THE SAFE SYSTEM APPROACH

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

Presenter:
Marcee Allen, Safety Engineer, FHWA-MT DIV

ROAD TO ZERO

But what is it ???

SAFE SYSTEM

APPROACH

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

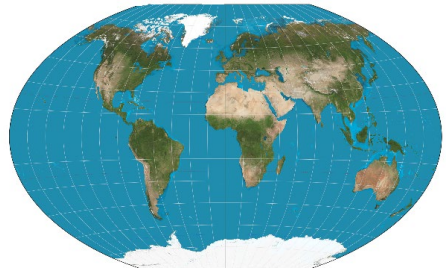
THE SAFE SYSTEM APPROACH

ROAD TO ZERO

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

WHAT IS IT?

- An international best practice



- A change in the way we perceive the road safety problem

- A change in the way we design and operate our road system

THE SAFE SYSTEM APPROACH

ROAD TO ZERO

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

Safe System Guiding Principles

Death/serious injury is unacceptable

Humans make mistakes

Humans are vulnerable

Responsibility is shared

Redundancy is crucial

Safety is proactive, not reactive

Safe System Principles

- Death/serious injury is unacceptable
- Humans make mistakes
- Humans are vulnerable

PARADIGM SHIFT

ROAD TO ZERO

It's not about eliminating crashes, but about eliminating fatal and serious injuries.

What determines whether a crash is a fatal/severe injury vs. minor injury? (or better yet "Property Damage Only")

PARADIGM SHIFT

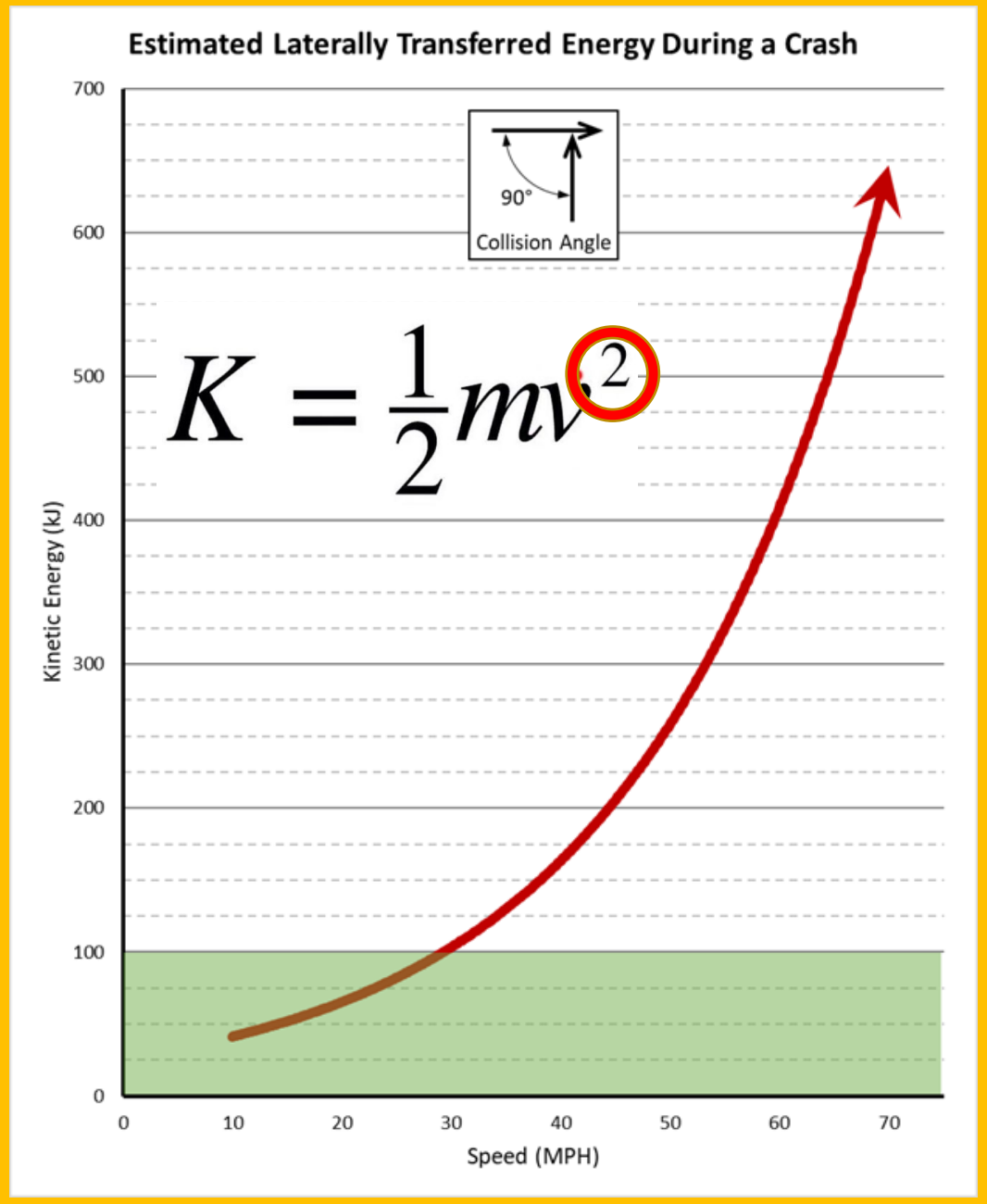
Designing safer roads is an exercise of managing kinetic energy

What determines the amount of kinetic energy in a crash?

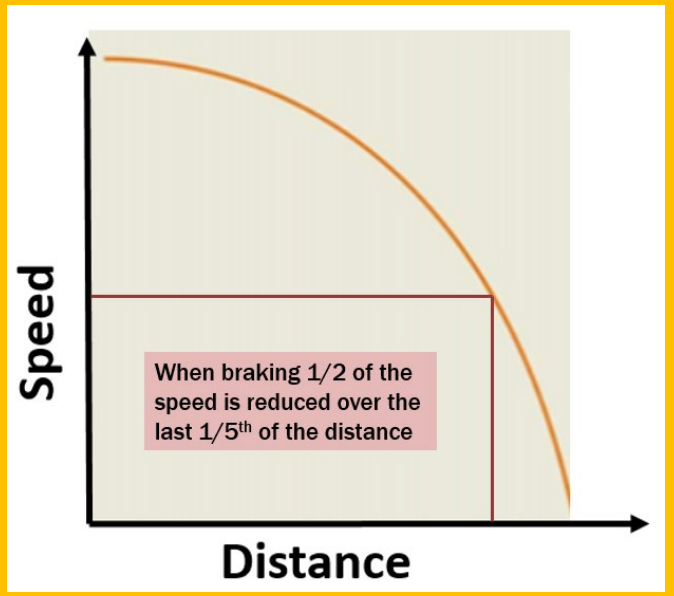
$$K = \frac{1}{2}mv^2$$

Velocity is a Vector

- Speed
- Direction (angle of impact)



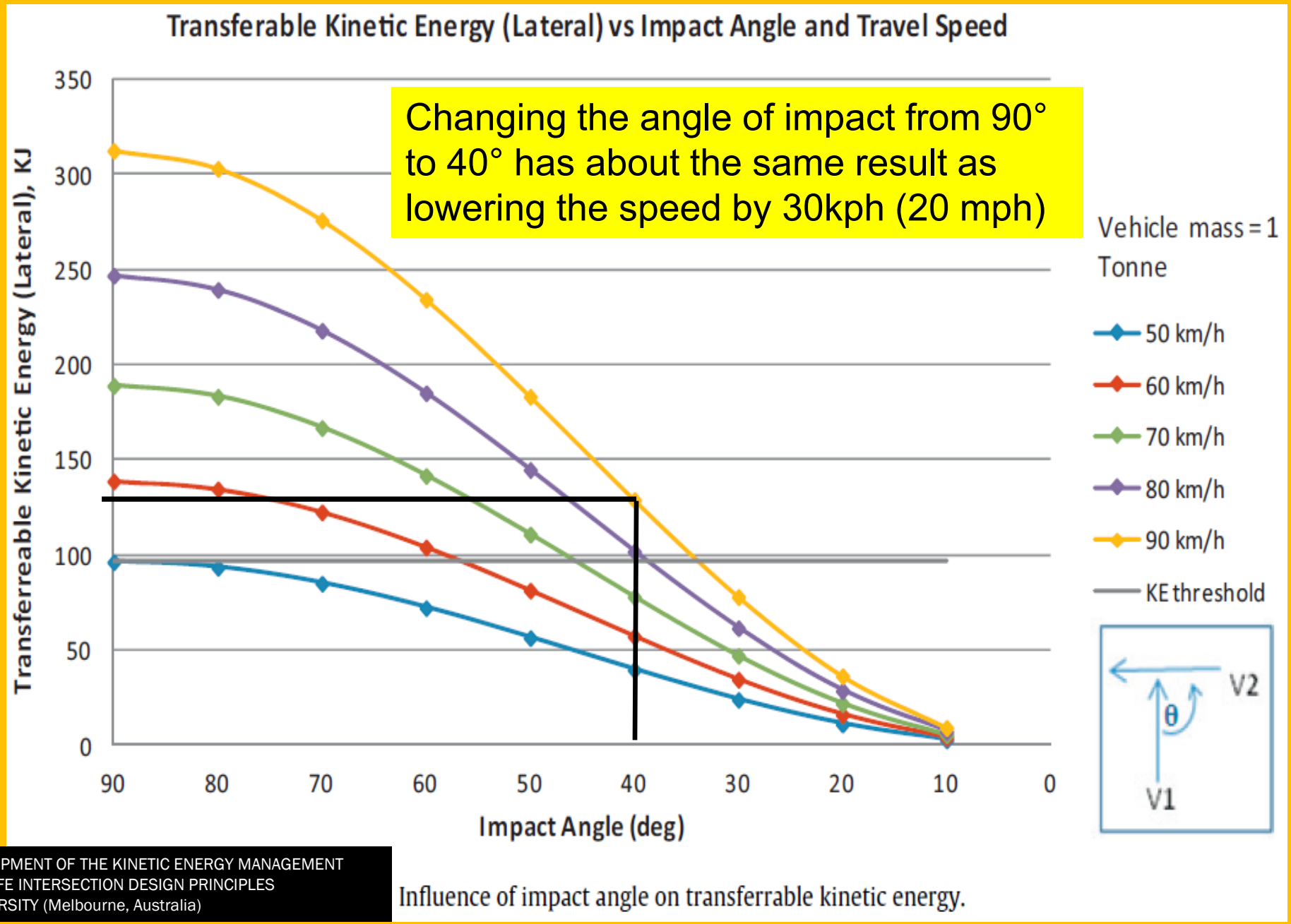
The influence of speed is exponential



Braking deceleration is also exponential

Suggested Video: Wipe Off 5

https://www.youtube.com/watch?v=hZINNGuU788



Influence of impact angle on transferrable kinetic energy.

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

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 !!!

BACK TO THE PRINCIPLES …

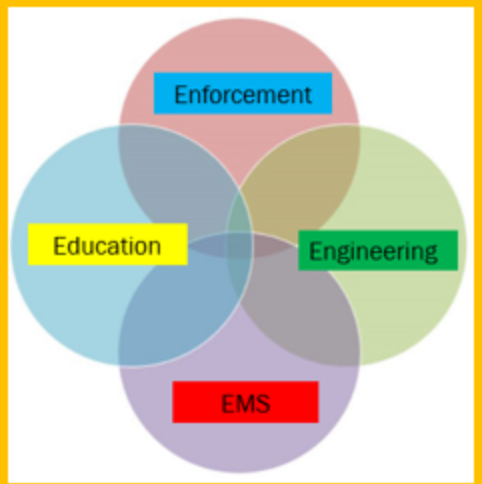
Safe System Principles

- Death/serious injury is unacceptable
- Humans make mistakes
- Humans are vulnerable
- Responsibility is shared

Partnerships Principles

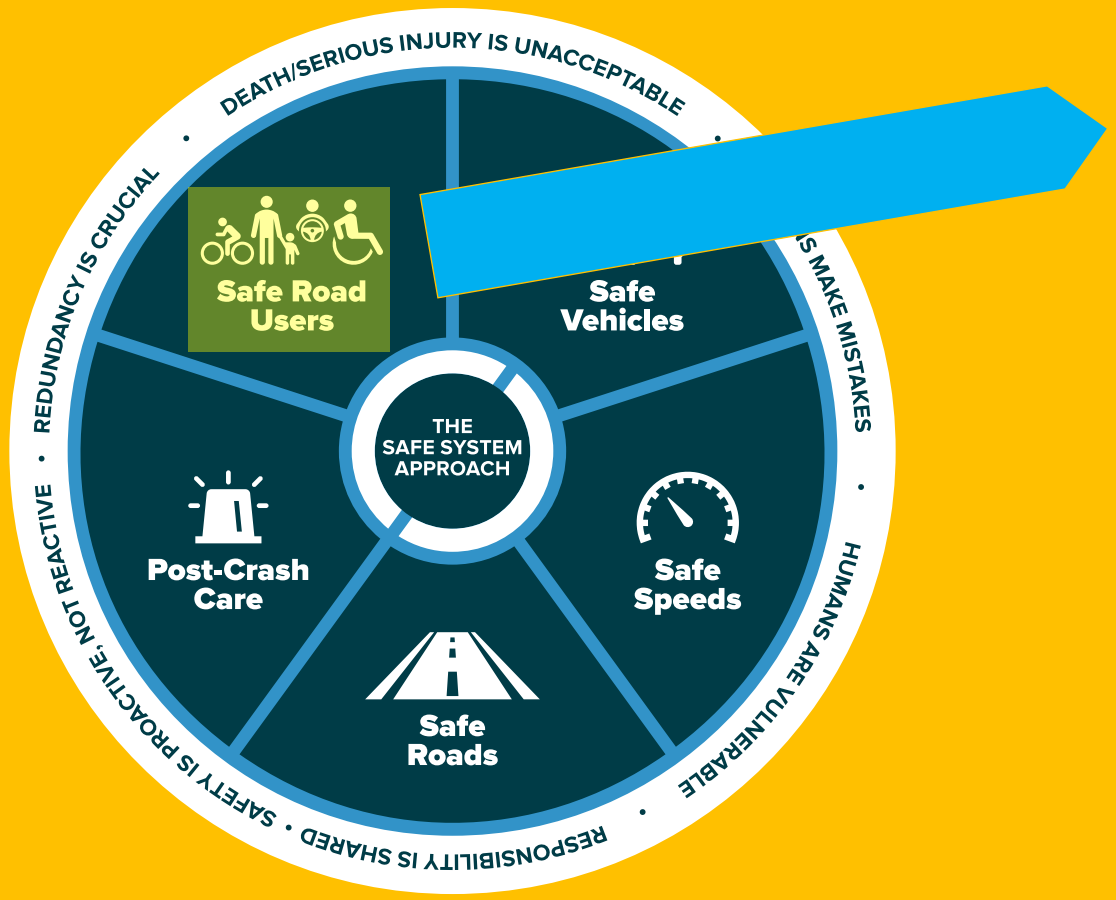
Five Safe System Elements

Do you recall the "4 E's" of safety – engineering, education, enforcement, and emergency medical services?



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

Five Safe System Elements



SAFE ROAD USERS

Follow rules

Education

Enforcement

Are not distracted or impaired

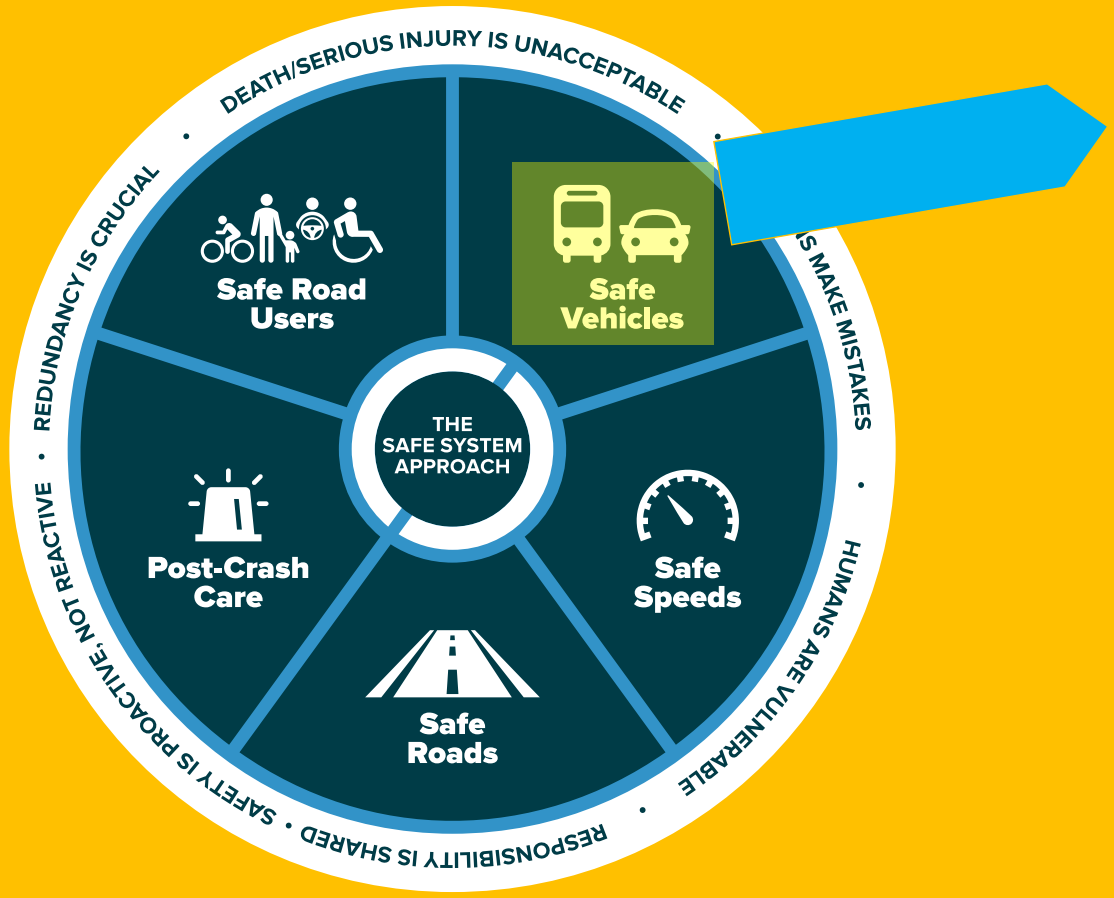
Education

Enforcement

Act within the limits of the road design

Engineering

Five Safe System Elements

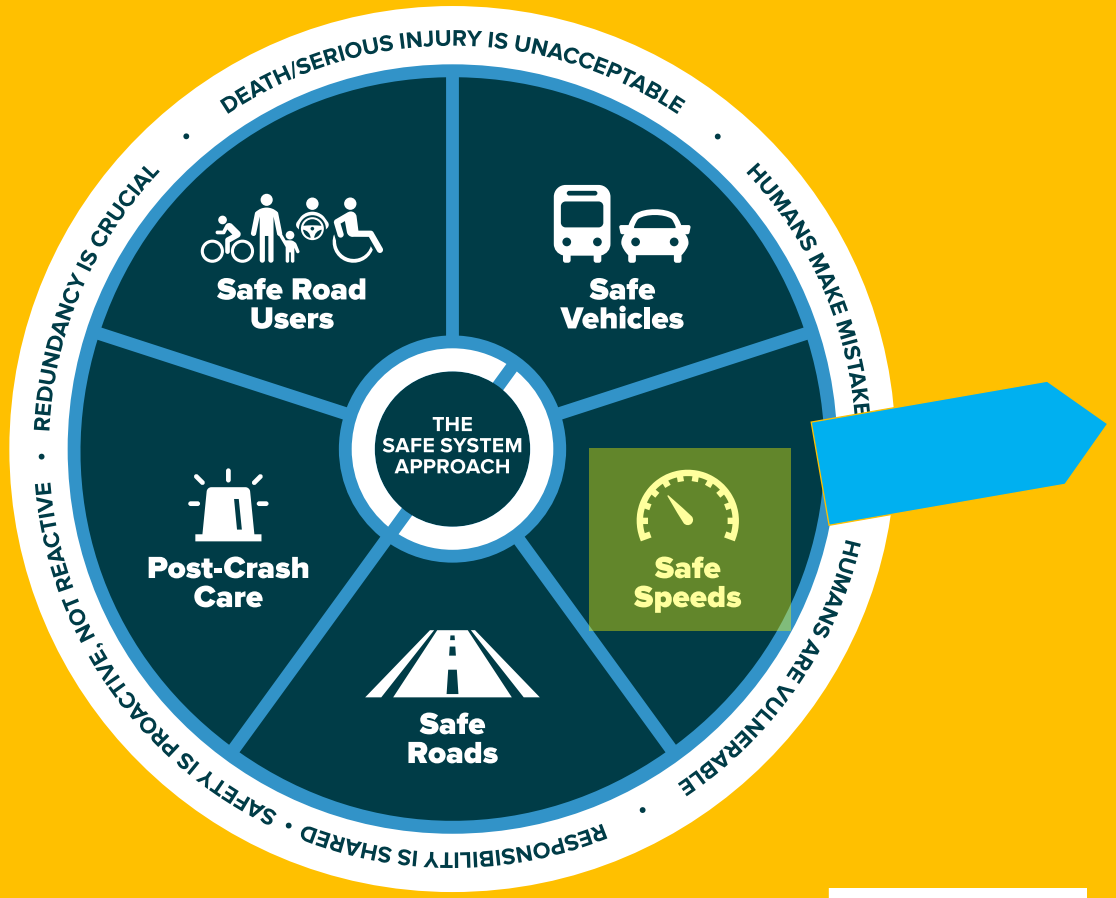


SAFE VEHICLES

- Pre-tensioned seatbelts
- Curtain airbags
- Crumple zones
- Lane departure warning
- Emergency stability control
- Rear-view and blind spot detection
- Anti-lock breaking
- Autonomous emergency breaking

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

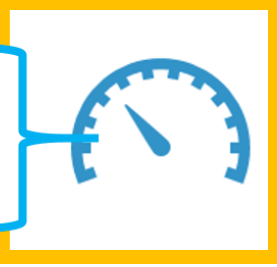
Five Safe System Elements



Education

Enforcement

Engineering



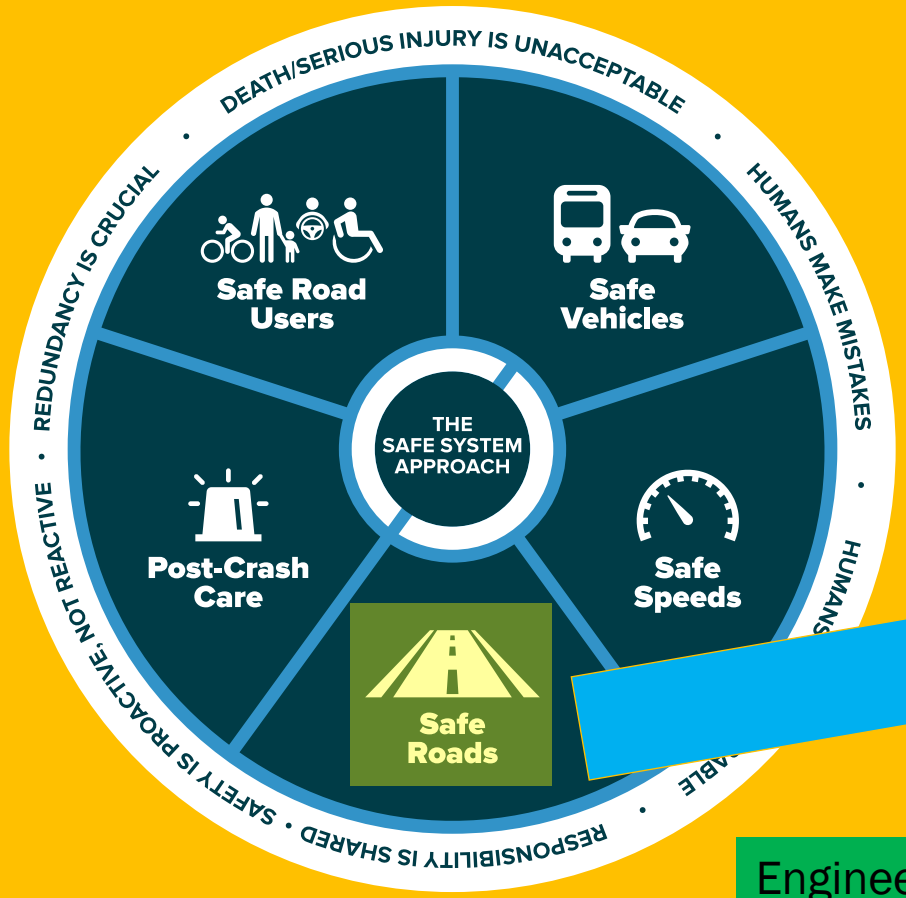
SAFE SPEEDS

Some roads are engineered to accommodate higher speeds …

… and others not.

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

Five Safe System Elements



Engineering

SAFE ROADS

Safe Roads are designed and operated to:

1. Avoid crashes
2. Keep impacts to the human body at tolerable levels

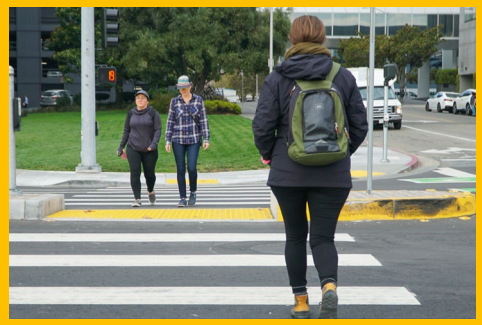
Designing to Avoid Crashes

1. Separating users in space

Sidewalks, medians, pedestrian islands, pedestrian underpasses, separated bicycle lanes, protected intersections, vehicle turn lanes

2. Separating users in time

Leading pedestrian interval, exclusive pedestrian phase, protected-only vehicle left turn signal phasing



3. Increasing attentiveness and awareness

Street lighting, enhanced pedestrian crosswalk markings, increased visibility between drivers and pedestrians, rectangular rapid flashing beacons, signal head back plates with retroreflective borders, rumble strips, horizontal curve enhanced delineation

Keeping Crashes Survivable

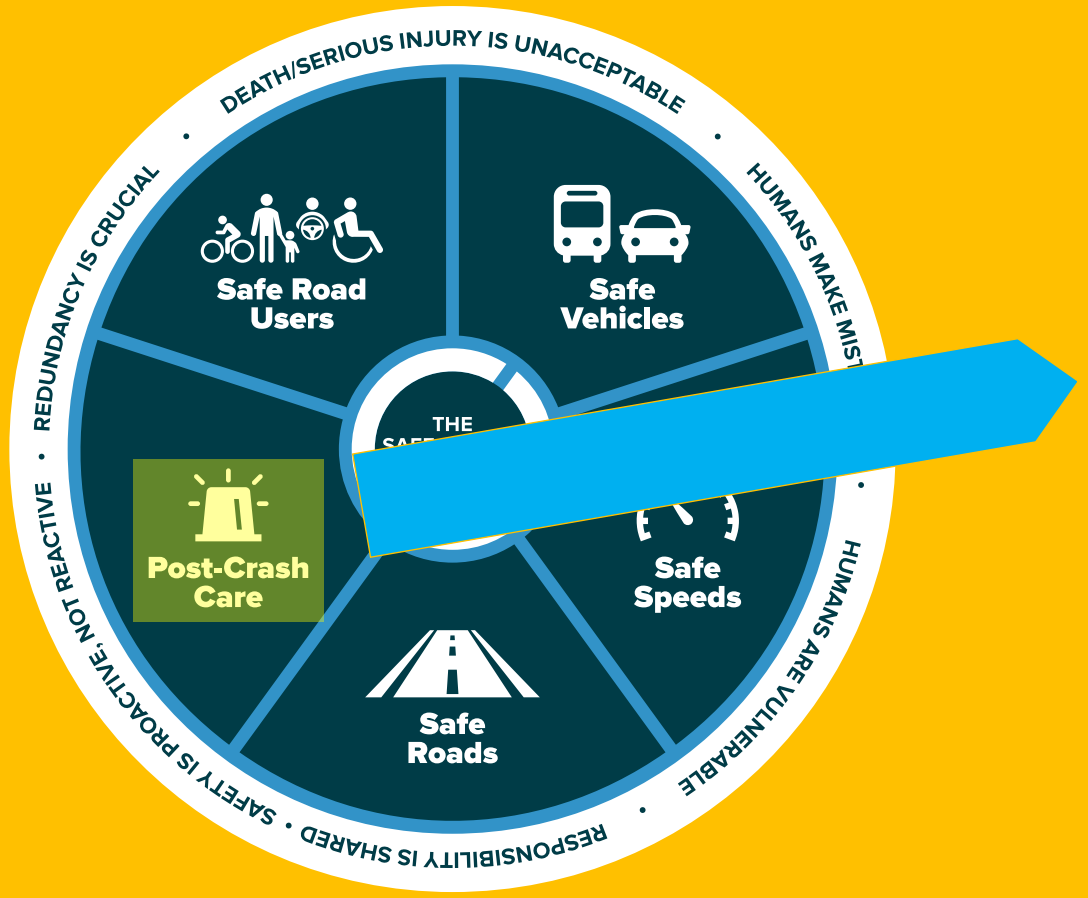
Designing safer roads is an exercise of managing kinetic energy

Manage Speed

Manage Impact Angle

Manage Kinetic Energy Transfer

Five Safe System Elements



POST CRASH CARE

EMS

First responders

Medical care

Traffic incident management

Engineering

Crash investigation

BACK TO THE PRINCIPLES …

Safe System Principles

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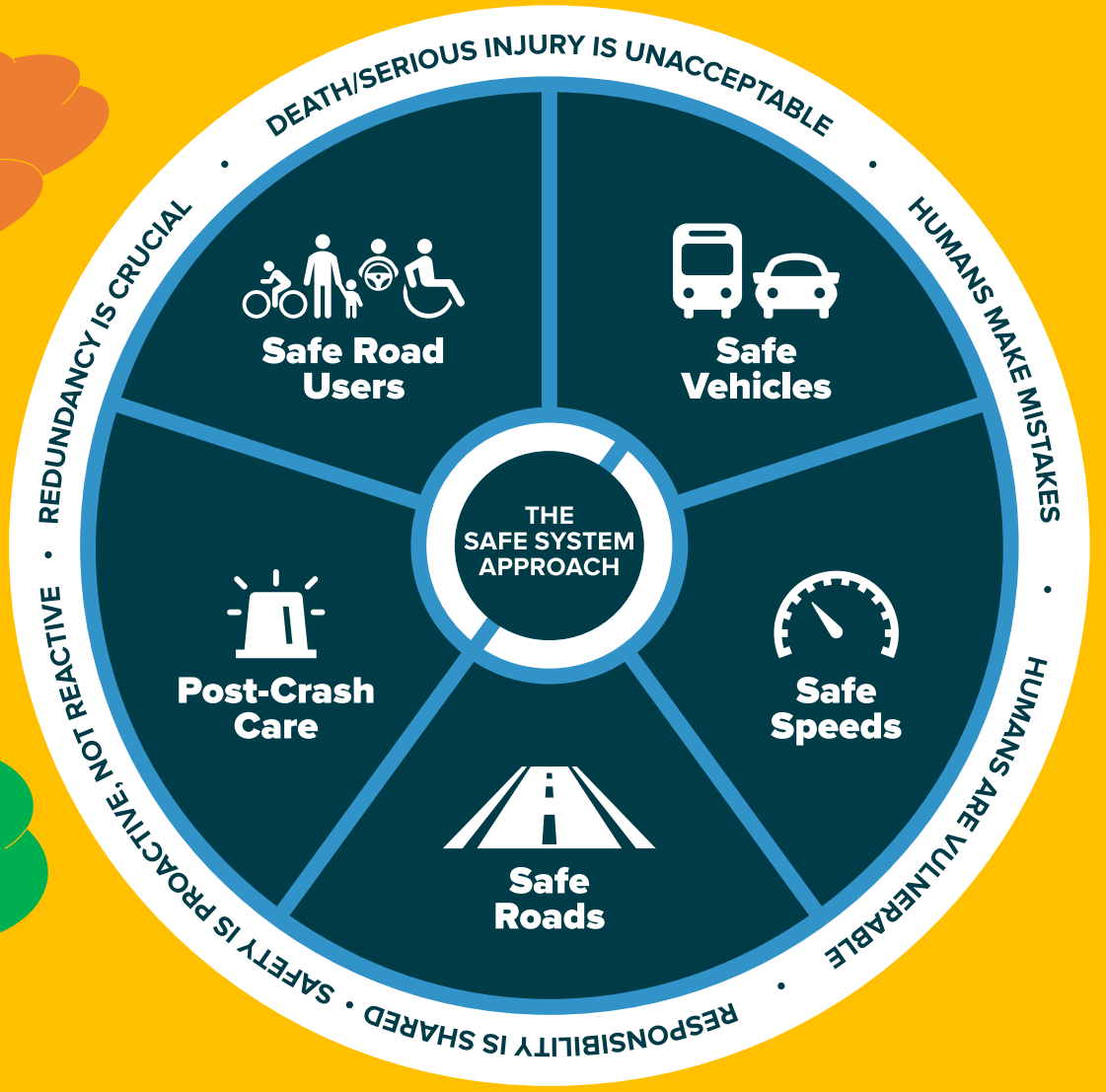
- Responsibility is shared
- Redundancy is crucial
- Safety is proactive, not reactive

Partnerships
Principles

A Safe System cannot be achieved through Engineering alone

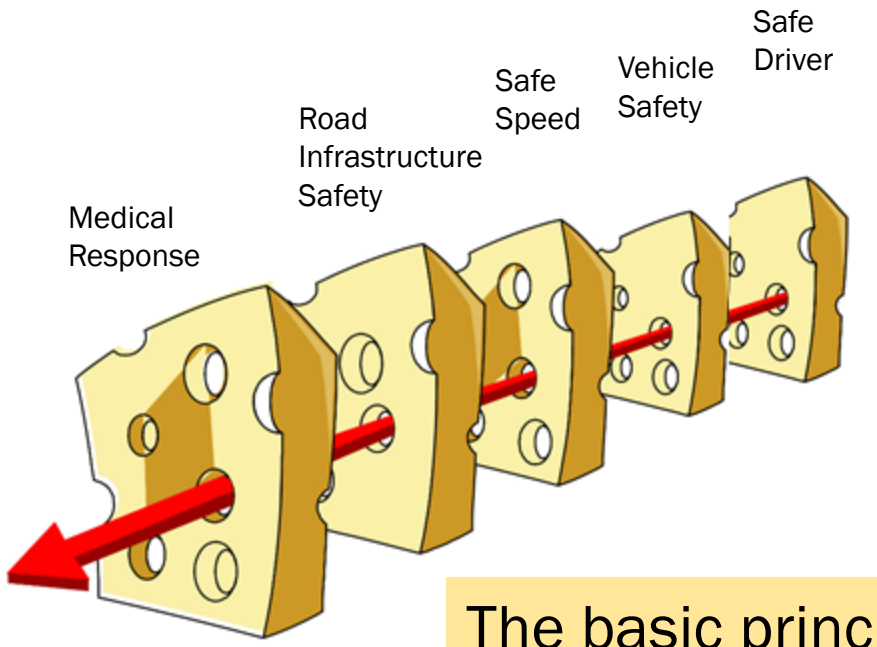


Five Safe System Elements

REDUNDANCY IS CRUCIAL

Shared Responsibility / Strengthen All Parts

SWISS CHEESE **MODEL**



- **Layers with “holes” representing weaknesses in individual system elements.**
- **A “failure” rarely occurs when a hole in each slice aligns to permit a hazard to pass through all of the elements.**

The basic principle is that lapses and weaknesses in one part of the system can occur, but other parts compensate to not allow a failure.

The “Swiss Cheese Model” is applicable to numerous risk management fields and was originally propounded by Dante Orlandella and James T. Reason of the University of Manchester

REDUNDANCY IS CRUCIAL

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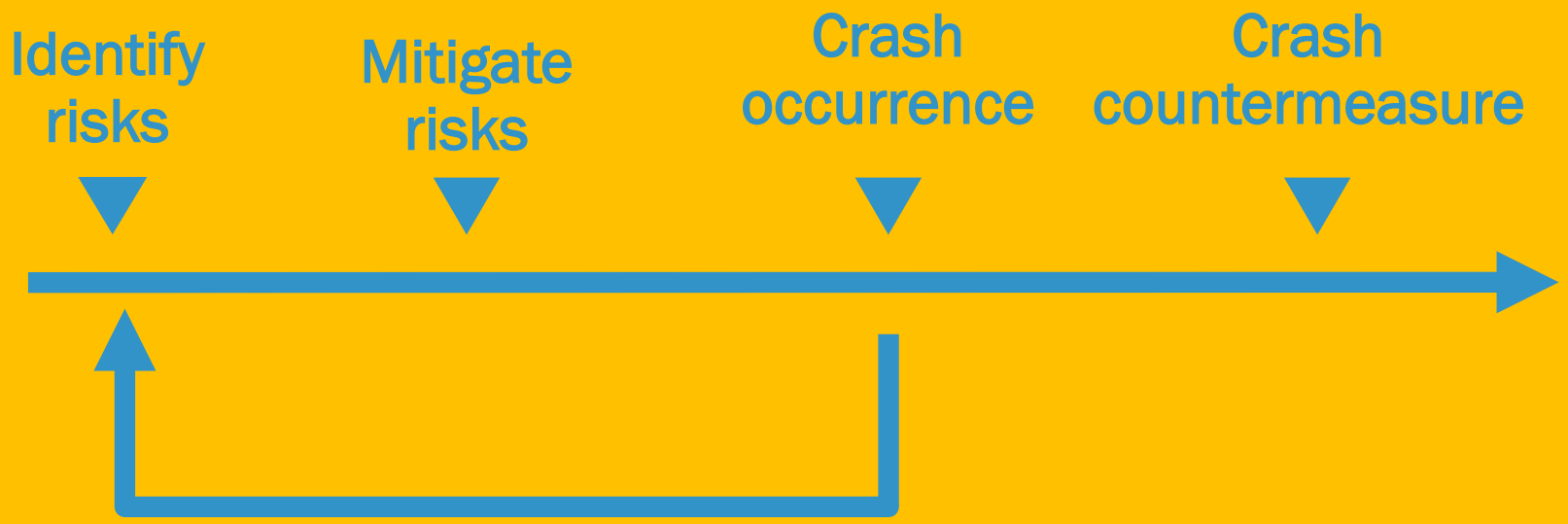
Proactive vs. Reactive



The Systemic Approach to Safety uses roadway characteristics and other data to identify patterns of risk features that lead to certain crash types.

Countermeasures may then be implemented at all locations exhibiting the particular risk characteristics (irrespective of past collision history).

Additional information on the Systemic Approach to Safety is available at https://safety.fhwa.dot.gov/systemic/

THE SAFE SYSTEM APPROACH

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

WHAT IS IT?

Paradigm Shift

	Traditional Approach	Safe System Approach
What is the problem?		

ROAD TO ZERO