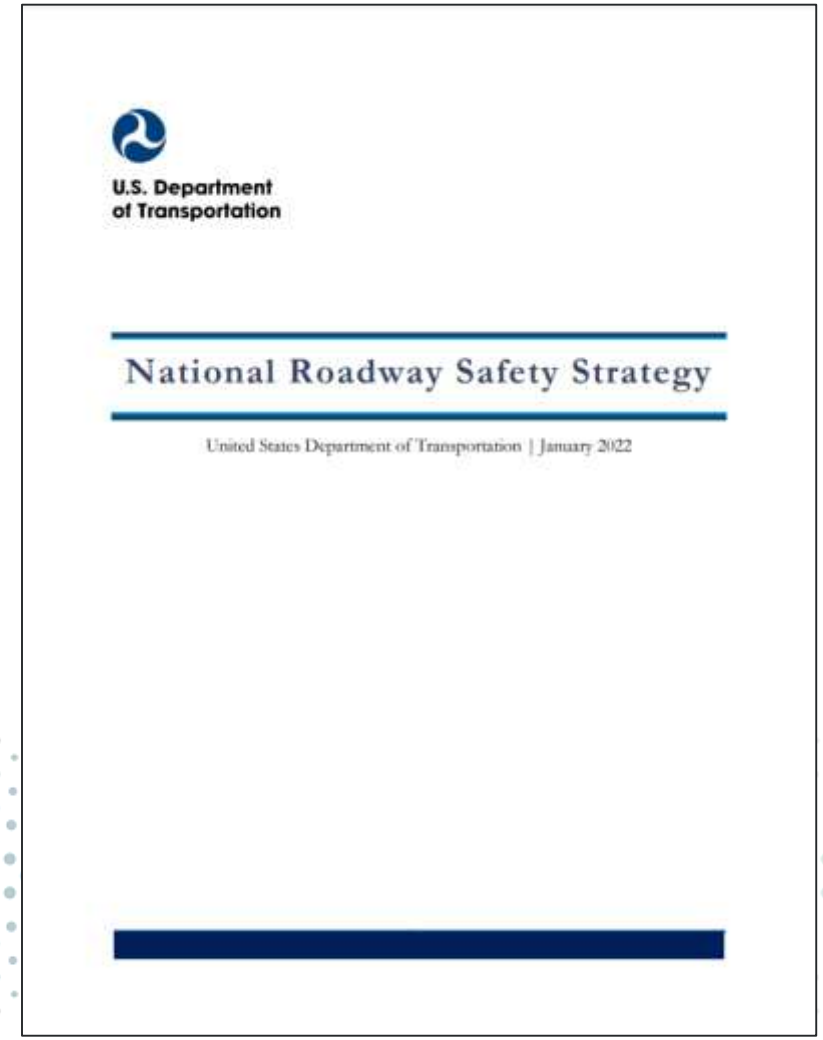
Traffic Safety Engineering and the Safe System Approach

NEVADA DOT
SAFE AND CONNECTED

5/18/2022

National Roadway Safety Strategy

National Roadway Safety Strategy (NRSS)



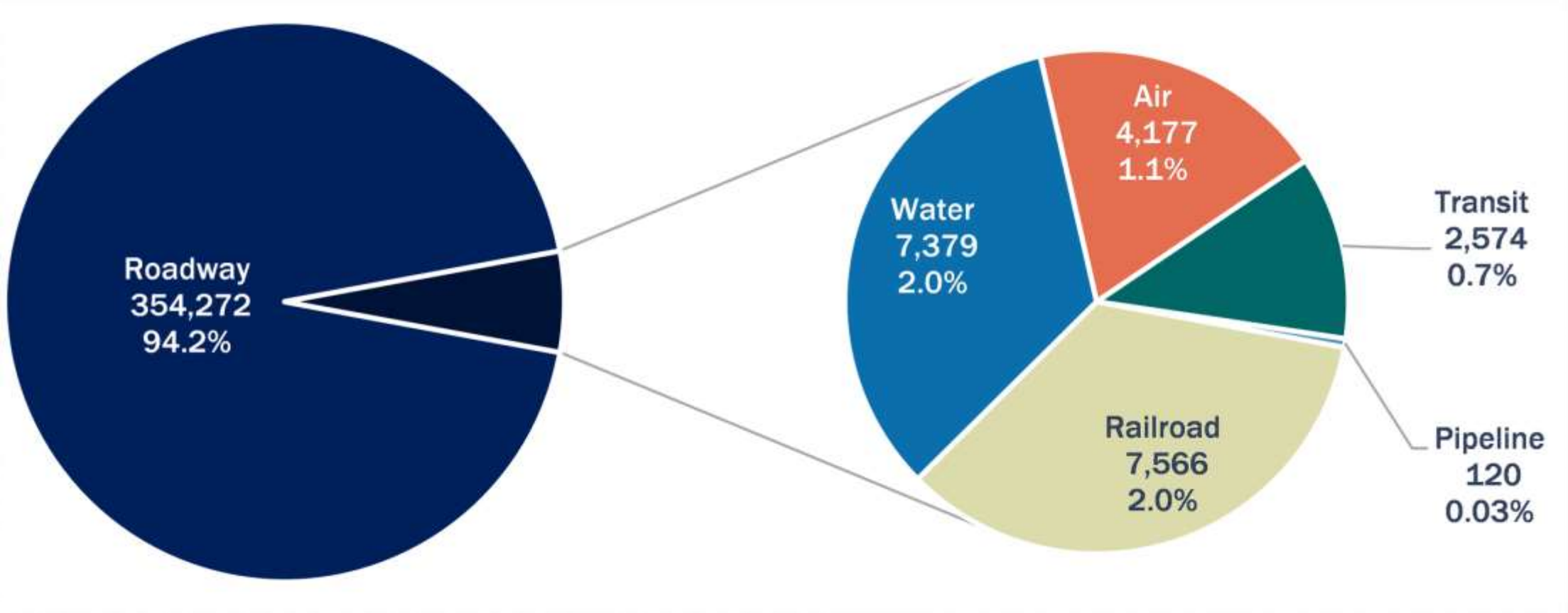
- January 2022 U.S. DOT released the NRSS
- Information about the NRSS if from the U.S.DOT and can be found at: https://www.transportation.gov/NRSS

What is the NRSS?

- U.S. DOT's comprehensive approach to significantly reduce fatalities and serious injuries
- First step in reaching long-term goal of zero fatalities
- Represents a Department-wide approach to working with stakeholders across the county to achieve this goal

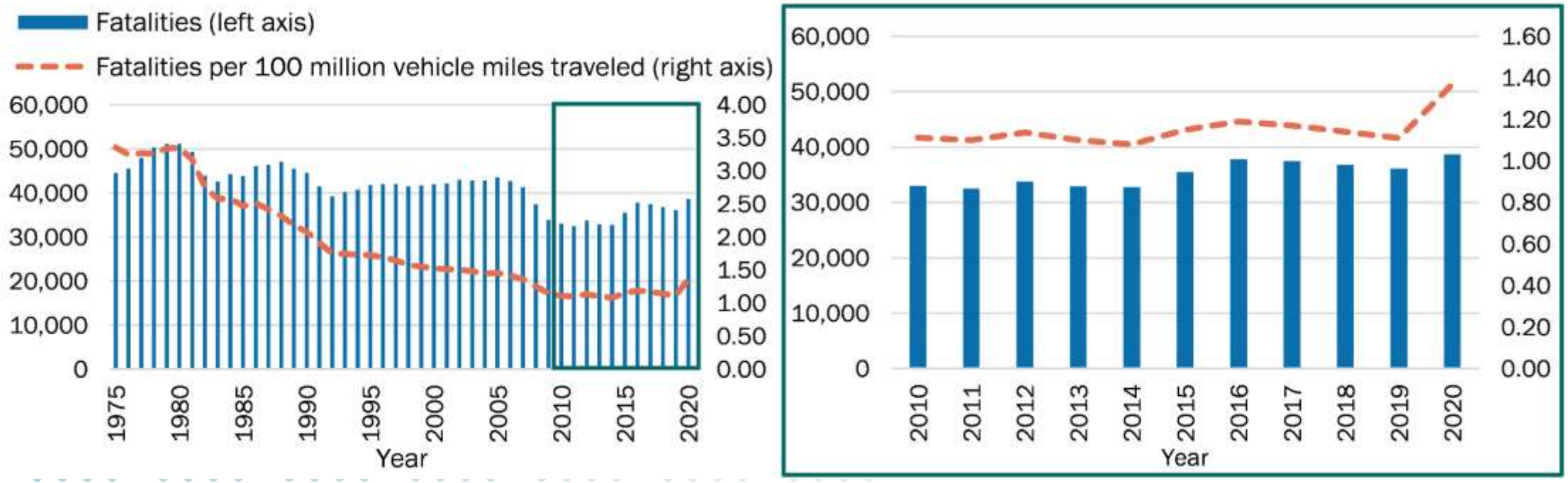
The Roadway Safety Problem

The Roadway Safety Problem



Source: Bureau of Transportation Statistics

The Roadway Safety Problem



Source: Fatality Analysis Reporting System

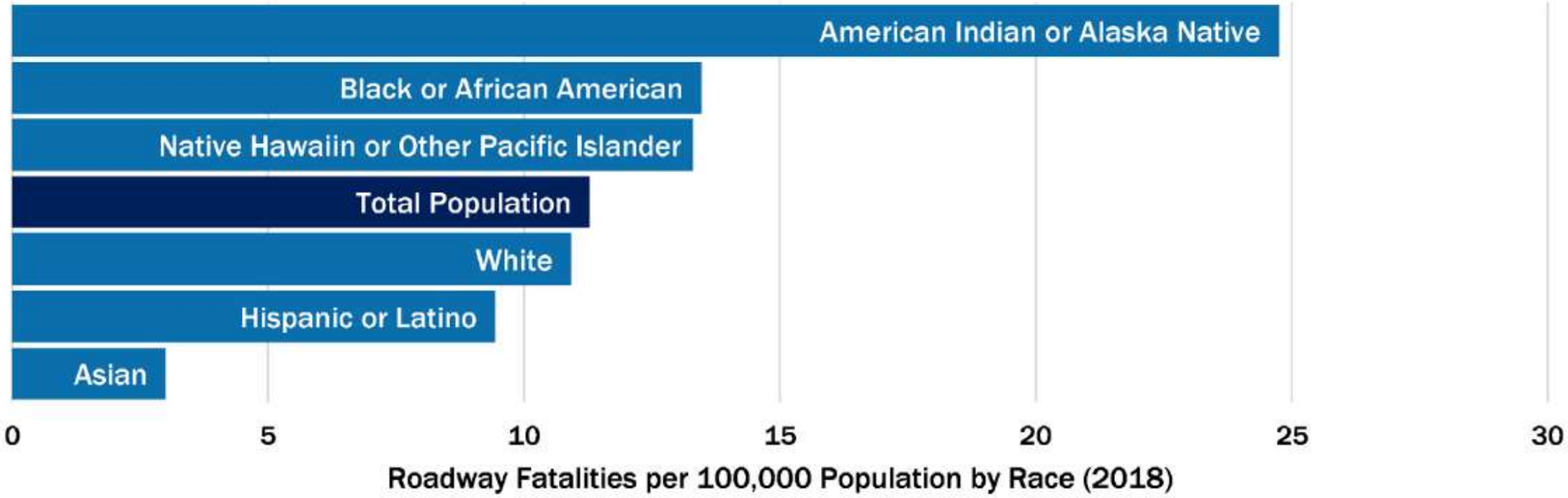
The Roadway Safety Problem

- Compared to 2019, fatalities increased:
- 7% overall
- 23% per mile driven
- 23% among Black people
- 20% involving persons ejected from a vehicle
- 18% among occupants not wearing seatbelts
- 15% among ages 16-24
- 14% among ages 35-44
- 9% alcohol involvement
- 9% among motorcyclists

38,600 people died on America's roads in 2020

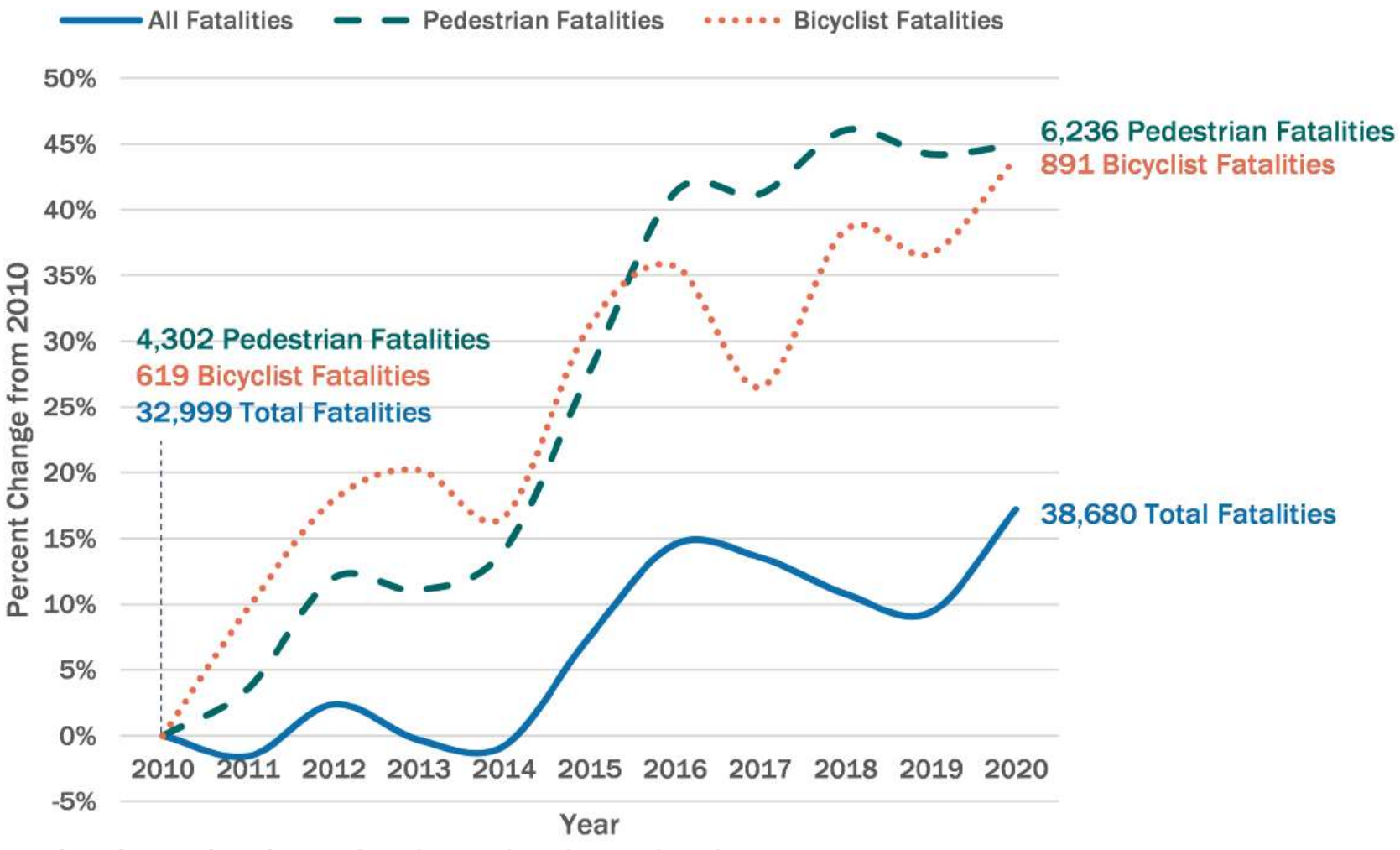
Source: Fatality Analysis Reporting System

Fatalities Impact Communities Differently



Source: Fatality Analysis Reporting System 2018 Final File; Population – Census Bureau

Fatalities Among All Users Have Been Increasing, Particularly for Pedestrians and Bicyclists



Source: Fatality Analysis Reporting System 2018 Final File; Population – Census Bureau

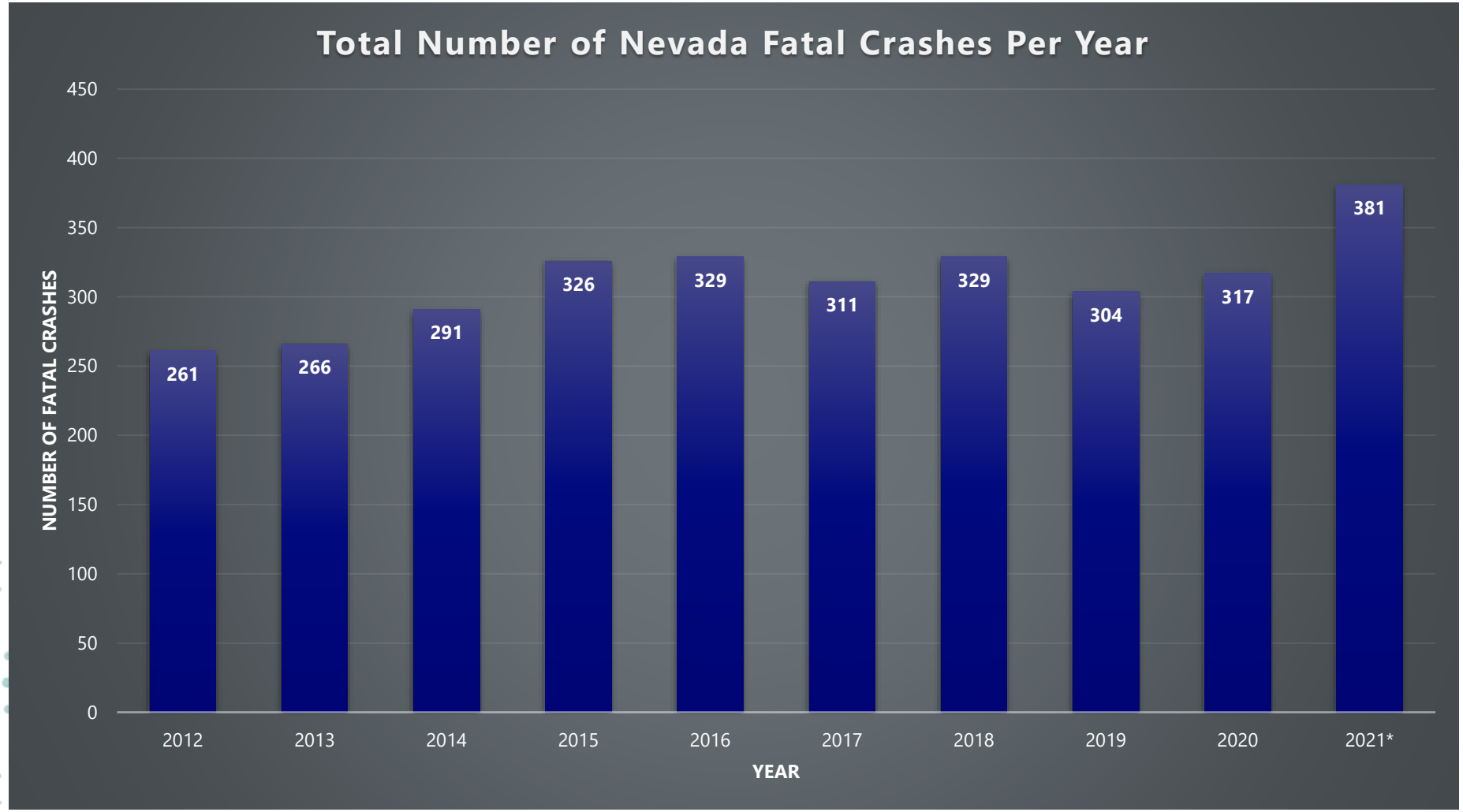
Implementation

Implementation

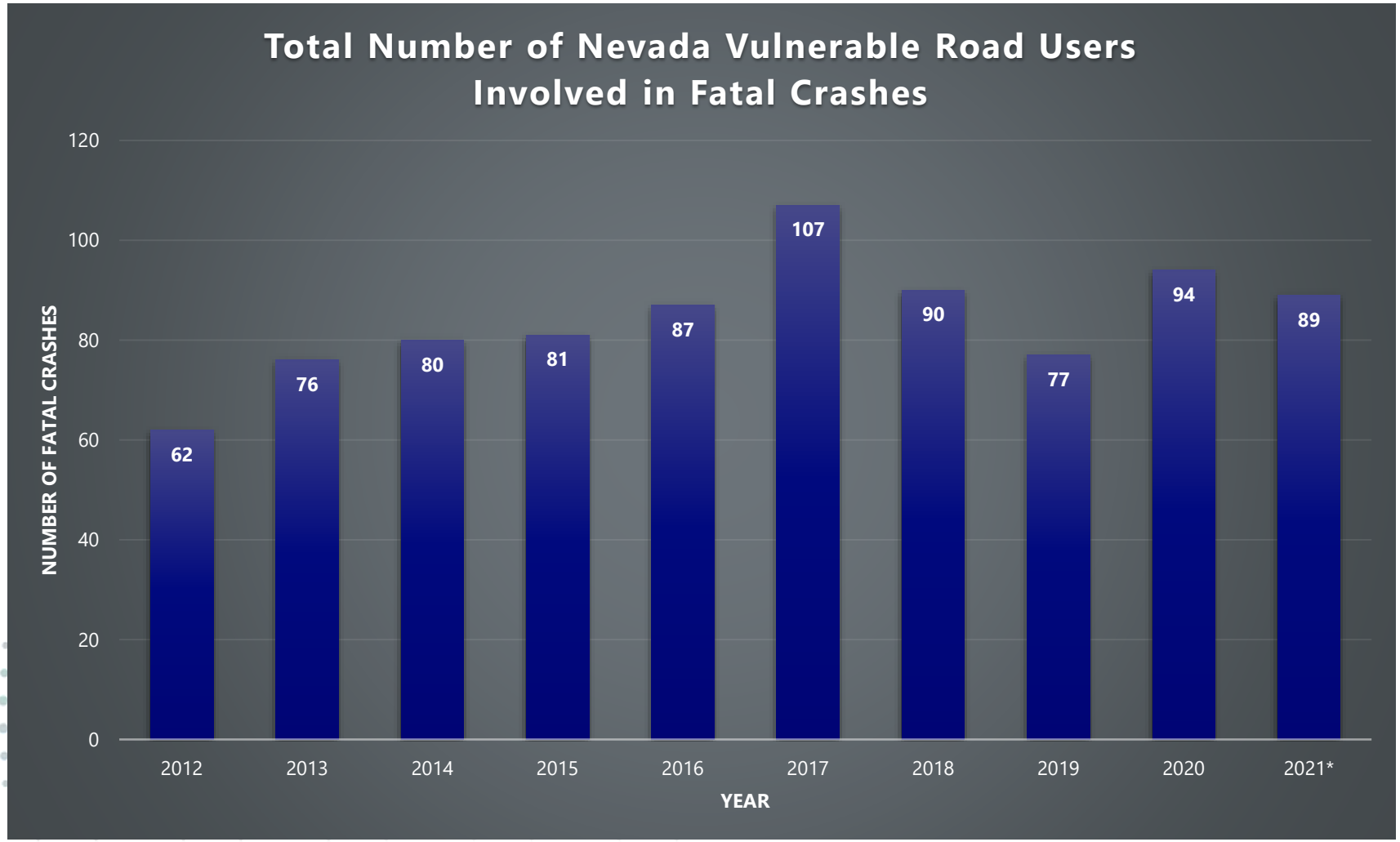
- NRSS identifies each of the objectives and defines actions the U.S. DOT is committed to taking into action
- Actions are listed for the following objectives
  - Safer People
  - Safer Roads
  - Safer Vehicles
  - Safer Speeds
  - Post-Crash Care

Safe Systems Approach

Hundreds of Lives are Lost in Nevada Each Year



Pedestrian Fatalities are High



The Safe System Approach

The 6 Safe Systems Principles

The 5 Safe System Elements

Safe Systems Principles

The 6 Safe Systems Principles

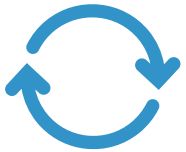
Death/serious injury is unacceptable

Humans make mistakes

Humans are vulnerable

Responsibility is shared

Safety is proactive



Redundancy is crucial

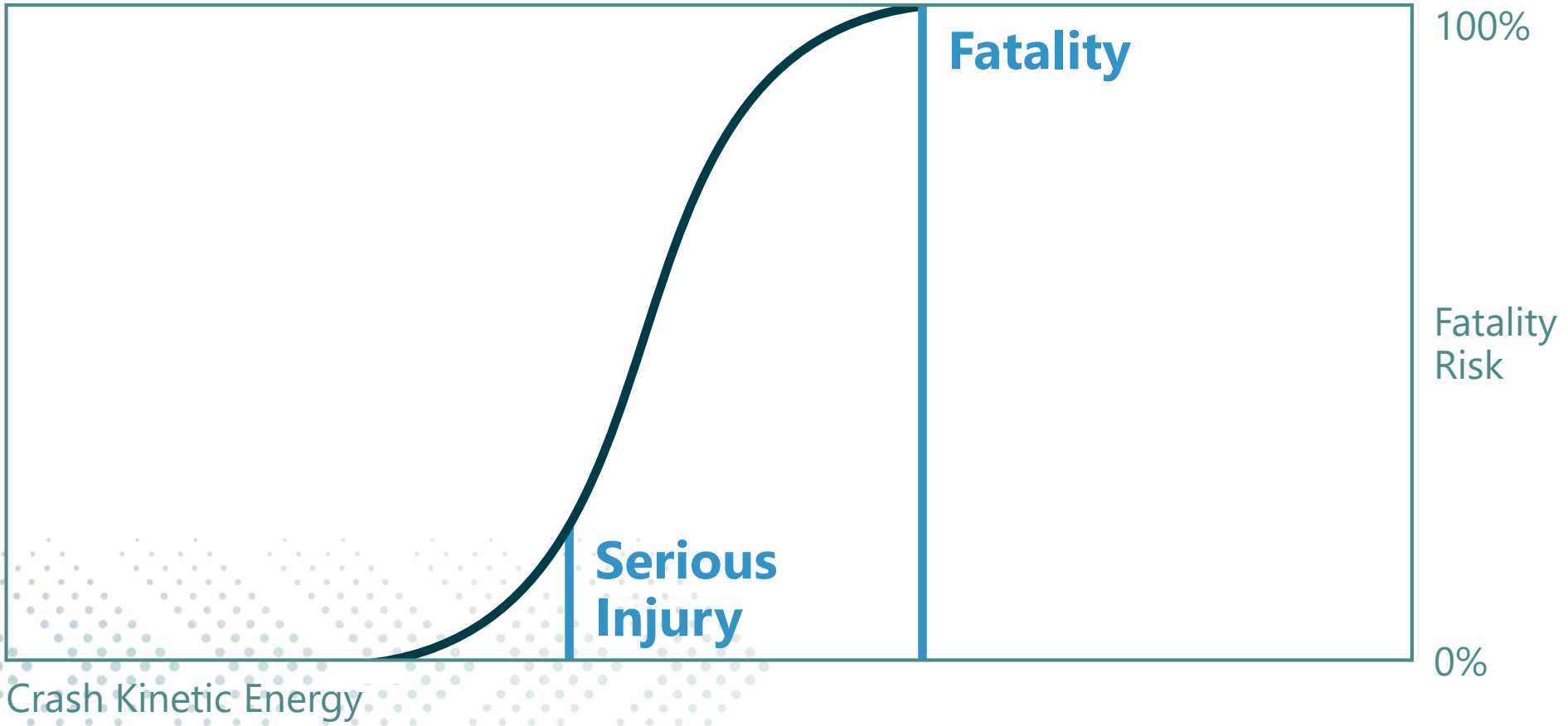
Death/Serious Injury is Unacceptable

Source: Vision Zero Network

Humans Make Mistakes

Source: Fehr & Peers

Humans Are Vulnerable



Source: FHWA

Responsibly Is Shared

System managers

Planners, designers, builders, operators, maintenance workers

Vehicle manufacturers

Law enforcement personnel

Post-crash personnel

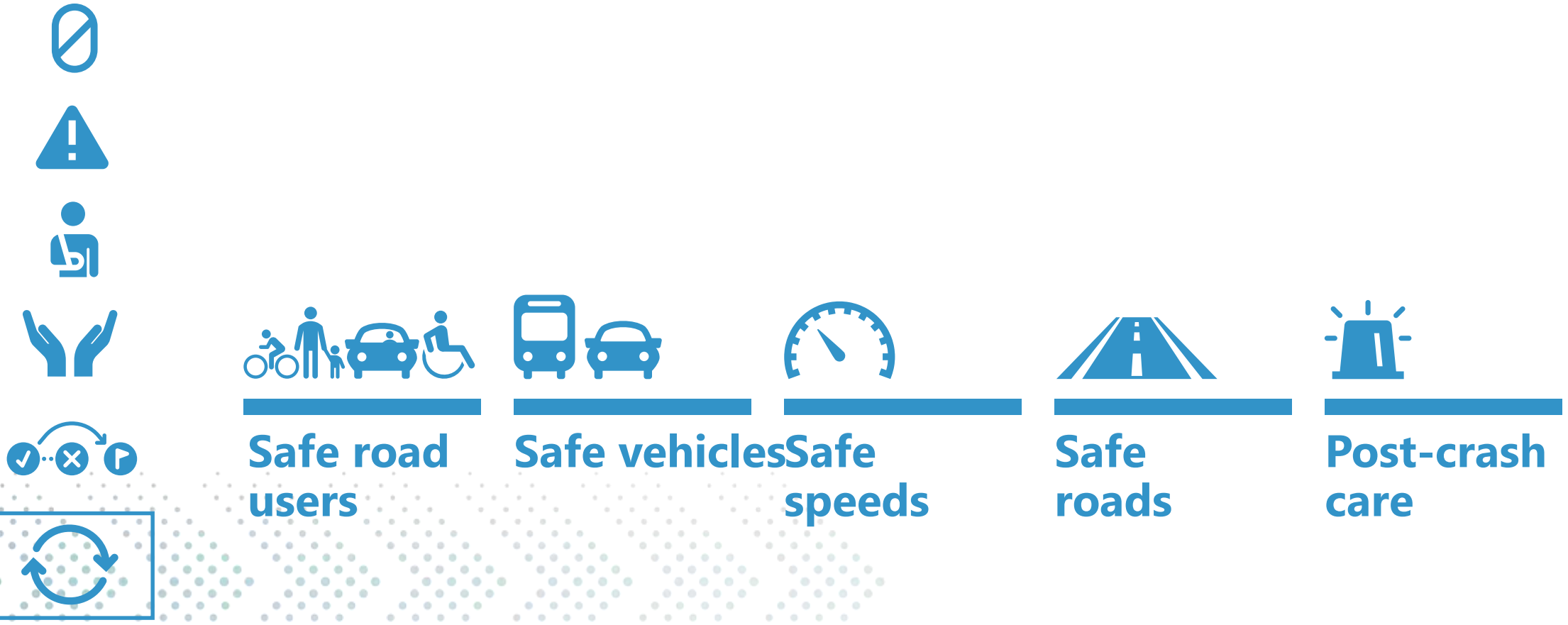
System users

Safety Is Proactive

Identify risks

Mitigate risks

Redundancy Is Crucial



Safe Systems Elements

The 5 Safe Systems Elements

Safe road users

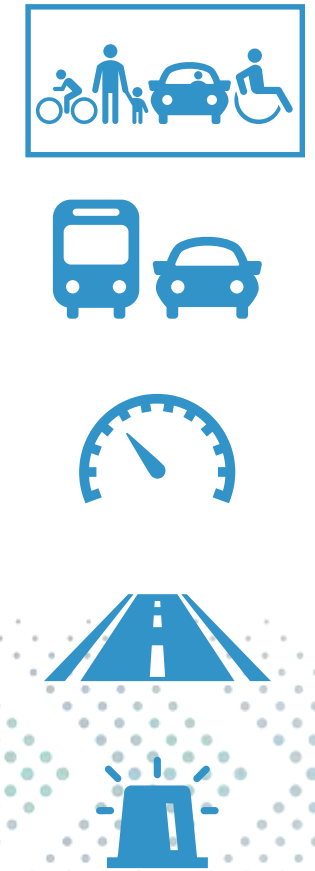
Safe vehicles

Safe speeds

Safe roads

Post-crash care

Safe Road Users



Walk

Bike

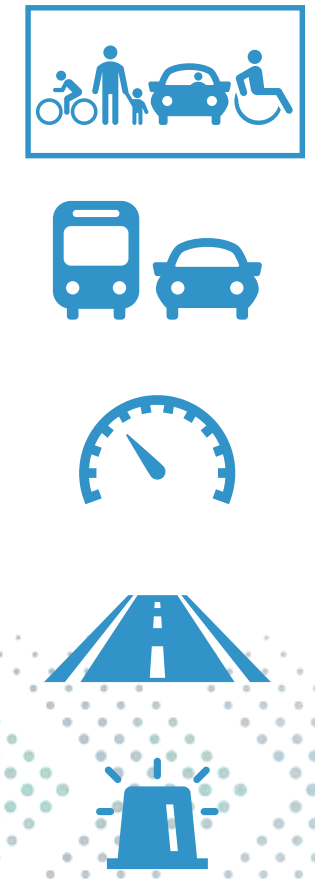
Drive

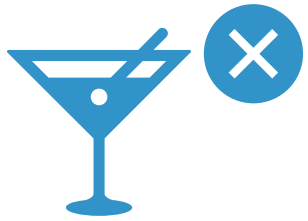
Transit

Other

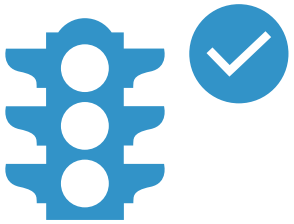
Source for all images: Fehr & Peers

Safe Road Users - Continued

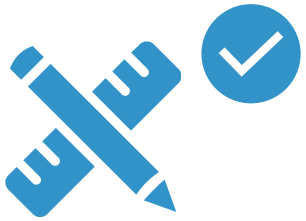




Not distracted or impaired

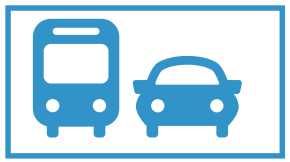


Follow rules



Act within the limits of the road design

Safe Vehicles



Active safety

Measures to reduce the chance of a crash occurring

- Lane departure warning
- Autonomous emergency braking

Passive safety

Protective systems for when crashes do occur

- Seatbelts and airbags
- Crash-absorbing vehicle crumple zones

Safe Vehicles - Continued

Other road user safety

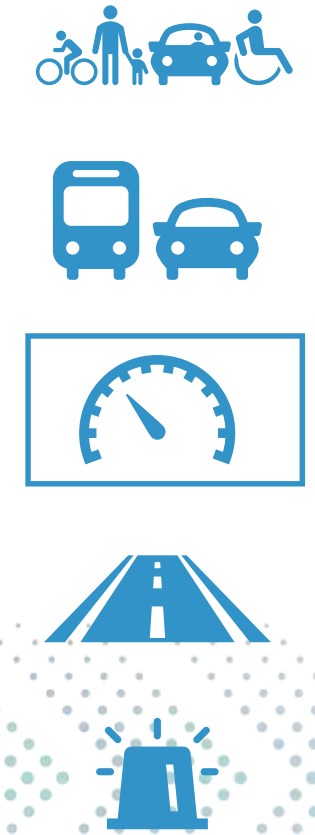
Measures that protect other road users

- Bicyclist and pedestrian detection
- Vehicle size and design

New technology

Leveraging connected and automated vehicle (CAV) technology to improve safety

Safe Speeds



> “Speed is at the heart of a forgiving road transport system. It transcends all aspects of safety: without speed there can be no movement, but with speed comes kinetic energy and with kinetic energy and human error come crashes, injuries, and even deaths.”

Organization for Economic Co-operation and Development

Safe Speeds: Reducing Pedestrian Fatalities

Hit by a vehicle traveling at

23 MPH

10% risk of death

Hit by a vehicle traveling at

42 MPH

50% risk of death

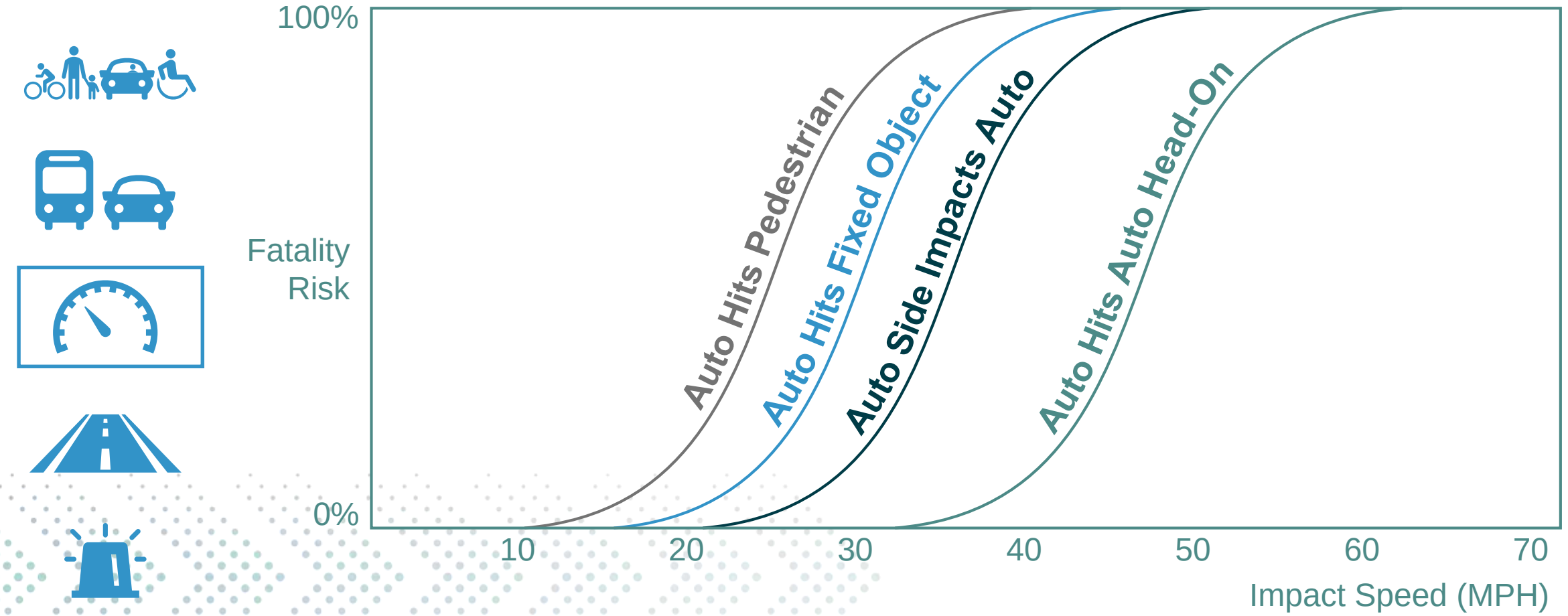
Hit by a vehicle traveling at

58 MPH

90% risk of death

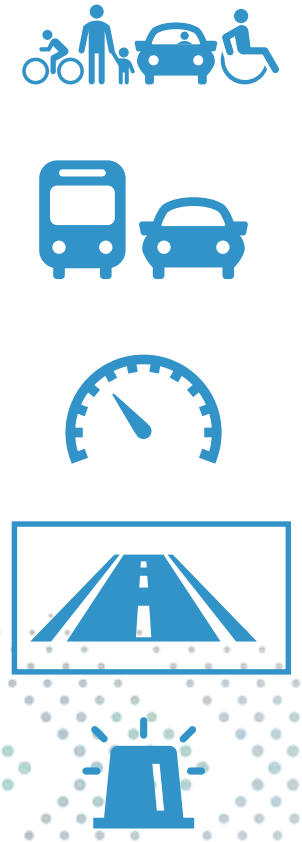
Source: FHWA

Safe Speeds: Fatality Risks



Source: FHWA

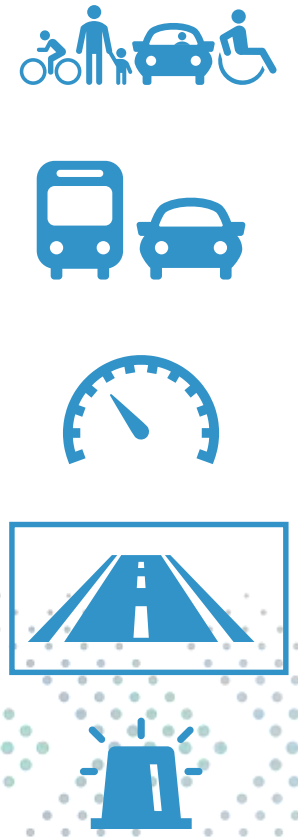
Safe Roads



Safe roads are designed and operated to:

1. **Prevent crashes**
2. **Keep impacts on the human body at tolerable levels**

Safe Roads: Avoiding Crashes



Avoiding crashes involves:

Separating users in space

Separating users in time

Increasing attentiveness and awareness

Source for all images: Fehr & Peers

Safe Roads: Crash Kinetic Energy

Managing crash kinetic energy involves:

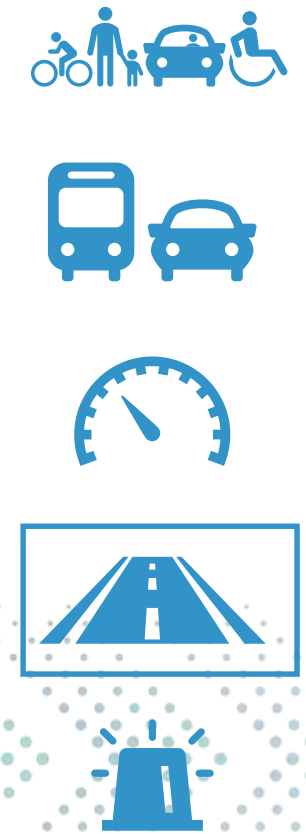
Managing speed

Manipulating mass

Manipulating crash angles

Sources: Fehr & Peers, Fehr & Peers, City of Carmel, IN

Safe Roads: All Aspects of the Roadway System



Safe roads include all aspects of the roadway system:

- Design
- Construction
- Maintenance
- Operation

Post-Crash Care

Vital post-crash actions include:

First responders

Medical care

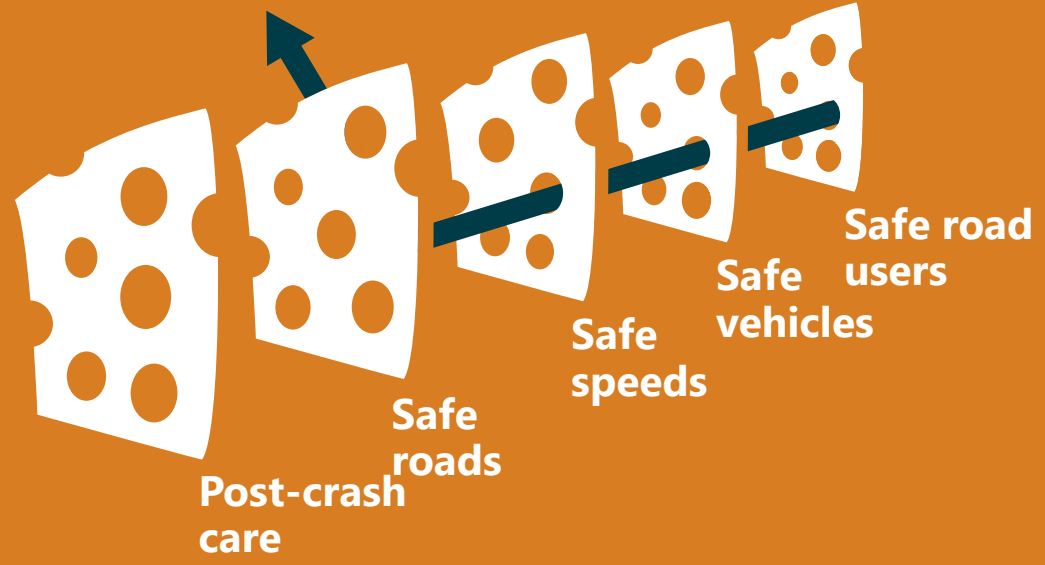
Crash investigation

Traffic incident management

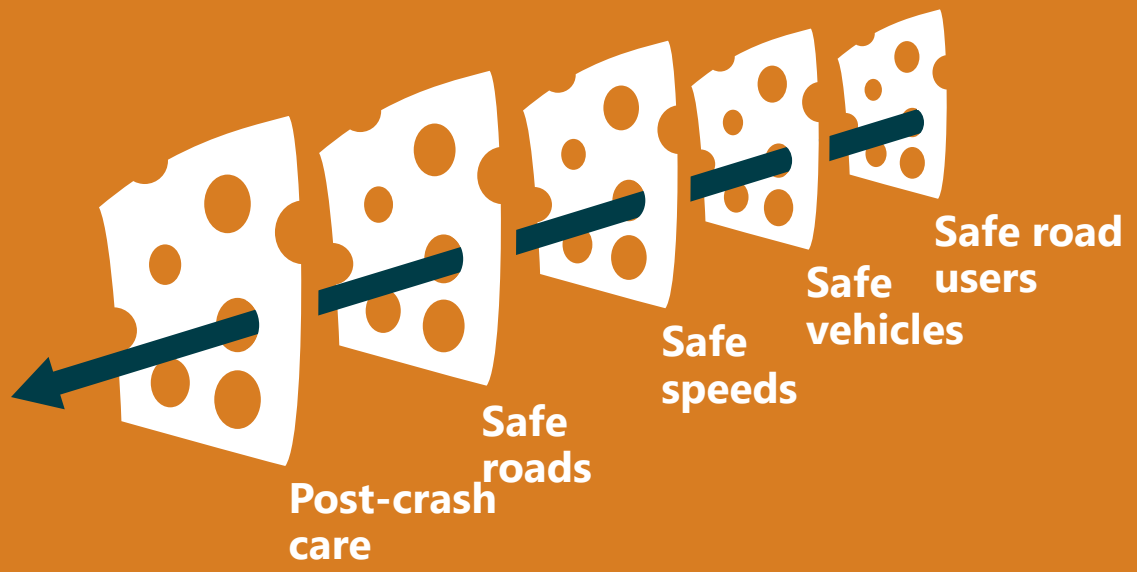
Justice

The 5 Safe System Elements Create Redundancy

The "Swiss Cheese Model" of redundancy creates layers of protection



Death and serious injuries only happen when all layers fail



Source: FHWA

Changes in Approach

Traditional approach		Safe System approach
Prevent crashes	→	Prevent death and serious injuries
Improve human behavior	→	Design for human mistakes/limitations
Control speeding	→	Reduce system kinetic energy
Individuals are responsible	→	Share responsibility
React based on crash history	→	Proactively identify and address risks

Safe Systems Approach Implementation in Nevada

Preliminary Implementation

- Incorporate the Safe Systems approach into Nevada's Highway Safety Improvement Program (HSIP) and Strategic Highway Safety Plan (SHSP)
- Speed Management Action Plan
  - Target Speeds
  - Strategies to achieve Target Speeds
- Local Road Safety Plans
- Traffic Incident Management

Incorporate Safe Systems into the HSIP and SHSP

HSIP and SHSP Overview

- FHWA Highway Safety Improvement Program (HSIP)
  - Core Federal-aid program under 23 U.S.C. 148
  - Goals to reduce fatal and serious injury crashes on ALL public roads
  - Managed by NDOT Traffic Safety Engineering team
  - Current HSIP guidance aligns with the Safe Systems Approach

- Nevada Strategic Highway Safety Plan (SHSP)
  - Required under the FHWA HSIP program
  - Plan and framework for reducing fatalities on Nevada's roadways
  - Nevada's SHSP was last updated in 2021
  - Updates include foals and strategies for the 6E's of traffic safety
  - The 6E's are: Equity, Engineering, Enforcement, Education, EMS, and Everyone
  - NDOTs plan and framework support Safe System Approach Goals

Speed Management Action Plan

What is a Speed Management Action Plan (SMAP)?

- Characterizes speeding-related safety problems
- Identifies countermeasures and strategies (including 6Es)
- Outlines strategies and actions to reduce speeding and speeding-related fatalities and serious injuries
- Facilitates coordination and cooperation among safety stakeholders
- FHWA has documented guidance for SMAPs

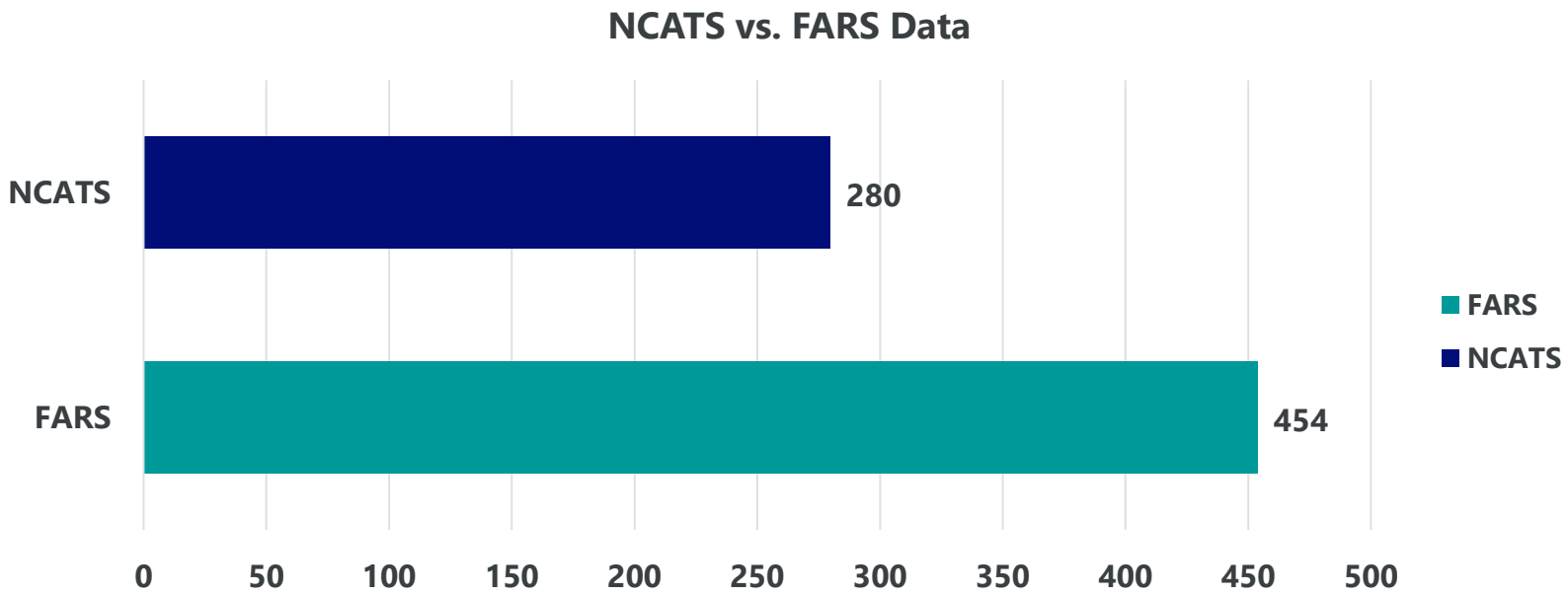
- "Mini SHSP" to address speeding

Speed and Impact on Crashes

- Speed influences the risk of a crash
- Speed influences the severity of a crash
- Controlling speed can prevent crashes
- Controlling speed can lessen severity of crashes
- At 50 mph: death is 20 times more likely than at 20 mph (source: WHO)

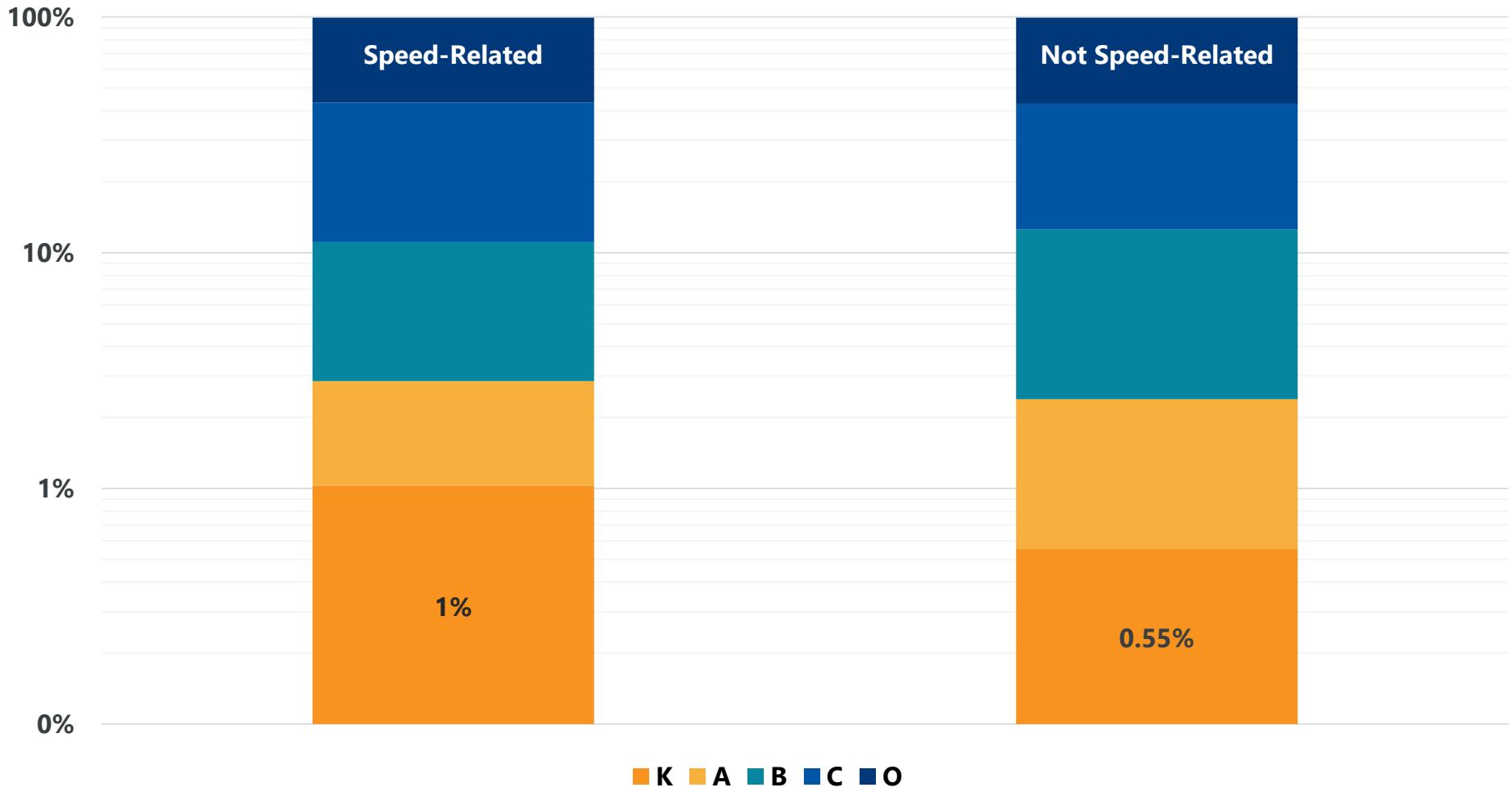
Speeding-Related Data Sources

- Speeding-related fatal crash counts vary between data sources
  - Nevada Citation and Accident Tracking System (NCATS)
  - Fatality Analysis Reporting System (FARS)



Source: 2015-2019 Crash data obtained from NDOT, 2015-2019 FARS data

NCATS – KABCO Breakdown



Source: 2015-2019 Crash data obtained from NDOT
Note: The Y-Axis of this figure is on a logarithmic scale

SMAP Strategies and Actions

Summary of Strategies and Actions

- Communications and Educations
- Setting Speed Limits
- Plan/Design for Speed Management
- Systemic Actions and Strategies in High Crash Corridors
- Education and Publicity on High Crash Corridors
- Systemic Speed review within the Highway Safety Improvement Program (HSIP) and other Safety Programs
- Speed and Speeding-Related Data

Countermeasures to Set Target Speeds

Determine Roadway Environment

Roadway Environment		Description	Target Speed (mph)
RE1	Natural	Adjacent land is in a Bureau of Land Management (BLM), natural or wilderness condition, including lands unsuitable for settlement due to BLM or natural conditions.	60-70
			50-60
RE2	Rural	Sparsely settled lands; may include desert, agricultural land, grassland, woodland, and wetlands.	55-70
			50-60
RE2T	Rural Town	Small concentrations of developed areas immediately surrounded by rural and natural areas; includes rural and historic towns.	40-45
			30-35
			≤ 25
RE3R	Suburban Residential	Mostly residential uses within large blocks and a disconnected/sparse roadway network.	40-45
			30-35
			≤ 25
RE3C	Suburban Commercial/ Industrial	Mostly non-residential uses with large building footprints and large parking lots. Buildings are within large blocks.	40-45
			35
			≤ 30
RE4	Urban General	Mix of uses set within small blocks with a well-connected roadway network. May extend long distances. The roadway network usually connects to residential neighborhoods immediately along the corridor or behind the uses fronting the roadway.	40-45
			35
			30
RE5	Urban/ Small Town Center	Mix of uses set within small blocks with a well-connected roadway network. Typically concentrated around a few blocks and identified as part of the community, town, or city of a civic or economic center.	35
			30
			25
RE6	Urban Core	Areas with the highest densities and with building heights typically greater than four floors within urbanized areas (population >250,000). Buildings have mixed uses, are built up to the roadway, and are within a well-connected roadway network.	30-35
			25
RE7	Entertainment District	Areas with casinos and other tourist-related land uses such as hotels, gaming establishments, and large crowd generators such as arenas, theatres, and other tourist-related attractions.	30-35
			25

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Speed Management Countermeasures Along Roadways

- Speed safety cameras (speed safety cameras are currently not legal in Nevada)
- Lane narrowing
- Technology-driven solutions – could include speed feedback signs, speed monitoring cameras, Strategic Traffic Monitoring Sites (STMS), etc.
- In-pavement speed limit markings
- Transverse lane markings
- Gateway treatment
- Addition of median or two-way left-turn lane (TWLTL)
- Horizontal deflection
- Medians and pedestrian refuge islands
- Roadway reconfiguration (four- to three-lane conversion)
- Landscaping
- Terminated vista
- On-street parking
- Vertical deflection

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Speed Management Countermeasures At Intersections

- Increase Visibility
- Roundabout
- Small modern roundabouts and mini roundabouts (not traffic circles)
- Bulb-outs/neck downs
- Textured surfaces
- Diagonal diverter
- Raised intersection/vertical deflection
- Neighborhood traffic circle (not roundabouts)
- Transverse rumble strips

Selecting Countermeasures to Achieve Target Speed

- Practitioners should consider a variety of factors when selecting countermeasures including the following:
  - The roadway environment
  - Desired operating speed
  - Existing operating speed
  - Existing and future community needs
  - Existing and future multimodal needs
  - Safety of roadway users
  - Emergency response vehicles

Countermeasures to Achieve Target Speed Along Roadways

Roadway Environment		Description	Target Speed (mph)	Speed Safety Cameras	Lane Narrowing	Technology-Driven Solutions	In-Pavement Speed Limit Markings	Transverse Lane Markings	Gateway Treatment	Addition of Median or TWLTL	Horizontal Deflection	Medians and Pedestrian Refuge Islands	Roadway Reconfiguration	Landscaping	Terminated Vista	On-street Parking	Vertical Deflection
RE1	Natural	Adjacent land is in a BLM, natural or wilderness condition, including lands unsuitable for settlement due to BLM or natural conditions.	60-70	x		x											
			50-60	x	x	x											
RE2	Rural	Sparsely settled lands; may include desert, agricultural land, grassland, woodland, and wetlands.	60-70	x		x											
			50-60	x	x	x											
RE2T	Rural Town	Small concentrations of developed areas immediately surrounded by rural and natural areas; includes rural and historic towns.	40-45	x	x	x	x	x	x	x	x						
			30-35		x	x	x	x	x	x	x	x	x	x	x	x	
			≤ 25		x	x	x	x	x	x	x	x	x	x	x	x	x
RE3R	Suburban Residential	Mostly residential uses within large blocks and a disconnected/sparse roadway network.	40-45		x	x				x	x						
			30-35		x	x				x	x	x	x	x	x		
			≤ 25		x	x				x	x	x	x	x	x	x	x
RE3C	Suburban Commercial/ Industrial	Mostly non-residential uses with large building footprints and large parking lots. Buildings are within large blocks.	40-45	x	x	x				x	x						
			35		x	x				x	x	x	x	x	x		
			≤ 30		x	x				x	x	x	x	x	x	x	x
RE4	Urban General	Mix of uses set within small blocks with a well-connected roadway network. May extend long distances. The roadway network usually connects to residential neighborhoods immediately along the corridor or behind the uses fronting the roadway.	40-45	x	x	x				x	x	x					
			35		x	x				x	x	x	x	x	x	x	
			30		x	x				x	x	x	x	x	x	x	x
RE5	Urban/ Small Town Center	Mix of uses set within small blocks with a well-connected roadway network. Typically concentrated around a few blocks and identified as part of the community, town, or city of a civic or economic center.	35		x	x				x		x	x	x		x	
			30		x	x				x	x	x	x	x	x	x	
			25		x	x				x	x	x	x	x	x	x	x
RE6	Urban Core	Areas with the highest densities and with building heights typically greater than four floors within urbanized areas (population >250,000). Buildings have mixed uses, are built up to the roadway, and are within a well-connected roadway network.	30-35		x	x				x	x	x	x	x	x	x	
			25		x	x				x	x	x	x	x	x	x	x
RE7	Entertainment District	Areas with casinos and other tourist-related land uses such as hotels, gaming establishments, and large crowd generators such as arenas, theatres, and other tourist-related attractions.	30-35		x	x				x		x	x	x	x		x
			25		x	x				x		x	x	x	x		x

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Countermeasures to Achieve Target Speed at Intersections

Roadway Environment		Description	Target Speed (mph)	Increase Visibility	Roundabout	Small Modern Roundabouts and Mini-Roundabouts	Bulb- Outs/ Neck Down	Textured Surfaces	Diagonal Diverter	Raised Intersection / Vertical Deflection	Neighborhood Traffic Circles	Transverse Rumble Strips
RE1	Natural	Adjacent land is in a BLM, natural or wilderness condition, including lands unsuitable for settlement due to BLM or natural conditions.	60-70	x								x
			50-60	x								x
RE2	Rural	Sparsely settled lands; may include desert, agricultural land, grassland, woodland, and wetlands.	60-70	x								x
			50-60	x								x
RE2T	Rural Town	Small concentrations of developed areas immediately surrounded by rural and natural areas; includes rural and historic towns.	40-45	x	x							x
			30-35	x	x	x	x	x				
			≤ 25	x	x	x	x	x	x	x	x	
RE3R	Suburban Residential	Mostly residential uses within large blocks and a disconnected/sparse roadway network.	40-45	x	x							
			30-35	x	x	x	x	x				
			≤ 25	x	x	x	x	x	x	x		
RE3C	Suburban Commercial/ Industrial	Mostly non-residential uses with large building footprints and large parking lots. Buildings are within large blocks.	40-45	x	x							
			35	x	x	x	x	x				
			≤ 30	x	x	x	x	x	x	x		
RE4	Urban General	Mix of uses set within small blocks with a well-connected roadway network. May extend long distances. The roadway network usually connects to residential neighborhoods immediately along the corridor or behind the uses fronting the roadway.	40-45	x	x							
			35	x	x	x	x	x				
			30	x	x	x	x	x	x	x	x	
RE5	Urban/Small Town Center	Mix of uses set within small blocks with a well-connected roadway network. Typically concentrated around a few blocks and identified as part of the community, town, or city of a civic or economic center.	35	x	x		x					
			30	x	x	x	x	x	x			
			25	x	x	x	x	x	x	x	x	
RE6	Urban Core	Areas with the highest densities and with building heights typically greater than four floors within urbanized areas (population >250,000). Buildings have mixed uses, are built up to the roadway, and are within a well-connected roadway network.	30-35	x	x	x	x	x	x			
			25	x	x	x	x	x	x	x		
RE7	Entertainment District	Areas with casinos and other tourist-related land uses such as hotels, gaming establishments, and large crowd generators such as arenas, theatres, and other tourist-related attractions.	30-35	x	x	x	x	x		x		
			25	x	x	x	x	x		x		

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Multi-Year Implementation

Multi-year Implementation Plan

- Work with internal and external stakeholders to execute the Proposed Strategies and Actions outlined earlier
- Evaluate the Plan using safety measures
  - Reduction in the speeding-related fatalities to zero by 2050
  - Number of actions completed
  - Adoption of an NDOT policy to Strategies to Achieve Desired Operating Speeds
  - Number of locations where Strategies to Achieve Desired Operating Speeds are implemented
  - Reduction in 85th percentile speeds to target speeds at locations where Countermeasures to Achieve Target Speeds are implemented
- SMAP Updates pending evaluation and experience

Local Road Safety Plans

What is a LRSP?

- A Local Road Safety Plan (LRSP) is a FHWA Proven Safety Countermeasure to reduce fatal and serious crashes on local roads
- A LRSP uses a data-driven, risk-based process to identify, analyze, and prioritize safety issues, and targets countermeasures and strategies to address fatal and serious injury crashes on local roads
- LRSP's help local agencies:
  - Be proactive about safety
  - Develop partnerships with other local agencies, stakeholders, and the public
  - Fosters multi-disciplinary cooperation
  - Safer roads
  - Improve position to acquire safety funds

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How Is NDOT Supporting Local Road Safety?

- One element of the Safe Systems Approach is that safety is redundant
- HSIP funds are intended to improve safety on all state and local roads
- NDOT is launching a program to fund and support locals in the development of a LRSP
- NDOT is providing the best available crash data and consultant support
- NDOT will be funding data driven projects that reduce fatal and serious injury crashes for all locals
- Could be used to obtain safety funds eligible in Safe Streets and Roads for All (SS4A) as part of the Bipartisan Infrastructure Law (BIL)

Traffic Incident Management and Other Opportunities

Other Actions and Opportunities

- Traffic Incident Management
  - Coordinated process to detect, respond, and clear traffic incidents
  - Program started in 2008
- Safe Systems Pilot and Matrix
  - NDOT is working with the FHWA to apply the Safe Systems Approach in Nevada
  - Testing Safe Systems approach in an FHWA and Nevada Specific matrix
- Data improvement programs to improve Data Driven Safety Analysis

Questions?


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