

Peer Systems Review

For Domestic and International
Peer Systems

Massachusetts Department of Transportation
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November 9, 2018



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Lessons Learned from the Peer Systems Review

How We are Using Information from the Peer Systems Review

Based on findings from the Peer Systems Review, the Rail Vision project may consider one or more alternatives that would provide:

- Full and partial system electrification
- Different solutions for different components of the rail system
- Different solutions for high-density and low-density areas
- Time-based transfers in addition to one-seat rides
- Increased frequency throughout the day
- Clockface headways
- New connections to the Boston termini



MassDOT and the MBTA wish to learn from peer commuter rail systems in the U.S. and internationally how other agencies have optimized their rail networks to serve passenger demand efficiently and effectively. In spring 2018, the Rail Vision team conducted a desktop review of 16 domestic and international commuter rail systems. The 16 systems reviewed are illustrated in the map on this page. The systems were evaluated for their applicability to the MBTA’s commuter rail region and for ideas that could potentially benefit future service planning for the Rail Vision study. The full findings from this analysis are provided over the pages that follow. The bullets below provide some of the key takeaways from this effort and describe applicability to the Rail Vision:

- **Fleet Composition:** Very few peer systems operate diesel-powered trains alone, with only two other systems (Caltrain and Metrolink) relying solely on diesel-powered locomotives. The majority (ten) operate a fully electrified system, with the remaining four systems operating both diesel-powered trains and electric-powered trains. None of the international systems rely on diesel-powered technology at this time. The most recent peer system to commit to purchasing electric trains is GO Transit in Toronto, with environmental benefits cited as a key factor in this decision. Two peer systems (SEPTA and London Overground) operate a similar sized fleet to the MBTA and two (Metrolink – lower frequencies, and Caltrain – single line) operate smaller fleets; all others operate a larger fleet than the MBTA. **Based on the experience of all peer agencies (with the exception of Caltrain and Metrolink), the Rail Vision project will consider full and partial electrification of the system.**
- **Size of Service Area:** The MBTA’s service area is large compared to its peer systems and the MBTA operates more routes than nearly all other peer systems. Although agencies do not consistently report the size of their service area, and therefore size of service area is not included in the key statistics table at the end of this document, the MBTA operates more commuter rail lines with a longer network of route miles than most of the systems reviewed. NJ Transit is a notable exception, providing service in both New York City and Philadelphia. GO Transit in Toronto supplements its commuter rail network with buses (branded in the same way as the commuter rail trains) by running them in lieu of train service during the midday and to extend the reach of commuter rail past the terminal stations at a lower cost. **Because the MBTA operates in a more extensive service area than most of the peer systems reviewed, the Rail Vision project may consider providing different services across lines and within lines.**
- **Market Served:** Most peer systems operate service in higher-density areas, with only four peer systems having a lower population within one mile of stations than the MBTA despite the MBTA having a longer network of route miles than most of the systems reviewed. The majority of international systems in particular serve greater population within one mile of stations despite serving smaller urban areas. The transit mode share is also greater in international peer system urban areas, while the transit mode share in the Boston urban area is similar to other urban areas in the U.S. with the exceptions of New York (31 percent) and Los Angeles (5 percent). **Consistent with service operated by international peer systems and domestic peer systems such as SEPTA and Caltrain, the Rail Vision project may consider alternatives that focus on service improvements to high-density areas.**
- **Transfers:** Many of the systems reviewed, including LIRR and NJ Transit in the greater NYC region, and the European systems such as London Overground and Berlin S-Bahn, operate on a time-based transfer model for passengers on some lines traveling to/from the downtown area. Instead of focusing on the provision of a one-seat ride, these peer systems assume transfers will be made, and thus work to minimize the wait time when transferring between trains. In addition, some systems (including MNR and NJ Transit) provide zonal express service, requiring transfers to reach intermediate stations within a line, **Consistent with MNR, LIRR, NJ Transit, London Overground, and Berlin S-Bahn, the Rail Vision project may consider alternatives that require a time-based transfer to travel to/from downtown Boston or intermediate stations within each line.**

- **Operating Efficiencies and Farebox Recovery:** Operating efficiencies are reported in a number of ways and can be difficult to capture for the international peer systems. One metric that was collected for most systems was the operating cost per passenger trip, and those numbers varied dramatically between systems, ranging from \$1.75/trip in Berlin to \$15.85/trip in Los Angeles. In general, the international systems operated more efficiently than the U.S. systems, and at \$11.93/trip, MBTA operates on par with many of the U.S. systems. Of note, however, is the exceptional efficiency of SEPTA with operating expenses of \$7.40/trip, and of Caltrain with operating expenses of \$6.11/trip (although on a single line). The farebox recovery rate compares these operating expenses to fare revenues. The MBTA's commuter rail system operates at a lower farebox recovery rate (49 percent) than most of the systems reviewed. The highest farebox recovery rates were observed in the San Francisco Bay Area (Caltrain, at 79 percent), and in Singapore (101 percent). At 49 percent, MBTA ranked 6th out of the 8 domestic systems and 12th out of the 17 systems in total (7 domestic, 9 international, and the MBTA). Interestingly, however, the systems with the lowest farebox recovery rates both recover less than \$4 for every \$10 invested – Paris's system observes a 38 percent farebox recovery and Melbourne's Metro observes a 27 percent farebox recovery. **The Rail Vision project may consider alternatives that focus on service improvements to high-density areas, as SEPTA, Caltrain, and most international systems operate more efficiently and typically serve higher-density areas as noted in the description of markets served above. Although the MBTA operates at a lower farebox recovery rate than most of the systems reviewed, these differences may derive from policy regarding fares and public subsidy, which is currently under review as part of another study.**
- **Frequency:** Most peer systems operate more frequent service than the MBTA's commuter rail system. The average peak hour frequency of the most frequent peer system lines is every 12 minutes, and the average off-peak frequency is every 32 minutes (for comparison, the most frequent MBTA commuter rail line peak hour frequency is 20 minutes and off-peak frequency is 60 minutes). All international systems outside North America operate at peak hour frequencies of at least trains operating every 10 minutes, with many operating trains every 20 minutes or better in the off peak. Many of these international systems operate service on consistent, clockface headways throughout the day. **All international systems provide a model for operating higher-frequency peak and off-peak service, and many of the international systems provide consistent, clockface headways throughout the day. The Rail Vision project will consider alternatives that provide high-frequency service during the peak and throughout the day similar to international systems, MNR, LIRR, NJ Transit, and SEPTA. The Rail Vision project will also incorporate clockface headways into all alternatives, consistent with typical operations in most international systems.**
- **Number of Terminals:** Boston has two stub end terminals in the Central Business District (CBD) of downtown Boston – North Station and South Station. The peer reviews evaluated how this compares to other cities, with the result varying – from Paris having none and operated as run-through service in the CBD, to SEPTA operating a through-running system with three central terminals, to five terminals in Melbourne, all encircling the CBD. What is interesting is that many of the systems reviewed operate through service between terminals, or offer creative solutions to provide some rail service between central terminals. For example, in Manchester, England the agency built a light rail system to link the 2 central terminal stations and built a physical rail link on the outskirts to allow services from the North to connect into the South). **Based on the peer review, the Rail Vision project may include alternatives that provide a range of connections to the two Boston termini, either with a through-running service (i.e., North-South Rail Link) or via other solutions.**

Key Reporting Statistics from the Desktop Review of Peer Systems^{1,2}

City/Region Served	Population within 1 Mile of Stations	Urban Area Size (Sq. Miles)	Transit Mode Share	No. Routes	No. Route Miles	Fleet Power Source*	No. of Vehicles in Fleet	Peak Frequency	Off-Peak Frequency**	Operating Expenses/ Passenger Trip***	Farebox Recovery	No. of Central Terminals
Boston	1,716,012	1,873	13%	14	388	Diesel	480	20	60	\$ 11.93	49%	2
1 NYC - MNR	2,527,227	3,450	31%	5	273	Electric	1,206	5	20	\$ 13.43	60%	1
2 NYC - LIRR	2,766,043	3,450	31%	11	319	Electric	1,185	10	30	\$ 12.69	55%	1
3 NYC - NJ Transit	3,292,830	3,450	31%	12	501	Both	1,350	15	30	\$ 11.25	57%	2
4 Philadelphia	5,441,567	1,981	9%	13	224	Electric	404	15	30	\$ 7.40	57%	3
5 Chicago	2,946,626	2,443	12%	11	488	Both	1,188	20	90	\$ 10.00	47%	4
6 Los Angeles	1,060,244	1,736	5%	7	412	Diesel	258	30	120	\$ 15.85	39%	1
7 SF Bay Area	687,870	524	17%	1	77	Diesel	134	20	45	\$ 6.11	79%	2
8 Toronto	1,618,941	243	23%	7	341	Both	725	15	30	\$ 8.80	62%	1
9 Barcelona	Uncertain	160	20%	9	290	Electric	Uncertain	10	30	\$ 3.61	57%	3
10 Paris	6,831,468	933	20%	13	900	Electric	1,182	5	5	\$ 8.03	38%	0
11 London	3,429,647	606	44%	9	103	Electric	425	7.5	10	\$ 2.18	78%	2
12 Manchester	2,022,004	211	14%	10	189	Both	1,062	15	15	\$ 8.86	61%	3
13 Berlin	2,881,970	476	39%	15	203	Electric	650	10	15	\$ 1.75	71%	3
14 Melbourne	2,274,090	3,857	35%	8	298	Electric	866	10	20	\$ 10.75	27%	5
15 Hamburg	1,004,032	292	18%	6	91	Electric	Uncertain	10	10	Uncertain	Uncertain	Uncertain
16 Singapore	5,085,891	278	Uncertain	8	131	Electric	Uncertain	2	5	Uncertain	101%	0

Notes:

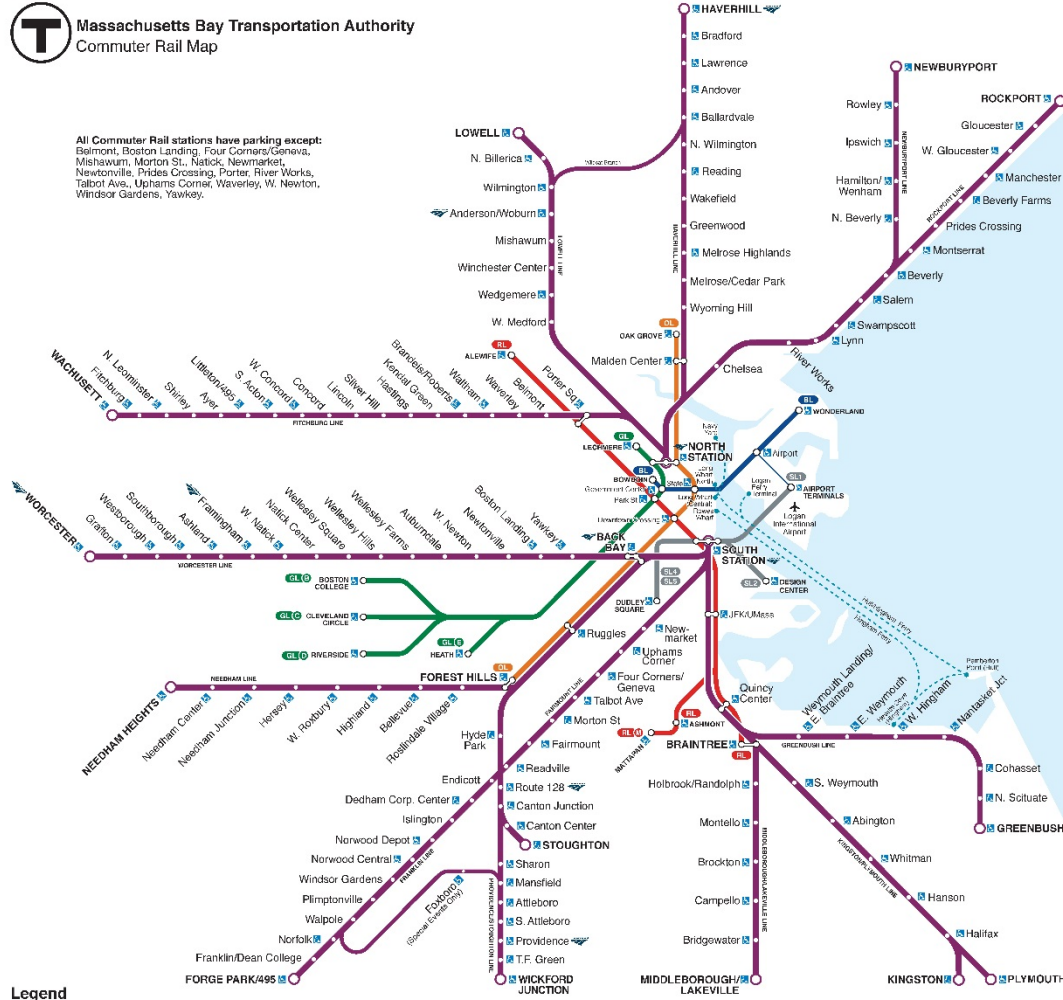
- * Use of the term "both" represents that the agency operates both diesel-powered trains and electric-powered trains.
- ** Off-peak frequency varies by system and by line. What is represented in this table is the best off-peak frequency operated for all systems.
- *** Operating expenses for international systems should be viewed with caution because they are not reported in a reliable manner and were converted into US dollars.

¹ Since the peer review relies on a wide range of sources, it is not always possible to obtain data on the precise same geographic or reporting basis. Metrics used throughout the peer review make use of the best data publicly available for each individual metric. However, in some cases it is not always possible to directly compare either between metrics or between systems.

² Note that due to the range of different sources necessarily used due to data limitations in the following sections, the maps and the statistics presented are not always entirely comparable.

T Massachusetts Bay Transportation Authority
Commuter Rail Map

All Commuter Rail stations have parking except:
Belmont, Boston Landing, Four Corners/Geneva,
Mishawum, Morton St., Natick, Newmarket,
Newtonville, Prides Crossing, Porter, River Works,
Talbot Ave., Uphams Corner, Waverley, W. Newton,
Windsor Gardens, Yawkey.



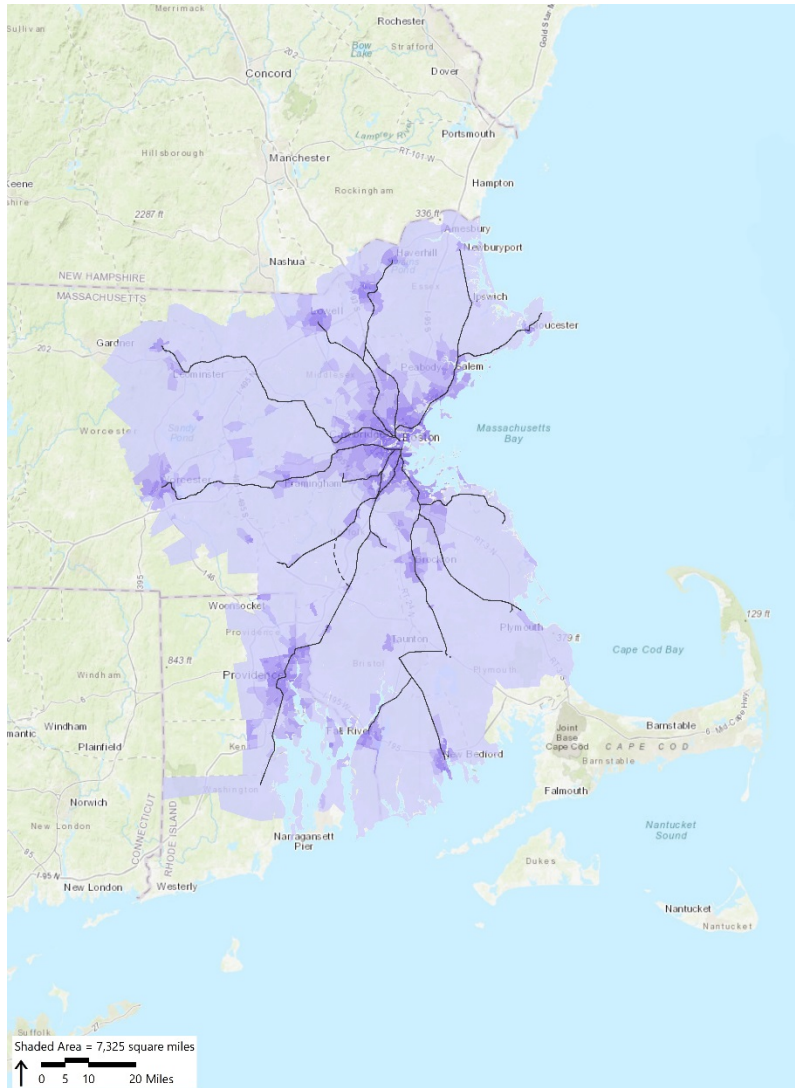
Legend

COMMUTER RAIL LINES	RED LINE	SILVER LINE and branches	Transfer station	Free Logan Airport shuttle bus	Customer Communications & Travel Info 617-222-3200, 1-800-392-6100, TTY 617-222-5149, www.mbta.com
Under Construction	MATTAPAN LINE	ORANGE LINE	Accessible station All MBTA and Transport bus and ferry stations are accessible.	Amtrak service	MBTA Transit Police: 911 TTY 617-222-1200
Terminus Station	BLUE LINE	GREEN LINE and branches	FERRY	Elevator/escalator updates: 800-392-6100	

© May 2017 v.30 Not to scale

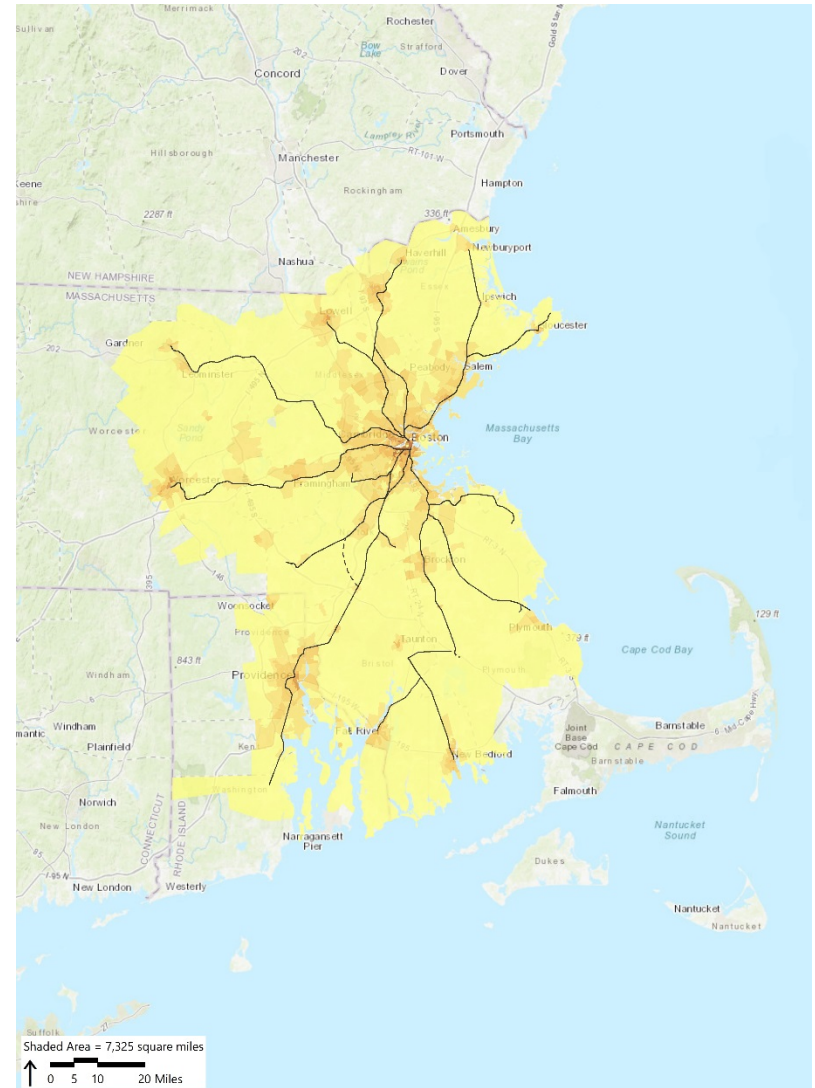
Source Information: MBTA, Commuter Rail Map

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Boston Employment Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Massachusetts Bay Transportation Authority (MBTA) Boston, Massachusetts



Demographics and Land Use

INFORMATION	MBTA SOURCE	MBTA COMMUTER RAIL
Major City Served	N/A	Boston
Population within 1 Mile of Stations		1,716,012
Name of UZA	NTD ¹	Boston, MA-NH-RI
Size of UZA (sq. miles)	NTD	1,873
Population of UZA	NTD	4,181,019
Jobs in Area*	BLS	2,677,320
Average Wage in Area*	BLS	\$64,080
Peak Hours Spent in Congestion per Commuter	Inrix	60
Major Geographic Features	System Map ²	Boston Harbor Charles River
Mode Split (Drove Alone)* ³	Census	67%
Mode Split (Transit)*	Census	13%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ The National Transit Database (NTD) compiles statistics and information for domestic transit systems. A glossary of terms used by the NTD is available online at: <https://www.transit.dot.gov/ntd/national-transit-database-ntd-glossary>.

² Massachusetts Bay Transportation Authority, Maps, <https://mbta.com/maps>.

³ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



Massachusetts Bay Transportation Authority (MBTA) Boston, Massachusetts



System Characteristics

INFORMATION	MBTA SOURCE	MBTA COMMUTER RAIL
Number of Lines	Industry Knowledge	14
Length of Longest Line (miles)	Industry Knowledge	63
Number of Route Miles	NTD (Derived)	388
Number of Track Miles	NTD	697
Number of Stations	NTD	138
Percent Stations That are Accessible	NTD (Derived)	75%
Annual Unlinked Trips	NTD	33,830,904
Percent of Agency Unlinked Trips	NTD (Derived)	8%
Number of Central Terminals	System Map	2 ⁴
Central Terminals in Relation to CBD	System Map	Both in CBD
On-Time Performance (System-Wide)	MBTA Dashboard ⁵	89% (2017)
Peak Line Frequency (Most Frequent/Other)	MBTA Schedules ⁶	20 minutes / 25-50 minutes
Off-Peak Line Frequency (Most Frequent/Other)	MBTA Schedules	40 minutes / 1-2 hours

⁴ This considers North Station and South Station central terminals. This does not consider Back Bay Station a terminal, although it serves a large proportion of the ridership for commuter rail lines on the south side of the system.

⁵ Massachusetts Bay Transportation Authority, Performance Dashboard, <http://www.mbtackontrack.com/performance/index.html#/download>.

⁶ Massachusetts Bay Transportation Authority, schedules effective November 20, 2017, available at <https://www.mbta.com/schedules/commuter-rail>.



Massachusetts Bay
Transportation Authority (MBTA)
Boston, Massachusetts



Operating Characteristics

INFORMATION	MBTA SOURCE	MBTA COMMUTER RAIL
Annual Operating Expenses	NTD	\$403,654,786
Farebox Revenues	NTD	\$198,331,440
Farebox Recovery	NTD	49.1%
Fare Range (Single One-Way Trip) ⁷	MBTA Fare Chart ⁸	\$2.25 - \$12.50
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93

Fleet Characteristics

INFORMATION	MBTA SOURCE	MBTA COMMUTER RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)
Number of Vehicles in Fleet	NTD	480
Percent Spare Vehicles	NTD (Derived)	12.3% ⁹
Average Vehicle Age (Years)	NTD	23.0
Power Source(s)	NTD	Diesel
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800 ¹⁰

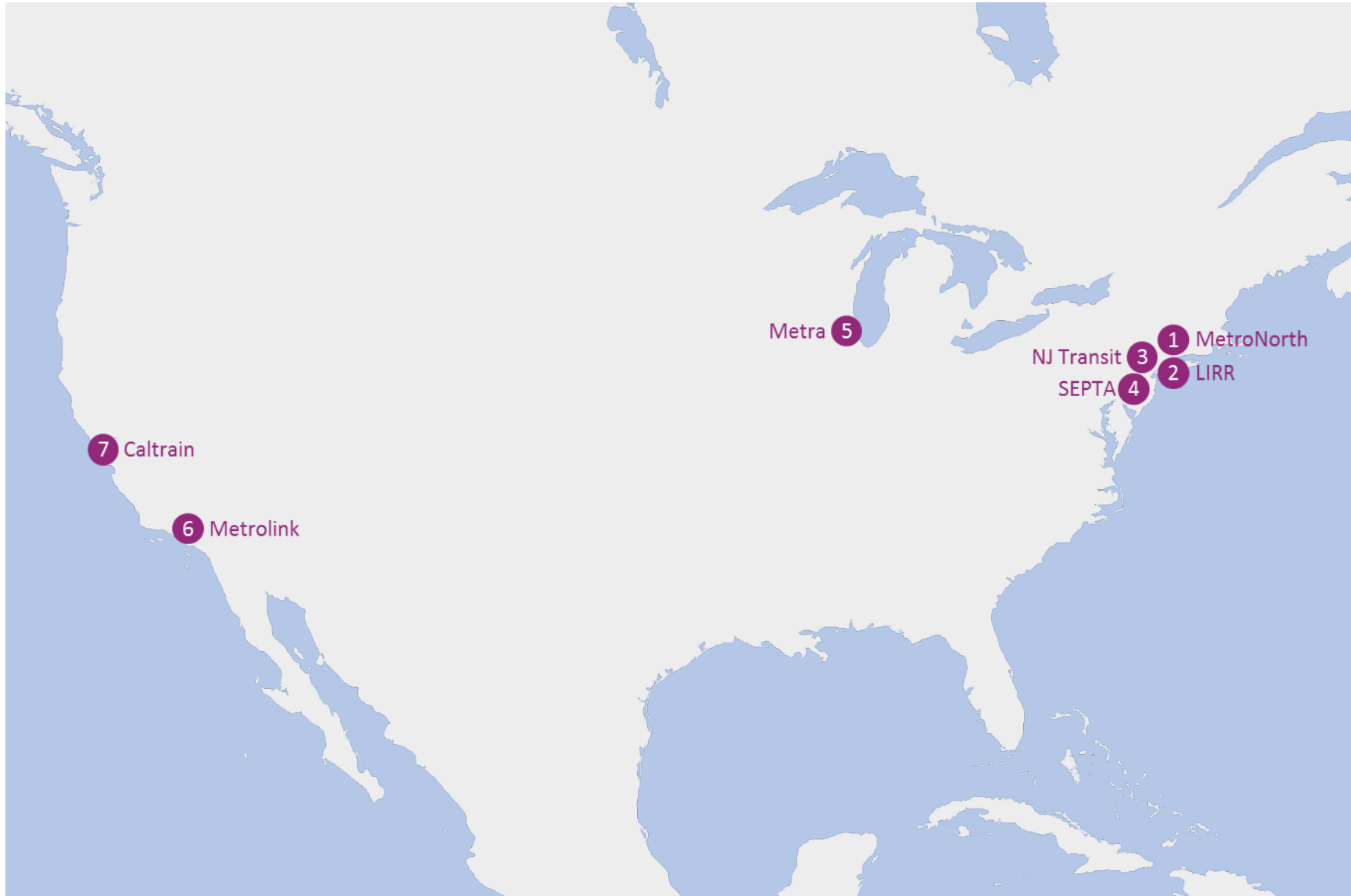
⁷ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

⁸ Massachusetts Bay Transportation Authority, "Commuter Rail Fare Zones," <https://www.mbta.com/fares/commuter-rail/zone>.

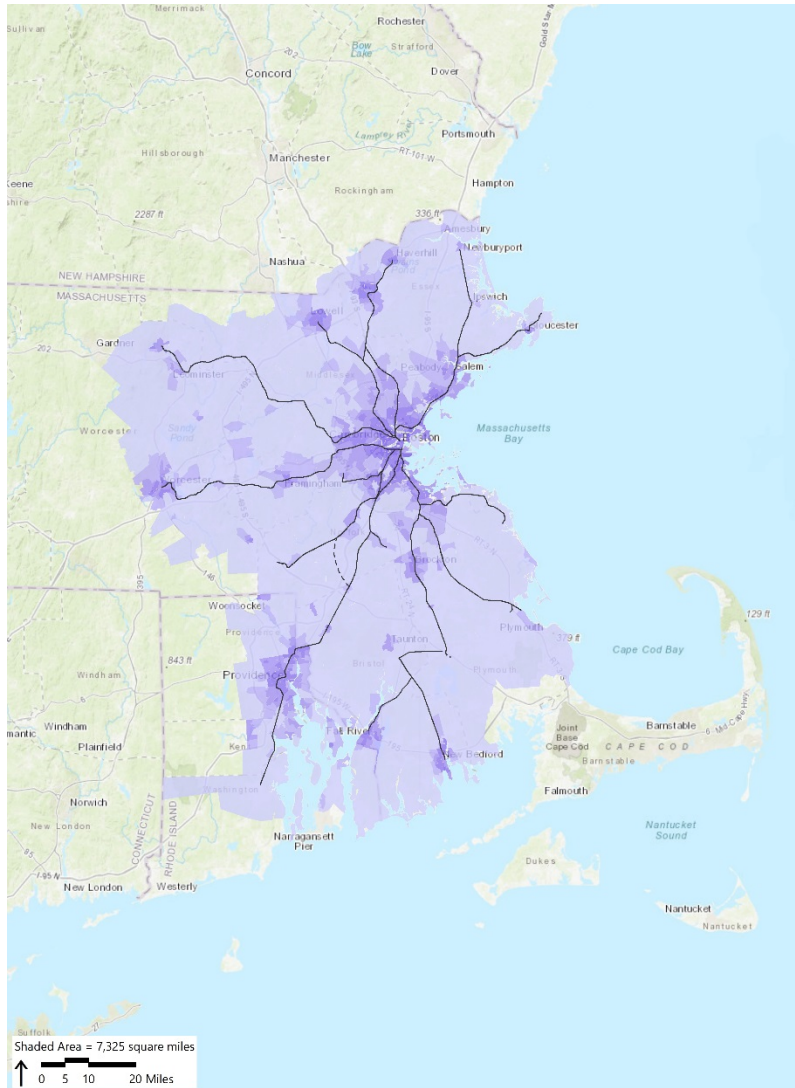
⁹ The MBTA maintains a 28% diesel locomotive spare ratio, 20% cab spare ratio, and 11% trailer spare ratio per data made available by Keolis Commuter Services, Inc.

¹⁰ Approximate average, based on equipment cycles.

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT LONDON SEPTA METRA METROLINK CALTRAIN
MELBOURNE BERLIN MANCHESTER CHESTER

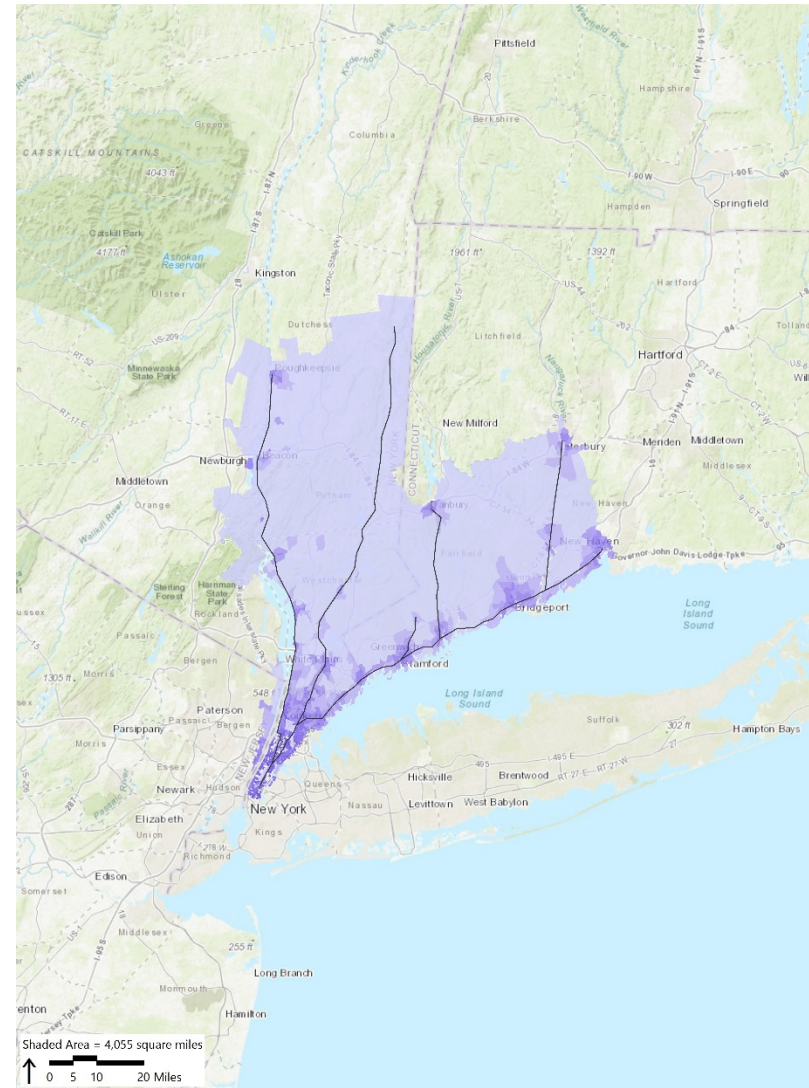


Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

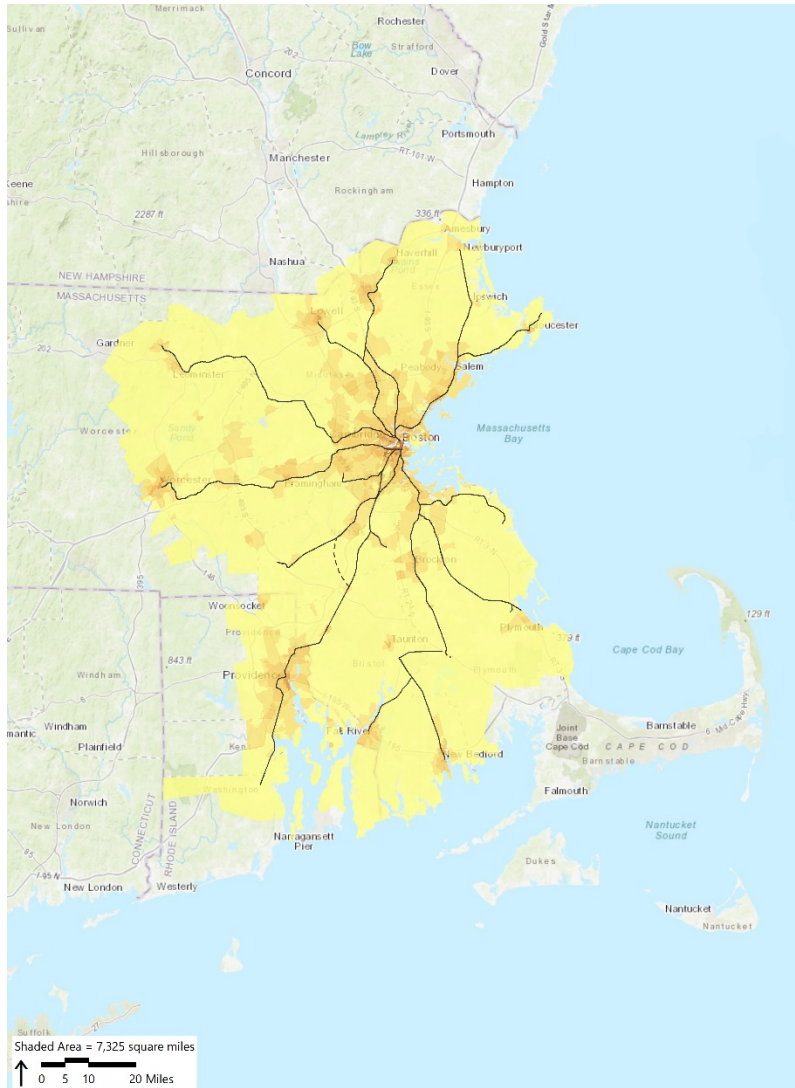
New York City Population Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://www.baruch.cuny.edu/confluence/display/geoportal/NYC+Mass+Transit+Spatial+Layers>

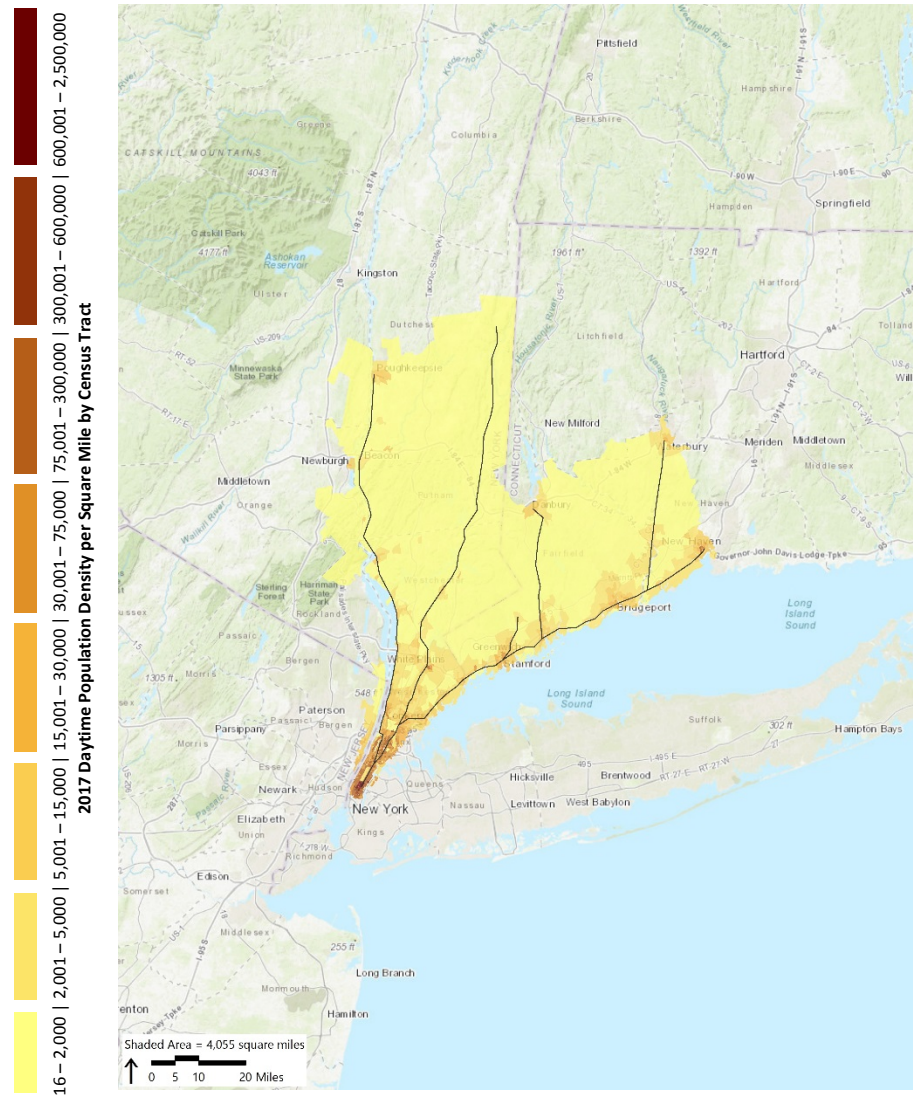
MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

New York City Employment Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://www.baruch.cuny.edu/confluence/display/geoportal/NYC+Mass+Transit+Spatial+Layers>

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Metro-North Railroad

New York and Connecticut



Metro-North Commuter Railroad (Metro-North Railroad, or MNR) offers high-frequency service (both during peak and off-peak periods) connecting Connecticut and southern New York with New York City, which has the greatest population and employment density of all the U.S. cities reviewed. MNR operates mainly Electric Multiple Units (EMUs). The system has over two and a half times the ridership of the MBTA, and operates with a high on-time performance. MNR operates the majority of its service but has an agreement with NJ Transit to operate its Port Jervis and Pasack Valley lines.

Demographics and Land Use

INFORMATION	MNR SOURCE	MBTA COMMUTER RAIL	MNR
Major City Served	N/A	Boston	New York City
Population within 1 Mile of Stations	Esri	1,716,012	2,527,227
Name of UZA	NTD	Boston, MA-NH-RI	New York-Newark, NY-NJ-CT
Size of UZA (sq. miles)	NTD	1,873	3,450
Population of UZA	NTD	4,181,019	18,351,295
Jobs in Area*	BLS	2,677,320	9,169,850
Average Wage in Area*	BLS	\$64,080	\$61,790
Peak Hours Spent in Congestion per Commuter	Inrix	60	91
Major Geographic Features	System Map ¹	Boston Harbor Charles River	Long Island Sound Hudson River East River Harlem River New Jersey Border
Mode Split (Drove Alone)* ²	Census	67%	50%
Mode Split (Transit)*	Census	13%	31%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ Metro-North Railroad, System Map, <http://web.mta.info/mnr/html/mnrmap.htm>.

² This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

TORONTO
 MBTA
 LIRR
 MNR
 CATALUNYA
 PARIS
 NJ TRANSIT
 SEPTA
 METRA
 METROLINK
 BERLIN
 MANCHESTER
 CALTRAIN
 MELBOURNE



Metro-North Railroad

New York and Connecticut



System Characteristics

INFORMATION	MNR SOURCE	MBTA COMMUTER RAIL	MNR
Number of Lines	System Map	14	5 ³
Length of Longest Line (miles)	MNR Schedules ⁴	63	95
Number of Route Miles	NTD (Derived)	388	273
Number of Track Miles	NTD	697	808
Number of Stations	NTD	138	112
Percent Stations That are Accessible	NTD (Derived)	75%	41%
Annual Unlinked Trips	NTD	33,830,904	86,297,511
Percent of Agency Unlinked Trips	NTD (Derived)	8%	99%
Number of Central Terminals	System Map	2	1 ⁵
Central Terminals in Relation to CBD	System Map ⁶	Both in CBD	1 in CBD
On-Time Performance (System-Wide)	MTA ⁷	89% (2017)	94% (2017)
Peak Line Frequency (Most Frequent/Other)	MNR Schedules	20 minutes / 25-50 minutes	5 minutes / 10-30 minutes
Off-Peak Line Frequency (Most Frequent/Other)	MNR Schedules	40 minutes / 1-2 hours	15 minutes / 20 minutes-3 hours

³ Statistics include Port Jervis and Pasack Valley Lines, which are shown in NJ Transit map as they are operated by NJ Transit.

⁴ Metro-North Railroad, schedules effective March 2017, available at <http://web.mta.info/mnr/html/planning/schedules/>.

⁵ This includes Grand Central Terminal only. The Port Jervis and Pasack Valley Lines have a terminal at Hoboken, requiring a transfer at Secaucus Junction to travel to/from New York City.

⁶ This assumes that Manhattan represents the CBD.

⁷ Metropolitan Transportation Authority, "Meeting of the Metro-North and Long Island Committees," February 2018.



Metro-North Railroad

New York and Connecticut



Operating Characteristics

INFORMATION	MNR SOURCE	MBTA COMMUTER RAIL	MNR
Annual Operating Expenses	NTD	\$403,654,786	\$1,158,814,834
Farebox Revenues	NTD	\$198,331,440	\$694,640,173
Farebox Recovery	NTD	49.1%	59.9%
Fare Range (Single One-Way Trip) ⁸	MNR Fare Charts ^{9,10}	\$2.25 - \$12.50	\$2.75 - \$26.25
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$16.65
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$13.43

Fleet Characteristics

INFORMATION	MNR SOURCE	MBTA COMMUTER RAIL	MNR
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	Internal (MTA)
Number of Vehicles in Fleet	NTD	480	1,206
Percent Spare Vehicles	NTD (Derived)	12.3%	3.5% ¹¹
Average Vehicle Age (Years)	NTD	23.0	14.7
Power Source(s)	NTD	Diesel	Electric ¹²
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	800 ¹³

⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

⁹ Metropolitan Transportation Authority, "Hudson and Harlem Line Fares," http://web.mta.info/mnr/html/planning/faresMar2017/hhfares_mar2017.html.

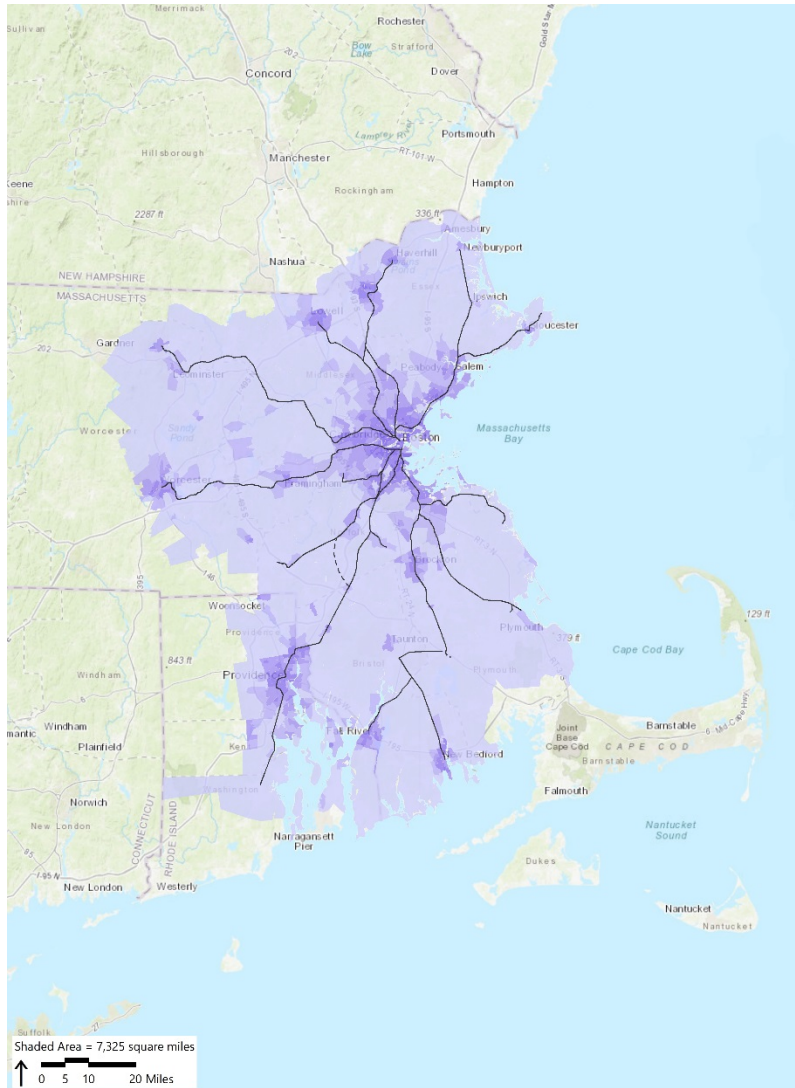
¹⁰ Metropolitan Transportation Authority, "Select Intermediate Fares to Stamford," http://web.mta.info/mnr/html/fares_CT/170101fares-stamford.htm.

¹¹ Metro-North Railroad maintains spare ratios of 18% for diesel locomotives, 31% for trailers, 11% for cabs, 15% for M2/M8 EMUs, 17% for M3/M7 EMUs, and 26% for dual-mode locomotives, per Metro-North Railroad "Equipment Fleet Requirements" (note that these exceed the spare ratio derived from NTD data).

¹² MNR operates mainly EMUs. The Waterbury Branch and the northern portion of the Harlem Line operate diesel vehicles. The Danbury Branch and the northern portion of the Hudson Line operate dual mode locomotives.

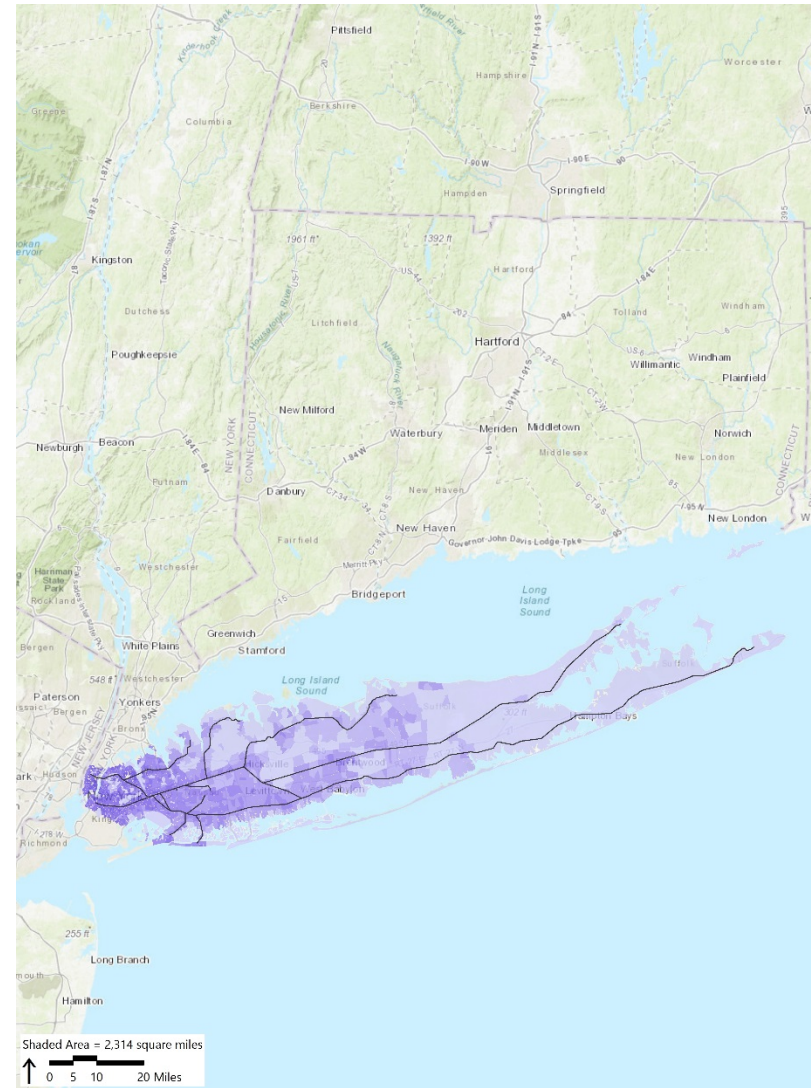
¹³ Assumes a typical train consists of 8 single-level EMU vehicles.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

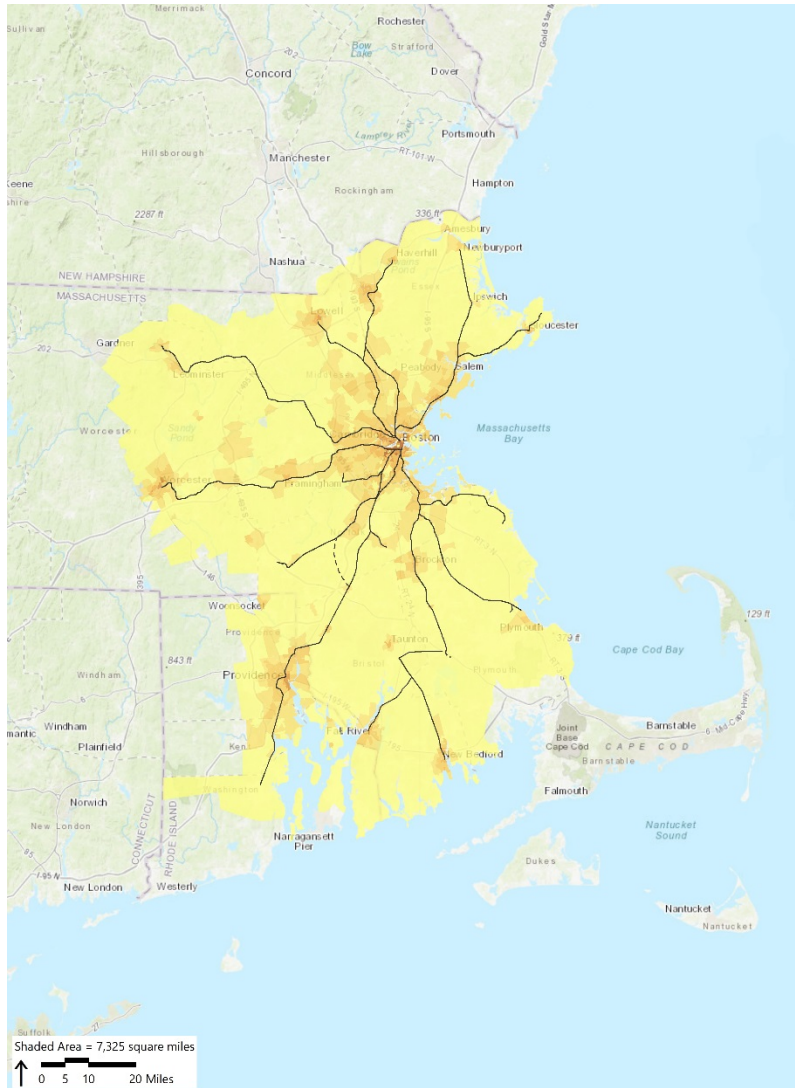
Long Island Population Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://www.baruch.cuny.edu/confluence/display/geoportal/NYC+Mass+Transit+Spatial+Layers>

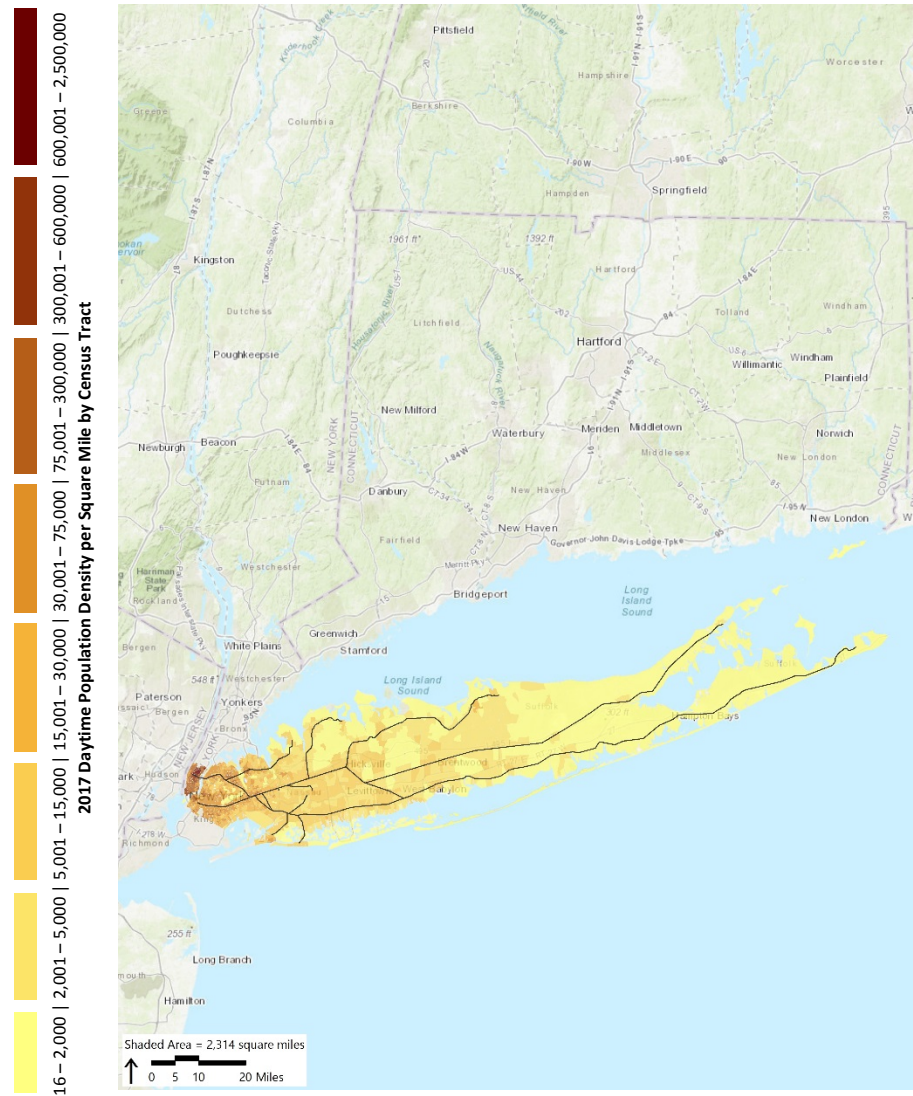
MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Long Island Employment Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://www.baruch.cuny.edu/confluence/display/geoportal/NYC+Mass+Transit+Spatial+Layers>

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Long Island Rail Road Long Island, New York



Long Island Rail Road (LIRR) offers high-frequency service (during peak and off-peak periods) connecting Long Island to New York City, which has the greatest population and employment density of all the U.S. cities reviewed. Long Island is more geographically constrained than Boston, surrounded by water on all sides with a connection to New York City across the East River. LIRR operates mainly EMUs. It has a number of long-distance lines, but uses a timed-transfer model that requires transfers from these lines to reach New York City or nearby secondary terminals.

Demographics and Land Use

INFORMATION	LIRR SOURCE	MBTA COMMUTER RAIL	LIRR
Major City Served	N/A	Boston	New York City
Population within 1 Mile of Stations	Esri	1,716,012	2,766,043
Name of UZA	NTD	Boston, MA-NH-RI	New York-Newark, NY-NJ-CT
Size of UZA (sq. miles)	NTD	1,873	3,450
Population of UZA	NTD	4,181,019	18,351,295
Jobs in Area*	BLS	2,677,320	9,169,850
Average Wage in Area*	BLS	\$64,080	\$61,790
Peak Hours Spent in Congestion per Commuter	Inrix	60	91
Major Geographic Features	System Map ¹	Boston Harbor Charles River	Atlantic Ocean Long Island Sound Great South Bay East River
Mode Split (Drove Alone)* ²	Census	67%	50%
Mode Split (Transit)*	Census	13%	31%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ Long Island Rail Road, System Map, <http://web.mta.info/lirr/Timetable/lirrmmap.htm>.

² This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



Long Island Rail Road

Long Island, New York



System Characteristics

INFORMATION	LIRR SOURCE	MBTA COMMUTER RAIL	LIRR
Number of Lines	LIRR Website ³	14	11
Length of Longest Line (miles)	LIRR Website ⁴	63	116
Number of Route Miles	NTD (Derived)	388	319
Number of Track Miles	NTD	697	670
Number of Stations	NTD	138	124
Percent Stations That are Accessible	NTD (Derived)	75%	83%
Annual Unlinked Trips	NTD	33,830,904	103,196,857
Percent of Agency Unlinked Trips	NTD (Derived)	8%	100%
Number of Central Terminals	System Map	2	1 ⁵
Central Terminals in Relation to CBD	System Map ⁶	Both in CBD	1 in CBD
On-Time Performance (System-Wide)	LIRR ⁷	89% (2017)	91% (2017)
Peak Line Frequency (Most Frequent/Other)	LIRR Schedules ⁸	20 minutes / 25-50 minutes	10 minutes / 20-60 minutes
Off-Peak Line Frequency (Most Frequent/Other)	LIRR Schedules	40 minutes / 1-2 hours	25 minutes / 0.5-2 hours

³ Metropolitan Transportation Authority, "Long Island Rail Road – General Information," <http://web.mta.info/lirr/about/GeneralInformation/>.

⁴ Metropolitan Transportation Authority, "Montauk," <http://lirr42.mta.info/stationInfo.php?id=138>.

⁵ This includes Penn Station only. Atlantic Terminal, Jamaica, and Hunterspoint Avenue, located within New York City limits, serve as secondary terminals.

⁶ This assumes that Manhattan represents the CBD.

⁷ Long Island Rail Road, "Long Island Rail Road: On-Time Performance by the Numbers (2017)," Report 12-2018, March 2018, <https://www.osc.state.ny.us/osdc/rpt12-2018-lirr-performance.pdf>.

⁸ Metropolitan Transportation Authority, Long Island Rail Road, schedules effective February 26 – May 20, 2018, available at <http://web.mta.info/mnr/html/planning/schedules/>.

MBTA TORONTO MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
 PARIS LONDON MANCHESTER BERLIN MELBOURNE



Long Island Rail Road
Long Island, New York



Operating Characteristics

INFORMATION	LIRR SOURCE	MBTA COMMUTER RAIL	LIRR
Annual Operating Expenses	NTD	\$403,654,786	\$1,309,290,914
Farebox Revenues	NTD	\$198,331,440	\$719,213,774
Farebox Recovery	NTD	49.1%	54.9%
Fare Range (Single One-Way Trip) ⁹	LIRR Fare Chart ¹⁰	\$2.25 - \$12.50	\$3.25 - \$29.25
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$19.61
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$12.69

Fleet Characteristics

INFORMATION	LIRR SOURCE	MBTA COMMUTER RAIL	LIRR
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	Internal (MTA)
Number of Vehicles in Fleet	NTD	480	1,185
Percent Spare Vehicles	NTD (Derived)	12.3%	13.9% ¹¹
Average Vehicle Age (Years)	NTD	23.0	14.7
Power Source(s)	NTD	Diesel	Electric ¹²
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	1,000 ¹³

⁹ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

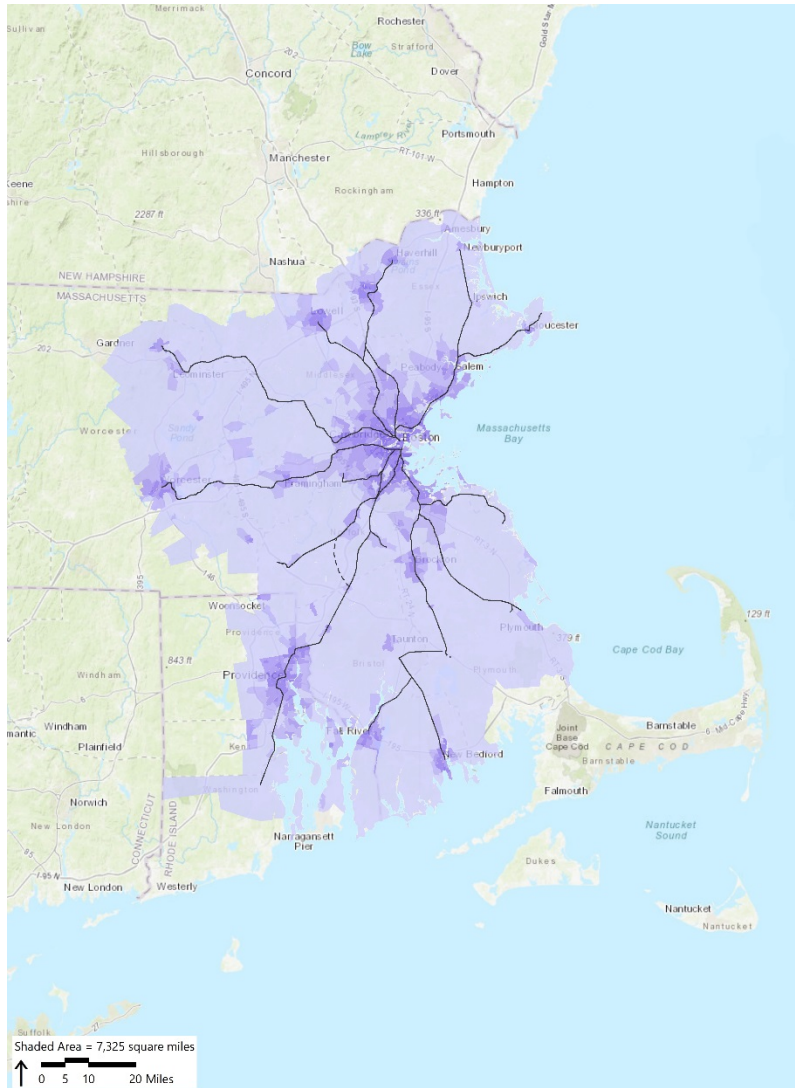
¹⁰ Metropolitan Transportation Authority, "Fare Chart," <http://web.mta.info/lirr/about/TicketInfo/Fares03-19-17.htm#farechart>.

¹¹ LIRR maintains a 18.6% combined diesel and dual mode locomotive spare ratio, 1.5% combined trailer and cab spare ratio, and 8.0% EMU spare ratio per LIRR fleet data from May 2017.

¹² Most trains are electrically-powered using Electric Multiple Unit vehicles. Limited Oyster Bay, Port Jefferson and Montauk Branch trains operate with dual mode locomotives that provide service from these diesel branches to Penn Station New York. Most Oyster Bay, Port Jefferson and Montauk Branch trains (and all Main Line trains east of Ronkonkoma) are diesel, requiring a transfer to travel to Penn Station New York.

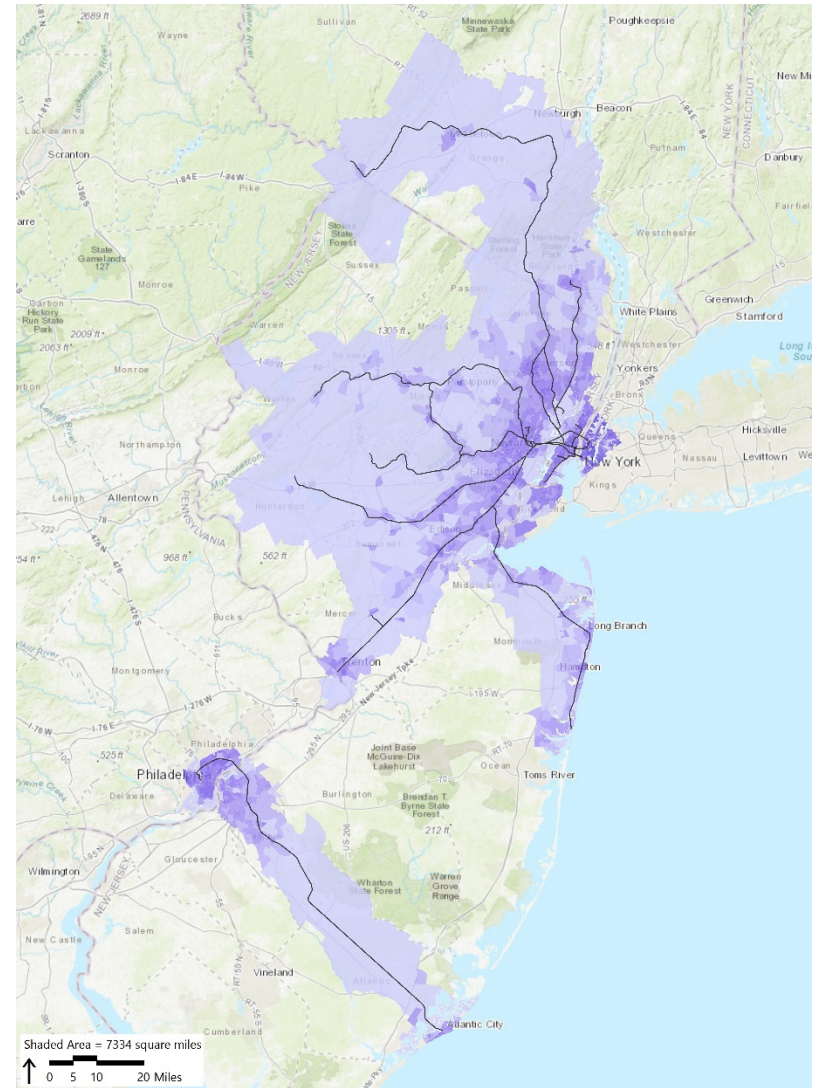
¹³ Assumes a typical train consists of nine single-level EMU vehicles.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

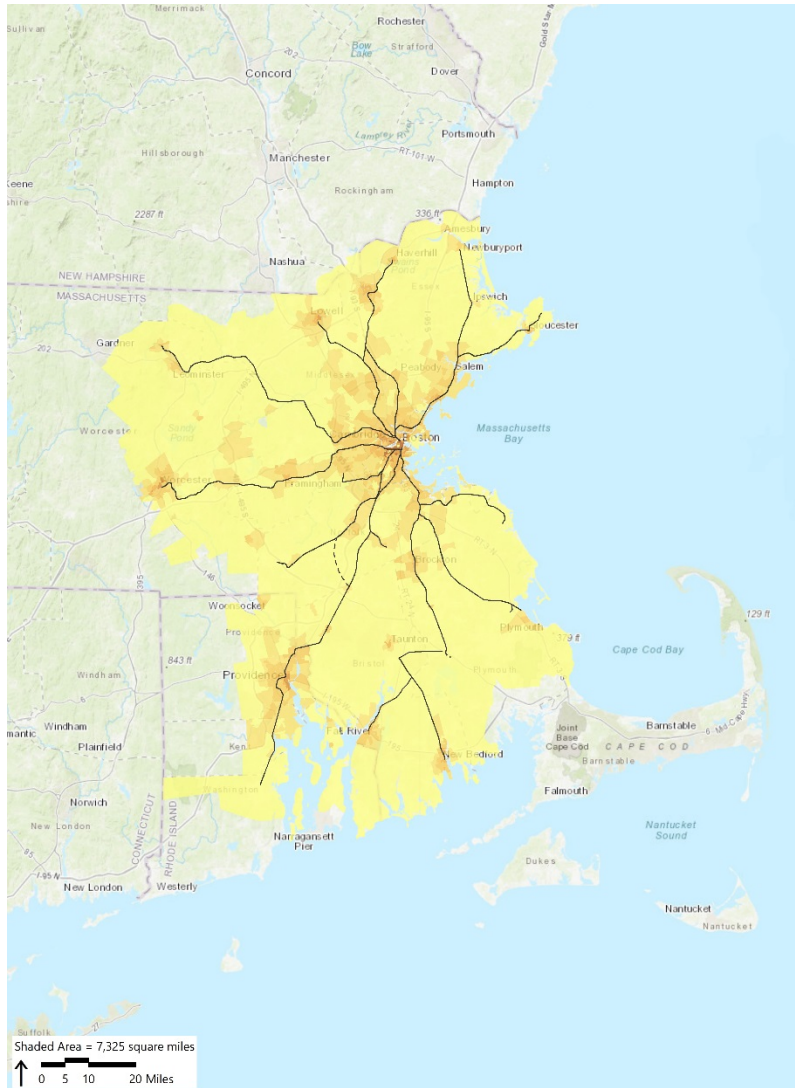
New Jersey Area Population Density



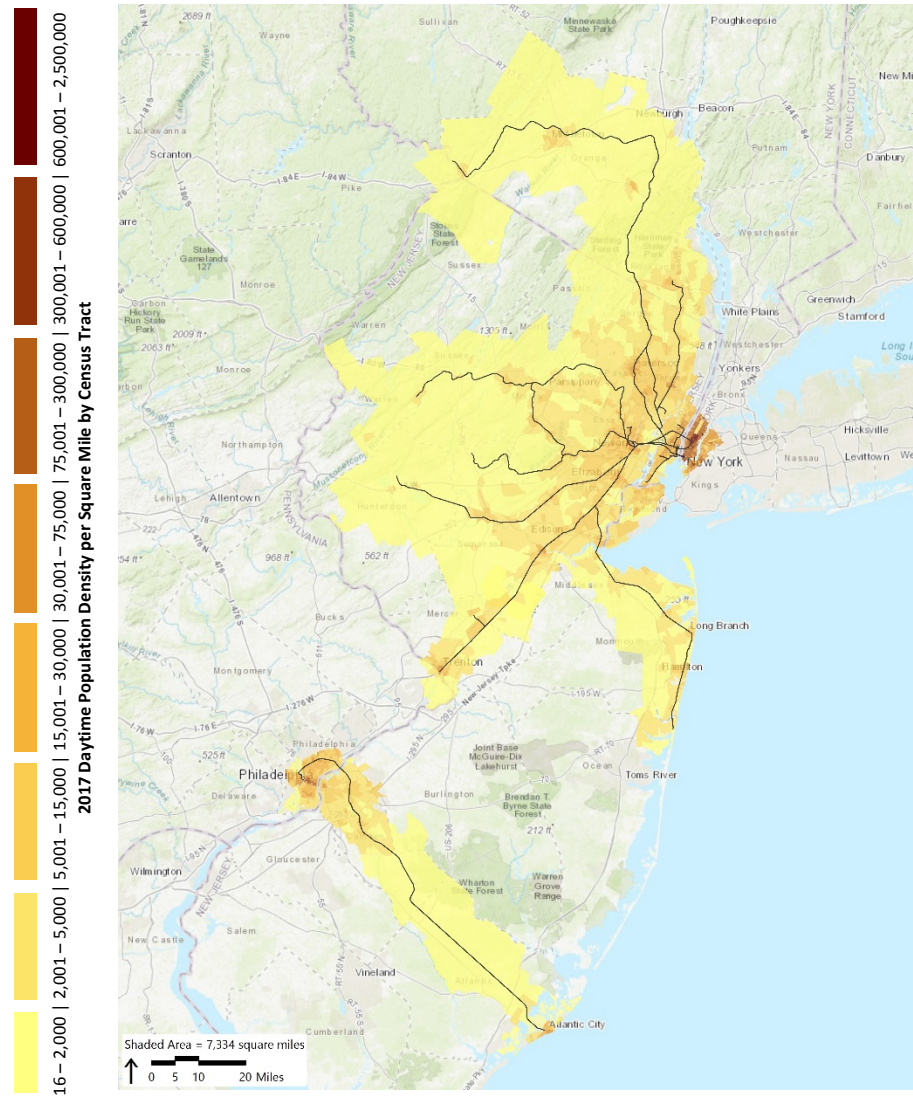
Source Information: ArcGIS Online, Business Analyst Online,
https://njgin.state.nj.us/NJ_NJGINExplorer/DataDownloads.jsp

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



New Jersey Area Employment Density



MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

2017 Daytime Population Density per Square Mile by Census Tract
16 - 2,000 | 2,001 - 5,000 | 5,001 - 15,000 | 15,001 - 30,000 | 30,001 - 75,000 | 75,001 - 300,000 | 300,001 - 600,000 | 600,001 - 2,500,000

Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Source Information: ArcGIS Online, Business Analyst Online,
https://njgin.state.nj.us/NJ_NJGINexplorer/DataDownloads.jsp



NJ TRANSIT Rail New Jersey



NJ TRANSIT covers a vast area, providing service to multiple large cities (New York City, Newark, Philadelphia). The majority of NJ TRANSIT rail lines serve the New York area, with a subset of these lines serving New York City Penn Station, and others requiring transfers at Secaucus Junction or Newark Penn Station. NJ TRANSIT has a complex schedule integration with Amtrak. NJ TRANSIT rail lines have nearly triple the ridership of the MBTA Commuter Rail. NJ TRANSIT operates trains using a mix of diesel and electric propulsion.

Demographics and Land Use

INFORMATION	NJ TRANSIT SOURCE	MBTA COMMUTER RAIL	NJ TRANSIT RAIL
Major City Served	N/A	Boston	New York City ¹
Population within 1 Mile of Stations	Esri	1,716,012	3,292,830
Name of UZA	NTD	Boston, MA-NH-RI	New York-Newark, NY-NJ-CT
Size of UZA (sq. miles)	NTD	1,873	3,450
Population of UZA	NTD	4,181,019	18,351,295
Jobs in Area*	BLS	2,677,320	9,169,850
Average Wage in Area*	BLS	\$64,080	\$61,790
Peak Hours Spent in Congestion per Commuter	Inrix	60	91
Major Geographic Features	System Map ²	Boston Harbor Charles River	Hudson River Atlantic Ocean Delaware River New Jersey Border
Mode Split (Drove Alone)* ³	Census	67%	50%
Mode Split (Transit)*	Census	13%	31%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ NJ TRANSIT also serves the Philadelphia area with one line, connecting to Atlantic City.

² NJ TRANSIT, System Map, https://www.njtransit.com/pdf/rail/Rail_System_Map.pdf.

³ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



NJ TRANSIT Rail New Jersey



System Characteristics

INFORMATION	NJ TRANSIT SOURCE	MBTA COMMUTER RAIL	NJ TRANSIT RAIL
Number of Lines	Facts at a Glance ⁴	14	12 ⁵
Length of Longest Line (miles)	ArcGIS (Derived)	63	65-70 (Approximate)
Number of Route Miles	NTD (Derived)	388	501
Number of Track Miles	NTD	697	868
Number of Stations	NTD	138	165
Percent Stations That are Accessible	NTD (Derived)	75%	47%
Annual Unlinked Trips	NTD	33,830,904	90,872,267
Percent of Agency Unlinked Trips	NTD (Derived)	8%	33%
Number of Central Terminals	System Map	2	2 ⁶
Central Terminals in Relation to CBD	System Map Center City District Map ⁷	Both in CBD	1 in CBD, 1 Outside CBD ⁸
On-Time Performance (System-Wide)	NJ TRANSIT Website ⁹	89% (2017)	91% (2017) ¹⁰
Peak Line Frequency (Most Frequent/Other)	NJ TRANSIT Schedules ¹¹	20 minutes / 25-50 minutes	15 minutes / 20-25 minutes
Off-Peak Line Frequency (Most Frequent/Other)	NJ TRANSIT Schedules	40 minutes / 1-2 hours	30 minutes / 0.5-2 hours

⁴ NJ TRANSIT, "NJ TRANSIT Facts at a Glance," Fiscal Year 2017.

⁵ Statistics exclude Port Jervis and Pasack Valley Lines, which are included in map as they are MetroNorth lines operated by NJ TRANSIT.

⁶ This includes Penn Station and Hoboken only.

⁷ City Center District, "CCD Boundary Map," <https://centercityphila.org/ccd-boundary-map>, accessed March 29, 2018.

⁸ This assumes that Manhattan represents the CBD for lines in the New York City area. The Philadelphia central terminal is just outside the CBD.

⁹ NJ TRANSIT, "NJ TRANSIT On-Time Performance: Rail, February 2016-January 2018, available at http://www.njtransit.com/AdminTemp/rail_otp.pdf.

¹⁰ The average shown is a 12-month average for February 2017 through January 2018.

¹¹ NJ TRANSIT, schedules effective January 7, 2018, available at

http://www.njtransit.com/sa/sa_servlet.srv?hdnPageAction=ServiceAdjustmentTo&AdjustmentId=9792.



NJ TRANSIT Rail New Jersey



Operating Characteristics

INFORMATION	NJ TRANSIT SOURCE	MBTA COMMUTER RAIL	NJ TRANSIT RAIL
Annual Operating Expenses	NTD	\$403,654,786	\$1,022,642,280
Farebox Revenues	NTD	\$198,331,440	\$582,194,827
Farebox Recovery	NTD	49.1%	56.9%
Fare Range (Single One-Way Trip) ¹²	NJ Transit Schedules	\$2.25 - \$12.50	\$1.50 - \$18.00
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$16.66
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$11.25

Fleet Characteristics

INFORMATION	NJ TRANSIT SOURCE	MBTA COMMUTER RAIL	NJ TRANSIT RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	Internal (NJ Transit)
Number of Vehicles in Fleet	NTD	480	1,350
Percent Spare Vehicles	NTD (Derived)	12.3%	6.1% ¹³
Average Vehicle Age (Years)	NTD	23.0	17.6
Power Source(s)	NTD	Diesel	Diesel and Electric ¹⁴
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	1,100 ¹⁵

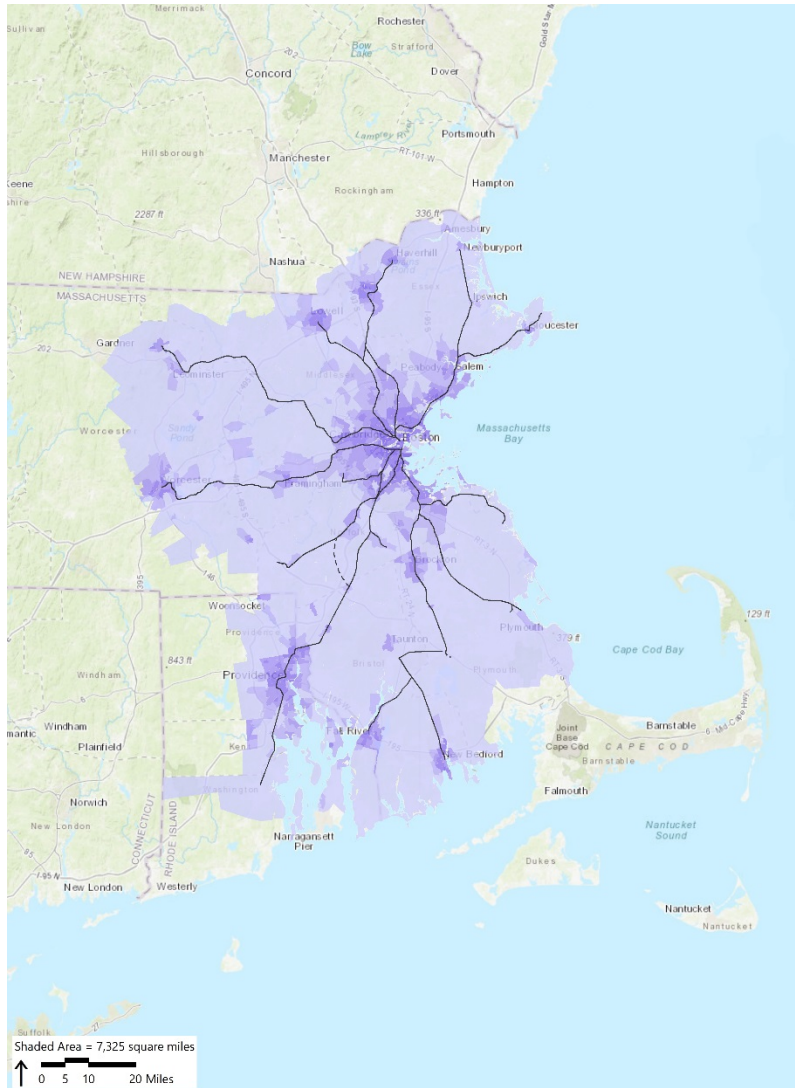
¹² Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

¹³ NJ TRANSIT maintains a 52% diesel locomotive spare ratio, 35% electric spare ratio, 44% single-level cab spare ratio, 34% multi-level cab spare ratio, 20% single-level trailer spare ratio, 20% multi-level trailer spare ratio, 22% EMU spare ratio, and 26% dual-mode locomotive spare ratio, per NJ TRANSIT AM Peak Lineup Sheets and most recent car and locomotive ownership data (note that these exceed the spare ratio derived from NTD data).

¹⁴ NJ TRANSIT's fleet includes diesel locomotives, dual mode locomotives, electric locomotives, and EMUs.

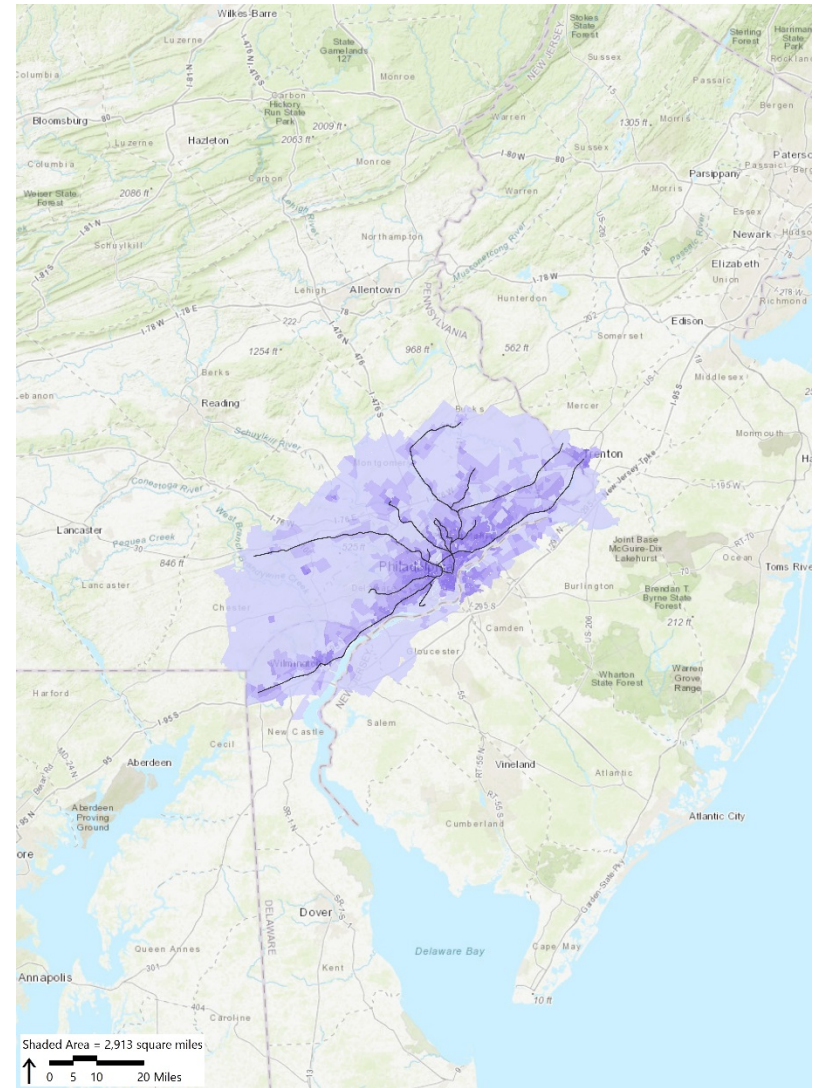
¹⁵ Assumes a typical train consists of nine bi-level electric coaches.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

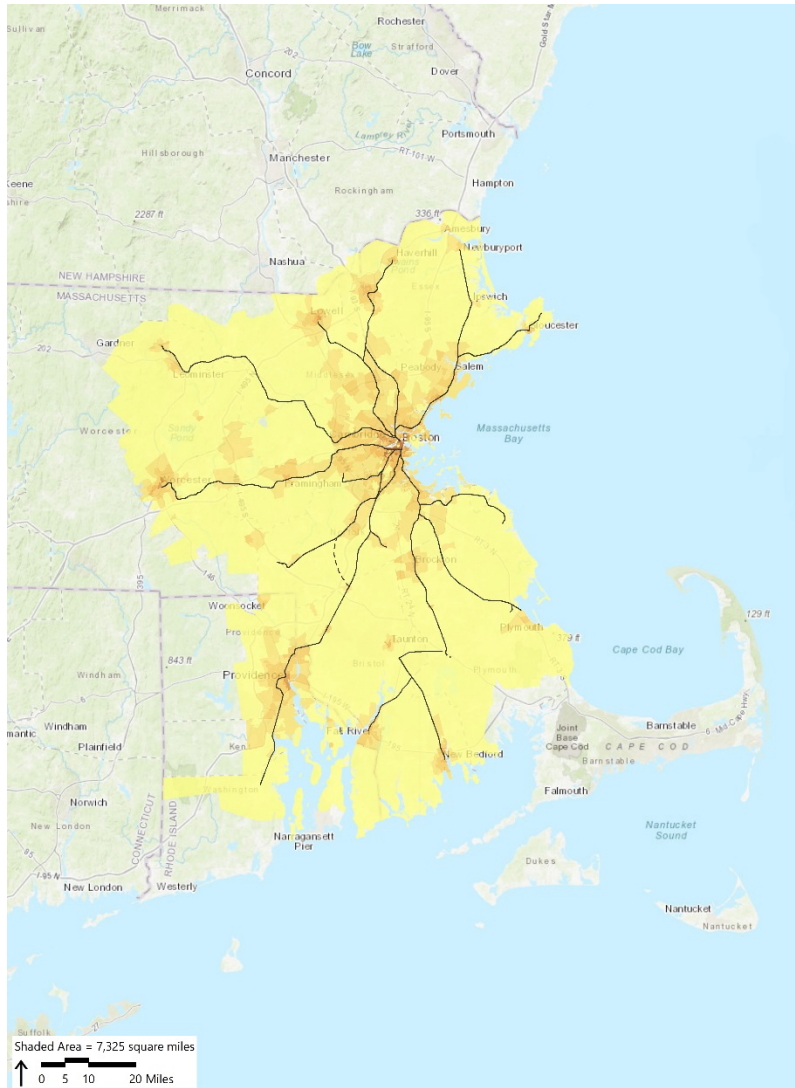
Philadelphia Population Density



Source Information: ArcGIS Online, Business Analyst Online, SEPTA GIS

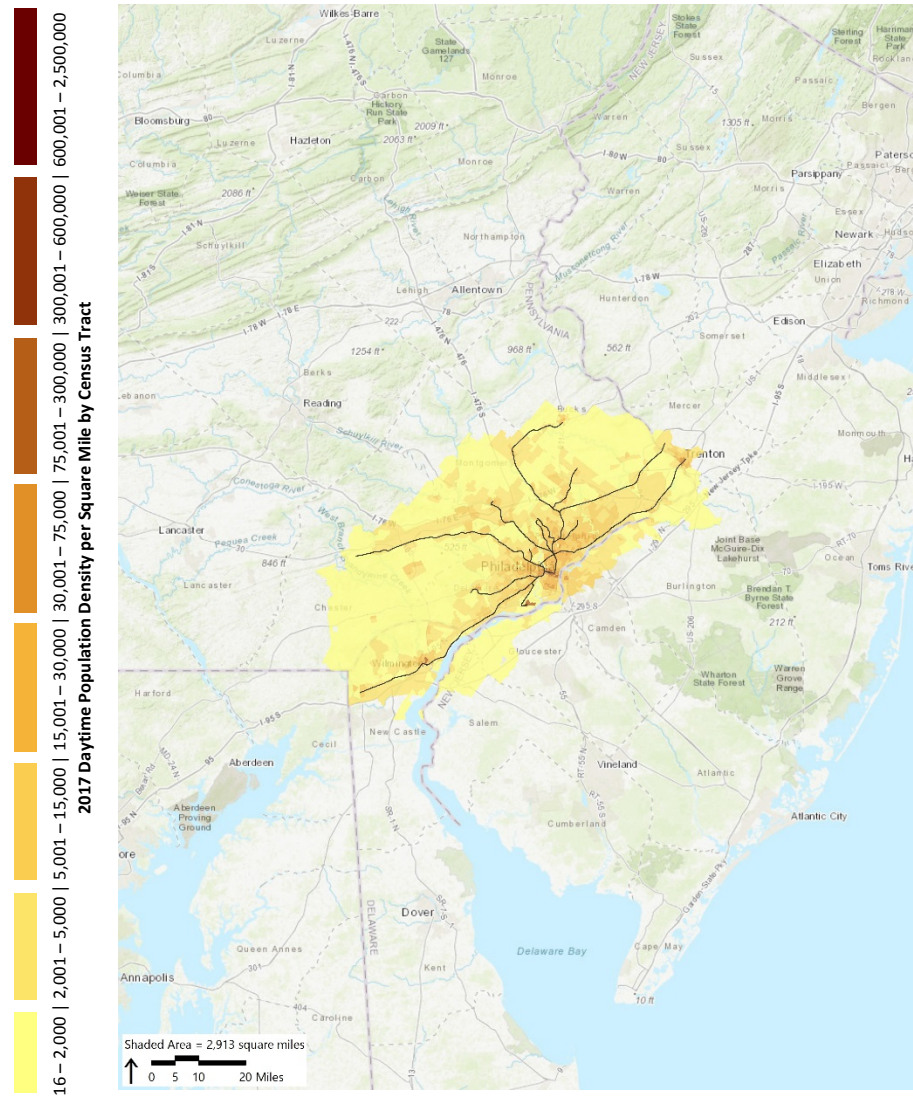
MBTA MNR LIRR NJ TRANSIT **SEPTA** METRA METROLINK CALTRAIN
 TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Philadelphia Employment Density



Source Information: ArcGIS Online, Business Analyst Online, SEPTA GIS

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



SEPTA Regional Rail Philadelphia, Pennsylvania



Philadelphia has similar demographics and land use as Boston, but Southeastern Pennsylvania Transportation Authority Railroad Division (SEPTA Regional Rail) serves a much smaller area than the MBTA Commuter Rail. SEPTA Regional Rail serves a similar number of riders to the MBTA commuter rail over fewer route miles, and has lower operating expenses than the MBTA Commuter Rail per passenger and per mile. SEPTA Regional Rail has a fully electrified, through-running system, with three central terminals.

Demographics and Land Use

INFORMATION	SEPTA SOURCE	MBTA COMMUTER RAIL	SEPTA REGIONAL RAIL
Major City Served	N/A	Boston	Philadelphia
Population within 1 Mile of Stations	Esri	1,716,012	1,671,994
Name of UZA	NTD	Boston, MA-NH-RI	Philadelphia, PA-NJ-DE-MD
Size of UZA (sq. miles)	NTD	1,873	1,981
Population of UZA	NTD	4,181,019	5,441,567
Jobs in Area*	BLS	2,677,320	2,777,730
Average Wage in Area*	BLS	\$64,080	\$53,450
Peak Hours Spent in Congestion per Commuter	Inrix	60	37
Major Geographic Features	System Map ¹	Boston Harbor Charles River	Delaware River Schuylkill River
Mode Split (Drove Alone)* ²	Census	67%	73%
Mode Split (Transit)*	Census	13%	9%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ Southeastern Pennsylvania Transportation Authority, System Map, <http://www.septa.org/maps/pdf/click-map.pdf>.

² This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



SEPTA Regional Rail
Philadelphia, Pennsylvania



System Characteristics

INFORMATION	SEPTA SOURCE	MBTA COMMUTER RAIL	SEPTA REGIONAL RAIL
Number of Lines	Route Statistics ³	14	13
Length of Longest Line (miles)	Route Statistics	63	41
Number of Route Miles	NTD (Derived)	388	224
Number of Track Miles	NTD	697	616
Number of Stations	NTD	138	155
Percent Stations That are Accessible	NTD (Derived)	75%	45%
Annual Unlinked Trips	NTD	33,830,904	36,187,570
Percent of Agency Unlinked Trips	NTD (Derived)	8%	10%
Number of Central Terminals	System Map	2	3 ⁴
Central Terminals in Relation to CBD	Center City District Map ⁵	Both in CBD	2 in CBD, 1 Outside CBD
On-Time Performance (System-Wide)	SEPTA Website ⁶	89% (2017)	86% (2017)
Peak Line Frequency (Most Frequent/Other)	SEPTA Schedules ⁷	20 minutes / 25-50 minutes	15 minutes / 20-40 minutes
Off-Peak Line Frequency (Most Frequent/Other)	SEPTA Schedules	40 minutes / 1-2 hours	15 minutes / 0.5-2 hours

³ Southeastern Pennsylvania Transportation Authority, Service Planning Department, "SEPTA Route Statistics 2017."

⁴ SEPTA has three central through-running stations.

⁵ City Center District, "CCD Boundary Map," <https://centercityphila.org/ccd-boundary-map>, accessed March 29, 2018.

⁶ Southeastern Pennsylvania Transportation Authority, "On-Time Performance," <http://www.septa.org/service/rail/improvement/otp.html>, accessed March 13, 2018.

⁷ Southeastern Pennsylvania Transportation Authority, schedules effective January 14, 2018, available at <http://www.septa.org/schedules/rail/>.

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA MANCHESTER BERLIN METRA METROLINK CALTRAIN
 NJ TRANSIT SEPTA METRO MANCHESTER BERLIN METRA METROLINK CALTRAIN
 TORONTO CATALUNYA PARIS LONDON SEPTA MANCHESTER BERLIN METRA METROLINK CALTRAIN



SEPTA Regional Rail
Philadelphia, Pennsylvania



Operating Characteristics

INFORMATION	SEPTA SOURCE	MBTA COMMUTER RAIL	SEPTA REGIONAL RAIL
Annual Operating Expenses	NTD	\$403,654,786	\$267,844,193
Farebox Revenues	NTD	\$198,331,440	\$151,908,278
Farebox Recovery	NTD	49.1%	56.7%
Fare Range (Single One-Way Trip) ⁸	SEPTA Fare Chart ⁹	\$2.25 - \$12.50	\$3.75 - \$9.25
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$13.85
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$7.40

Fleet Characteristics

INFORMATION	SEPTA SOURCE	MBTA COMMUTER RAIL	SEPTA REGIONAL RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	Internal
Number of Vehicles in Fleet	NTD	480	404
Percent Spare Vehicles	NTD (Derived)	12.3%	16.1% ¹⁰
Average Vehicle Age (Years)	NTD	23.0	28.3
Power Source(s)	NTD	Diesel	Electric
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	400 ¹¹

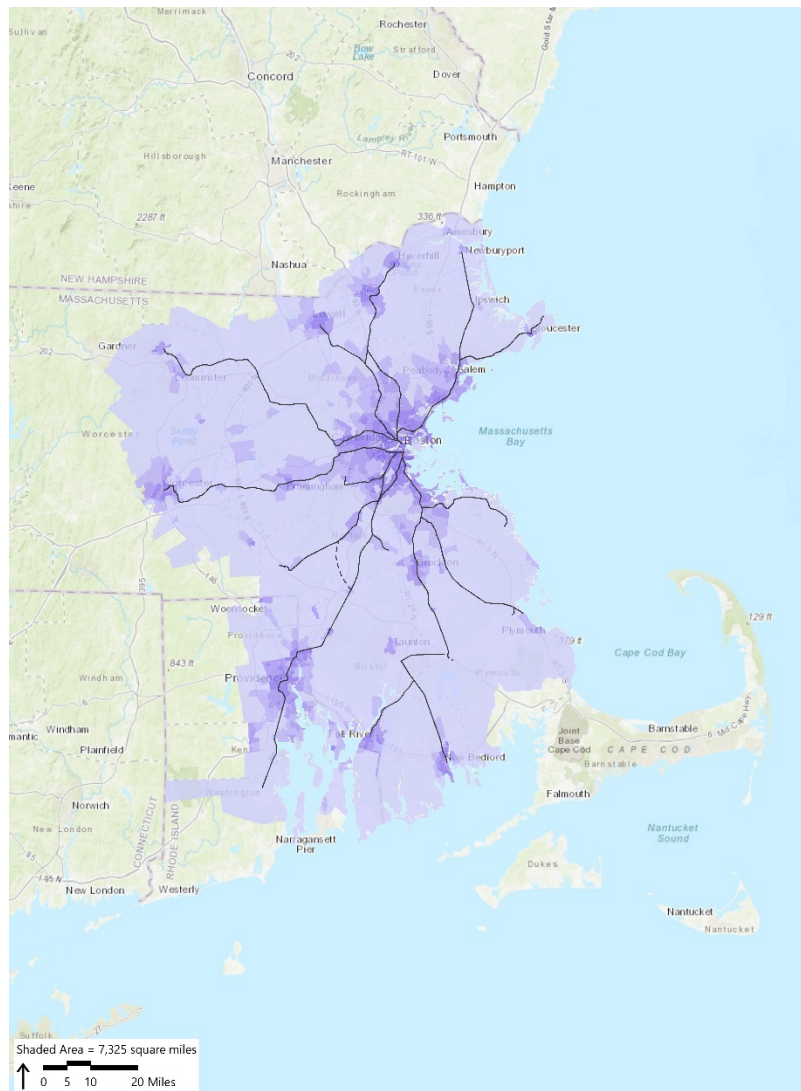
⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

⁹ Southeastern Pennsylvania Transportation Authority, "Tickets," <http://www.septa.org/fares/ticket/index.html>.

¹⁰ SEPTA maintains a 25% electric locomotive spare ratio, 7% trailer and cab spare ratio, and 17% EMU spare ratio, per SEPTA RR Peak Fleet/Seat Accommodations table and SEPTA Car Placement Sheets.

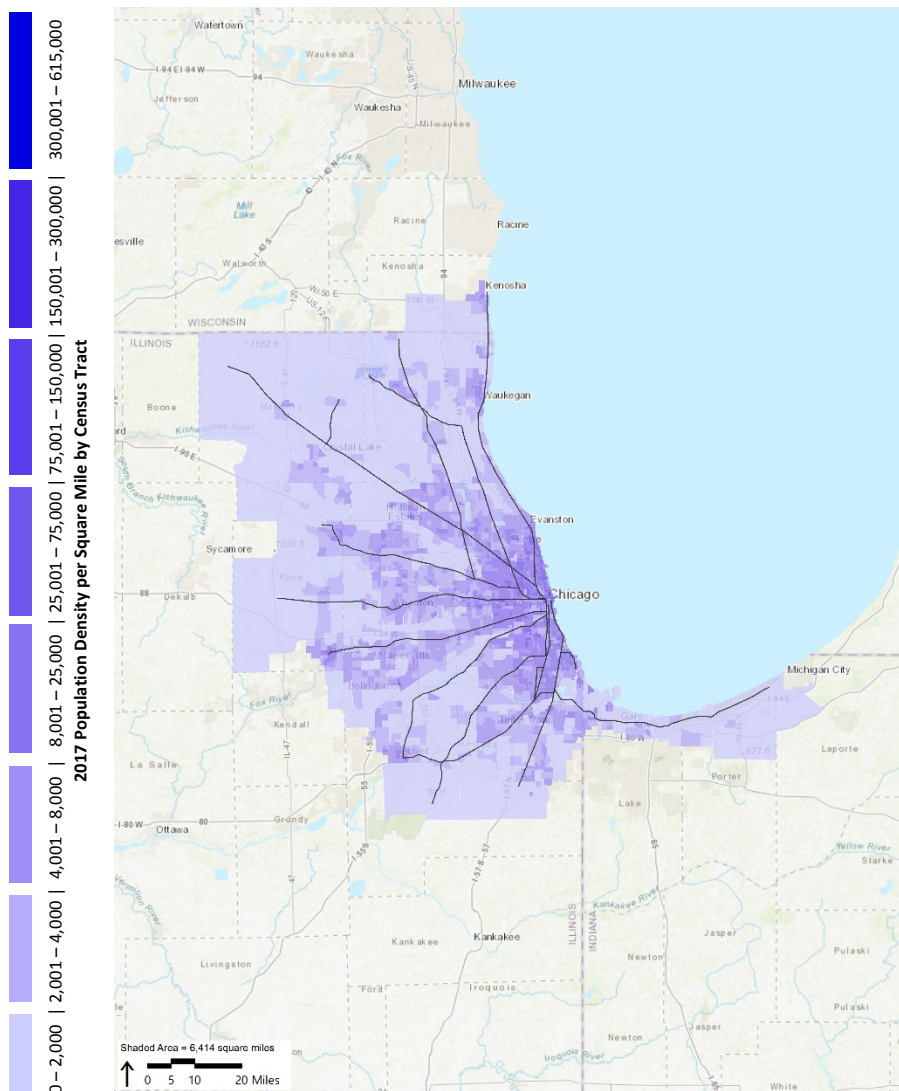
¹¹ Assumes a typical train consists of three single-level EMU vehicles.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

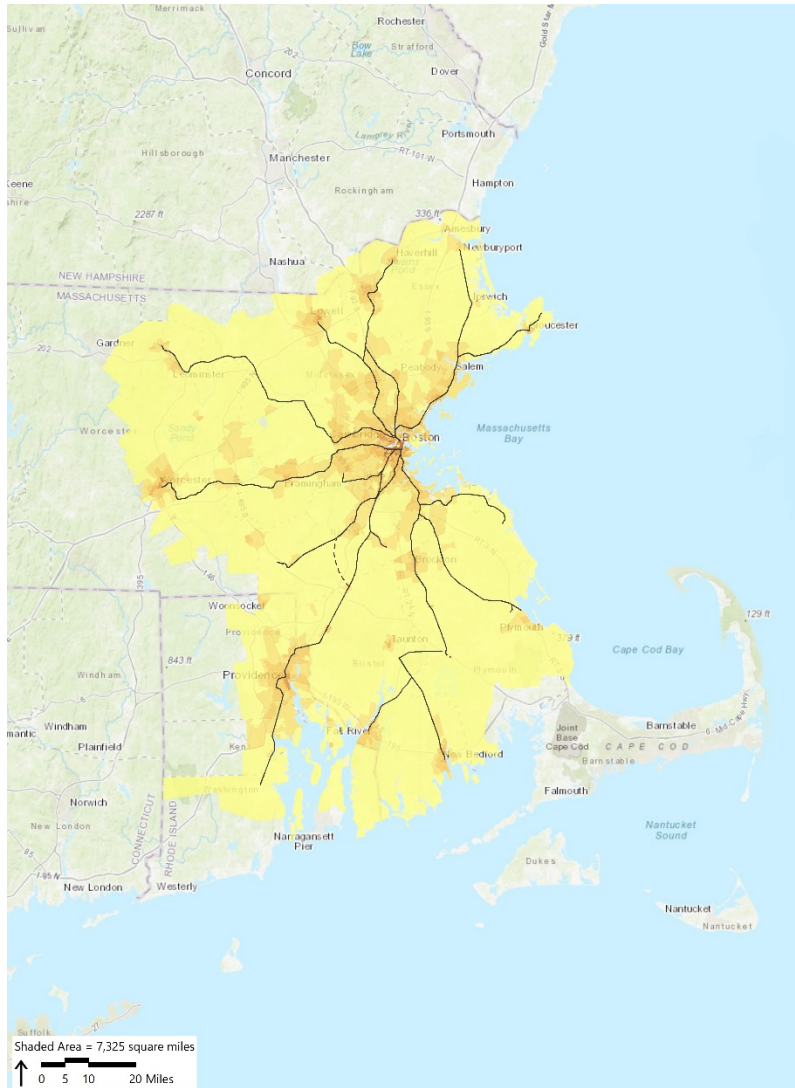
Chicago Population Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://data.cityofchicago.org/Transportation/Metra-Lines/q8wx-dznq/data>

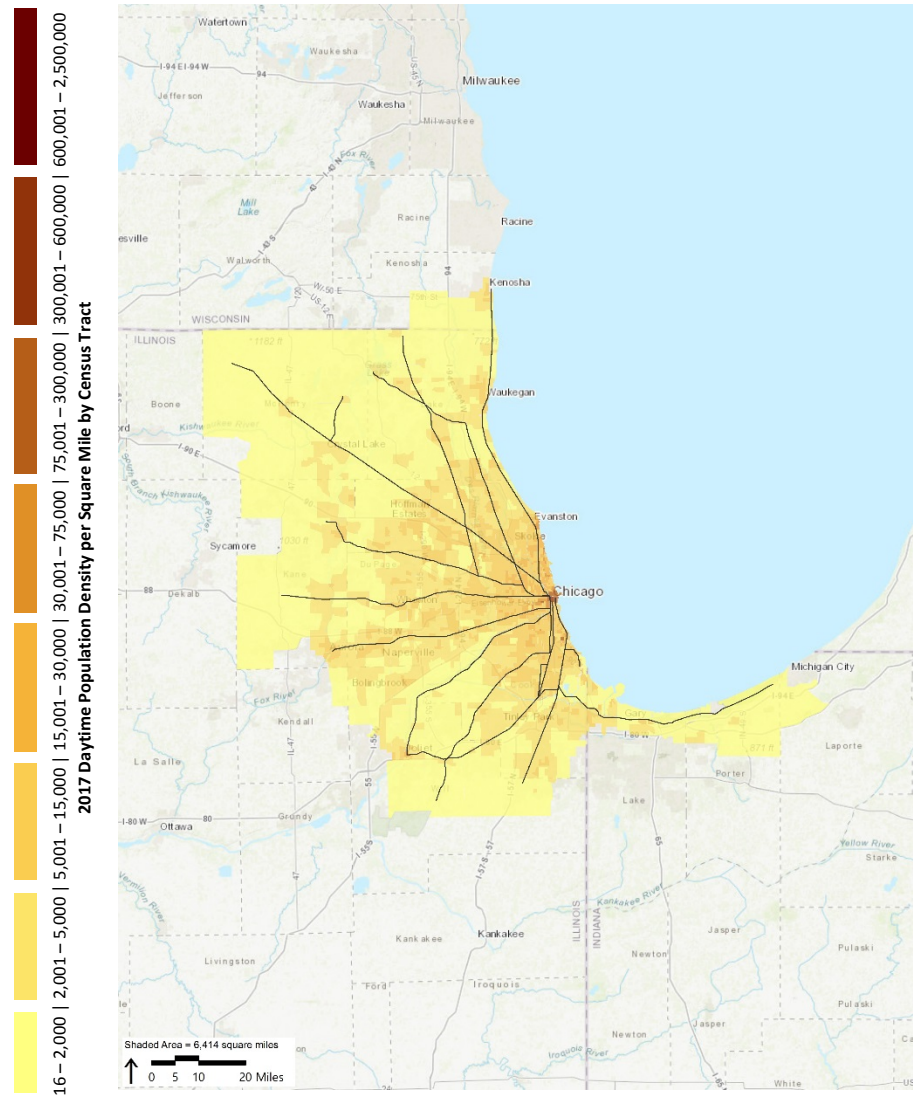
MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
 TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Chicago Employment Density



Source Information: ArcGIS Online, Business Analyst Online,
<https://data.cityofchicago.org/Transportation/Metra-Lines/q8wx-dznq/data>

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Metra Chicago, Illinois



Chicago is a larger city than Boston, but has similar commute metrics and geographic similarities, with water on one side of the CBD. The Commuter Rail Division of the Regional Transportation Authority and the Northeast Illinois Regional Commuter Railroad Corporation (Metra) offers only rail service, and has a similar radial system layout as the MBTA. Metra has multiple central terminals, with each line serving a single central terminals. Metra provides service using lines owned by the freight railroads, sharing tracks with a number of the freight railroads operating the service on their lines.

Demographics and Land Use

INFORMATION	METRA SOURCE	MBTA COMMUTER RAIL	METRA RAIL
Major City Served	N/A	Boston	Chicago
Population within 1 Mile of Stations	Esri	1,716,012	2,946,626
Name of UZA	NTD	Boston, MA-NH-RI	Chicago, IL-IN
Size of UZA (sq. miles)	NTD	1,873	2,443
Population of UZA	NTD	4,181,019	8,608,208
Jobs in Area*	BLS	2,677,320	4,552,180
Average Wage in Area*	BLS	\$64,080	\$53,320
Peak Hours Spent in Congestion per Commuter	Inrix	60	57
Major Geographic Features	System Map ¹	Boston Harbor Charles River	Lake Michigan Chicago River
Mode Split (Drove Alone)* ²	Census	67%	70%
Mode Split (Transit)*	Census	13%	12%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ Metra, System Map, <https://metrarail.com/maps-schedules/system-map>.

² This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



Metra
Chicago, Illinois



System Characteristics

INFORMATION	METRA SOURCE	MBTA COMMUTER RAIL	METRA RAIL
Number of Lines	State of the System ³	14	11
Length of Longest Line (miles)	State of the System	63	71
Number of Route Miles	NTD (Derived)	388	488
Number of Track Miles	NTD	697	1,206
Number of Stations	NTD	138	241
Percent Stations That are Accessible	NTD (Derived)	75%	76%
Annual Unlinked Trips	NTD	33,830,904	72,289,606
Percent of Agency Unlinked Trips	NTD (Derived)	8%	100%
Number of Central Terminals	System Map	2	4
Central Terminals in Relation to CBD	City of Chicago ⁴	Both in CBD	All in CBD
On-Time Performance (System-Wide)	Metra ⁵	89% (2017)	96% (2016)
Peak Line Frequency (Most Frequent/Other)	Metra Schedules ⁶	20 minutes / 25-50 minutes	20 minutes / 0.5-2 hours
Off-Peak Line Frequency (Most Frequent/Other)	Metra Schedules	40 minutes / 1-2 hours	1 hour / 1.5-3 hours

³ Metra, Division of Strategic Capital Planning, “2016 State of the System,” July 2016.

⁴ City of Chicago, “Chicago Central Business District,” <https://data.cityofchicago.org/Facilities-Geographic-Boundaries/Boundaries-Central-Business-District/tksj-nvsw>.

⁵ Metra, “Commuter Rail System On-Time Performance Report,” January 2017.

⁶ Metra, schedules effective February 5, 2018, available at <https://metrarail.com/maps-schedules>.

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT METRA MANCHESTER BERLIN METROLINK CALTRAIN MELBOURNE



Metra
Chicago, Illinois



Operating Characteristics

INFORMATION	METRA SOURCE	MBTA COMMUTER RAIL	METRA RAIL
Annual Operating Expenses	NTD	\$403,654,786	\$722,591,592
Farebox Revenues	NTD	\$198,331,440	\$341,966,405
Farebox Recovery	NTD	49.1%	47.3%
Fare Range (Single One-Way Trip) ⁷	Metra Fare Chart ⁸	\$2.25 - \$12.50	\$4.00 - \$11.00
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$16.60
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$10.00

Fleet Characteristics

INFORMATION	METRA SOURCE	MBTA COMMUTER RAIL	METRA RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	Internal ⁹
Number of Vehicles in Fleet	NTD	480	1,188
Percent Spare Vehicles	NTD (Derived)	12.3%	10.7%
Average Vehicle Age (Years)	NTD	23.0	24.0
Power Source(s)	NTD	Diesel	Diesel and Electric ¹⁰
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	900 ¹¹

⁷ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

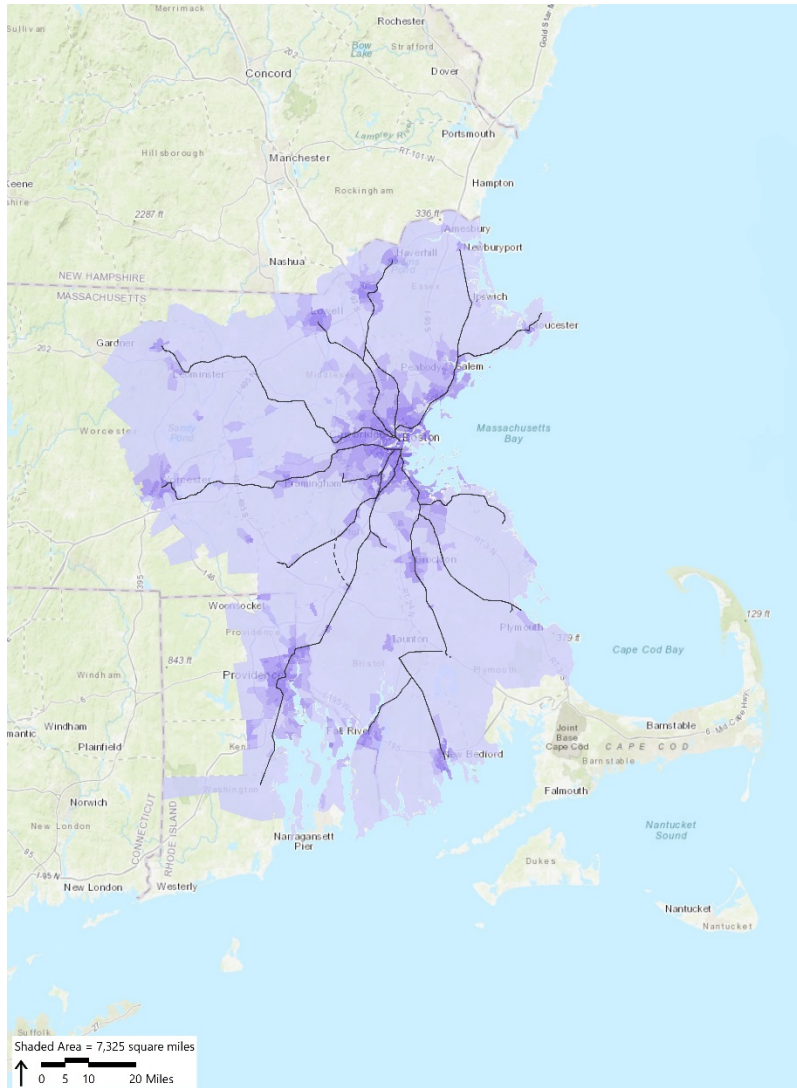
⁸ Metra, "Fares," <https://metrarail.com/tickets/ticket-options#quicktabs-fare-information>.

⁹ Several of the host railroads operate the service on their lines (e.g., Union Pacific, BNSF Railway); Metra operates the other lines.

¹⁰ Metra operates both diesel locomotives and EMU vehicles.

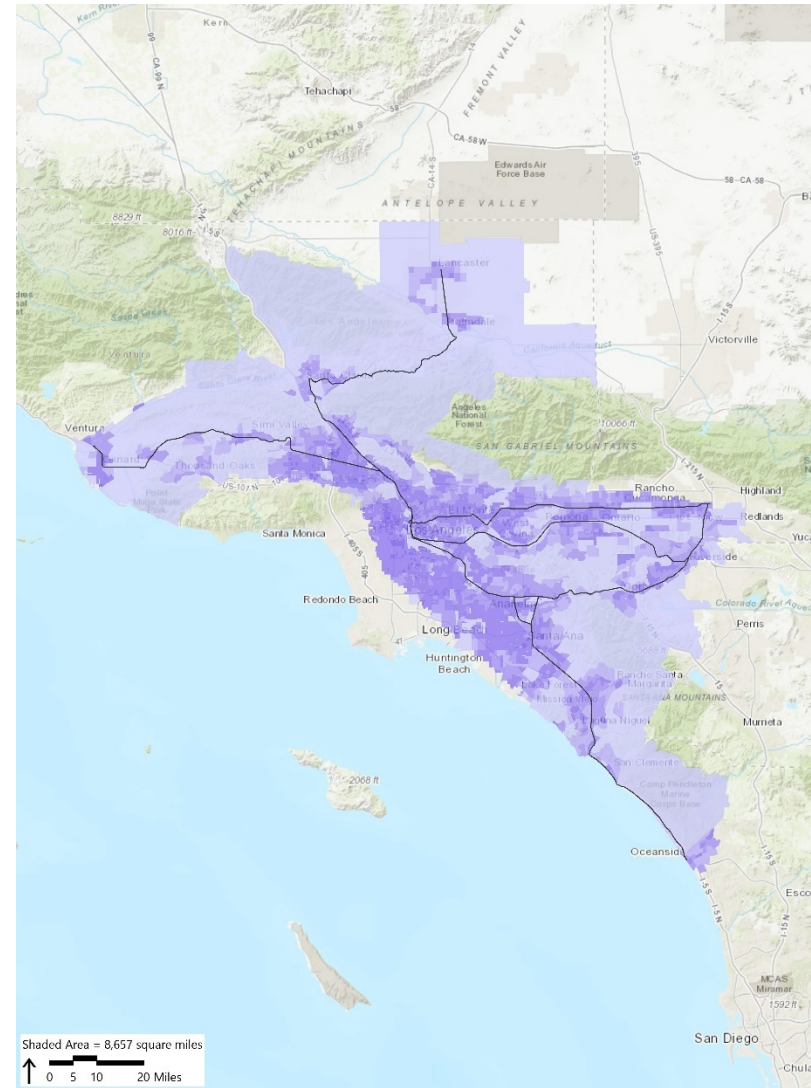
¹¹ Assumes a typical train consists of approximately six gallery-type coaches.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

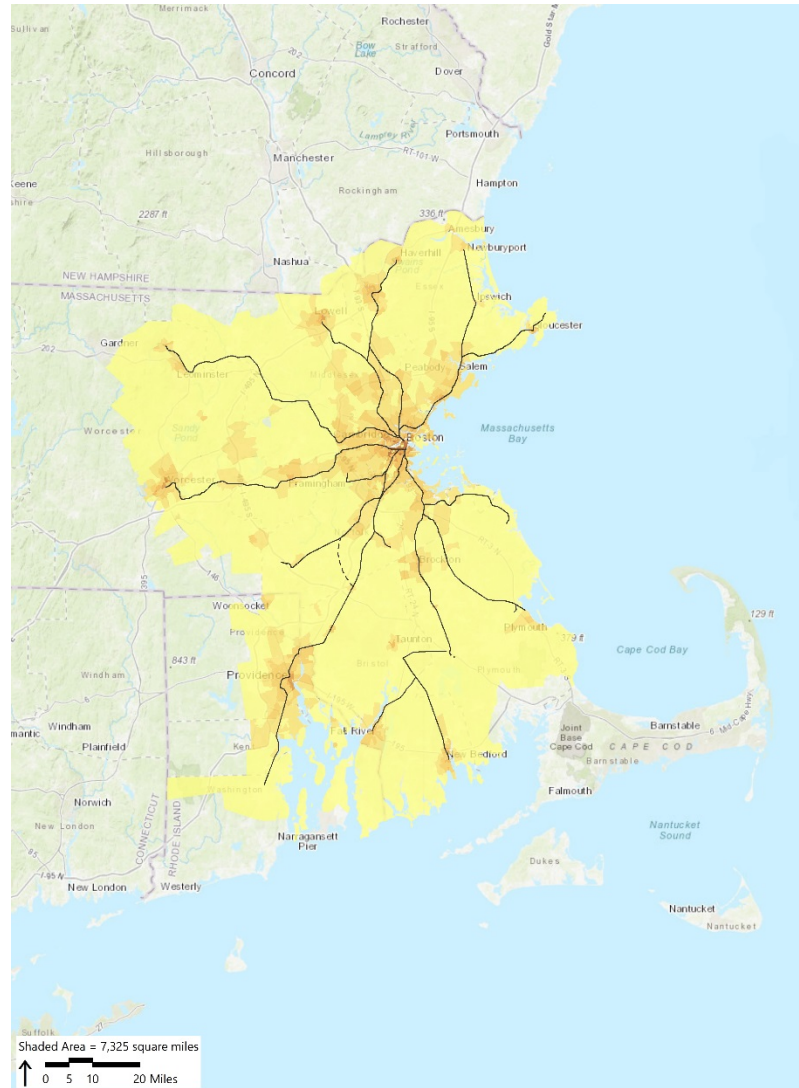
Los Angeles Population Density



Source Information: ArcGIS Online, Business Analyst Online,
http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/RR_Commuter_13.html

MBTA TORONTO
MNR CATALUNYA
LIRR NJ TRANSIT
PARIS
SEPTA LONDON
METRA MANCHESTER
MELBOURNE
CALTRAIN BERLIN
METROLINK
MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Los Angeles Employment Density



Source Information: ArcGIS Online, Business Analyst Online,
http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/RR_Commuter_13.html

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Metrolink

Los Angeles, California



The Los Angeles region features a larger area of high-density population and employment than Boston. Los Angeles experiences the greatest levels of congestion in the United States, and has a low transit modal split. MetroLink is a relatively new system and is expanding rapidly to provide alternatives to driving. Metrolink now has seven lines, covering a greater number of route miles than the MBTA Commuter Rail with a greater distance between stations.

Demographics and Land Use

INFORMATION	METROLINK SOURCE	MBTA COMMUTER RAIL	METROLINK RAIL
Major City Served	N/A	Boston	Los Angeles
Population within 1 Mile of Stations	Esri	1,716,012	1,060,244
Name of UZA	NTD	Boston, MA-NH-RI	Los Angeles-Long Beach-Anaheim, CA
Size of UZA (sq. miles)	NTD	1,873	1,736
Population of UZA	NTD	4,181,019	12,150,996
Jobs in Area*	BLS	2,677,320	5,783,690
Average Wage in Area*	BLS	\$64,080	\$55,650
Peak Hours Spent in Congestion per Commuter	Inrix	60	102
Major Geographic Features	System Map ¹	Boston Harbor Charles River	Pacific Ocean Los Padres National Forest Angeles National Forest
Mode Split (Drove Alone)* ²	Census	67%	75%
Mode Split (Transit)*	Census	13%	5%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ Metrolink, System Map & Timetables, <https://www.metrolinktrains.com/globalassets/schedules/all-lines-timetable---december-16.pdf>.

² This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA METRA METROLINK BERLIN MANCHESTER METROLINE MELBOURNE CALTRAIN



Metrolink

Los Angeles, California



System Characteristics

INFORMATION	METROLINK SOURCE	MBTA COMMUTER RAIL	METROLINK RAIL
Number of Lines	Metrolink ³	14	7
Length of Longest Line (miles)	Metrolink ⁴	63	87
Number of Route Miles	NTD (Derived)	388	412
Number of Track Miles	NTD	697	679
Number of Stations	NTD	138	59
Percent Stations That are Accessible	NTD (Derived)	75%	100%
Annual Unlinked Trips	NTD	33,830,904	13,758,419
Percent of Agency Unlinked Trips	NTD (Derived)	8%	100%
Number of Central Terminals	System Map	2	1
Central Terminals in Relation to CBD	Downtown Center BID ⁵	Both in CBD	Just Outside CBD
On-Time Performance (System-Wide)	Metrolink ⁶	89% (2017)	94% (2013)
Peak Line Frequency (Most Frequent/Other)	Metrolink Schedules ⁷	20 minutes / 25-50 minutes	30 minutes / 35 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Metrolink Schedules	40 minutes / 1-2 hours	1.5 hours / 2-2.5 hours

³ Metrolink, "Our Future is On Track: Short-Range Transit Plan 2015-2020."

⁴ Metrolink, "Keeping Southern California's Future On Track," https://metrolinktrains.com/globalassets/news/metrolink_matters_special_edition_25_anniversary.pdf.

⁵ Downtown Center Business Improvement District, "Downtown BIDs," <https://www.downtownla.com/about-us/who-we-are/downtown-bids>.

⁶ Metrolink, "Our Future is On Track: Short-Range Transit Plan 2015-2020."

⁷ Metrolink, Timetable, effective December 16, 2017, <https://www.metrolinktrains.com/globalassets/schedules/all-lines-timetable---december-16.pdf>.



Metrolink

Los Angeles, California



Operating Characteristics

INFORMATION	METROLINK SOURCE	MBTA COMMUTER RAIL	METROLINK RAIL
Annual Operating Expenses	NTD	\$403,654,786	\$218,012,890
Farebox Revenues	NTD	\$198,331,440	\$84,505,943
Farebox Recovery	NTD	49.1%	38.8%
Fare Range (Single One-Way Trip) ⁸	Metrolink Price Finder ⁹	\$2.25 - \$12.50	\$1.75 - \$16.75
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$16.66
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$15.85

Fleet Characteristics

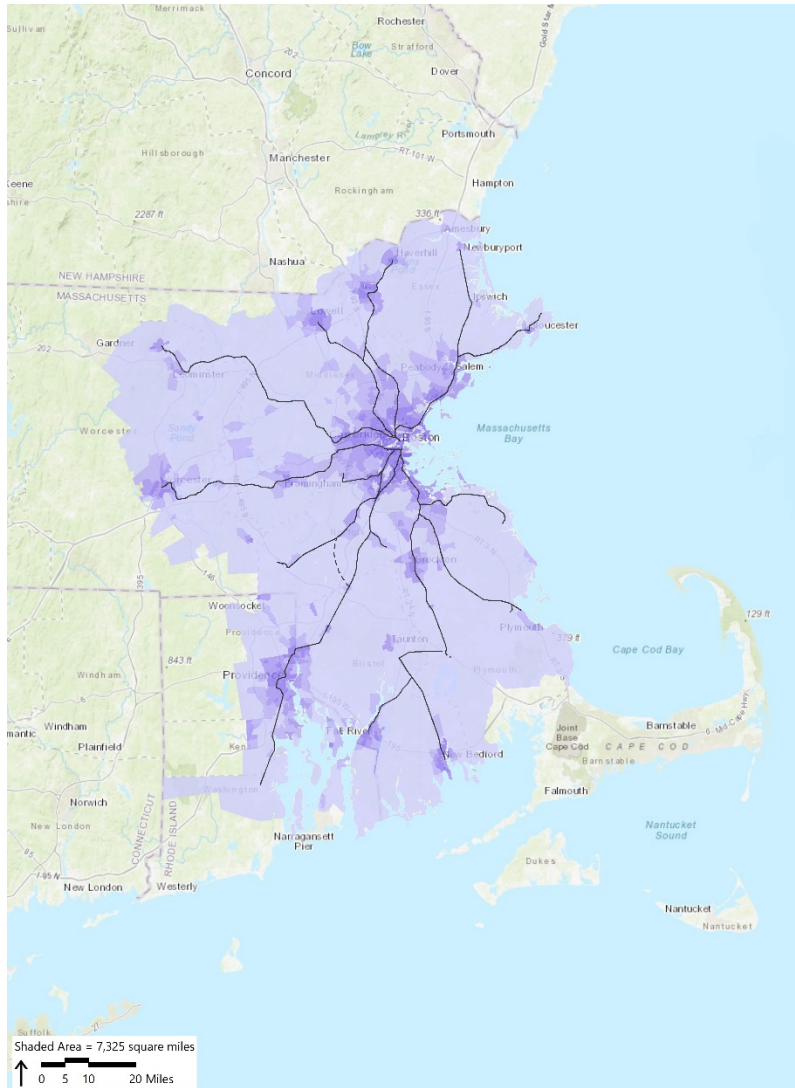
INFORMATION	METROLINK SOURCE	MBTA COMMUTER RAIL	METROLINK RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	External (Amtrak)
Number of Vehicles in Fleet	NTD	480	258
Percent Spare Vehicles	NTD (Derived)	12.3%	24.4%
Average Vehicle Age (Years)	NTD	23.0	13.7
Power Source(s)	NTD	Diesel	Diesel
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	800 ¹⁰

⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

⁹ Metrolink, "Price Finder," <https://www.metrolinktrains.com/ticketsOverview/ticket-info/price-finder/>.

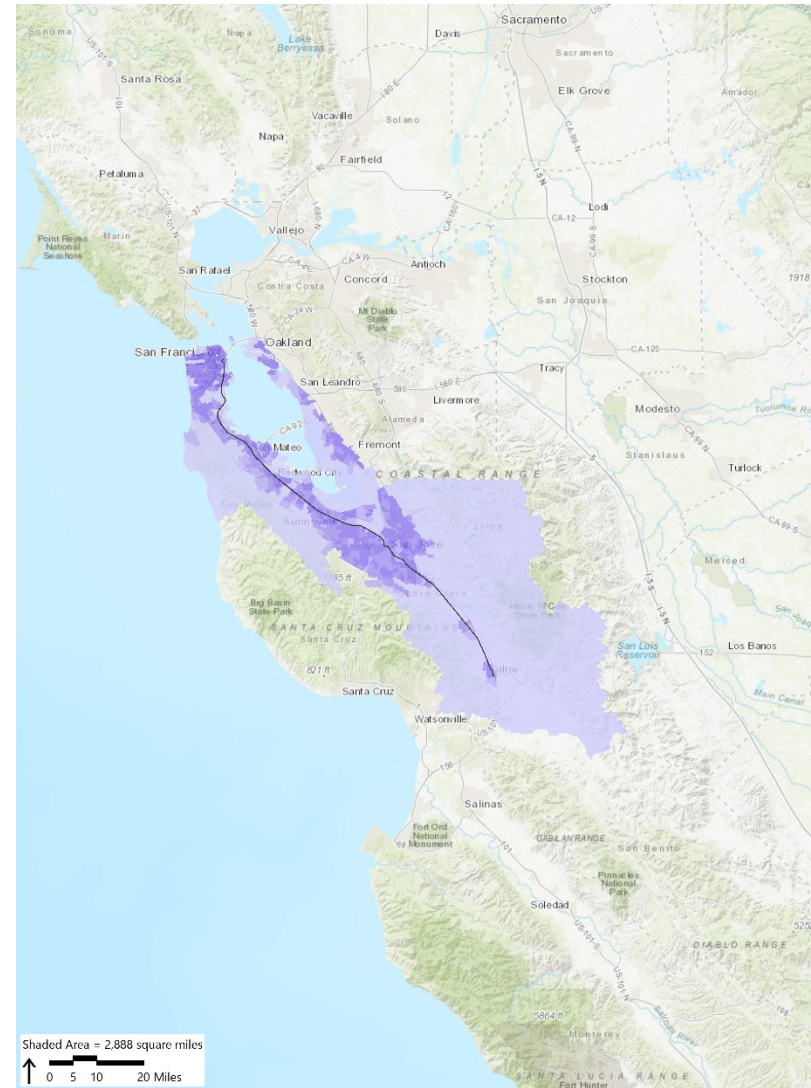
¹⁰ Assumes a typical train consists of six bi-level coaches.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

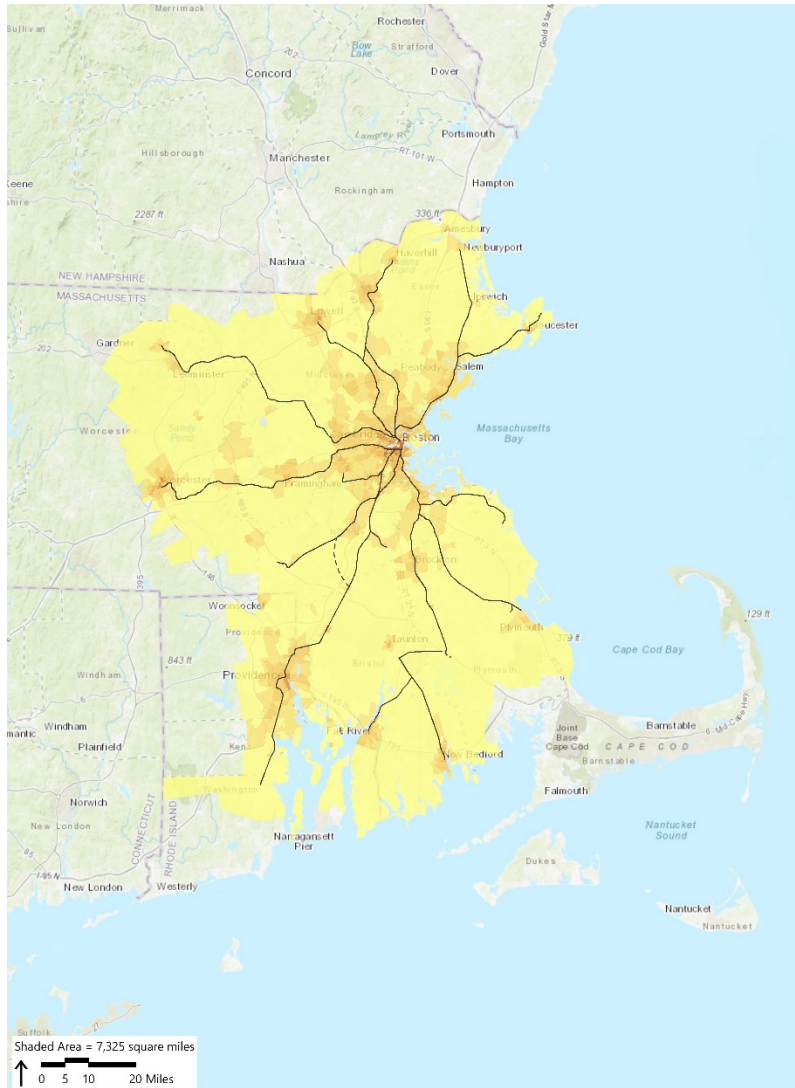
Bay Area Population Density



Source Information: ArcGIS Online, Business Analyst Online,
http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/RR_Commuter_13.html

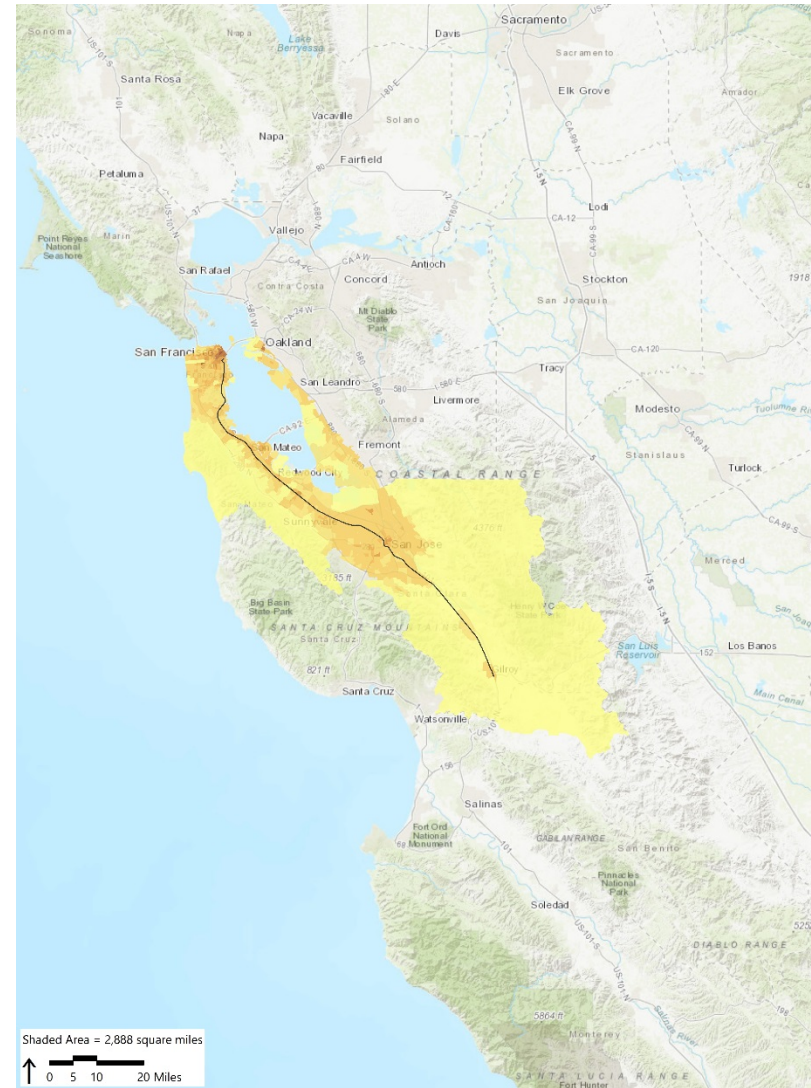
MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Bay Area Employment Density



Source Information: ArcGIS Online, Business Analyst Online,
http://www.dot.ca.gov/hq/tsip/gis/datalibrary/Metadata/RR_Commuter_13.html

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Caltrain

San Francisco Bay Area, California



San Mateo County Transit District operates a single line (Caltrain)¹ connecting San Francisco to San Jose, and extending further south to the City of Gilroy. Caltrain serves this high-density corridor with service levels similar to many MBTA lines, generating strong bi-directional ridership with a high farebox recovery ratio and low operating expenses per passenger. Transit America Services operates Caltrain, with a high on-time performance.

Demographics and Land Use

INFORMATION	CALTRAIN SOURCE	MBTA COMMUTER RAIL	CALTRAIN RAIL
Major City Served	N/A	Boston	San Francisco Bay Area
Population within 1 Mile of Stations	Esri	1,716,012	687,870
Name of UZA	NTD	Boston, MA-NH-RI	San Francisco-Oakland, CA
Size of UZA (sq. miles)	NTD	1,873	524
Population of UZA	NTD	4,181,019	3,281,212
Jobs in Area*	BLS	2,677,320	2,263,090
Average Wage in Area*	BLS	\$64,080	\$69,110
Peak Hours Spent in Congestion per Commuter	Inrix	60	79
Major Geographic Features	System Map ²	Boston Harbor Charles River	Pacific Ocean San Francisco Bay
Mode Split (Drove Alone)* ³	Census	67%	58%
Mode Split (Transit)*	Census	13%	17%

* BLS and Census areas selected to most closely reflect UZA identified by NTD.

¹ San Mateo County Transit District oversees operations of Caltrain, while the Peninsula Corridor Joint Powers Board is the governing entity.

² Caltrain, System Map, <http://www.caltrain.com/stations/systemmap.html>.

³ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



Caltrain

San Francisco Bay Area, California



System Characteristics

INFORMATION	CALTRAIN SOURCE	MBTA COMMUTER RAIL	CALTRAIN RAIL
Number of Lines	System Map	14	1
Length of Longest Line (miles)	SPUR ⁴	63	77
Number of Route Miles	NTD (Derived)	388	77
Number of Track Miles	NTD	697	154
Number of Stations	NTD	138	32
Percent Stations That are Accessible	NTD (Derived)	75%	81%
Annual Unlinked Trips	NTD	33,830,904	18,355,641
Percent of Agency Unlinked Trips	NTD (Derived)	8%	96%
Number of Central Terminals	System Map	2	2 ⁵
Central Terminals in Relation to CBD	San Francisco Planning ^{6,7}	Both in CBD	Both in CBD
On-Time Performance (System-Wide)	Caltrain ⁸	89% (2017)	95% (2017) ⁹
Peak Line Frequency (Most Frequent/Other)	Caltrain Schedules ¹⁰	20 minutes / 25-50 minutes	20 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Caltrain Schedules	40 minutes / 1-2 hours	45 minutes

⁴ San Francisco Planning + Urban Research Association, "Saving Caltrain – For the Long Term: Strategies for Funding and Governing a Critical Regional Rail System," April 6, 2011.

⁵ This considers both San Francisco and San Jose Diridon as central terminals.

⁶ City and County of San Francisco, Planning Department, "San Francisco Zoning Map," October 2017, <http://sf-planning.org/zoning-map>.

⁷ San Francisco Planning + Urban Research Association, "The Future of Downtown San Jose," March 2014.

⁸ Caltrain, "On Time Performance & Delay Mitigation," November 16, 2017, <http://www.caltrain.com/Assets/BAC/pdf/BAC+On+Time+Performance+!26+Delay+Mitigation+11.16.17.pdf>.

⁹ This averages monthly on-time performance for January-October, 2017.

¹⁰ Caltrain, schedules effective October 1, 2017, available at http://www.caltrain.com/schedules/PDF_Schedules.html.



Caltrain

San Francisco Bay Area, California



Operating Characteristics

INFORMATION	CALTRAIN SOURCE	MBTA COMMUTER RAIL	CALTRAIN RAIL
Annual Operating Expenses	NTD	\$403,654,786	\$112,219,456
Farebox Revenues	NTD	\$198,331,440	\$89,104,140
Farebox Recovery	NTD	49.1%	79.4%
Fare Range (Single One-Way Trip) ¹¹	Caltrain Fare Chart ¹²	\$2.25 - \$12.50	\$3.75 - \$15.00
Operating Expenses per Vehicle Revenue Mile	NTD (Derived)	\$17.15	\$15.55
Operating Expenses per Unlinked Passenger Trip	NTD	\$11.93	\$6.11

Fleet Characteristics

INFORMATION	CALTRAIN SOURCE	MBTA COMMUTER RAIL	CALTRAIN RAIL
Fleet Operator (Name, Internal/External)	NTD	External (Keolis)	External (Transit America Services)
Number of Vehicles in Fleet	NTD	480	134
Percent Spare Vehicles	NTD (Derived)	12.3%	21.6% ¹³
Average Vehicle Age (Years)	NTD	23.0	24.6
Power Source(s)	NTD	Diesel	Diesel ¹⁴
Seated Capacity of Trains (Approximate)	NTD, Industry Knowledge	800	900 ¹⁵

¹¹ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

¹² Caltrain, "Fare Chart," <http://www.caltrain.com/Fares/farechart.html>.

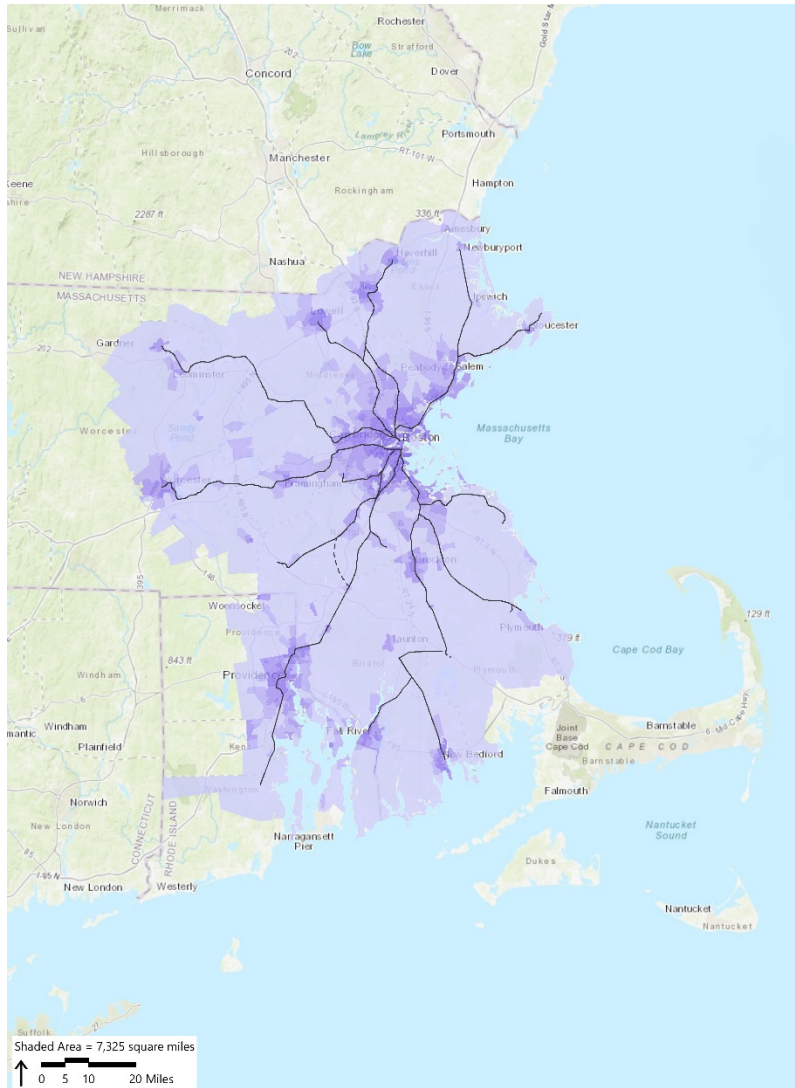
¹³ Caltrain maintains a 24% diesel locomotive spare ratio, 17% cab spare ratio, and 9% trailer spare ratio.

¹⁴ Electrification is now under construction with bi-level Electric Multiple Unit trains on order; some diesel express trains will remain for a time after electrification and all Gilroy service will remain diesel in the long term.

¹⁵ Assumes a typical train consists of six bi-level coaches.

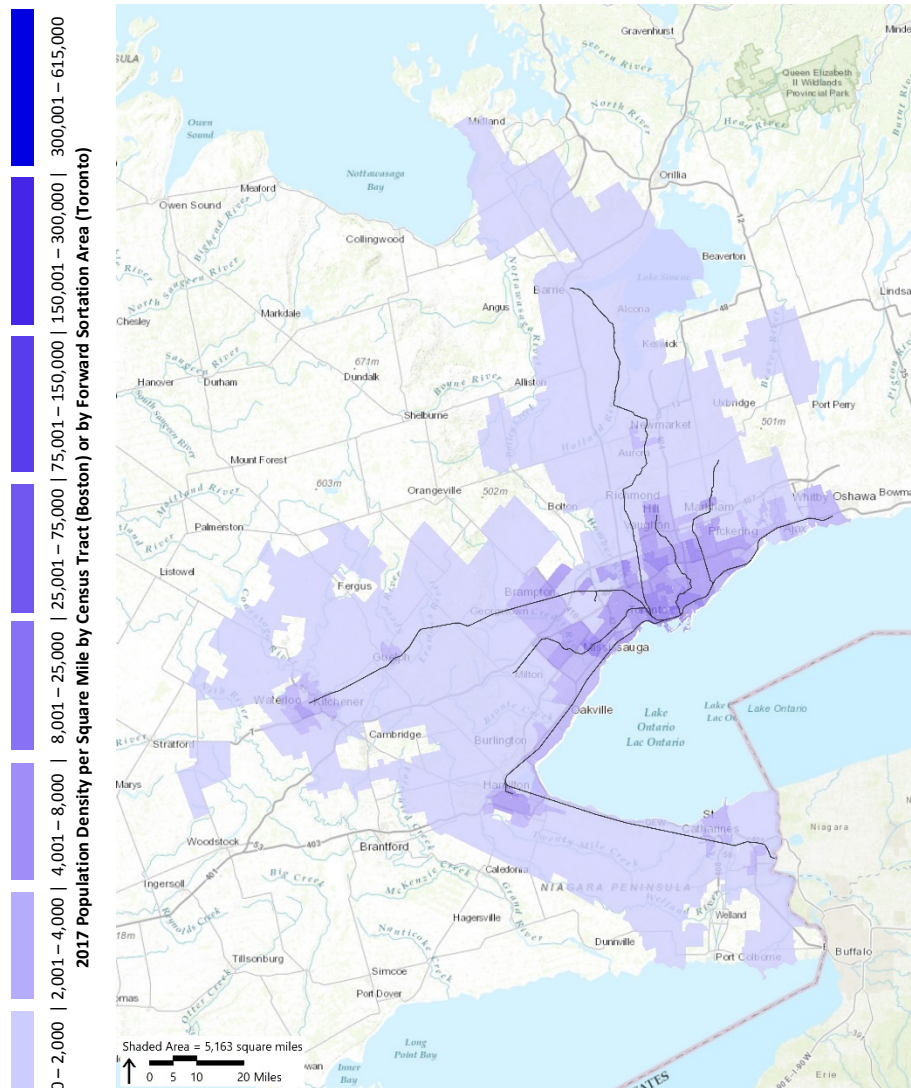


Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

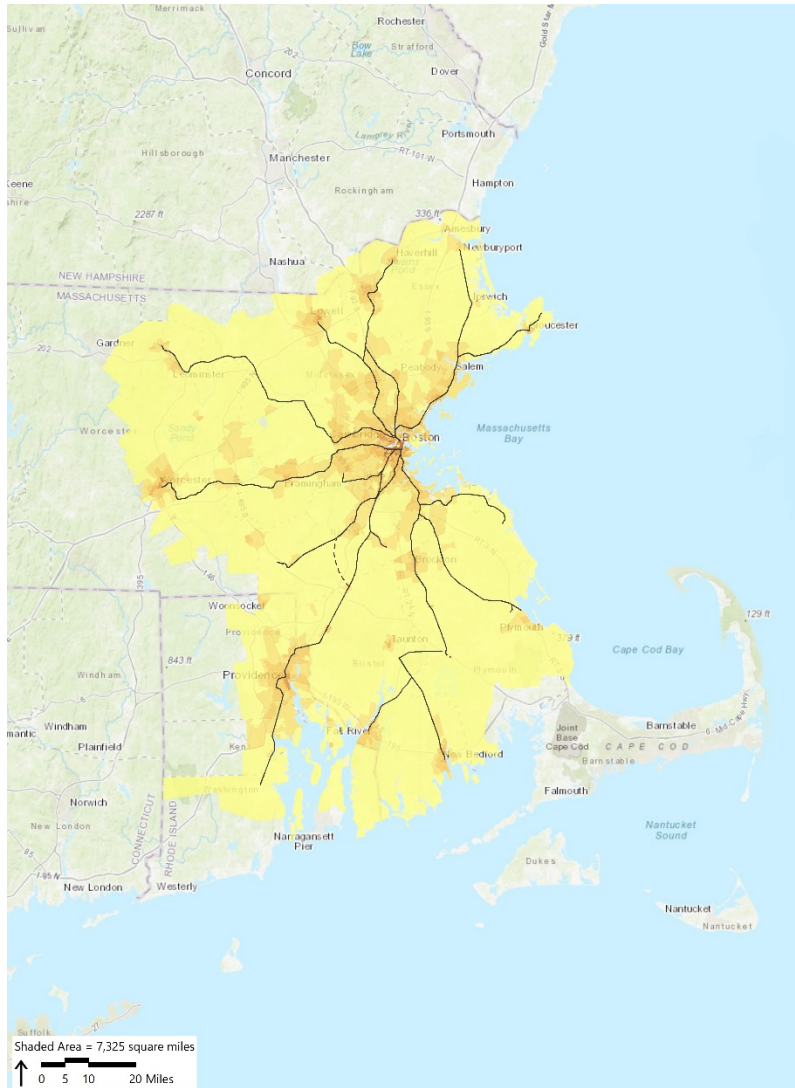
Toronto Population Density



Source Information: ArcGIS Online, Business Analyst Online, GO Transit

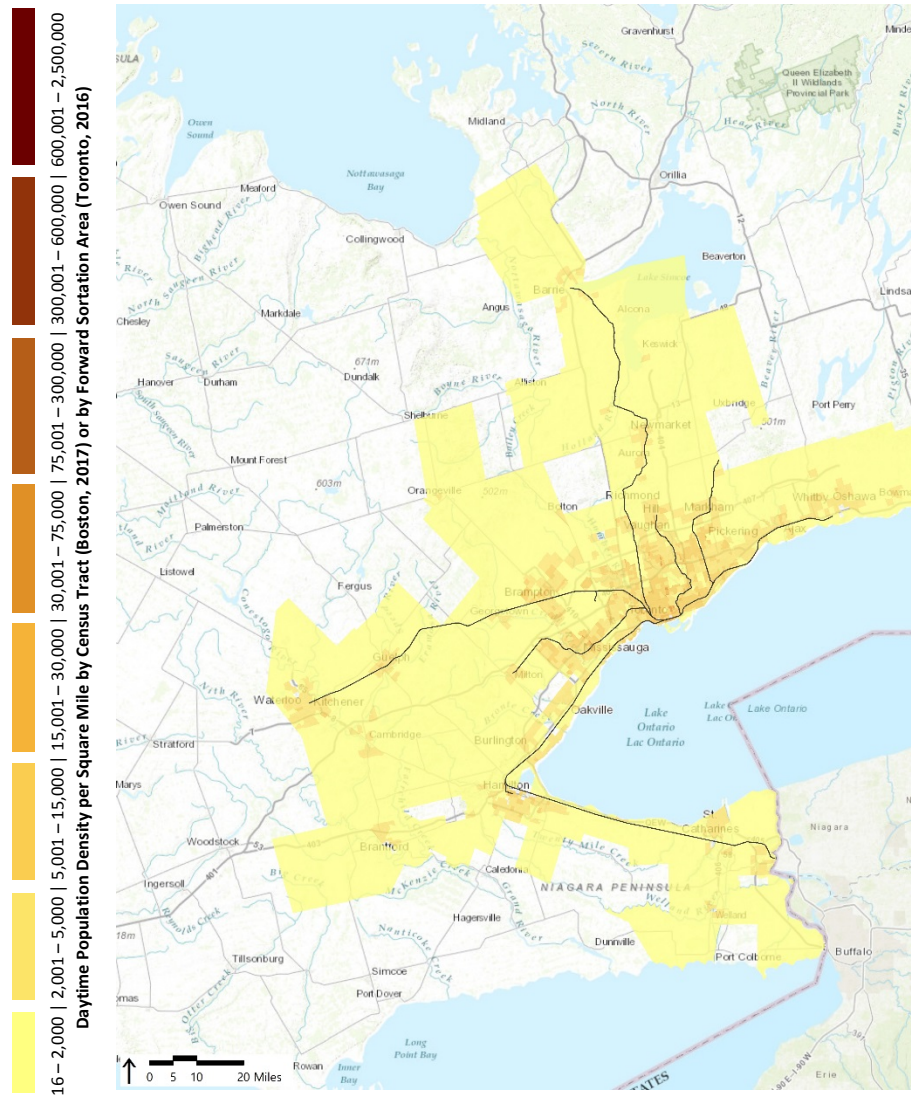
MBTA **TORONTO** MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Toronto Employment Density



Source Information: ArcGIS Online, Business Analyst Online, GO Transit, Statistics Canada 2016 Census

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



GO Transit
Toronto, Canada



Toronto offers many similarities to Boston, including population, labor market and geography. GO Transit has made consistent, incremental improvements since its takeover of commuter rail operations in 1967, adding services and lines and introducing higher capacity, bi-level vehicles. Early on, GO Transit introduced long distance commuter bus services to feed the rail network and provide all day coverage to areas which could not justify or operate beyond peak periods. Since 2000, planning began for a more ambitious expansion that reintroduced all day service to most lines starting in 2007, and the new Big-Move/RER vision approved in 2014 (CAN\$10 billion) outlined all-day, high-frequency service, electrification, route extensions and new stations, and better integration with other transit modes. Design is well underway with a Design-Build-Operate-Maintain (DBOM) style procurement currently underway¹.

Demographics and Land Use

INFORMATION	TORONTO SOURCE	MBTA COMMUTER RAIL	TORONTO GO TRANSIT
Major City Served	N/A	Boston	Toronto
Population within 1 Mile of Stations	Esri	1,716,012	1,618,941
Name of UZA	N/A	Boston, MA-NH-RI	Toronto
Size of UZA (sq. miles)*	Statistics Canada	1,873	243
Population of UZA*	Statistics Canada	4,181,019	2,731,571
Jobs in Area	City of Toronto	2,677,320	1,461,020
Average Wage in Area	Statistics Canada	\$64,080	\$61,342 ²
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ³	34 mins
Major Geographic Features	System Map	Boston Harbor Charles River	Lake Ontario
Mode Split (Drove Alone) ⁴	Statistics Canada	67%	59%
Mode Split (Transit)	Statistics Canada	13%	23%

* OECD data provides most consistent set of econometric data for international comparisons – Statistics Canada and City of Toronto data has been used to supplement. UZA internationally will typically be classified as urban area.

¹ <http://www.infrastructureontario.ca/Request-for-Qualifications-Issued-RER-GO-Regional-Express-Rail-Corridor/>

² Using exchange rate of \$1.00 CAD = \$0.78 USD.

³ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁴ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



GO Transit
Toronto, Canada



System Characteristics

INFORMATION	TORONTO SOURCE	MBTA COMMUTER RAIL	TORONTO GO TRANSIT
Number of Lines	Go Transit	14	7
Length of Longest Line (miles)	Go Transit	63	63.8 ⁵
Number of Route Miles	Go Transit	388	341
Number of Track Miles	Not publicly available	697	N/A
Number of Stations	Go Transit	138	66
Percent Stations That are Accessible	Go Transit	75%	~92% ⁶
Annual Unlinked Trips	Go Transit	33,830,904	59,376,096
Percent of Agency Unlinked Trips	Go Transit	8%	81%
Number of Central Terminals	Go Transit	2	1
Central Terminals in Relation to CBD	Go Transit	Both in CBD	Within the CBD
On-Time Performance (System-Wide)	Go Transit	89% (2017)	95%
Peak Line Frequency (Most Frequent/Other)	Go Transit	20 minutes / 25-50 minutes	15 minutes / 30 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Go Transit	40 minutes / 1-2 hours	30 minutes / N/A ⁷

⁵ Kitchener line.

⁶ Upgrades taking place to make this 100%.

⁷ Regular headways maintained with buses in Off-Peak.

MBTA TORONTO MNR LIRR CATALUNYA NJ TRANSIT SEPTA METRA METROLINK CALTRAIN PARIS LONDON MANCHESTER BERLIN MELBOURNE



GO Transit
Toronto, Canada



Operating Characteristics

INFORMATION	TORONTO SOURCE	MBTA COMMUTER RAIL	TORONTO GO TRANSIT
Annual Operating Expenses (US Dollars)	Go Transit	\$403,654,786	\$605,400,000 ⁸
Farebox Revenues (US Dollars)	Go Transit	\$198,331,440	\$374,000,000
Farebox Recovery	Go Transit	49.1%	62.0%
Fare Range (Single One-Way Trip) ⁹	Go Transit	\$2.25 - \$12.50	\$3.90 - \$12.26
Operating Expenses per Vehicle Revenue Mile	Not Publicly Available	\$17.15	N/A ¹⁰
Operating Expenses per Unlinked Passenger Trip	Go Transit	\$11.93	\$8.80 ¹¹

Fleet Characteristics

INFORMATION	TORONTO SOURCE	MBTA COMMUTER RAIL	TORONTO GO TRANSIT
Fleet Operator (Name, Internal/External)	Go Transit	External (Keolis)	External (Bombardier)
Number of Vehicles in Fleet	Go Transit	480	75 Locomotives, 725 coaches
Percent Spare Vehicles	Go Transit	12.3%	~15%
Average Vehicle Age (Years)	Go Transit	23.0	~24
Power Source(s)	Go Transit	Diesel	Diesel
Seated Capacity of Trains (Approximate)	Go Transit	800	1,804

⁸ Includes all modes for Go Transit.

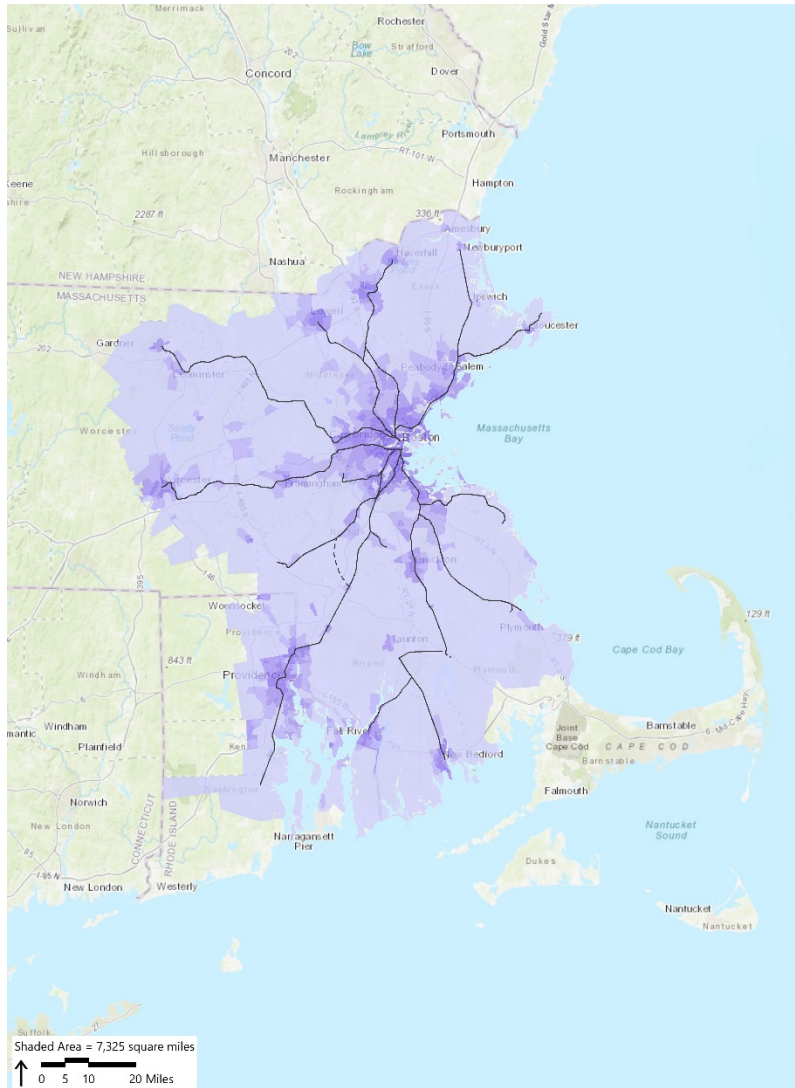
⁹ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

¹⁰ Go Transit does not publish the number of vehicle revenue miles per year.

¹¹ The operating costs quoted include bus costs, hence bus passengers have also been included in this calculation (meaning it does not simply equal the reported operating costs divided by the reported passenger trips).

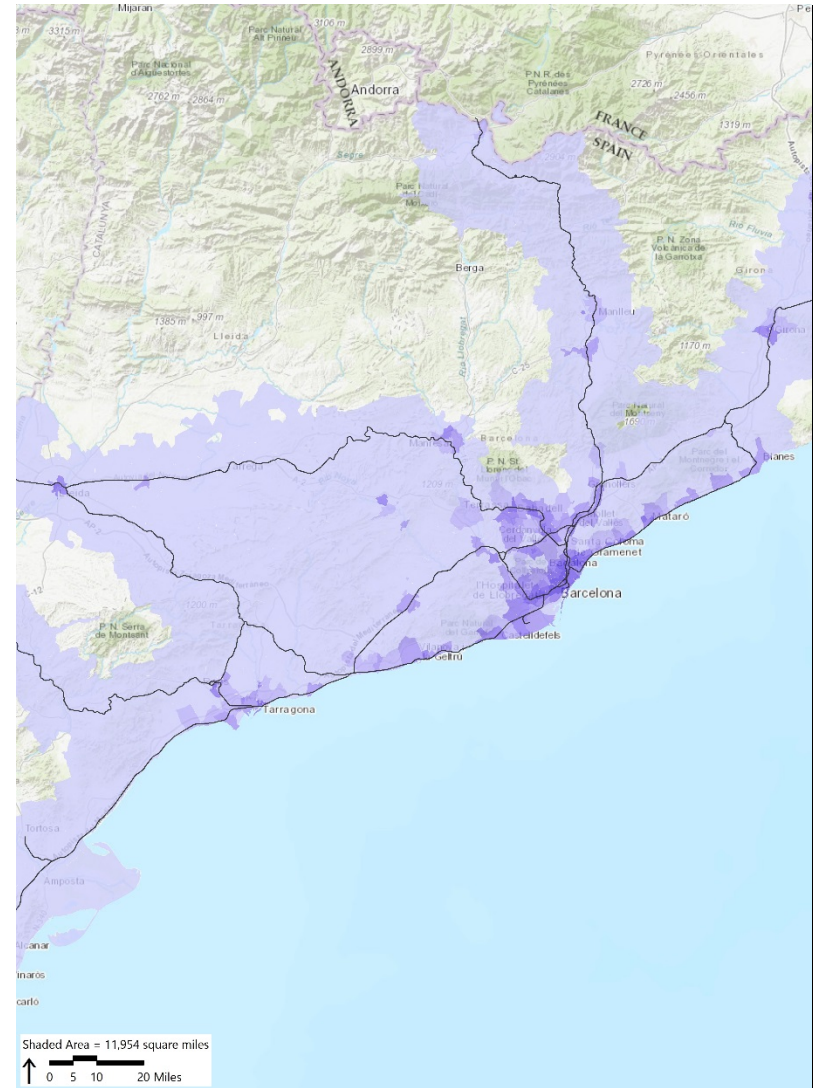
MBTA TORONTO
MNR CATALUNYA
LIRR LONDON
NJ TRANSIT PARIS
SEPTA LONDON
METRA MANCHESTER
METROLINK BERLIN
CALTRAIN MELBOURNE

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

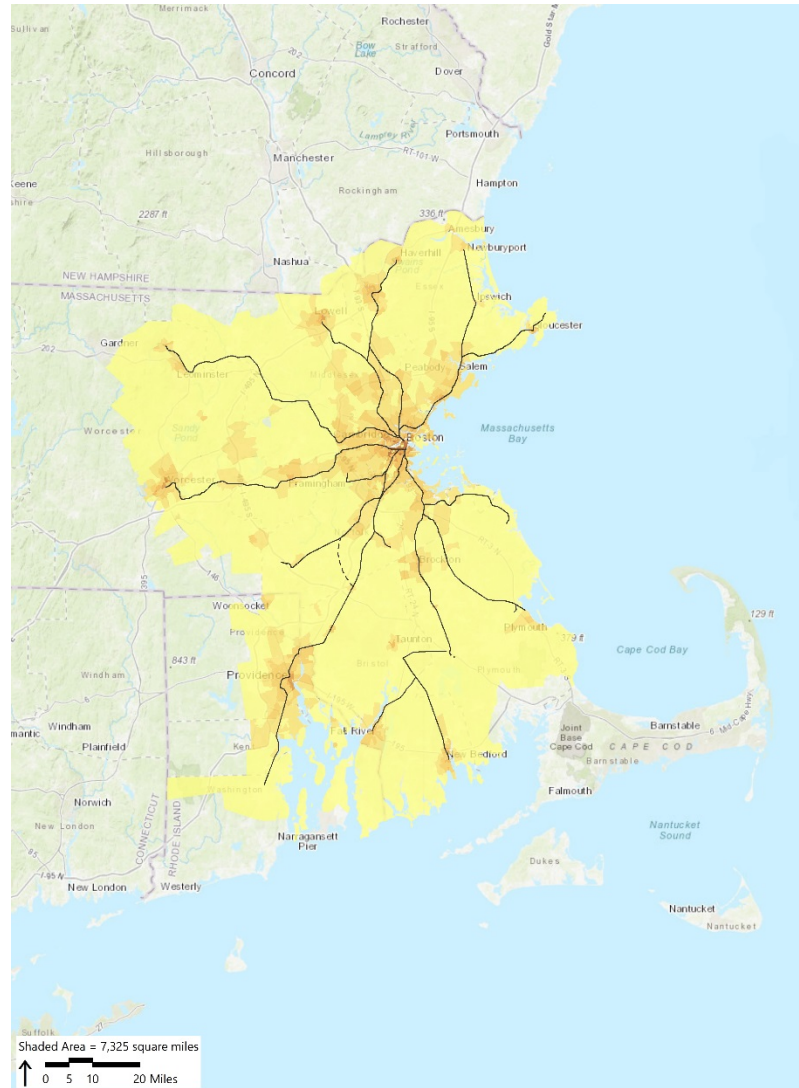
Barcelona Population Density



Source Information: ArcGIS Online, Business Analyst Online, Generalitat de Catalunya Departament de Territori i Sostenibilitat – “Graf d’infraestructures terrestres”

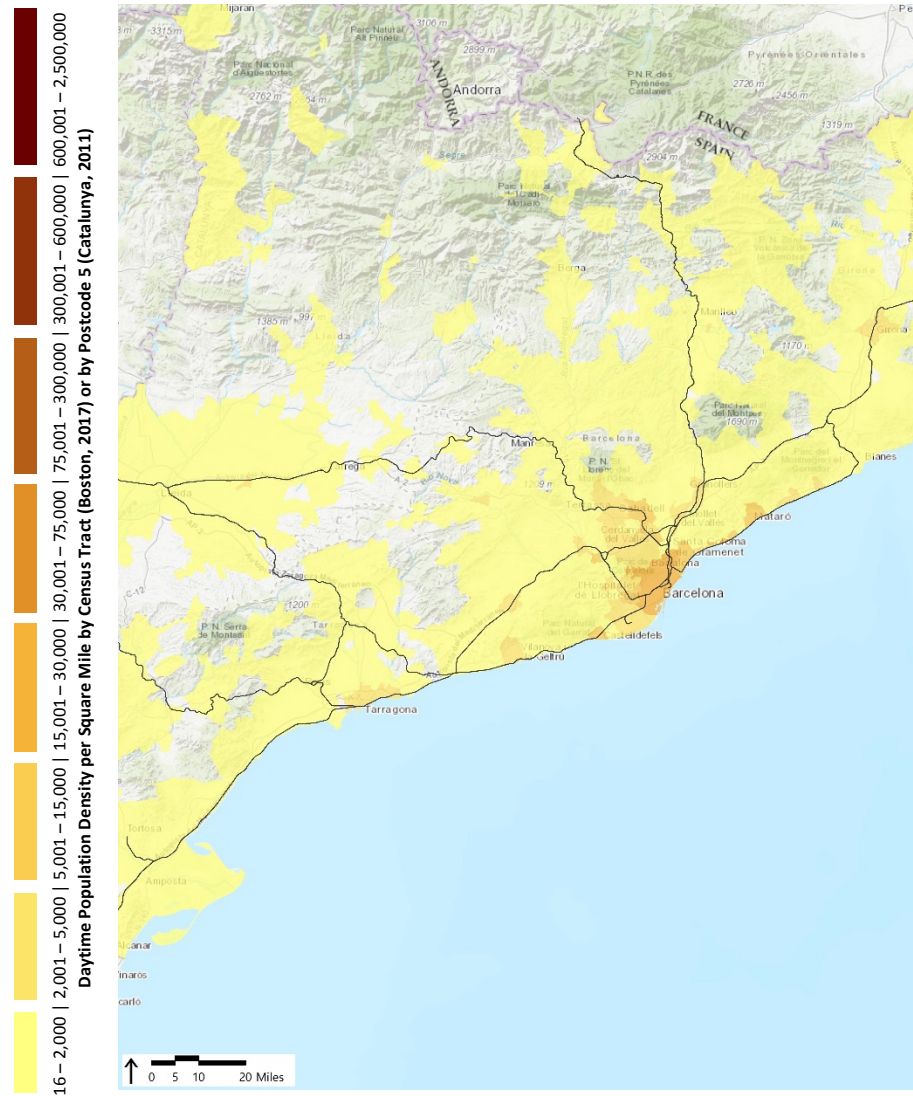
MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Barcelona Employment Density



Source Information: ArcGIS Online, Business Analyst Online, Generalitat de Catalunya Departament de Territori i Sostenibilitat – “Graf d’infraestructures terrestres”, Instituto Nacional de Estadística Population and Housing Census 2011

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Rodalies Barcelona Barcelona, Spain



Catalunya and Barcelona have a similar geography to Boston, being bordered by water on one side. Only limited data is readily publicly available on many aspects of the system.

Demographics and Land Use

INFORMATION	RODALIES SOURCE	MBTA COMMUTER RAIL	RODALIES BARCELONA
Major City Served	N/A	Boston	Barcelona, Catalonia, Spain
Population within 1 Mile of Stations	Esri	1,716,012	N/A
Name of UZA	N/A	Boston, MA-NH-RI	Barcelona
Size of UZA (sq. miles)*	OECD	1,873	160
Population of UZA*	OECD	4,181,019	2,972,343
Jobs in Area	Barcelona City Council	2,677,320	1,060,000
Average Wage in Area	Expatfocus.com	\$64,080	\$40,992 ¹
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ²	31 mins
Major Geographic Features	System Map	Boston Harbor Charles River	Mediterranean Sea (West), Collserola Mountains (East)
Mode Split (Drove Alone) ³	EMTA ⁴	67%	33% ⁵
Mode Split (Transit)	EMTA	13%	20%

* OECD data provides most consistent set of econometric data for international comparisons. UZA internationally will typically be classified as urban area.

¹ Using exchange rate of €1.00 = \$1.23.

² This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

³ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

⁴ European Metropolitan Transport Authorities.

⁵ Drivers & Passengers.

TORONTO MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
 CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Rodalies Barcelona Barcelona, Spain



System Characteristics

INFORMATION	RODALIES SOURCE	MBTA COMMUTER RAIL	RODALIES BARCELONA
Number of Lines	Rodalies de Catalunya	14	9 - Line 2 currently split
Length of Longest Line (miles)	Rodalies de Catalunya	63	100
Number of Route Miles	Rodalies de Catalunya	388	290
Number of Track Miles	Rodalies de Catalunya	697	580
Number of Stations	Rodalies de Catalunya	138	109
Percent Stations That are Accessible	Rodalies de Catalunya	75%	>75%
Annual Unlinked Trips	Rodalies de Catalunya	33,830,904	108,300,000 ⁶
Percent of Agency Unlinked Trips	Rodalies de Catalunya	8%	100% ⁷
Number of Central Terminals	Rodalies de Catalunya	2	3
Central Terminals in Relation to CBD	Rodalies de Catalunya	Both in CBD	All in CBD
On-Time Performance (System-Wide)	Politikon.es	89% (2017)	94%
Peak Line Frequency (Most Frequent/Other)	Rodalies de Catalunya	20 minutes / 25-50 minutes	10 minutes / 30 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Rodalies de Catalunya	40 minutes / 1-2 hours	10 minutes / 30 minutes

⁶ Including regional services.

⁷ Other modes run by other agencies.

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT METRA METROLINK CALTRAIN
MANCHESTER BERLIN MELBOURNE



Rodalies Barcelona Barcelona, Spain



Operating Characteristics

INFORMATION	RODALIES SOURCE	MBTA COMMUTER RAIL	RODALIES BARCELONA
Annual Operating Expenses	RENFE	\$403,654,786	\$391,000,000
Farebox Revenues	RENFE	\$198,331,440	\$223,000,000
Farebox Recovery	Derived	49.1%	56.9%
Fare Range (Single One-Way Trip) ⁸	EMTA	\$2.25 - \$12.50	\$2.65 - \$9.35
Operating Expenses per Vehicle Revenue Mile	Not publicly available	\$17.15	N/A
Operating Expenses per Unlinked Passenger Trip	Derived	\$11.93	\$3.61

Fleet Characteristics

INFORMATION	RODALIES SOURCE	MBTA COMMUTER RAIL	RODALIES BARCELONA
Fleet Operator (Name, Internal/External)	Rodalies de Catalunya	External (Keolis)	Renfe (Spanish State Rail Operator)
Number of Vehicles in Fleet	Not publicly available	480	N/A
Percent Spare Vehicles	Not publicly available	12.3%	N/A
Average Vehicle Age (Years)	Rodalies de Catalunya	23.0	~22 ⁹
Power Source(s)	Rodalies de Catalunya	Diesel	Electric
Seated Capacity of Trains (Approximate)	Rodalies de Catalunya	800	~725 ¹⁰

⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

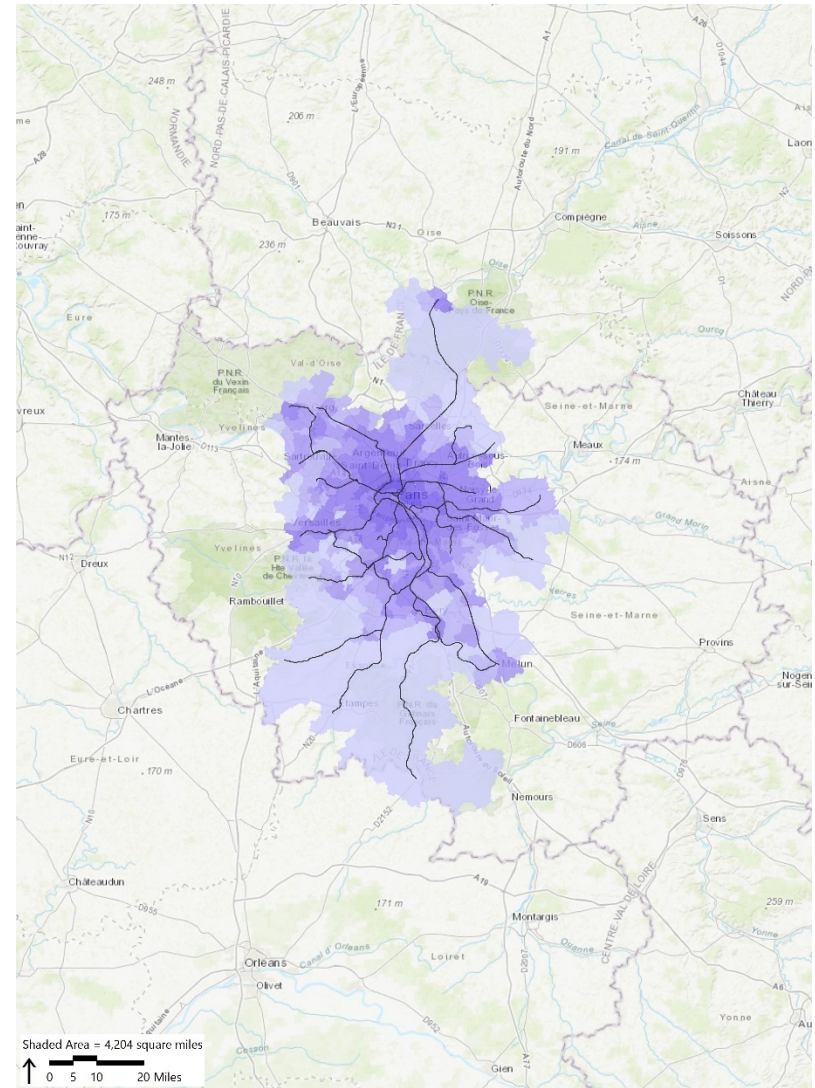
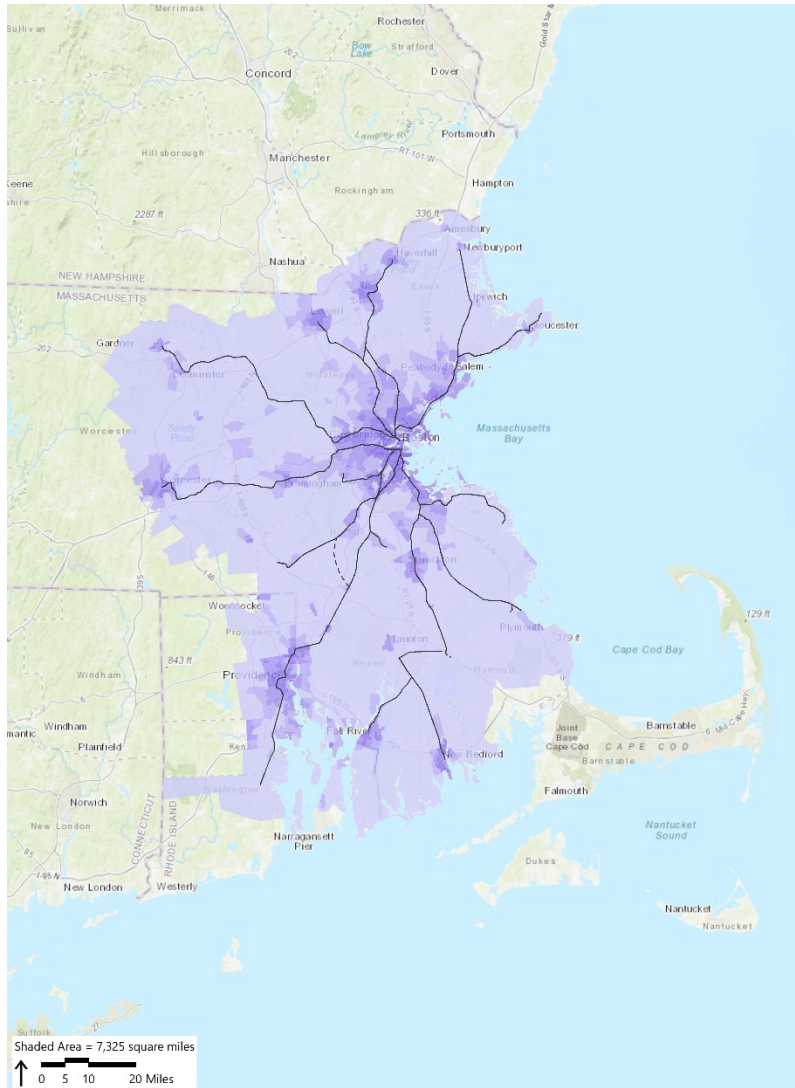
⁹ Series 447 & 450: 1990-2; Civia: 2000.

¹⁰ Various capacities: 207 per vehicle in 2 to 5 vehicle trains.

Boston Population Density

Paris Population Density

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Source Information: ArcGIS Online, Business Analyst Online, Le Syndicat des Transports d'Île-de-France Open Data - <https://opendata.stif.info/page/home/>
Employment data unavailable



Paris RER Paris, France



The Réseau Express Regional (RER) is run by two operators who provide varying levels of data publicly. The RER is closely integrated with the Paris Metro, so the passenger flow is different from the MBTA system. Best available data have been provided in this desktop review although in some cases, such as select operating characteristics, it is not possible through a desktop review to separate RER from Metro data.

Demographics and Land Use

INFORMATION	PARIS SOURCE	MBTA COMMUTER RAIL	PARIS RER
Major City Served	N/A	Boston	Paris, France
Population within 1 Mile of Stations	Esri	1,716,012	6,831,468 ¹
Name of UZA	N/A	Boston, MA-NH-RI	Paris, France
Size of UZA (sq. miles)*	OECD	1,873	933
Population of UZA*	OECD	4,181,019	2,229,000
Jobs in Area*	OECD	2,677,320	5,746,030
Average Wage in Area	Payscale.com	\$64,080	\$60,110 ²
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ³	40 mins
Major Geographic Features	System Map	Boston Harbor Charles River	River Seine & Peripherique (urban motorway)
Mode Split (Drove Alone) ⁴	EMTA ⁵	67%	38%
Mode Split (Transit)	EMTA	13%	20%

* OECD data provides most consistent set of econometric data for international comparisons. UZA internationally will typically be classified as urban area.

¹ Includes population within one mile of rail stations within shaded area.

² Using exchange rate of €1.00 = \$1.23.

³ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁴ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

⁵ European Metropolitan Transport Authorities.



Paris RER
Paris, France



System Characteristics

INFORMATION	PARIS SOURCE	MBTA COMMUTER RAIL	PARIS RER
Number of Lines	EMTA	14	13 lines ⁶
Length of Longest Line (miles)	EMTA	63	118
Number of Route Miles	EMTA	388	900
Number of Track Miles	EMTA	697	1,800
Number of Stations	EMTA	138	449
Percent Stations That are Accessible	EMTA	75%	>75%
Annual Unlinked Trips	EMTA	33,830,904	1,441,000,000 (2016) ⁷
Percent of Agency Unlinked Trips	EMTA	8%	25%
Number of Central Terminals	EMTA	2	N/A (cross-city urban rail lines)
Central Terminals in Relation to CBD	EMTA	Both in CBD	N/A
On-Time Performance (System-Wide)		89% (2017)	90%
Peak Line Frequency (Most Frequent/Other)	EMTA	20 minutes / 25-50 minutes	5 minutes ⁸
Off-Peak Line Frequency (Most Frequent/Other)	EMTA	40 minutes / 1-2 hours	5 minutes

⁶ RER - Not including other commuter rail.

⁷ Includes RER and Metro.

⁸ >12 trains per hour (through Central Paris).

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT METRA METROLINK CALTRAIN
MELBOURNE BERLIN MANCHESTER



Paris RER
Paris, France



Operating Characteristics

INFORMATION	PARIS SOURCE	MBTA COMMUTER RAIL	PARIS RER
Annual Operating Expenses	EMTA	\$403,654,786	\$11,569,000,000 ⁹
Farebox Revenues	EMTA	\$198,331,440	\$4,400,000,000
Farebox Recovery	EMTA	49.1%	38%
Fare Range (One-Way Trip) ¹⁰	EMTA	\$2.25 - \$12.50	\$2.30 - \$12.70
Operating Expenses per Vehicle Revenue Mile	Not available publicly	\$17.15	N/A
Operating Expenses per Unlinked Passenger Trip	EMTA	\$11.93	\$8.03

Fleet Characteristics

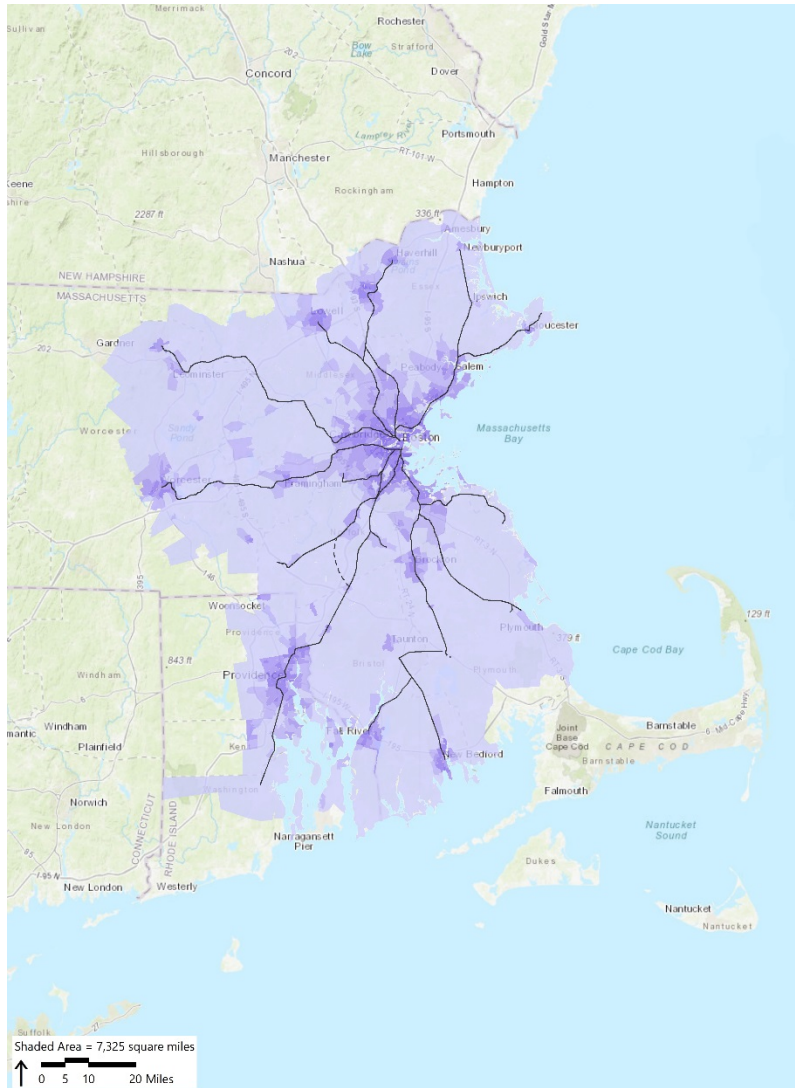
INFORMATION	PARIS SOURCE	MBTA COMMUTER RAIL	PARIS RER
Fleet Operator (Name, Internal/External)	EMTA	External (Keolis)	Paris RATP & SNCF
Number of Vehicles in Fleet	EMTA	480	1,182
Percent Spare Vehicles	Not available publicly	12.3%	N/A
Average Vehicle Age (Years)	Not available publicly	23.0	N/A
Power Source(s)	EMTA	Diesel	Electric ¹¹
Seated Capacity of Trains (Approximate)	EMTA	800	> 1,500

⁹ Includes Metro & Bus.

¹⁰ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

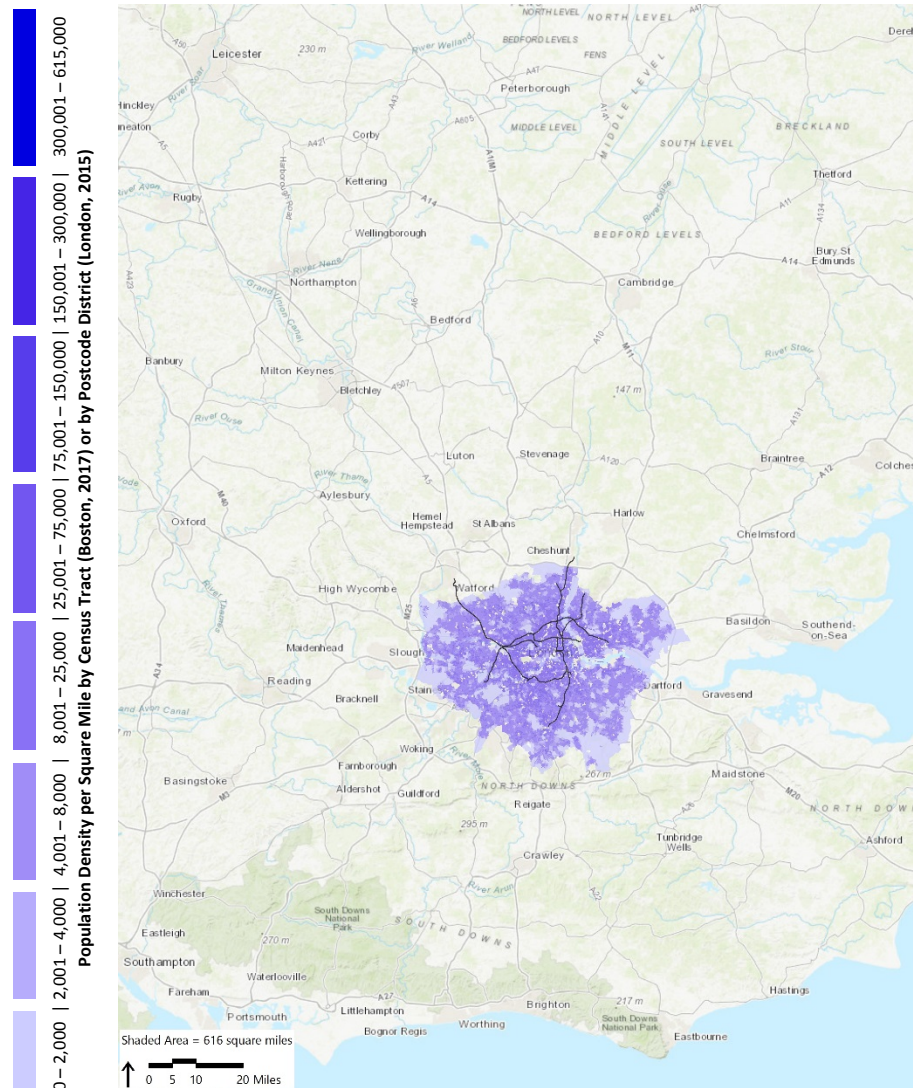
¹¹ Primarily Overhead.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

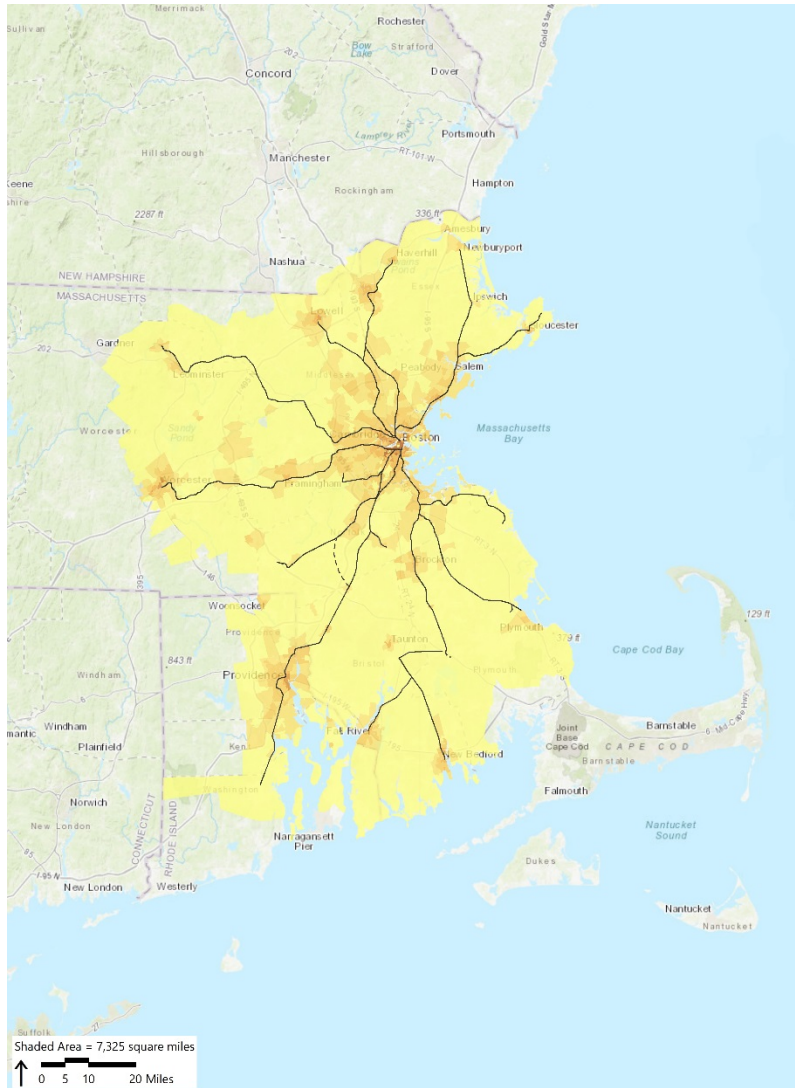
London Population Density



Source Information: ArcGIS Online, Business Analyst Online, Open Street Map Great Britain, Contains OS data © Crown copyright and database right (2017), Office for National Statistics Local Authority Districts (December 2015) Full Clipped Boundaries in Great Britain, Nomis

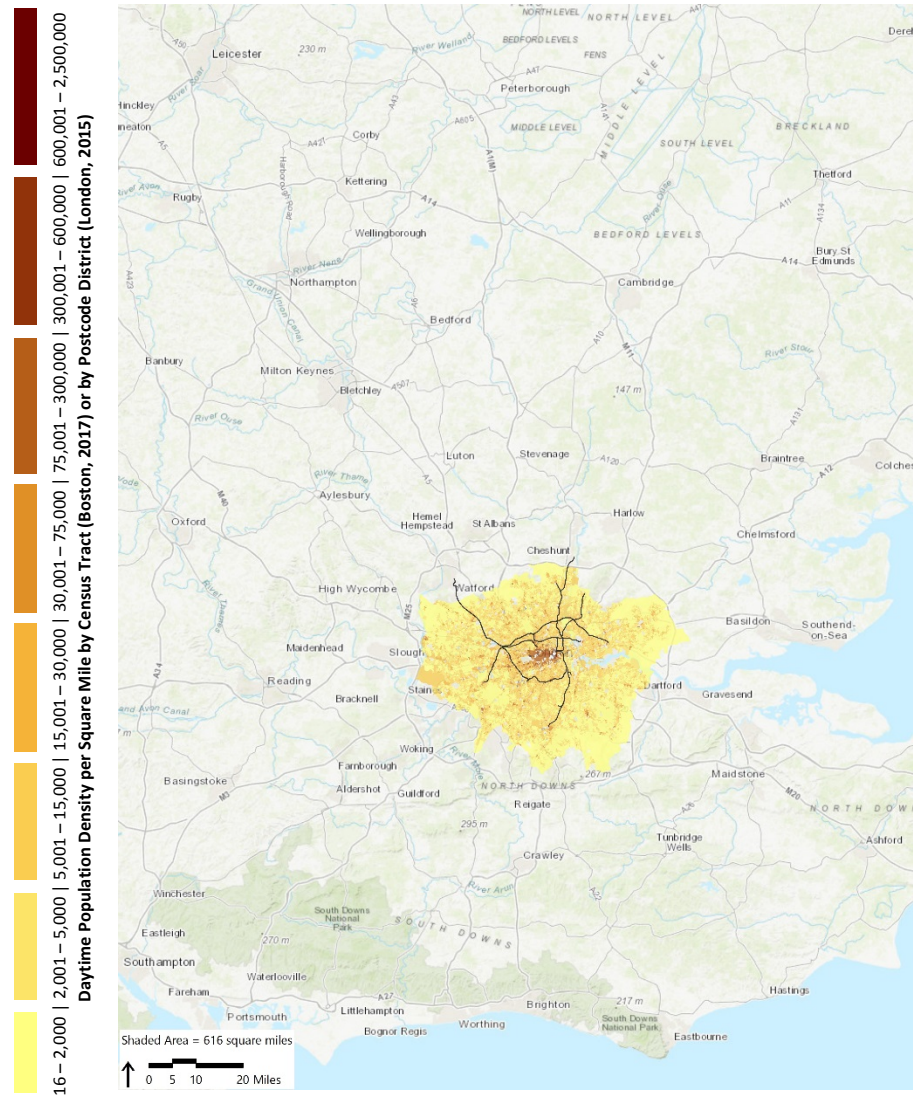
MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

London Employment Density



Source Information: ArcGIS Online, Business Analyst Online, Open Street Map Great Britain, Contains OS data © Crown copyright and database right (2017), Office for National Statistics Local Authority Districts (December 2015) Full Clipped Boundaries in Great Britain, Nomis

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



London Overground London, United Kingdom



The success of the London Overground is well known, taking a railway from 1850 and transforming it, driving growth. Performance is the focus of most services, while costs and revenues have seen significant improvements over the past 10 to 15 years. Transport for London (TfL) and Department for Transport (DfT) have a variety of different types of operating contracts.

Demographics and Land Use

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON OVERGROUND
Major City Served	N/A	Boston	London, UK
Population within 1 Mile of Stations	Esri	1,716,012	3,429,647 ¹
Name of UZA	OECD	Boston, MA-NH-RI	Greater London
Size of UZA (sq. miles)*	OECD	1,873	606
Population of UZA*	OECD	4,181,019	8,800,000
Jobs in Area*	Office for National Statistics	2,677,320	5,909,000
Average Wage in Area*	Office for National Statistics	\$64,080	\$48,800 ²
Peak Hours Spent in Congestion per Commuter	TomTom Traffic Data (Derived)	29 mins ³	40 mins
Major Geographic Features	System Map	Boston Harbor Charles River	River Thames M25 (London boundary)
Mode Split (Drove Alone)** ⁴	Transport for London	67%	7%
Mode Split (Transit)**	Transport for London	13%	44%

* OECD data provides most consistent set of econometric data for international comparisons – UK Government Office for National Statistics (ONS) has been used to supplement. UZA internationally will typically be classified as urban area.

** Transport for London (TfL) data – beyond Greater London, UK Department for Transport data is used.

¹ Includes population within one mile of London Overground rail stations within shaded area.

² \$1.40 to £1-pound conversion assumed.

³ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁴ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



London Overground

London, United Kingdom



System Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON OVERGROUND
Number of Lines	Transport for London	14	9
Length of Longest Line (miles)	Transport for London	63	N/A - Circular service ⁵
Number of Route Miles	Transport for London	388	103
Number of Track Miles	Transport for London	697	206
Number of Stations	Transport for London	138	112
Percent Stations That are Accessible	Transport for London	75%	51% (75% by 2023)
Annual Unlinked Trips	Office of Rail and Road	33,830,904	188,780,000 (2017)
Percent of Agency Unlinked Trips	Transport for London	8%	4.7%
Number of Central Terminals	System Map	2	2 + circular service
Central Terminals in Relation to CBD	System Map	Both in CBD	Both in CBD
On-Time Performance (System-Wide)	Office of Rail and Road	89% (2017)	94.8% (2017)
Peak Line Frequency (Most Frequent/Other)	Transport for London	20 minutes / 25-50 minutes	7.5 minutes / 15 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Transport for London	40 minutes / 1-2 hours	10 minutes / 15 minutes

⁵ Primarily a circular/orbital network with some arterial links into the CBD



London Overground London, United Kingdom



Operating Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON OVERGROUND
Annual Operating Expenses	Office of Rail and Road	\$403,654,786	\$411,700,000 (2017)
Farebox Revenues	Office of Rail and Road	\$198,331,440	\$321,600,000 (2017)
Farebox Recovery	Office of Rail and Road	49.1%	78% ⁶ (less than 50% in 2007)
Fare Range (Single One-Way Trip) ⁷	Transport for London	\$2.25 - \$12.50	\$2.10 - \$7.40 (\$2.40 - \$12.00 rush hours)
Operating Expenses per Vehicle Revenue Mile	Office of Rail and Road	\$17.15	\$19.30
Operating Expenses per Unlinked Passenger Trip	Office of Rail and Road	\$11.93	\$2.18

Fleet Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON OVERGROUND
Fleet Operator (Name, Internal/External)	Transport for London	External (Keolis)	External (Arriva)
Number of Vehicles in Fleet	Transport for London	480	425
Percent Spare Vehicles	Transport for London	12.3%	<10%
Average Vehicle Age (Years)	Transport for London	23.0	<10 years
Power Source(s)	Transport for London	Diesel	Electric (by end 2018)
Seated Capacity of Trains (Approximate)	Transport for London	800	186 seats + >420 standing

⁶ Projected to break even by 2023.

⁷ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.



London Consolidated (8 Operators)

London, United Kingdom



Demographics and Land Use

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON NJ TRANSIT SEPTA METRA MANCHESTER BERLIN MELBOURNE CALTRAIN METROLINK

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON CONSOLIDATED (8 OPERATORS)
Major City Served	N/A	Boston	London, UK
Population within 1 Mile of Stations	Esri	1,716,012	13,915,705 ¹
Name of UZA	OECD	Boston, MA-NH-RI	Greater London
Size of UZA (sq. miles)*	OECD	1,873	606
Population of UZA*	OECD	4,181,019	8,800,000
Jobs in Area	Office for National Statistics	2,677,320	5,909,000
Average Wage in Area	Office for National Statistics	\$64,080	\$48,800 ²
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ³	40 mins
Major Geographic Features	System Map	Boston Harbor Charles River	River Thames M25 (London boundary)
Mode Split (Drove Alone) ⁴	Transport for London	67%	7%
Mode Split (Transit)	Transport for London	13%	44%

* OECD data provides most consistent set of econometric data for international comparisons – UK Government Office for National Statistics (ONS) has been used to supplement. UZA internationally will typically be classified as urban area.

¹ Includes population within one mile of rail stations within a defined boundary, with an extent reaching beyond Greater London. Statistics for Greater London are provided to approximate area demographics and land use characteristics.

² \$1.40 to £1-pound conversion assumed.

³ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁴ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



London Consolidated (8 Operators) London, United Kingdom



System Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON CONSOLIDATED (8 OPERATORS)
Number of Lines	Transport for London	14	>60
Length of Longest Line (miles)	Transport for London	63	~60 ⁵
Number of Route Miles	Transport for London	388	2,671 (25% of UK rail network)
Number of Track Miles	Transport for London	697	5,342 ⁶
Number of Stations	Transport for London	138	915
Percent Stations That are Accessible	Transport for London	75%	>75%
Annual Unlinked Trips	Office of Rail and Road	33,830,904	1,100,000,000 (2017)
Percent of Agency Unlinked Trips	Transport for London	8%	N/A
Number of Central Terminals	System Map	2	15 (6 with through services)
Central Terminals in Relation to CBD	System Map	Both in CBD	All in CBD
On-Time Performance (System-Wide)	Office of Rail and Road	89% (2017)	>85% (2017)
Peak Line Frequency (Most Frequent/Other)	Transport for London	20 minutes / 25-50 minutes	15 minutes / 30 minutes ⁷
Off-Peak Line Frequency (Most Frequent/Other)	Transport for London	40 minutes / 1-2 hours	15 minutes / 30 minutes ⁸

⁵ Ashford, Kent, taken as reasonable estimation of max typical commuting length; actual rail lines extend significantly further.

⁶ Excluding fast lines.

⁷ Typical frequency on outer branches.

⁸ Typical frequency on outer branches (similar to peak (less on evenings & weekends)).

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT METRA MANCHESTER METROLINK BERLIN METROLINK CALTRAIN
 SEPTA NJ TRANSIT METRA MANCHESTER METROLINK BERLIN METROLINK CALTRAIN



London Consolidated (8 Operators) London, United Kingdom



Operating Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON CONSOLIDATED (8 OPERATORS)
Annual Operating Expenses	Office of Rail and Road	\$403,654,786	\$5,500,000,000 (2017)
Farebox Revenues	Office of Rail and Road	\$198,331,440	\$5,600,000,000 (2017)
Farebox Recovery	Office of Rail and Road	49.1%	102%
Fare Range (Single One-Way Trip) ⁹	Transport for London	\$2.25 - \$12.50	\$2.10 - ~\$12.00 ¹⁰
Operating Expenses per Vehicle Revenue Mile	Office of Rail and Road	\$17.15	\$7.52
Operating Expenses per Unlinked Passenger Trip	Office of Rail and Road	\$11.93	\$5.10

Fleet Characteristics

INFORMATION	LONDON SOURCE	MBTA COMMUTER RAIL	LONDON CONSOLIDATED (8 OPERATORS)
Fleet Operator (Name, Internal/External)	Transport for London	External (Keolis)	External (various)
Number of Vehicles in Fleet	Transport for London	480	>7,000
Percent Spare Vehicles	Transport for London	12.3%	<10%
Average Vehicle Age (Years)	Transport for London	23.0	~10 years ¹¹
Power Source(s)	Transport for London	Diesel	Primarily Electric (>90%)
Seated Capacity of Trains (Approximate)	Transport for London	800	~400 ¹²

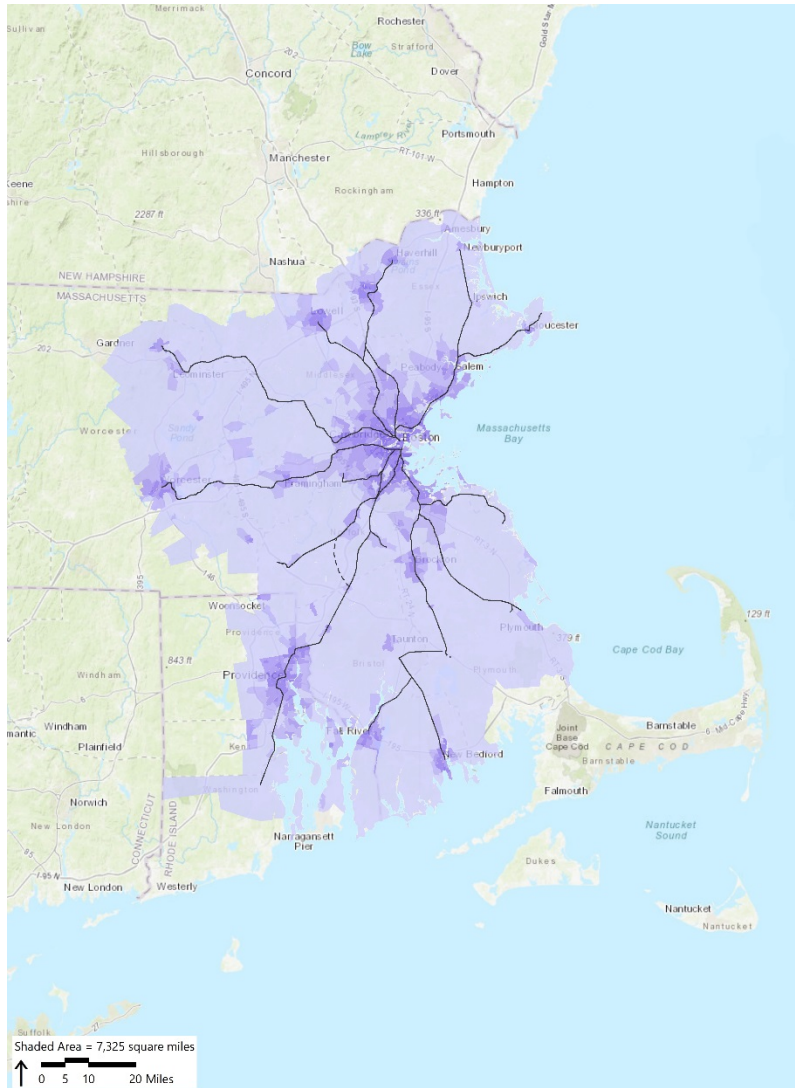
⁹ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

¹⁰ Various fares set by each operator.

¹¹ Range of stock ages between 0 & 40 years old.

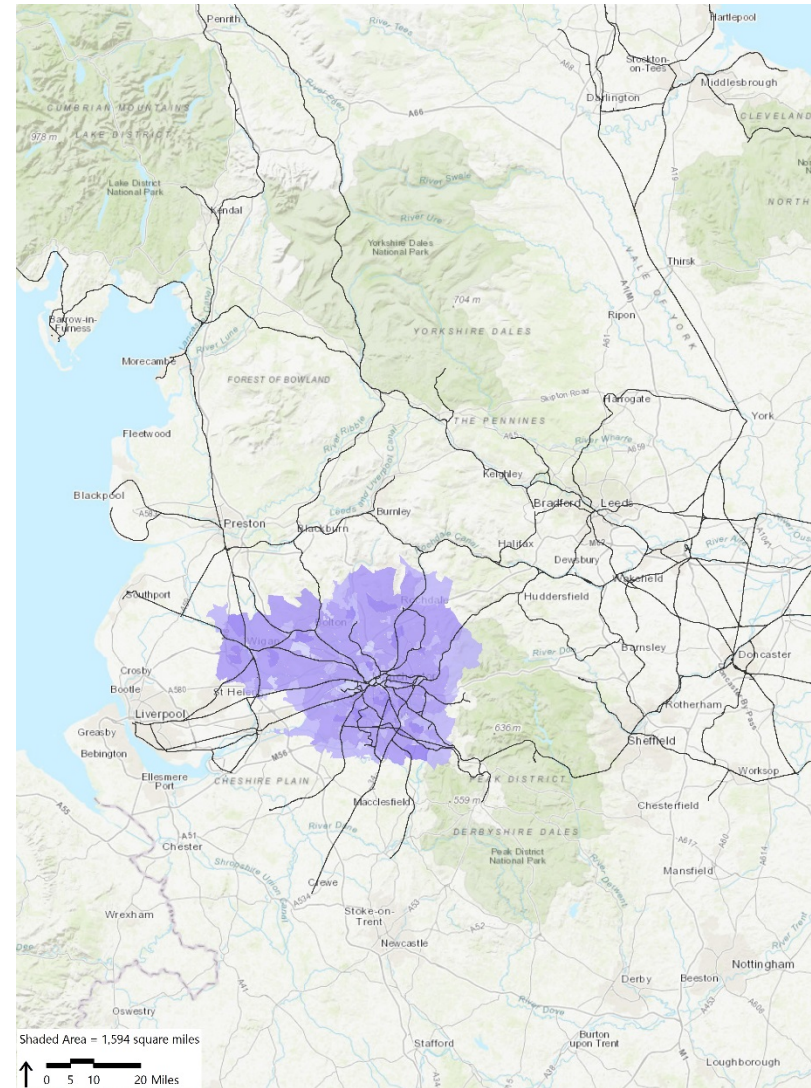
¹² A wide range of rolling stock is utilized by different operators.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

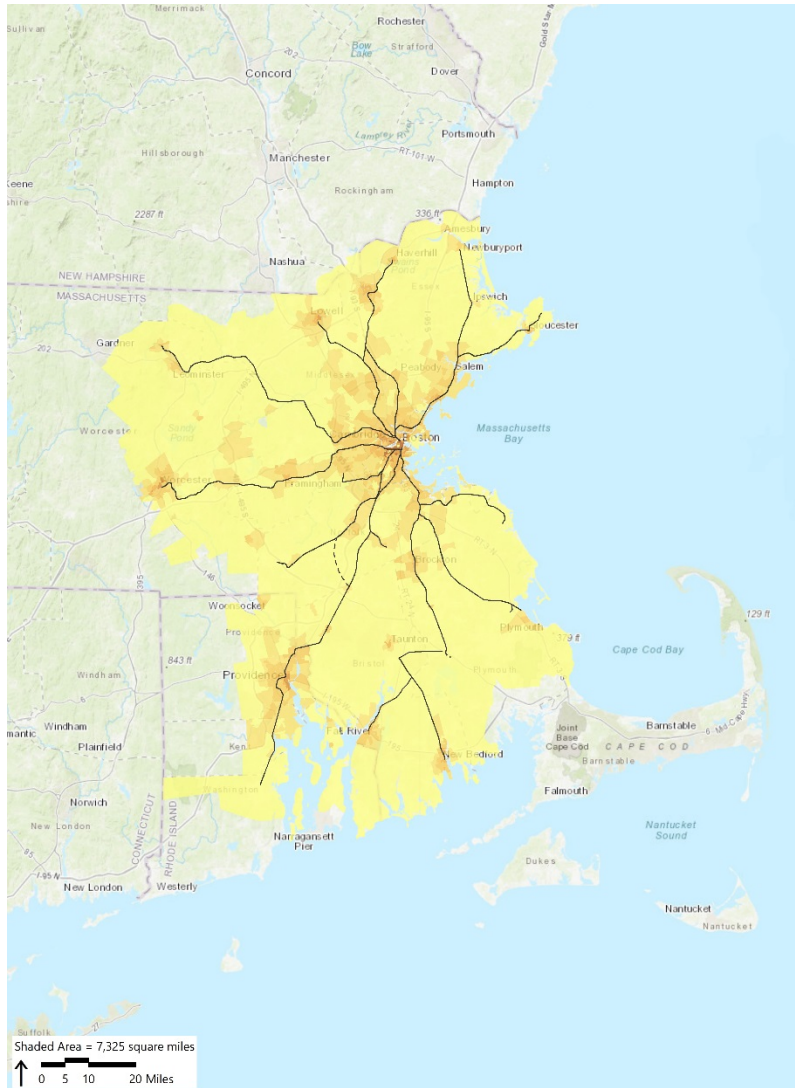
Manchester Population Density



Source Information: ArcGIS Online, Business Analyst Online, Open Street Map Great Britain, Contains OS data © Crown copyright and database right (2017), Nomis

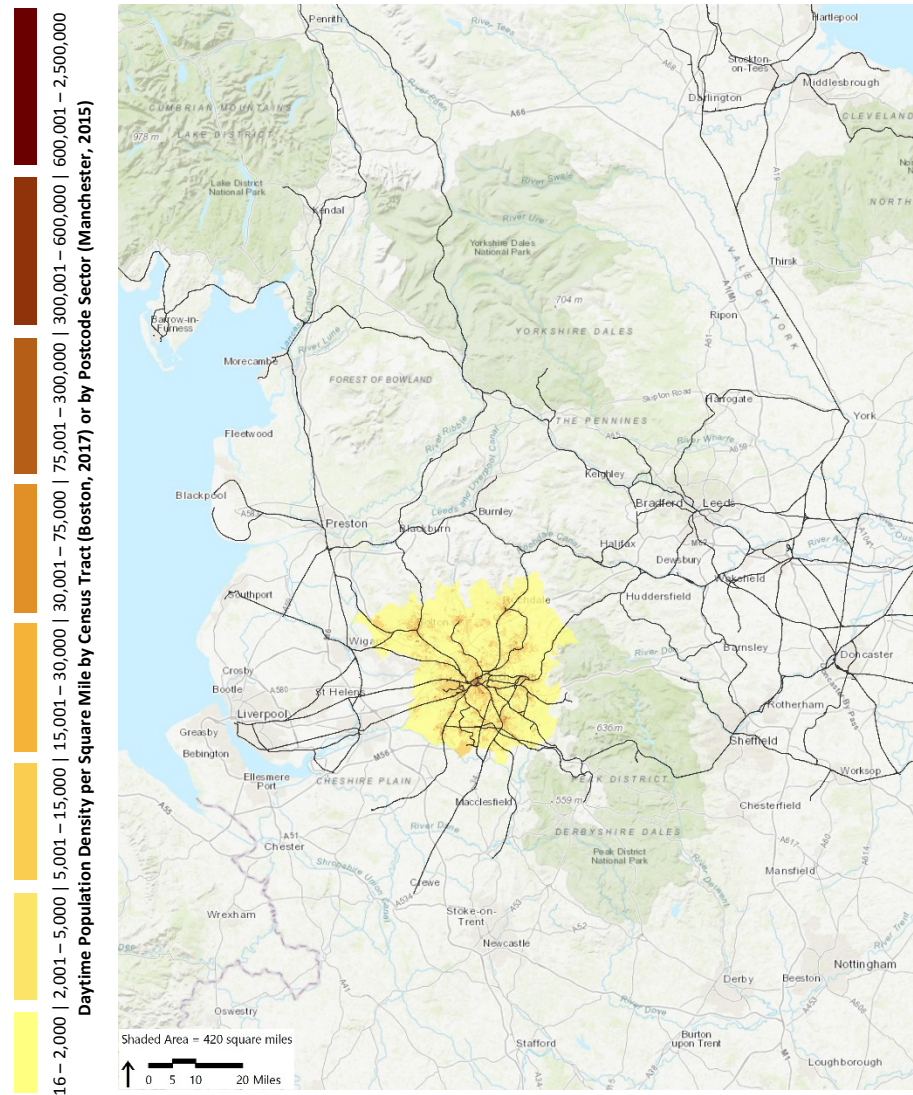
MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON **MANCHESTER** BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Manchester Employment Density



Source Information: ArcGIS Online, Business Analyst Online, Open Street Map Great Britain, Contains OS data © Crown copyright and database right (2017), Nomis

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON **MANCHESTER** BERLIN MELBOURNE



Manchester Rail Franchises

Manchester, United Kingdom



There are a multitude of operators that serve Manchester. The two primary operators serve most of the North of England, so it is hard to specifically use Manchester as a benchmark. Similar to Boston, there are two main stations that serve the city. Manchester has found a creative way to connect these two stations to allow for through train movement.

Demographics and Land Use

INFORMATION	MANCHESTER SOURCE	MBTA COMMUTER RAIL	MANCHESTER FRANCHISES
Major City Served	N/A	Boston	Manchester, UK
Population within 1 Mile of Stations	Esri	1,716,012	2,022,004 ¹
Name of UZA	Office for National Statistics	Boston, MA-NH-RI	Manchester
Size of UZA (sq. miles)*	Office for National Statistics	1,873	211 ²
Population of UZA*	Office for National Statistics	4,181,019	1,536,500
Jobs in Area	Office for National Statistics	2,677,320	426,000
Average Wage in Area	Office for National Statistics	\$64,080	\$36,276 ³
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ⁴	44 mins
Major Geographic Features	System Map	Boston Harbor Charles River	Mostly flat, but contains numerous rivers and canals
Mode Split (Drove Alone) ⁵	Department for Transport	67%	52% ⁶
Mode Split (Transit)	Department for Transport	13%	14%

* OECD data provides most consistent set of econometric data for international comparisons – UK Government Office for National Statistics (ONS) has been used to supplement. UZA internationally will typically be classified as urban area.

¹ Includes population within one mile of rail stations within shaded area.

² Includes Manchester, Salford, Stockport, Tameside, and Trafford.

³ \$1.40 to £1-pound conversion assumed.

⁴ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁵ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

⁶ <https://data.gov.uk/dataset/transport-statistics-greater-manchester-background-information> Table 6.30. Assumes only one car passenger per car.

MBTA TORONTO MNR CATALUNYA LIRR NJ TRANSIT SEPTA METRA MANCHESTER METROLINK BERLIN CALTRAIN MELBOURNE



Manchester Rail Franchises

Manchester, United Kingdom



System Characteristics

INFORMATION	MANCHESTER SOURCE	MBTA COMMUTER RAIL	MANCHESTER FRANCHISES
Number of Lines	System Map	14	10 ⁷
Length of Longest Line (miles)	System Map	63	21 ⁸
Number of Route Miles	System Map	388	189
Number of Track Miles	System Map	697	566
Number of Stations	TfGM	138	91
Percent Stations That are Accessible	Manchester City Council	75%	100% ⁹
Annual Unlinked Trips	Office of Rail and Road	33,830,904	134,446,145 ¹⁰
Percent of Agency Unlinked Trips	TfGM	8%	100% ¹¹
Number of Central Terminals	System Map	2	3
Central Terminals in Relation to CBD	System Map	Both in CBD	Adjacent to CBD
On-Time Performance (System-Wide)	Office of Rail and Road	89% (2017)	88-89%
Peak Line Frequency (Most Frequent/Other)	Schedules	20 minutes / 25-50 minutes	15 minutes / 30 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Schedules	40 minutes / 1-2 hours	15 minutes / 30 minutes

⁷ Distinct lines in/out of Manchester – the full network of the two train companies operating in/out of Manchester is larger than this.

⁸ Within the Greater Manchester boundary.

⁹ Although some require advanced booking prior to travel for assistance.

¹⁰ Total for entire of Northern and TransPennine Express rail franchises. Within this there are reported to be approximately 35m boardings and alightings at all 83 non-terminal stations in Greater Manchester (terminal stations include long distance services to the rest of the UK).

¹¹ Statistics refer to entire of Northern and TransPennine Express rail franchises.



Manchester Rail Franchises Manchester, United Kingdom



Operating Characteristics

INFORMATION	MANCHESTER SOURCE	MBTA COMMUTER RAIL	MANCHESTER FRANCHISES
Annual Operating Expenses	Office of Rail and Road	\$403,654,786	\$1,191,000,000 ¹²
Farebox Revenues	Office of Rail and Road	\$198,331,440	\$727,000,000 ¹³
Farebox Recovery	Office of Rail and Road	49.1%	61.0%
Fare Range (Single One-Way Trip) ¹⁴	National Rail Enquiries	\$2.25 - \$12.50	\$2.80 – ~\$9.00
Operating Expenses per Vehicle Revenue Mile	Office of Rail and Road	\$17.15	\$17.94
Operating Expenses per Unlinked Passenger Trip	Derived	\$11.93	\$8.86

Fleet Characteristics

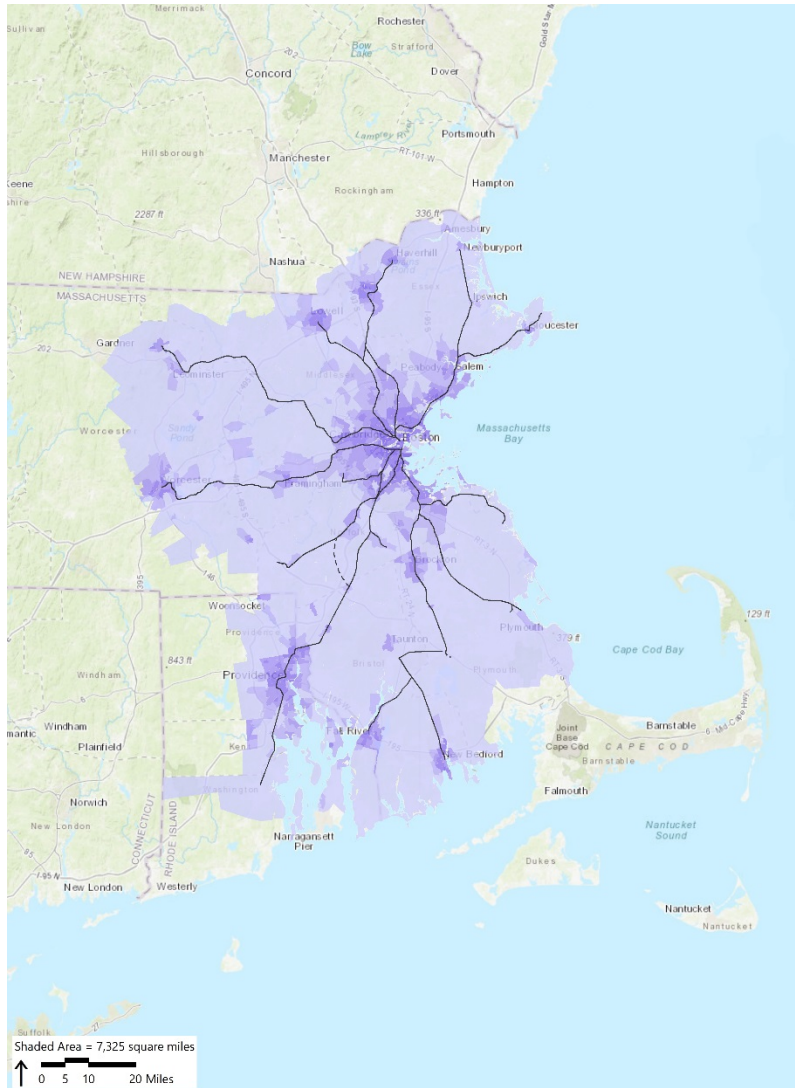
INFORMATION	MANCHESTER SOURCE	MBTA COMMUTER RAIL	MANCHESTER FRANCHISES
Fleet Operator (Name, Internal/External)	Department for Transport	External (Keolis)	External (Arriva Rail North & First TransPennine Express Limited)
Number of Vehicles in Fleet	Department for Transport	480	1,062
Percent Spare Vehicles	-	12.3%	<10%
Average Vehicle Age (Years)	Current Fleet (Derived)	23.0	~27
Power Source(s)	NTD	Diesel	Both Diesel and Electric
Seated Capacity of Trains (Approximate)	Current Fleet (Derived)	800	~479

¹² Statistics refer to entire of Northern and TransPennine Express rail franchises.

¹³ Statistics refer to entire of Northern and TransPennine Express rail franchises.

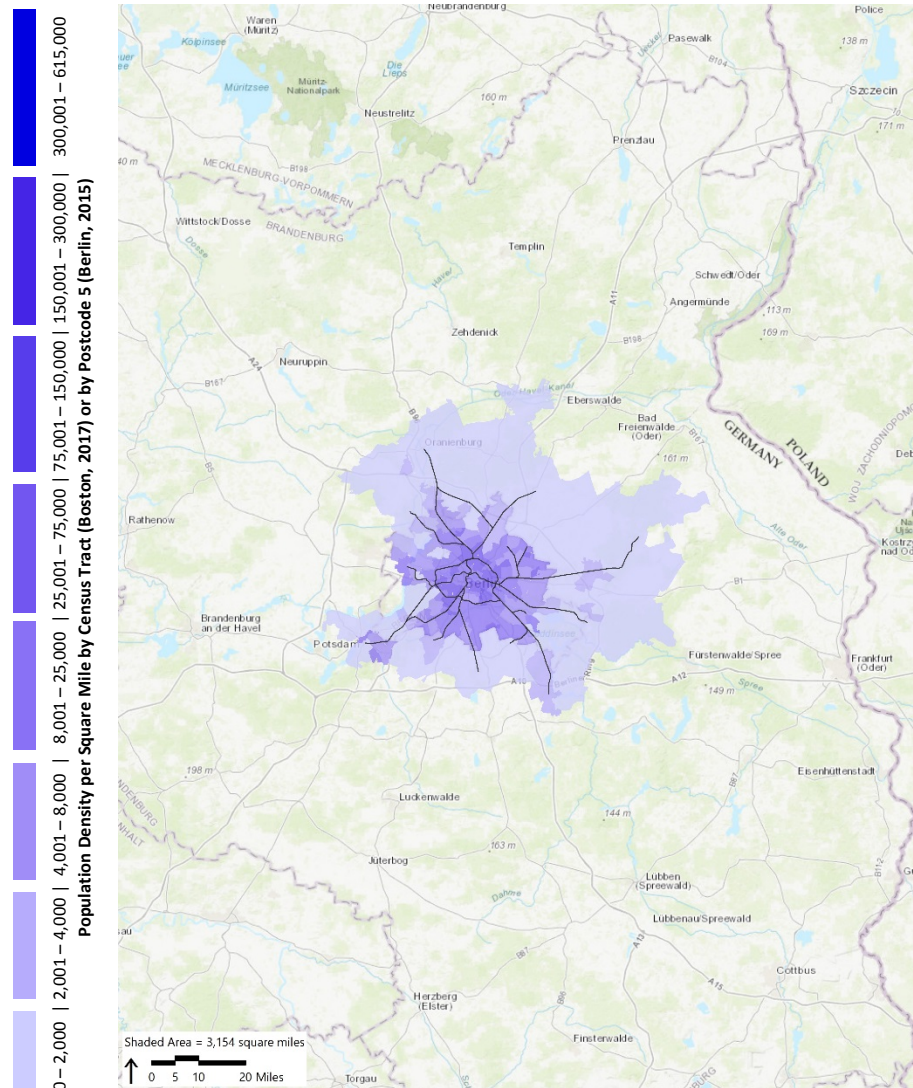
¹⁴ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Berlin Population Density



Source Information: ArcGIS Online, Business Analyst Online, OpenStreetMap Brandenburg
Employment data not available

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER **BERLIN** MELBOURNE



Berlin S-Bahn Berlin, Germany



S-Bahn Berlin GmbH (S-Bahn) is largely integrated with the national operator and the subway. The city of Berlin is polycentric as part of the legacy of the Cold War. The system is still being re-shaped as part of re-integrating the city. Complete information about the system is not publicly available.

Demographics and Land Use

INFORMATION	BERLIN SOURCE	MBTA COMMUTER RAIL	BERLIN S-BAHN
Major City Served	N/A	Boston	Berlin, Germany
Population within 1 Mile of Stations	Esri	1,716,012	2,881,970
Name of UZA	N/A	Boston, MA-NH-RI	Berlin
Size of UZA (sq. miles)*	OECD	1,873	476
Population of UZA*	OECD	4,181,019	3,500,000
Jobs in Area	European Commission	2,677,320	1,400,000
Average Wage in Area	Payscale.com	\$64,080	\$54,473 ¹
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ²	28 mins
Major Geographic Features	System Map	Boston Harbor Charles River	Flat with many small rivers including the Spree - Polycentric due to division in Cold War
Mode Split (Drove Alone) ³	London School of Economics	67%	34% ⁴
Mode Split (Transit)	London School of Economics	13%	39%

* OECD data provides most consistent set of econometric data for international comparisons – other data sources have been used to supplement. UZA internationally will typically be classified as urban area.

¹ Using exchange rate of €1.00 = \$1.23.

² This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

³ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.

⁴ All drivers.



Berlin S-Bahn
Berlin, Germany



System Characteristics

INFORMATION	BERLIN SOURCE	MBTA COMMUTER RAIL	BERLIN S-BAHN
Number of Lines	S-Bahn Berlin GmbH	14	15
Length of Longest Line (miles)	S-Bahn Berlin GmbH	63	36
Number of Route Miles	S-Bahn Berlin GmbH	388	203
Number of Track Miles	S-Bahn Berlin GmbH	697	406
Number of Stations	S-Bahn Berlin GmbH	138	166
Percent Stations That are Accessible	S-Bahn Berlin GmbH	75%	>90%
Annual Unlinked Trips	S-Bahn Berlin GmbH	33,830,904	416,800,000
Percent of Agency Unlinked Trips	EMTA ⁵	8%	100% ⁶
Number of Central Terminals	System Map	2	3
Central Terminals in Relation to CBD	System Map	Both in CBD	1 in each center
On-Time Performance (System-Wide)	S-Bahn Berlin GmbH	89% (2017)	91.8%
Peak Line Frequency (Most Frequent/Other)	Schedules	20 minutes / 25-50 minutes	10 minutes / 10 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Schedules	40 minutes / 1-2 hours	15 minutes / 30 minutes

⁵ European Metropolitan Transport Authorities

⁶ All other modes managed by Berliner Verkehrsbetriebe.



Berlin S-Bahn Berlin, Germany



Operating Characteristics

INFORMATION	BERLIN SOURCE	MBTA COMMUTER RAIL	BERLIN S-BAHN
Annual Operating Expenses	S-Bahn Berlin GmbH & EMTA	\$403,654,786	\$2,325,000,000 ⁷
Farebox Revenues	S-Bahn Berlin GmbH & EMTA	\$198,331,440	\$1,653,000,000
Farebox Recovery	S-Bahn Berlin GmbH & EMTA	49.1%	71%
Fare Range (Single One-Way Trip) ⁸	S-Bahn Berlin GmbH & EMTA	\$2.25 - \$12.50	\$3.40 - \$4.20
Operating Expenses per Vehicle Revenue Mile	S-Bahn Berlin GmbH & EMTA	\$17.15	\$8.70
Operating Expenses per Unlinked Passenger Trip	S-Bahn Berlin GmbH & EMTA	\$11.93	\$1.75

Fleet Characteristics

INFORMATION	BERLIN SOURCE	MBTA COMMUTER RAIL	BERLIN S-BAHN
Fleet Operator (Name, Internal/External)	S-Bahn Berlin GmbH	External (Keolis)	S-Bahn Berlin GmbH ⁹
Number of Vehicles in Fleet	S-Bahn Berlin GmbH	480	650
Percent Spare Vehicles	S-Bahn Berlin GmbH	12.3%	14%
Average Vehicle Age (Years)	S-Bahn Berlin GmbH	23.0	~27 ¹⁰
Power Source(s)	S-Bahn Berlin GmbH	Diesel	Electric ¹¹
Seated Capacity of Trains (Approximate)	Current Fleet (Derived)	800	376 seats + 800 standing ¹²

⁷ Includes costs for Metro & Urban buses.

⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

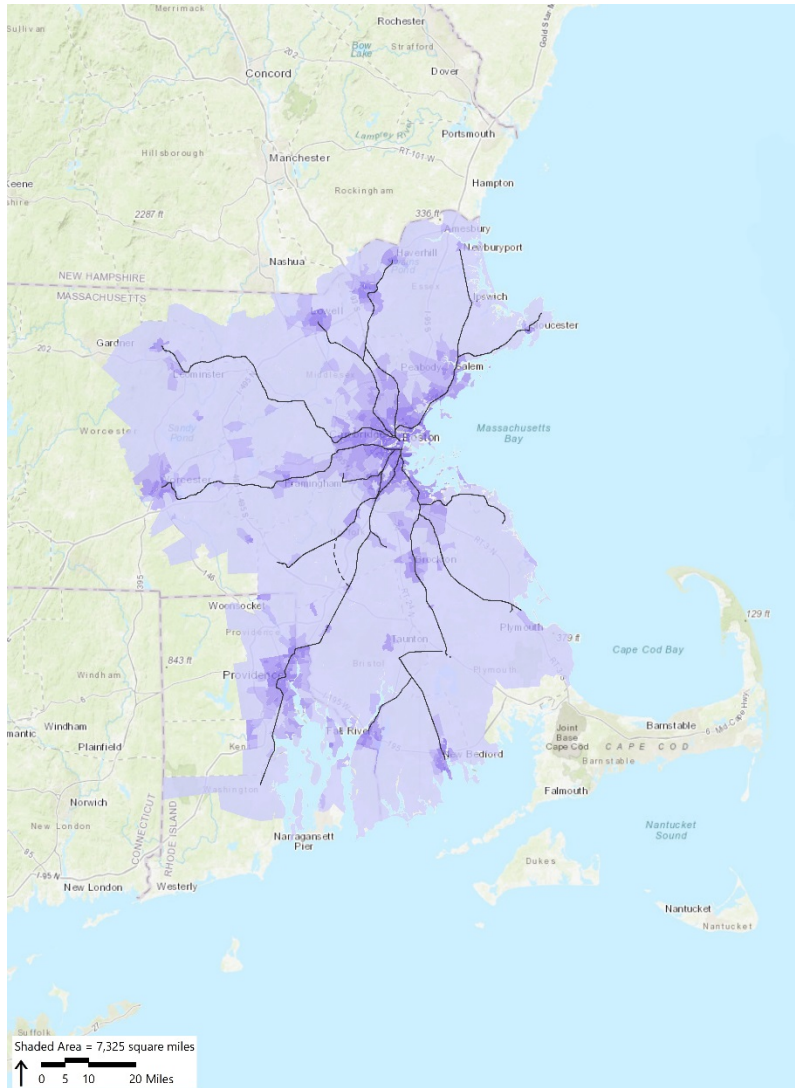
⁹ A subsidiary of Deutsche Bundesbahn, the national rail operator.

¹⁰ Built in 1986 and 1996.

¹¹ Bottom contact electrified 3rd Rail.

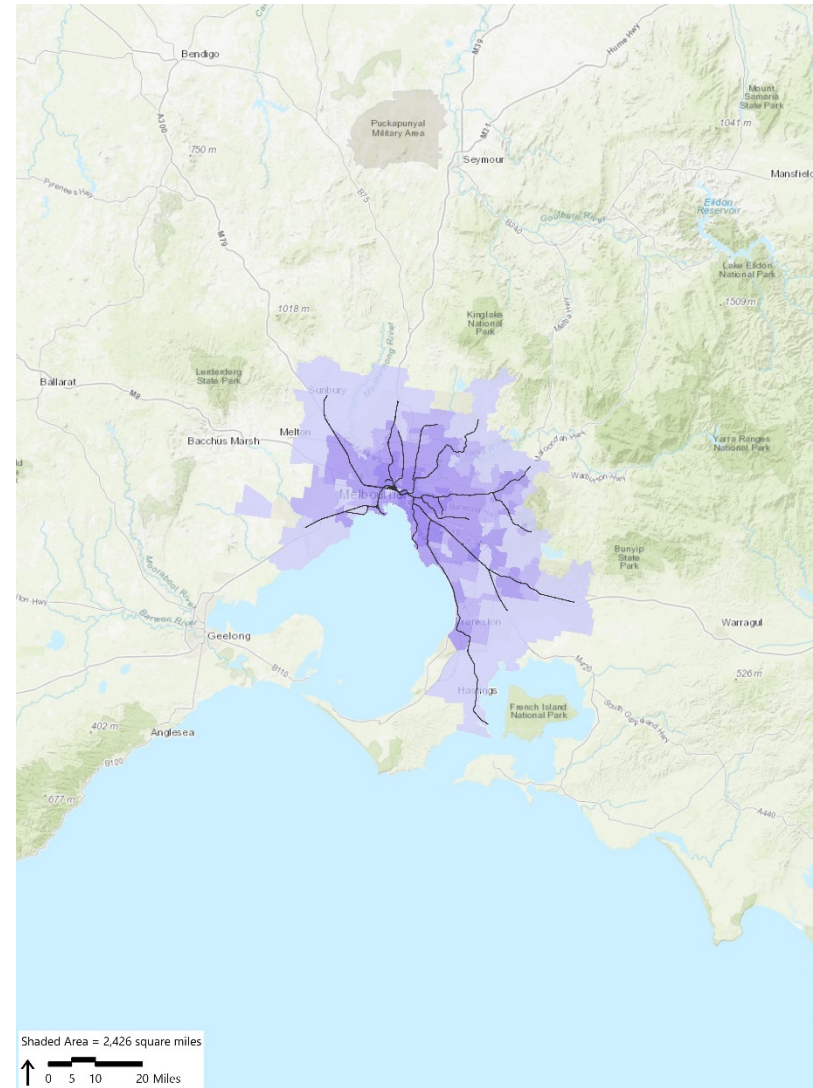
¹² Average based on typical fleet composition (<https://sbahn.berlin/en/about-us/vehicle-fleet/>).

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

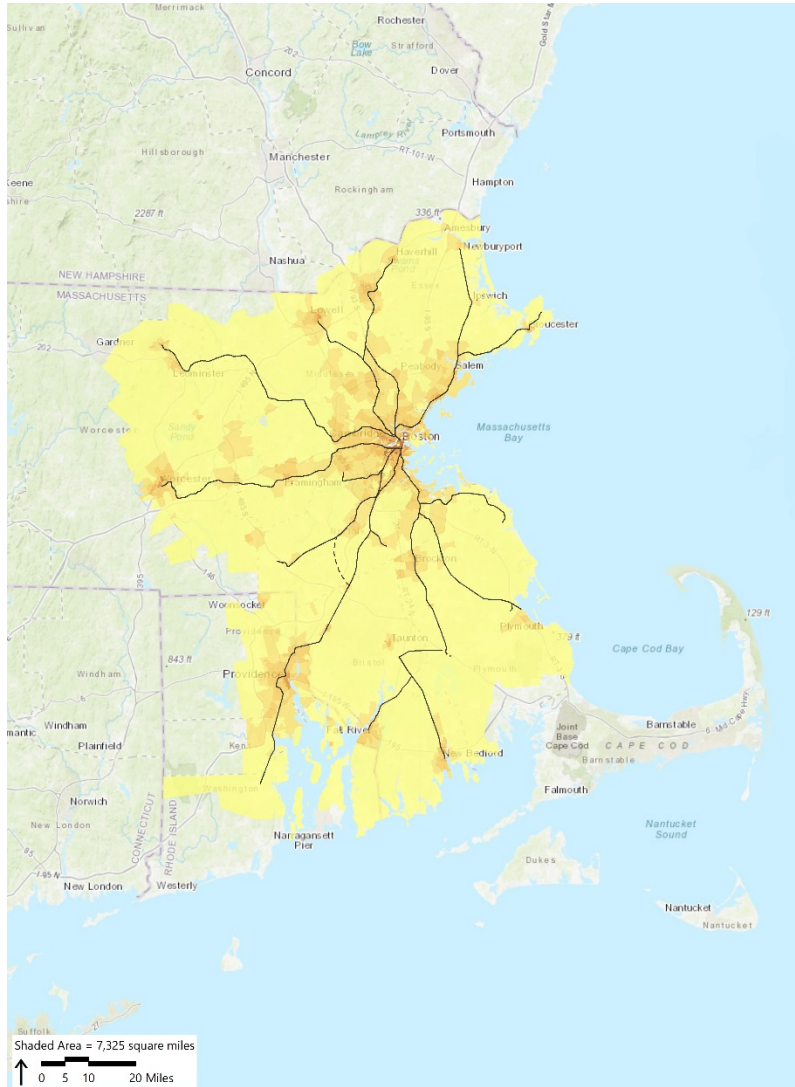
Melbourne Population Density



Source Information: ArcGIS Online, Business Analyst Online, Victoria State Government – “Public Transport a collection of PTV datasets”

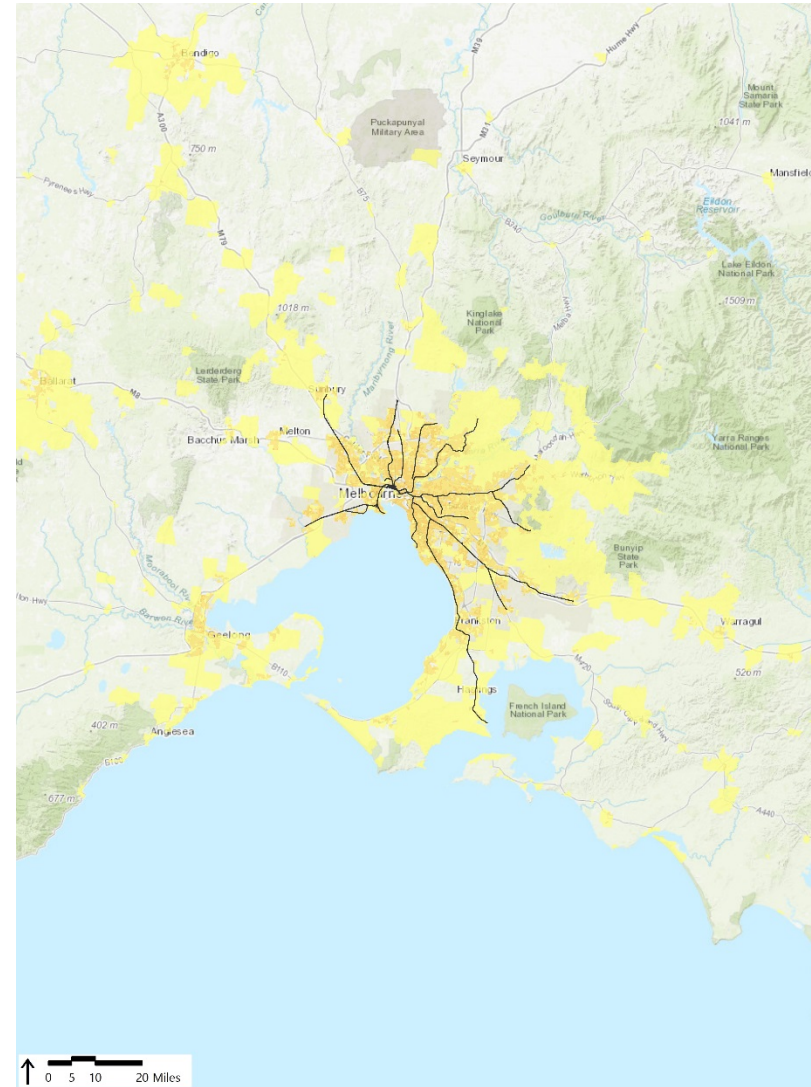
MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE

Boston Employment Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Melbourne Employment Density



Source Information: ArcGIS Online, Business Analyst Online, Victoria State Government – “Public Transport a collection of PTV datasets”, Australian Bureau of Statistics

MBTA MNR LIRR NJTRANSIT SEPTA METRA METROLINK CALTRAIN
TORONTO CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE



Melbourne Metro

Melbourne, Australia



Metro Trains Melbourne (Metro) has similarities to the MBTA in terms of its layout and distinction from the national network. Melbourne also has a similar geography and culture to Boston. Public Transport Victoria is a single public transport operator who controls all public transport for the state. The Rail system is operated by a private operator.

Demographics and Land Use

INFORMATION	MELBOURNE SOURCE	MBTA COMMUTER RAIL	MELBOURNE METRO
Major City Served	N/A	Boston	Melbourne, Australia
Population within 1 Mile of Stations	Esri	1,716,012	2,274,090
Name of UZA	N/A	Boston, MA-NH-RI	Melbourne
Size of UZA (sq. miles)*	OECD	1,873	3,857
Population of UZA*	OECD	4,181,019	4,226,836
Jobs in Area	.idcommunity ¹	2,677,320	2,115,491
Average Wage in Area	Payscale.com	\$64,080	\$46,563 ²
Peak Hours Spent in Congestion per Commuter	TomTom	29 mins ³	34 mins
Major Geographic Features	System Map	Boston Harbor Charles River	Port Phillip Bay Yarra River
Mode Split (Drove Alone) ⁴	Infrastructure Australia	67%	44%
Mode Split (Transit)	Infrastructure Australia	13%	35%

* OECD data provides most consistent set of econometric data for international comparisons – other sources have been used to supplement. UZA internationally will typically be classified as urban area.

¹ Australian Demographic Resources.

² \$0.77 USD to \$1.00 AUS conversion assumed.

³ This data has been amended relative to the US comparators, to allow a more like-for-like comparison, using the same data source (TomTom).

⁴ This document shows a subset of modes in order to understand existing transit and auto use. The mode shares shown do not sum to 100% since the comparison does not show data for all modes.



Melbourne Metro

Melbourne, Australia



System Characteristics

INFORMATION	MELBOURNE SOURCE	MBTA COMMUTER RAIL	MELBOURNE METRO
Number of Lines	Metro Trains Melbourne	14	16 lines / 8 routes
Length of Longest Line (miles)	Metro Trains Melbourne	63	35.4
Number of Route Miles	Metro Trains Melbourne	388	297.8
Number of Track Miles	Not publicly available	697	Not Available
Number of Stations	Metro Trains Melbourne	138	207
Percent Stations That are Accessible	Metro Trains Melbourne	75%	99.5% ⁵
Annual Unlinked Trips	Public Transport Victoria	33,830,904	235,400,000
Percent of Agency Unlinked Trips	Public Transport Victoria	8%	100% ⁶
Number of Central Terminals	Public Transport Victoria	2	5
Central Terminals in Relation to CBD	Public Transport Victoria	Both in CBD	Encircle the CBD
On-Time Performance (System-Wide)	Metro Trains Melbourne	89% (2017)	91.8%
Peak Line Frequency (Most Frequent/Other)	Public Transport Victoria	20 minutes / 25-50 minutes	10 minutes / 10 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Public Transport Victoria	40 minutes / 1-2 hours	20 minutes / 20 minutes

⁵ All but 1.

⁶ Other modes run by other companies

MBTA TORONTO MNR LIRR CATALUNYA PARIS LONDON SEPTA NJ TRANSIT METRA MANCHESTER METROLINK BERLIN CALTRAIN
MELBOURNE



Melbourne Metro Melbourne, Australia



Operating Characteristics

INFORMATION	MELBOURNE SOURCE	MBTA COMMUTER RAIL	MELBOURNE METRO
Annual Operating Expenses	Public Transport Victoria	\$403,654,786	\$2,530,000,000 ⁷
Farebox Revenues	Public Transport Victoria	\$198,331,440	\$671,000,000
Farebox Recovery	Public Transport Victoria	49.1%	26.5%
Fare Range (Single One-Way Trip) ⁸	Public Transport Victoria	\$2.25 - \$12.50	\$3.30 - \$6.30
Operating Expenses per Vehicle Revenue Mile	Not publicly available	\$17.15	N/A
Operating Expenses per Unlinked Passenger Trip	Public Transport Victoria	\$11.93	\$10.75

Fleet Characteristics

INFORMATION	MELBOURNE SOURCE	MBTA COMMUTER RAIL	MELBOURNE METRO
Fleet Operator (Name, Internal/External)	Metro Trains Melbourne	External (Keolis)	External (Metro Trains Melbourne)
Number of Vehicles in Fleet	Metro Trains Melbourne	480	866
Percent Spare Vehicles	Not publicly available	12.3%	Not Available
Average Vehicle Age (Years)	Current Fleet	23.0	~20 ⁹
Power Source(s)	Industry Knowledge	Diesel	2 DMUs, remainder Overhead powered EMUs
Seated Capacity of Trains (Approximate)	Current Fleet	800	~720 ¹⁰

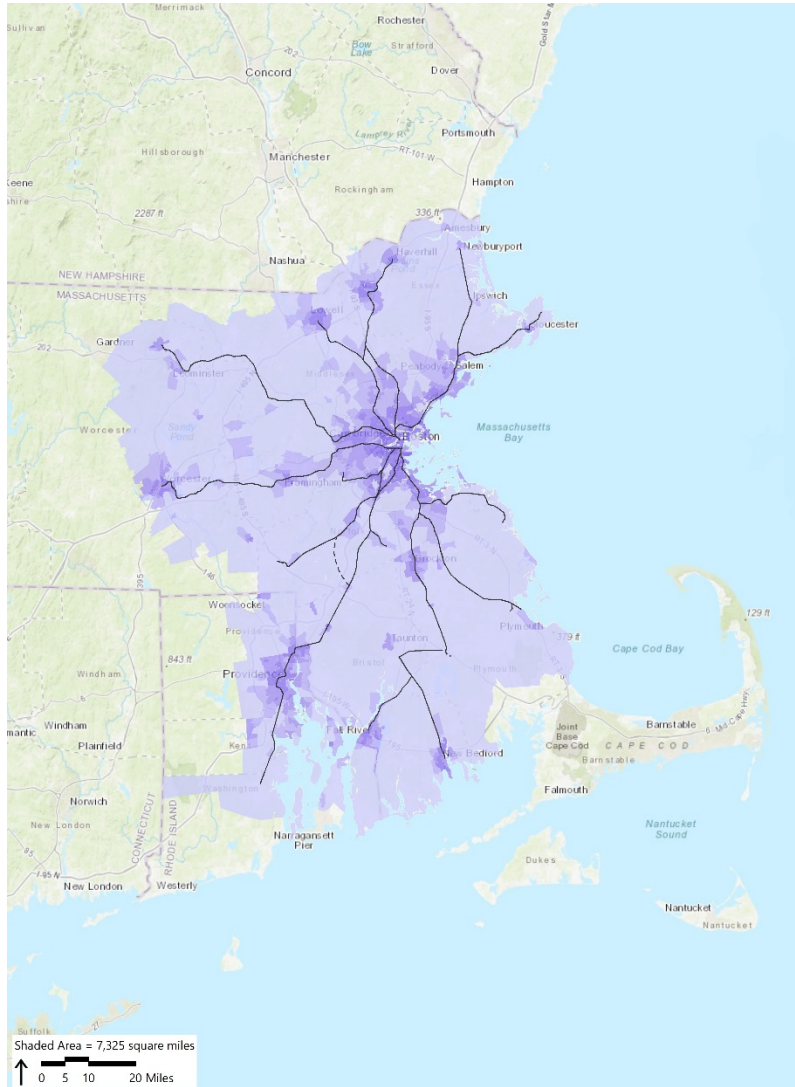
⁷ Includes Tram and Victoria Intercity Rail.

⁸ Assumes a single, one-way trip on a single line using off-board payment at a non-discounted rate.

⁹ Existing trains between 10 & 30 years old. 65 new trains on order.

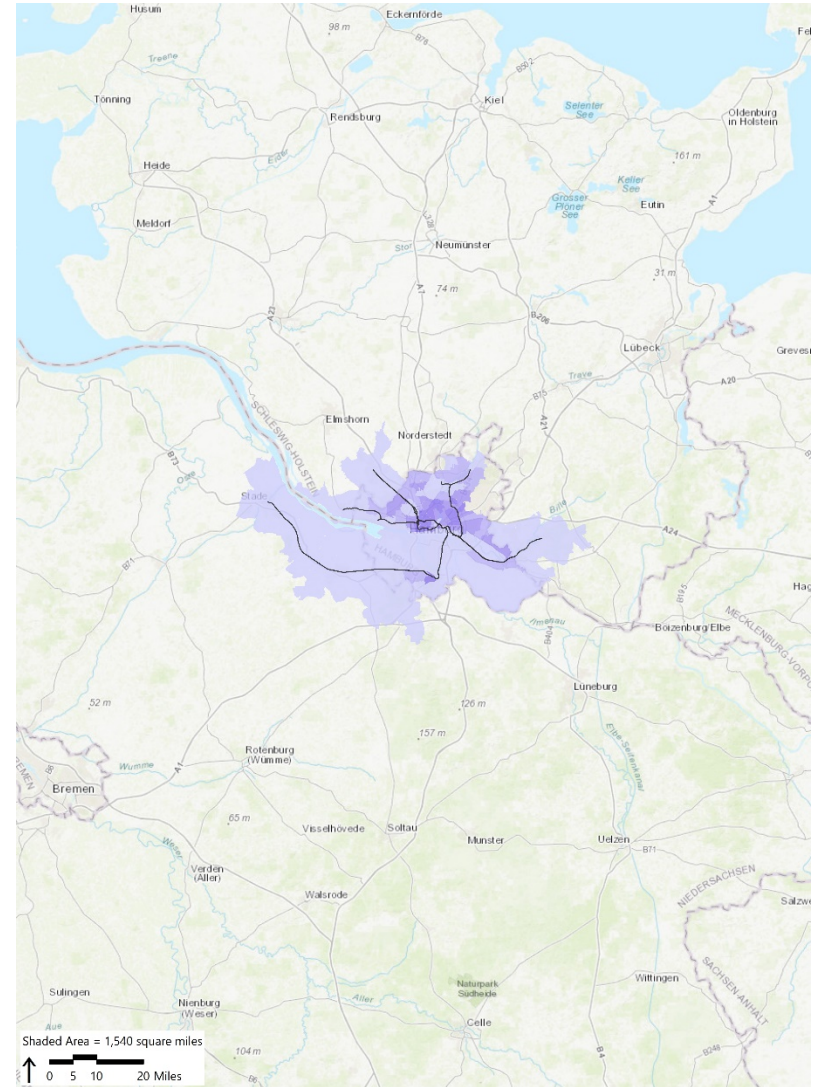
¹⁰ Between 216 and 268 per two-car married pair. Typical train length is 6 cars.

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Hamburg Population Density



Source Information: ArcGIS Online, Business Analyst Online, OpenStreetMap
Employment data not available

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN TORONTO
CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE **HAMBURG** SINGAPORE



Hamburg S-Bahn Hamburg, Germany



Hamburg has only 5 road crossings and 1 S-Bahn line across the main branch of the Elbe river (Süderelbe). The Harbor area is surrounded by both branches of the river and is only connected with 3 road bridges, 1 tunnel, and the rail bridge. The rest of the S-Bahn network is north of the river / harbor area, and is supplemented by regional rail service. Comparability with Boston is therefore considered limited. Financial data is not available publicly (it is part of HVV¹, with no public information on how revenues/costs are allocated).

Summary Information

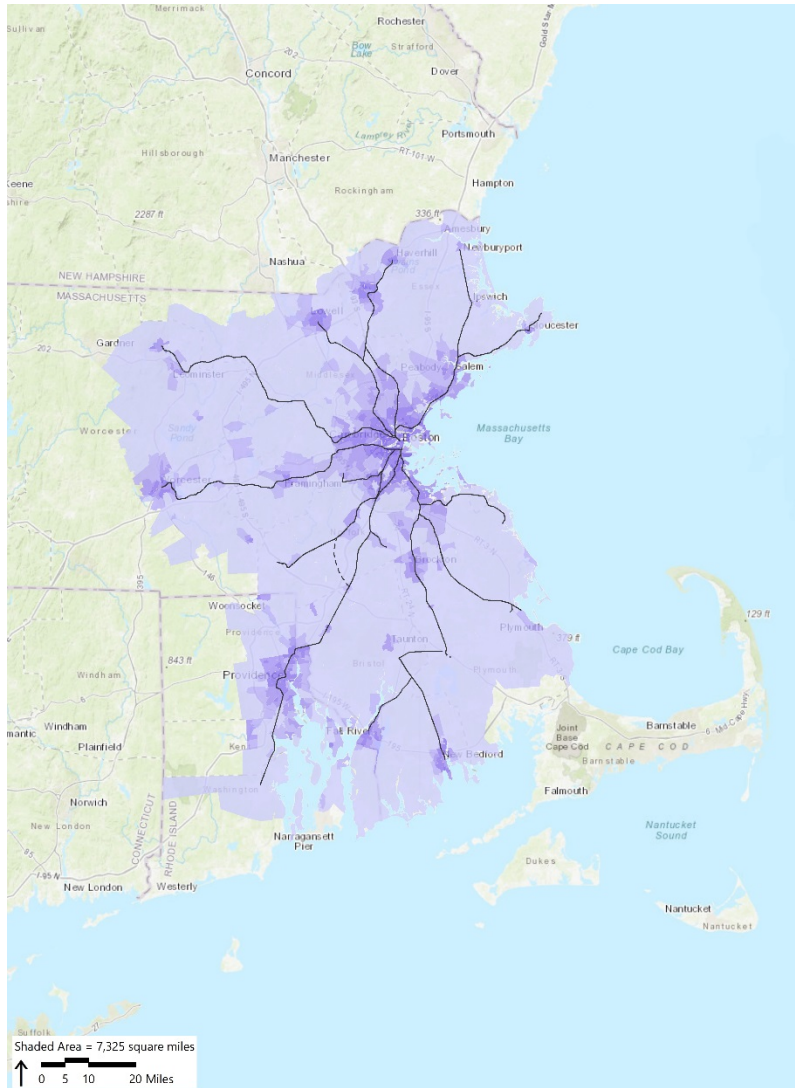
INFORMATION	HAMBURG SOURCE	MBTA COMMUTER RAIL	HAMBURG S-BAHN
Major City Served	N/A	Boston	Hamburg, Germany
Population within 1 Mile of Stations	Esri	1,716,012	1,004,032
Name of UZA	N/A	Boston, MA-NH-RI	Hamburg
Size of UZA (sq. miles)	Statistical office Hamburg	1,873	292
Population of UZA	Statistical office Hamburg	4,181,019	1,860,000
Jobs in Area	European Commission	2,677,320	948,700
Average Wage in Area	Payscale.com	\$64,080	\$59,808 ²
Major Geographic Features	System Map	Boston Harbor Charles River	Elbe River
Mode Split (Drove Alone)	City of Hamburg statistics	67%	31%
Mode Split (Transit)	City of Hamburg statistics	13%	18%
Number of Lines	S-Bahn Hamburg	14	6
Number of Route Miles	S-Bahn Hamburg	388	91
Annual Unlinked Trips	S-Bahn Hamburg	33,830,904	280,000,000
Peak Line Frequency (Most Frequent/Other)	S-Bahn Hamburg	20 minutes / 25-50 minutes	10-15 minutes ³
Off-Peak Line Frequency (Most Frequent/Other)	S-Bahn Hamburg	40 minutes / 1-2 hours	10-15 minutes

¹ Hamburger Verkehrsverbund, a company that coordinates public transportation in the Hamburg area.

² Using exchange rate of €1.00 = \$1.23.

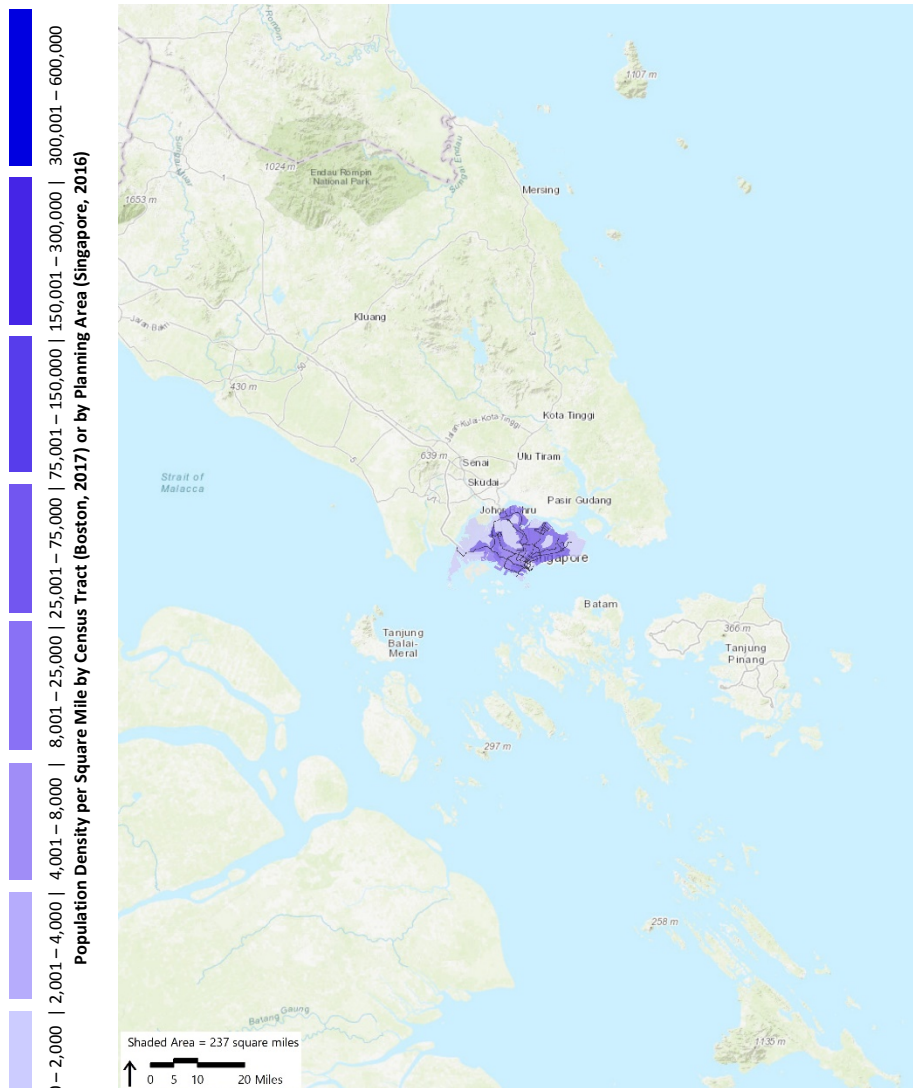
³ Based on reported 1,100 trains per day over 6 lines, with assumed typical 20 operational hours per day

Boston Population Density



Source Information: ArcGIS Online, Business Analyst Online, MassGIS

Singapore Population Density



Source Information: ArcGIS Online, Business Analyst Online, OpenStreetMap
Employment data not available

MBTA MNR LIRR NJ TRANSIT SEPTA METRA METROLINK CALTRAIN TORONTO
CATALUNYA PARIS LONDON MANCHESTER BERLIN MELBOURNE HAMBURG SINGAPORE



MRT Singapore



Singapore does not have a comparable commuter rail operation – we therefore use statistics for MRT (subway). There are two operators, SMRT and SBS Transit. These operators also operate buses and taxis, and SMRT maintains infrastructure. Many statistics are for the whole company.

Summary Information

INFORMATION	SINGAPORE SOURCE	MBTA COMMUTER RAIL	SINGAPORE MRT
Major City Served	N/A	Boston	Singapore
Population within 1 Mile of Stations	Esri	1,716,012	5,085,891
Name of UZA	N/A	Boston, MA-NH-RI	Singapore
Size of UZA (sq. miles)	Dept. of Statistics Singapore	1,873	278
Population of UZA	Dept. of Statistics Singapore	4,181,019	5,610,000
Jobs in Area	Dept. of Statistics Singapore	2,677,320	3,670,000
Average Wage in Area	Payscale.com	\$64,080	\$43,420 ¹
Major Geographic Features	System Map	Boston Harbor Charles River	Singapore Strait Johor Strait
Number of Lines	SBS Transit & SMRT	14	8 ²
Number of Route Miles	SBS Transit & SMRT	388	131
Number of Stations	SBS Transit & SMRT	138	134 ³
Annual Unlinked Trips	SBS Transit & SMRT	33,830,904	~1,200,000,000 ⁴
Peak Line Frequency (Most Frequent/Other)	Land Transport Authority	20 minutes / 25-50 minutes	2-3 minutes
Off-Peak Line Frequency (Most Frequent/Other)	Land Transport Authority	40 minutes / 1-2 hours	5-7 minutes
Farebox Recovery	SBS Transit & SMRT	49.1%	101% ⁵

¹ Using exchange rate of S\$1.00 = \$0.74.

² 5 heavy rail lines; 4 light rail lines.

³ 134 MRT; 42 LRT.

⁴ 356million reported for SBS Rail; 756million reported for SMRT; 1.2billion reported overall (discrepancy unclear).

⁵ 105% operating ratio reported for whole SBS group; 101% reported for SMRT Rail Operations.