Safer Speeds: Considerations for Speed Limits for all Street-users

(Image: Photo by David Lofink)

Presented by:

Dr. Offer Grembek

Berkeley SafeTREC

Presented at:

MTC Tech Transfer Seminar: Operating Complete Streets

February 3, 2020

Goal of the transportation system?

Provide <u>mobility</u>.

Goal of the transportation system?

Provide mobility.

Provide efficient, cost-effective, equitable, sustainable, …, and safe mobility.

So, is our transportation system safe?

So, is our transportation system safe?

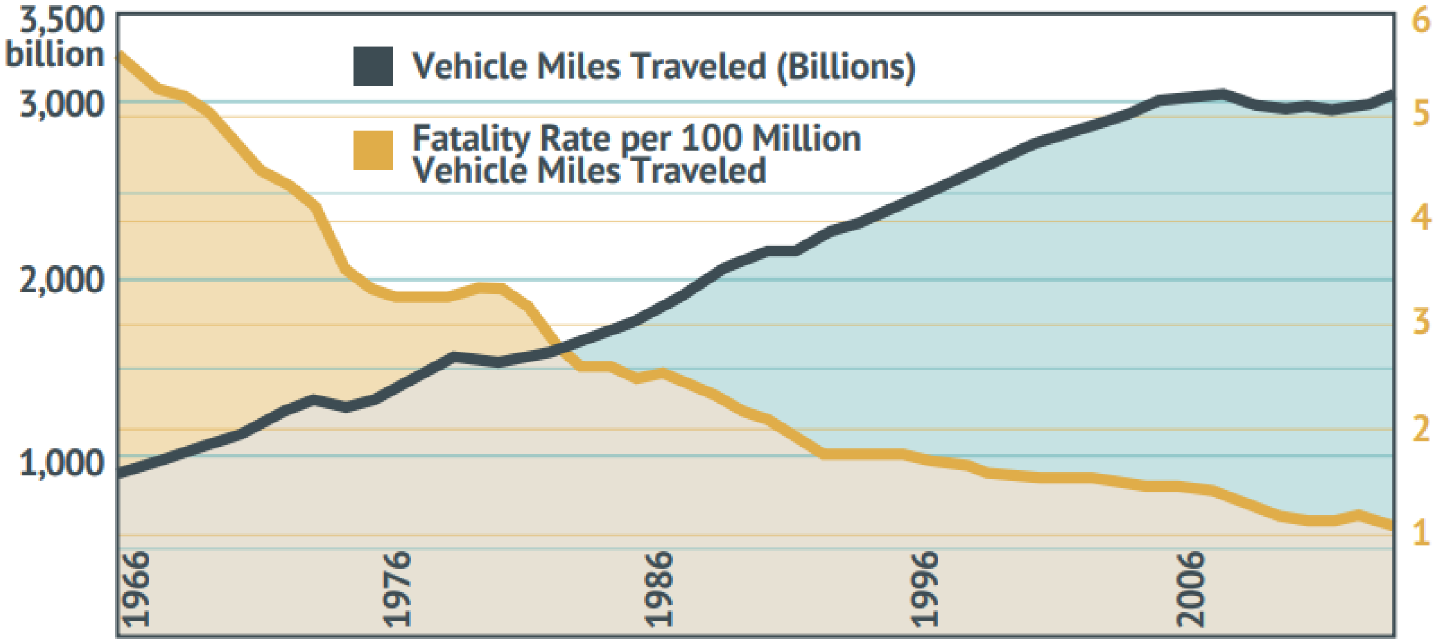


FIGURE 1-3: Fatality Rate and Vehicle Miles Traveled, 1966-2013 (Source: NHTSA FARS)

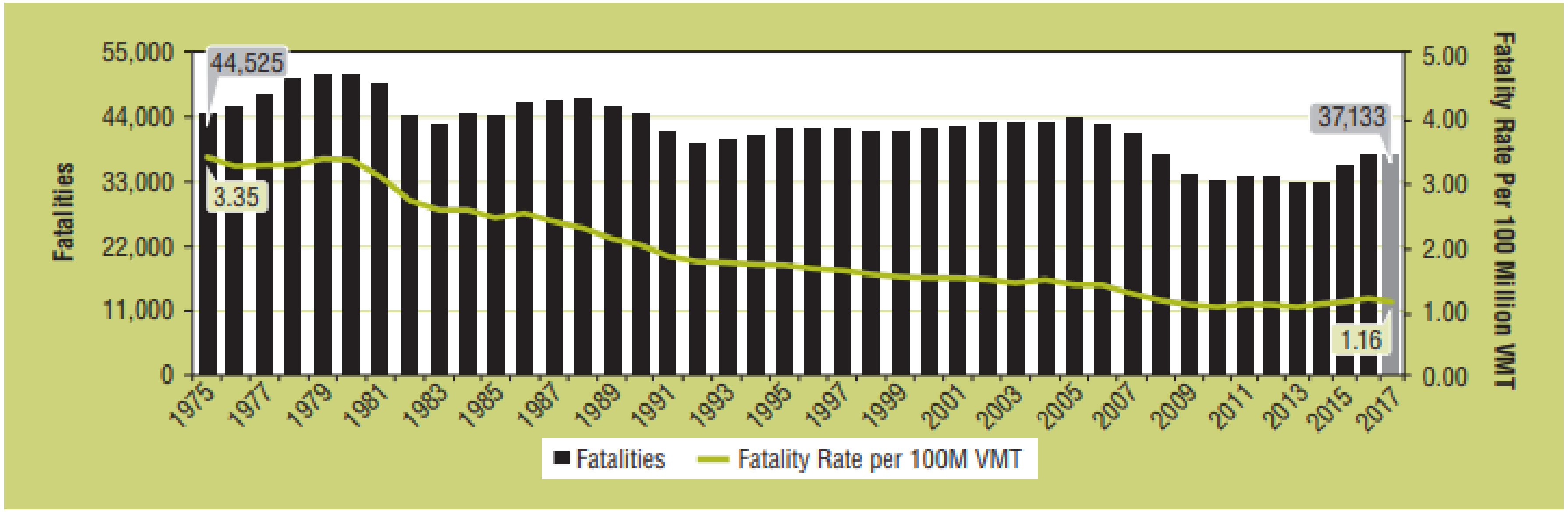
The fatality rate has demonstrated a downward trend for decades.

We're on the right track towards safety.

So, is our transportation system safe?

No. It is not safe.

Fatalities and Fatality Rate per 100 Million VMT, by Year, 1975–2017



Sources: FARS 1975–2016 Final File, 2017 ARF; Vehicle Miles Traveled (VMT): FHWA.

<u>2017 Fatalities:</u>

California:
3,602

USA:
37,133

Globally:
Over 1,300,000

So, is our transportation system safe?

No. It is <u>not</u> safe.

10 Leading Causes of Injury Deaths by Age Group Highlighting Unintentional Injury Deaths, United States – 2017

Rank	Age Groups										Total
	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	
1	Unintentional Suffocation 1,106	Unintentional Drowning 424	Unintentional MV Traffic 327	Unintentional MV Traffic 428	Unintentional MV Traffic 6,697	Unintentional Poisoning 16,478	Unintentional Poisoning 15,032	Unintentional Poisoning 14,707	Unintentional Poisoning 10,581	Unintentional Fall 31,190	Unintentional Poisoning 64,795
2	Homicide Unspecified 139	Unintentional MV Traffic 362	Unintentional Drowning 125	Suicide Suffocation 280	Unintentional Poisoning 5,030	Unintentional MV Traffic 6,871	Unintentional MV Traffic 5,162	Unintentional MV Traffic 5,471	Unintentional MV Traffic 5,584	Unintentional MV Traffic 7,667	Unintentional MV Traffic 38,659
3	Unintentional MV Traffic 90	Homicide Unspecified 129	Unintentional Fire/Burn 94	Suicide Firearm 185	Homicide Firearm 4,391	Homicide Firearm 4,594	Suicide Firearm 3,098	Suicide Firearm 3,937	Suicide Firearm 4,219	Suicide Firearm 5,996	Unintentional Fall 36,338
4	Homicide Other Spec., Classifiable 76	Unintentional Suffocation 110	Homicide Firearm 78	Homicide Firearm 126	Suicide Firearm 2,959	Suicide Firearm 3,458	Suicide Suffocation 2,562	Suicide Suffocation 2,294	Unintentional Fall 2,760	Unintentional Unspecified 5,125	Suicide Firearm 23,854
5	Undetermined Suffocation 56	Unintentional Fire/Burn 95	Unintentional Suffocation 36	Unintentional Drowning 110	Suicide Suffocation 2,321	Suicide Suffocation 3,063	Homicide Firearm 2,561	Suicide Poisoning 1,604	Suicide Suffocation 1,631	Unintentional Suffocation 3,920	Homicide Firearm 14,542

Data Source: National Center for Health Statistics (NCHS), National Vital Statistics System.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

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So, is our transportation system safe?

No. It is not safe.

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Data Source: National Center for Health Statistics (NCHS), National Vital Statistics System.
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First, or

Second;

Age > 1yr

So, is our transportation system safe?

a system in which people cannot die despite human error.

Job, and Sakashita. 2016a

safe system

So, is our transportation system dangerous?

So, is our transportation system dangerous?

dangerous system

a system in which people can die with no human error (e.g., mine field, avalanche area).

Job, and Sakashita. 2016a

Our system is not safe and also not dangerous

Our system is not safe and also not dangerous

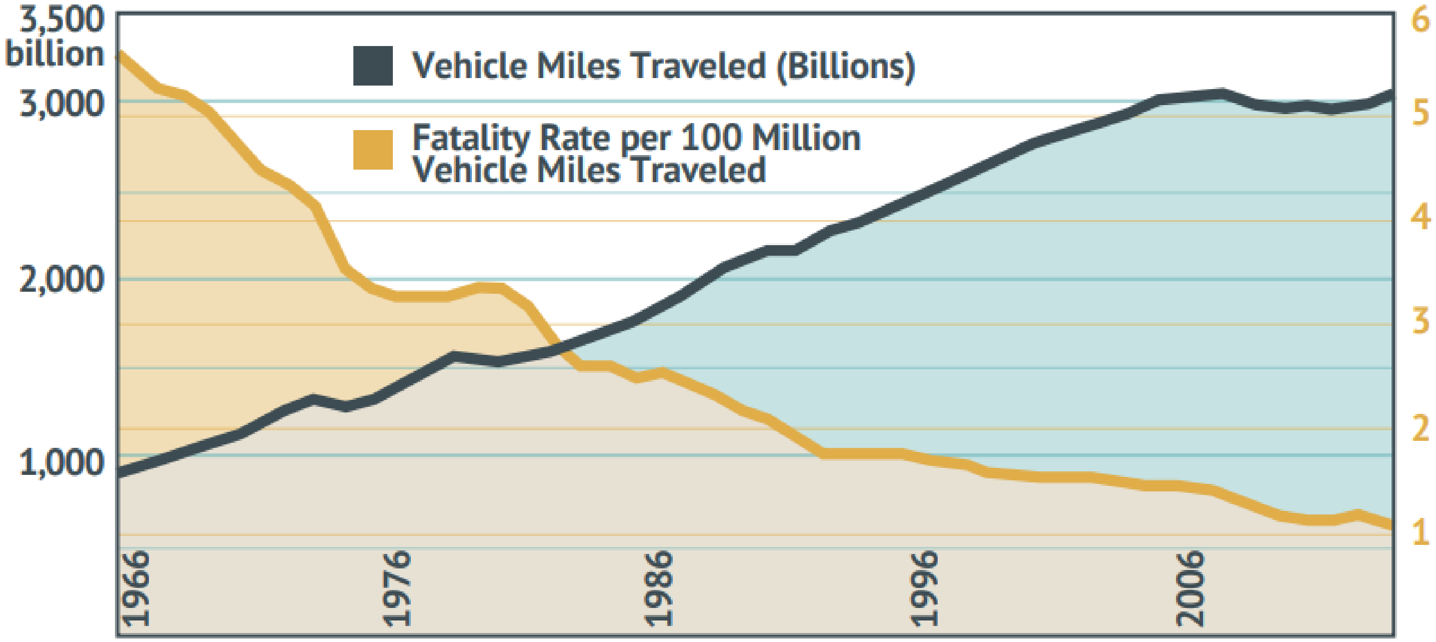

FIGURE 1-3: Fatality Rate and Vehicle Miles Traveled, 1966-2013 (Source: NHTSA FARS)

unsafe system

a system in which people can die through human error

Job, and Sakashita. 2016a

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Policy innovation to move the needle

V1.0

V2.0

dangerous system

unsafe system

safe system

Policy innovation to move the needle

Vision Zero & *Safe System*

challenge our ability to reach zero without a major change

ROAD TO ZERO

Toward Zero Deaths
National Strategy on Highway Safety

dangerous system

unsafe system

safe system

Principles of Safe System

Mooren et al., 2011

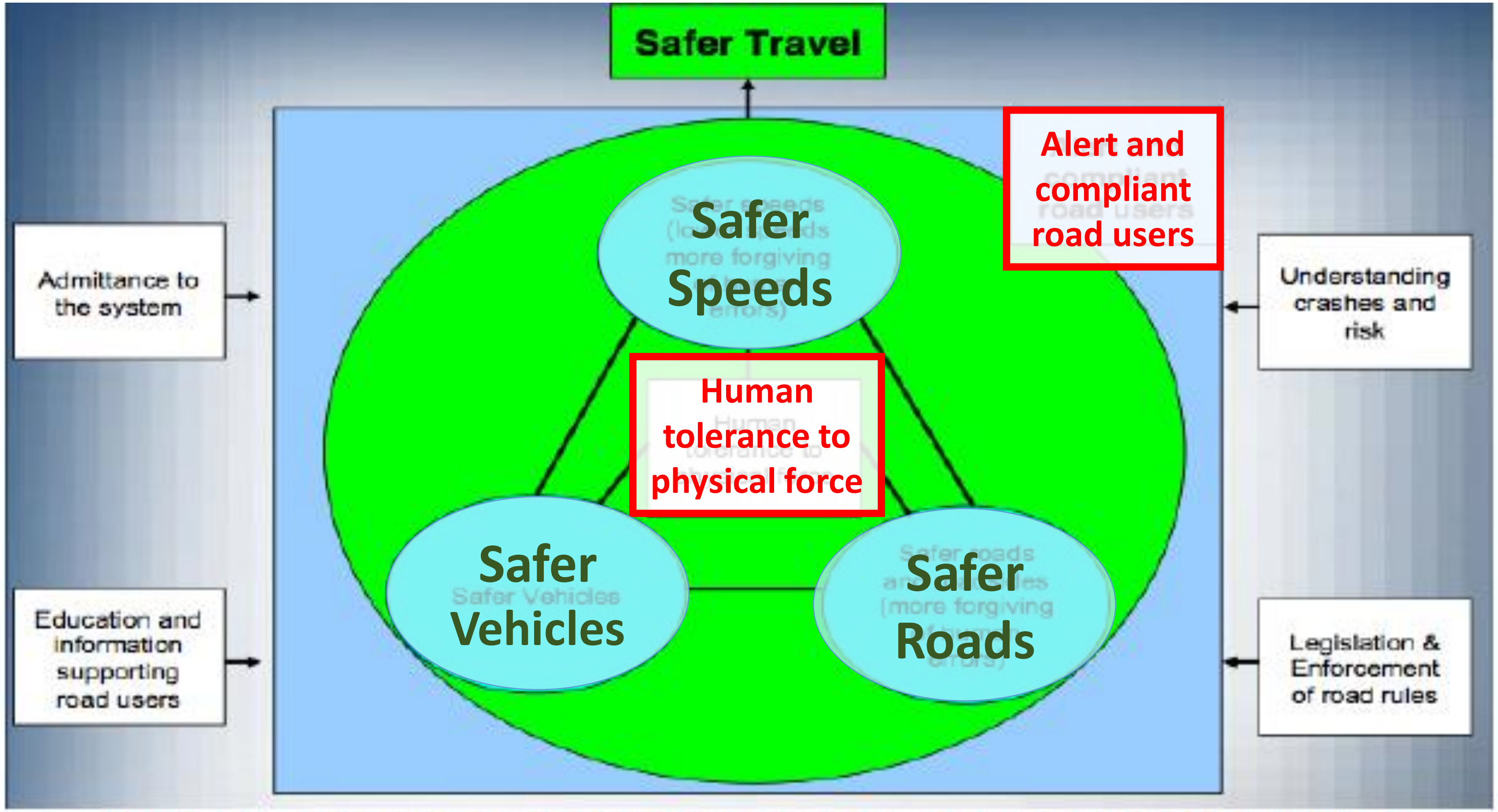

Figure 3 – The Safe System model reproduced from Howard, 2004 [25]

Users make mistakes

Surviving Kinetic Energy

Inequitable safety impact

Grembek, 2012

Injuries in California (2005-2009)		Mode *j* Inflicted an injury								
		Foot	Bicycle	PTW	Car	Transit	SUV	Truck	Object	Total
Mode *i* Suffered an injury	Foot	31	488	327	32,455	631	5,736	531	3	**40,202**
	Bicycle	195	1,551	213	28,657	320	4,833	397	1,655	**37,821**
	PTW	159	106	4,847	21,036	118	4,199	647	8,864	**39,976**
	Car	607	331	2,814	221,444	2,655	76,543	18,323	110,105	**432,822**
	Transit	28	15	10	2,829	578	596	347	474	**4,877**
	SUV	66	46	332	43,543	330	23,403	3,262	19,213	**90,195**
	Truck	2	5	18	2,305	58	578	1,638	1,663	**6,267**
	Object	0	0	0	0	0	0	0	0	**0**
	Total	**1,088**	**2,542**	**8,561**	**352,269**	**4,690**	**115,888**	**25,145**	**141,977**	**652,160**

RV for Individual modes	Foot	Bicycle	PTW	Car	Transit	SUV	Truck	Object
	36.95	**14.88**	**4.67**	**1.23**	**1.04**	**0.78**	**0.25**	**0.00**

Pedestrians suffer **36.95** times more injuries than they inflict.

Users make mistakes

Surviving Kinetic Energy

Speed management as a critical regulator

- Vehicle speed is an important regulating factor for safe road traffic since it is subject to road-user behavior and misjudgment
- Kinetic energy is proportional to the square of its speed, and established the level of protection needed to design of a safe transport system

Types of Speed Limits in CA/US

- Basic Speed Law (CVC 22350) states that a driver may never driver faster than is reasonable or prudent for current conditions.
- Two types of speed limits
  - Statutory speed limit
  - Posted speed limit

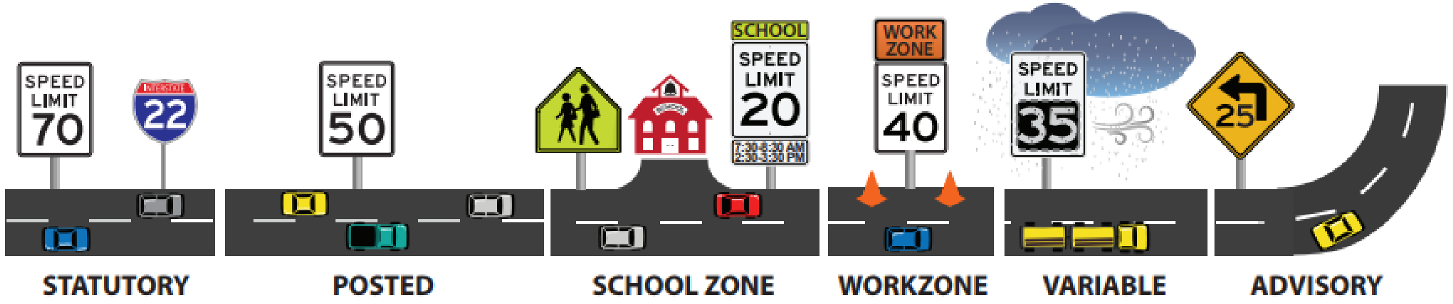

Image from FHWA-SA-16-076

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Statutory and Posted Speed Limits

- Statutory speed limit (maximum speed limit)
  - Set by the State Legislature and enforceable even if speed limit sign is not posted
- Posted speed limit (regulatory speed)
  - Set by a local jurisdiction (city or county)
  - Must have an up-to-date Engineering and Traffic Survey
  - Takes priority over the established statutory speed limit

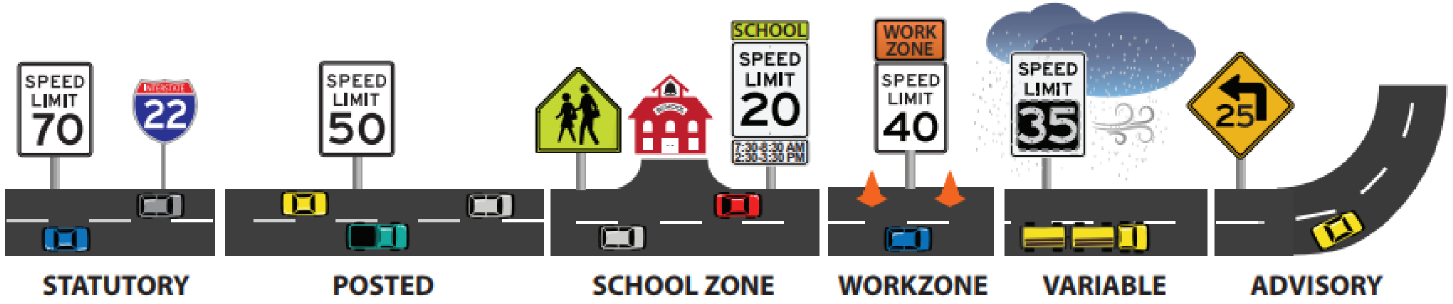

Image from FHWA-SA-16-076

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Posted Speed Limits in the US

- Speed limits are established by computing the 85th percentile speed during free-flow travel.
- This approach was attributed to a 1964 USDOT report labeled “Accidents on Main Rural Highways Related to Speed”. The report’s findings have not been successfully replicated since.
- Another stated rationale is that speed limits below the 85th percentile discourage drivers’ compliance with the posted speed limit.

Research Synthesis for AB 2363 Zero Traffic Fatalities Task Force

- **Evidence about speed and safety (why is this important?)**
- **History of the 85th percentile (where does the current practice came from?)**
- **Limitations of the current speed limit setting practices (why we need to reconsider it?)**
- **What are promising alternatives to set speed limits (how can we do it better?)**

Research Synthesis for AB 2363 Zero Traffic Fatalities Task Force

Evidence about speed and safety (why is this important?)

- There is consistent evidence that as speed increases the probably of fatality given a crash increases too. Supported by the laws of physics.
- There is also strong statistical relationship between average operating speed and crashes. This does not mean that traveling 50 mph on an urban arterial is safer than traveling 70 mph on a highway, but these findings establish that, all else equal, going faster is less safe.
- In light of this, reducing speed limits will most likely create safety benefits.

Research Synthesis for AB 2363 Zero Traffic Fatalities Task Force

History of the 85th percentile (where does the current practice came from?)

- The current practice of setting speed limits to the 85th percentile can be traced back to the late 1930s.
- This was based on the assumption that 85 percent of the drivers are sufficiently careful not to operate their cars too fast for conditions. It was also noted that it must, however, be adjusted in the light of crashes.
- There is no empirical study that demonstrates that the 85th percentile speed optimizes safety.

Research Synthesis for AB 2363 Zero Traffic Fatalities Task Force

Limitations of the current speed limit setting practices (why we need to reconsider it?)

- Drivers have a tendency to underestimate speed. This demonstrates that drivers have limited capability to self-regulate a safe speed, especially at lower speed areas. It is therefore undesirable to rely on operating speed to establish safe speed. Moreover, over time, the practice of the 85th percentile can create an upward drift in operating speeds
- *e.g., assume that collectively drivers elect speeds such that about half of them drive faster than the speed limit. This behavior, if coupled with a periodical application of the 85th percentile rule, would cause an upward drift in speeds*.

Evolution of Speed

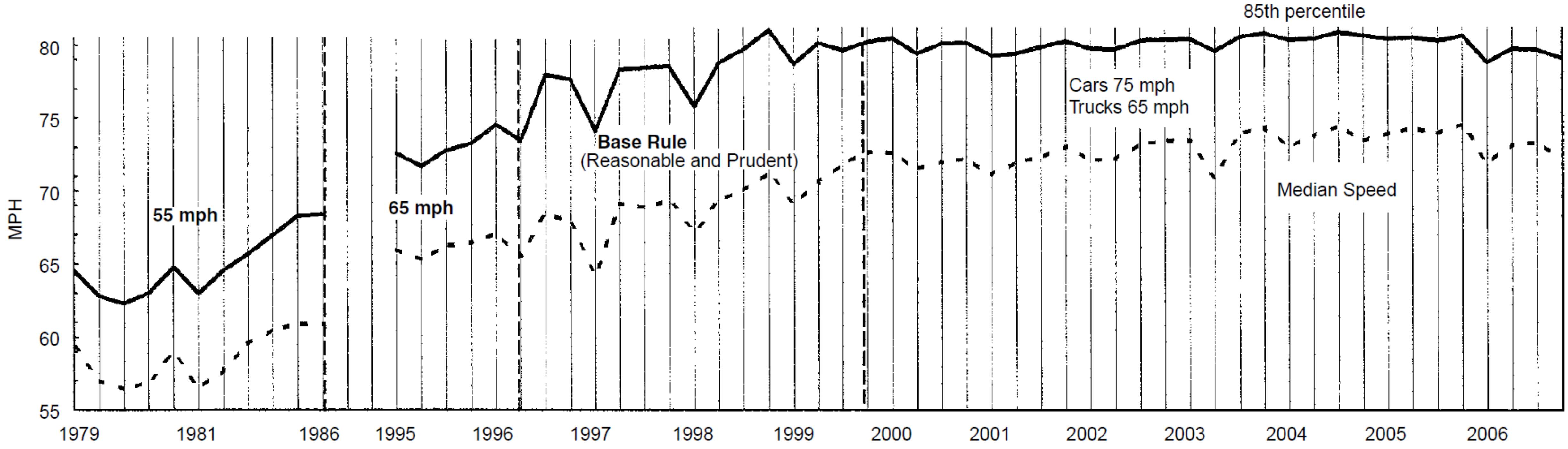

FIGURE 1 Median and 85th percentile speeds on rural Interstates in Montana. (Source: R. Retting of the Insurance Institute for Highway Safety.)

Hauer, E. (2009). Speed and Safety. Transportation Research Record, 2103(1), 10–17.

Practitioner Survey

National Committee on
Uniform Traffic Control Devices
12615 West Keystone Drive • Sun City West, AZ, 85375
Telephone (623)680-9592 • e-mail: ncutcd@aol.com

- Spring 2018
- 13 questions
- Distributed to numerous transportation professionals
- Number of respondents: 740
- Over 80% use MUTCD regularly
- Average experience: 20 years

Based on slide by Randy McCourt, Chair NCUTCD Task Force on Speed Limit

Factors most utilized in setting speed Limits?

Utilization criteria (top 10 with always utilized)	Overall Rank	10 years or less (rank)	11-20 years (rank)	Over 20 years (rank)
Speed of vehicles	**1**	4	1	2
Crash history	**2**	2	3	3
Context - location	**3**	1	2	5
Statutory requirements	**4**	9	4	1
Geometrics (curve)	**5**	6	5	4
Facility classification type	**6**	7	10	7
Context - land use	**7**	3	6	10
Geometrics (sight distance)	**8**	--	8	6
Geometrics (lane width, CS)	**9**	10	9	9
% vehicles above PSL / speed distribution curve / % veh in pace	**10**	--	7	8

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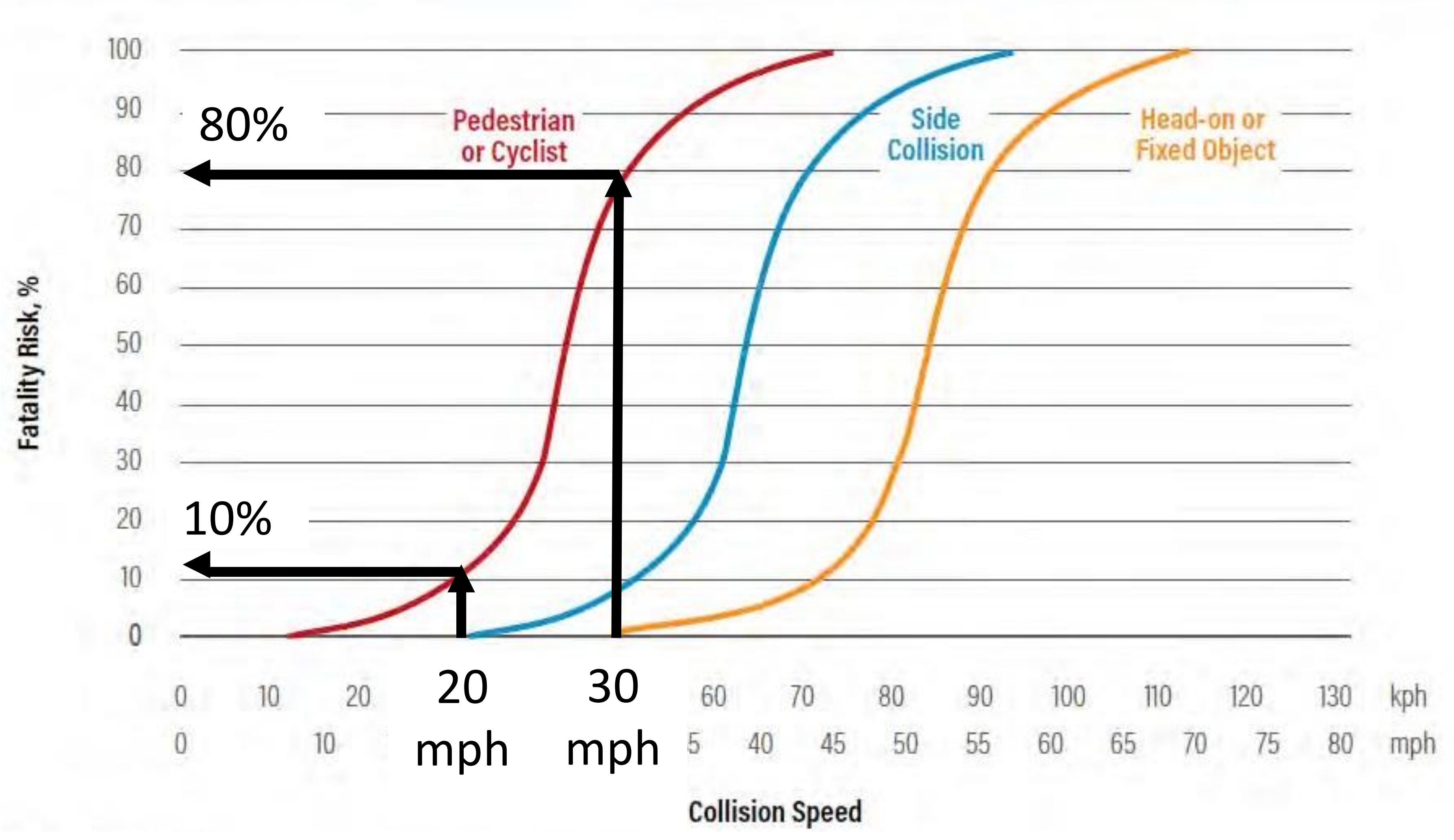
Slide by Randy McCourt, Chair NCUTCD Task Force on Speed Limit

Research Synthesis for AB 2363 Zero Traffic Fatalities Task Force

What are promising alternatives to set speed limits (how can we do it better?)

- Other countries with desirable safety performance set speed limits based on the combination of the built environment including roadway features and geometry, the vehicle fleet, and the potential road users.
- Moreover, some jurisdictions, including domestic ones, are incorporating speed limit setting laws that give cities more flexibility to implement slower speed zones in urban areas.

Fatality risk for collision speed, by crash type



Human tolerance to physical force

Source: Wramborg, P. 2005." A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas." Paper presented at 13th International Conference on Road Safety on Four Continents, Warsaw, Poland, October 5–7.

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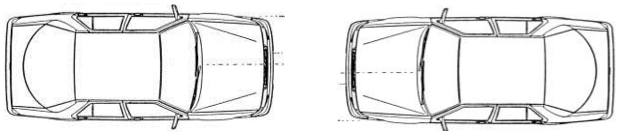
Speed limits for a safe system in Sweden

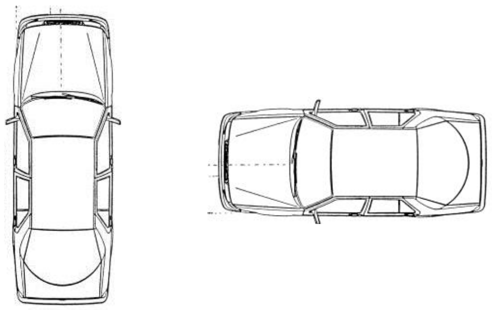
Safer Vehicles

45
mph



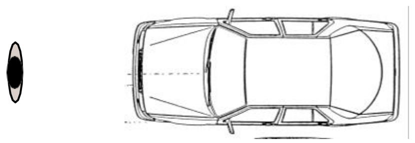
A safe car can protect occupants up to **45 mph** in a head-on collision

30
mph



A safe car can protect occupants up to **30 mph** in a side collision

20
mph



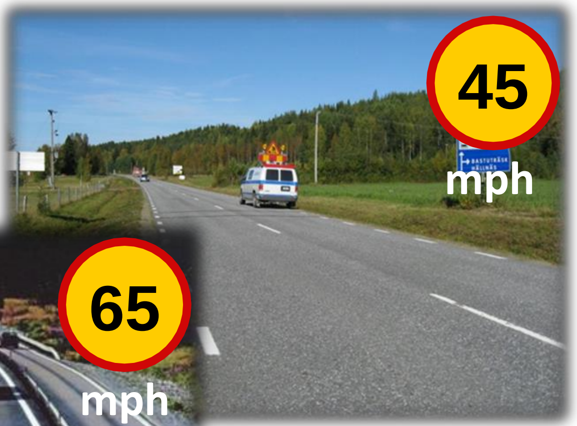
Most unprotected road users survive if a car travelling **20 mph** hits them

Source: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI.
Original Values have been converted from kph to mph and rounded.

Rural speed limits for safe system, Sweden

Safer
Roads

- **45 mph** (70 km/h): default limit on rural roads
- **50 mph** (80-90 km/h): 2-lane roads (milled rumble strips in middle of road)
- **65 mph** (100 km/h): 2+1 roads with median barrier
- **70 mph** (110 km/h): motorways
- **75 mph** (120 km/h): motorways with high standard and low traffic flow



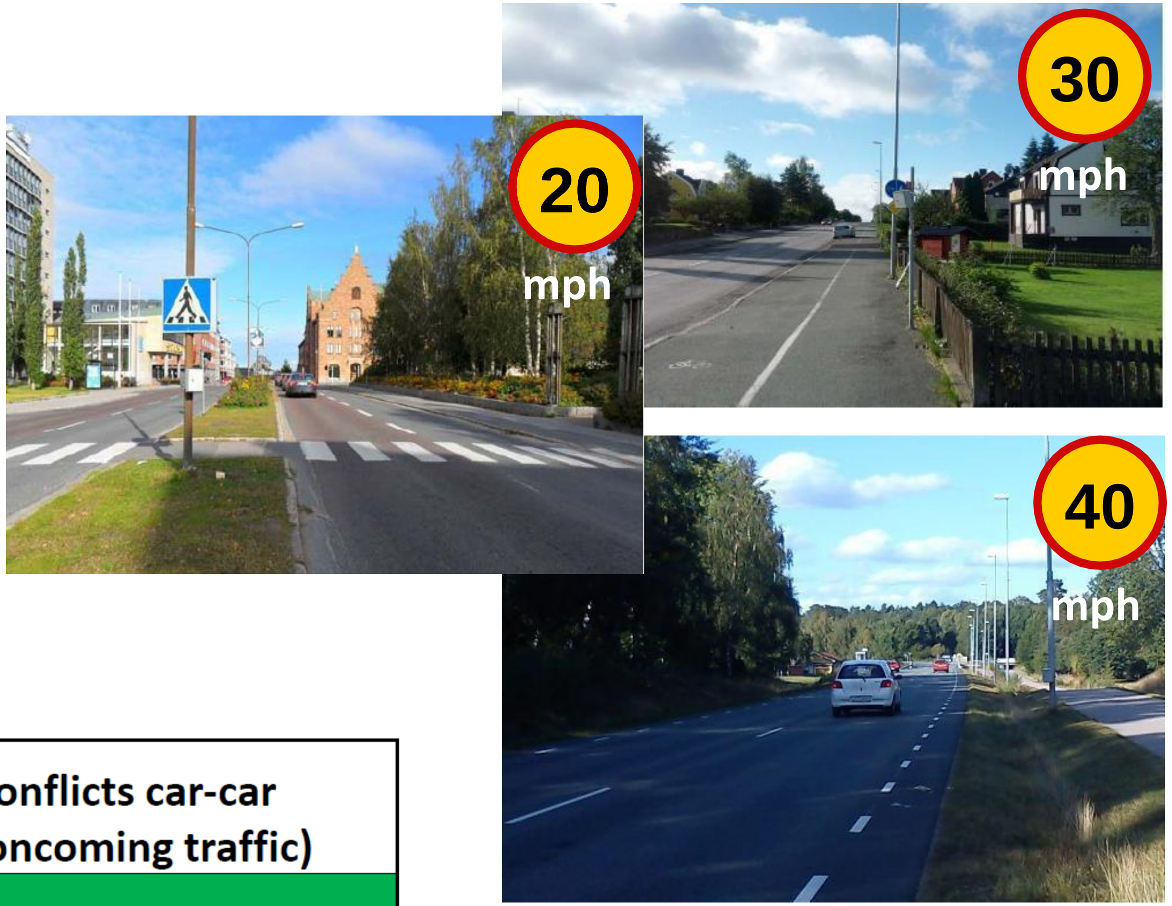
Year	Increased speed limit (km)	Decreased speed limit (km)
2008	1 000	2 500
2009	1 600	15 000

Source: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI Original Values have been converted from kph to mph and rounded.

Urban speed limits for a safe system, Sweden

Guidelines consider:

- City's character
- Accessibility
- Security
- Traffic Safety
- Health and Environment



Safety Level	Conflicts VRU-car	Conflicts car-car (intersections)	Conflicts car-obstacle	Conflicts car-car (oncoming traffic)
High	≤ 20 mph	≤ 30 mph	≤ 40 mph	45 mph

Based on: Vision Zero and New Speed Limits in Sweden, Anna Vadeby, VTI.
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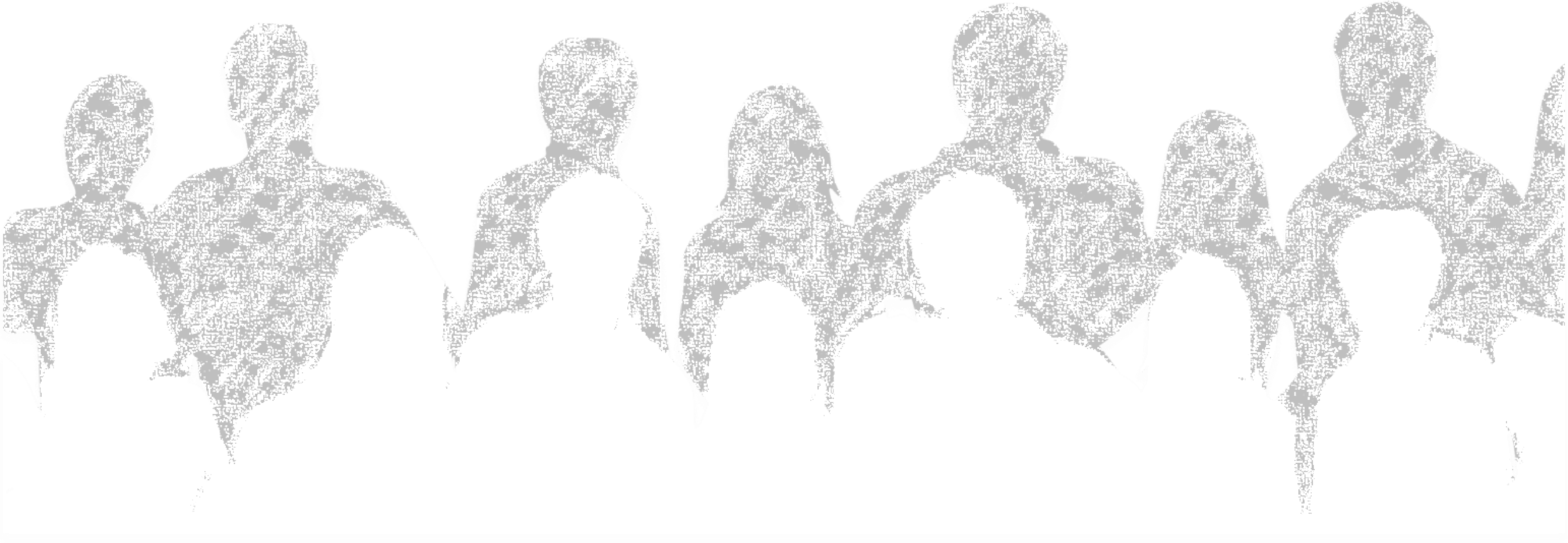

Thank you!

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