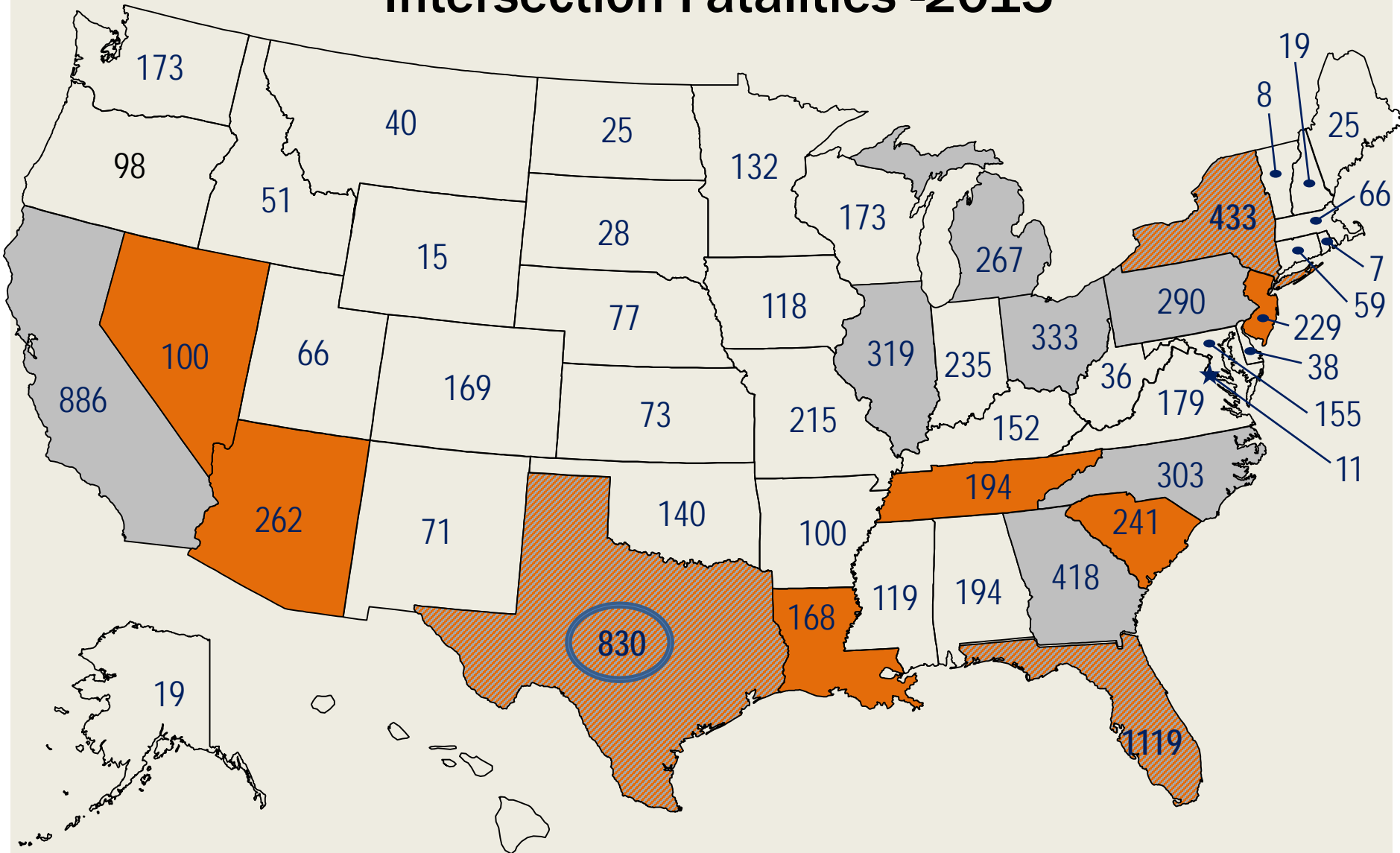


October 16, 2018

92<sup>nd</sup> Texas Transportation Short Course

# **INNOVATIVE INTERSECTION DESIGN**

# Intersection Fatalities -2015



Note: Focus States are those where ratio of Actual/Expected intersection fatalities exceed 1.0 relative to Rural/Urban adjusted Centerline Miles, Vehicle Miles Traveled and Population (rev 2014)

Top 10 Intersection Fatalities

FHWA Intersection Focus States

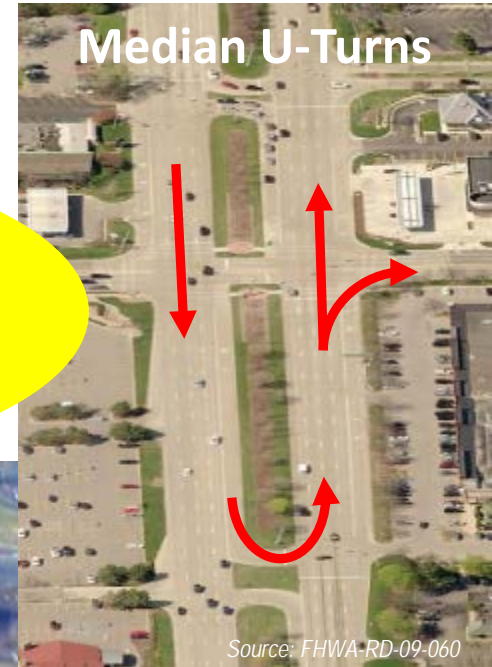
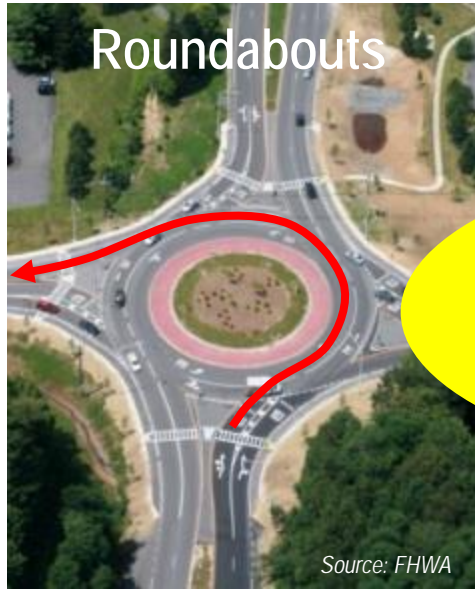
Top 10 and Int Focus State

Data source: FARS (2015)

# Every Day Counts 2

## Intersection & Interchange Geometrics

(2013-14)



*These solutions reduce severe crashes while enhancing efficiency*



# Innovative Intersection Benefits

## SAFETY

- Fewer, less severe conflict points
- Significant crash reductions
- Speed management potential

## MOBILITY

- Shorter trip duration
- Better trip reliability
- Reduced congestion
- Opportunities for walking and biking

## VALUE

- Less right-of-way
- Quicker construction
- Decreased costs
- Balanced solutions

*For greater benefits, emphasize Corridor or Network level approaches!*

# Innovative Intersection Solutions

Essential ingredients:

- Improve the way ***people*** move across intersections
- Eliminate, relocate or modify conflict points
- Strategically optimize traffic control

*“cho·re·og·ra·phy”*

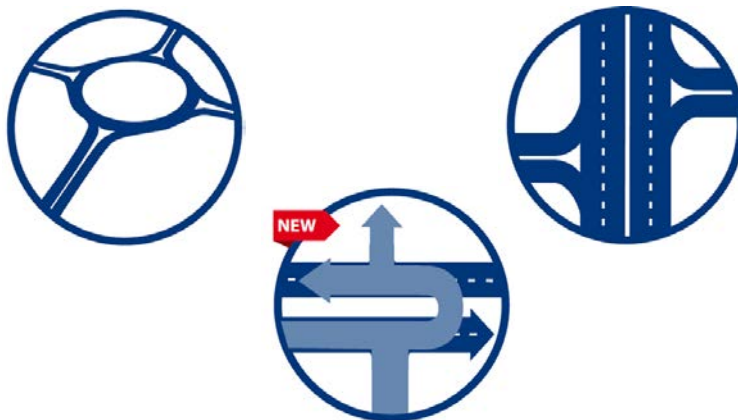
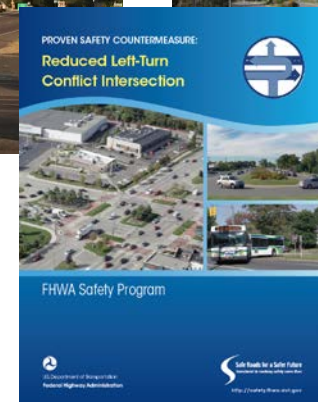


# Doubling Down on What Works



## Innovative Intersections as FHWA Proven Safety Countermeasures

- Roundabouts (added in 2008)
- Corridor Access Management (added in 2012)
- Reduced Left-Turn Conflict Intersections (added in 2017)
  - Includes the Restricted Crossing U-Turn and Median U-Turn

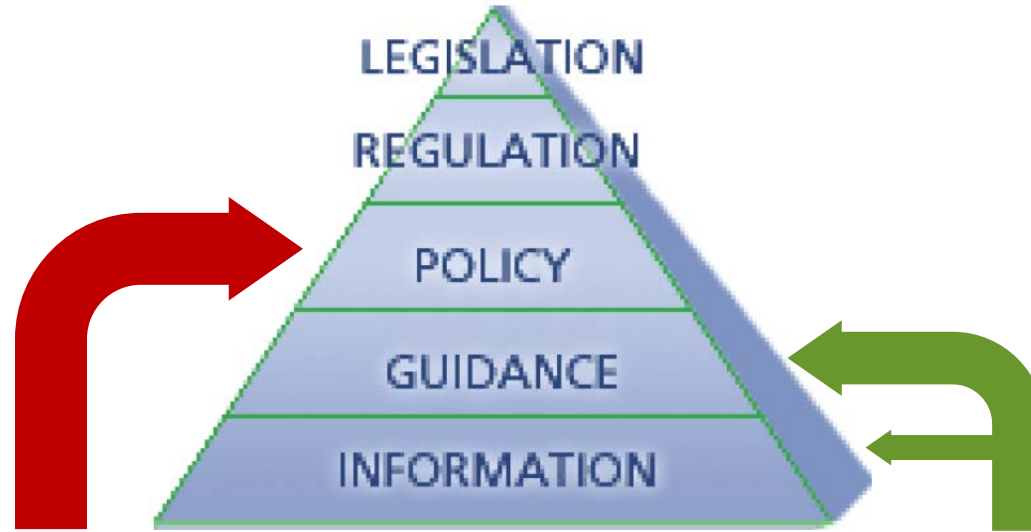


# Long Term Vision for IIG

*Agencies include innovative intersection solutions in their evaluation processes or policies in a manner that ensures they are considered and evaluated alongside other improvement alternatives, and implemented when appropriate.*

*aka Intersection Control Evaluation (ICE)  
Policies/Procedures*

# Generally, ICE is...



## POLICY

*Establishes the general applicability and future effect; sets forth a course of action, plan or procedure; expectation that it will be implemented and adhered to without deviation*

## PROCESS

*Describes the framework and methodologies by which a Policy can be successfully implemented; describes the desired outcomes; facilitates consistency of effort and results*



# The ICE Framework

Typically a 2-Stage Screening Process

- Stage 1 – high-level performance-based assessment, considers all possibilities, quickly filters down to a short list
- Stage 2 – more rigorous assessment of the performance criteria for short listed options



***Goal: Consistent...Objective...Safer***

# Why is ICE needed?

- Sustain progress achieved with innovative intersections
- Ensure routine, objective and consistent consideration
- Result in frequent implementation
- Complements performance-oriented program framework and value-based project delivery



# Realizing SHSP Vision

ICE is *cross-cutting* and can link SHSP priorities to all facets of highway program

 **Critical Emphasis Area:**  
**INTERSECTIONS**

## PERFORMANCE MEASURES

- Number of intersection-related fatalities
- Number of intersection-related serious injuries

## STRATEGIES

1. Implement geometric improvements
2. Use appropriate traffic controls to reduce conflicts
3. Improve sight distance and traffic control visibility
4. Improve access management to reduce conflicts
5. Improve behavior at intersections through the use of education and enforcement



 **MOST COMMON COLLISION ATTRIBUTES**

- MALE DRIVERS, age 26–45
- Day of week, FRIDAY
- 61% DURING DAYLIGHT and 32% in dark, but lighted locations
- ANGLE, SINGLE VEHICLE, AND NON-COLLISION are the most common crash types

## PERFORMANCE MEASURES

- Number of intersection-related fatalities
- Number of intersection-related serious injuries

## STRATEGIES

1. Implement geometric improvements
2. Use appropriate traffic controls to reduce conflicts
3. Improve sight distance and traffic control visibility
4. Improve access management to reduce conflicts
5. Improve behavior at intersections through the use of education and enforcement



Intersection CEA Fact Sheet, Action Plan and Team Roster are included in the Supplement and will be updated on an annual basis.

# ICE and Safety PM Final Rule

Safety PM Final Rule establishes 5 performance measures to carry out HSIP (5-year rolling avgs):

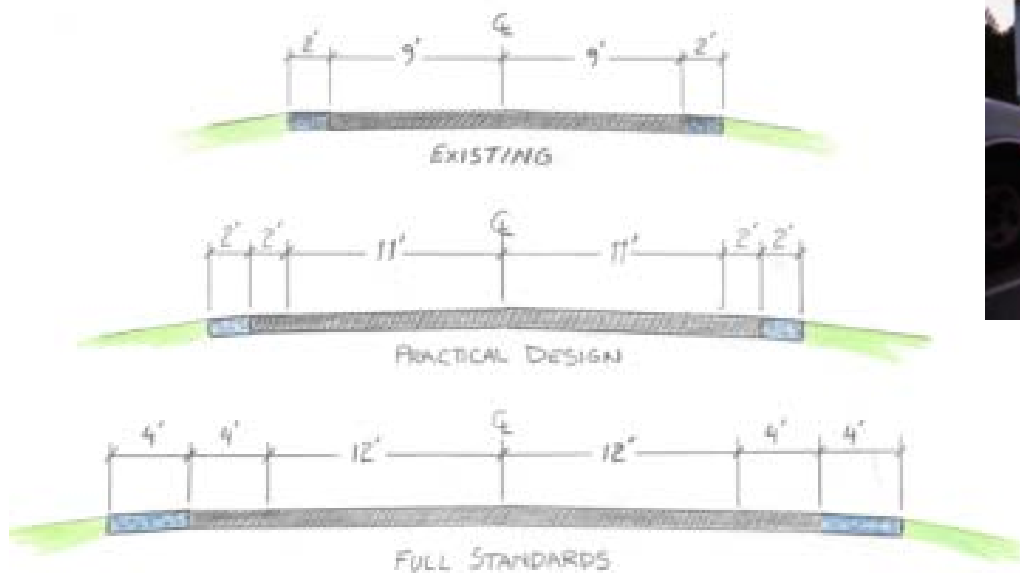
- (1) Number of Fatalities
- (2) Rate of Fatalities per 100 million VMT
- (3) Number of Serious Injuries
- (4) Rate of Serious Injuries per 100 million VMT
- (5) Number of Non-motorized Fatalities and Serious Injuries

States establish and report on targets; annual evaluation on meeting or making significant progress toward targets

*ICE Policies/Procedures can help achieve  
Safety PM targets across entire highway program  
(Not limited to HSIP)!*

# Overlap with PBPD\*

- Emphasis on objective, measurable, performance-based solutions
- Leveraging and adapting existing conditions to something better
- Engineered solutions – intersection “*choreography*”



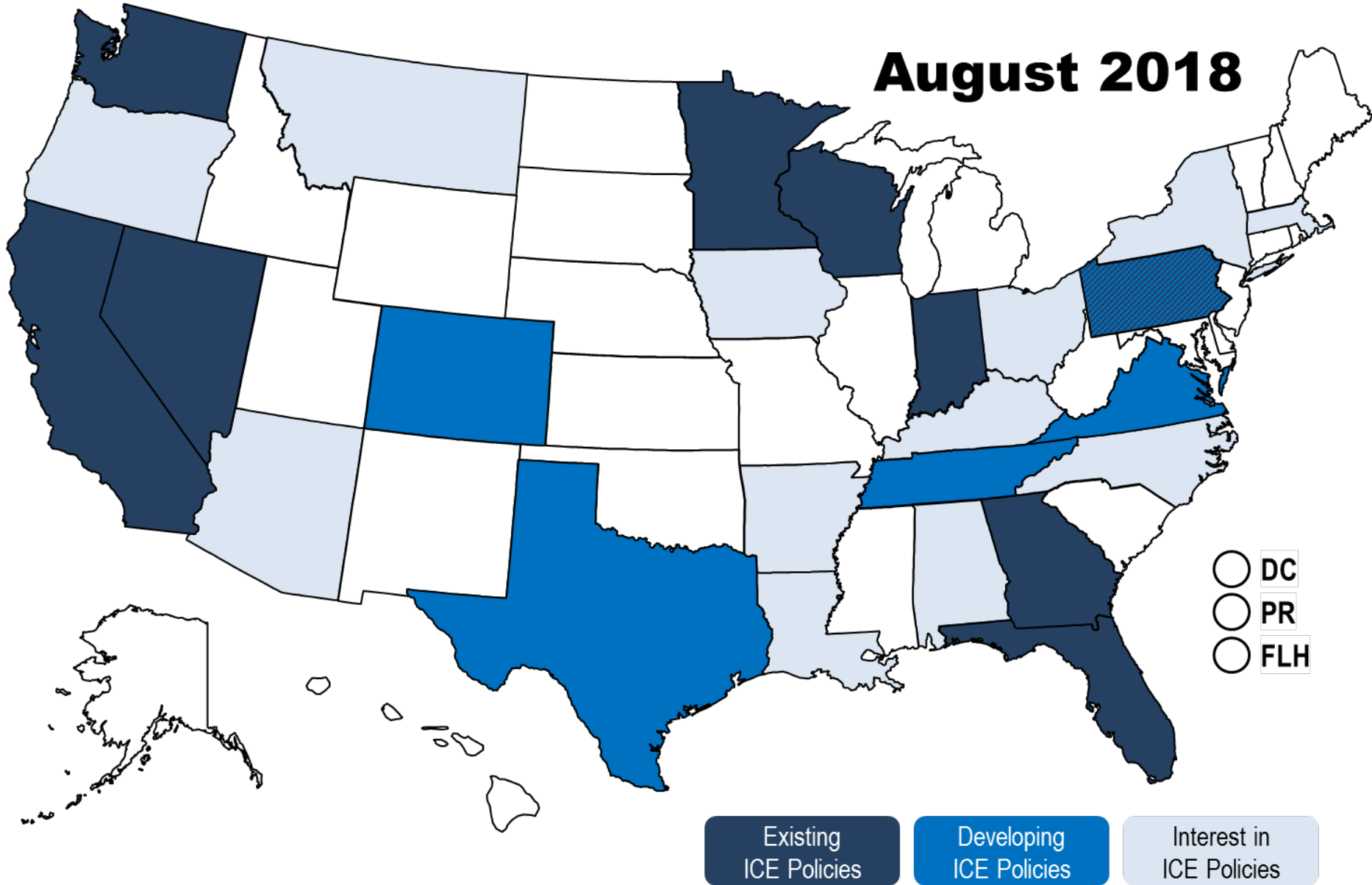
\* PBPD = Performance-Based Practical Design

# ICE Performance Criteria

- Safety (substantive, not nominal)
- Operations (core MOEs, not LOS)
- Right-of-Way Impacts
- Costs
- Practical Feasibility (i.e., local posture)
- Pedestrians and Bicycles
- Freight Network (incl. OSOW)
- Environmental Impacts

# State Progress on ICE Policies

August 2018

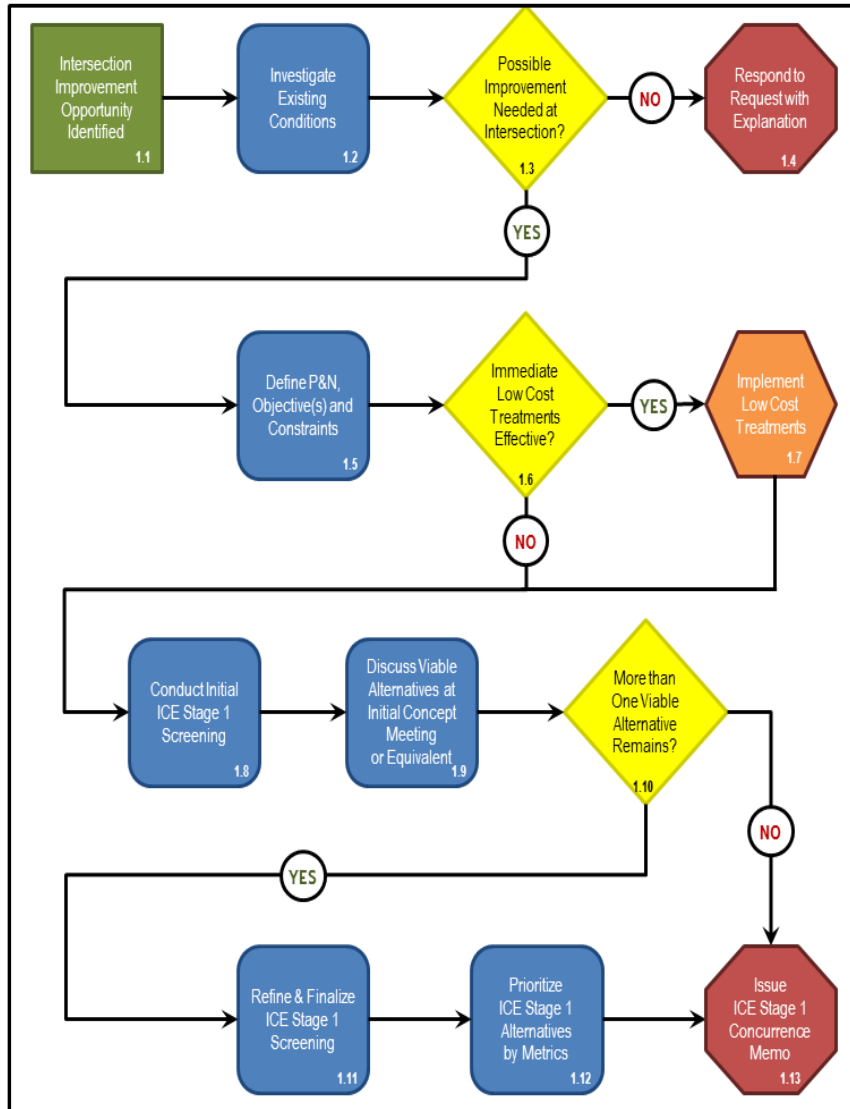


# ICE Lead State Lessons Learned

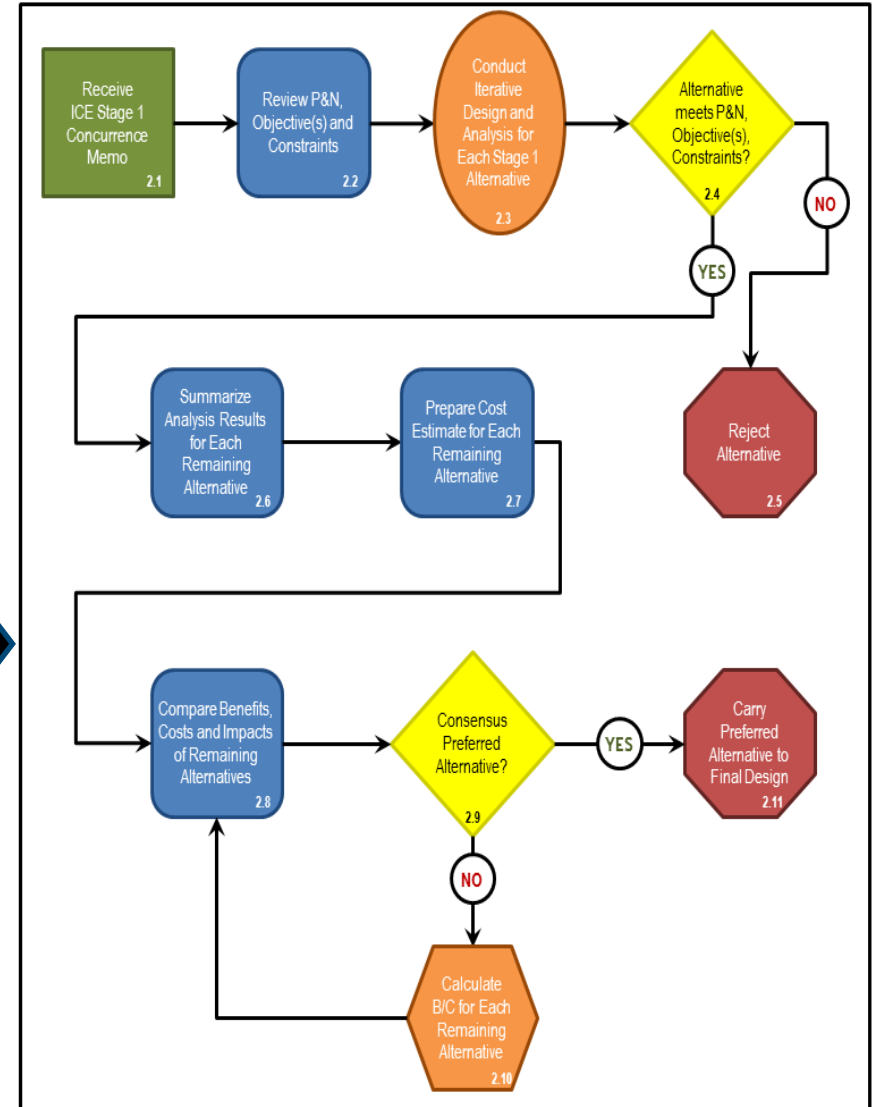
ICE helped meet the following needs:

- Helped advance alternative intersections
- Incorporates safety performance in to scoping stage
- Helped vet possibilities for context and risk
- Addressed concerns about documentation sufficiency and consistency
- Provides a basis for early non-motorized assessment





**STAGE 1**



**STAGE 2**

# ICE Lead State Policies

Minnesota (2007)

California (2013)

Nevada (2018)

Florida (2018)

Pennsylvania (2018)

Georgia (2017)

Washington (2015)

Indiana (2014)

Wisconsin (2008)

# Tools to Support ICE

## National Resources

- CAP-X (**UPDATED Coming October 30!**)
- SPICE (**NEW Coming October 30!**)
- LCCET (via NCHRP 03-110)

## State Resources

- Kentucky (IDAT)
- Georgia (ICE Tool)
- Virginia (V-JuST)
- Florida, Pennsylvania

***FHWA Web Conferencing Portal:***

***<https://collaboration.fhwa.dot.gov/dot/fhwa/WC/default.aspx>***



U.S. Department of Transportation  
Federal Highway Administration

# SPICE

Safety Performance for Intersection Control Evaluation

Version 1.4  
July 2018

FHWA-SA-18-026 SPICE Tool.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View ACROBAT SecureZIP Tell me what you want to do

Clipboard Font Alignment Number Styles

M24

## Safety Performance for Intersection Control Evaluation Tool

**Results**  
*Summary of crash prediction results for each alternative*

Project Information		
Project Name:		Intersection Type At-Grade Intersections
Intersection:		Opening Year 0
Agency:		Design Year --
Project Reference:		Facility Type On Urban and Suburban Arterial
City:		Number of Legs 3-leg
State:		
Date:		
Analyst:		

Crash Prediction Summary					
Control Strategy	Crash Type	Opening Year	Design Year	Total Project Life Cycle	AADT Within Prediction Range?
1-lane Roundabout	Total				N/A
	Fatal & Injury				
2-lane Roundabout	Total				N/A
	Fatal & Injury				
Minor Road Stop	Total				Yes
	Fatal & Injury				
Traffic Signal	Total				Yes
	Fatal & Injury				
Traffic Signal (Alt)	Total				Yes
	Fatal & Injury				
Displaced Left-Turn (DLT)	Total				N/A
	Fatal & Injury				
Median U-Turn (MUT)	Total				N/A
	Fatal & Injury				
Signalized RCUT	Total				N/A
	Fatal & Injury				
Unsignalized RCUT	Total				N/A
	Fatal & Injury				
Continuous Green-T (CGT) Intersection	Total				N/A
	Fatal & Injury				

Compute/Update Results

Please complete the Opening/Design Year Inputs and AADTs Before Viewing Results

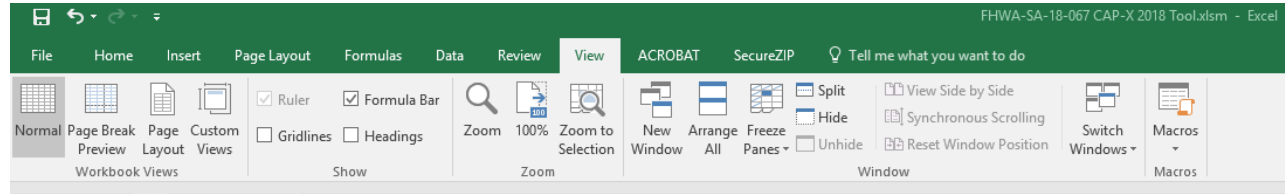


U.S. Department of Transportation  
Federal Highway Administration

# CAPX

Capacity Analysis for  
Planning of Junctions

Version 3.0  
September 2018



## Capacity Analysis for Planning of Junctions

Detailed Results Worksheet

Project Name:	Cap-X Sample Street	<i>Estimated Volume-to-Capacity Ratio</i>			
Project Number:	10000	Number of Configurations			
Location	Anywhere, USA	< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00
Date	2017 AM	44	2	0	4

### Results for Non-roundabout Intersections

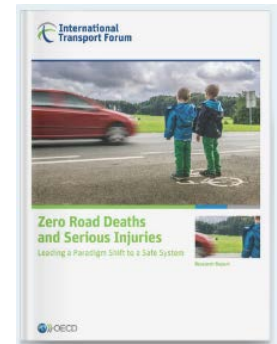
TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			
Traffic Signal	FULL									1102	0.65	0.65	Good	Good
Two-Way Stop Control	N-S									-	1.26	1.26	Fair	Good
	E-W									-	1.30	1.30	Fair	Good
All-Way Stop Control	FULL									1572	1.31	1.31	Excellent	Excellent
Continuous Green T	W									321	0.18	0.18	Fair	Fair
	N									246	0.14	0.14	Fair	Fair
	E									476	0.27	0.27	Fair	Fair
	S									482	0.28	0.28	Fair	Fair
Quadrant Roadway	S-W			390	0.22			242	0.14	373	0.21	0.22	Good	Good
	N-E	352	0.20			291	0.17			459	0.26	0.26	Good	Good
	S-E			392	0.22	379	0.22			408	0.23	0.23	Good	Good
Partial Displaced Left Turn	N-W	313	0.18					282	0.16	424	0.24	0.24	Good	Good
	N-S	574	0.32	342	0.19					849	0.48	0.48	Good	Good
Displaced Left Turn	E-W					268	0.15	339	0.19	543	0.31	0.31	Good	Good
	FULL	303	0.17	225	0.12	150	0.08	186	0.10	357	0.20	0.20	Good	Good
Signalized Restricted Crossing U-Turn	N-S	437	0.24	702	0.39	709	0.39	576	0.32			0.39	Excellent	Excellent
	E-W	576	0.32	1200	0.67	908	0.50	437	0.24			0.57	Excellent	Excellent

# Toward a Safe Systems Approach

*“A Safe System requires understanding and managing the complex and dynamic interaction between operating speeds, vehicles, road infrastructure and road user behavior, in a holistic and integrated way, so that the sum of the individual parts of the system combine for a greater overall effect and if one part fails the other parts will still prevent serious harm from occurring.”*

*Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System - October 2016*

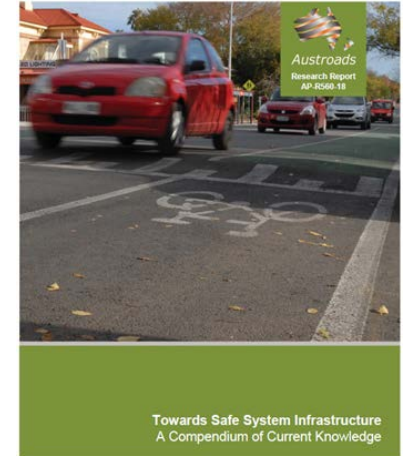
Excerpts from the Foreword



<http://www.oecd.org/publications/zero-road-deaths-and-serious-injuries-9789282108055-en.htm>

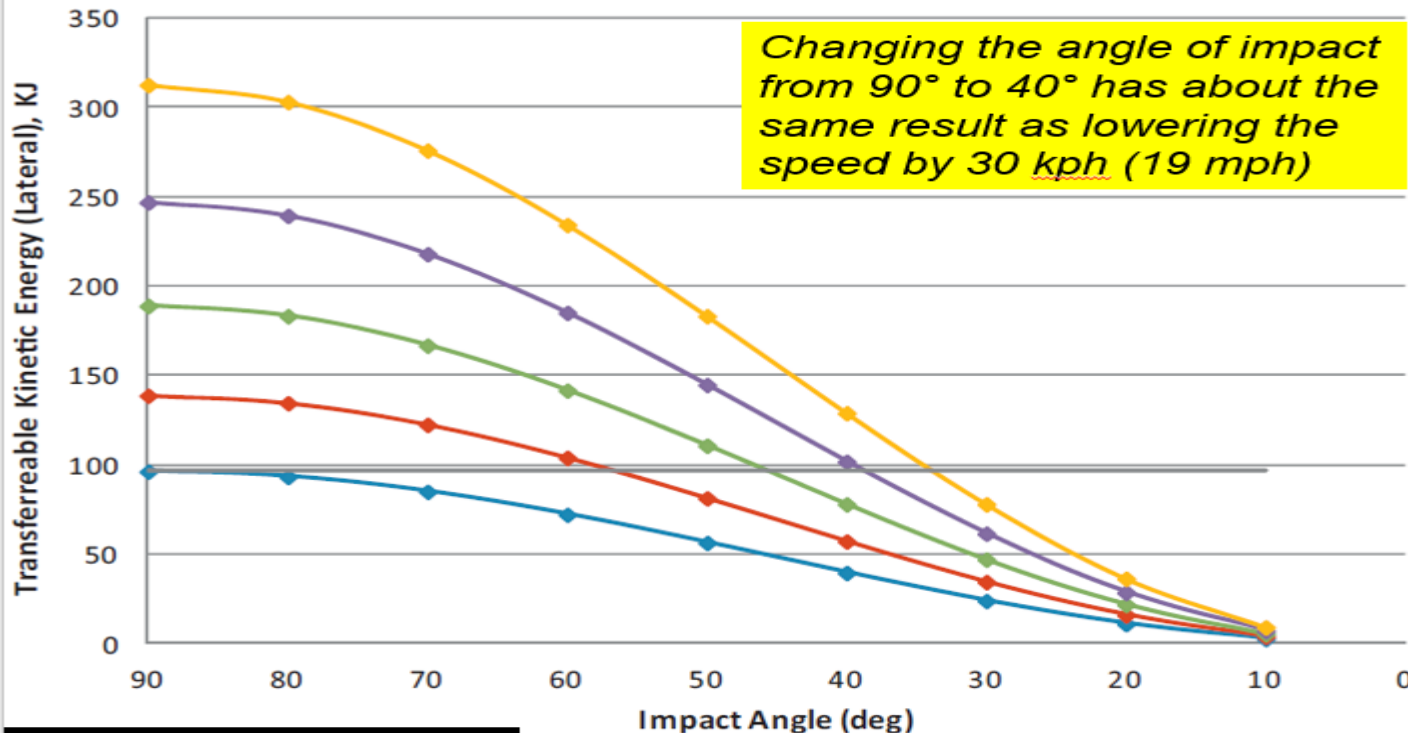
# Safe Systems for Intersections

“Safe System is the management and design of the road system such that impact energy on the human body is firstly avoided or secondly managed at tolerable levels by **manipulating speed, mass and crash angles** to reduce crash injury severity.”



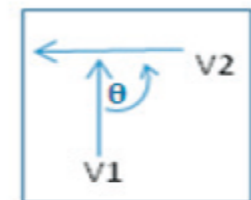
Reference: Austroads Report AP-R560-18 Towards Safe System Infrastructure: A Compendium of Current Knowledge

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



Vehicle mass = 1 Tonne

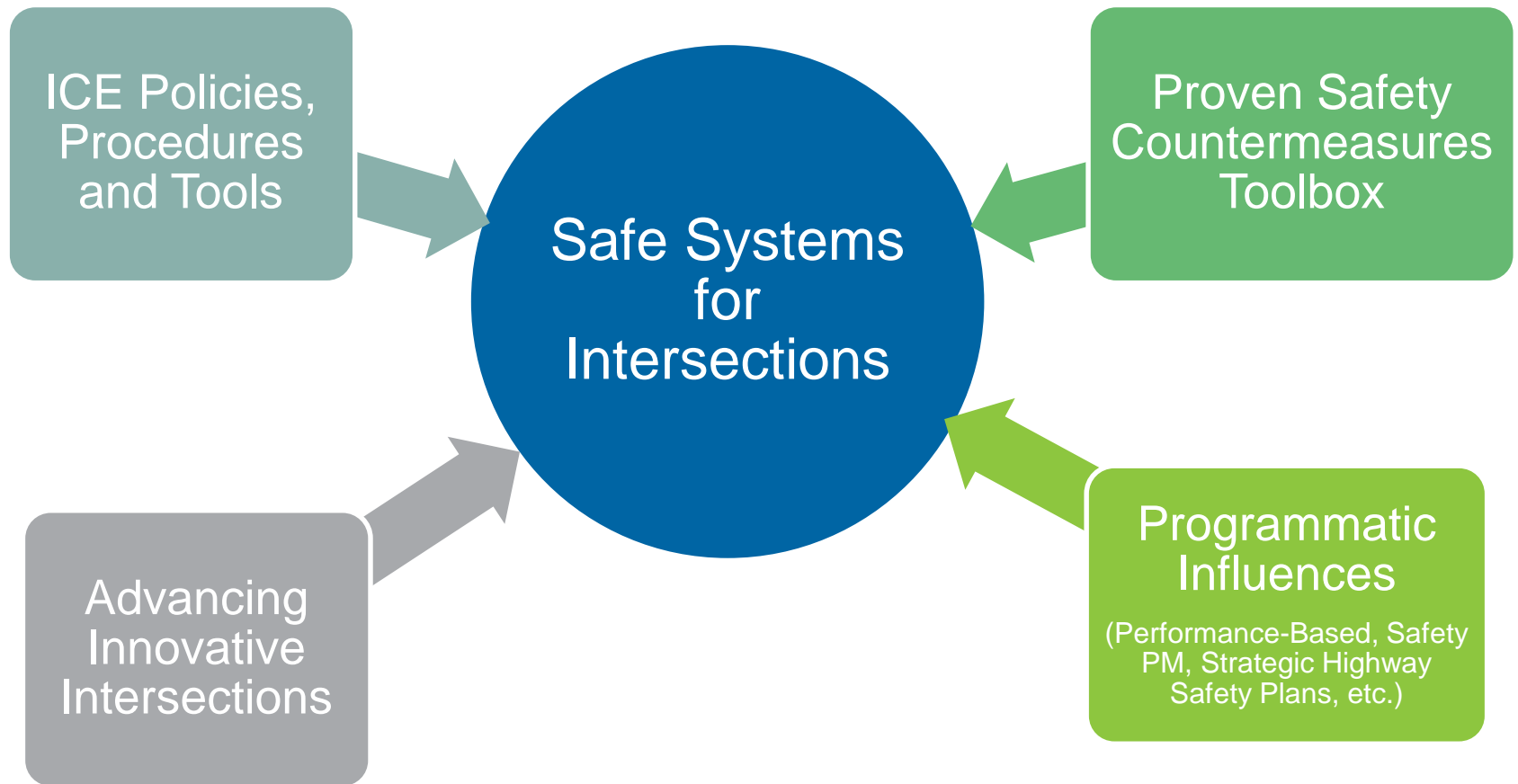
- 50 km/h
- 60 km/h
- 70 km/h
- 80 km/h
- 90 km/h
- KE threshold



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

Influence of impact angle on transferrable kinetic energy.

# Converging on Success





# Thank You!

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(202) 738-7793

