Boston Safe Fleet Transition Plan

Current Fleet Analysis and Proposed Tiers Framework

Alyssa Brodeur, Alexander K Epstein, PhD, Arielle Herman, MPA, Grace Truslow

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14. ABSTRACT
As a leader in adopting fleet safety technologies and countermeasures, the City of Boston partnered with the USDOT Volpe Center to develop a Safe Fleet Transition Plan (SFTP). The SFTP formalizes a set of best-practice vehicle-safety technologies for all City vehicles to prevent and mitigate crashes, in direct support of Vision Zero. The plan proposal has been developed with input from Boston Central Fleet and Boston Fire Department fleet representatives, is modeled on a planning framework implemented since 2017 by the City of New York and includes prioritized safety countermeasure implemented across the over 2,000 Boston fleet units. Categorization of safety technologies was based on technology maturity, results of pilot testing, strategic initiatives, and NYC Fleet program actions such as recent executive orders.

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Contents

1 Introduction

1.1 Background

The City of Boston owns or operates over 3,000 vehicles in its fleet, including approximately 800 school buses, over 1,100 Central Fleet vehicles spanning nine departments, over 300 in Boston Fire Department, and over 900 more in Police. As a leader in adopting fleet safety technologies and countermeasures, the City of Boston partnered with the U.S. Department of Transportation's (USDOT) John A. Volpe National Transportation Systems Center (Volpe) in 2024 to help formalize a set of best-practice vehicle-safety technologies for all City vehicles to prevent and mitigate crashes, in direct support of the City's Vision Zero initiative.

Volpe previously partnered with the City of Boston to assess vehicle visibility across the fleet from light- to heavy-duty vehicles, including in the 2023 Blind Zone Safety Initiative and 2024 Commonwealth of Massachusetts Direct Vision Study, and Volpe has collaborated with the City on truck lateral protective device (side guard), mirror, camera monitoring system, and other specific safety research, implementation, and evaluation topics since 2013.

This Safe Fleet Transition Plan builds on the prior efforts and is based on Central Fleet and Boston Fire operations, which collectively account for about two-thirds of the City Fleet—see Table 1. The Plan may be expanded to Boston Police and other City agencies in the future.[1] Volpe similarly partnered with NYC's Department of Citywide Administrative Services to research fleet safety technologies in 2017, and subsequently, to update the SFTP in the 2019 and 2025 plan updates.

The goal of the Boston SFTP is to document and build sustained progress in reducing crash risk through a systematic, coordinated approach to fleet vehicle safety investment. Its effective implementation depends on cross-agency communication, agency willingness to pilot new safety technologies, working collaboratively with OEMs and suppliers, and regular revision of the Plan itself. As technologies and techniques for fleet safety evolve with time, the SFTP is expected to be regularly reviewed and revised by the City of Boston, in coordination with agency fleet management. This memo presents the proposed 2025 SFTP, based upon which the City proposes to require *Tier 1* technologies, encourage adoption of *Tier 2*, and further study *Tier 3*.

[1] Other quasi-public agencies such as Boston Water and Sewer Commission also own vehicles, but these are outside City jurisdiction.

Table 1. Summary of fleets assessed for this SFTP.

Departments and Divisions	Fleet Type	Assessed in this Plan?
Fire Department Central Fleet • Parks & Recreation • Boston Transportation • Public Works • Property Management • Age Strong • Boston Center for Youth & Families • Elections • Inspectional Services • Mayor's Office	City Fleet	Yes
Police Department	City Fleet	No
Water & Sewer Public Health Commission (including EMS) Housing Authority Public Schools Public Library Planning & Development	Quasi-public Fleet	No

1.2 Development and feedback process

The present SFTP document draws on the approach developed in partnership with the NYC Fleet since 2017. Volpe developed the initial draft in consultation with Robert Pardo, Director of Central Fleet at Boston Public Works Department Central Fleet Management Division; Christopher Willet, Director of Transportation at Boston Fire Department; and Clive McDermott, Fleet Safety Coordinator at Boston Fire Department.

Consensus determination of Tiers for different safety countermeasures was based on existing usage and experience on fleet, literature review, Volpe evaluation of the maturity of technologies, and consultation with the Central Fleet and Boston Fire Department teams. Through a series of regular discussions in late 2024 through March 2025, Volpe invited and incorporated both City and external subject matter expert feedback (from MassDOT, Together for Safer Roads, and Stantec) to develop a consensus SFTP tiers table, utilizing the starting points of a partial inventory of existing Central Fleet safety investments and the recently updated NYC Fleet SFTP tiers table. From the City, Charlotte Fleetwood (Boston Transportation Department), Michael Lawrence Evans (Mayor's Office of Emerging Technology), Mary Bovenzi and Ella Froggatt (Boston Public Health Commission) participated in these discussions to represent mayoral, Vision Zero, and public health perspectives on the plan development and provided feedback.

2 Tiers Table and Baseline

The following summary table displays the proposed SFTP tier designations.

Tier 1	Tier 2	Tier 3
	Best Practice Technologies	Exploratory Technologies
Rightsized vehicles for operational requirements	**Training** in appropriate use of technologies where feasible	**Dashcam** or other external-facing cameras
High vision truck cab where available/applicable for Class 3-8	**Blind spot monitors**	**Intelligent speed assistance (ISA)**
OEM 360-degree camera when available	**Aftermarket 360-degree camera** for Class 3-8	**Aftermarket Lane Departure Warning** for Class 3-8
Telematics to enable utilization, collision, speed, and safety reporting, among other uses	**Navigation system**	**Rear Automatic Emergency Braking** for Class 3-8
Backup camera where rear view is not otherwise included by surround cameras	**Rear Automatic Emergency Braking** for Class 1-2	
OEM Pedestrian Automatic Emergency Braking for Class 1-2	**OEM Pedestrian Automatic Emergency Braking** for Class 3-8 where available	
OEM Forward Collision Warning for Class 1-2	**OEM Forward Collision Warning** for Class 3-8	
OEM Lane Departure Warning when available		
White noise (multifrequency) backup alarm for Class 3-8		
Blind spot warning decals for Class 3-8 §		
Automatic headlights where available		
Power windows where available		
Power mirrors and **heated mirrors** *		
Crossover mirrors for Class 3-8 §		
Convex side mirrors for Class 3-8 §		
Lateral protective devices (side guards) for Class 3-8 §		

* Except for heavy-duty fire response vehicles that are fully staffed at every window.

§ City of Boston, An Ordinance Requiring City Vendors to Safeguard Unprotected Road Users: https://www.cityofboston.gov/isd/weightsandmeasures/sideguards/documents/ordinance.pdf

2.1 Baseline deployment in Boston Central Fleet and Fire Department

In support of this effort to determine the adoption of safety technologies, Volpe reviewed Original Equipment Manufacturer (OEM) information to identify fleet vehicles with safety technology that manufacturers already include as standard. In doing so, Volpe was able to estimate baseline deployment of six of the OEM-supplied technologies identified in this SFTP for light- and medium-duty vehicles.

Information on OEM safety technology including advanced driver-assistance systems (ADAS) is available through the NHTSA VIN decoder. The NHTSA VIN decoder provides manually compiled technology information for light- and medium-duty vehicle models produced by a select number of principally light-duty manufacturers (see Appendix Table 7). The safety technologies identified in this SFTP that are also recorded in the NHTSA VIN decoder include:

- Backup cameras (rear visibility systems)
- Pedestrian Automatic Emergency Braking
- Rear Automatic Emergency Braking
- Forward Collision Warning
- Lane Departure Warning
- Blind Spot Monitors

Volpe staff additionally estimated the number of high-vision vehicles in the Boston Central Fleet and Fire Department using direct vision scores for vehicles rated in the 2023 Boston Blind Zone Safety Initiative[2] and the 2024 Commonwealth of Massachusetts Direct Vision Study.[3] While these combined ratings do not cover all vehicles in either fleet, this analysis provides a baseline for setting future procurement targets. Please see Appendix 6.1 for more information on how Volpe conducted the OEM safety technology and direct vision baseline analysis.

The City of Boston has made numerous investments in safety technology highlighted in the SFTP. Table 2 shows the estimated tally of OEM safety technologies in the Central Fleet and Fire Department as of March 2025. The table relies both on information pulled through the NHTSA VIN decoder and on discussion with Boston Central Fleet and Fire Department.

[2] https://rosap.ntl.bts.gov/view/dot/68730

[3] https://www.mass.gov/info-details/direct-vision-study

Table 2. City of Boston Central Fleet and Fire Department combined safety investments (excluding trailers), 2025

Technology	Light Duty	Medium Duty	Heavy Duty	Total
Total Vehicles Across Boston Central Fleet and Fire Department	**917**	**317**	**180**	**1,631^**
Rightsized vehicles for operational requirements				
High vision truck cab where available/applicable for Class 3-8	197	94	81	372
OEM 360-degree camera when available				
Telematics to enable utilization, collision, speed, and safety reporting, among other uses	701	279	57	1,037
Backup camera where rear view is not otherwise included by surround cameras	582	102	109	793
OEM Pedestrian Automatic Emergency Braking for Class 1-2 (Tier 2: Class 3-8)	276	13		289
OEM Forward Collision Warning for Class 1-2 (Tier 2: Class 3-8)	295	46		341
OEM Lane Departure Warning when available	266	8		274
White noise (multifrequency) backup alarm for Class 3-8*		14	6	20
Blind spot warning decals for Class 3-8 §				
Automatic headlights where available				
Power windows where available	701			701
Power mirrors and heated mirrors				
Crossover mirrors for Class 3-8 §				
Convex side mirrors for Class 3-8 §				
Lateral protective devices (side guards) for Class 3-8 §				
Training in appropriate use of technologies where feasible				
Blind spot monitors	117	6		123
Aftermarket 360-degree camera for Class 3-8				
Navigation system				
Rear Automatic Emergency Braking for Class 1-2 (Tier 3: Class 3-8)	78	6		84
Dashcam or other external-facing cameras				
Intelligent speed assistance (ISA)				
Aftermarket Lane Departure Warning for Class 3-8				

^ The total includes 105 vehicles from Boston Central Fleet of unknown GVWR, some of which are off-road vehicles

*As of June 2025; 80 additional units were in process of installation by Central Fleet

§ City of Boston, An Ordinance Requiring City Vendors to Safeguard Unprotected Road Users: https://www.cityofboston.gov/isd/weightsandmeasures/sideguards/documents/ordinance.pdf

As Volpe's analysis was limited by available vehicle data, Volpe developed a framework for Central Fleet's tracking system to help the City capture the remaining data. The Boston Central Fleet and Fire Department plan to actively collect data on the remaining safety countermeasures in the SFTP and complete this baseline inventory as vehicles cycle through routine maintenance in future months.

3 Tier Designations

3.1 Tier 1

3.1.1 Rightsizing vehicles for operational requirements

Rightsizing and downsizing fleet vehicles can lead to safety as well as operational benefits. A 2018 NACTO-Volpe study found that smaller vehicles can offer increased maneuverability, with smaller turning radii, and allow cities to employ a wider variety of traffic calming countermeasures to reduce speeding and reckless driving.[4] Substituting light-duty vehicles for medium-duty ones, or low-speed vehicles for light-duty vehicles may additionally decrease the risk of severe injury to people struck by that vehicle in a crash, depending on the front-end design[5] and maximum speed, e.g., low-speed vehicles cannot exceed 25 mph. Rightsizing fleet units can additionally increase the number of high vision medium- and heavy-duty vehicles available for a set of operational requirements (see safety benefits of high vision vehicles 3.1.2 below), while in cases where a heavy-duty vehicle can be replaced with a medium-duty one, rightsizing can reduce the need for fleet operators with commercial driver licenses, increasing operational flexibility.

3.1.2 High vision truck cabs where applicable (class 3-8 vehicles) or available

Direct vision improvements increase a driver's direct view of the area near the vehicle and reduce vehicle blind zones, helping the driver to make eye contact with road users. While other vision-enhancing mechanisms such as mirrors, lenses, cameras, and sensors can partially compensate for poor direct vision, these workarounds can also increase complexity, create new blind spots, and impair direct eye contact with other road users. Direct eye contact is important in avoiding crashes: NHTSA recommends pedestrians and bicyclists make eye contact with drivers to help ensure they have been seen,[6] and research has found that eye contact with drivers can significantly reduce drivers' speed approaching a crosswalk.[7] High-vision cabs are additionally associated with a reduction in crashes: in a University of Leeds Study commissioned by Transport for London, the number of drivers in the study who struck simulated pedestrians was about five times greater in traditional truck cabs than in low-entry, high-vision cabs. Since the London Direct Vision Standard went into effect in 2021, there has been a 62 percent reduction in the number of pedestrians and cyclists killed by a large truck, compared to the

[4] https://nacto.org/wp-content/uploads/2018USDOTVolpe_Downsizing_FINAL_updated12-21-18.pdf
[5] https://www.iihs.org/news/detail/vehicle-height-compounds-dangers-of-speed-for-pedestrians
[6] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/ped-t.pdf
[7] https://www.sciencedirect.com/science/article/pii/S1877705816003015; https://www.wsj.com/articles/the-key-to-crossing-the-street-safely-eye-contact-1427734205

2017-19 baseline.[8] In a study of fatal crashes involving NYC private waste trucks from 2011 to 2018, Volpe found that among 10 fatal crashes that involved the driver running over a person as the driver accelerated from a stop and could not see them, all 10 involved low vision conventional cabs and none involved higher vision (at least in the forward direction) cab forward truck models.[9]

There are several key components of high-vision cab design that distinguish it from traditional cab design:

- Either cab-forward design, wherein the driver sits forward of the front axle (versus conventional cab design wherein the engine and front axle are forward of the driver), or snub-nosed, van-type cab design;
- Lower driver seat height from the ground and lower dashboard height relative to the driver's eye height to allow a more complete view of surroundings; and
- Increased glazing and lower beltline relative to the driver's eye height throughout the cab body and doors.

Figure 1: Driver's eye perspective of direct vision, areas visible through line of sight, indirect vision through mirrors and cameras, and the blind zone.

As in NYC, London, and Europe, where policy changes have encouraged availability and use of high vision truck designs, this change would involve a transition period for industry to adapt. The City of Boston may require a high-vision specification only where it can be competitively procured and is operationally feasible and re-evaluate as the market responds and offers more choice.

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[8] https://tfl.gov.uk/info-for/media/press-releases/2024/october/world-leading-direct-vision-standard-for-hgvs-strengthened-in-the-capital-helping-to-reduce-road-danger-and-save-lives
[9] https://rosap.ntl.bts.gov/view/dot/60703/dot_60703_DS1.pdf

Figure 2. High vision and limited direct vision truck comparison.

Figure 3: High-vision cabs expand near-vehicle visibility for drivers. Top: Mercedes/Freightliner Econic. Bottom left: Volta Zero. Bottom right: REE P7-C.

To objectively compare direct vision between truck models, an approach developed by the City of Boston, MassDOT, and Volpe can be used, based on the distance at which a median-height male driver can see a three-foot-tall object in the forward direction and a four-foot-tall object in the passenger side direction.[10] Codifying this method, the City of New York's Executive Order 39 has defined "high vision trucks" as those that allow the driver to see the three-foot-tall object no more than 8 feet forward of the truck and four-foot-tall object no farther than 6 feet to the right of the truck.[11] Volpe has applied this definition in combination with City of Boston and MassDOT vehicle measurements to estimate that 32% of medium/heavy-duty trucks in the Central Fleet and 35% in the Boston Fire Department currently meet this definition (see 6.1 for additional methodology on applying the direct vision ratings). As with all SFTP safety countermeasures, the City would determine whether any given specification is compliant with the SFTP and in consideration of existing technology options and limitations.

3.1.3 OEM 360-degree cameras when available

360-degree cameras, sometimes referred to as surround cameras, provide a complementary approach to increase truck driver's awareness of the people and roadway surrounding them. OEM 360-degree cameras are a tier 1 technology as they can help compensate for poor direct vision when it is not possible to acquire a high-vision truck. This is particularly pertinent given the potentially long lead time of transitioning medium- and heavy-duty fleet units to high vision designs.

Camera systems providing a 360-degree, stitched, top-down display can also be used in tandem with other direct vision improvements or safety technology. For example, a pilot study on 30 NYC fleet vehicles examined the feasibility of incorporating a vulnerable road user (VRU) detection system integrated into the camera view.[12] The camera display can also serve as a backup camera, fully or partially switching to rear view when the truck is in reverse. As of spring 2025, the City of Boston is actively retrofitting 100 of its Public Works medium and heavy trucks to include 360-degree camera monitoring systems.

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[10] https://www.mass.gov/doc/commonwealth-of-massachusetts-direct-vision-study/download

[11] https://www.nyc.gov/office-of-the-mayor/news/39-002/executive-order-39: "The distance from the forward of the center of the vehicle bumper at which the driver can first see the top of a 3-foot cone shall not exceed eight feet and the distance beyond the exterior of the passenger side door at which the driver can first see the top of the 4-foot cone shall not exceed six feet."

[12] https://togetherforsaferroads.org/wp-content/uploads/sites/341/TOF-VOLPE-REPORT-FINAL-4.11.24.pdf

Figure 4. Split screen 360-degree camera and perspective view (OEM example)

3.1.4 Telematics to enable utilization, collision, speed, safety reporting, and other uses

Telematics enable managers to assess driver behavior in emergency and non-emergency situations through the collection of metrics such as speed. The Boston Central fleet already uses telematics in all its vehicles and reports experiencing benefit in real time: for example, speeding behavior is observed to decrease in response to speeding alerts, notably on limited access roads such as the Massachusetts Turnpike. The system also facilitates overall summaries of fleet safety metrics, and currently, Boston Central Fleet reviews and issues safety scorecards for fleet vehicles.

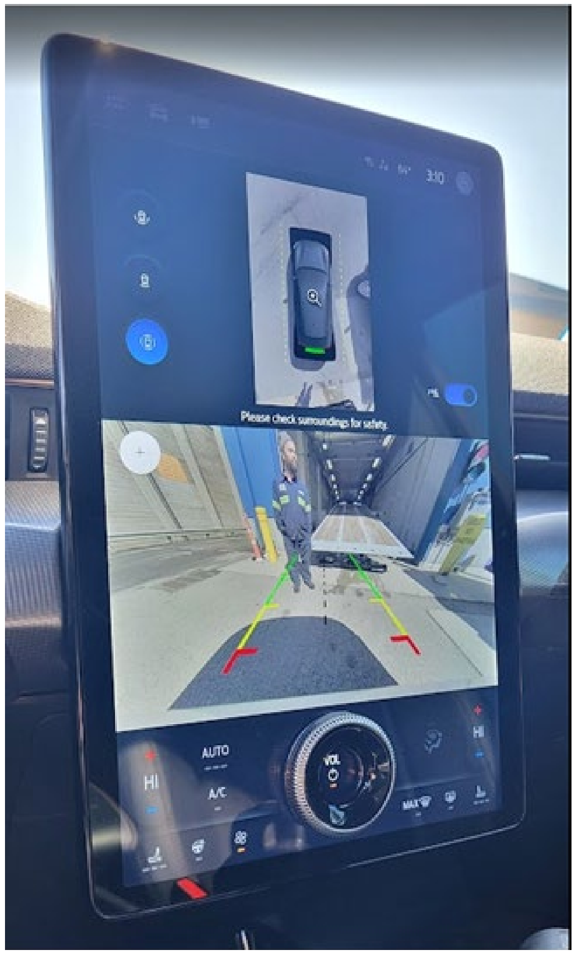
3.1.5 Backup cameras where rear view is not otherwise included by surround cameras

A 2017 study[13] found that backup cameras reduce the likelihood of back-over pedestrian crashes by 41%. Backup cameras complement the benefits of high-vision trucks, as trucks generally do not permit the driver to see behind, and under the Boston, NYC, MassDOT, TSR, and Quebec BNQ 1030-100[14] direct vision frameworks are rated only in terms of front and side visibility. For vehicles manufactured in 2018 or later with a GVWR of up to 10,000 lbs., backup cameras are already federally required.[15]

While Boston Central fleet does not currently have data on the number of fleet vehicles with backup cameras, Volpe analysis found that backup cameras came standard on at least 366 light-duty and at least 64 medium-duty fleet vehicles. Backup cameras are standard in the Boston Fire Department fleet.

[13] https://www.sciencedirect.com/science/article/pii/S0001457516303992
[14] https://www.bnq.qc.ca/en/standardization/protection-and-safety/safety-of-heavy-vehicles.html
[15] https://www.federalregister.gov/documents/2014/04/07/2014-07469/federal-motor-vehicle-safety-standards-rear-visibility

Figure 5. Backup camera display on a City of Boston Ford Mach-E (Source: City of Boston)



3.1.6 OEM Pedestrian Automatic Emergency Braking (AEB) for Class 1-2 vehicles

Pedestrian Automatic emergency braking (AEB) detects pedestrians surrounding a vehicle and automatically engages a vehicle’s brakes to slow or stop the vehicle if the driver does not quickly respond. A 2022 study of found pedestrian AEB to be associated with a 25-27% reduction in pedestrian crash risk.[16] All new passenger cars and light trucks will be required to have pedestrian AEB by September 2029 under a 2024 Federal Motor Vehicle Safety Standard from the National Highway Traffic Safety Administration.[17]

Pedestrian AEB comes standard in at least 216 light-duty Boston Central Fleet vehicles, and 60 Boston Fire Department light-duty vehicles.

[16] https://www.sciencedirect.com/science/article/abs/pii/S0001457522001221

[17] https://www.nhtsa.gov/press-releases/nhtsa-fmvss-127-automatic-emergency-braking-reduce-crashes

3.1.7 OEM Forward Collision Warning (FCW) for Class 1-2 vehicles

Forward collision warning systems assess the speed of the vehicle and the vehicle ahead, and will alert the driver if they are likely to hit the vehicle in front of them. FCW does not take action to stop a potential crash but can be used in combination with AEB. A 2017 study on FCW and AEB in light-duty vehicles found that FCW reduced front-to-rear crash rates by 27% and injury crash rates by 20%.[18] The same study found that FCW in combination with AEB reduced front-to-rear crashes by 50% and front-to-rear injury crashes by 56%.

OEM FCW is standard in at least 234 light-duty vehicles in the Boston Central Fleet, and at least 61 in the Boston Fire Department fleet.

3.1.8 OEM Lane Departure Warning (LDW) when available

Lane departure warning systems (LDWs) alert the driver if the vehicle approaches the lane boundary without an active turn signal. LDW is a NHTSA recommended safety technology that has the potential to prevent certain crash types, such as sideswipes, drifting out of one's lane, and single-vehicle rollovers resulting from veering off the road shoulder.[19] Over the past decade, LDW has become increasingly common in new light-duty vehicles. For example, LDW now comes standard on nearly all new Toyotas, Hondas, Fords, and Chevrolets. A 2018 Insurance Institute for Highway Safety analysis of passenger vehicles, comparing the crash involvement rates of vehicles with LDW and of vehicles without LDW, indicated that the technology reduced relevant crashes of all severities by an estimated 11% and reduced injury crashes by 21% after controlling for driver demographics.[20] Further, LDW systems have been reported to have an increasingly high level of driver use when installed on vehicles: in a recent observational study of over 2,000 vehicles, 87% of vehicles equipped with LDW had the technology turned on.[21]

In the Boston Central Fleet, at least 205 light-duty vehicles and at least 2 medium-duty vehicles are equipped with LDW. In the Boston Fire Department fleet, at least 61 light-duty vehicles and at least 6 medium-duty vehicle are equipped.

3.1.9 White noise (multifrequency) backup alarms for Class 3-8 vehicles

White noise backup alarms (also known as multifrequency or broadband) emit multiple tones in the alarm sound and provide improved spatial cueing to people outside of the vehicle, compared to traditional or tonal backup alarms. In other words, a person walking or biking can more easily locate the

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[18] https://doi.org/10.1016/j.aap.2016.11.009
[19] https://www.nhtsa.gov/vehicle-safety/driver-assistance-technologies
[20] https://www.sciencedirect.com/science/article/pii/S002243751730556X
[21] https://www.iihs.org/topics/bibliography/ref/2314

direction and therefore the source of a white noise alarm.[22] Due to their greater perceptibility, white noise backup alarms can also reduce noise pollution[23] while still providing safety benefit. Note that this SFTP technology only applies to vehicles and trailers with GVWR in excess of 10,000 lbs (Class 3-8).

All 336 medium- and heavy-duty vehicles (Class 3-8) of the Boston Central Fleet are fitted with some type of backup alarm, and 100 of these are currently being retrofitted with white noise models. Inspection of vehicles, in the course of routine maintenance, will help determine the number of vehicles with white noise backup alarms. All Boston Fire Department vehicles currently have traditional, tonal backup alarms. The City of Boston can choose to set procurement targets to transition fleets toward white noise backup alarms as a Tier 1 technology.

3.1.10 Blind spot warning decals for Class 3-8 vehicles

Blind spot warning decals warn surrounding vehicles and road users if they are within an area that the driver cannot see. This is particularly pertinent for Class 3-8 vehicles, which have larger blind zones than light-duty vehicles, and it is required by the City's "Ordinance Requiring City Vendors to Safeguard Unprotected Road Users."[24]

3.1.11 Automatic headlights where available

Basic automatic headlights detect surrounding light (dawn, dusk, or dark) and activate the headlights accordingly. [25] While the SFTP refers to this type of automatic headlight, other automatic headlights incorporate additional features. For example, adaptive headlights react to the vehicle's speed or direction to increase illumination around curves or hills.[26] In 2023, IIHS found that curve-adaptive headlights in light-duty vehicles were associated with significant reductions in the frequency of property damage claims (5.2%) and collision claims (1.4%) across common vehicle manufacturers.[27] Another type of automatic headlights is Auto High Beam Assist, which uses cameras to switch between high or low beams given the presence or absence of other vehicles on the road. This maximizes visibility without blinding other drivers. A 2021 study (Leslie et. al) of GM vehicles, found that auto high beam assistance reduced night pedestrian, cyclist, and animal crashes by 26 percent.[28]

[placeholder for inventory info]

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[22] https://journals.lww.com/nohe/fulltext/2013/15670/comparison_of_sound_propagation_and_perception_of.7.aspx
[23] https://clocs-a.org.au/wp-content/uploads/2023/08/Tier-Individual-Specifications-V7.pdf
[24] https://www.cityofboston.gov/isd/weightsandmeasures/sideguards/documents/ordinance.pdf
[25] https://www.regit.cars/car-news/what-are-automatic-headlights-a-complete-guide-for-drivers
[26] https://www.iihs.org/topics/headlights
[27] https://www.iihs.org/media/d391f0fa-2c92-4308-a27f-c93d60757e55/3VeIsw/HLDI%20Research/Collisions%20avoidance%20features/40-04-compendium.pdf
[28] https://www.sciencedirect.com/science/article/pii/S0001457521003067

3.1.12 Power windows when available

Power windows (compared to manual crank window systems) allow drivers to easily lower all vehicle windows to listen for auditory signals from workers or other people outside the vehicle, potentially helping prevent collisions navigating worksites, deliveries, or while navigating in crowded city areas.

All of the approximately 700 light-duty vehicles in the Boston Central Fleet have power windows. In procuring other fleet vehicles, power windows will be prioritized when available.

3.1.13 Power mirrors and heated mirrors

Power mirrors enable drivers to properly align their view of the surroundings through buttons in the interior of the vehicle rather than having to unbuckle and reach across the cab to reposition the side mirrors. Power mirrors can help drivers to minimize their avoidable blind spots. Heated mirrors, meanwhile, automatically defrost mirrors in cold conditions to ensure that the mirrors are clear, so that drivers can see their surroundings regardless of weather. Both power and heated mirrors can help ensure that drivers gain the most situational awareness from the mirror system.

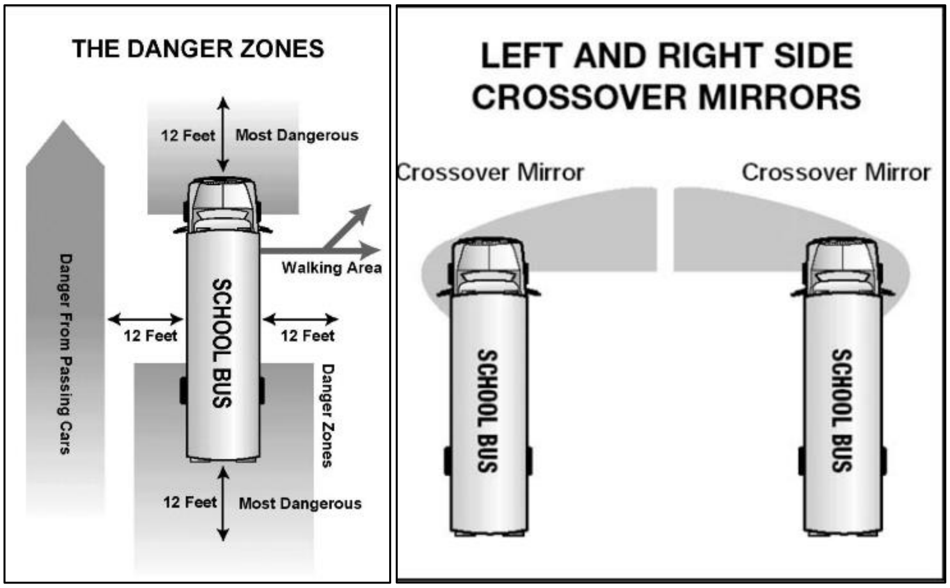
3.1.14 Crossover mirrors for Class 3-8 vehicles

Crossover mirrors enable truck drivers to see objects immediately in front of a conventional cab hood. Mirrors are mounted on the hood or fender of the vehicle. The Massachusetts 2022 Act to Reduce Traffic Fatalities[29] requires that vehicles in class 3 or above leased or purchased by the Commonwealth of Massachusetts are equipped with crossover mirrors, starting July 2025. Figure 6 shows the blind spots around a typical school bus, including the 12 feet directly in front of the vehicle (left), and the increased visible area (in gray) afforded by crossover mirrors (right).[30] This technology has the potential to improve fleet vehicles with low visibility, or increase visibility of newly acquired vehicles if high vision elements were unavailable.

[29] Chapter 358 of the Acts of 2022 amended M.G.L. c. 90, § 7
https://malegislature.gov/Laws/SessionLaws/Acts/2022/Chapter358

[30] https://www.dmv.ca.gov/portal/handbook/commercial-driver-handbook/section-10-school-buses/

Figure 6. Bus Blind Spots and Crossover Mirror Visibility (Source: CA DMV Commercial Driver handbook)

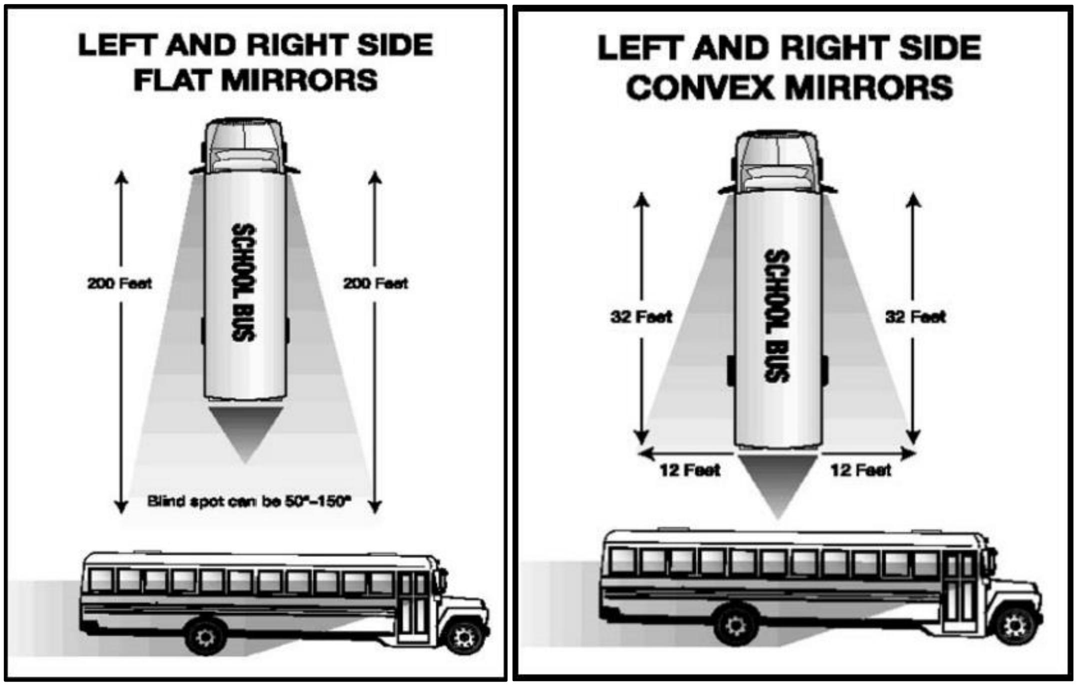


3.1.15 Convex side mirrors for Class 3-8 vehicles

Convex mirrors allow drivers of Class 3-8 vehicles to see objects on the right or left sides of the vehicle. These mirrors are mounted on doors and have wide angles that can reduce blind spots behind the vehicle.[31] Massachusetts's "Act to Reduce Traffic Fatalities (Chapter 358 of the Acts of 2022 amended M.G.L. c. 90, § 7) requires that vehicles in class 3 or above leased or purchased by the Commonwealth are equipped with convex mirrors. This regulation will be applied to vehicles operated under a contract with the Commonwealth starting in July 2025.

31 https://www.dmv.ca.gov/portal/handbook/commercial-driver-handbook/section-10-school-buses/

Figure 7. Impact of Convex Side Mirrors on Bus Blind Spots (Source: CA DMV Commercial Driver Handbook)



3.1.16 Lateral protective devices (side guards) for Class 3-8 vehicles

Lateral protective devices or side guards reduce the severity of crashes, especially truck crashes with vulnerable road users like pedestrians and bicyclists. The Massachusetts "Act to Reduce Traffic Fatalities (Chapter 358 of the Acts of 2022 amended M.G.L. c. 90, § 7) requires that vehicles in class 3 or above leased or purchased by the Commonwealth are equipped with lateral protective devices, starting July 2025. The Commonwealth follows a best practice specification previously developed by Volpe.[32] Since July 2015, the City of Boston has required city agencies to contract with vendors that have properly installed side guards, convex mirrors, cross-over mirrors, and blind-spot awareness decals.[33]

[32] https://www.volpe.dot.gov/sites/volpe.dot.gov/files/2021-04/USDOT_Volpe_Lateral_Protective_Device_Best_Practice_Specification.pdf

[33] https://www.boston.gov/sites/default/files/file/document_files/2017/04/trucksideguard_handout_vf2.pdf; https://www.cityofboston.gov/isd/weightsandmeasures/sideguards/documents/ordinance.pdf

Figure 8. Lateral Protective Side Guard with Reflective Tape (Source: Right Driver)[34]

3.2 Tier 2

3.2.1 Training in appropriate use of technologies where feasible

Providing drivers with training on appropriate use of technologies will allow drivers to feel more comfortable using technologies and will ensure that the maximum benefit is derived from new investments. Training on new technologies can be added into existing driver training programs or can be provided separately. According to a recent study (Yan et. al., 2023) that uses the technology acceptance model (developed by Davis et. al. in 1989), use of new technology systems relies on providing drivers with information to increase perceptions of usefulness and ease of use.[35] An example of driver training includes the virtual training, Bicycle Safety for Public Works Fleet Drivers,[36] produced for the City of Boston by LivableStreets Alliance and MassBike. Another example is the NYC DCAS fleet training materials on roadway safety and the usage of safety technology such as truck sideguards.[37]

3.2.2 Blind spot monitors

Blind spot monitors alert drivers of vehicles in their blind spot. Blind spot systems can provide a variety

[34] https://mocktheorytest.com/resources/what-are-lateral-protection-devices-and-side-underrun-protection/
[35] https://doi.org/10.1016/j.trf.2023.01.005
[36] PWD Fleet Driver Training Presentation Video Full FINAL
[37] Fleet Training - Department of Citywide Administrative Services

of audio or visual warnings to drivers. The systems can monitor vehicles in the blind spot through rear-facing cameras or proximity sensors.[38] A 2018 study found that blind spot monitors reduced involvement in police-reported lane-change crashes by 14%. According to this rate, in 2015, equipping every U.S. vehicle with blind spot monitoring would have prevented 50,000 crashes.[39] Blind spot monitors provide additional information for drivers as they change lanes and make turns and help to address a major crash factor between heavy vehicles and vulnerable road users of vulnerable roads users being within the driver's blind spot.[40] Blind spot intervention systems will provide light braking pressure or will guide steering wheels back to the original lane if drivers try to switch lanes when there is another vehicle in their blind spot.

3.2.3 Aftermarket 360-degree cameras for Class 3-8 vehicles

When high-vision trucks are not available or vehicles are not equipped with 360-degree cameras, aftermarket 360-degree cameras can provide drivers with a stitched, bird's eye view of their surroundings, including people walking or biking or road obstructions in the vehicle blind zones (see 3.1.3). They can also help the driver with parking and maneuvering in tight spaces. Aftermarket camera systems are available from a wide range of vendors to retrofit fleet class 3-8 vehicles with 360-vision as a near-term countermeasure while the City and industry transition to high-vision trucks.

See additional potential benefits of OEM 360-degree cameras listed in section 3.1.3.

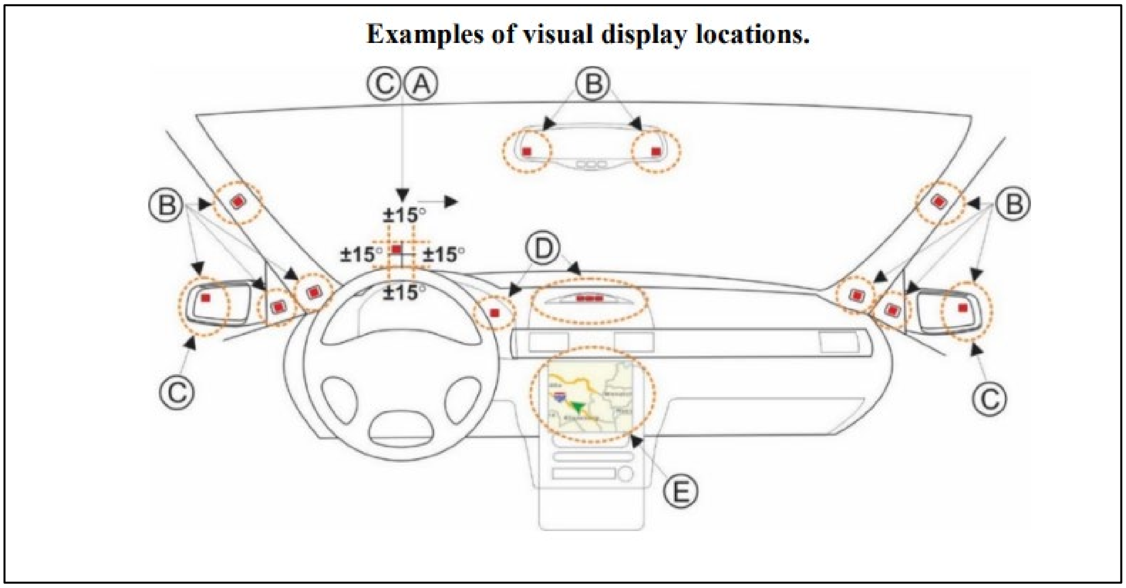
Figure 9: Split screen 360-degree camera and forward view (aftermarket example)

NHTSA design guidance suggests that critical displays for continuous vehicle control or critical warnings

[38] https://rosap.ntl.bts.gov/view/dot/24587/dot_24587_DS1.pdf
[39] https://doi.org/10.1080/15389588.2018.1476973
[40] https://doi.org/10.1016/j.aap.2023.107242

related to the vehicle forward path be located within ± 15 degrees of the central line of sight of the driver and as close to the central line of sight as practicable.[41] The camera display should not create any additional blind spots and should not be subject to glare. Location D in Figure 10 represents a center placement that could provide good spatial compatibility between seeing a pedestrian in front of the vehicle and the glance location (both towards the front center), thereby reducing the driver's response time to a minimum.[42] The City could specify that 360-degree displays be installed in one of these preferred locations.

Figure 10. Forward view screen placement.



3.2.4 Navigation systems

In-vehicle navigation systems provide drivers with greater information about their current and upcoming surroundings (potential delays, directions, etc.) without use of a more distracting mobile device such as a cell phone, allowing drivers to make more informed and potentially safer navigation decisions. This can help drivers focus more on driving when they are navigating to unfamiliar locations.

3.2.5 Rear Automatic Emergency Braking (AEB) for Class 1-2 vehicles

Rear Automatic Emergency Braking (RAEB) systems can help avoid low-speed backing collisions. The

[41] J. Campbell, J. Brown, J. Graving, C. Richard, M. Lichty, T. Sanquist, P. Bacon, R. Woods, H. Li, D. N. Williams and J. Morgan, "Human Factors Design Guidance for Driver-Vehicle Interfaces," National Highway Traffic Safety Administration, Washington, DC, 2016.
[42] M. Ambrosecchia, B. Marino, L. Gawryszewski and L. Riggio, "Spatial stimulus-response compatibility and affordance effects are not ruled by the same mechanisms," *Frontiers in Human Neuroscience,* vol. 2, 2015

Insurance Institute for Highway Safety reported that General Motors' rear autobrake system reduced reported backing crashes by 62 percent.[43] As RAEB systems are not currently designed to detect pedestrians, bicyclists, children, etc.,[44] unlike Pedestrian AEB (see 3.1.6, they may not offer immediate value in reducing traffic fatalities and injuries for Vision Zero. Still, they may be an effective means to reduce property damage costs. Based on Volpe's research, the City of Boston believes this technology will have a positive impact on the client fleets as well as agencies that operate large numbers of light-duty vehicles in tight spaces such as parking lots and garages.

The Boston Central Fleet includes 42 light-duty vehicles in which Rear AEB is standard OEM equipment. The Boston Fire Department includes at least 36 light-duty vehicles in which Rear AEB is standard.

3.2.6 OEM Pedestrian Automatic Emergency Braking (AEB) for Class 3-8 vehicles

Pedestrian AEB is a tier 1 technology for light-duty vehicles, and benefits are described in 3.1.6 above. The benefits of basic AEB in large trucks have been studied: A 2021 study, examining crashes involving Class 8 trucks on highway driving, found that that AEB was associated with a 41% reduction in rear-end crashes and a 12% reduction in overall crashes.[45] However, because of the shorter history of truck PAEB technology, the benefits of PAEB for Class 3-8 vehicles are less established. Pedestrian collision warning systems are becoming available factory-installed from some truck manufacturers. For example, Mitsubishi Fuso Trucks of America announced that Fuso FE and FG Series trucks would be available with factory-installed Mobileye 6 Series PCW beginning with the 2017 model year.

At least 42 medium-duty Boston Central fleet vehicles are equipped with AEB by default, and at least 6 medium-duty Boston Fire Department vehicles.

3.2.7 OEM Forward Collision Warning (FCW) for Class 3-8 vehicles

The benefits of Forward Collision Warning (FCW) among light-duty vehicles are established in section 3.1.7. Notably, FCW is now universally available to retrofit vehicles.[46]

OEM FCW is standard in at least 8 medium-duty vehicles in the Boston Central Fleet, and 8 in the Boston Fire Department fleet.

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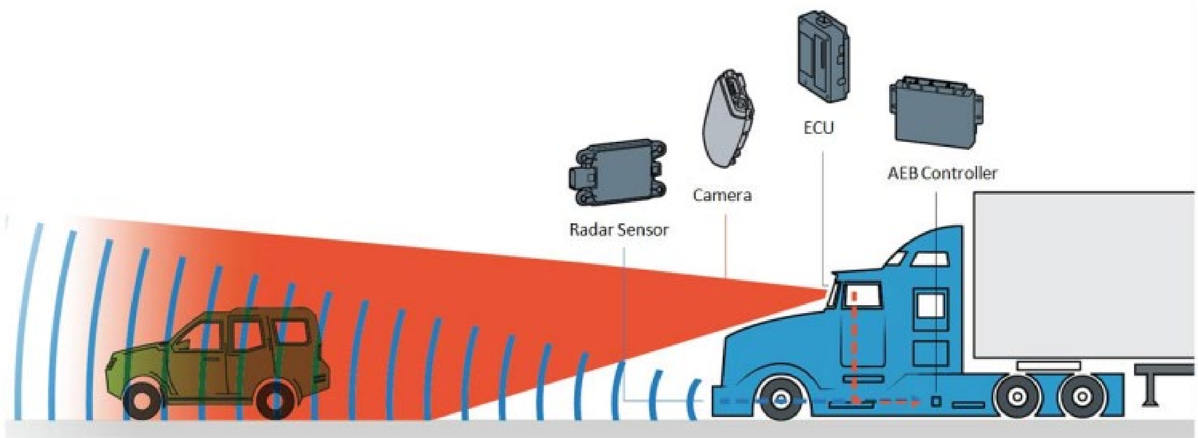
[43] http://www.iihs.org/iihs/news/desktopnews/rear-crash-prevention-ratings-aim-to-cut-parking-lot-collisions
[44] http://www.iihs.org/frontend/iihs/documents/masterfiledocs.ashx?id=2150; https://my.cadillac.com/learnAbout/automatic-braking/2018/XT5
[45] Effectiveness of front crash prevention systems in reducing large truck real-world crash rates
[46] https://www.umasstransportationcenter.org/images/umtc/UMTC-TAC/CV-STAC%202020/Collision%20Avoidance%20Systems/NACTO-Volpe-Optimizing-Large-Vehicles_ADAS.pdf
https://www.umasstransportationcenter.org/images/umtc/UMTC-TAC/CV-STAC%202020/Collision%20Avoidance%20Systems/NACTO-Volpe-Optimizing-Large-Vehicles_ADAS.pdf

Figure 11. Key FCW/AEB System Components (Cost and Weight Analysis of Heavy Vehicle Forward Collision Warning)[47]



3.3 Tier 3

3.3.1 Dashcams or other external-facing cameras

Dashcams or other external-facing cameras collect audio and video data from outside, and sometimes inside, the vehicle, and are typically placed on the dashboard or windshield. Once turned on, dashcams can continually record, and some dashcams can be triggered by a potential impact. Dashcams are already widely used by law enforcement and long-haul commercial truck drivers, but they are increasingly common in commercial and passenger vehicles. This information can be critical for analyzing crashes and resolving insurance disputes. The presence of dashcams can also encourage good behavior by drivers, promoting safer driver habits. A 2011 study funded by the Federal Motor Carrier Safety Administration evaluated the usage of an onboard safety monitoring system. The study found that video monitoring and behavioral feedback based on this monitoring saw a reduction in the rate of safety-related events for both long- and short-haul trucking fleets.[48]

No Boston Fire Department vehicles have dashcams as of the writing of this report.

3.3.2 Intelligent Speed Assistance (ISA)

Intelligent speed assistance technologies incorporate in-vehicle technologies and GPS data to intervene when drivers are exceeding speed limits. ISA can vary from providing drivers with alerts to automatically

[47] https://lindseyresearch.com/wp-content/uploads/2019/06/NHTSA-2011-0066-0092-DTNH2216D00037_T147_FCW_AEB_Final_Report.pdf
[48] https://doi.org/10.1016/j.trf.2010.11.010

preventing speeding.[49] In NYC's pilot of ISA, the technology resulted in a 64% relative decrease in the amount of time that drivers exceed the speed by 11 mph or more. Mitigating speeding behavior is an important road safety strategy, as 29% of U.S. traffic fatalities are at least partially attributable to speeding.[50]

Currently, no Boston Central or Fire Department fleet vehicles have ISA.

3.3.3 Aftermarket Lane departure warnings for Class 3-8 vehicles

Several truck OEMs provide aftermarket custom installations of lane departure warning (LDW) technology, including Kenworth[51] and Volvo[52] as medium- and heavy-duty vehicles are not typically fitted with LDW. In light-duty vehicles, LDWs have been shown to decrease crashes and augment safety (see 3.1.8). These benefits can also be seen in heavy-duty vehicles, with a 2015 study[53] estimating that installed LDW systems resulted in a 48% reduction in LDW-related truck crashes, such as lane departure crashes

LDW comes standard in 2 medium-duty vehicles in the Boston Central Fleet, and 6 in the Boston Fire Department. See section 3.1.8 for the description of LDW as a tier 1 technology for light-duty vehicles.

3.3.4 Rear Automatic Emergency Braking (AEB) for Class 3-8 vehicles

Rear Automatic Emergency Braking is a tier 2 technology for Class 1-2 vehicles and a tier 3 technology for Class 3-8 vehicles because Rear AEB is less available among medium- and heavy-duty vehicles (see benefits in light-duty vehicles in section 3.2.5). Still, heavy-duty vehicles are more prone to rear-end collisions and unstable braking due to their larger inertia and higher center of gravity.[54] A 2023 study reconstructing heavy-duty vehicle crashes concluded that automatic emergency braking avoided 35% of collisions.[55]

Rear AEB comes standard in at least 6 medium-duty (class 3-6) vehicles in the Boston Fire Department.

4 Implementation of High Vision and

[49] https://www.nhtsa.gov/book/countermeasures-that-work/speeding-and-speed-management/countermeasures/other-strategies-1
[50] https://www.nhtsa.gov/risky-driving/speeding
[51] https://www.kenworth.com/innovation/driver-assistance-technologies/#:~:text=LANE%20KEEPING%20ASSIST,the%20direction%20of%20the%20truck
[52] https://www.volvotrucks.us/our-difference/safety/active-driver-assist/
[53] https://www.sciencedirect.com/science/article/pii/S0022437514001145
[54] https://doi.org/10.1049/itr2.12229
[55] https://doi.org/10.1177/03611981231166374

Rightsizing

This section summarizes Volpe research on selected vehicle procurement options that could support Boston's intended transition to rightsized, high vision vehicles where feasible and available. The following describes considerations when transitioning the fleet to high-vision vehicles, offers non-exhaustive examples of high-vision truck makes and models, including those that appear to be compatible with snowplow and salting operations, and identifies rightsized light-duty vehicle options with sufficient cargo bed capacity for transporting cargo such as trash and recycling bins.

4.1 High Vision Implementation

This section describes several considerations to transition the City fleet toward high-vision vehicles.

When selecting vehicle models to increase the drivers' direct vision, agency fleets may be constrained by current agency specifications and vendors, and the current specifications may need to be revisited to expand the vendor pool. Table 3 provides a high-level overview of representative models that could improved direct vision. High-vision truck makes and models that are compatible with snowplows and salting are listed in 4.3.

Table 3. Implementation strategies and example vehicle models for improved direct vision.

Implementation Strategy	Direct Vision Element	Example Vehicle Models
Transformative ("best in class")	*Low-entry cabover ("high vision cab")*	Freightliner EconicSD Dennis Eagle ProView Battle Motors LNT
Incremental	*Cab-forward/cabover*	Isuzu NPR Mitsubishi Fuso Mack MR GMC T7500 Kenworth K370
	Sloped hood	HINO 338 Freightliner M2 106 Thomas Saf-T-Liner C2
	Peep and teardrop windows	Various makes and models

Although the SFTP is intended for new City vehicles, the City of Boston may also consider using this SFTP as a guide to retrofit some vehicles as a pilot to ascertain costs, benefits, and effort.

Limited direct vision improvements in the form of door retrofits with additional lower windows could be available for some existing fleet vehicles.[56] As shown in Table 3 and the visual catalog in the following

[56] https://www.kudauk.ltd.uk/shop/health-and-safety-equipment/lower-door-windows-clearview

figures, retrofits and short- and long-term procurements can be combined to create meaningful safety improvements incrementally.

Figure 12: Example of available high vision cab model: Freightliner EconicSD

Figure 13: Example of available high vision cab model: Dennis Eagle Proview

Figure 14: Example of high vision cab model: Battle Motors Low-Entry Cabover

Figure 15: Example of available high vision cab model: Mack LR

Figure 16: Example of available high vision cab model: McNeilus Volterra ZSL

4.2 High Vision Truck Examples

The following is a list of selected available high-vision vehicles, referencing the definition of high vision as side and front ratings of 3 or more stars out of five.

- Heavy
  - Dennis Eagle Proview
  - Freightliner EconicSD
  - McNeilus Volterra ZSL
  - Battle Motors LNT
  - Mack LR
- Medium
  - REE P7C
  - Ford F-350
  - Hino 195
  - International Terrastar SFA
  - Freightliner M2 106

4.3 Plow-Compatible High Vision Truck Options

To support the City's intended transition to right-sized vehicles where feasible (see Tier 1: 3.1.1), Volpe conducted a review of available snow-plow compatible higher-vision truck makes and models. At least seven plow-compatible high-vision truck options were identified, while the compatibility of three other models was not immediately possible to confirm (see Table 4).

Table 4. Plow-Compatible Truck Options

Medium/heavy-duty cab style	Example Vehicle Models	Plow Compatible?
Low-entry cab-forward	Freightliner EconicSD	Yes[57]
	Eagle ProView	TBD
	Mack LR	Yes, routinely in NYC
	Oshkosh McNeilus Volterra	Yes (per email with OEM)
	Isuzu NPR/NRR	Yes (video)
	Chevrolet Low Cab Forward	Probably, same as GMC
High-entry cab-forward	Mack MR	Yes, routinely in NYC
	Kenworth K370	TBD
Sloped hood conventional	HINO 338	Yes but confirm
	Freightliner M2 106	Yes

4.4 Light Truck and Street-Legal Low Speed Vehicle (LSV) Cargo Beds

Volpe conducted a review of low-speed trucks and vans, to identify those with bed sizes that would meet Boston Central Fleet operational requirements (8 ft).[58] While a few low-speed-vehicle trucks approach bed lengths of 8 feet (Vantage Extended Cab Truck and Club Car Urban), low-speed vans provide the greatest cargo bed capacity, up to a maximum of 14.3 ft (see Table 5).

[57] Driver manual mentions snowplough: https://dtnacontent-dtna.prd.freightliner.com/content/dam/public/dtna-servicelit/dtna/pdfs/en_us/freightliner/drivers-manuals/EconicSD%20Operator's%20Manual.pdf

[58] Ford pickup models in the Boston Central Fleet (Ford F-150, F-250, and F-350) are manufactured with bed lengths ranging from 5.5 to 8 feet.

Figure 17. Vantage LSV and Mercedes Sprinter van for comparison (photo credit: Kate Fillin-Yeh)

Table 5. Cargo Bed Lengths of Low Speed Vehicles (LSVs)[59]

Vehicle Make/Model	Light truck or LSV	Extended Cargo Bed Length
Ford Transit Cargo Van	Van	10.5 -14.3 ft
Mullen One	Van (electric)	8.75 ft
Ford F-250 XL	Pickup	8.2 ft
Kia PV5 Cargo Long L2H1	Van (electric)	*8.1 ft[60]
Telo MT1	Pickup (electric)	8.0 ft
Ford F-150 XL	Pickup	8.0 ft
Vantage Extended Cab Truck	LSV	7.4 ft
Club Car Urban LSV/XR (FLA)	LSV	7.1 ft
Toyota Tacoma	Pickup	6.1 ft
GEM eL XD	LSV	5.8 ft
Club Car Carryall 710 LSV	LSV	5.5 ft
Pickman Classic	LSV	5.3 ft

[59] There were two other LSVs researched but excluded from the above table given limited cargo bed lengths: Cushman Hauler Pro LSV (no extended bed option) and Club Car Carryall 510 LSV (3.5ft).
[60] The Kia PV5 is scheduled for release in Q3/4 2025 in Korea and Europe, with other market launches schedule for 2026. A concept vehicle was hand measured to provide the 8.1 ft extended cargo length.

4.5 Kei truck example comparison

Figure 18. Electric kei van example. (Mitsubishi Minicab EV)

The following is a comparison for illustration of how the City could choose to right-size pickup truck and van units that may currently exceed what is needed for operations. The reduced footprint and maneuverability of kei-class vehicles could be especially beneficial in central business district and older neighborhood street driving with limited curb space throughout Boston. As of September 2024, the MA RMV permits registering kei vehicles.[61]

Table 6. Kei-Class Truck Comparison

Comparison Type	Kei-Class Trucks	Ford F-150 XL SuperCab	2009 Honda Acty
Price	$500-$10,000[62]	$41,560[63]	
Vehicle Footprint	~11.2 ft x ~4.9 ft[64] (~54.9 sq. ft)	19.3 ft x 6.7 ft (128.7 sq. ft)	11.2 ft x 4.8 ft[65] (~54 sq. ft)
Cargo Bed Size	~6.5 ft x ~4.3 ft (27.95 sq. ft)	6.5 ft x 4.2 ft (27 sq. ft)	6.3 ft x 4.6 ft (29.4 sq. ft)[66]
Cargo Bed Capacity	Max payload: 770 lb	max payload: 1670 lb	max payload: 772 lb[67]
Battery Size	20 kWh	107 kWh	
Battery Range	112 miles	230 miles	
Battery Charge Time	7.5 hrs at 3 kW[68]	13 hours at 7.7 kW[69]	

61 https://www.mass.gov/news/advisory-massachusetts-rmv-announces-update-to-kei-vehicle-policy
62 https://www.cnn.com/2024/07/14/business/kei-trucks-japan-tiny-movement/index.html
63 Ford F-150 XL price and specs: https://www.ford.com/trucks/f150/models/f150-xl/
64 https://oiwagarage.co/blogs/kei-truck/kei-truck-dimensions-small-size-big-impact-20250214190033
65 https://www.honda.co.jp/auto-archive/actytruck/2009/dimensions/
66 https://www.honda.co.jp/auto-archive/actytruck/2009/loadingplatform/
67 https://www.honda.co.jp/auto-archive/actytruck/2009/loadingplatform/
68 Example: Mitsubishi Minicab EV: https://www.mitsubishi-motors.com/en/newsroom/newsrelease/2023/20231124_3.html
69 https://media.ford.com/content/dam/fordmedia/North%20America/US/product/2022/f-150-lightning/pdf/F-150_Lightning_Tech_Specs.pdf

5 Conclusion

This SFTP proposes a systematic approach to prioritizing investments in City fleet safety countermeasures, directly supporting the City's Vision Zero road safety goal. This plan adapts the model employed by the City of New York fleet since 2017, in which the City can require Tier 1 countermeasures, encourage Tier 2 countermeasures, and explore Tier 3 countermeasures.

This report is based on targeted research by Volpe as well as review of current operational experience and consultation with Boston fleet agencies leading fleet safety technology adoption. This SFTP will continue to serve as a living document. As safety technologies and best practices develop, as their availability and cost evolves, and as the state of research advances, the document will be updated in future cycles. The City anticipates reviewing and updating this document every two years going forward.

The City expects to use the results of this report to establish fleet safety procurement targets, potentially in combination with an update to the City's existing Ordinance to Safeguard Vulnerable Road Users to align with new statewide Commonwealth specifications introduced in 2023.[70] The City of Boston's goal is for all future vehicle purchases to include all Tier 1 safety countermeasures in this SFTP and retrofit existing vehicles to the extent possible. Additional procurement targets may include but not be limited to the minimum percentage of vehicles incorporating high vision design. The City's effort to complete the safety countermeasure inventory will guide the setting of these procurement targets.

Among future fleet safety efforts anticipated by the City is a focused investigation of applying the SFTP to the school bus sector and student transportation.

[70] https://malegislature.gov/Laws/SessionLaws/Acts/2022/Chapter358

6 Appendix

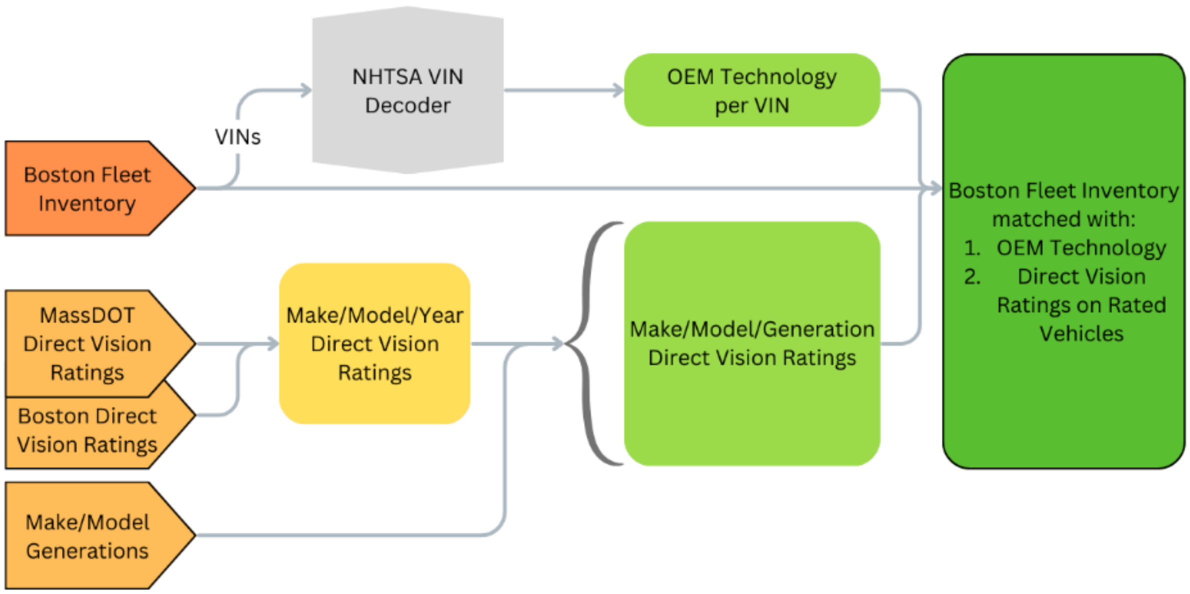
6.1 Inventory Baseline Analysis: OEM Safety Technologies and Direct Vision Ratings

Volpe staff helped identify high-vision vehicles and estimate adoption of OEM safety technologies by analyzing the Boston Central and Boston Fire Department fleet inventories. Volpe staff decoded OEM safety technology information by passing the fleet Vehicle Identification Numbers (VINs) through the NHTSA VIN decoder.[71] High vision vehicles were additionally identified using direct vision scores for vehicles rated in two reports:

- 2023 Boston Blind Zone Initiative report (DOT-VNTSC-BOS-23-01), focusing on vehicles used for Boston's public schools, Fire Department, and Public Works[72]
- 2024 Commonwealth of Massachusetts Direct Vision Study (DOT-VNTSC-MADOT-24-01), focusing on fleets purchased and leased by the Commonwealth[73]

The ratings from these reports scored vehicles for specific model years, which were expanded to encompass make-model generations, to cover more vehicles in the Boston Central and Fire Department fleets.

Figure 19. Inventory Baseline Analysis Data Flow



[71] https://www.nhtsa.gov/vin-decoder; This process was programmed using the software package, vindecodr.
[72] https://www.nyc.gov/assets/dcas/downloads/pdf/fleet/boston-blind-zone-safety-initiative-us-dot-volpe-study.pdf
[73] https://www.mass.gov/doc/commonwealth-of-massachusetts-direct-vision-study/download

Information on OEM ADAS technology is not collected for all vehicles. Currently, the NHTSA VIN decoder team manually compiles manufacturer information for light- and medium-duty vehicles for a select number of manufacturers (See Table 7). Data collection may be expanded in the future as ADAS technology becomes more prevalent across manufacturers and heavy-duty vehicles. When data are available, an ADAS technology for a vehicle is coded as "Standard" (the manufacturer includes the ADAS technology by default), "Optional" (the manufacturer allows the ADAS technology as a customizable option), or "Not Applicable" (the ADAS technology is irrelevant to the vehicle type). When data are unavailable, an ADAS technology is coded as blank for that vehicle. Blank values indicate that the data have not been collected or could not be identified, and so cannot speak to either the presence or absence of the technology for the given vehicle. Since numerous vehicles return blank values on ADAS technologies, these results provide a starting point for Boston Central Fleet and Fire Department to complete upon inspection of individual vehicles through routine maintenance.

Table 7. Vehicle Manufacturers that the NHTSA VIN Decoder Team reviews for ADAS Technology

Acura	Honda	MINI
Alfa Romeo	Hyundai	Mitsubishi
Aston Martin	Infiniti	Nissan
Audi	Jaguar	Polestar
Bentley	Jeep	Porsche
BMW	Kia	Ram
Buick	Lamborghini	Rivian
Cadillac	Land Rover	Rolls-Royce
Chevrolet	Lexus	Smart
Chrysler	Lincoln	Subaru
Dodge	Lotus	Tesla
Ferrari	Lucid	Toyota
Fiat	Maserati	Volkswagen
Ford	Mazda	Volvo
Genesis	McLaren	
GMC	Mercedes-Benz	

Additionally, not all vehicles are rated. The direct vision ratings from 2023 Boston Blind Zone Initiative and 2024 Commonwealth of Massachusetts Direct Vision Study cover the majority of Buses, Large Trucks, and Trucks, and Vans in the Boston Central Fleet (see Table 8), and the minority of vehicles in the Boston Fire Department (Table 7). This analysis can be used as a baseline to develop procurement targets. Rated vehicles not in either fleet can provide direction in procuring high vision vehicles.

Table 8. Boston Fire Department: Direct Vision Ratings (Buses, Large Trucks, Trucks)

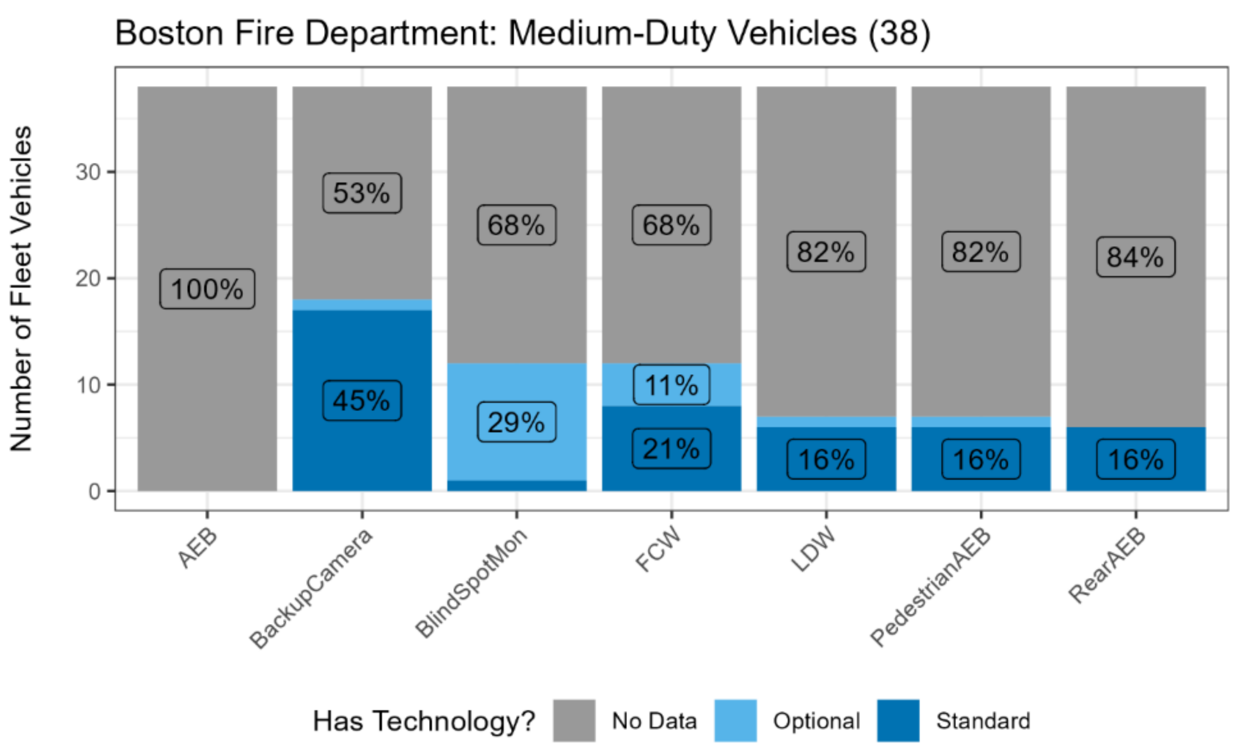
Vehicle Type	Vehicles	Rated Vehicles	High Vision	Low Vision
Fire Engine	91	51	51 (100%)	-
Light-Duty Truck	27	4	3 (75%)	1 (25%)
Medium/Heavy-Duty Truck	51	5	1 (20%)	4 (80%)
Shuttle Bus	6	0	-	-
Total	175	60	55 (92%)	5 (8%)

Table 9. Boston Central Fleet: Direct Vision Ratings (Buses, Large Trucks, Trucks)

Vehicle Type	Vehicles	Rated Vehicles	High Vision	Low Vision
Bus	68	50	50 (100%)	-
Light-Duty Truck	280	142	142 (100%)	-
Medium/Heavy-Duty Truck	332	223	123 (55%)	100 (45%)
Total	680	415	315 (76%)	100 (24%)

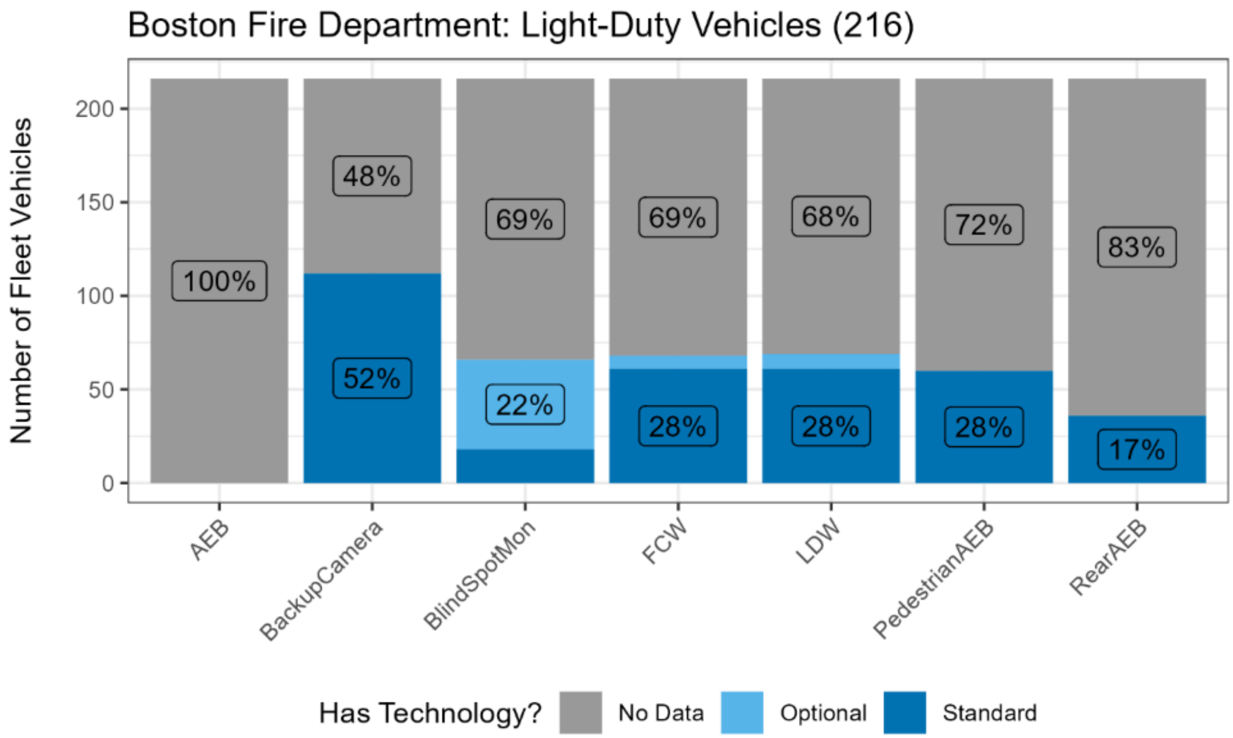
The Boston Fire Department fleet has 38 medium-duty vehicles (see Figure 20). Backup cameras are standard in almost half (45 percent) of medium-duty. Forward collision warning (FCW) is standard in about one fifth (21 percent) of medium-duty vehicles, and optional an additional 11 percent. Data on the other ADAS technologies are not available for the majority of medium-duty vehicles (68 – 100 percent).

Figure 20. Boston Fire Department: Adoption of ADAS Technology in Medium-Duty Vehicles



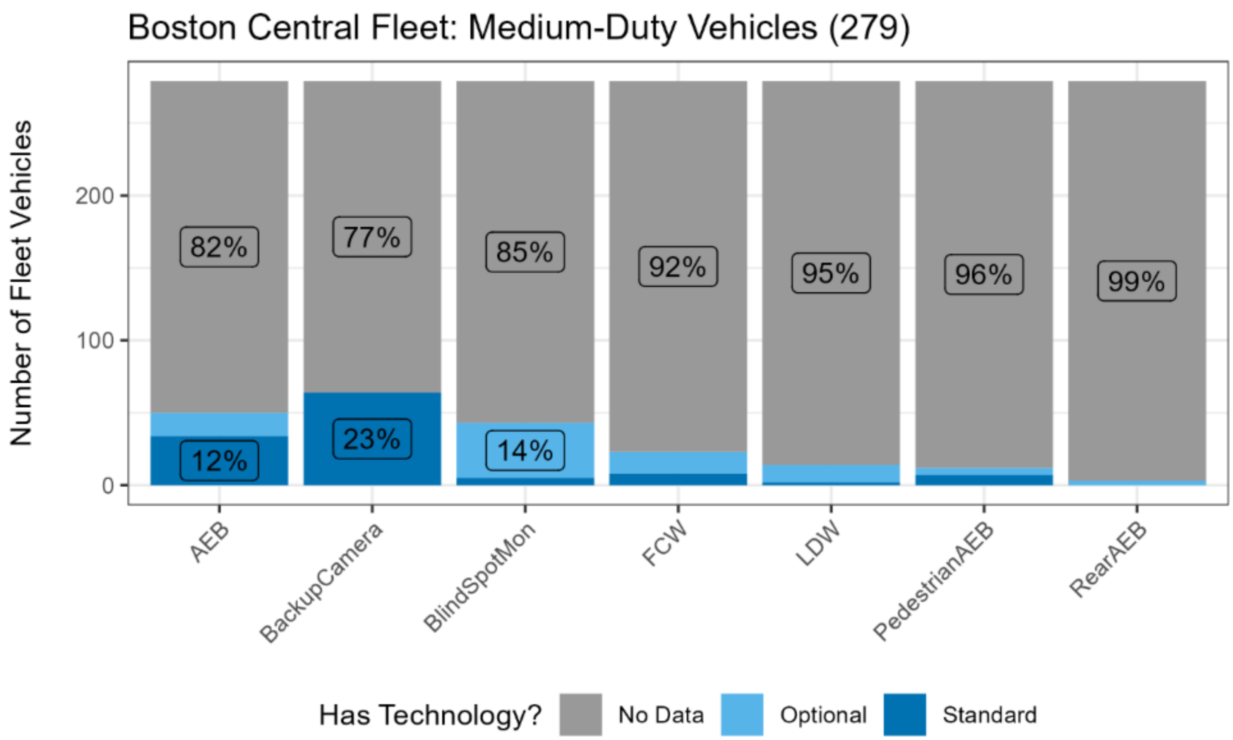
The Boston Fire Department has 216 light-duty vehicles. Like medium-duty vehicles, backup cameras come standard on at least half (52%) of light-duty vehicles. FCW, LDW, and pedestrian AEB each come standard in about one third (28%) of light-duty vehicles.

Figure 21. Boston Fire Department: Adoption of ADAS Technology in Light-Duty Vehicles (216)



Backup cameras come standard in 23% of medium-duty vehicles. AEB is standard among 12%, with an optional customization to include AEB in less than 10% of medium-duty vehicles in the Boston Central Fleet.

Figure 22. Boston Central Fleet: Adoption of ADAS Technology in Medium-Duty Vehicles



More than half (52%) of Boston Central Fleet light-duty vehicles include backup cameras by default. And about one third of light-duty vehicles FCW (33%), LDW (29%), and Pedestrian AEB (31%). Blindspot monitors are standard in 14% of light-duty vehicles, and optional in an additional 24%. AEB is standard among 42% of light-duty vehicles, while rear AEB is standard or optional in less than 10%.

Figure 23. Boston Central Fleet: Adoption of ADAS Technology in Light-Duty Vehicles

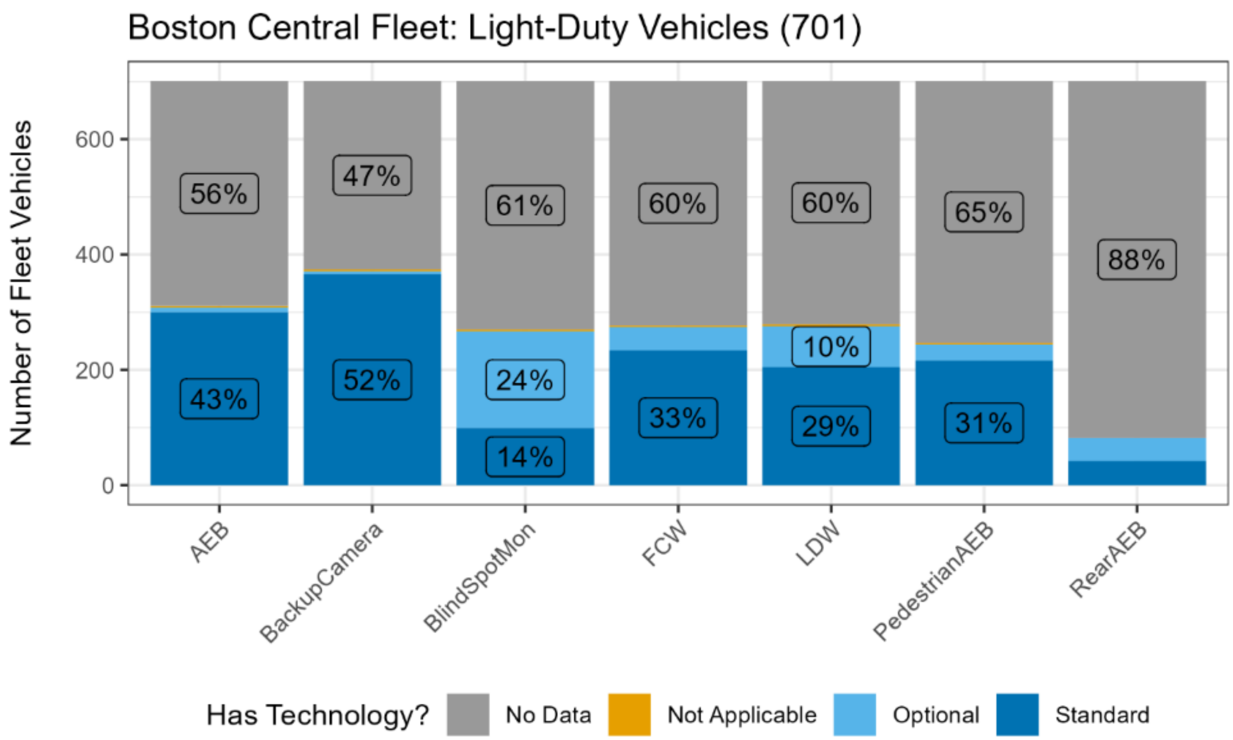


Figure 24. Boston Central Fleet: Direct Vision Ratings

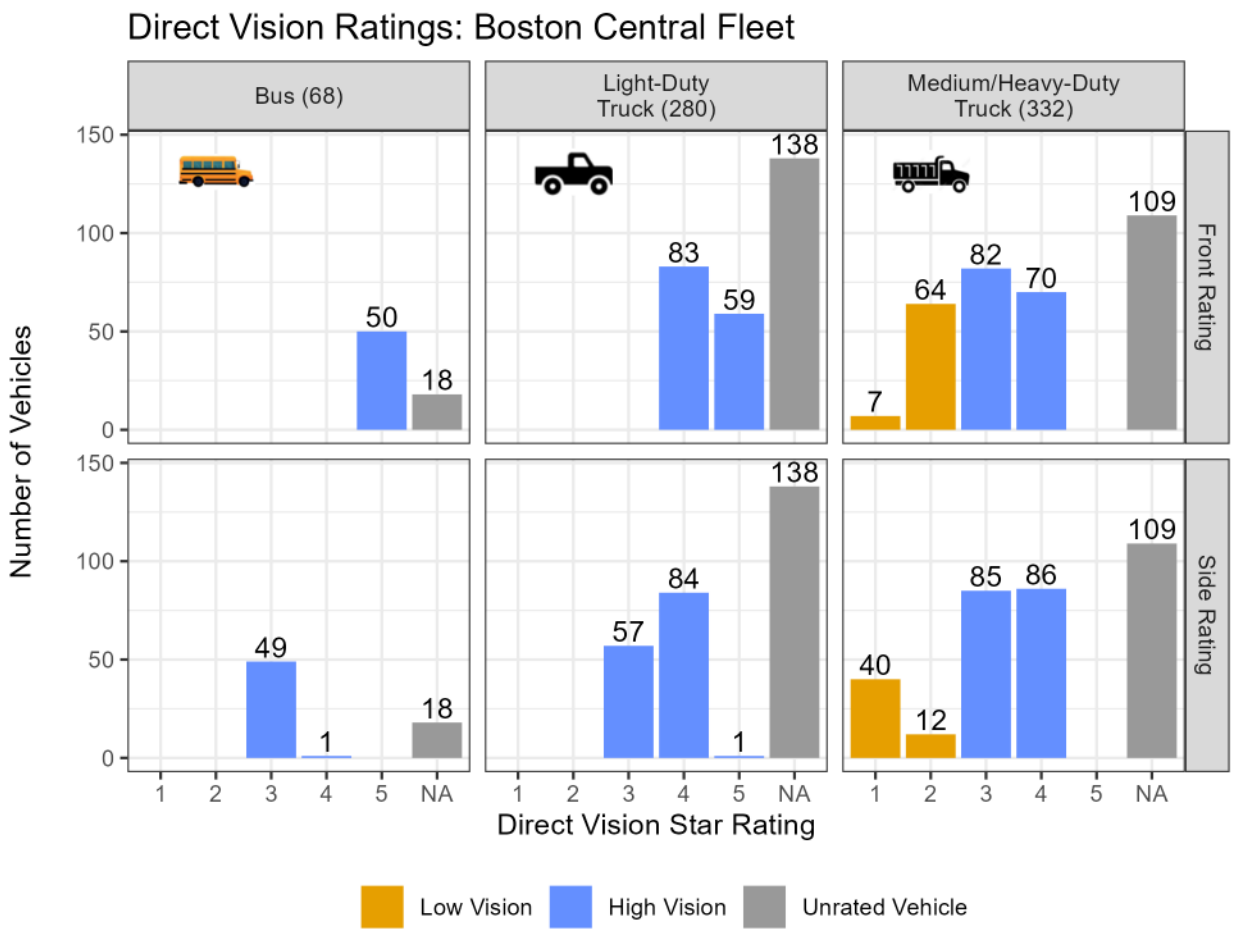


Figure 25. Boston Fire Department: Direct Vision Ratings