for municipalities on the Hartford Line. Property tax revenues rose the most (in percentage terms) in Enfield, Windsor Locks, and New Haven, in the two periods before and after the start of Hartford Line service. All three of these municipalities raised their mill rates during this timeframe as well. Windsor Locks and New Haven experienced an increase in assessed values by double-digit percentages during this time period as well, which correlates with the higher mill rates and in turn, higher property tax revenues near the Hartford Line stations.

2.5 Property Sales Prices and Sale Prices Per Square Foot

2.5.1 Task Description

As described above, the benefits of transit are often associated with increased residential and commercial property value changes because potential buyers tend to be willing to pay more for

real estate with greater access benefits (and sellers, realizing these potential benefits, demand a higher price from potential buyers of properties near transit). One major focus on this section of the report is on how price changes were different after the new transit service began. Specifically, the following hypothesis was tested, from a variety of different vantage points:

Hypothesis 3: Proximity to transit stations was associated with higher residential and commercial property values.

First, some context for the entire state can set the stage for a municipality-wide analysis and then a station area analysis.

Individuals licensed to represent buyers and sellers of real estate often consider the price per square foot of each property as one way to standardize the size of properties when comparing prices of property that have different square footage. Some analysis in this section of the report considers trends in sales price per square foot for properties close versus far from transit.

Prices of residential properties in much of Connecticut demonstrated a slight upward trend post-2015, with a large spike after 2020. This was true for both the property sales prices and the prices per square foot of residential properties. These trends can be seen in the figures below. Note that these figures are based on median listing prices, while the infographics below are based on actual sales prices. The properties' list price figures below are included to provide a general sense of overall housing trends.

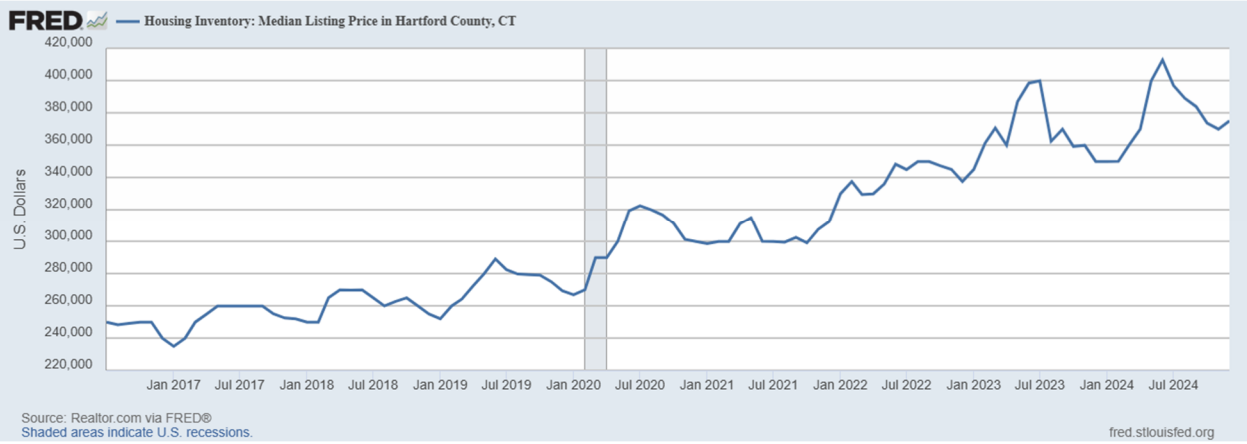

Figure 16 Median Listing Price in Hartford County, CT

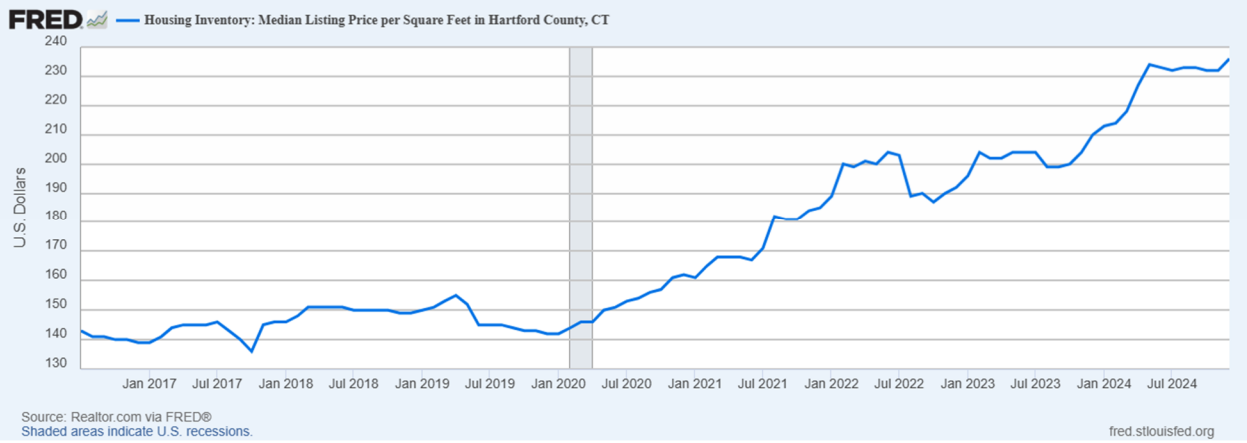

Figure 17 Median Listing Price per Square Feet in Hartford County, CT

Median listing prices in Hartford County followed a similar trend as median listing prices per square foot in the county, post-2016 and before 2020. While there are clear but small upward trends in both the median list price and the median list price per square foot in Hartford County, the list price per square foot trend was slightly less steep than the median list price. This implies the prices of homes that were listed for sale closer to the end of 2019 were somewhat larger (in square footage) than the counterparts listed in 2018 through 2019, since the listing prices were steadily increasing in this period.

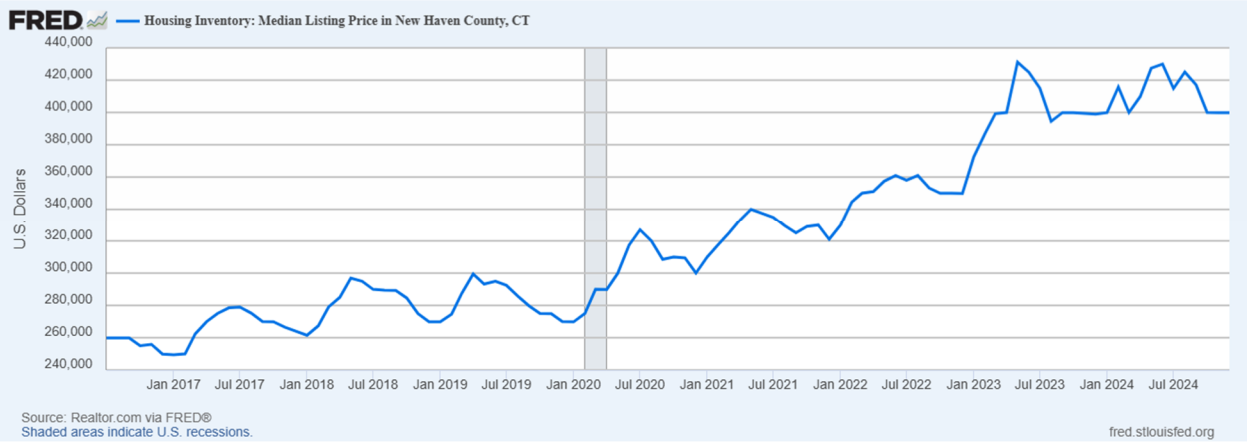

Figure 18 Median Listing Price in New Haven County, CT

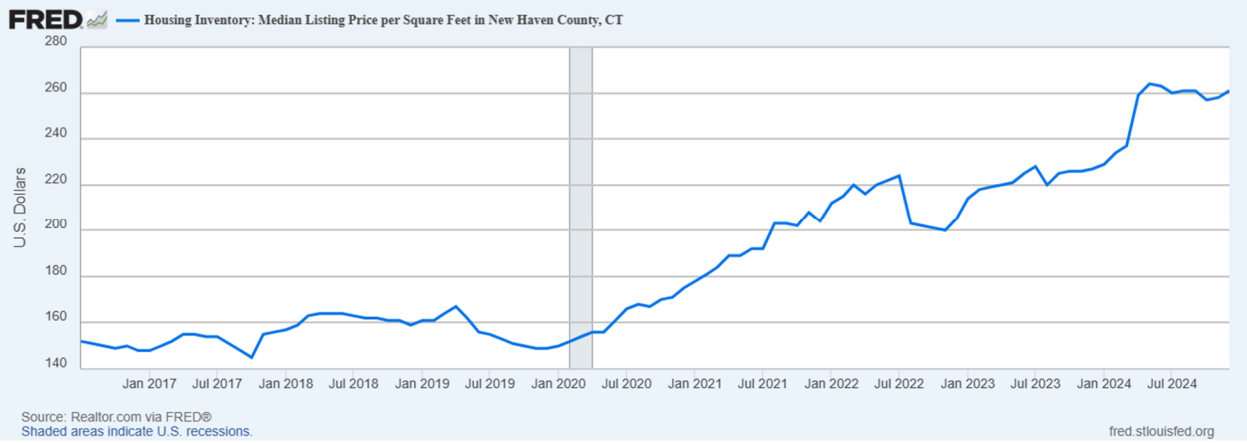

Figure 19 Median Listing Price per Square Feet in New Haven County, CT

There has been a slight upward trend in listing price per square foot of housing in New Haven County post-2016, and before 2020. The upward trend in list price per square foot seems to have followed the overall listing price trend in general. While the gap between list price per square foot and list price persisted in New Haven (as in Hartford) County, the wedge between the metrics in the above two trendlines was not as large in New Haven County as in Hartford County.

Finally, the figures below demonstrate how the number of pending home sales changed over time in the two counties under consideration where CTfastrak and the Hartford Line have stations.

All of these general trendlines set the background for the subsequent infographics that demonstrate how the residential real estate markets changed within various radii from the stations.

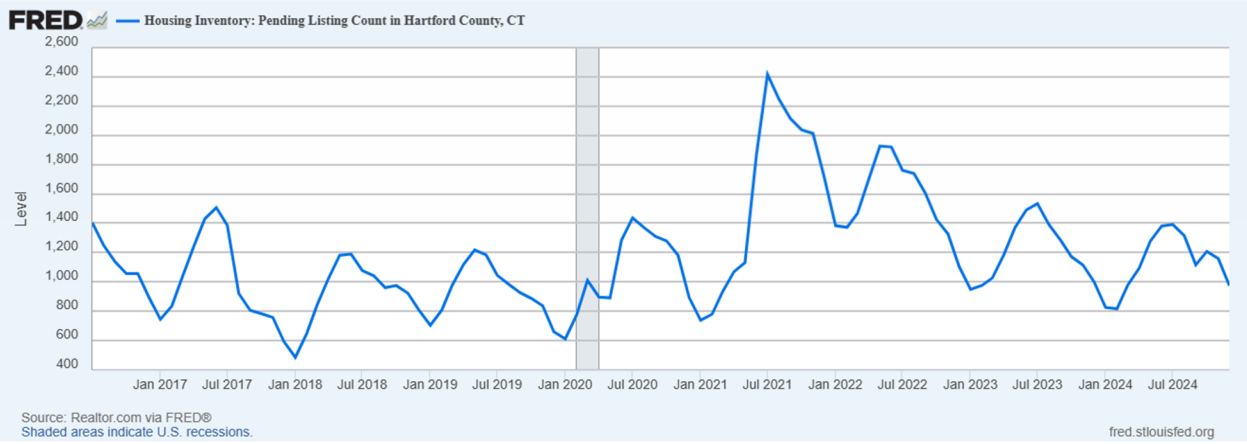

Figure 20 Pending Listing Count in Hartford County, CT

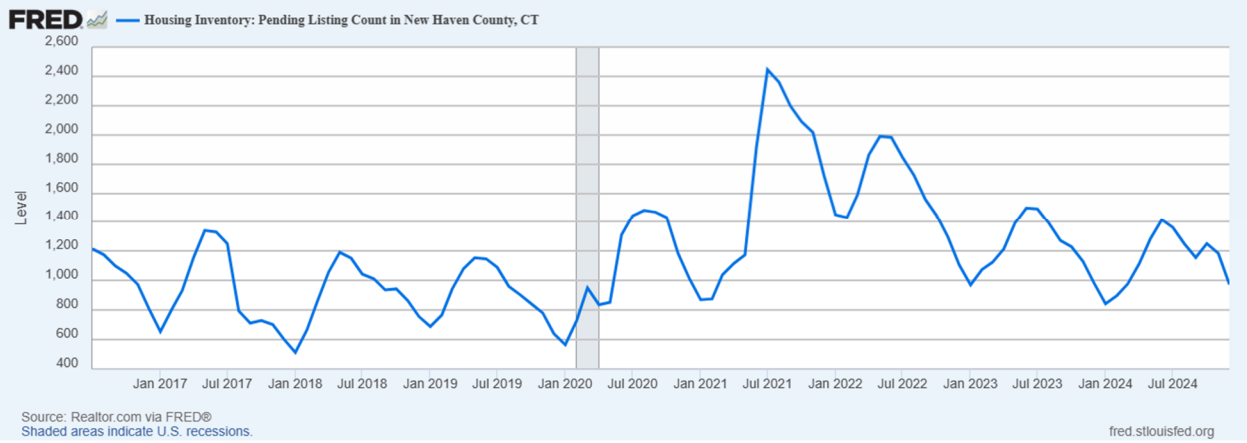

Figure 21 Pending Listing Count in New Haven County, CT

There was a slight downward trend in the number of pending listings after 2016 and before 2020 in Hartford and New Haven. This downward trend was slightly less pronounced in New Haven County than in the other two counties. Pending listings exploded in all 3 counties post-2020 and are still at or above the 2017 levels as of July 2024.

2.5.2 Infographics and Methodology

2.5.2.1 Municipality-wide Property Sales price change analysis

The intent of this analysis is to demonstrate how the broader real estate markets in each municipality changed over the time periods under study. The data are from Municipal Assessor Offices, as presented in the CTfastrak Phase 2 and the Hartford Line reports. Key attributes that are used to calculate the municipality-wide sales price change include:

- Key Attributes:
    - ✓ Sale Price
    - ✓ Property Type
    - ✓ City

The following steps are taken to generate the data used in the calculations:

Data Pre-process:

- Removed unreasonable entries:
    - ✓ Entries with missing sale prices.
    - ✓ Transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.
    - ✓ Duplicate records to avoid counting the same sale more than once.

- Removed Outliers:

    - ✓ Use a statistical method called the "Z-score" to measure how many standard deviations each data point was from the mean. The threshold is set to 3 standard deviations, which eliminated around 0.27% of data points that were extreme outliers (implausibly high or low values).

Calculations:

- Median of Sale Prices:

    - ✓ The median (midpoint value) of the sale prices are calculated in each municipality. This provides a general sense of the central tendency of prices.

- Comparison of Median Prices:

    - ✓ The median prices over time are compared, in order to understand how property prices have changed. The formula used for this comparison is:

Median Price Change = Later Period Median Price in Each Town - Previous Period Median Price in Each Town

- Percentage Change:

    - ✓ The percentage change in median sale prices is calculated to assess how much property prices have increased or decreased over time by percentage:

Median Price Percentage Change = 100 (Median Price Change in Each Municipality) / (Previous Period Median Price in Each Municipality)*

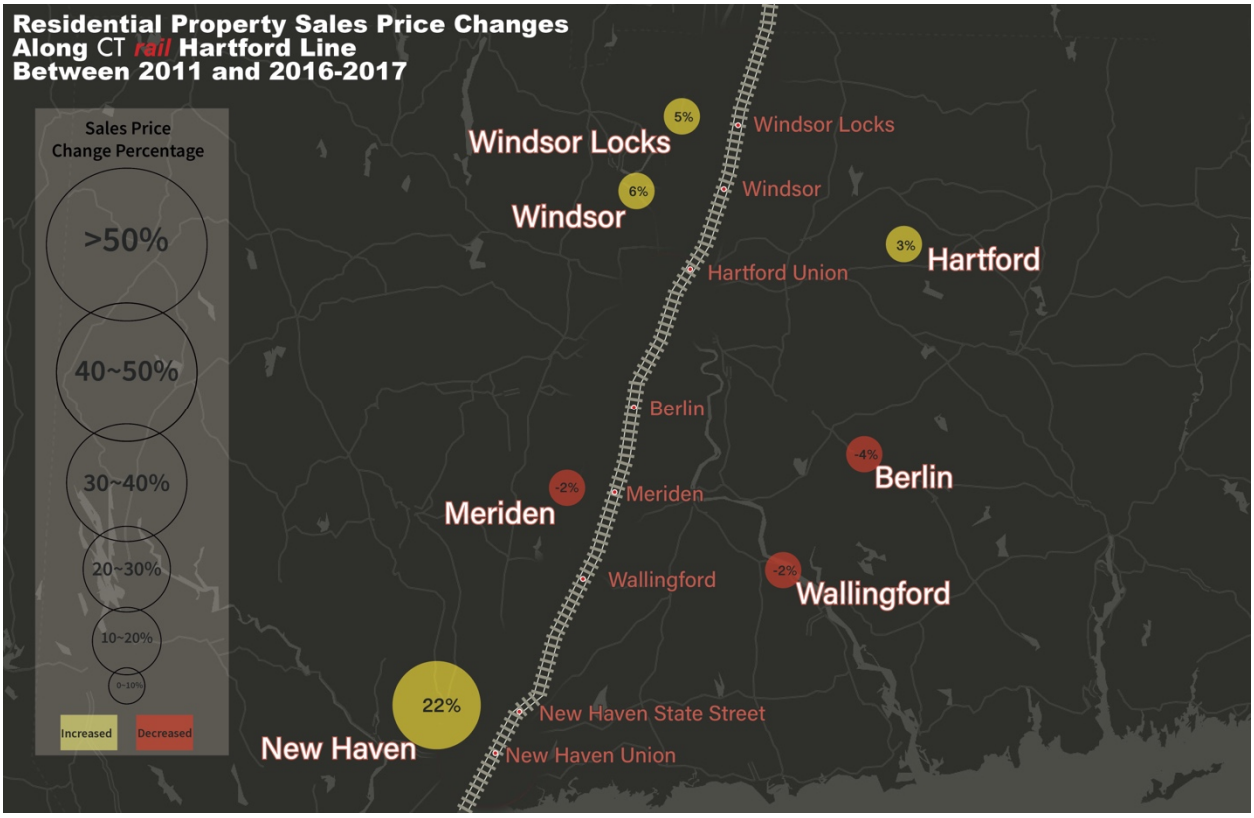

Figure 22 Residential Property Sales Price Change Along CTrail Hartford Line Between 2011 and 2016-2017

Municipal-wide residential price changes were positive in New Haven, Windsor, Hartford, and Windsor Locks, while Berlin, Wallingford, and Meriden experienced slightly lower municipal-wide prices. Given that the increases were positive overall in the larger population centers, perhaps residents in and closest to the larger areas benefitted the most from the Hartford Line service. In particular, New Haven's increase was 3 times as large as other municipalities in this comparison. It has seen a huge surge in multi-family residential development post-2020.

Figure 23 Residential Property Sales Price Change Along CTfastrak Between 2015 and 2016-2020

Municipal-wide residential prices rose in three out of the four localities served by CTfastrak. Both New Britain and Hartford experienced slightly less than a 40 percent increase overall during the first 5 years of service, while West Hartford saw a more modest 12 percent increase. West Hartford overall is much less transit-reliant than Hartford and New Britain, so the more micro-level analyses below would be expected to shed light on whether the residences near the stations experienced notable changes or if the town had across-the-board rises. Station-area Sales Price Changes

While the above municipal-wide analysis is of interest for an overall assessment of before versus after trends, a more disaggregated set of infographics should offer some additional details on where the changes were occurring relative to the transit stations. Radius infographics are developed to indicate the sales price change within various distances from the nearest station. The data are also from Municipal Assessor Offices. The key attributes and calculated attributes that are used in the radius infographics are as follows:

- Key Attributes:
    - ✓ Sale Price
    - ✓ Property Type
    - ✓ Distance to the Nearest Station
    - ✓ City

- Calculated Attribute:

    - ✓ Distance Category groups properties in four categories based on distance from nearest station (less than 0.75 miles, 0.75-1.0 miles, 1.0-2.0 miles, and beyond 2.0 miles

    - ✓ Distance was based on straight-line distance

The following steps are used to perform the calculations needed for the infographics.

Data Pre-process:

- Remove unreasonable entries:
    - ✓ Entries with missing sale prices.

    - ✓ Transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.

    - ✓ Duplicate records to avoid counting the same sale more than once.

- Removed Outliers:

    - ✓ Use a statistical method called the "Z-score" to measure how many standard deviations each data point was from the mean. The threshold was set to 3 standard deviations, which eliminated around 0.27% of data points that were extreme outliers (implausibly high or low values).

Calculation:

- Median of Sale Prices:

    - ✓ The median (midpoint value) of the sale prices are calculated in each distance radius from all of the stations in each municipality. This provides a general sense of the central tendency of prices.

- Comparison of Median Prices:

    - ✓ These median prices over time are compared in order to understand how property prices have changed. The formula used for this comparison is:

Median Price Change = Later Period Median Price in Each Distance Category of Each Town - Previous Period Median Price in Each Distance Category of Each Town

- Percentage Change in Price:

    - ✓ Calculated the percentage change in median sale prices to assess how much property prices have increased or decreased over time by percentage near all the stations in each town:

*Median Percentage Change in Price = 100 * (Median Price Change in Each Distance Category of Each Town) / (Previous Period Median Price in Each Distance Category of Each Town)*

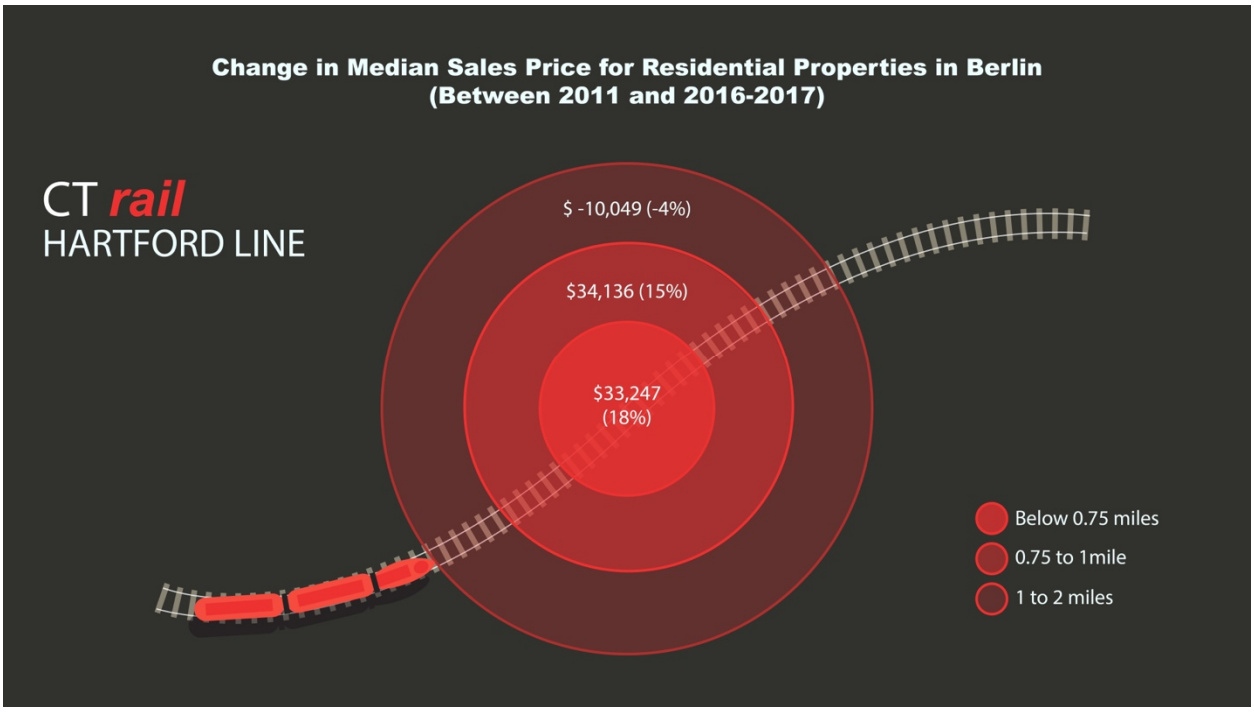

Figure 24 Change in Median sales price for residential properties in Berlin between 2011 and 2016-2017

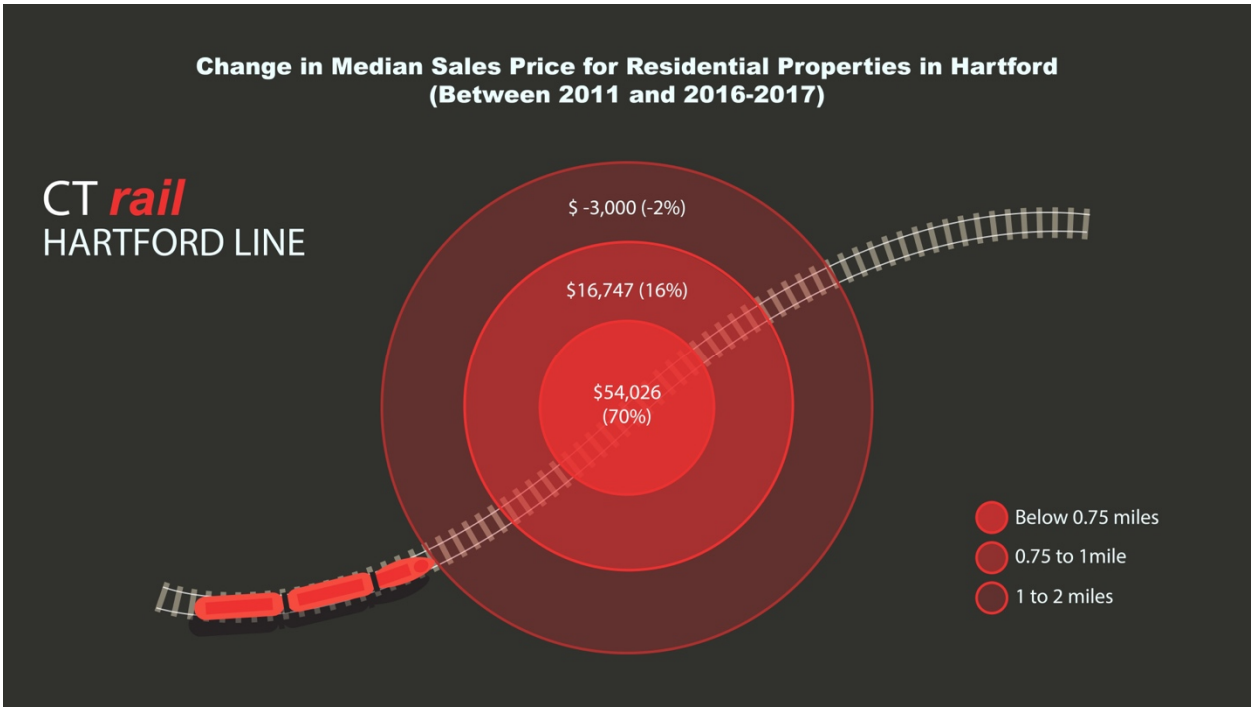

Figure 25 Change in Median sales price for residential properties in Hartford between 2011 and 2016-2017

Figure 26 Change in Median sales price for residential properties in West Hartford between 2015 and 2016-2020

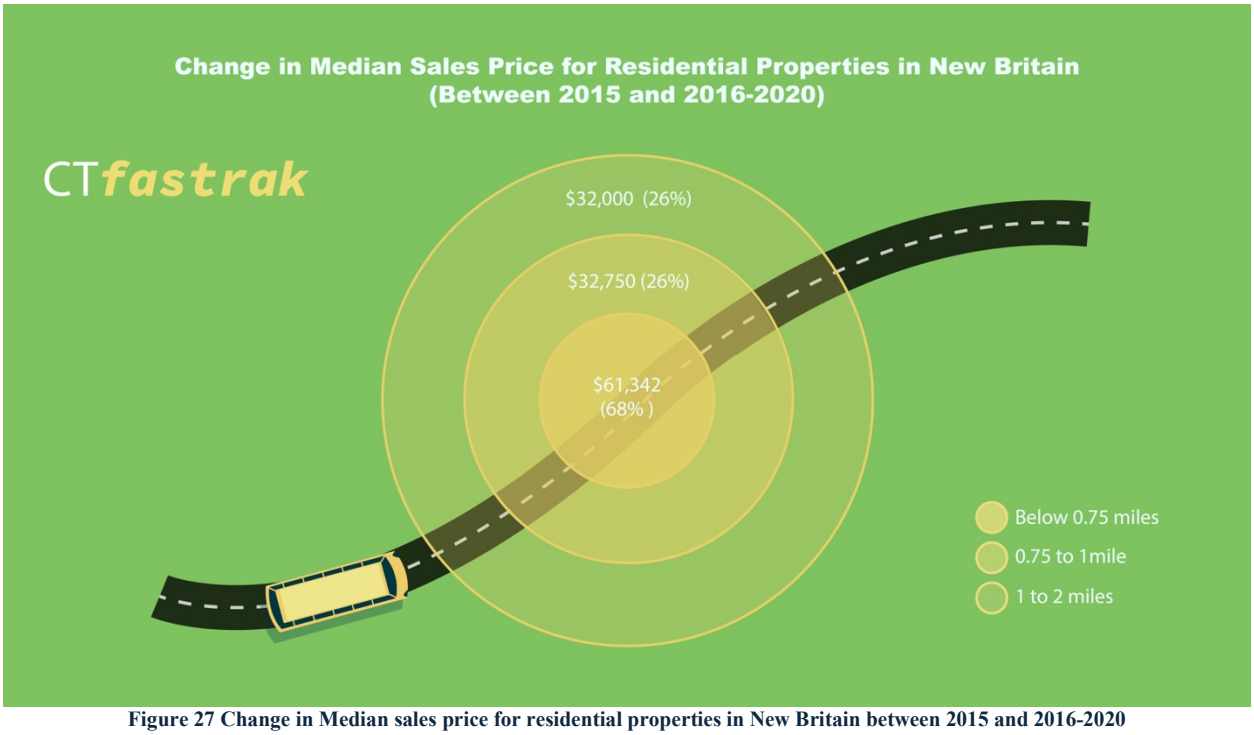

Figure 27 Change in Median sales price for residential properties in New Britain between 2015 and 2016-2020

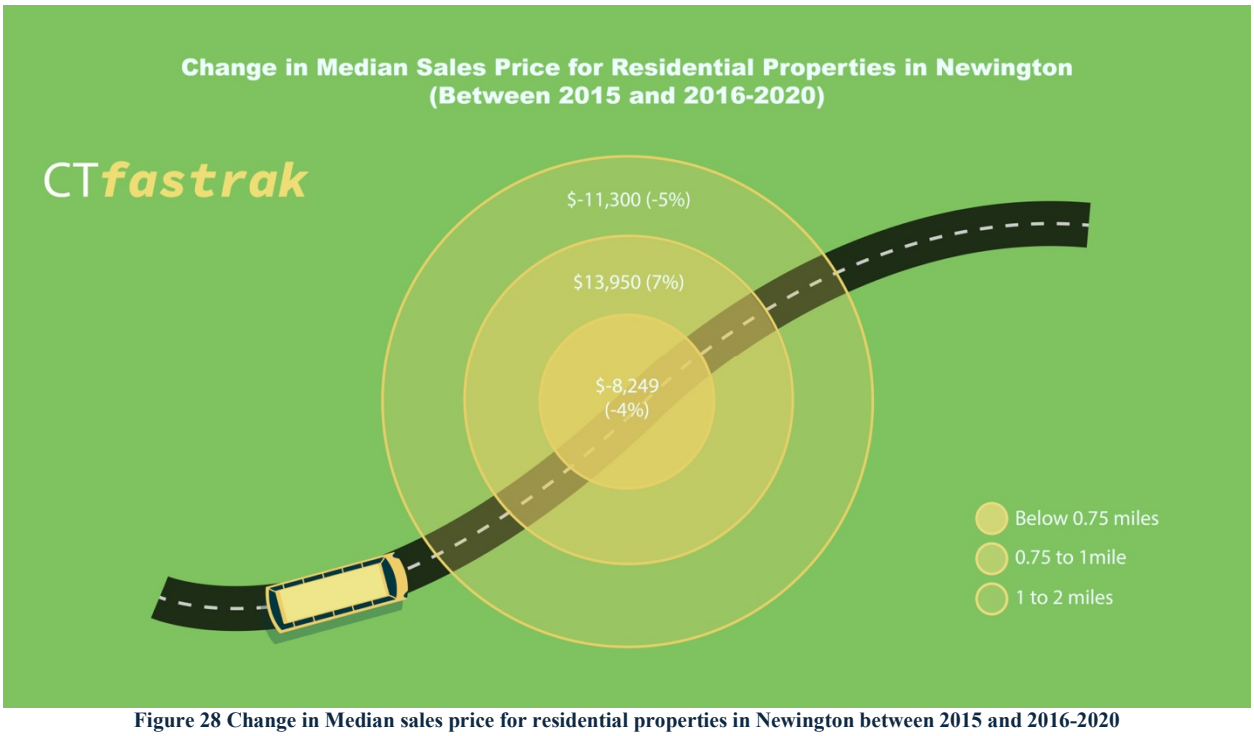

Figure 28 Change in Median sales price for residential properties in Newington between 2015 and 2016-2020

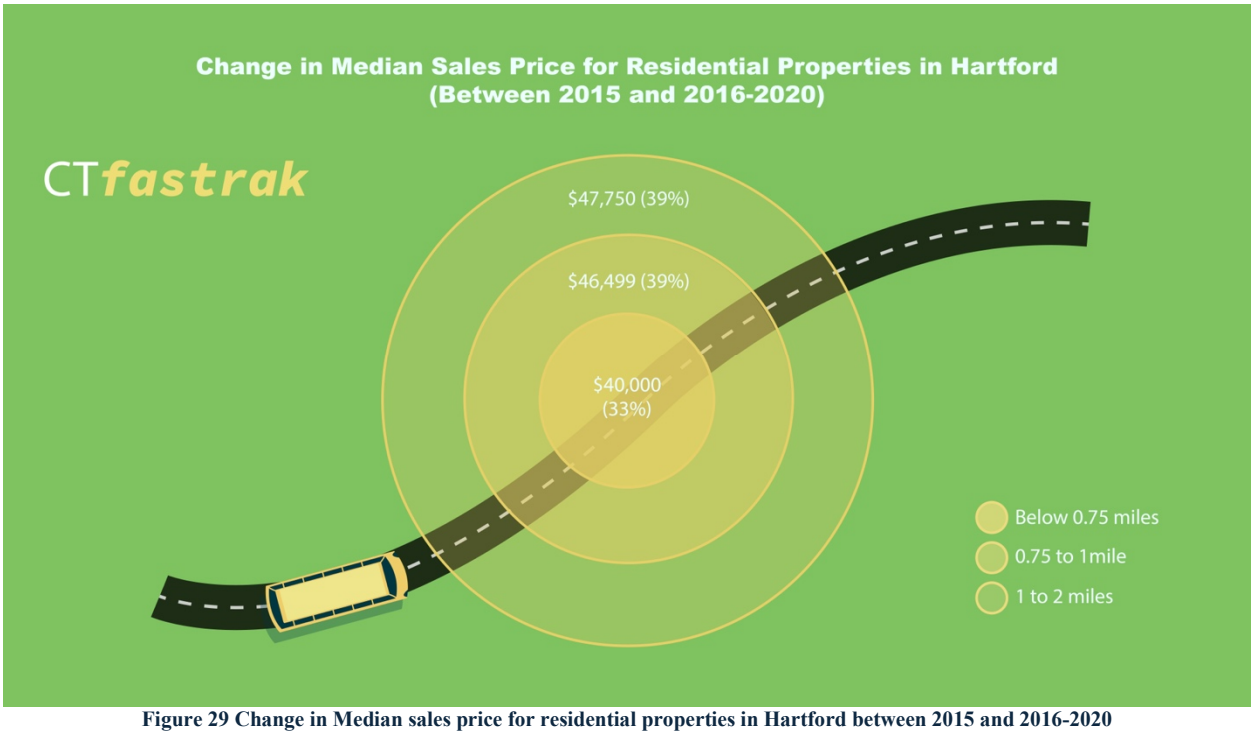

Figure 29 Change in Median sales price for residential properties in Hartford between 2015 and 2016-2020

2.5.2.2 Sales Price Change Causal Effect Analysis

Since many factors affect property values, the differences between the property prices are analyzed both by distance from the station, as well as before and after service initiation. The results that

have been presented in many of the sales prices infographics above allow for this comparison, with changes after versus before the opening at different radii from the station (near versus far).

In addition to calculating the difference between these two differences, one can control for other covarying factors (such as property gross living area) with a statistical approach called regression analysis when determining the causal effect. The details of the causal effect analysis that are done in this subtask, to test the hypothesis that proximity to transit stations caused higher real estate values, can be viewed below:

- Key Attributes:
    - ✓ Sale Price
    - ✓ Property Type
    - ✓ Distance to the Nearest Station
    - ✓ City
    - ✓ GLA (Gross Living Area)
- Calculated Attributes:
    - ✓ Distance: The innermost ring compares properties within 0.75 miles of a station (labeled with an indicator variable equal to 1) to those properties farther than 2 miles (labeled with the same indicator variable equal to 0).
    - ✓ Analysis is repeated for houses in the area between 0.75 and 1 mile from the station, to those farther than 2 miles.
    - ✓ Finally, analysis is repeated for houses in the area that were 1 mile to 2 miles from the nearest station to those houses that were farther than 2 miles.
    - ✓ Time Indicator Variable: Identifies whether a sale was from Phase 1 (labeled as 0 if the sale occurred in 2015) or Phase 2 (labeled as 1 if the sale occurred between 2016-2020).

The following steps are used to perform the calculations:

Data Pre-process:

- Remove unreasonable entries:
    - ✓ Entries with missing sale prices.
    - ✓ Transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.
    - ✓ Duplicate records to avoid counting the same sale more than once.
- Removed Outliers:

- ✓ Use a statistical method called the "Z-score" to measure how many standard deviations each data point was from the mean. The threshold is set to three standard deviations, which eliminates around 0.27% of data points that were extreme outliers (implausibly high or low values).

- Data Transformation:

  - ✓ Apply a logarithmic transformation, which helps smooth out the sale price distribution for ease of interpretation of results with these statistical methods. Logarithmic transformations have been the convention in regression analyses for real estate prices.

Calculation:

- Difference in Differences Regression Analysis:

  - ✓ The regression model below is estimated:

$$log(Sale\ Price) = a1 \times GLA + a2 \times Distance\ Label + a3 \times Time\ Label + a4 \times Distance\ Label \times Time\ Label + e$$

Note: a1, a2, a3, a4 were unknown regression coefficients that can be estimated with statistical software for the regression model with this data. Also, e was a random error term. GLA was the gross living area of the home, which enabled the researcher to control for potential variation in the house size effect on sale price.

- The coefficient a4 is the primary one of interest:

  - ✓ Causal effect of proximity to CTfastrak on the *logarithm of the Sale Price.*

- The Causal Effect on Sales Price Percentage Change:

  - ✓ The impact of CTfastrak proximity on the percentage change of Sale Price is:

$$Causal\ Effect\ on\ Sales\ Price\ Percentage\ Change = exp(a4) - 1$$

- The Causal Effect on Sales Price Change in Dollars:

  - ✓ The impact of station proximity on the Sale Price Change (in Dollars) is:

$$Causal\ Effect\ in\ Dollars = Median\ Sales\ Price\ in\ 2015 \times Sales\ Price\ Percentage\ Change$$

The infographics below show the estimated causal effects of CTfastrak, in each distance band.

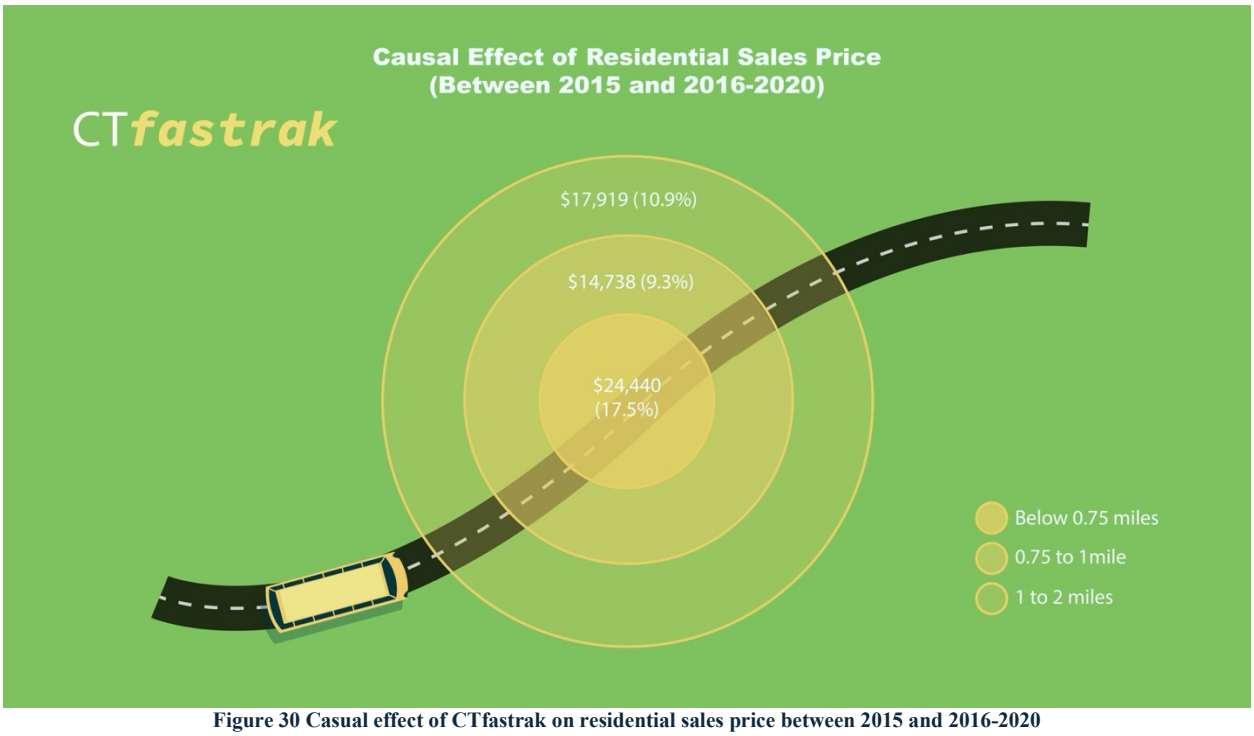

Figure 30 Casual effect of CTfastrak on residential sales price between 2015 and 2016-2020

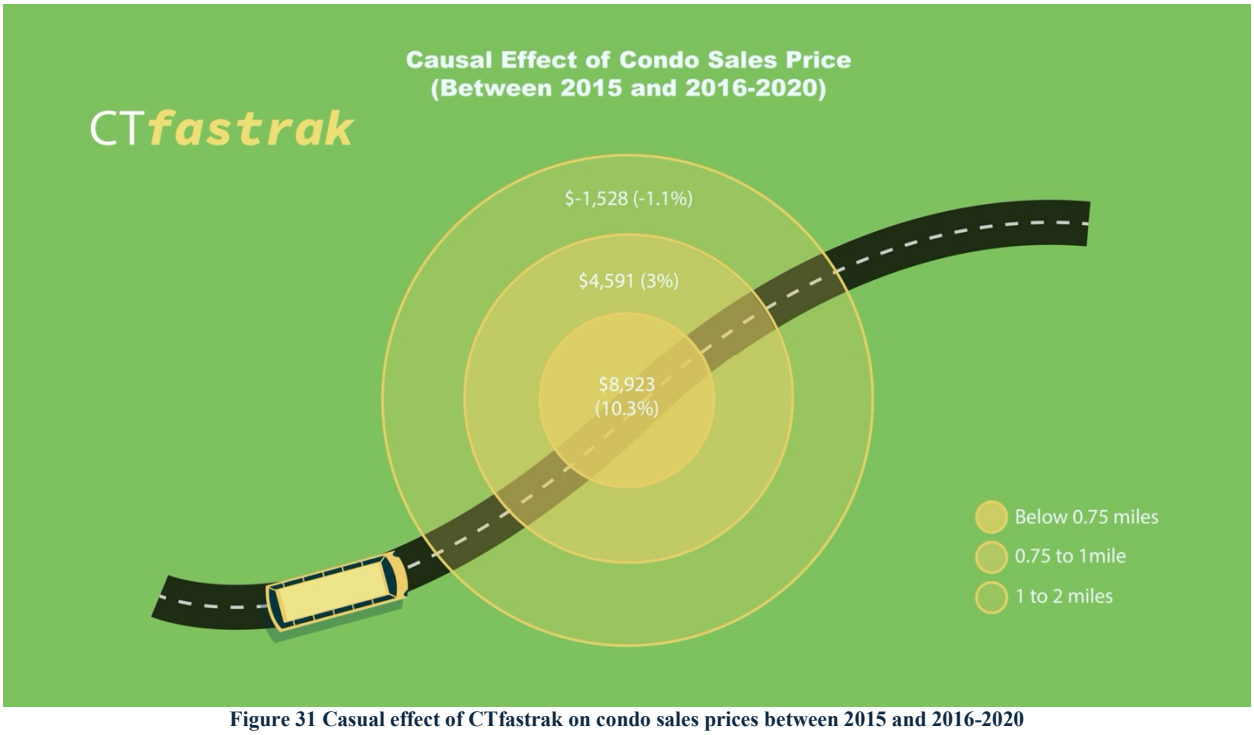

Figure 31 Casual effect of CTfastrak on condo sales prices between 2015 and 2016-2020

2.5.2.3 Property Sales Price Per Square Foot Change Analysis

Radius maps are developed to indicate the sales price per square foot changes for the distances from the nearest station. The data for these analyses originate from the municipal assessors. The

same data are used in the CTfastrak Phase 2 and in the Hartford Line study. Below are the key attributes in developing the sales price changes for various radii:

- Key Attributes:
    - ✓ Sale Price Per square foot of living area (SQ FT)
    - ✓ Property Type
    - ✓ Distance to the Nearest Station
    - ✓ Municipality
- Calculated Attributes:
    - ✓ Distance Category for properties in four different intervals, based on distance from nearest station (less than 0.75 miles, 0.75-1.0 miles, 1.0-2.0 miles, and beyond 2.0 miles
    - ✓ Distances were based on straight-line distances from each property to the nearest station

The following steps are followed to perform the calculations shown in the infographics:

Data Pre-process:

- Remove unreasonable entries:
    - ✓ Eliminate entries with missing sale prices.
    - ✓ Eliminate transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.
    - ✓ Duplicate records dropped to avoid counting the same sale more than once.
- Remove Outliers:
    - ✓ Eliminate around 5% of data points that were extreme outliers (very high or low sale prices per square foot).

Calculation:

- Median of Sale Price Per Square Foot:
    - ✓ The median (midpoint value) of the sale prices is calculated in each distance radius from all of the stations in each municipality. This provides a general sense of the central tendency of prices.
- Comparison of Median Sales Prices Per Square Foot:

✓ These median prices per square foot over time are compared, in order to understand how property prices per square foot have changed. The formula used for this comparison is:

Median Sale Price Per Sqft Change = Later Period Median Sale Price Per Sqft in Each Distance Category of Each Town - Previous Period Median Sale Price Per Sqft in Each Distance Category of Each Town

- Percentage Change in Price:

✓ Calculate the percentage change in median sale prices per square foot, to assess how much property sale prices per square foot have increased or decreased over time by percentage

*Median Percentage Change in Sale Price Per Sqft = 100 * (Median Sale Price Per Sqft Change in Each Distance Category of Each Town) / (Previous Period Median Sale Price Per Sqft in Each Distance Category of Each Town)*

Figure 32 Change in median sales price per square foot for residential properties in Hartford between 2015 and 2016-2020

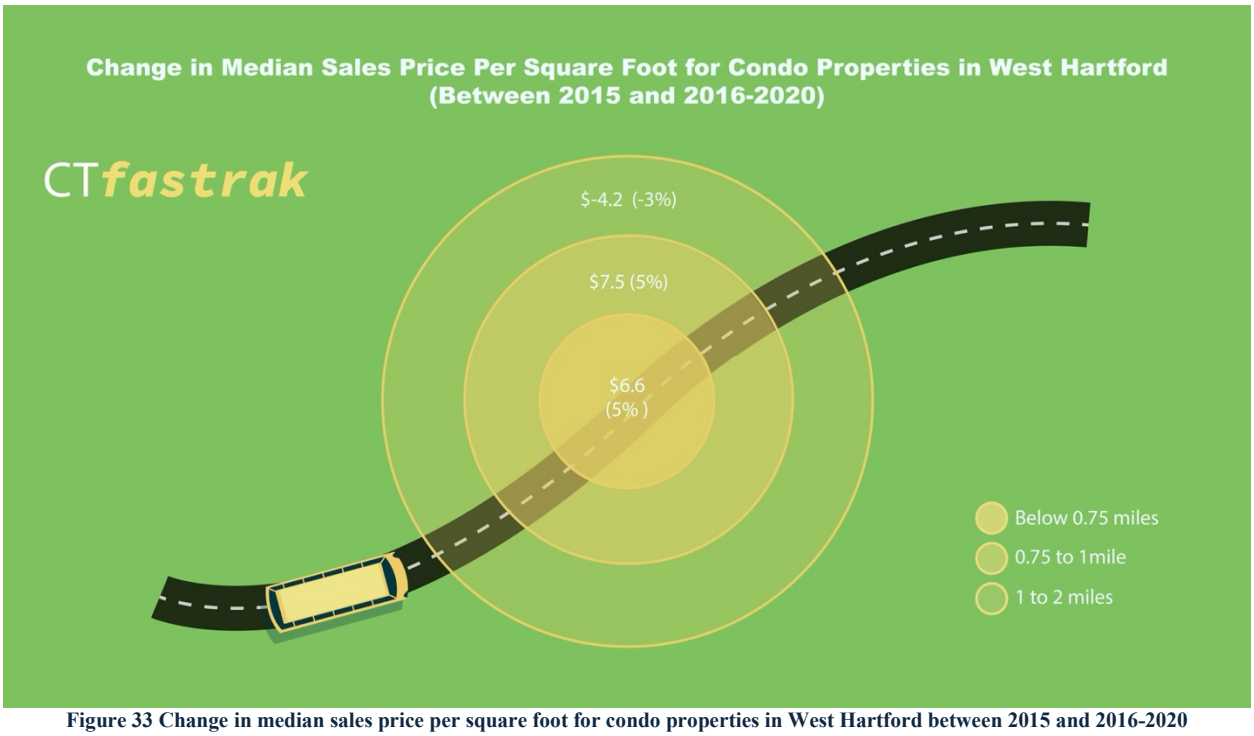

Figure 33 Change in median sales price per square foot for condo properties in West Hartford between 2015 and 2016-2020

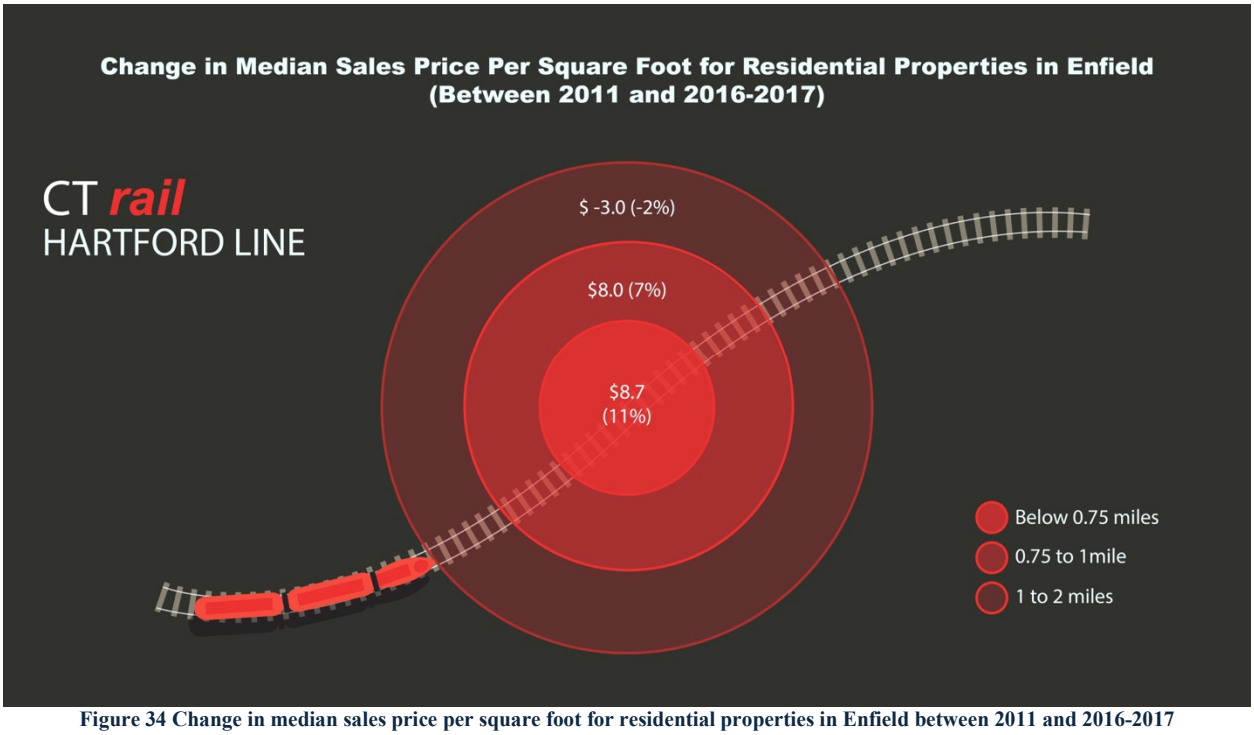

Figure 34 Change in median sales price per square foot for residential properties in Enfield between 2011 and 2016-2017

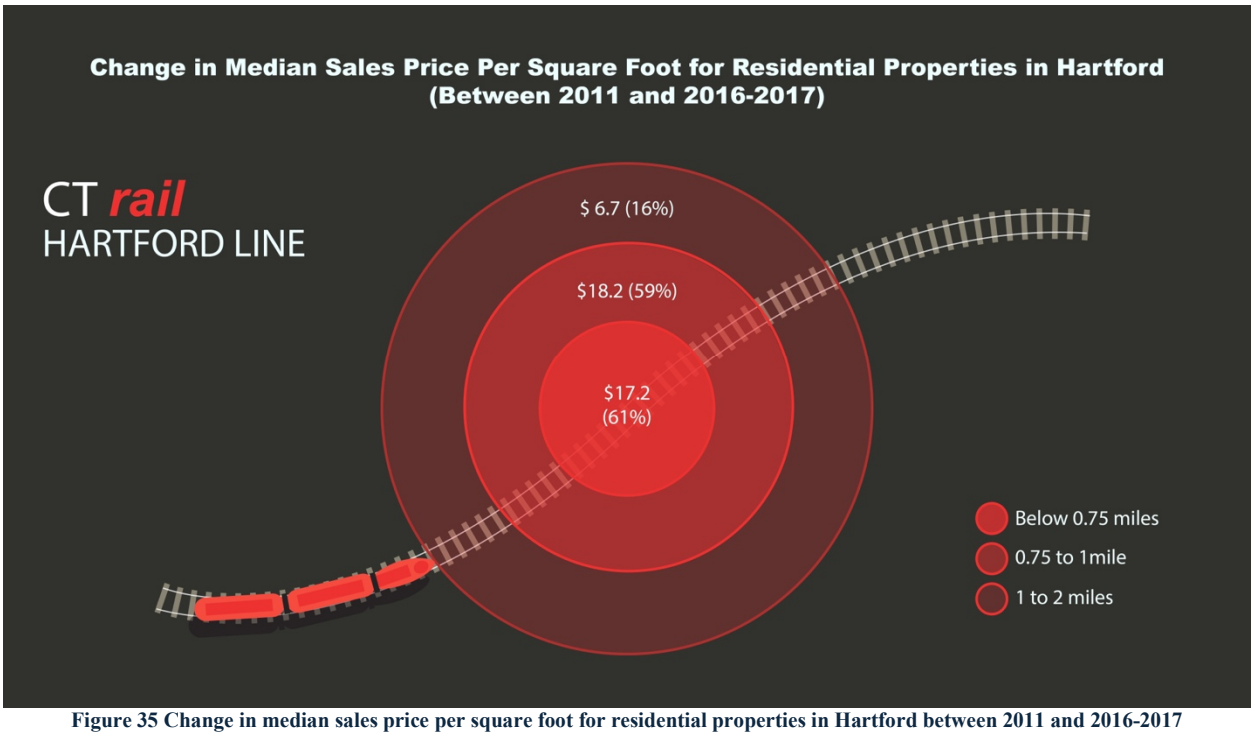

Figure 35 Change in median sales price per square foot for residential properties in Hartford between 2011 and 2016-2017

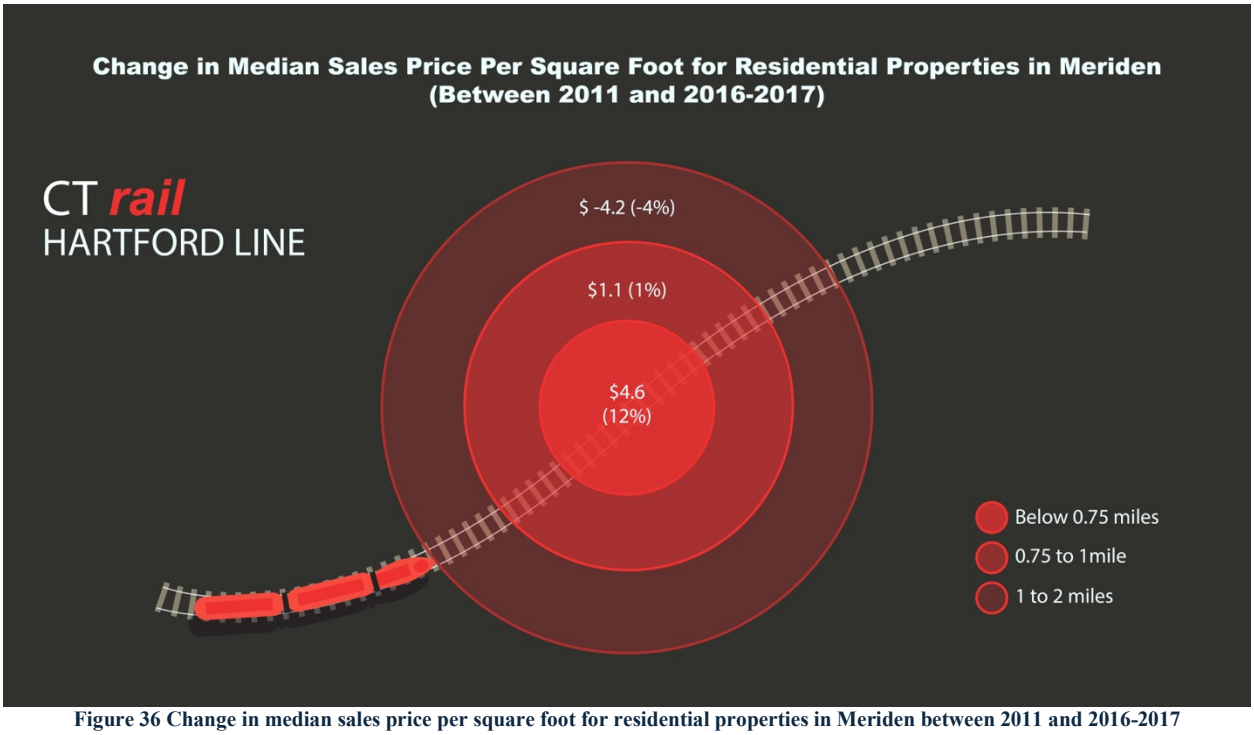

Figure 36 Change in median sales price per square foot for residential properties in Meriden between 2011 and 2016-2017

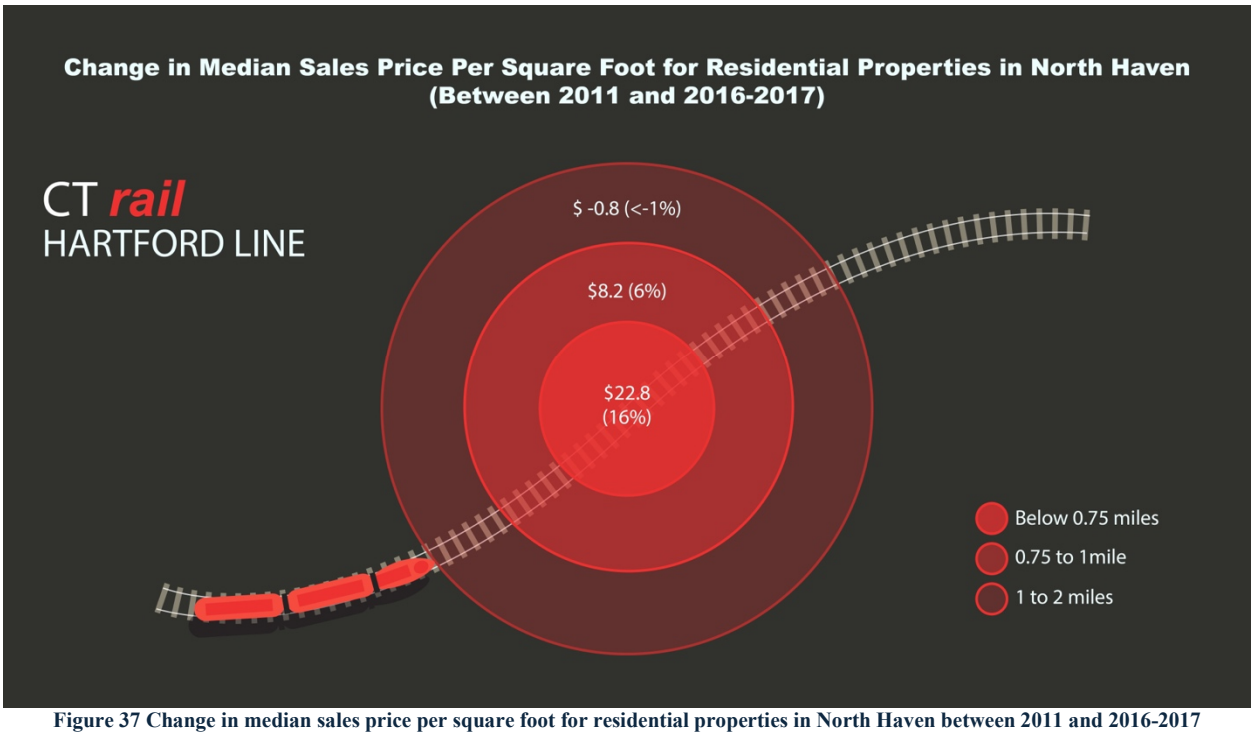

Figure 37 Change in median sales price per square foot for residential properties in North Haven between 2011 and 2016-2017

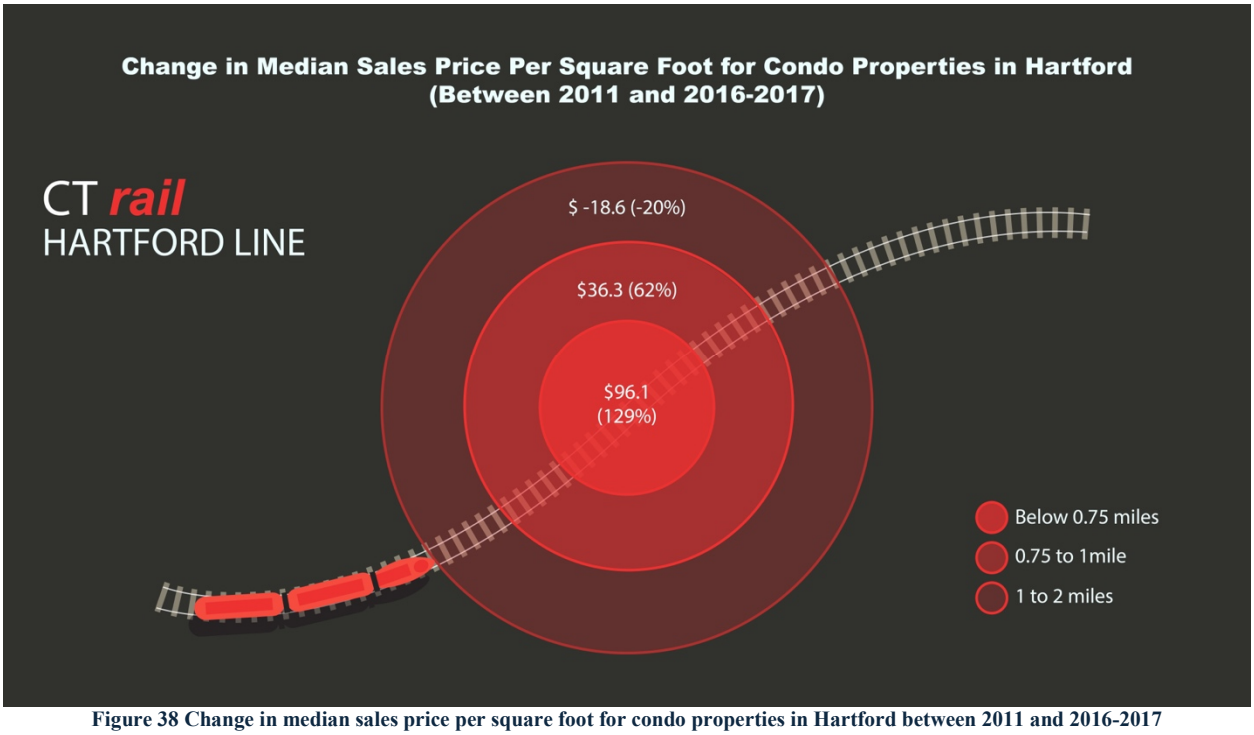

Figure 38 Change in median sales price per square foot for condo properties in Hartford between 2011 and 2016-2017

2.5.3 Insights

Municipal Level Price Changes:

The CTfastrak infographic for Hartford shows a large (38%) rise over the period 2015-2020, but the Hartford Line in Hartford experienced a single-digit increase. This may have been primarily attributable to the years under consideration, as there was little appreciation town-wide prior to 2020, at which point real estate prices in Hartford exploded. This may reflect the surge in new construction of multi-family residential properties in and around downtown Hartford at a significantly higher price point. Also, the number of properties close to the station was less than the number farther away, and some of this disparity may have arisen due to the small sample size close to the station that can also be affected by an increase in the number of high-end units being built there.

For similar reasons, but not as pronounced, two of the other three municipalities where there are CTfastrak stations also experienced municipality-wide increases, while Newington experienced a 3% decline.

Station Area Sales Price Changes:

In general, these infographics indicate that locations closer to the station had a more positive change in price. It would be valuable to compare this change in sale price (70%) to Hartford's overall change in sales price (3%) from 2011 to 2017. One other possible factor is that the proximity to connectivity offered by Hartford's Union Station propped up the values. Another explanation may be that newer high-end residential multi-family properties were located near Union Station relative to other parts of the city such as the West End, and proximity to Union Station was one factor among many that made downtown living increasingly attractive.

The sales prices near New Britain's CTfastrak station were larger than the overall city-wide effects, but only twice the magnitude. The neighborhood surrounding the station was ripe for development and therefore the transit likely was a major driver of real estate prices near the station.

Causal Analysis:

The causal analysis from phase 2 of the CTfastrak analysis relies on data for after versus before the start of service. The analysis found an average causal relationship of 17.5% and 10% for 1 to 4 family houses and condominiums within 0.75 miles of a typical station, respectively, with a dissipating effect moving farther away from a typical station.

The Hartford Line phase of the earlier project scope of work did not include causal analysis, as only 2 years of post-service start data would have been available at the time that work was done. Therefore, the future phases of the project will be ripe for Hartford Line causal analysis, especially with the passage of more time since the start of service that will offer a longer time frame of property sales data.

Price Per Square Foot Changes:

Another metric considered for both transit lines is the change in price per square foot. For CTfastrak in Hartford, there was a 33% increase close (less than 0.75 miles) versus 24% increase far (1 to 2 miles) from the stations. In contrast, there was very little change in the price per square foot of residential space in West Hartford. These smaller differences could have been attributed to some modest increases in the relative amount of space near versus far from the stations, which moderated the ratio of price per square foot in different locations from the stations.

A similar set of findings are apparent for Hartford's Union Station on the Hartford Line from 2011-2017. The price per square foot increased by 60% within 0.75 miles from the station, which was less than the 70% increase in overall prices for the same radius in the same time frame. The only difference between these two percent changes was the denominator of the former measure, which would have increased in order to reduce the ratio of price to square footage relative to the overall percent change. Most of the other infographics presented above for price per square foot change near Hartford Line stations were quite flat across most of the radii.

The conclusion supported by the price per square footage infographics is that square footage increased near the transit stations in Hartford for both transit lines. But there is less clear evidence of either more or less space available in the other municipalities.

2.6 Assessed Values of Residential and Commercial Properties

2.6.1 Task Description

This task provides visual evidence for the hypothesis that assessed property values were higher in closer proximity to the CTfastrak and the Hartford Line stations. Specifically, the hypothesis is:

Hypothesis 4: Assessed values were higher, the closer properties were to transit stations.

Assessed values were determined by the local assessor in each municipality, and typically revaluations occurred every five years in Connecticut municipalities. In Connecticut property has been typically assessed at 70 percent of the estimated market value.

Analysis of the assessed value relationships near transit stations can provide important information to planners and policy makers regarding how much revenue can be attributable to transit. It is important to note here, however, that the estimates below suggest how property values (opposed to land values) may have changed in tandem with the introduction of new transit in the state.

2.6.2 Methodology

The data for these analyses originate from the municipal assessors. The same data was used in the earlier CTfastrak and Hartford Line phases. The attributes that are used to estimate the assessed value change are:

- Key Attributes:
    - ✓ Assessed Value
    - ✓ Property Type
    - ✓ Distance to the Nearest Station
    - ✓ Municipality
- Calculated Attribute:
    - ✓ Distance Category groups properties in four categories based on distance from the nearest station (less than 0.75 miles, 0.75-1.0 miles, 1.0-2.0 miles, and beyond 2.0 miles
    - ✓ Distance is based on straight-line distance

The following steps are used to perform the calculations:

Data Pre-process:

- Entries with missing sale prices.
    - ✓ Transactions that did not represent market-based transactions, such as those prices below $1,000. These were often transfers between family members, moving properties into trust, and other non arms length transactions.
    - ✓ Duplicate records to avoid counting the same sale more than once.
- Removed Outliers:
    - ✓ Use a statistical method called the "Z-score" to measure how many standard deviations each data point was from the mean. The threshold is set to three standard deviations, which eliminates around 0.27% of data points that are extreme outliers (implausibly high or low values).
- Kept the Paired Data:
    - ✓ Pair each data point (i.e., address) with the same address across different assessment years, corresponding to the phases of the study (i.e., the CTfastrak phases 1 and 2, and the Hartford Line), to analyze changes over time

Calculation:

- Median of Assessed Value:
    - ✓ Calculate the median (midpoint value) of the assessed value in each distance category of each town. This provides a general sense of the central tendency of the assessed value data.

- Comparison of Median Assessed Values:

    ✓ Compare the median assessed value over time to understand how property assessed value have changed:

Median Assessed Value Change = Later Period Median Assessed Value in Each Distance Category of Each Town - Previous Period Median Assessed Value in Each Distance Category of Each Town

- Percentage Change in Assessed Value:

    ✓ Calculate the percentage change in median assessed value to assess how much property assessed value have increased or decreased over time by percentage:

*Median Percentage Change in Assessed Value = 100 * (Median Assessed Value Change in Each Distance Category of Each Town) / (Previous Period Median Assessed Value in Each Distance Category of Each Town)*

2.6.3 Infographics

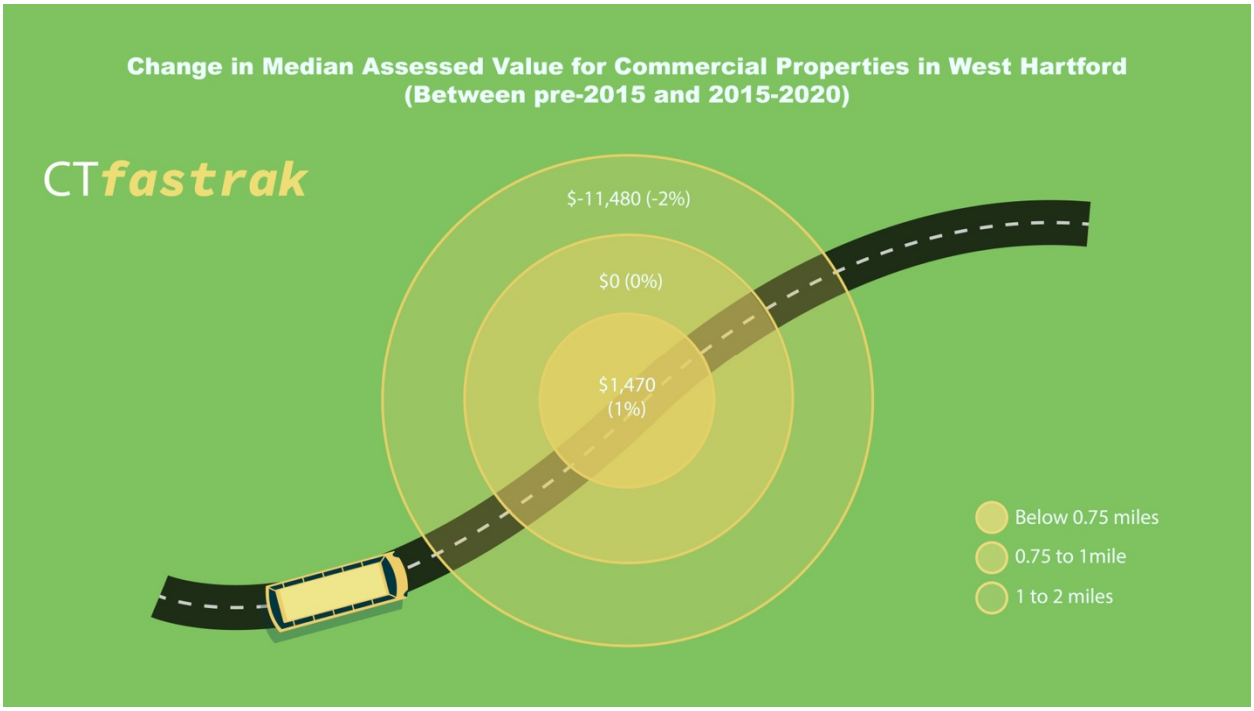

Figure 39 Change in Median Assessed Value for Commercial Properties in West Hartford (pre-2015 to 2015-2020)

Sometimes, the change in assessed values and the corresponding percentage change are not directly comparable across distance radii due to differing base values. For example, in the infographic above, the median assessed value of commercial properties within 0.75 miles increased by $1,470 (1%), while the 1–2 miles category saw a decrease of $11,480 (–2%). This difference in percentage change reflects the higher baseline in the 1–2 miles category ($661,500) compared to the 0.75 miles category ($249,760). Specifically, 1,470 ÷ 249,760 ≈ 0.59% (1%), and –11,480 ÷ 661,500 ≈ –1.73% (–2%).

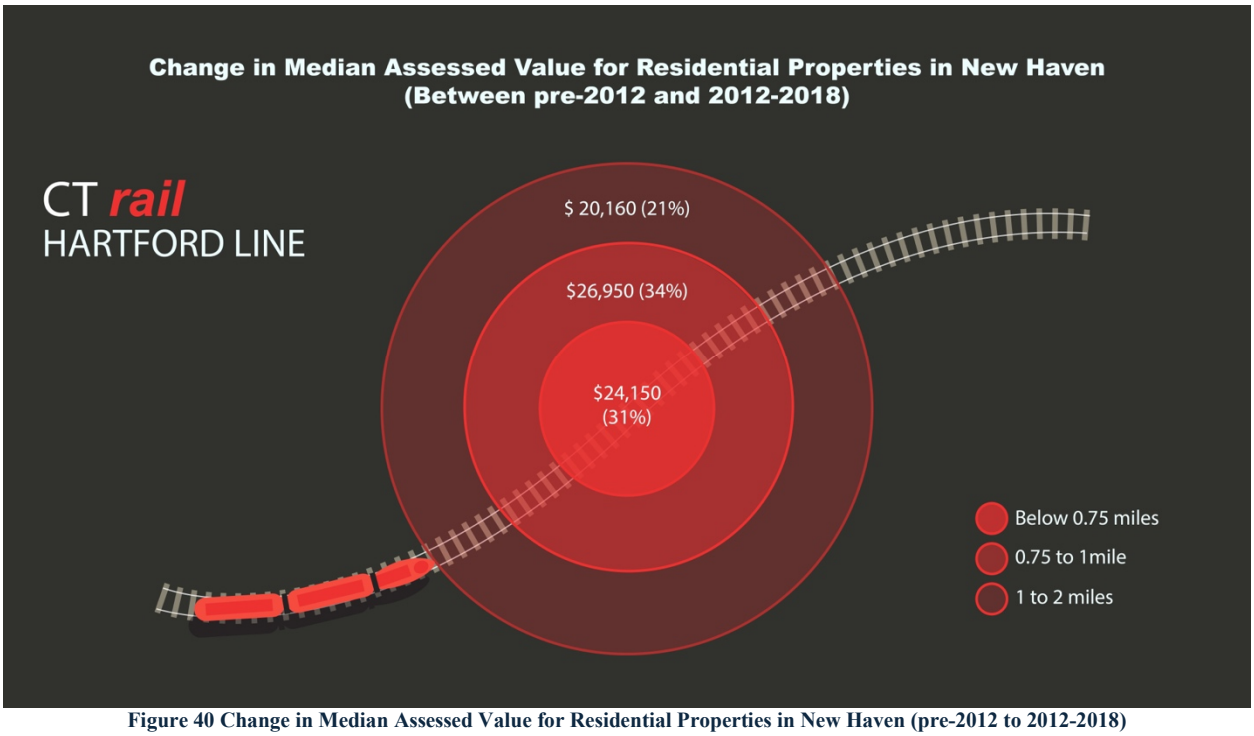

Figure 40 Change in Median Assessed Value for Residential Properties in New Haven (pre-2012 to 2012-2018)

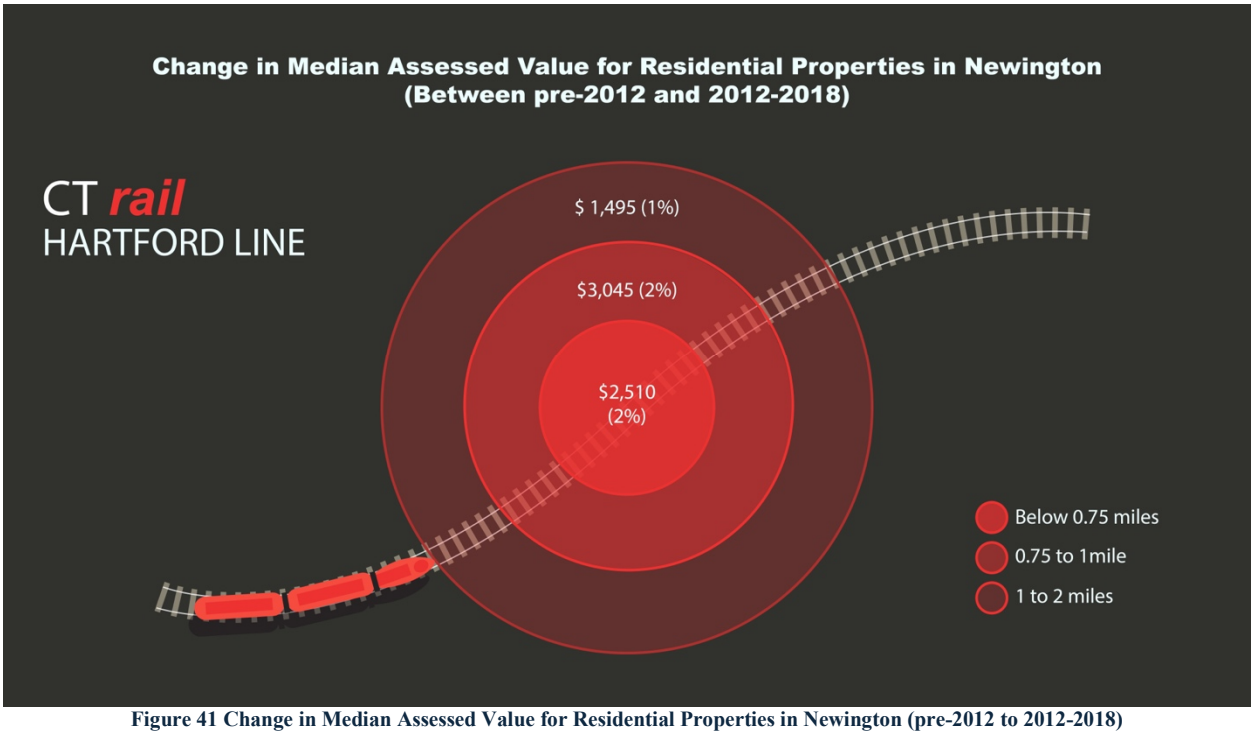

Figure 41 Change in Median Assessed Value for Residential Properties in Newington (pre-2012 to 2012-2018)

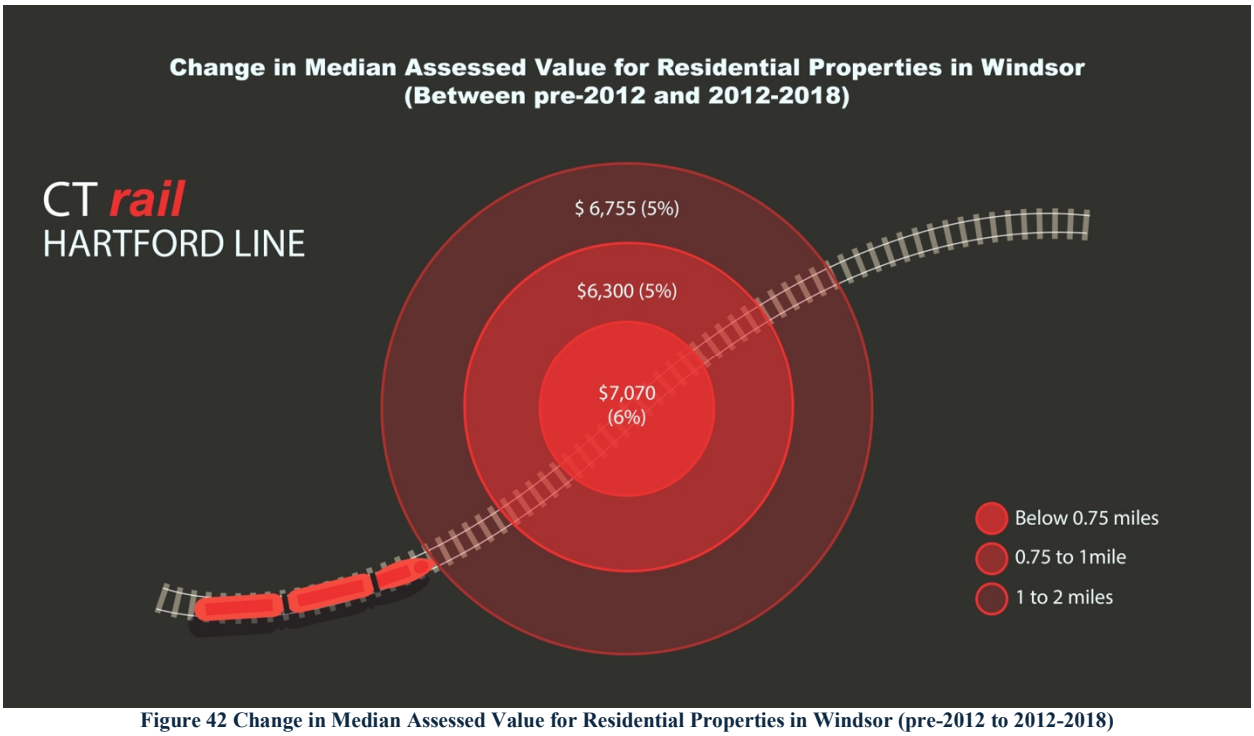

Figure 42 Change in Median Assessed Value for Residential Properties in Windsor (pre-2012 to 2012-2018)

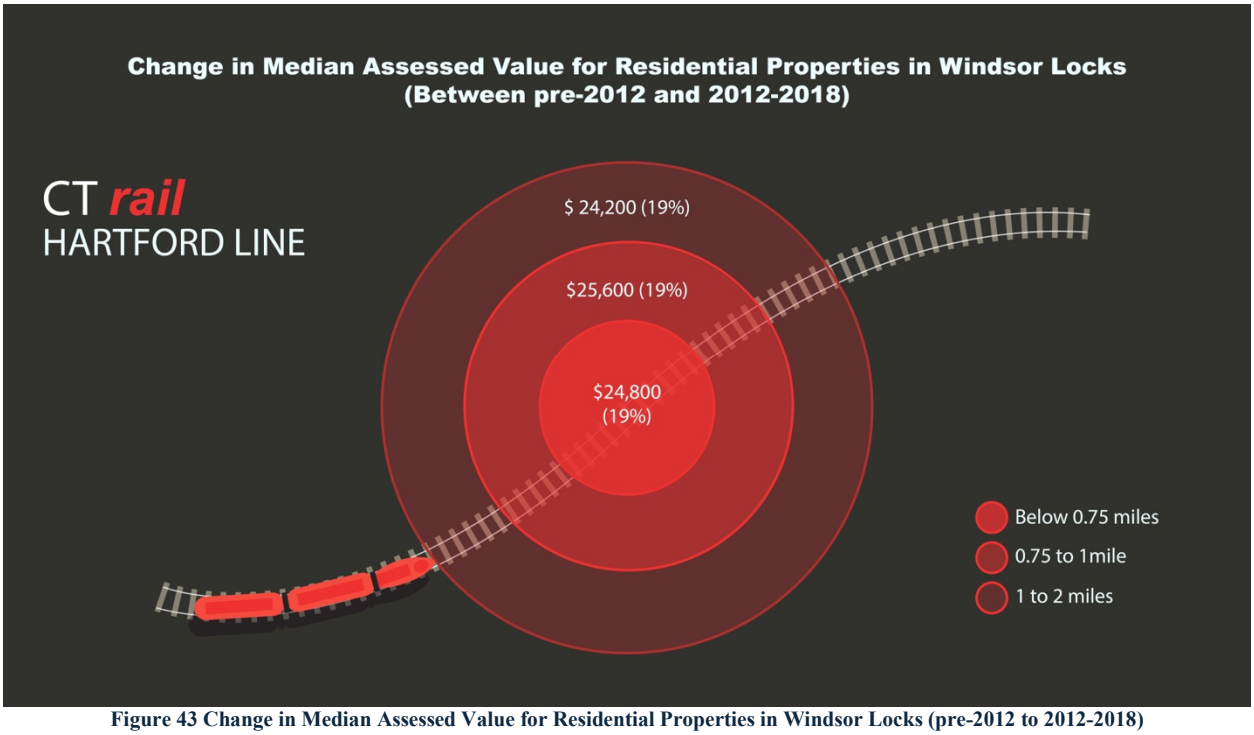

Figure 43 Change in Median Assessed Value for Residential Properties in Windsor Locks (pre-2012 to 2012-2018)

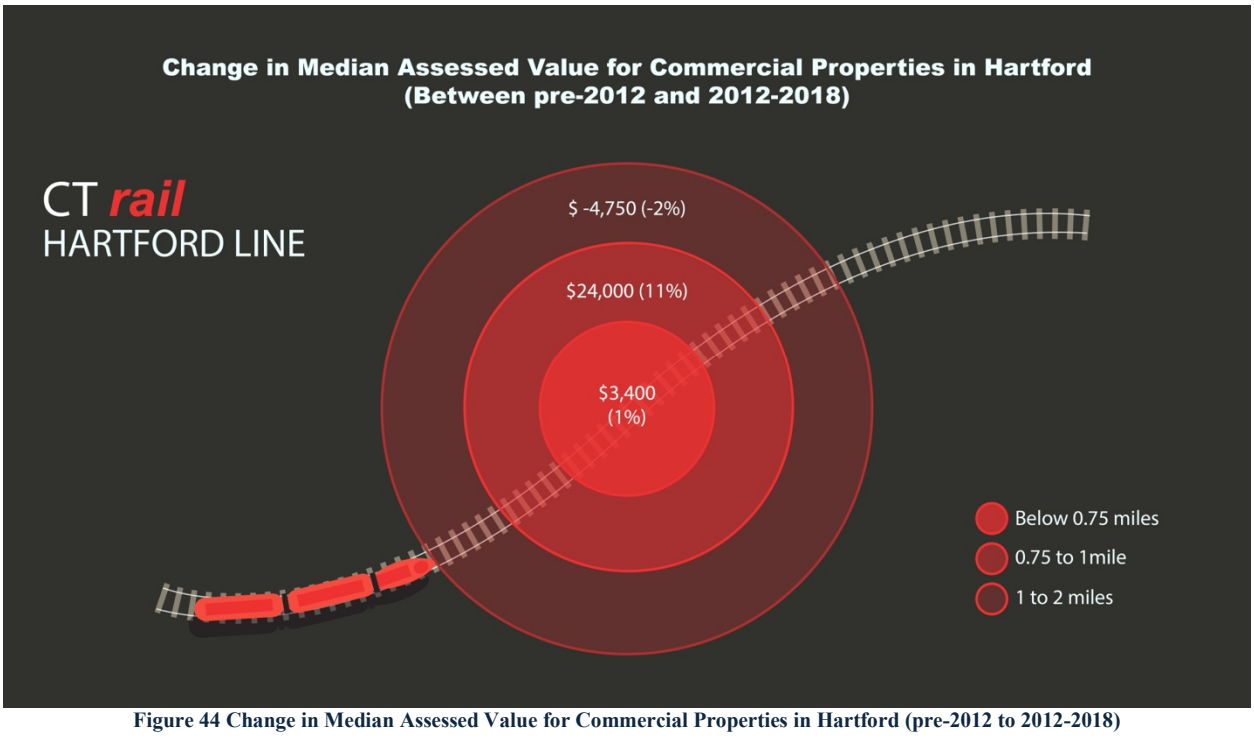

Figure 44 Change in Median Assessed Value for Commercial Properties in Hartford (pre-2012 to 2012-2018)

2.6.4 Insights

Considering assessed values without simultaneously analyzing the millage rates can be misleading. Often, municipalities will change their millage rates to achieve the desired level of tax revenue, given the levels of assessed values (or the value of the grand list of the municipality). Since revaluations are done every five years in Connecticut, some upward adjustments are typical during times of strong real estate markets. Therefore, there are limits to how one might be able to isolate the impacts of new transit on residential and commercial assessed values.

The infographics presented in this section offer some evidence that transit proximity is correlated with assessed values. For instance, some properties that were very close to the Hartford Line stations experienced smaller increases in assessed values than those properties between 0.75 miles and 1 mile away. This seemingly counterintuitive evidence may have been representative of the sentiment among some property owners that proximity to transit is important, but because of other disamenities (e.g., noise and air pollution, traffic congestion), it was optimal to locate close but not too close to transit. This is one possible explanation for the patterns shown in the above infographics, which offer some general support of the hypothesis that some transit proximity enhanced assessed values, but individual properties may not always conform to this general pattern. Existing land use patterns surrounding transit corridors are also important to consider. For instance, typically both the Hartford Line and CTfastrak corridors have been associated with industrial land use that is adjacent to a freight and passenger rail line. Existing and prior zoning of these properties reflects these land use patterns. In general, industrial and heavy commercial uses (such as auto service or repair, auto recyclers, landscapers, etc.) may be low in assessed value, have substantial external impacts, and be very difficult to relocate as the overall market shifts because they are more constrained in their alternatives.

2.7 Property Vacancies

2.7.1 Task Description

A decrease in the residential and/or commercial vacancy rates near transit stations implies that transit may have some role in attracting residents and/or businesses to locate near the stations. Therefore, the issue of vacancies is an important one to understand in more detail. This task tested the hypothesis:

Hypothesis 5: There were fewer residential and commercial vacancies near transit stations.

The U.S. postal service tracks residential and commercial addresses that have uncollected mail, and it labels these units as vacant. The data is made available to researchers, aggregated to the census tract level over time, separated for residential and commercial properties, through the U.S. Department of Housing and Urban Development website: https://www.huduser.gov/portal/datasets/usps.html. The data that are presented in the infographics below are from this USPS/HUD source. It is critical to make the distinction between vacant properties (often associated with development or unimproved land) and vacant residential and commercial units within existing buildings. This data source is specifically for vacant units because there would be little mail addressed to a vacant, unimproved parcel.

A trendline figure is presented below to demonstrate general trends in housing vacancies in Connecticut, for the timeframe of the early 2000's up through 2024. The data in the trendline figure below shows trends in residential vacancies in Connecticut, from a different source. Namely, the figure is based on data from the U.S. Census Bureau's American Community Survey, which is from survey data (opposed to the entire population of vacancies) for 5-year averages of tract-level vacancies:

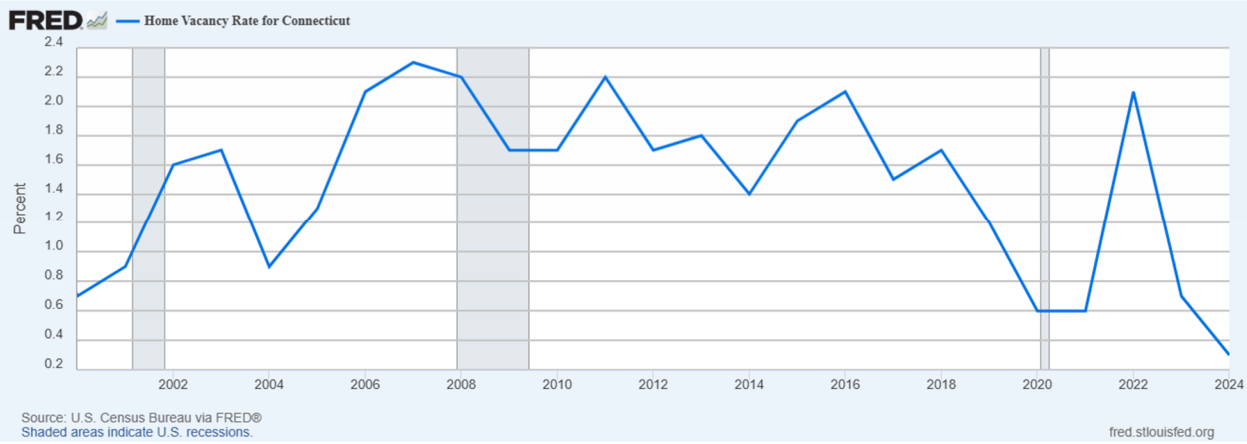

Figure 45 Home Vacancy Rate for Connecticut

This figure shows there was a sharp downward trend in home vacancies in Connecticut starting in 2016, which bottomed out in 2020. This downward trend was in tandem with the start of CTfastrak service in 2015, and the start of the Hartford Line service in 2018. The infographics below corroborate a similar change in vacancies near the stations during this same period.

2.7.2 Methodology

The data are reported by census tracts, which are small geographic areas used for population and housing analysis. Since each station was located within a specific census tract, the infographics presented below are focused on the census tracts where the stations were located. The data originated from the USPS and HUD (*https://www.huduser.gov/portal/datasets/usps.html*). Changes in vacancies of properties in each census tract over time are calculated as follows:

- Vacancy Change = Later Period Vacancy in Each Station's Tract - Previous Period Vacancy in Each Station's Tract

- Percentage Change = (Vacancy Change / Previous Period Vacancy in Each Station's Tract) × 100%

In the following table, the change in residential vacancies in the census tract where each station is located along CTfastrak, between 2015 and 2020, is shown:

Station	Year:2015	Year:2020	Vacancy Change	Percentage Change (based on 2015)
Sigourney Street Station	189	150	-39	-20.6%
Parkville Station	90	45	-45	-50.0%
Kane Street Station	90	45	-45	-50.0%
Flatbush Station	20	10	-10	-50.0%
Elmwood Station	20	10	-10	-50.0%
Newington Junction Station	23	10	-13	-56.5%
Cedar Street Station	23	10	-13	-56.5%
East Street Station	80	37	-43	-53.8%
East Main Street station- Northbound	80	37	-43	-53.8%
East Main Street station- Southbound	115	88	-27	-23.5%
New Britain Station	139	121	-18	-12.9%

Table 12 Change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

In the following table, the change in residential vacancies in the census tract where each station is located along CTfastrak, between 2009 and 2015, is shown:

Station	Year:2009	Year:2015	Vacancy Change	Percentage Change (based on 2009)
Sigourney Street Station	316	189	-127	-40.2%
Parkville Station	25	90	65	260.0%
Kane Street Station	25	90	65	260.0%
Flatbush Station	7	20	13	185.7%
Elmwood Station	7	20	13	185.7%
Newington Junction Station	45	23	-22	-48.9%
Cedar Street Station	45	23	-22	-48.9%
East Street Station	63	80	17	27.0%
East Main Street station- Northbound	63	80	17	27.0%
East Main Street station- Southbound	76	115	39	51.3%
New Britain Station	150	139	-11	-7.3%

Table 13 Change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

In the following table, the change in commercial vacancies in the census tract where each station is located along CTfastrak, between 2015 and 2020, is shown:

Station	Year:2015	Year:2020	Vacancy Change	Percentage Change (based on 2015)
Sigourney Street Station	73	59	-14	-19.2%
Parkville Station	45	39	-6	-13.3%
Kane Street Station	45	39	-6	-13.3%
Flatbush Station	105	83	-22	-21.0%
Elmwood Station	105	83	-22	-21.0%
Newington Junction Station	23	20	-3	-13.0%
Cedar Street Station	23	20	-3	-13.0%
East Street Station	13	9	-4	-30.8%
East Main Street station- Northbound	13	9	-4	-30.8%
East Main Street station- Southbound	11	11	0	0.0%
New Britain Station	126	121	-5	-4.0%

Table 14 Change in the number of commercial vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

In the following table, the change in commercial vacancies in the census tract where each station is located along CTfastrak, between 2009 and 2015, is shown:

Station	Year:2009	Year:2015	Vacancy Change	Percentage Change (based on 2009)
Sigourney Street Station	45	73	-127	62.2%
Parkville Station	35	45	65	28.6%
Kane Street Station	35	45	65	28.6%
Flatbush Station	101	105	13	4.0%
Elmwood Station	101	105	13	4.0%
Newington Junction Station	24	23	-22	-4.2%
Cedar Street Station	24	23	-22	-4.2%
East Street Station	9	13	17	44.4%
East Main Street station- Northbound	9	13	17	44.4%
East Main Street station- Southbound	10	11	39	10.0%
New Britain Station	107	126	-11	17.8%

Table 15 Change in the number of commercial vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

In the following table, the change in residential vacancies in the census tract where each station is located along the Hartford Line, between 2011 and 2017, is shown:

Station	Year:2011	Year:2017	Vacancy Change	Percentage Change (based on 2011)
Enfield*	60	144	84	140.0%
Windsor Locks	24	25	1	4.2%
Windsor	25	13	-12	-48.0%
Hartford Union	62	117	55	88.7%
West Hartford*	22	12	-10	-45.5%
Newington*	15	9	-6	-40.0%
Berlin	39	22	-17	-43.6%
Meriden	30	102	72	240.0%
Wallingford	96	59	-37	-38.5%
North Haven*	35	24	-11	-31.4%
New Haven State Street	53	16	-37	-69.8%
New Haven Union	1	2	1	100.0%

Table 16 Change in the number of residential vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

* denotes future stations

The following table shows the change in commercial vacancies in the census tract where each station is located along the Hartford Line, between 2011 and 2017:

Station	Year:2011	Year:2017	Vacancy Change	Percentage Change (based on 2011)
Enfield*	33	28	-5	-15.2%
Windsor Locks	38	40	2	5.3%
Windsor	10	19	9	90.0%
Hartford Union	291	290	-1	-0.3%
West Hartford*	117	105	-12	-10.3%
Newington*	6	5	-1	-16.7%
Berlin	48	64	16	33.3%
Meriden	24	16	-8	-33.3%
Wallingford	148	120	-28	-18.9%
North Haven*	28	34	6	21.4%
New Haven State Street	233	197	-36	-15.5%
New Haven Union	18	28	10	55.6%

Table 17 Change in the number of commercial vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

* denotes future stations

2.7.3 Infographics

The infographics can be seen below for vacancies by station. Two separate formats have been presented, one set of bar graphs that showed comparisons over time, and a set of radius infographics that show how vacancies changed over time.

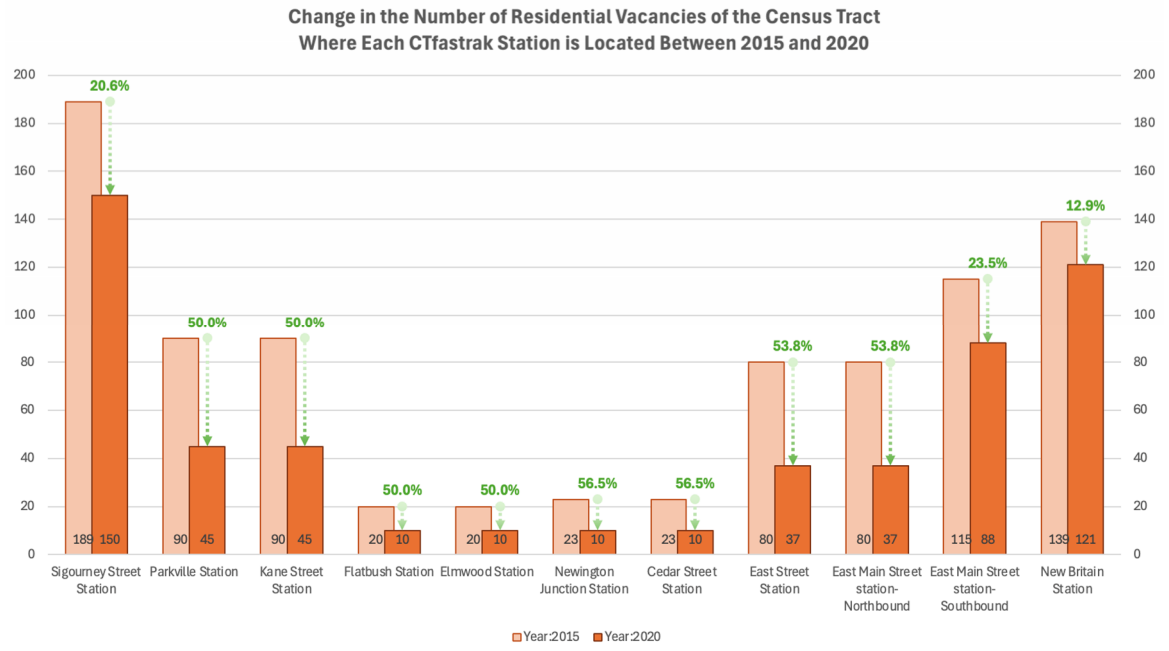

Figure 46 Change in the Number of Residential Vacancies of the Census Tract Where Each CTfastrak Station is Located Between 2015 and 2020

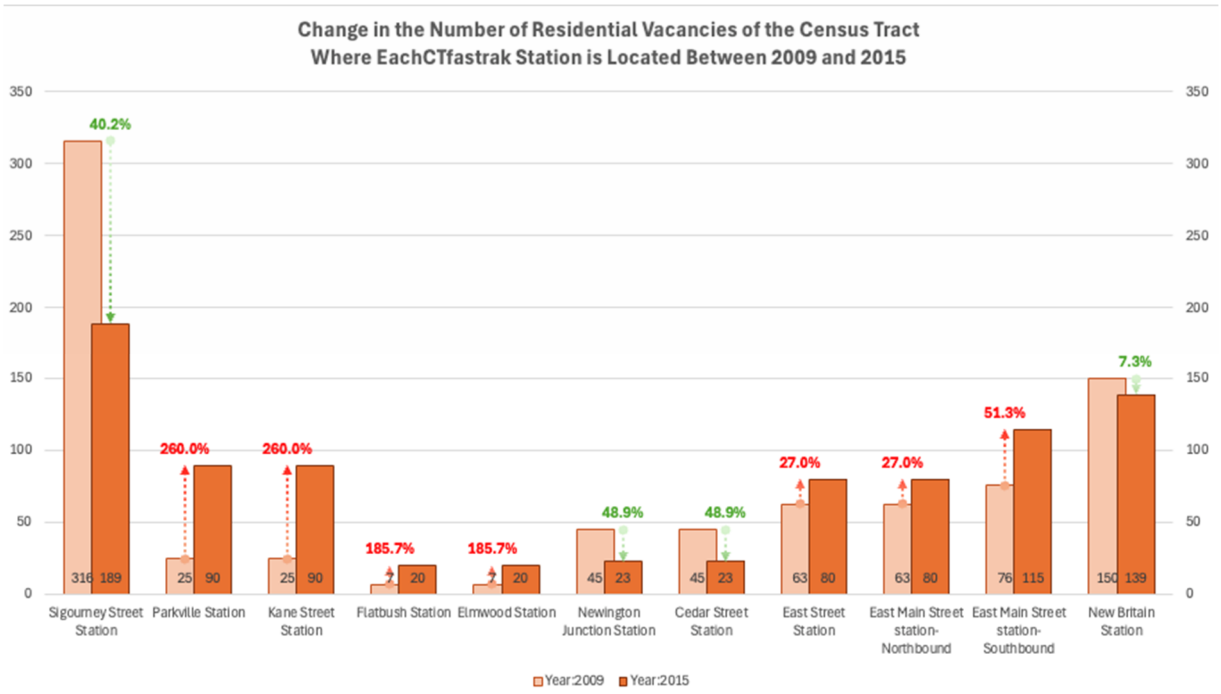

Figure 47 Change in the Number of Residential Vacancies of the Census Tract Where Each CTfastrak Station is Located Between 2009 and 2015

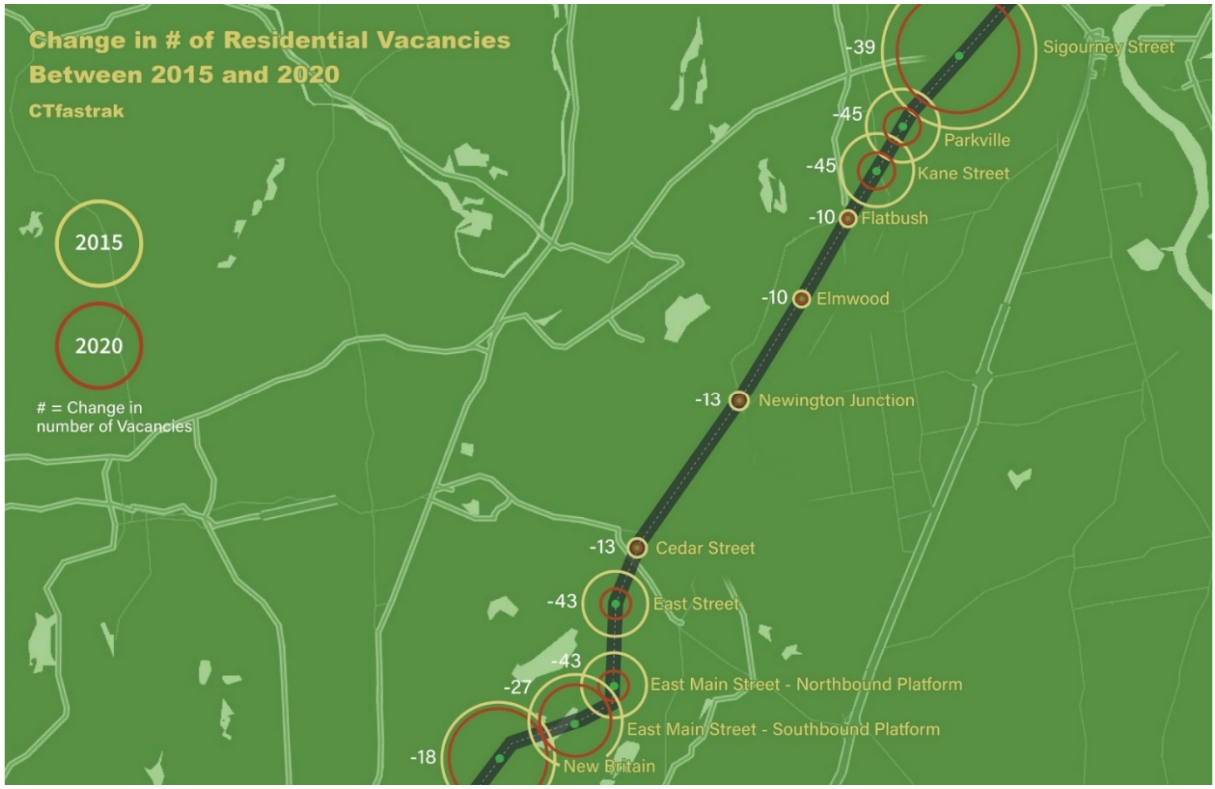

Figure 48 Map of the change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

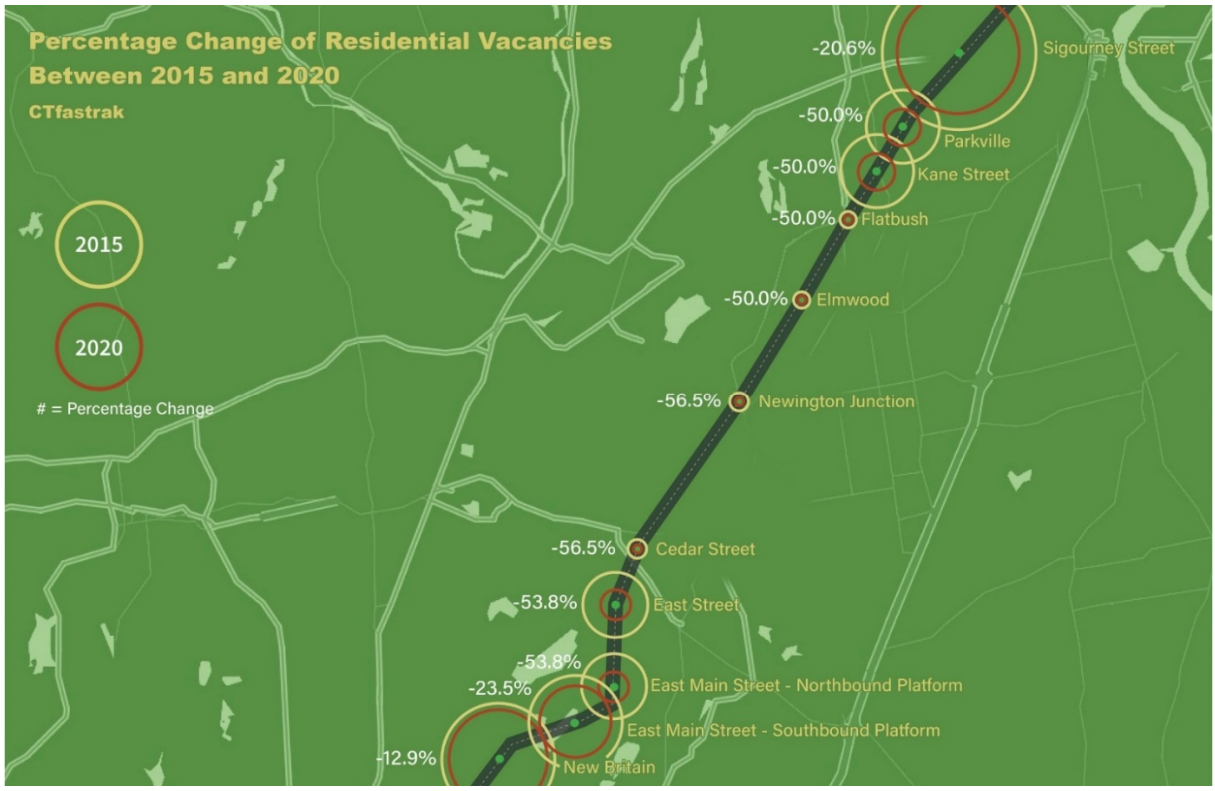

Figure 49 Map of the percentage change of residential vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

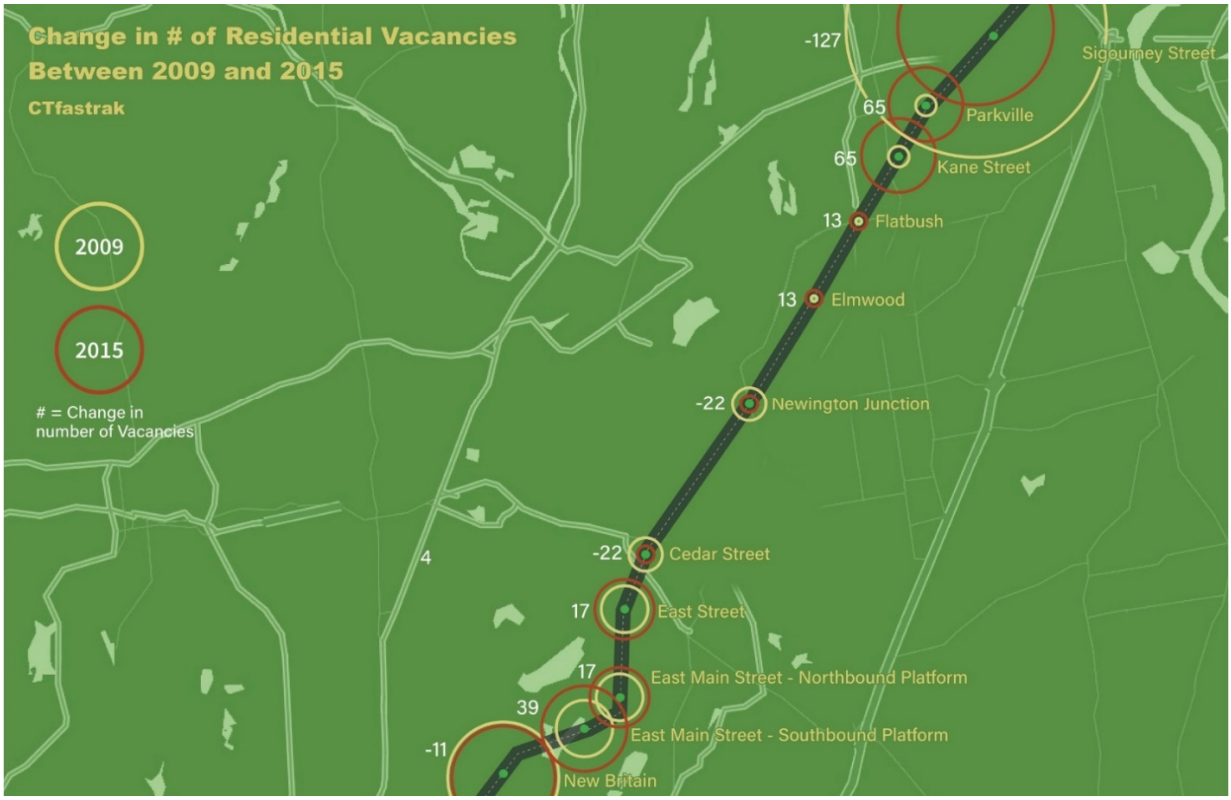

Figure 50 Map of the change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

Figure 51 Map of the percentage change of residential vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

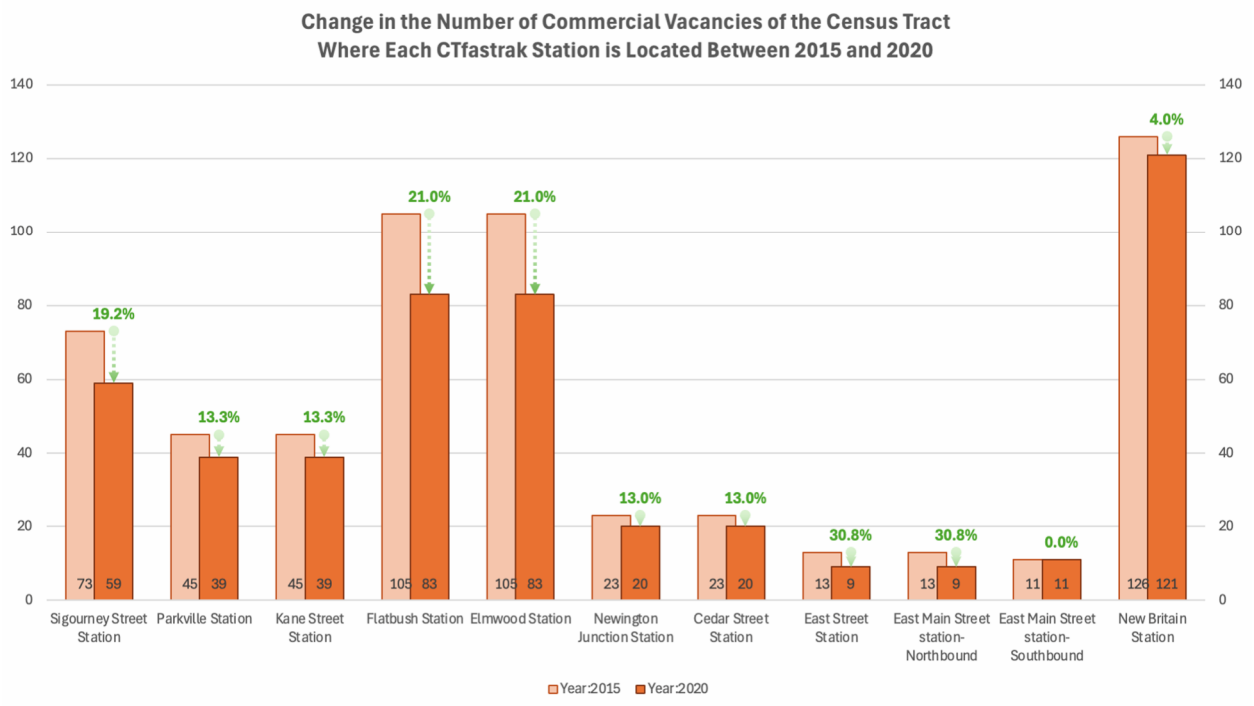

Figure 52 Change in the Number of Commercial Vacancies of the Census Tract Where Each CTfastrak Station is Located Between 2015 and 2020

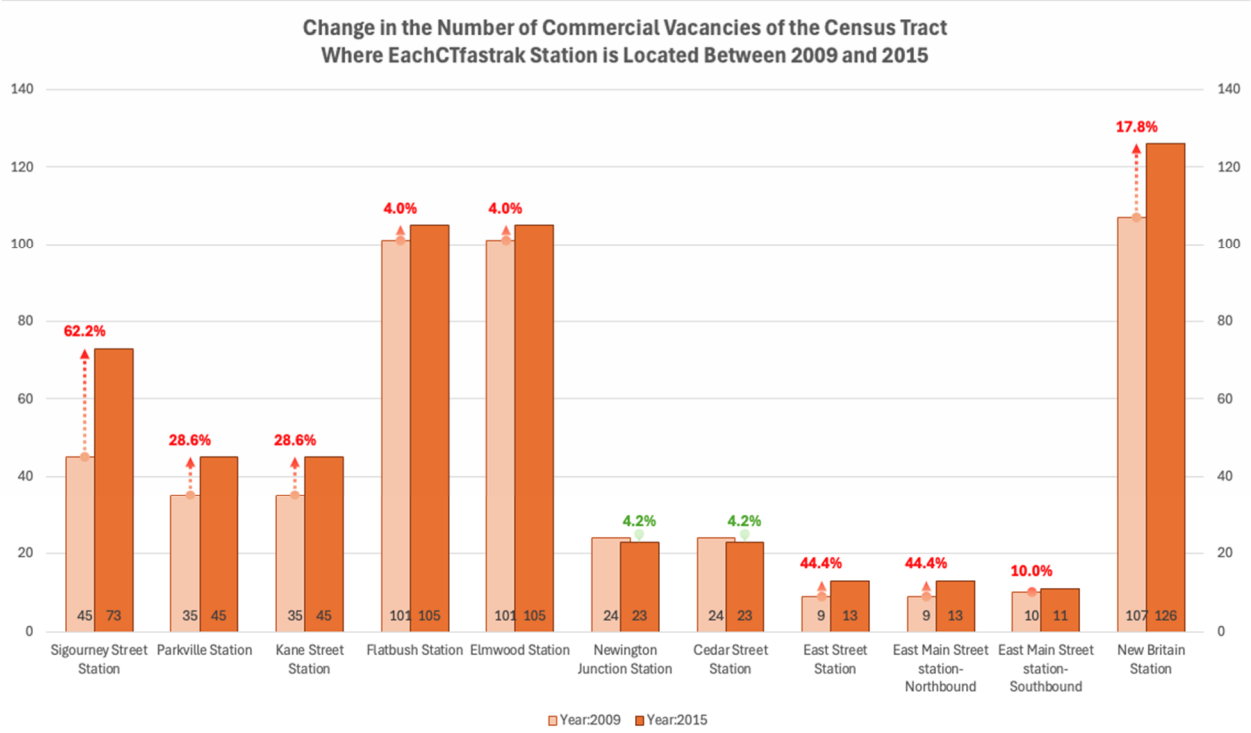

Figure 53 Change in the Number of Commercial Vacancies of the Census Tract Where Each CTfastrak Station is Located Between 2009 and 2015

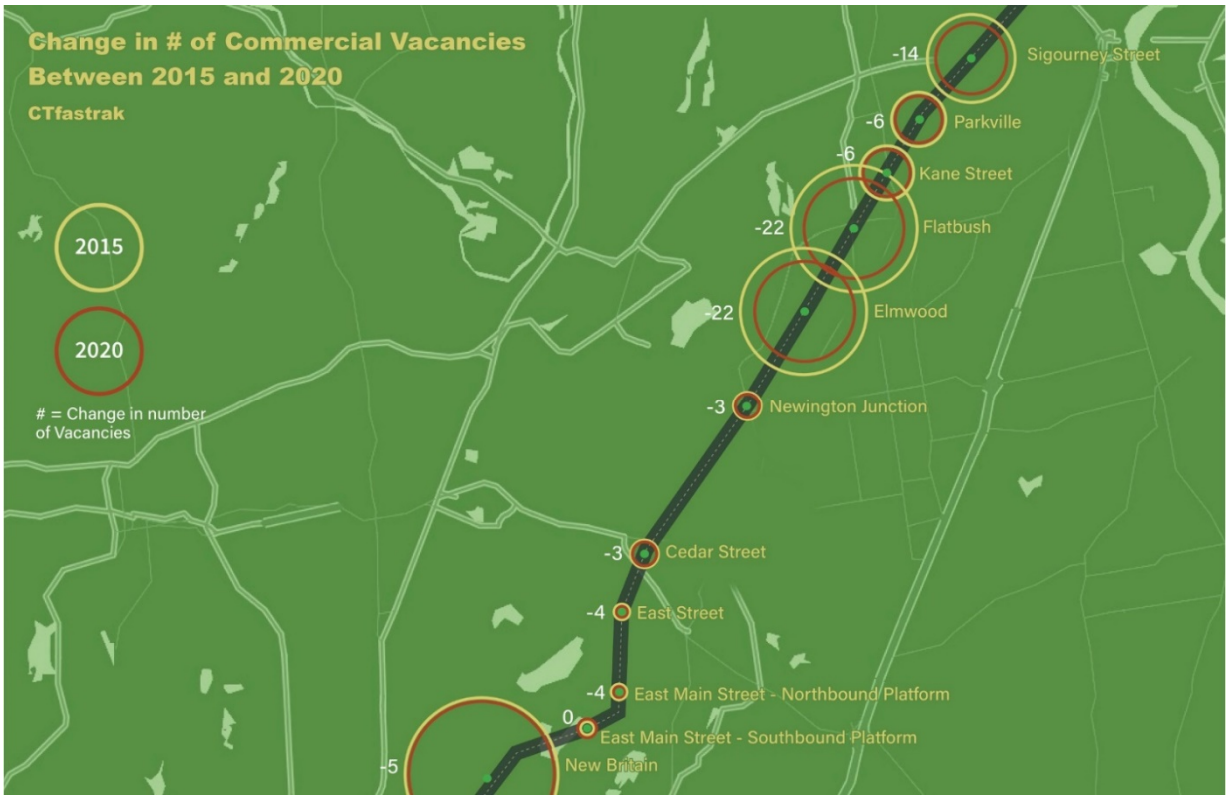

Figure 54 Map of the change in the number of commercial vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

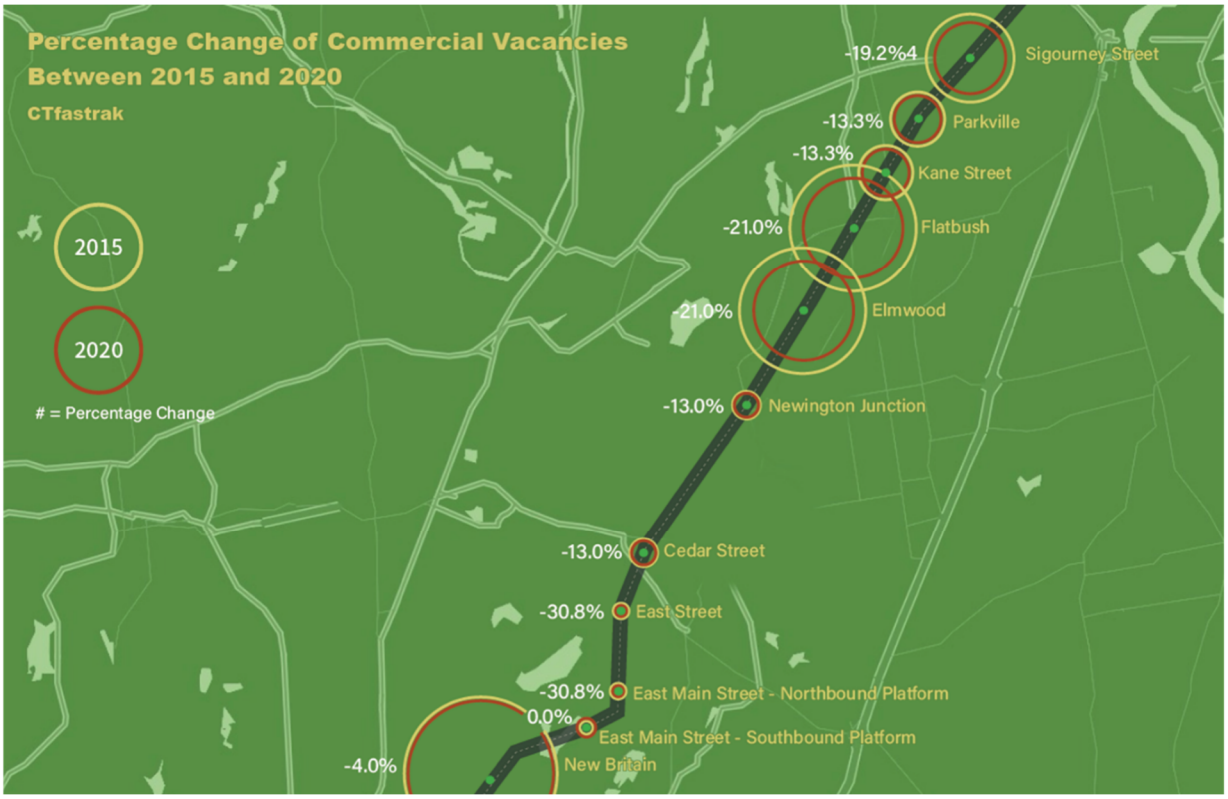

Figure 55 Map of the percentage change of commercial vacancies of the census tract where each CTfastrak station is located between 2015 and 2020

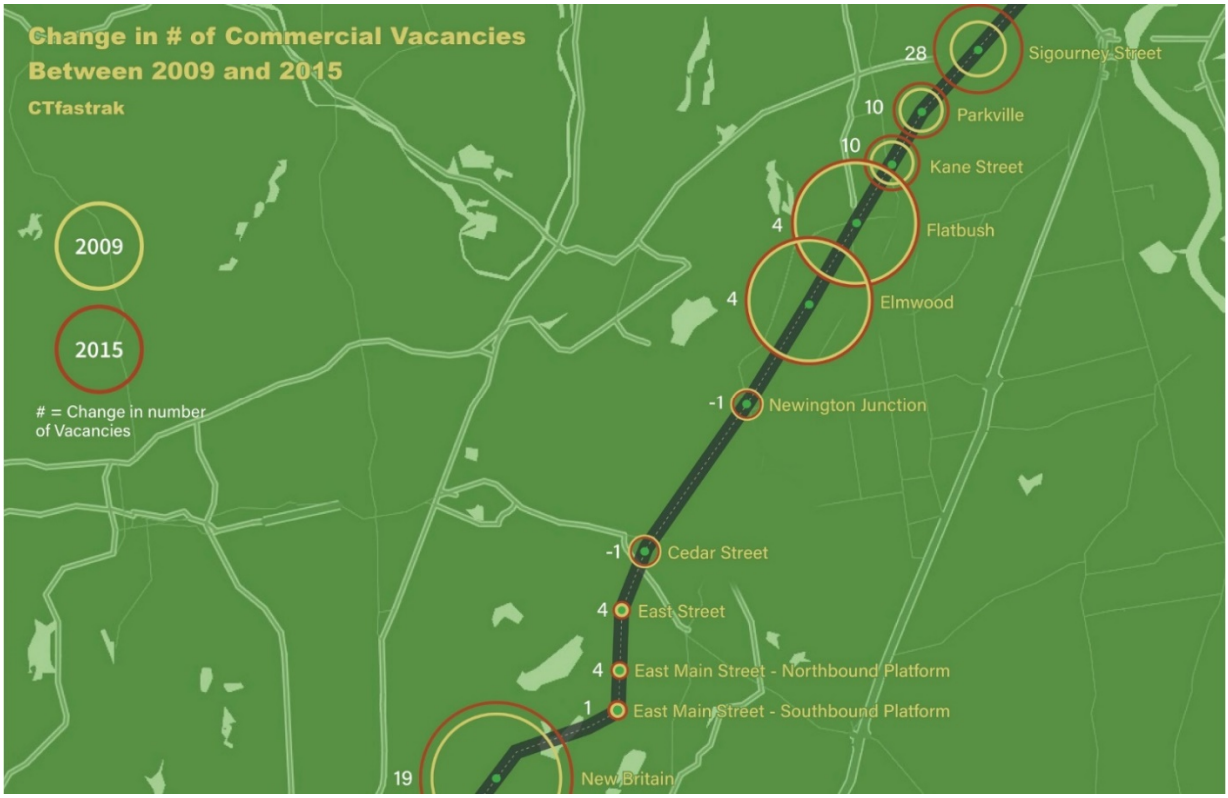

Figure 56 Map of the change in the number of commercial vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

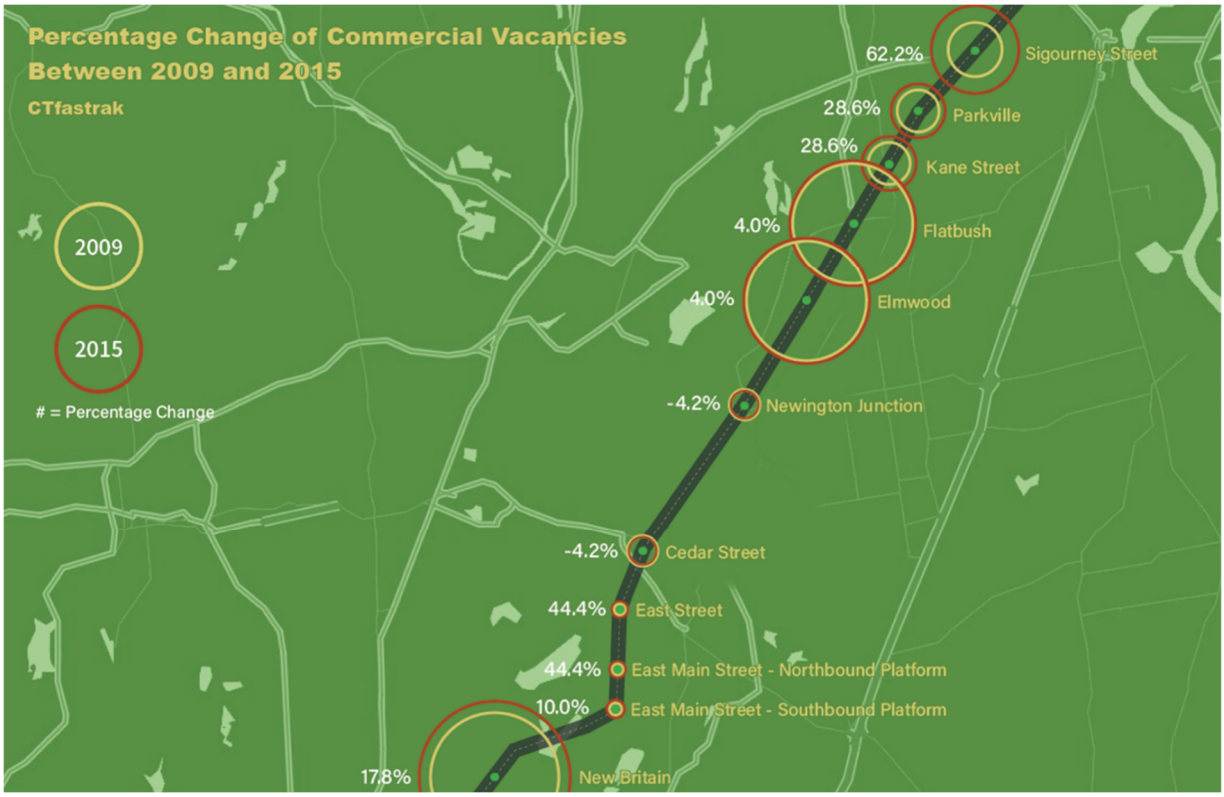

Figure 57 Map of the percentage change of commercial vacancies of the census tract where each CTfastrak station is located between 2009 and 2015

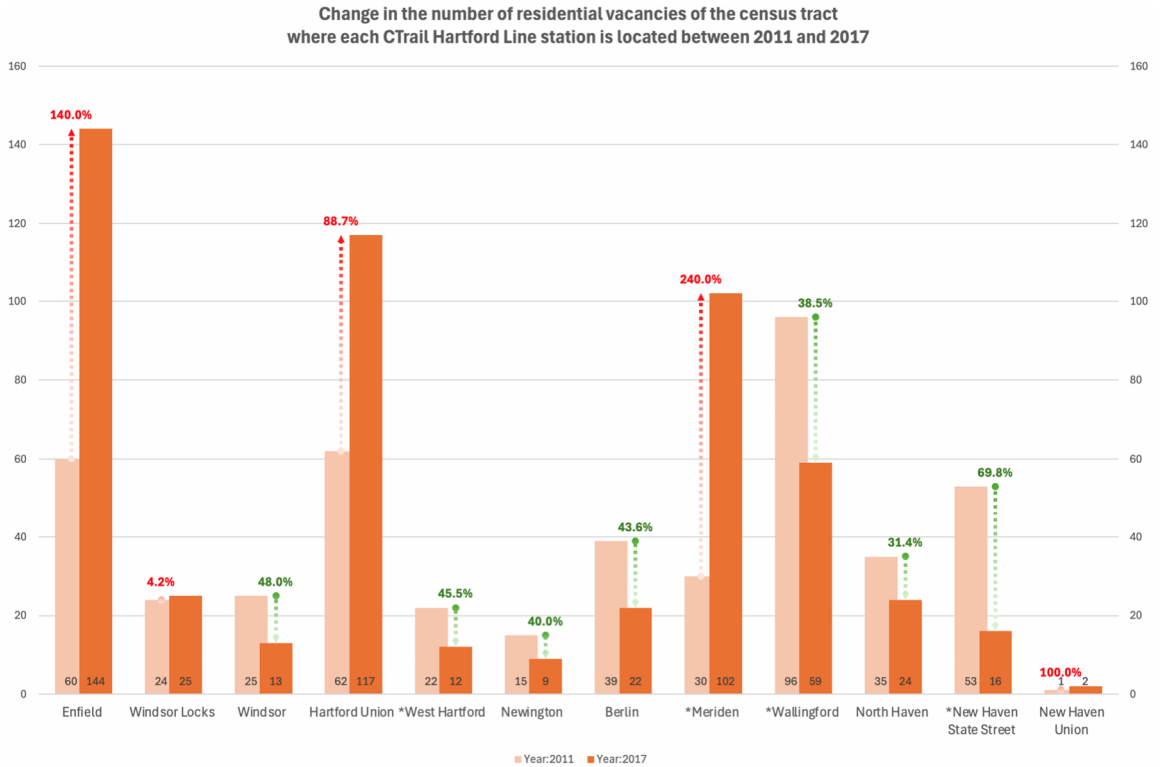

Figure 58 Change in the number of residential vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

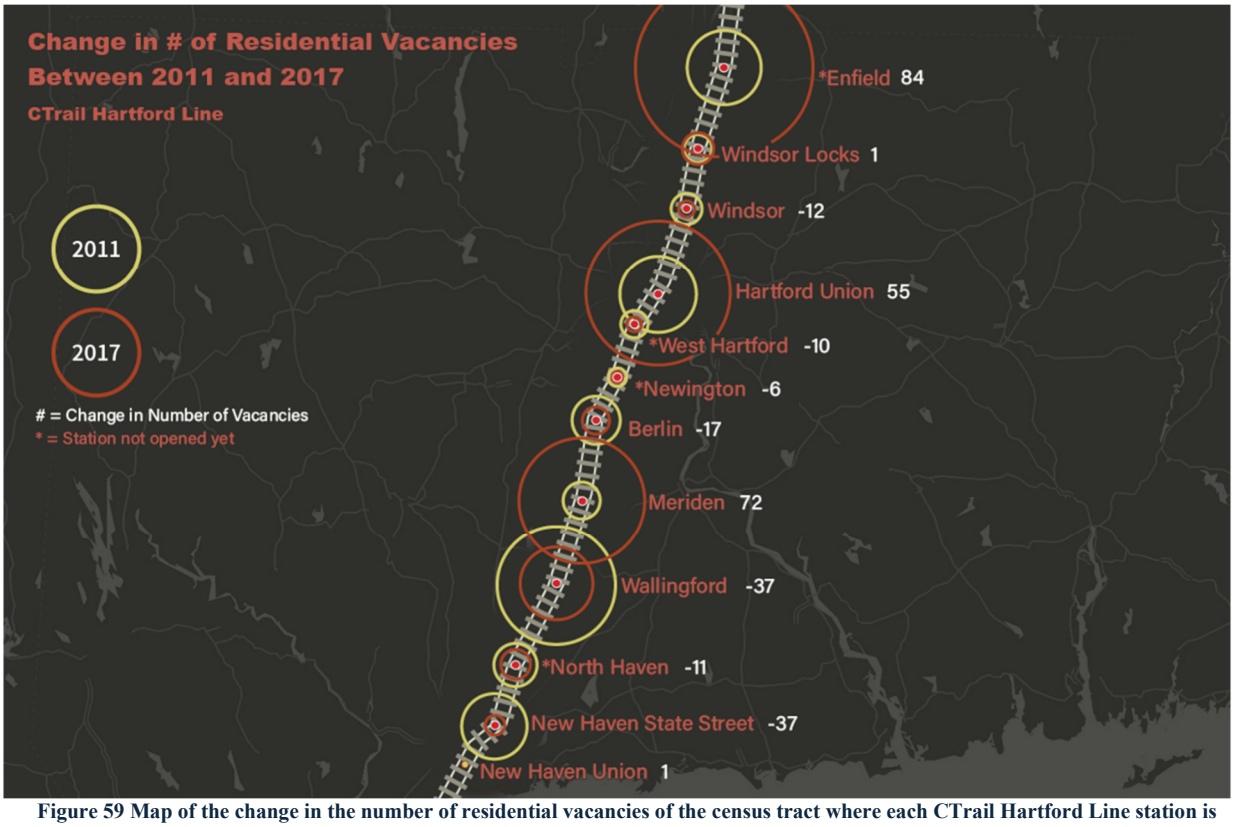

Figure 59 Map of the change in the number of residential vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

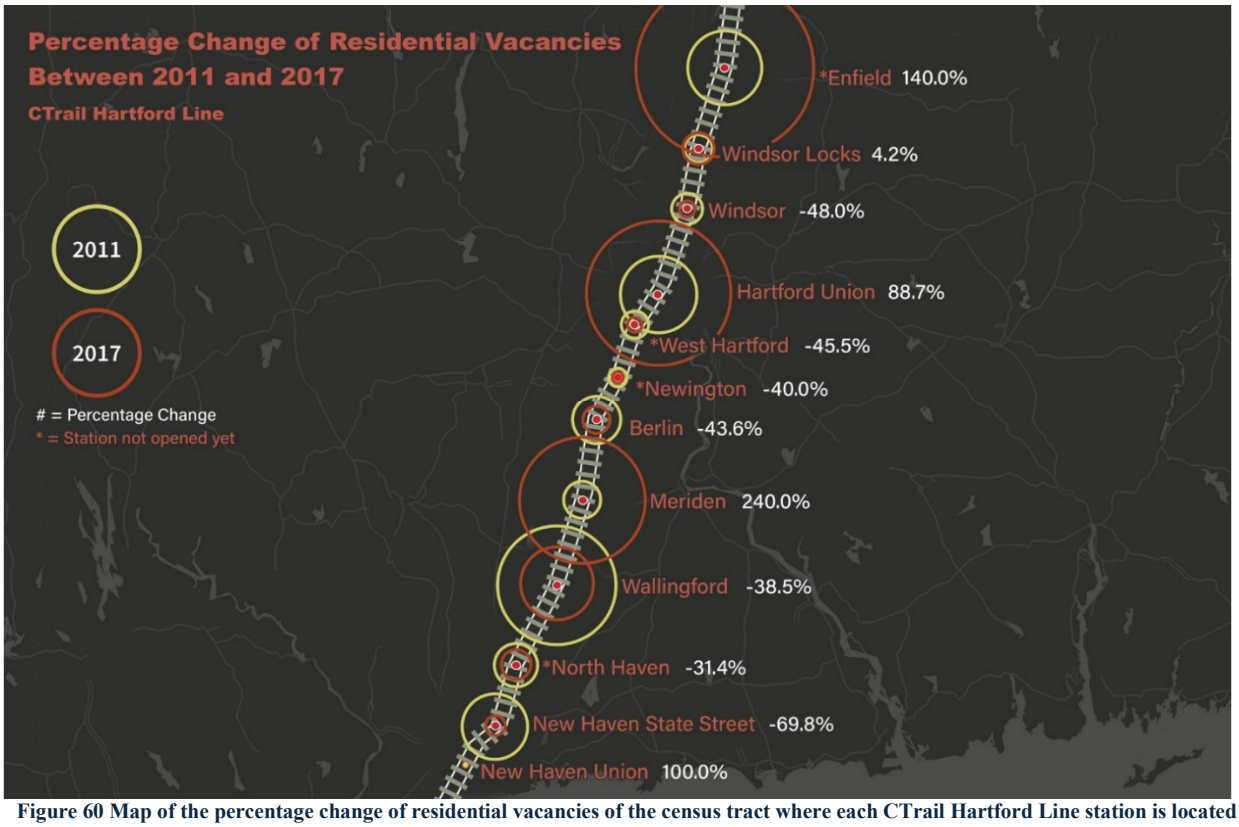

Figure 60 Map of the percentage change of residential vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

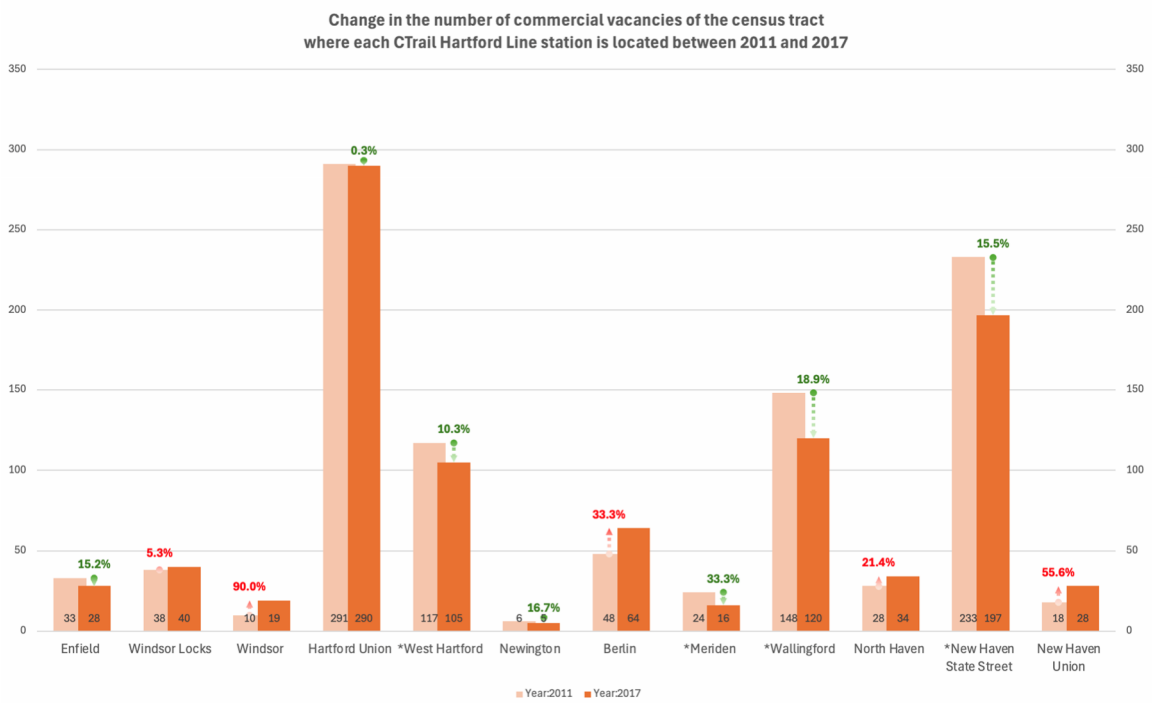

Figure 61 Change in the number of commercial vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

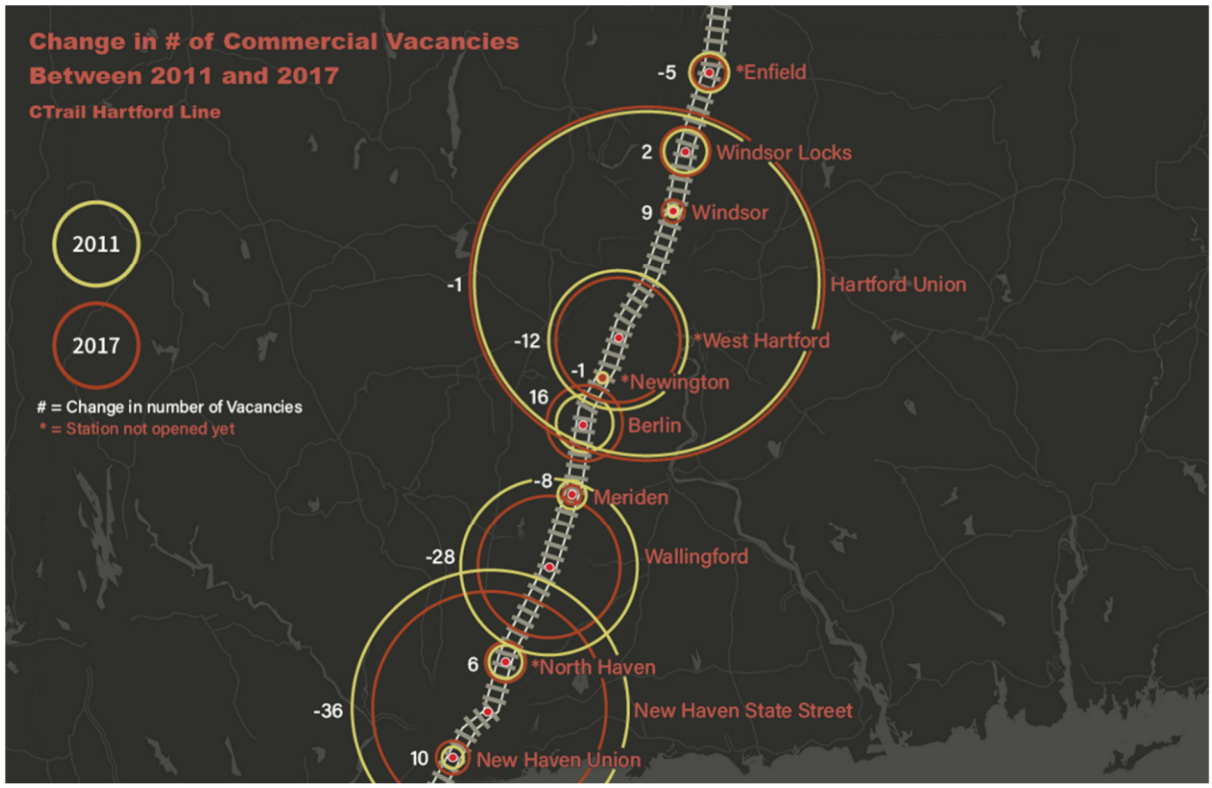

Figure 62 Map of the change in the number of commercial vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

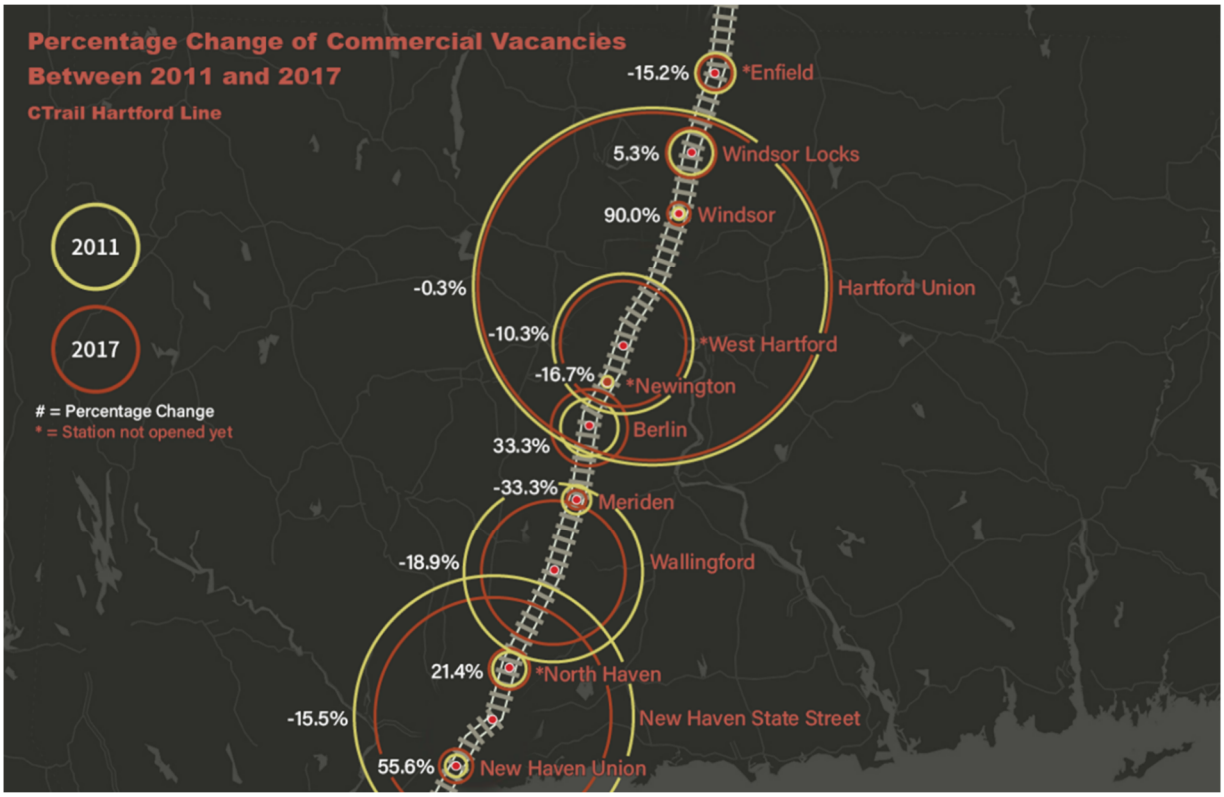

Figure 63 Map of the percentage change of commercial vacancies of the census tract where each CTrail Hartford Line station is located between 2011 and 2017

2.7.4 Insights

The vacancy trends for the census tracts near the Hartford Line stations are generally mixed.

For Meriden, residential vacancies rose in the time frame leading up to the Hartford Line service while many new condominiums were built. This was also at a time when the housing market in the state was slower than it had been more recently. Therefore, it likely took a fair amount of time for all of those new units in Meriden to become absorbed into the local market. It is quite likely that the additional construction of condominiums in Meriden was in anticipation of the Hartford Line beginning service there.

Commercial vacancies rose near some stations, which may have been related to the decline of the retail sector due to Amazon and other online retailers gaining prominence between 2011 and 2017.

For CTfastrak, residential vacancies declined throughout the census tracts near the stations for all locations, after the start of service in 2015. This coincided with the overall statewide downward trend in vacancies from 2015-2020 as shown in the trend graphs in section 3.7.1 above. This is in contrast to many of these same tracts having experienced an increase in residential vacancies during the 2009-2015 period.

In general, another phenomenon may have been at work here, and that was the interplay between vacancies, transit, and real estate prices. Lower commercial vacancies may have implied more job opportunities, which led more people to move in to fill those jobs, which in turn lowered residential

vacancies. Better transit may have made it more enticing for commuters to move into these areas with more job opportunities, as demonstrated in this report by the travel costs savings from riding transit opposed to car ownership. This was the general pattern across commercial and residential vacancies for CTfastrak in the 4 municipalities with stations, between 2015 and 2020.

It is possible that vacancies on the Hartford Line stations did not change in a uniform way because statewide vacancies generally stayed the same from 2011-2017, at around 1.5 to 2%. It is possible that the CTfastrak study showed more uniform vacancy reductions because the data in those phases of the study compared 2020 rates to 2015 rates, and 2020 was an all-time low for vacancies across the board in Connecticut. It is noteworthy that throughout the state in 2015-2020, there was a reduction in vacancies by about 66%. This drop is similar to the findings in the CTfastrak stations' census tract vacancy data.

In sum, the first five years of CTfastrak service were associated with lower residential and commercial vacancies near the stations, while the opposite occurred in the preceding five years. There is more mixed evidence of this association for the Hartford Line, but several municipalities with stations show evidence that proximity to a station was related to lower vacancies. Some of these effects may be attributed to new transit, although it is generally difficult to disentangle the local changes from the statewide trends. But it is also possible that some of the statewide trends are driven by changes in the towns along the Hartford Line and CTfastrak, so again, the directions of these relationships are complicated to pin down precisely.

2.8 Planned and Proposed Development

2.8.1 Task Description

Both the CTfastrak and the Hartford Line projects track planned and proposed development (including commercial and residential). A series of detailed graphics are created to visually represent this data, showcasing the development trends and potential impacts along the transit routes. These infographics enable the exploration of the following hypothesis:

Hypothesis 6: Transit has been associated with additional nearby planned and proposed development.

2.8.2 Methodology

For CTfastrak, the number of planned or proposed real estate developments within ¾ mile of an actual CTfastrak station are used in the infographics. For the CTrail Hartford Line, the number of planned or proposed real estate developments within ¾ mile of an actual Hartford Line station, or within ¾ mile of a future station that was considered as a future station as of the outset of the Hartford Line planning, are included in the infographics below. The data are sourced from municipal economic development agencies and municipal planning and zoning commission meeting minutes.

2.8.3 Infographics

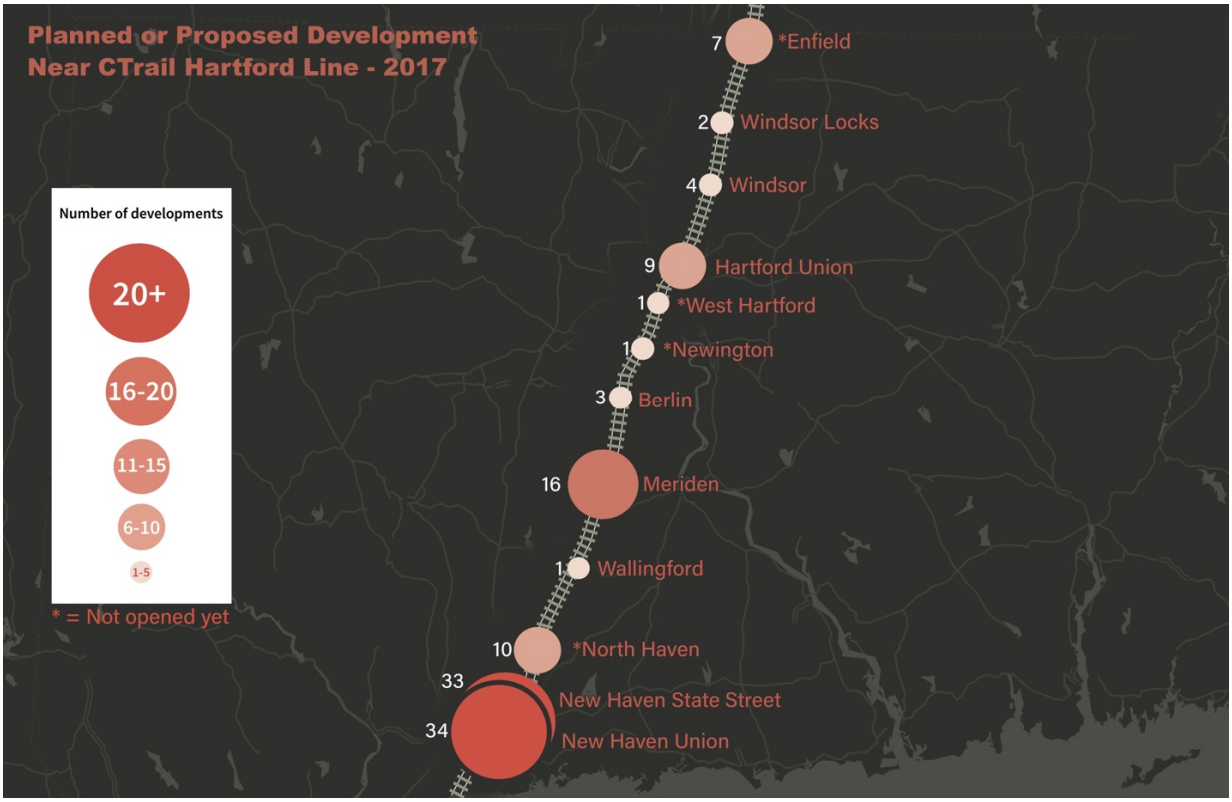

Figure 64 Planned or Proposed Development Near CTrail Hartford Line - 2017

Figure 65 Planned or Proposed Development Near CTfastrak - 2015

Figure 66 Planned or Proposed Development Near CTfastrak - 2020

2.8.4 Insights

CTrail Hartford Line development occurred primarily in New Haven, Meriden, and Hartford. Most of the other municipalities with intermediate stops did not see much development (at least not in the time frame of this phase of the Hartford Line study).

The CTfastrak station in New Britain experienced steady planned/proposed developments both at the time of starting service in 2015 and five years later (in 2020). This consistency is likely due to the central location of the station in New Britain, together with underdevelopment in that area prior to the opening of CTfastrak.

West Hartford's planned/proposed developments near the CTfastrak station declined over this same time period. For West Hartford, there was a large spurt of growth initially, and further new development stalled. However, in more recent years there appears to be less public resistance in West Hartford to additional developments, so it is expected that future phases of this project will reveal the recent additional planned/proposed development in West Hartford.

In contrast, in Hartford there was a notable increase in planned/proposed developments associated with CTfastrak in 2020 compared with 2015. The station's location in the state's capitol city may have led to growth in that neighborhood. These changes in Hartford also occurred at a time when there was additional development planned and proposed near the Hartford Line's Union Station.

Overall, the Hartford Line contributed to development in New Haven, Meriden and Hartford, and CTfastrak was associated with new development in Hartford and New Britain.

2.9 Zoning

2.9.1 Task Description

The latest zoning maps for CTfastrak (with 2020 data) and CTrail Hartford Line (with 2020 and 2023-2024 data) are developed using ArcGIS, to visualize the current zoning distribution along the routes of these two transit systems. This helps in understanding the zoning patterns of areas directly related to the transit routes. Given that the municipalities with CTfastrak service most recent zoning data is for 2020, a visual comparison is made between the 2020 data and the 2014 data from the CTfastrak phase 1. Therefore, it is possible to explore the following hypothesis for the CTfastrak phase 1 and phase 2:

Hypothesis 7: Zoning changes occurred close to transit stations.

For the Hartford Line, there is currently one set of zoning data available post-2018 (the start of the Hartford Line service). Therefore, over time moving forward, it will be possible to visually compare the changes in zoning in the areas near transit, so that one may assess whether there appeared to be any relationship between zoning patterns and the location of transit.

2.9.2 Methodology

The raw geospatial data for this task comes from two sources: the Capitol Region Council of Governments (CRCOG) official website (CRCOG GIS Portal) and the Data and Policy Analysis of the State of Connecticut website (Connecticut CAMA and Parcel Layer). The CRCOG data, from the years 2014 and 2020, are well-organized and specifically include a zoning type field. In contrast, the data from the State of Connecticut's website provide the Connecticut CAMA and Parcel Layer, which include a state use code that has to be mapped to zoning type using the provided mapping table:

State Use	Zoning Type
begin with "R". Like R-1, R2	Residential
"PDD *"	
VCPR	
start with "C", like C-1	Business/Commercial/Office
start with "I", like I-40	Industrial
include "Park"	Resource/Recreation/Public Use
with"/"	Mixed Use

Table 18 Mapping Table of State Use to Zoning Type

Here are the details of data sources used in the zoning analyses:

For the Hartford Line zoning map, 2020 zoning data from the Capitol Region Council of Governments (CRCOG) is used for the following towns: Enfield (future station), Windsor (future station), Windsor Locks, Hartford, West Hartford (future station), Newington (future station), and Berlin. For the remaining towns along the Hartford Line - Meriden,

Wallingford, North Haven (future station), and New Haven (Union Station and State Street Station), the 2023–2024 data from the Connecticut CAMA and Parcel dataset are used. Because the CRCOG data is already well organized as zoning data, the CRCOG data serve as the primary source, and the CAMA Parcel data are used as a supplement.
For the CTfastrak zoning map, both the 2014 and 2020 CRCOG zoning data are used. This allows a comparison of changes over time for the four towns with CTfastrak stations: Hartford, West Hartford, Newington, and New Britain.

ArcGIS Online is used to create the zoning maps below and publish them as web services for easy access and use.

2.9.3 Infographics

The zoning maps for CTfastrak's 4 towns (Hartford, West Hartford, Newington, and New Britain) can be seen below.

An ArcGIS StoryMap (R) has been developed to demonstrate these two zoning maps, which are also separately presented below. This StoryMap includes a sliding bar feature that clearly visualizes how zoning has changed between the years 2014 and 2020 in the four municipalities with CTfastrak service, which can be viewed here:
https://connecticut.maps.arcgis.com/apps/instant/media/index.html?appid=b17ff11ea1cc430d835aad43142cff11

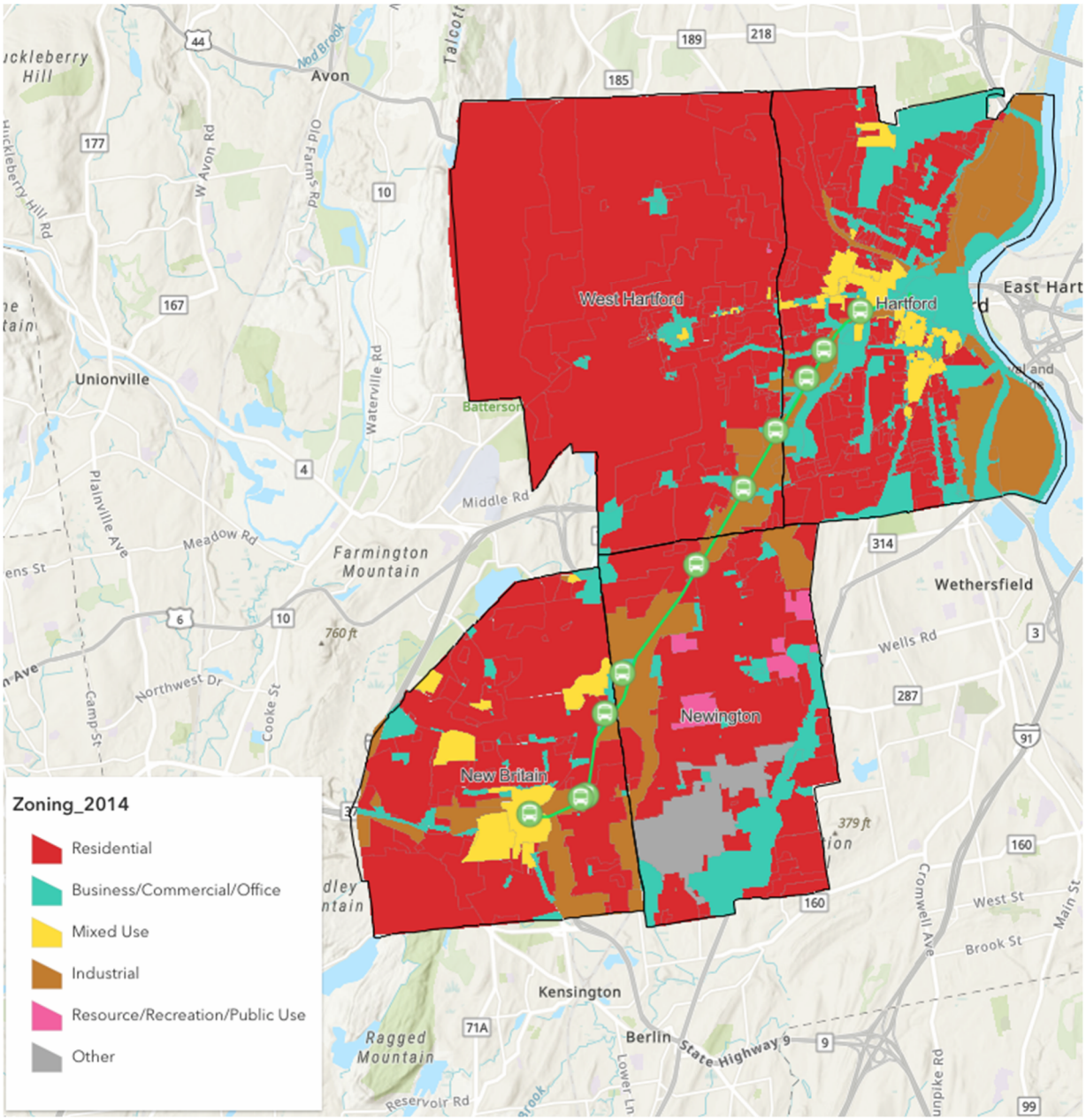

Figure 67 Zoning map along the route of CTfastrak of 2014

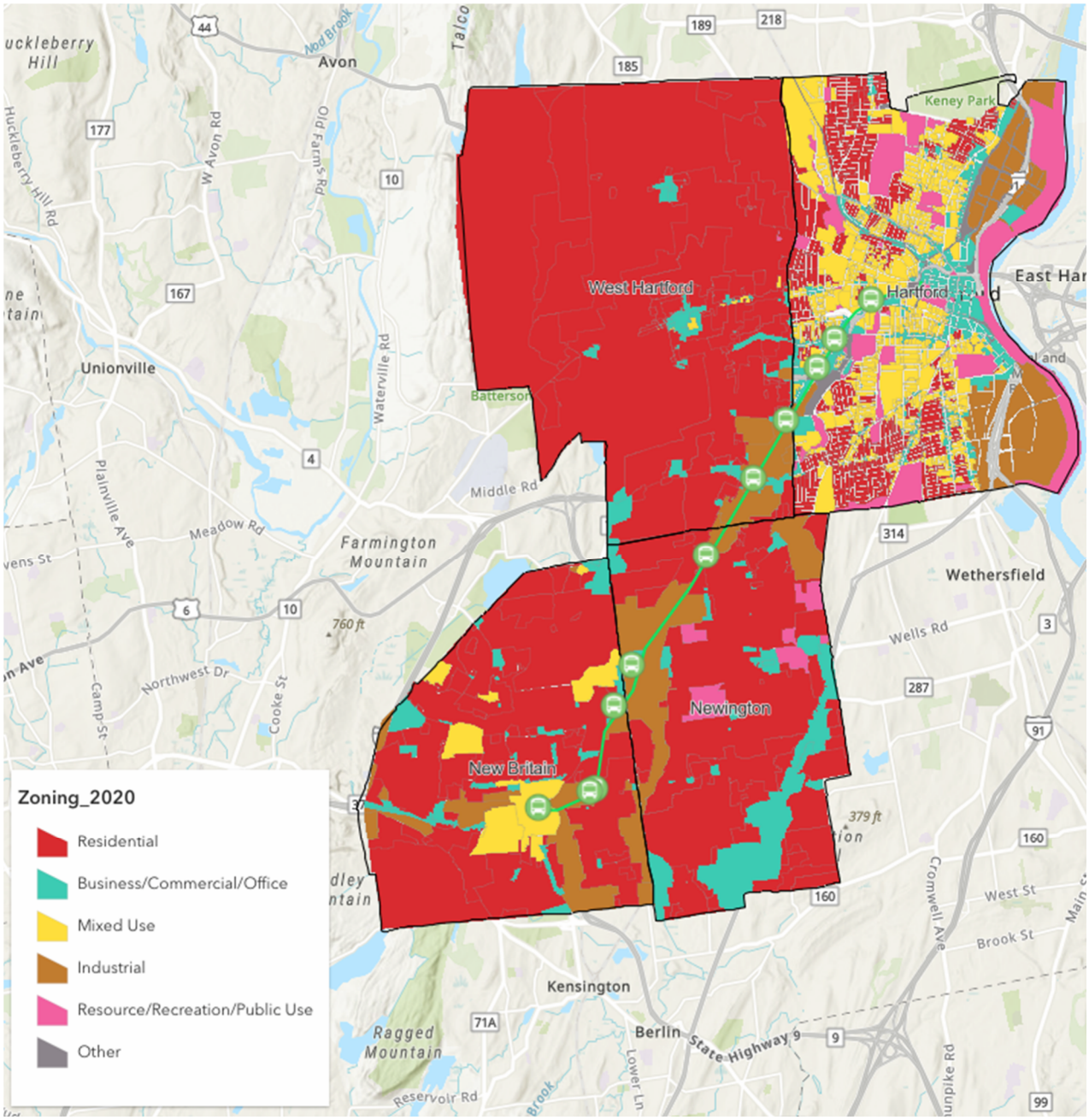

Figure 68 Zoning map along the route of CTfastrak of 2020

In the zoning map below, the zoning details can be seen for the municipalities where there are Hartford Line stations (including both planned and existing stations).

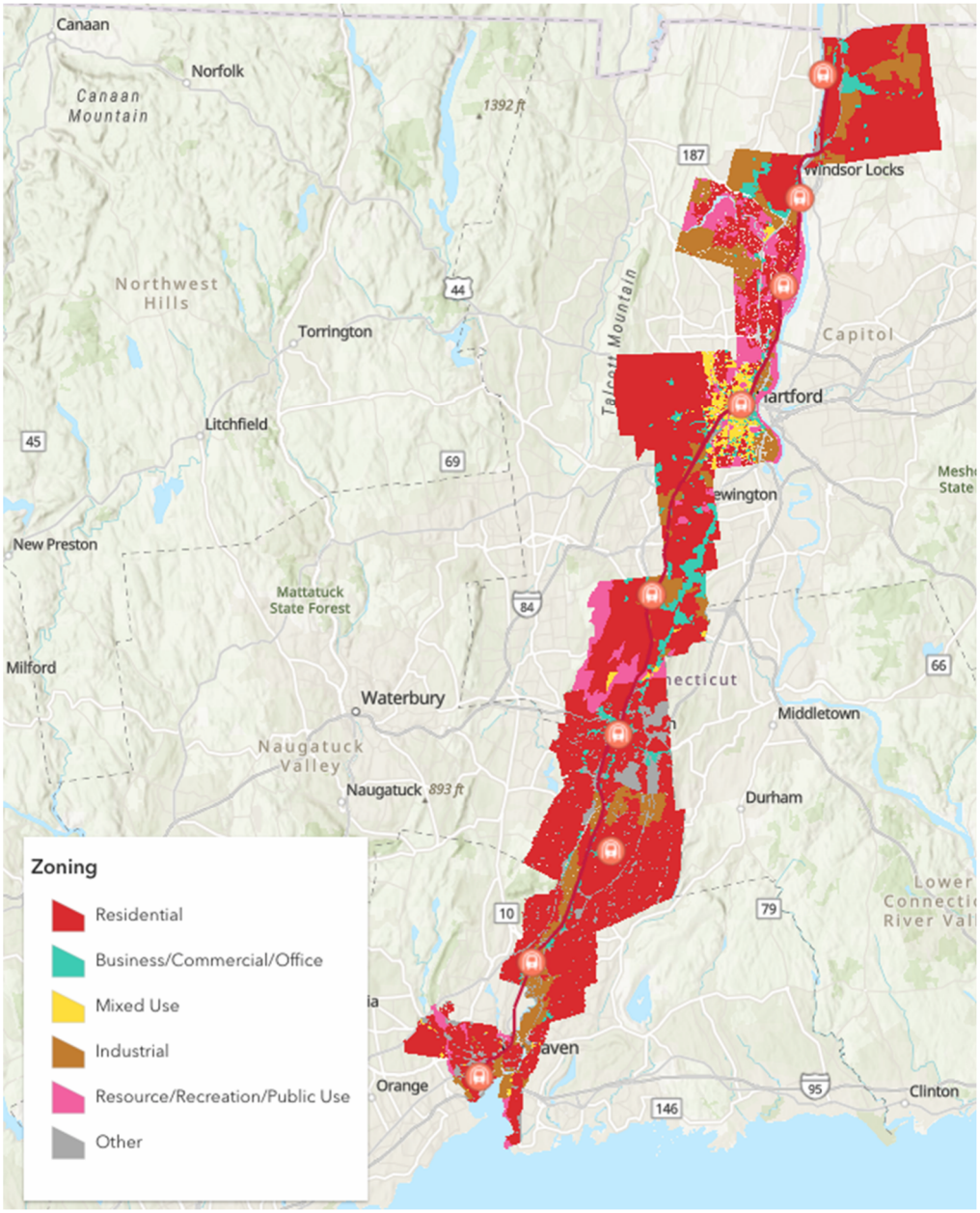

Figure 69 Zoning map along the route of CTrail Hartford Line around 2020

2.9.4 Insights

As described above, insights for changes over time are possible by comparing the zoning maps from phase 1 and phase 2 of the CTfastrak study. The most noticeable changes occurred in Hartford, where in 2020 compared with 2014 there was a shift from business and residential to much more mixed-use zoning, and in the northwest corner of the city where there was a shift from industrial to resource/recreation/public use. In Newington, there was a shift from "other" to residential in the southern part of town. The residential zoning changes in Hartford occurred close to the

Sigourney Street station, while in Newington the zoning changes were relatively far from the stations.

In Hartford, there is some evidence of additional mixed-use zoning occurring near the CTfastrak stations. But overall, across the other 3 municipalities, there is not much evidence to support the hypothesis that CTfastrak has changed zoning patterns near stations, and not enough data are available yet to form conclusions about the Hartford Line's effect on zoning patterns. Given that there are many more municipalities with stations on the Hartford Line than on CTfastrak, the chances of finding zoning changes over time for the former seem more likely than for the latter. But additional zoning data (i.e., later and/or earlier than 2023-24) for the state that stretched from the northern to the southern borders would be needed in order to validate the hypothesis for the Hartford Line.

3 Conclusions and Recommendations

This multi-phase evaluation of CTfastrak and the Hartford Line has provided critical insights into how strategic investments in transit infrastructure can reshape the economic and physical landscapes of urban and suburban communities in Connecticut. These findings not only validate the value of fixed-guideway transit systems but also highlight opportunities for enhancing their long-term impact.

The research demonstrated evidence that proximity to transit has been linked to increased property values, higher property tax revenues, reduced transportation costs, and enhanced development activity. The statistical and causal analyses reinforce the conclusion that transit-oriented development (TOD) is not just a planning concept, but a measurable economic driver with substantial benefits to municipalities, property owners, and commuters alike.

While these benefits tend to be more pronounced around CTfastrak stations than those of the Hartford Line, largely due to the longer period of analysis and the novelty of BRT in the CTfastrak corridor, both systems contribute to more vibrant, accessible, livable, and economically viable communities. The evidence presented also points to areas for improvement and deeper investigation—particularly in zoning reform and comprehensive land use planning.

Policy Recommendations Include:

1. Continue to Expand and Prioritize TOD Corridors:

Municipalities and the state should continue to prioritize development around existing and planned transit corridors. Special emphasis should be placed on updating zoning codes more frequently to permit analysis of the extent of higher density, mixed-use developments within 0.75 miles of transit stations. Such zoning policies should be designed to support walkability, reduced car dependency, and increased residential and commercial density near transit hubs. Continued exploration of the benefits from connecting with the East-West rail initiative from Boston to Springfield, Massachusetts could further enhance the property values in the north-central parts of Connecticut. This greater connectivity could capitalize additional access benefits in local real estate prices.

2. Enhance Data Collection and Performance Monitoring:

CT DOT should consider continuing an ongoing monitoring framework to evaluate TOD effectiveness over time. This includes tracking changes in property values, tax revenues, vacancy rates, and demographic shifts. With real-time and historical data, CT DOT and local governments can make evidence-based decisions for future expansions and policy modifications. This is particularly important and relevant because the prior phases of research all ended in 2020. The time frame during and following the Covid-19 pandemic each saw very different transit ridership patterns and real estate trends in the state, than during the pre-2021 time periods covered in the earlier phases of the study.

3. Leverage Federal Funding:

Given the $105 million in federal investment recently secured by Connecticut for the Hartford Line upgrades, the state could enhance its ability to encourage further transit improvements by continuing to pursue additional funding opportunities. A robust portfolio of success stories, backed by data and visual analytics similar to the infographics above, can be used to advocate for expanded federal support and demonstrate the effectiveness of transit as an engine for economic revitalization and continued growth.

In conclusion, the findings from this project underscore the transformative potential of TOD in Connecticut. When paired with thoughtful policy and planning, investments in public transit can be a powerful tool for catalyzing real estate development, supporting local economies, and enhancing quality of life for residents. Considering these policy recommendations will help CT DOT and its partners build on existing momentum and ensure that Connecticut's transit infrastructure continues to drive growth.