

# THE SAFE SYSTEM APPROACH: WHAT IS IT AND WHY IS IT GETTING SO MUCH ATTENTION?



# SAFE SYSTEM APPROACH

Zero is our goal. A Safe System is how we get there.



U.S. Department of Transportation  
**Federal Highway Administration**

**ZERO IS OUR GOAL**  
A SAFE SYSTEM IS HOW WE GET THERE

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# What is it?

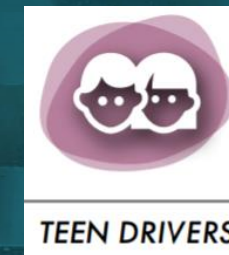
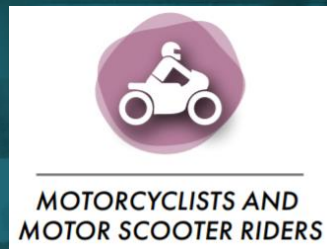
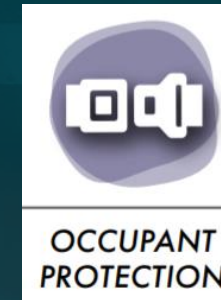
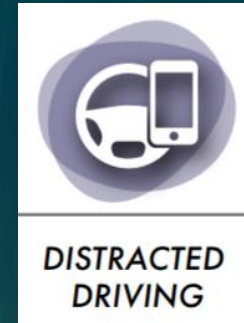


- It is *not* a slogan
- It is *not* a program
- It is *not* “NEW”



It is a paradigm shift in how we approach safe mobility

# Why are people killed or seriously injured on the roads?



**People are killed or seriously injured on the roads when collision forces transferred to the human body exceed tolerable thresholds.**

**PARADIGM SHIFT**



***“ In road injury epidemiology,  
kinetic energy is the pathogen ”***

Robertson LS. *Injury epidemiology*. Oxford: Oxford University Press, 1992

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# WHAT IS THE SAFE SYSTEM APPROACH?

A different way of thinking about the road safety problem ...



**Accommodating  
human mistakes**

Example: rumble strips

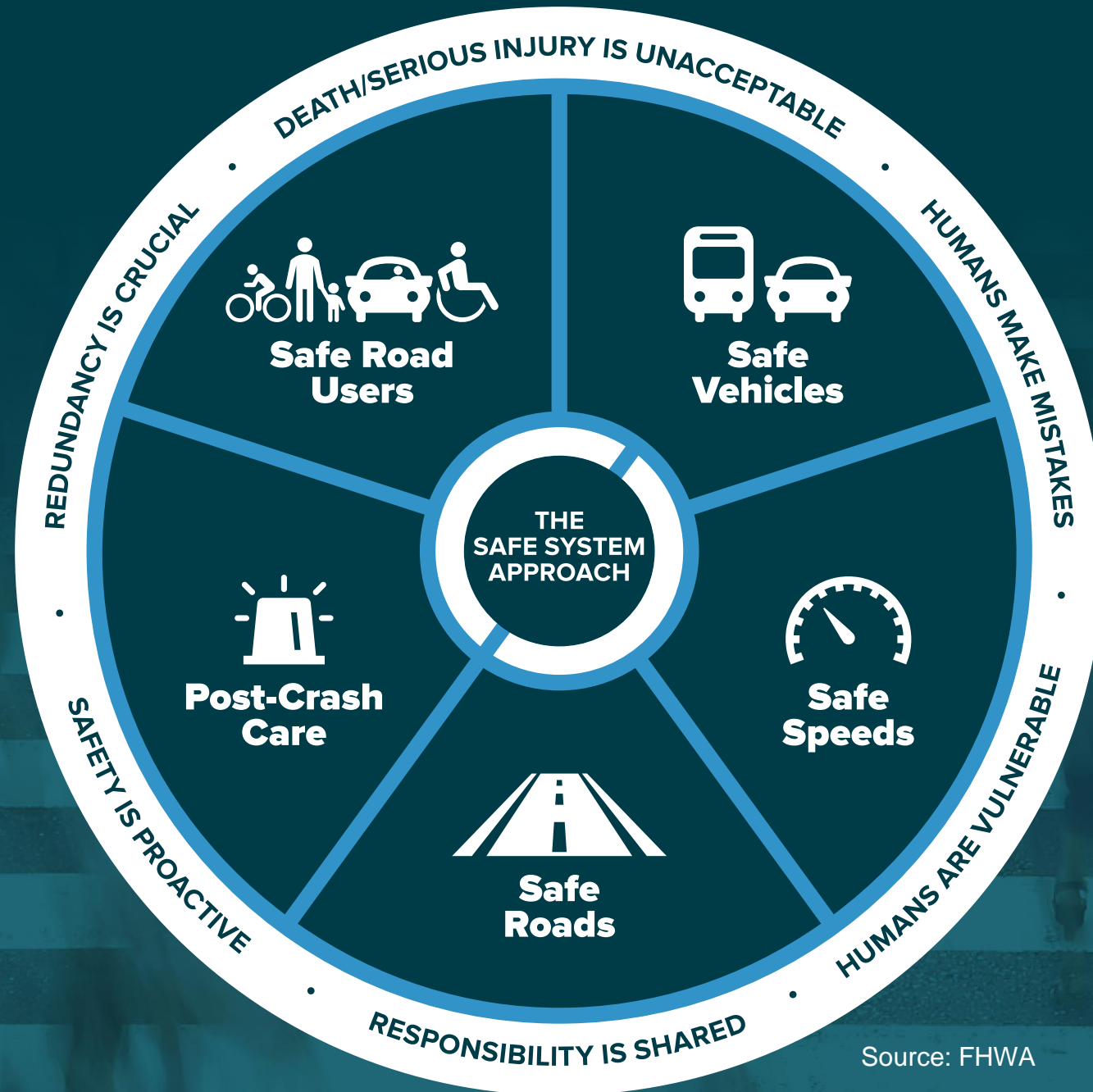
**PARADIGM SHIFT** ||



**Keeping impacts on the human  
body at tolerable levels**

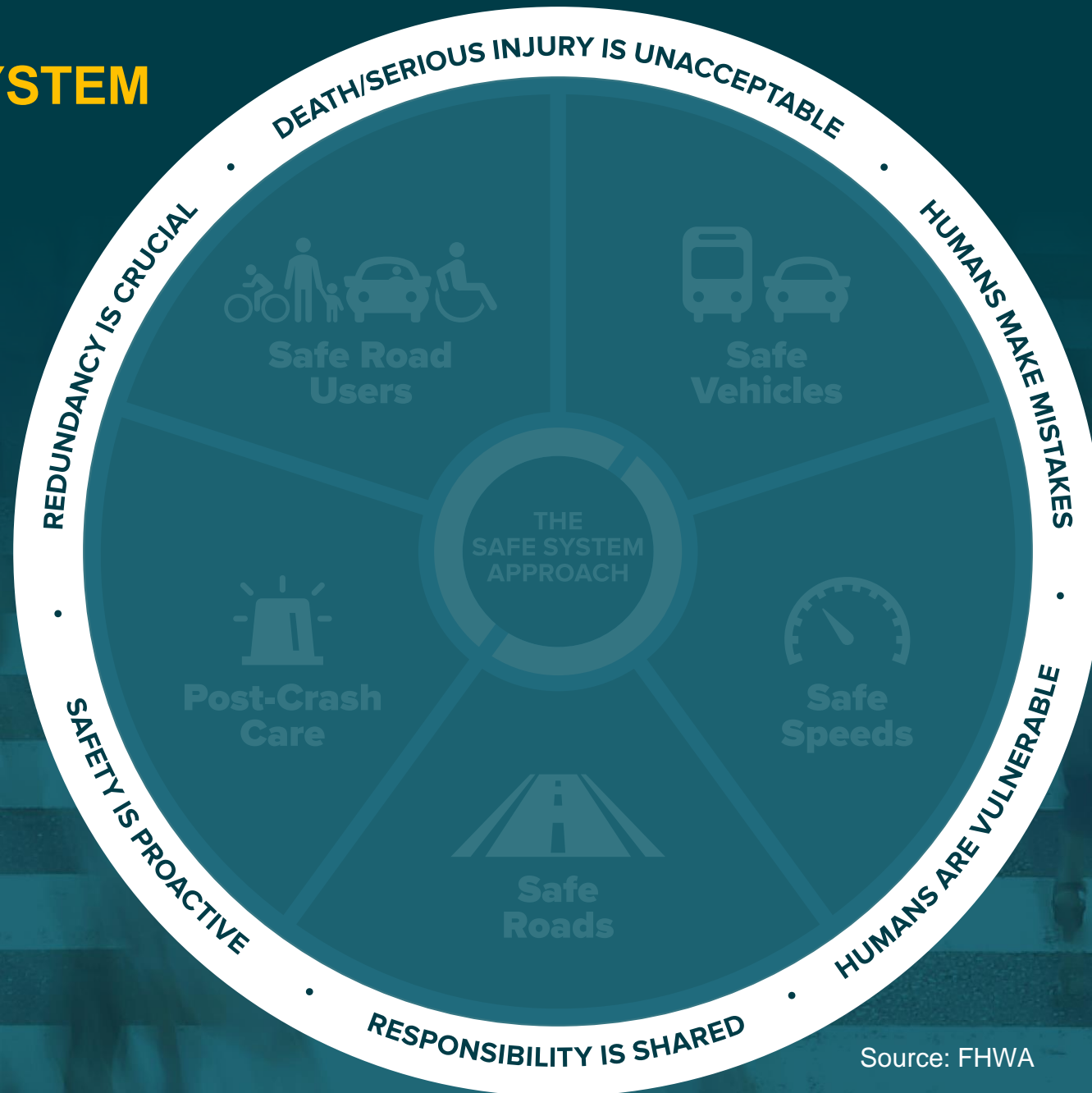
Example: physically separating bicyclists and pedestrians

# THE SAFE SYSTEM APPROACH



Source: FHWA

# THE 6 SAFE SYSTEM PRINCIPLES



Death/serious injury is unacceptable



Humans make mistakes



Humans are vulnerable



Responsibility is shared



Safety is proactive



Redundancy is crucial

# THE 6 SAFE SYSTEM PRINCIPLES



Death/serious injury is unacceptable



Humans make mistakes



Humans are vulnerable

DEATH/SERIOUS INJURY IS UNACCEPTABLE

REDUNDANCY IS CRUCIAL

SAFETY IS PROACTIVE

RESPONSIBILITY IS SHARED

HUMANS MAKE MISTAKES

HUMANS ARE VULNERABLE



Responsibility is shared



Safety is proactive



Redundancy is crucial

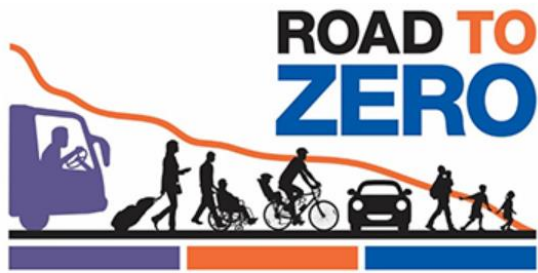


# Focus on Fatalities and Serious Injuries



Death/serious injury  
is unacceptable

National Efforts



VISION 4 ERONETWORK



A Community of Transportation Professionals



U.S. Department of Transportation

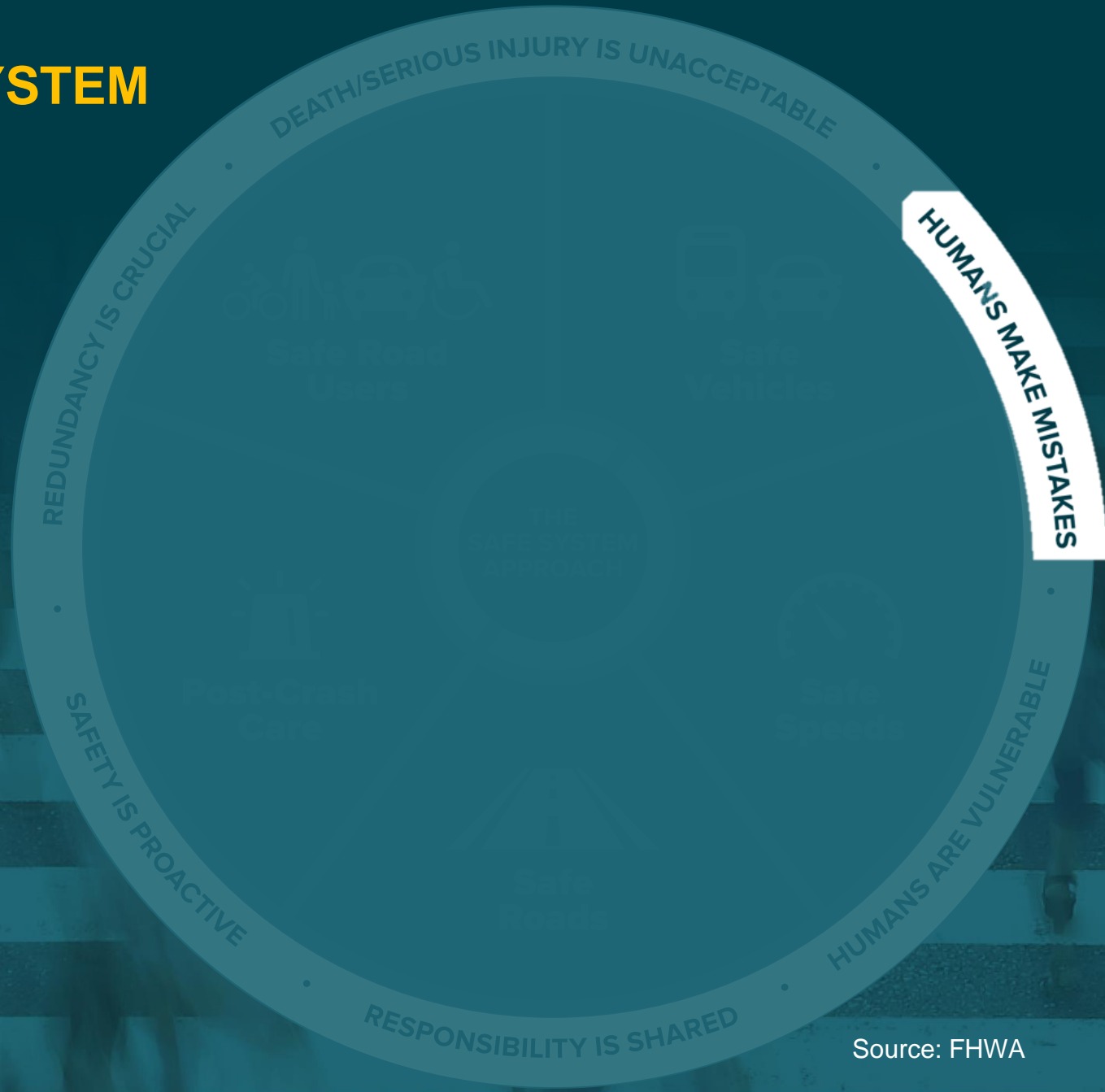
ABOUT DOT ▾

PRIORITIES ▾

## National Roadway Safety Strategy

The United States Department of Transportation National Roadway Safety Strategy (NRSS) outlines the Department's comprehensive approach to significantly reducing serious injuries and deaths on our Nation's highways, roads, and streets. This is the first step in working toward an ambitious long-term goal of reaching zero roadway fatalities. Safety is U.S. DOT's top priority, and the NRSS represents a Department-wide approach to working with stakeholders across the country to achieve this goal.

# THE 6 SAFE SYSTEM PRINCIPLES



Death/serious injury is unacceptable



Humans make mistakes



Humans are vulnerable



Responsibility is shared



Safety is proactive



Redundancy is crucial

Source: FHWA



Humans make mistakes

PARADIGM SHIFT



As road users, people will inevitably make mistakes and those mistakes may lead to crashes

In a Safe System approach, owners and operators of the system strive to make it easy for humans to not make mistakes by designing roads and vehicles to be in tune with human competences.

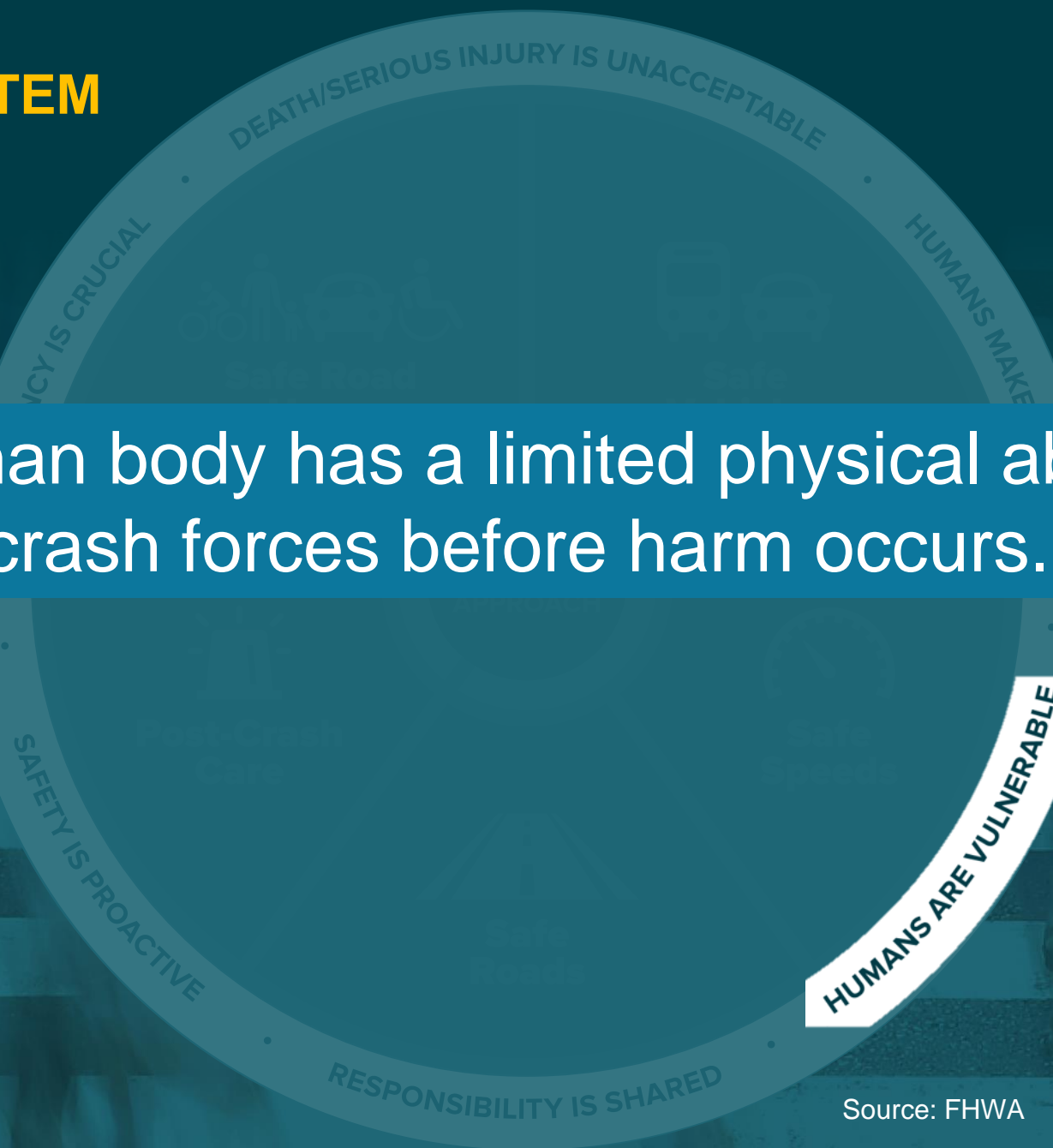


# THE 6 SAFE SYSTEM PRINCIPLES

The human body has a limited physical ability to tolerate crash forces before harm occurs.



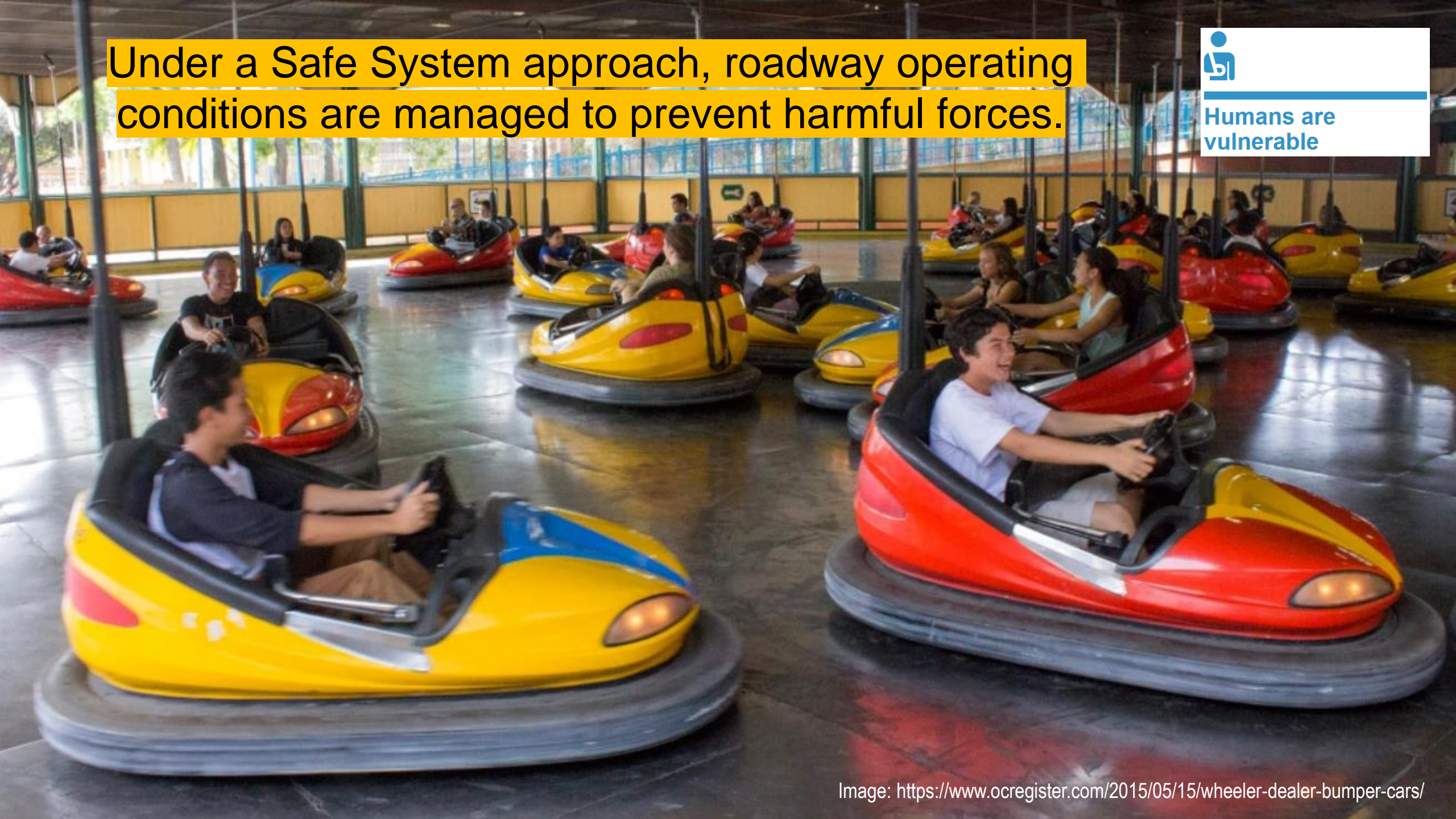
Humans are vulnerable




Under a Safe System approach, roadway operating conditions are managed to prevent harmful forces.



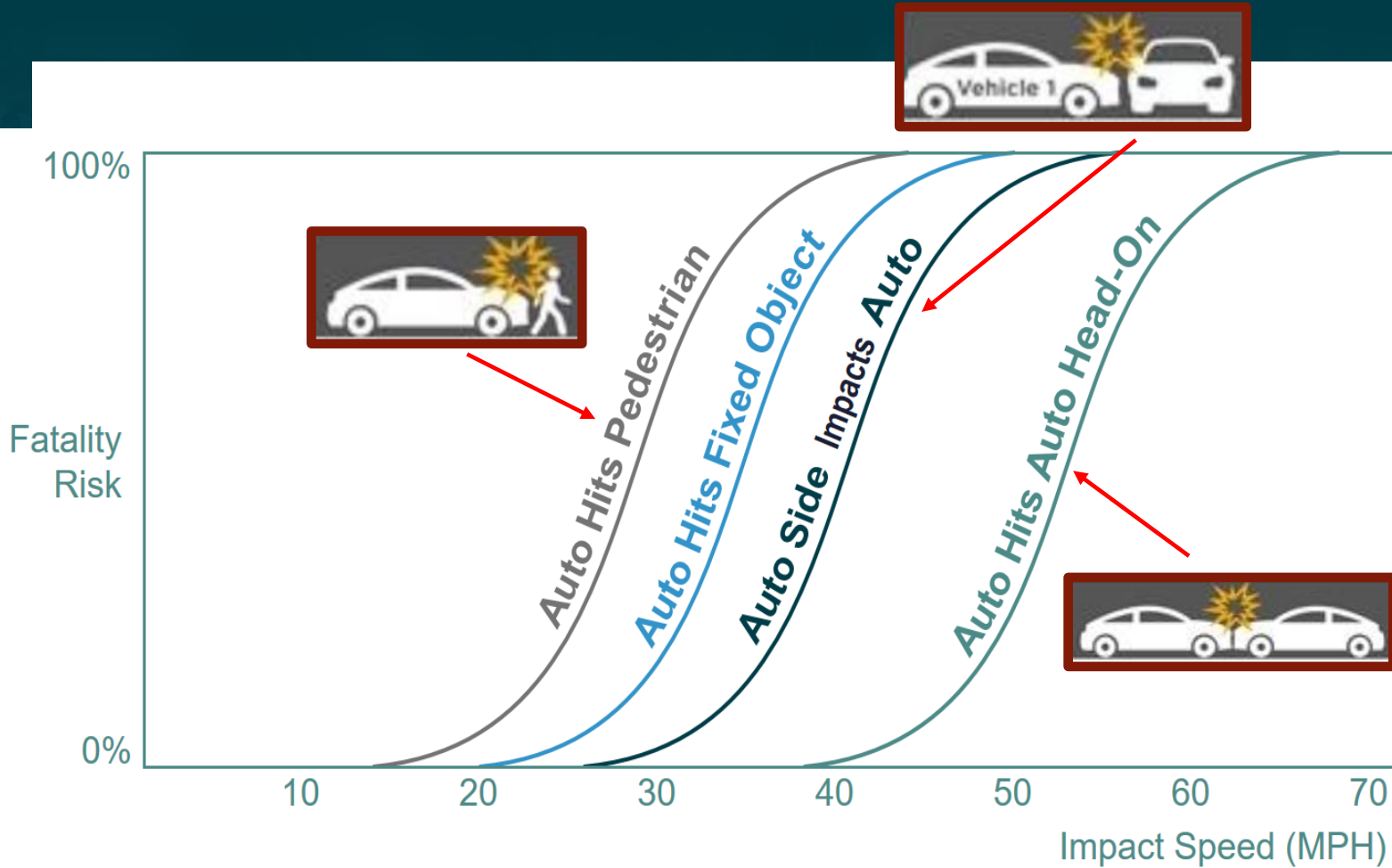
Humans are vulnerable



# HUMANS ARE VULNERABLE



Humans are vulnerable



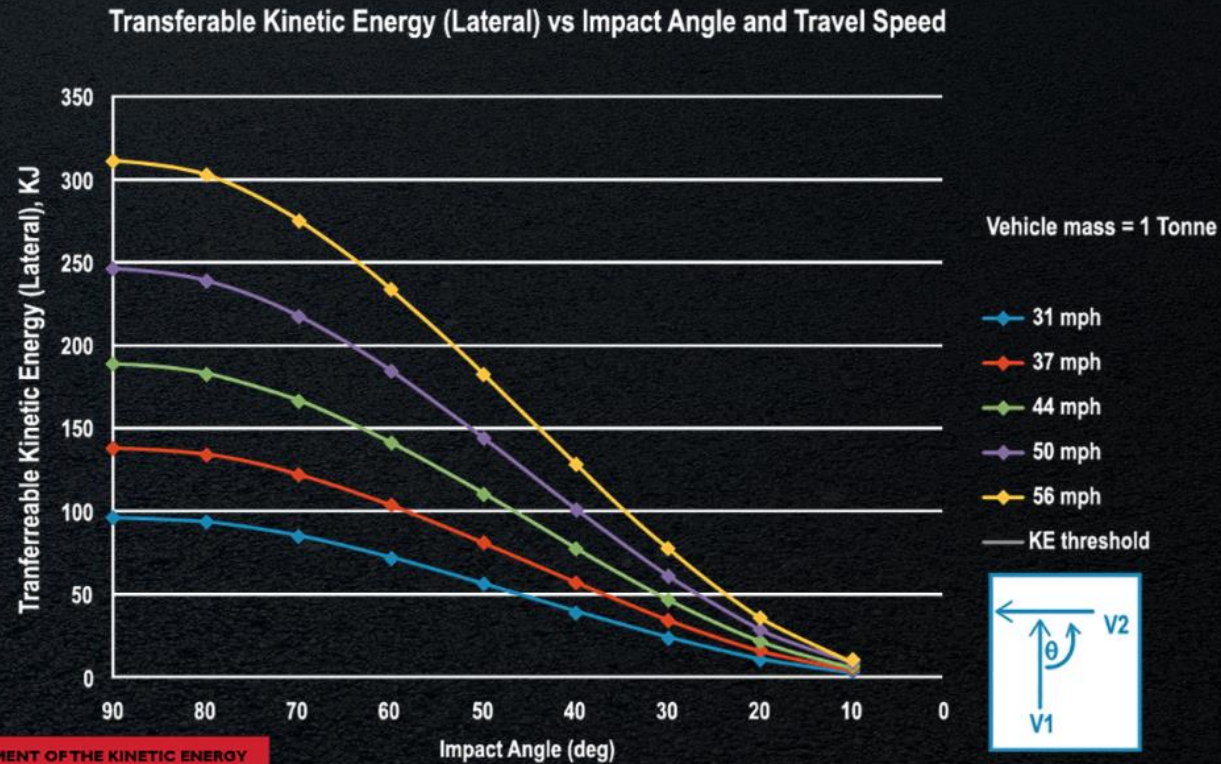
Designing safer roads is an exercise of managing kinetic energy

$$K = \frac{1}{2}mv^2$$

Velocity is a vector

- Speed
- Direction (angle of impact)

# Transferable Kinetic Energy (Lateral) vs Impact Angle and Travel Speed



Source: DEVELOPMENT OF THE KINETIC ENERGY MANAGEMENT MODEL AND SAFE INTERSECTION DESIGN PRINCIPLES  
MONASH UNIVERSITY (Melbourne, Australia)

Fig. 1 Influence of impact angle on transferable kinetic energy.

Changing collision impact angle from  $90^\circ$  to  $40^\circ$  reduces kinetic energy as if vehicle speeds were about 20 mph less



Image derived from: <https://dublinohiousa.gov/roundabouts>

## Example: Roundabouts vs Signalized Intersections


		
Lower Speeds		
Lower Impact Angles		
Fewer Conflict Points		

*Is this why roundabouts are so effective at reducing severe crashes?*

**YES !!!**




# THE 6 SAFE SYSTEM PRINCIPLES




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Death/serious injury is unacceptable



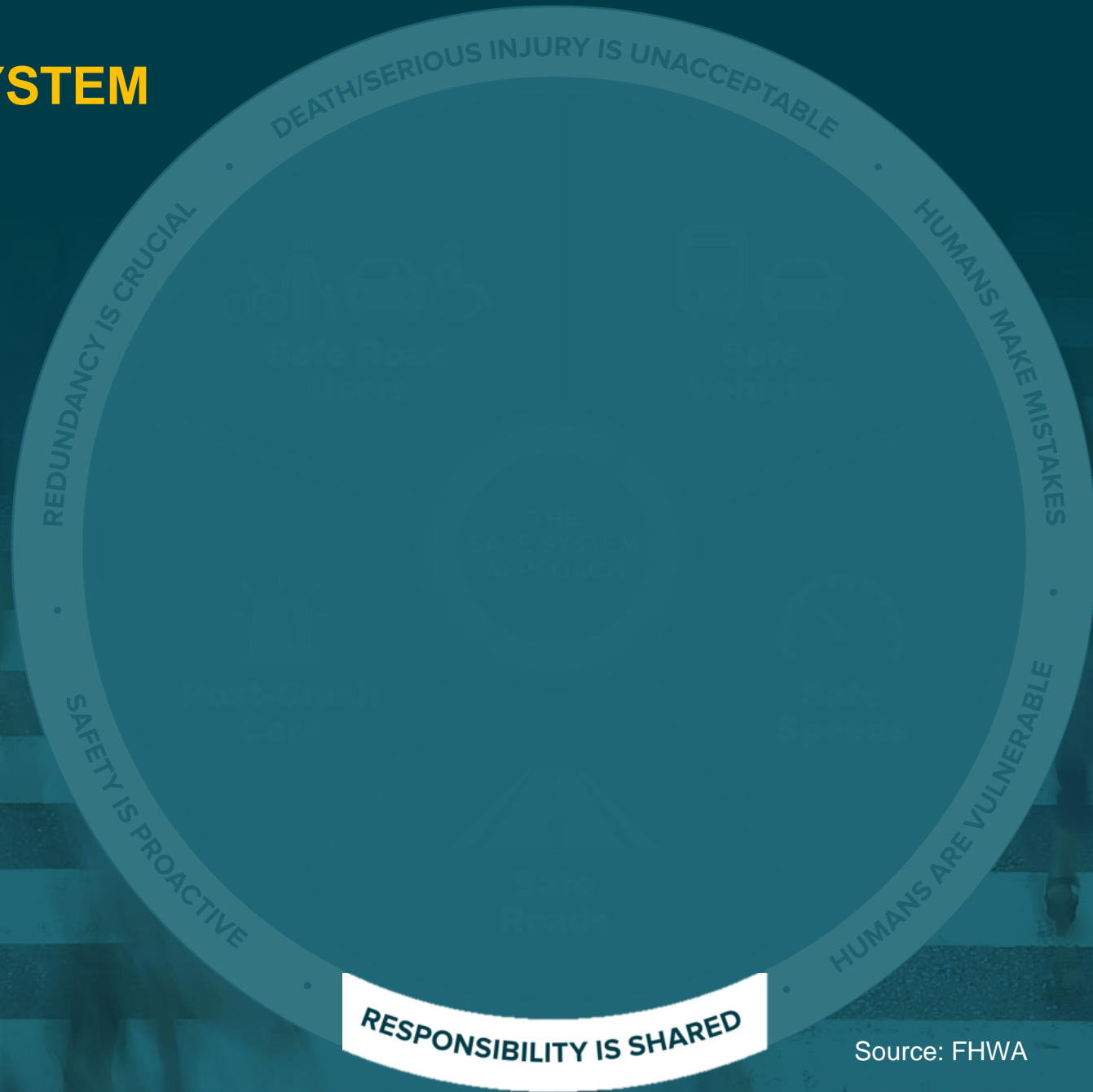
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Humans make mistakes



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Humans are vulnerable



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Responsibility is shared



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Safety is proactive



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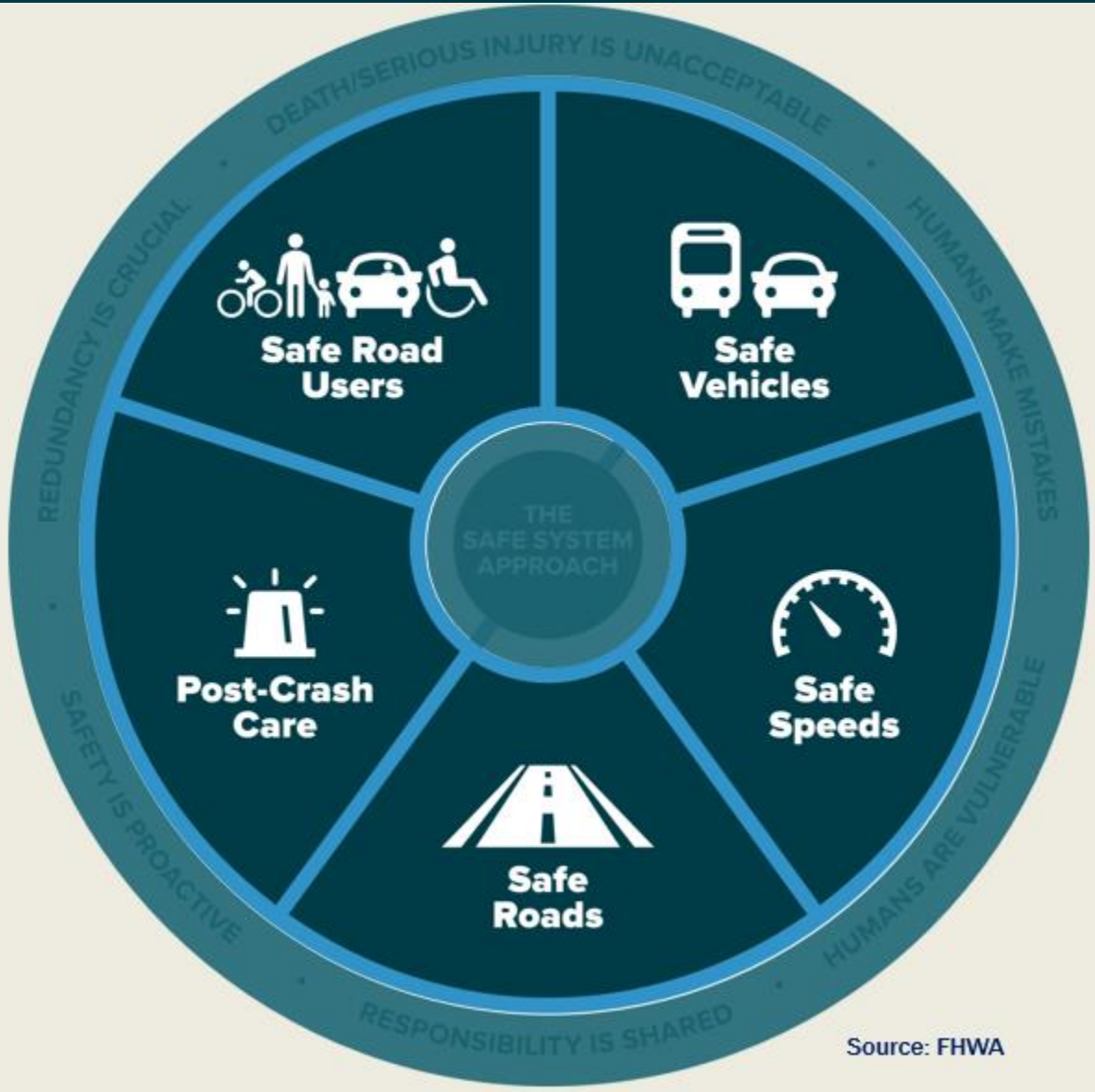
Redundancy is crucial

Source: FHWA

# Five Safe System Elements

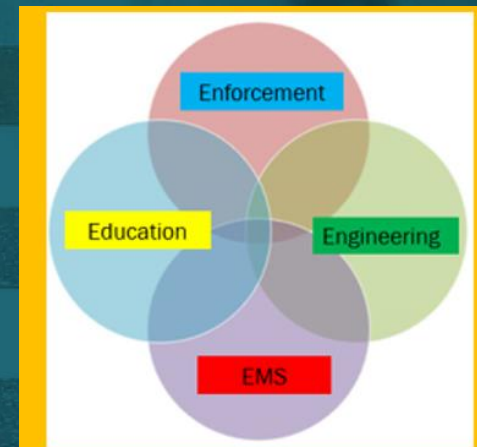


Responsibility is shared



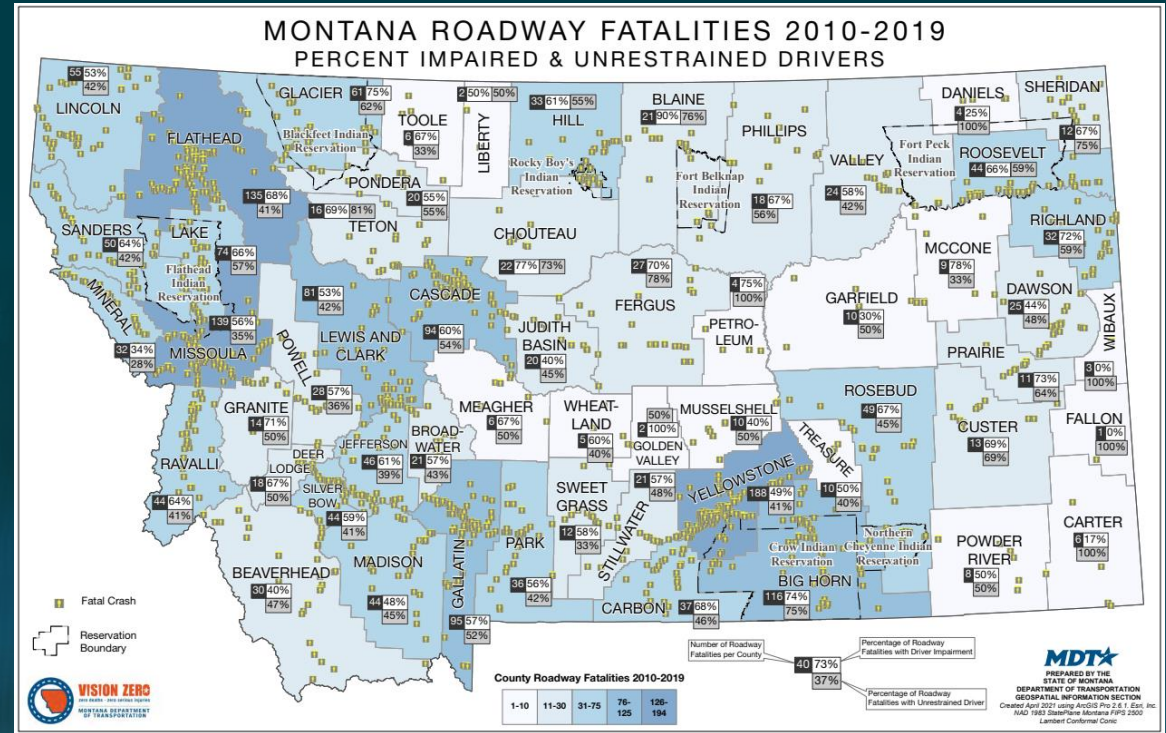
Source: FHWA

Implementing the Safe System approach is a shared responsibility  
*It cannot be achieved by any one discipline alone*



Source: FHWA Strategic Highway Safety Plans: A Champion's Guidebook to Saving Lives, Second Edition  
<https://safety.fhwa.dot.gov/shsp/guidebook/ovrwn.cfm>

# Five Safe System Elements



*A good example of sharing responsibility among disciplines is through the collection and sharing of crash data which is vital for identifying weaknesses in the System.*

## National Roadway Safety Strategy Objective

# THE 5 SAFE SYSTEM ELEMENTS

*Encourage safe, responsible behavior by people who use our roads and create conditions that prioritize their ability to reach their destination unharmed.*



Source: FHWA



Image Credit: © ambrozinio / stock.adobe.com



Governors Highway Safety Association  
The States' Voice on Highway Safety

<https://www.ghsa.org/resources/GHSA/Safe-System-Report21>

# Putting the Pieces Together

Addressing the Role of Behavioral Safety  
in the Safe System Approach



Describes the integral role of behavioral safety and road user responsibility in the Safe System approach with actionable recommendations illustrating how organizations and advocates can work together to prevent roadway deaths.

## National Roadway Safety Strategy Objective

# THE 5 SAFE SYSTEM ELEMENTS



Expand the availability of vehicle systems and features that help to prevent crashes and minimize the impact of crashes on both vehicle occupants and non-vehicle occupants.

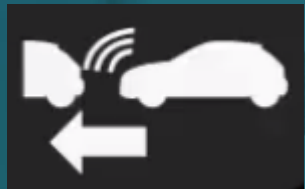
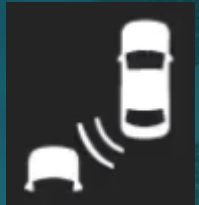
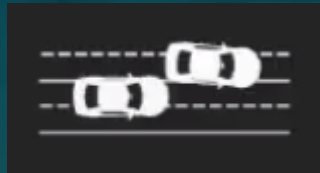


Source: FHWA

Image Credit: © Nomad\_Soul / stock.adobe.com



## Safe Vehicles



<b>Active Safety</b>	<b>Passive Safety</b>
Reduces the chance of a crash occurring	Protective systems for when crashes occur
<ul style="list-style-type: none"><li>• Lane departure warnings</li><li>• Lane keeping assist</li><li>• Forward collision warnings</li><li>• Autonomous emergency braking</li><li>• Pedestrian detection</li><li>• Backup camera</li><li>• Antilock brakes</li><li>• Electronic stability control</li></ul>	<ul style="list-style-type: none"><li>• Seatbelts</li><li>• Airbags</li><li>• Crumple zones</li><li>• Collapsible steering column</li></ul>

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

## National Roadway Safety Strategy Objective

# THE 5 SAFE SYSTEM ELEMENTS

Promote safer speeds in all roadway environments through a combination of thoughtful, context-appropriate roadway design, targeted education and outreach campaigns, and enforcement.



Source: FHWA

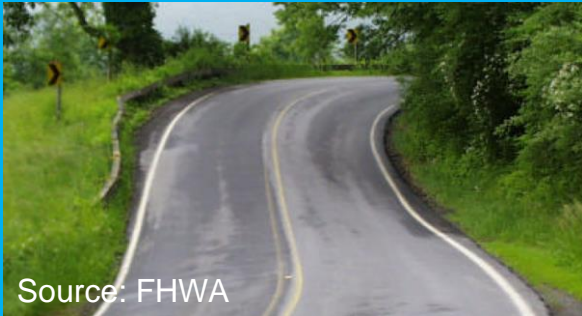
Image Credit: © Alexander Oganezov / stock.adobe.com





Source: FHWA

Some roads are engineered to accommodate higher speeds ...



Source: FHWA



Source: FHWA

... and others not.

# SAFE SPEEDS



***The Safe System approach is not about universally reducing speeds. It's about matching speed appropriate to the road conditions that exist.***

## National Roadway Safety Strategy Objective

# THE 5 SAFE SYSTEM ELEMENTS

Design roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users.



Source: FHWA

Image Credit: FHWA

# Thoughts on the Safe Roads Element



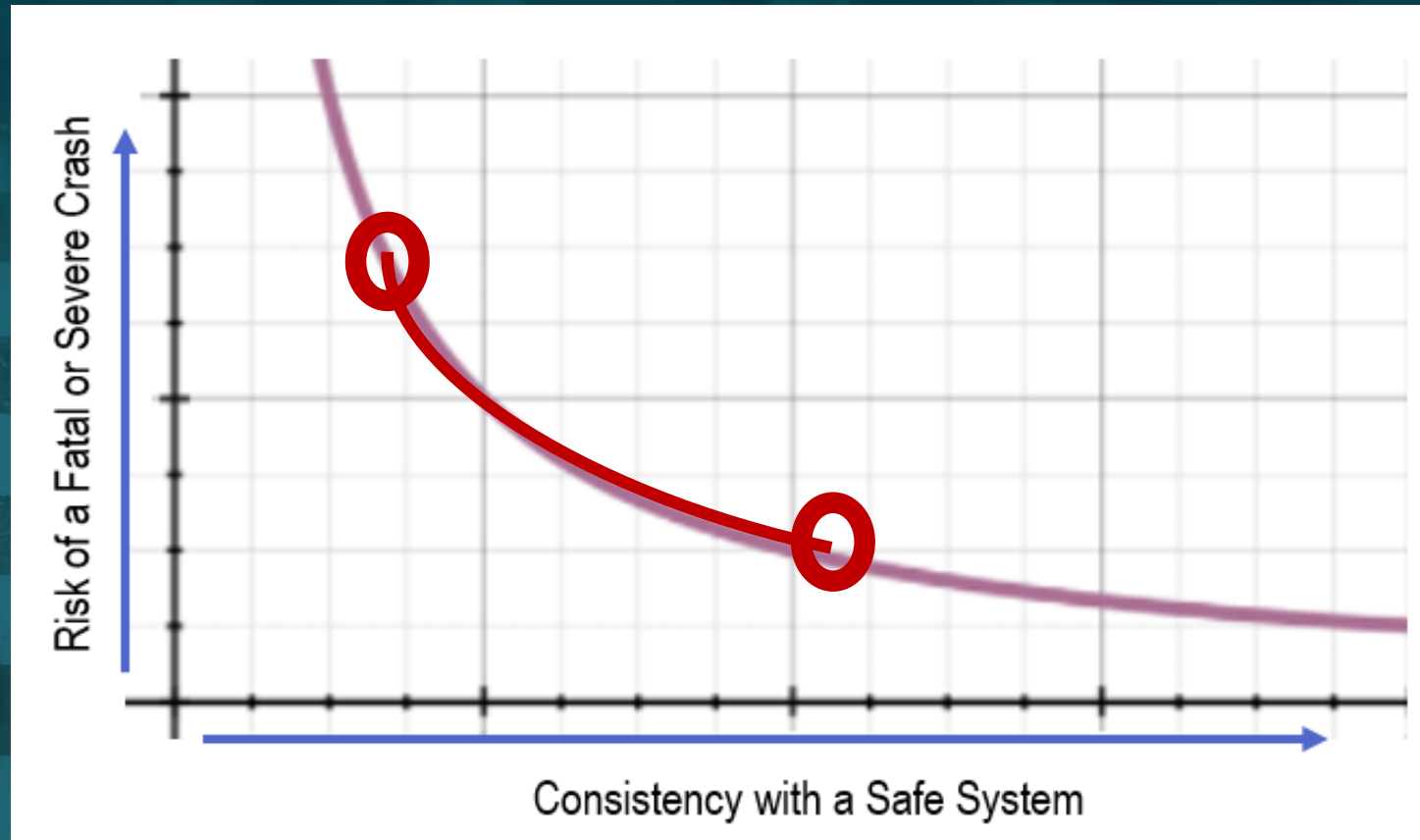
- The aim is to design and operate roads to continuously approach toward creating a Safe System by implementing features appropriate for the intended and actual road use and speed environment
  - Reduce the likelihood of error
  - Reduce the consequences of error



# Thoughts on the Safe Roads Element



Think of “Safe Roads” as a continuum – not an absolute



## National Roadway Safety Strategy Objective

# THE 5 SAFE SYSTEM ELEMENTS

Enhance the survivability of crashes through expedient access to emergency medical care.

Create a safe working environment for vital first responders and preventing secondary crashes through robust traffic incident management practices.



Source: FHWA

Image Credit: NHTSA



## Post-Crash Care

# Vital post-crash actions include:



**First  
responders**



**Medical care**



**Crash  
investigation**




**Traffic  
incident  
management**




**Justice**

# THE 6 SAFE SYSTEM PRINCIPLES




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Death/serious injury is unacceptable



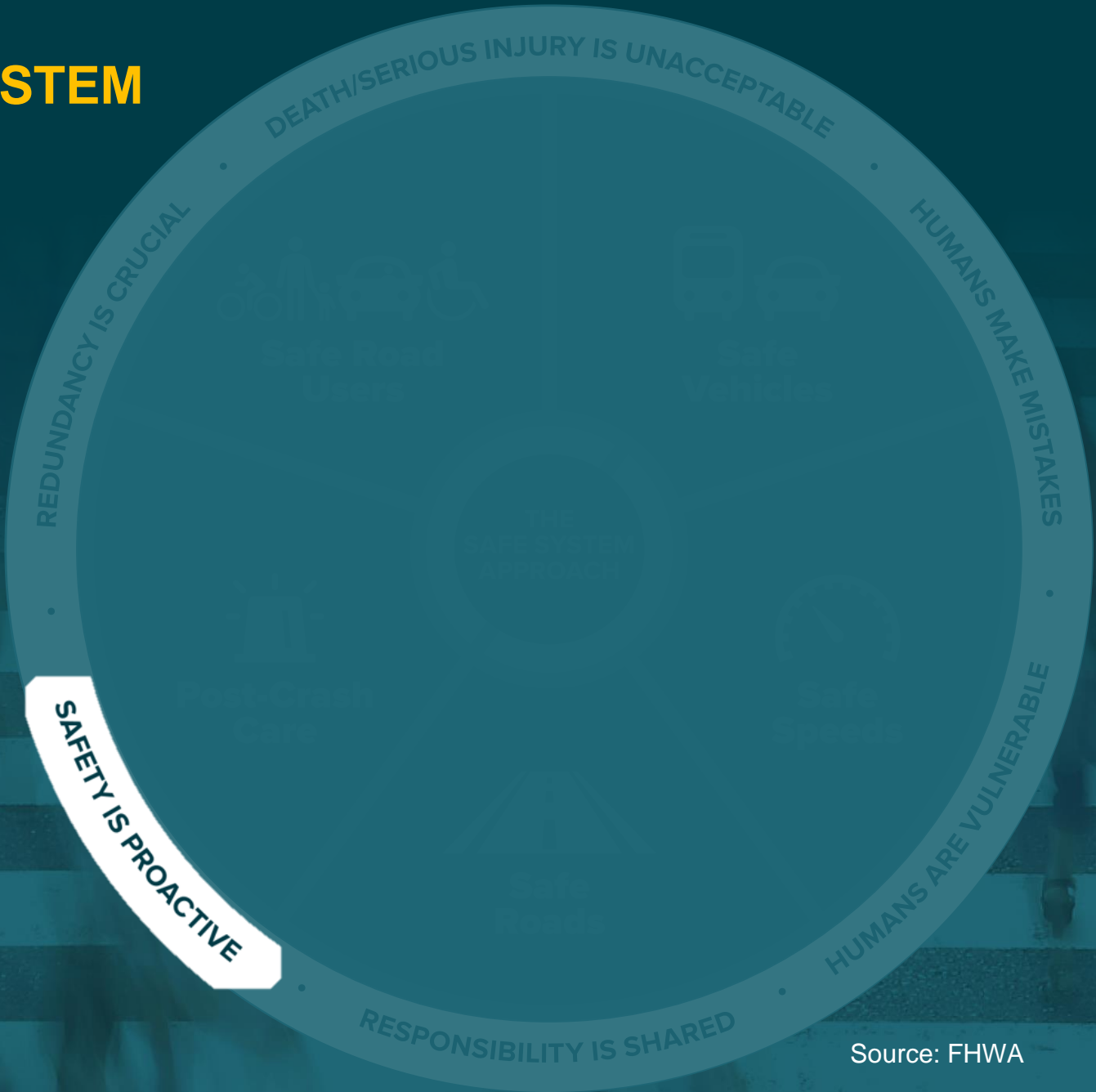
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Humans make mistakes



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Humans are vulnerable




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Responsibility is shared



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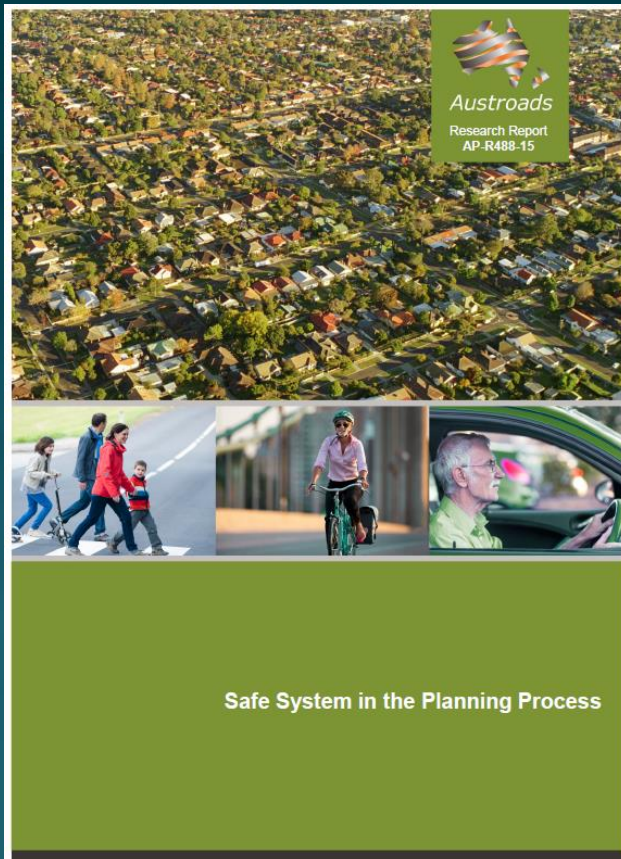
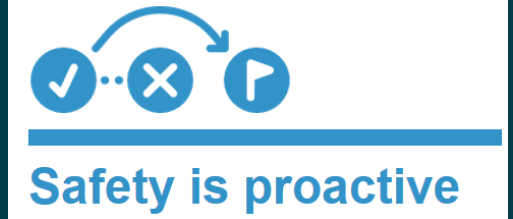
Safety is proactive



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Redundancy is crucial

# Safe System in the Planning Process




*“By applying Safe System principles early in the development process, transport and land-use planners may effectively contribute to the Safe System and address road user safety across all modes. Land-use and transport planning can primarily contribute to this through the built environment (including the road network) and speed management.”*

*“This report aims to promote the consideration of Safe System principles in planning decisions.”*




# THE 6 SAFE SYSTEM PRINCIPLES




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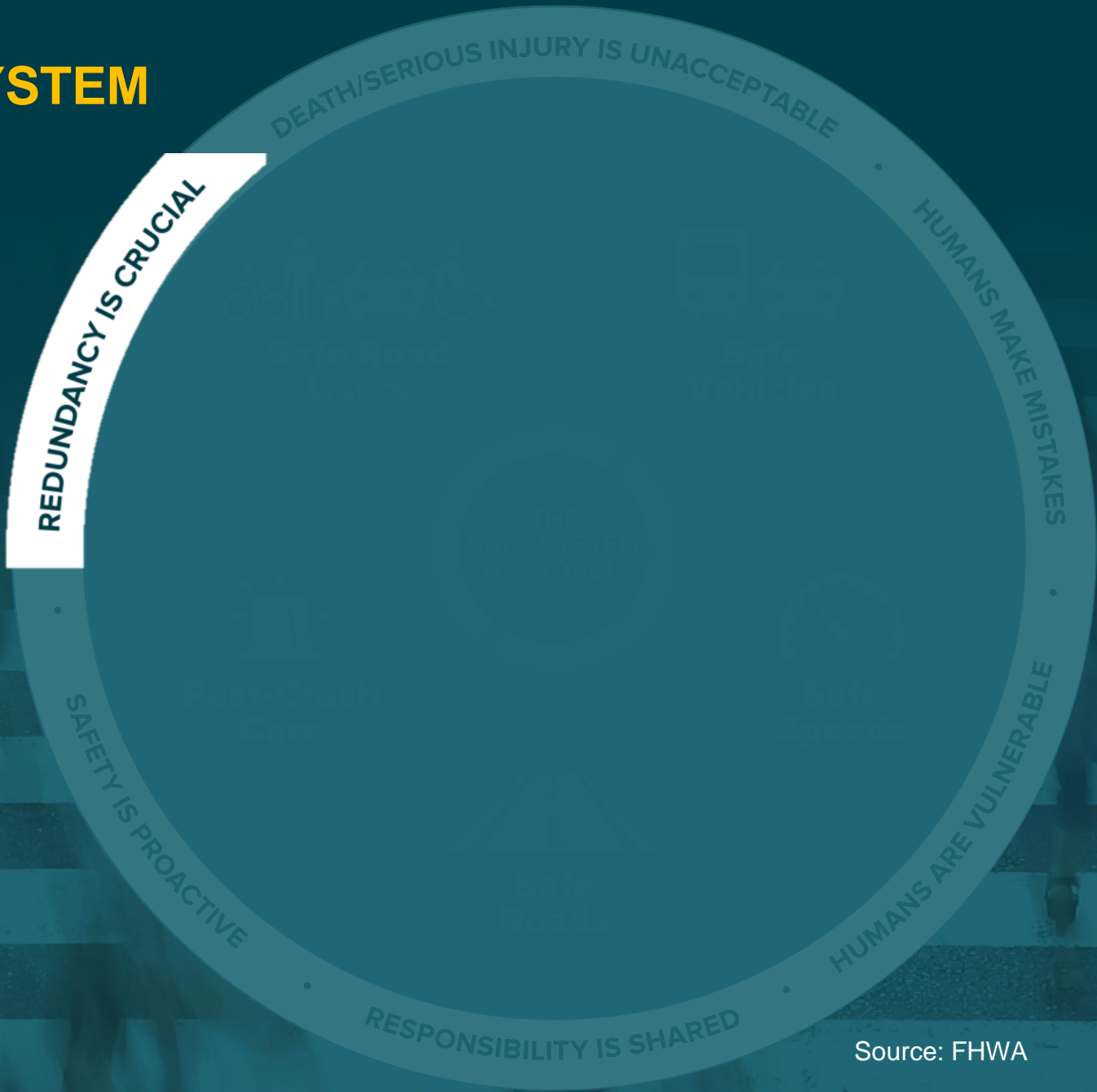
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# SAFE SYSTEM ELEMENTS CREATE REDUNDANCY



Redundancy  
is crucial

The “Swiss Cheese Model” of redundancy creates layers of protection

Death and serious injuries only happen when all layers fail



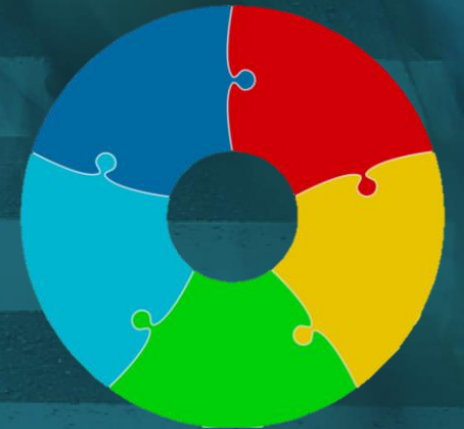
Adapted from James Reason’s model for analyzing accident causation  
<https://royalsocietypublishing.org/doi/10.1098/rstb.1990.0090>

Image Source: FHWA

# THE 5 SAFE SYSTEM ELEMENTS



**Redundancy  
is crucial**



Source: FHWA

# WHAT IS THE SAFE SYSTEM APPROACH?

*A guiding principle to address the safety of all road users. It involves a paradigm shift to improve safety culture, increase collaboration across all safety stakeholders, and refocus transportation system design and operation on anticipating human mistakes and lessening impact forces to reduce crash severity and save lives.*

[www.transportation.gov/grants/ss4a/nofo](http://www.transportation.gov/grants/ss4a/nofo)

PARADIGM SHIFT



**Accommodating human mistakes**



**Keeping impacts on the human body at tolerable levels**

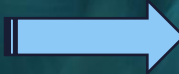
# What's Different?

PARADIGM SHIFT



## Traditional Approach

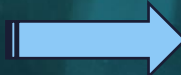
Reduce Crashes



Eliminate Fatalities & Serious Injuries



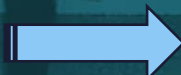
Speed Management



Kinetic Energy Management



Safety "Four E's"



Five Safe System Elements



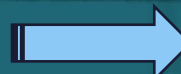
Apply Countermeasures at High Crash Locations



Proactively Apply Countermeasures in a "Systemic" Approach



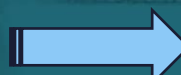
Examine crash records to identify causes or "deficiencies"



Strengthen all elements to reduce "system failures"



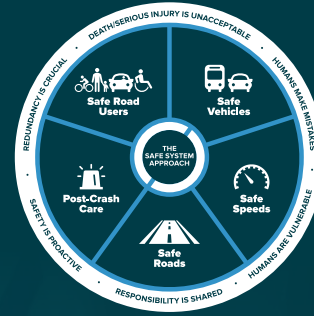
"Balance" Safety vs. Mobility



Only "Safe Mobility"



# TOP TAKEAWAYS

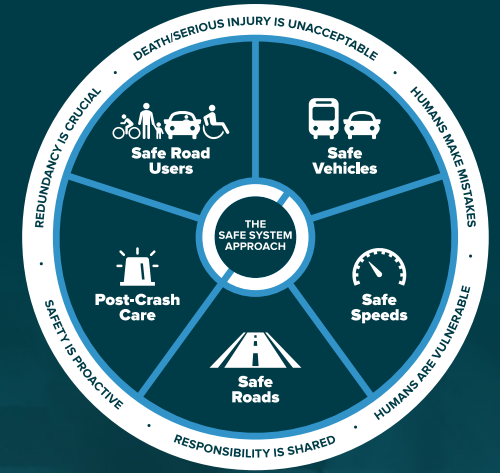


- A Safe System Approach is “***Principles Based***”
- Achieving a Safe System requires strengthening all five elements
- Safe Roads is a continuum, not an absolute



# SAFE SYSTEM APPROACH

Zero is our goal. A Safe System is how we get there.



FHWA Resources: [https://safety.fhwa.dot.gov/zerodeaths/zero\\_deaths\\_vision.cfm](https://safety.fhwa.dot.gov/zerodeaths/zero_deaths_vision.cfm)