FTA Standards Development Program: Crashworthiness/Crash Energy Management Follow-up for Less than 30 Ft Bus

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Outline

- Introduction and background
- Existing bus crashworthiness standards for paratransit body-on-chassis buses (cutaways)
- Data presentation and gap analysis
- Case study evaluations
- Conclusions
- Findings

Introduction and background

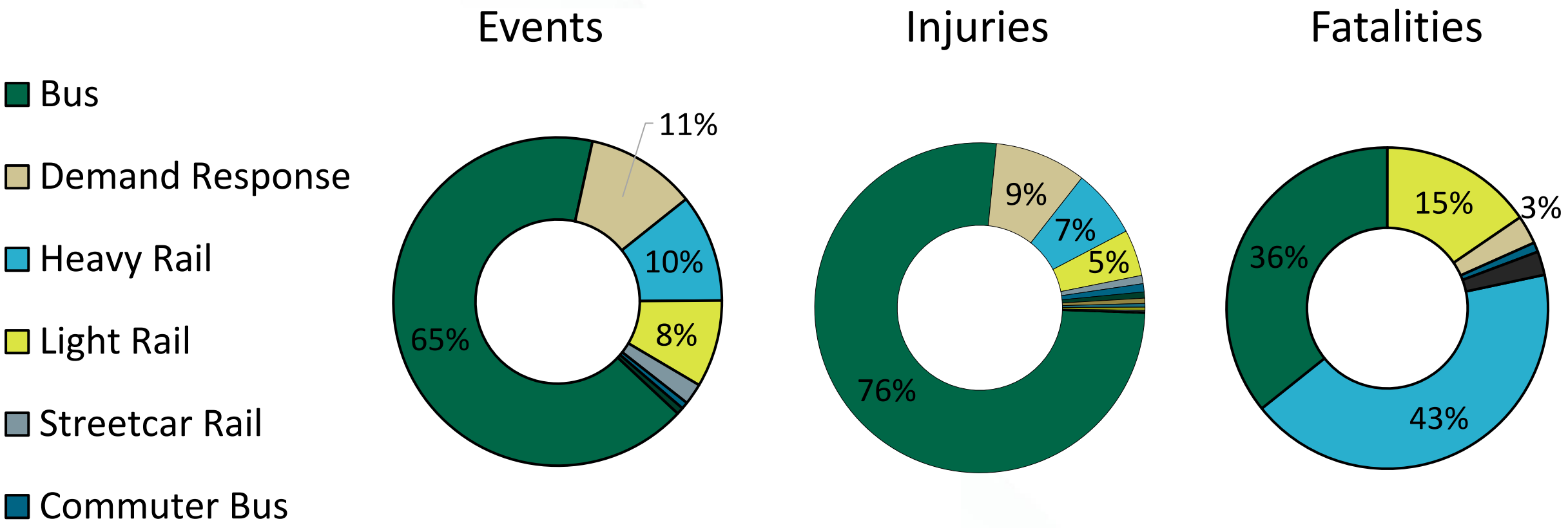
- FTA directed this study
- The findings can be leveraged to guide public transit agency decision-making in their cutaway procurement decisions
- Transit collisions are inevitable
  - Crashworthiness and crash energy management techniques and applications increase the likelihood of survivability

NTD Background Data

- (NTD) Safety and Security 40 (S&S 40) time series database indicates that more than 59,100 major bus collisions occurred between January 2008 and July 2020
- Bus safety and security events during that period resulted in 105,773 injuries, 60,355 of which were passenger injuries, and 1,233 fatalities, the majority of which were pedestrians or occupants of other vehicles
- There were also 8,772 collisions reported in the category of Demand Response services on the S&S 40 between 2008 and July 2020, with 70 demand response-related fatalities, including 14 passengers and 3 operators
- Additionally, there were 10,896 injuries associated with demand response safety and security events, 66% of which were to passengers or operators on the demand response vehicle

Safety & Security Events, 2008-2020

Percent of Events/Injuries/Fatalities by Mode, 2008-2020



Rural NTD Background Data

- In addition to S&S 40 data reported by urban systems, rural NTD data are collected for FTA Section 5311 agencies on NTD's RU-20 form
- RU-20 data 2007–2019 reveal
  - 7,595 reportable incidents
  - 130 fatalities
  - 4,716 non-fatal injuries

Existing federal bus crashworthiness standards for buses

Geography	Type of Rule	Document	Title	Applicability	Target (crashworthiness related)
US (FMVSS)	Regulation	49 CFR 571.204	Steering control rearward displacement	Transit Bus	Operator safety
US	Regulation	49 CFR 571.205	Glazing materials	Transit Bus	Occupant ejection
US	Regulation	49 CFR 571.213	Child restraint systems	Transit Bus	Built-in restraints
US	Regulation	49 CFR 571.217	Bus emergency exits and window retention and release	Transit Bus	Occupant ejection
US	Regulation	49 CFR 571.302	Flammability of interior materials	Transit Bus	Vehicle fires
US	Regulation	49 CFR 571.207	Seating systems	Transit Bus - Operator only	Seat failure
US	Regulation	49 CFR 571.208	Occupant crash protection	Transit Bus - Operator only	Forces on crash dummies
US	Regulation	49 CFR 571.209	Seatbelt assemblies	Transit Bus - Operator only	Operator safety
US	Regulation	49 CFR 571.210	Seatbelt assembly anchorages	Transit Bus - Operator only	Operator safety
US	Regulation	49 CFR 571.216	Roof crush resistance	Bus with GVWR < 10,000 lb	Rollover
US	Regulation	49 CFR 571.220	School bus rollover protection	School Bus	Rollover

FTA required testing through Altoona

- Altoona performs six testing procedures
  - **Distortion** – Observes operation of various subsystems when a bus is placed in a longitudinal twist (simulating operation over a 6-in. curb or through a 6-in. pothole) and subjected to a water spray mechanism simulating rain and traffic spray.
  - **Static Tow** – Determines strength characteristics of bus towing fixtures during static loading conditions.
  - **Dynamic Tow** – Verifies integrity of towing fixtures and determines feasibility of towing a bus using a heavy-duty wrecker and specified procedures.
  - **Jacking** – Determines damage caused by a deflated tire and feasibility of jacking a bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.
  - **Hoisting** – Determines possible damage or deformation caused by jack stands on jacking pads.
  - **Durability** – Performs an accelerated durability test that approximates up to 25% of the service life of a vehicle

Existing state bus crash-worthiness standards for buses

Geography	Type of Rule	Document	Title	Applicability	Target (crashworthiness related)
Florida	Rule	§ 14-90.007(1)(b) F.A.C.	Structural integrity	Bus procured through Florida's Transit Research Inspection Procurement Services Program (TRIPS)	CEM
Florida	Rule	§ 14-90.007(1)(c) F.A.C.	Compliance with FMVSS 49 CFR 571 sections 207, 209, 210, 217, and 302 are at least partially related to vehicle crashworthiness (shown above)	Bus procured through TRIPS Program	Seating systems, seat belt assembly, seat belt anchorages, emergency exits and window retention release, and flammability of interior materials
Florida	Rule	§ 14-90.007(8) F.A.C.	Emergency Exits	Bus procured through TRIPS Program	Emergency evacuation
Florida	Rule	§ 14-90.007(12) F.A.C.	Seatbelts	Bus procured through TRIPS Program	Operator safety
Minnesota	Rule	Minnesota Administrative Rules Chapter 8840.5940 § (1)	Rollover Protection	All vans and buses	Rollover
Wisconsin	Rule	Wisconsin Administrative Code Chapter Trans 330.10 (12)	Equipment requirements and standards (Frame)	Motor bus	The frame shall conform to the requirements under 49 CFR 393.201
Wisconsin	Rule	Wisconsin Administrative Code Chapter Trans 330.10 (20)	Equipment requirements and standards (Seating)	Motor bus	Seat performance

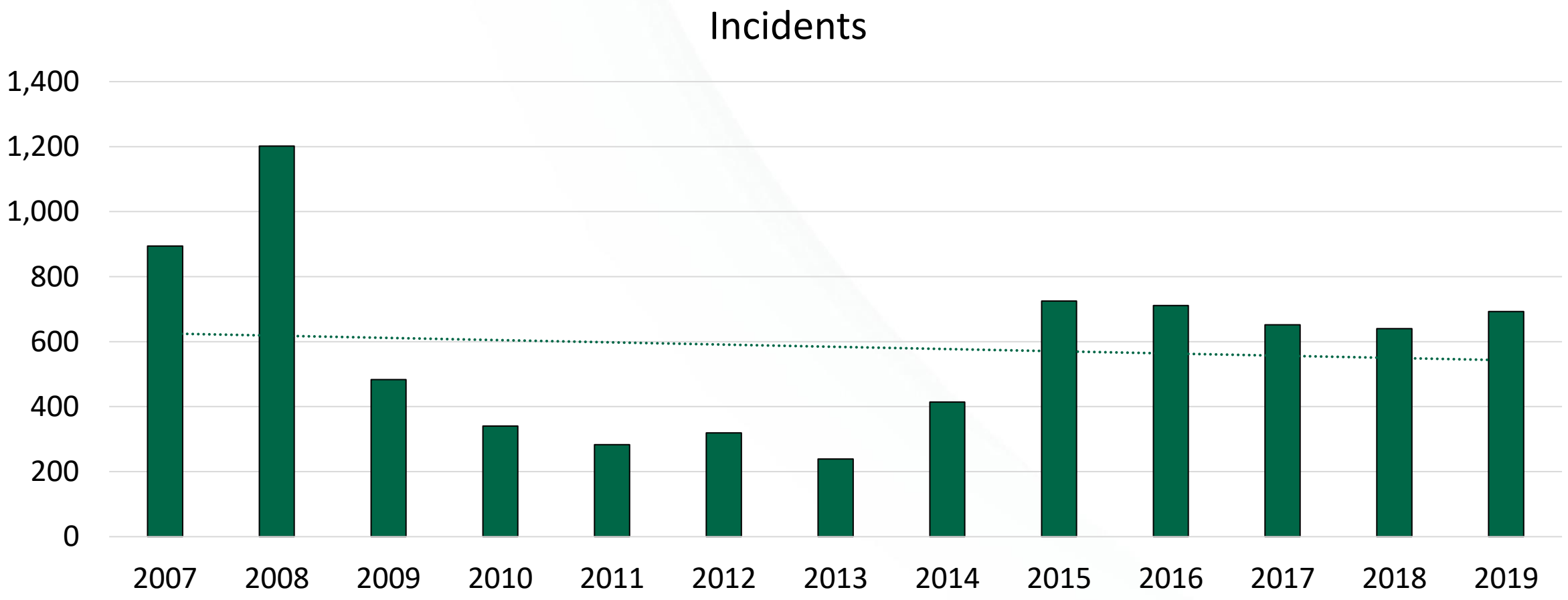
Existing bus crashworthiness standards for paratransit body-on-chassis buses (cutaways)

- The Florida Standard requires crashworthiness and safety assessments of paratransit body-on-chassis buses, and is comprised of
  - *Rollover Crashworthiness Assessment for Cutaway Buses Acquired by the State of Florida*
  - *Pre-Qualification Structural Testing for Cutaway Buses Acquired by the State of Florida*

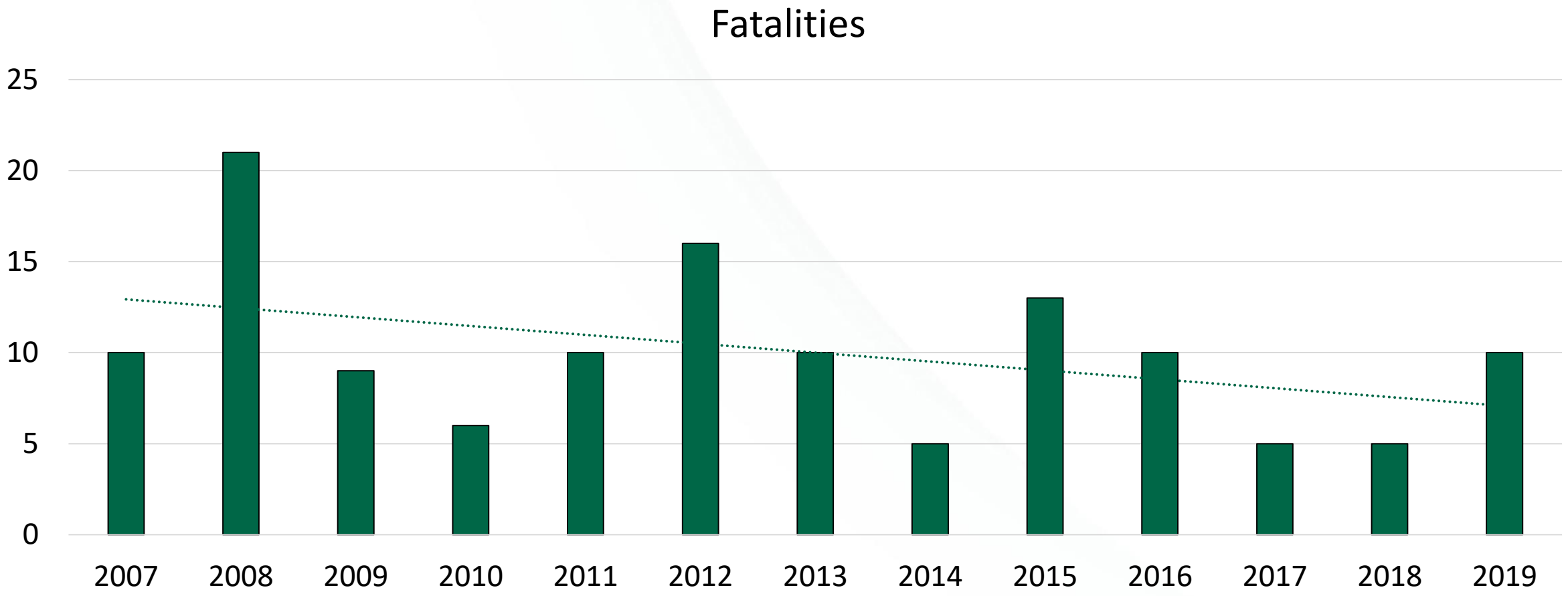
Data presentation and gap analysis

- Focusing specifically on the FTA Section 5311 Formula Grants for Rural Area safety data
- Rural reporters provide annual totals of incidents, fatalities, and injuries
- Annual trends are shown in the next several slides

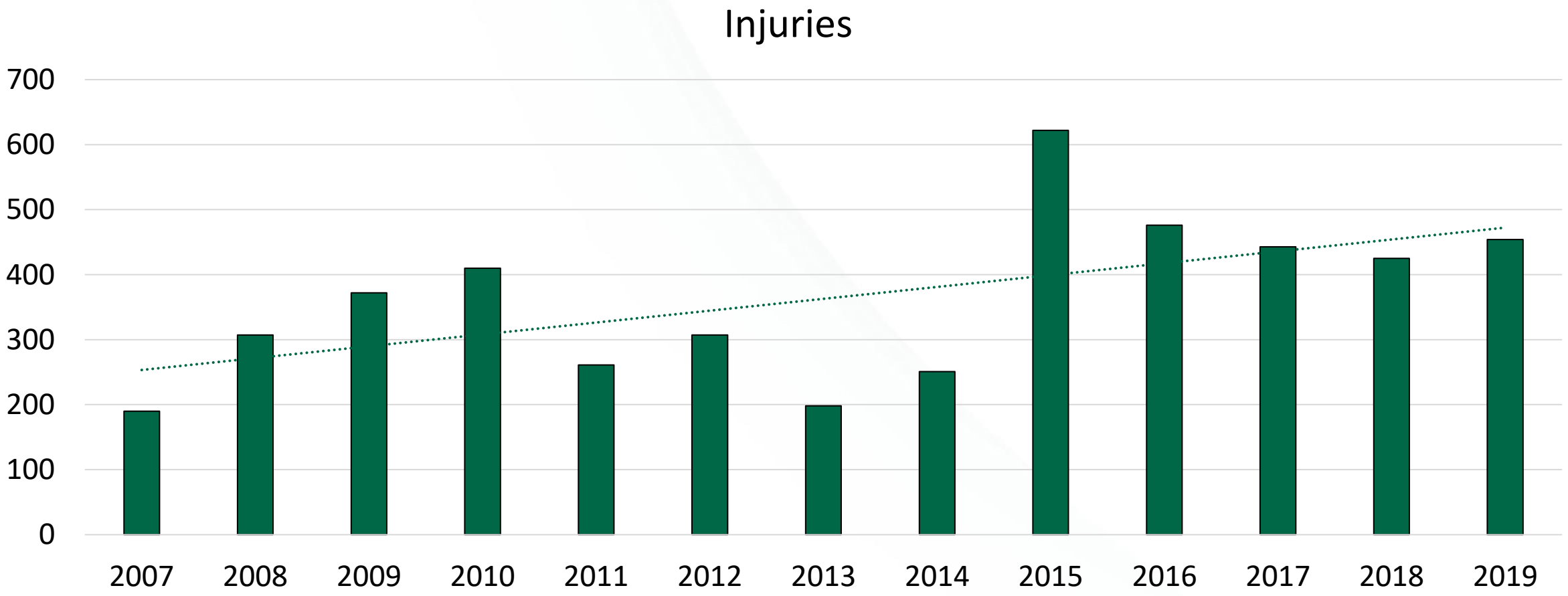
5311 Transit Agency Incidents, 2007-2019



5311 Transit Agency Fatalities, 2007-2019



5311 Transit Agency Injuries, 2007-2019



Case study evaluations

- Examinations of rural collision rate data, four states were selected as case study states
  - California
  - Florida
  - North Carolina
  - Tennessee

Confirmed Collision Involving Cutaway	Not a Cutaway	Not a Collision	No Data / Did Not Wish to Participate	No Response
4	31	7	41	56

Conclusions

- Rural operating environments are more dangerous
  - Higher operating speeds
  - Rural roads – more dirt shoulders (increased likelihood of rollovers), increased notification, response and transport times when collisions occur
- Two types of bus collisions likely to cause residual occupant space intrusion
  - Roof crush or rollover
  - Side-impact
- Aside from residual space loss, secondary impacts contribute to the likelihood of injury or fatality of paratransit occupants

Conclusions cont'd

- Challenges
  - Cutaways often have a GVWR that exceeds the 10,000-lb. limiting weight for many 49 CFR Part 571 Section 200 FMVSS standards
  - Collision and event data on paratransit vehicles operating in rural areas are scarce
    - The support of standards for these vehicles rests in the percentage these vehicles represent of all non-rail transit vehicles purchased with FTA funds coupled with the increased risk associated with rural highway travel and trips of longer duration

Findings

- **Finding 1** – Inclusion of vehicle type in NTD event descriptive data will allow analyses by vehicle types to be comprehensive and comparable across geographies
- **Finding 2** – Expanded applicability of FMVSS or other standards in cutaway vehicle procurement specifications may improve crashworthiness
- **Finding 3** – Additional research to support industry standards or guidance designed to mitigate the injuries and fatalities associated with secondary impact collisions, such as industry specifications for interior fittings, may help improve safety outcomes

Thank You!

Questions?

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