TODAY'S VEHICLE TECHNOLOGIES

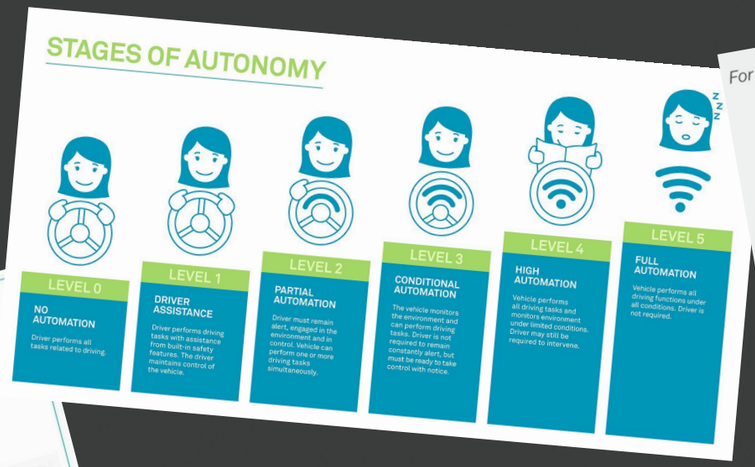
LEVELS OF DRIVING ASSITANCE & AUTOMATION

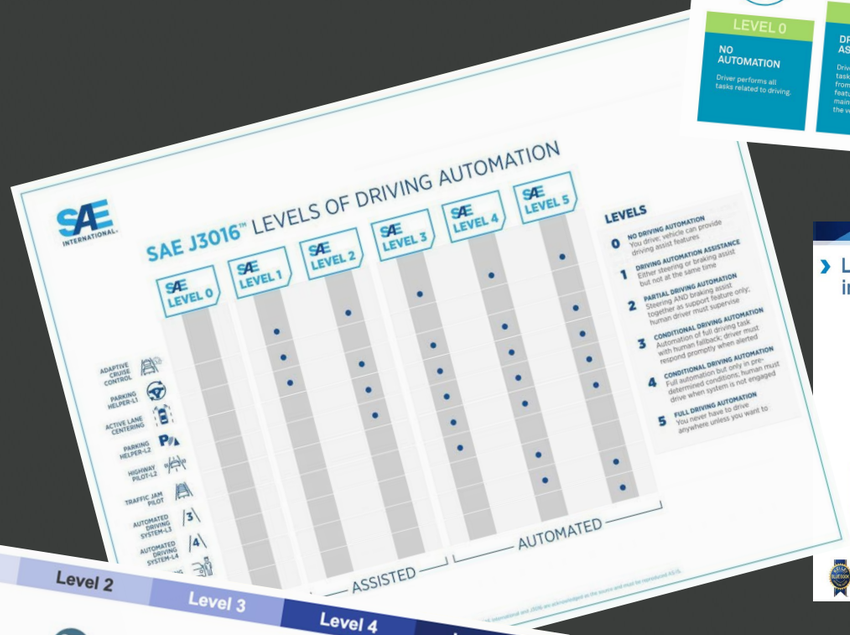
GHSA 2022

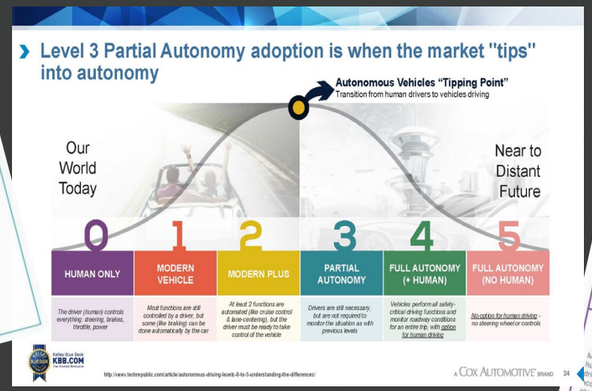
LEVELS OF DRIVING ASSISTANCE & AUTOMATION

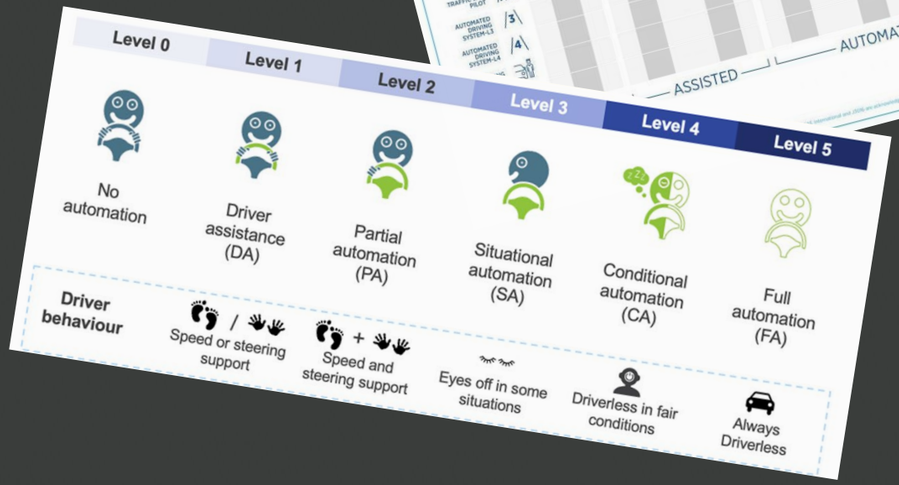
- Have you heard of Level 0 thru Level 5?
- How do you know what “Level” a vehicle is?
- What terms and definitions are used in the industry…
  - Where are we today?

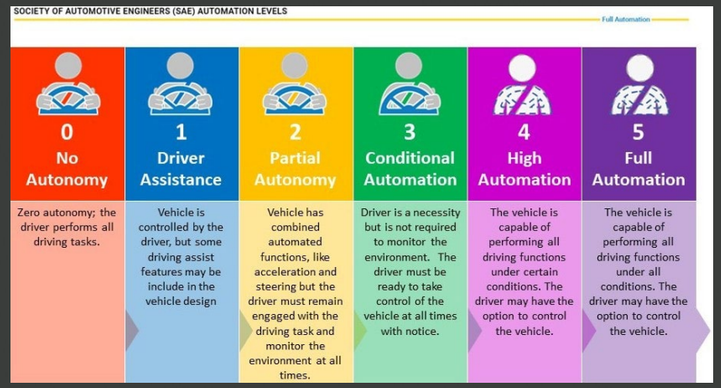
EASY TO GET LOST

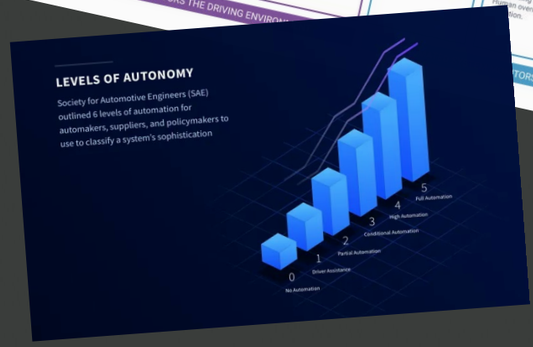




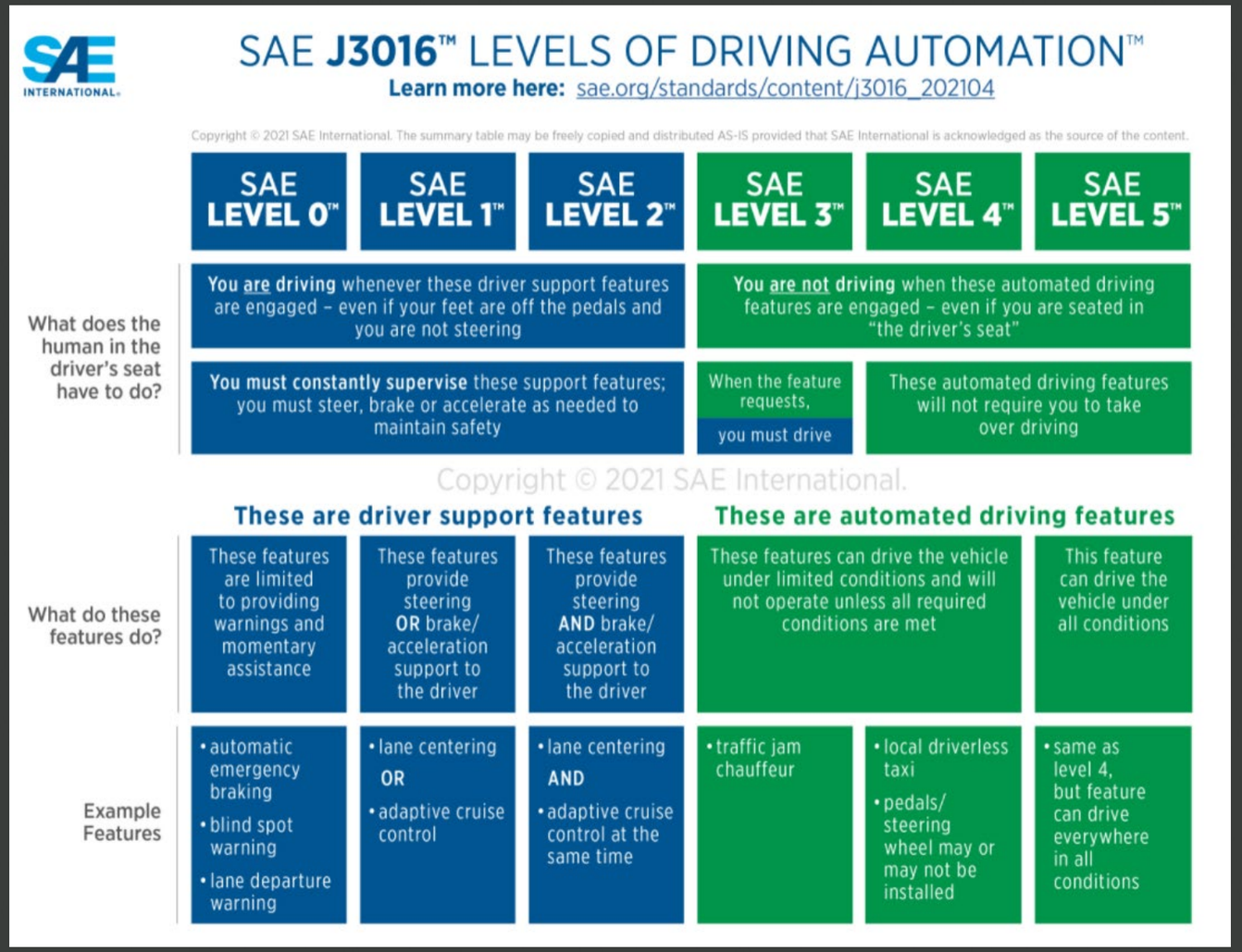








LEVELS OF DRIVING AUTOMATION



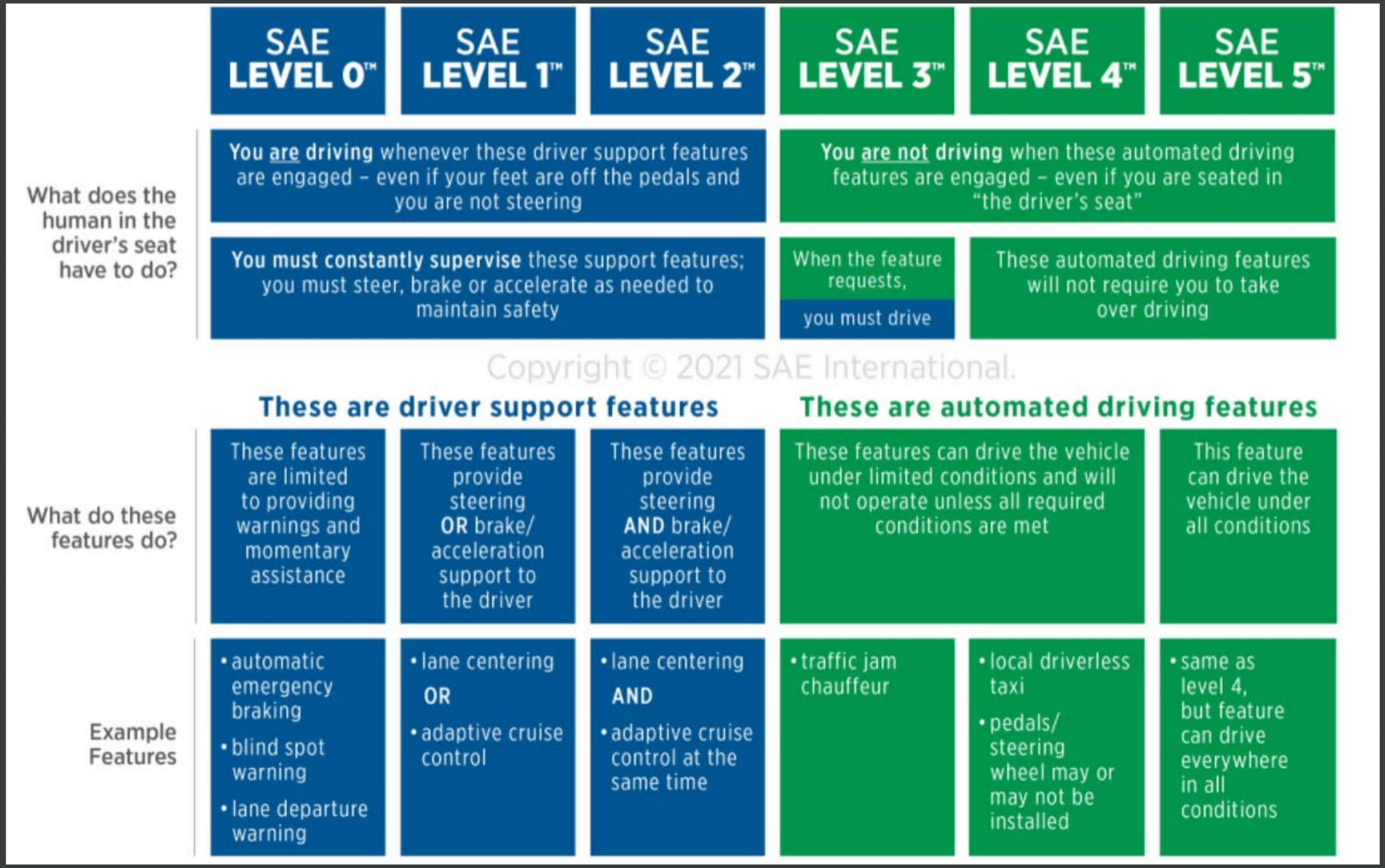
SAE INTERNATIONAL

SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: sae.org/standards/content/j3016_202104

	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	**You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			**These are automated driving features**		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/ acceleration support to the driver	These features provide steering **AND** brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/ steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

https://www.sae.org/blog/sae-j3016-update


SAE LEVEL 0™
SAE LEVEL 1™
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STATE OF THE INDUSTRY

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- How do you know what “Level” a vehicle is?

Level applies to the system, not the vehicle

STATE OF THE INDUSTRY

- What Levels are these systems?

Blind Spot Warning	Automatic Emergency Braking	Pedestrian Automatic Emergency Braking	Lane Departure Warning	Lane Keep Assist	Adaptive Cruise Control	Lane Centering Assistance	Adaptive Cruise & Lane Centering
							
0	0	0	0	0	1	1	2

STATE OF THE INDUSTRY

- Highest SAE Level of Driving Assistance & Automation on the road today (in the US)?

2

COLLISION WARNING	
Blind Spot Warning	Detects vehicles in the blind spot while driving and notifies the driver to their provide an additional warning if the driver activates the turn signal.
Forward Collision Warning	Detects a potential collision with a vehicle ahead and alerts the driver. Some s for pedestrians or other objects.
Lane Departure Warning	Monitors vehicle's position within the driving lane and alerts driver as the vehi lane markers.
Parking Collision Warning	Detects objects close to the vehicle during parking maneuvers and notifies th
Rear Cross Traffic Warning	Detects vehicles approaching from the side at the rear of the vehicle while in driver. Some systems also warn for pedestrians or other objects.

COLLISION INTERVENTION	
Automatic Emergency Braking	Detects potential collisions with a vehicle ahead, provides forward collision w brakes to avoid a collision or lessen the severity of impact. Some systems also other objects.
Automatic Emergency Steering	Detects potential collisions with a vehicle ahead and automatically steers to a of impact. Some systems also detect pedestrians or other objects.
Lane Keeping Assistance	Provides steering support to assist the driver in keeping the vehicle in the lan when the vehicle approaches or crosses a lane line or road edge.
Reverse Automatic Emergency Braking	Detects potential collisions while in reverse gear and automatically brakes to of impact. Some systems also detect pedestrians or other objects.

DRIVING CONTROL ASSISTANCE	
Adaptive Cruise Control	Cruise control that also assists with acceleration and/or braking to maintain a vehicle in front. Some systems can come to a stop and continue while others
Lane Centering Assistance[NEW]	Provides steering support to assist the driver in continuously maintaining the center of the lane.
Active Driving Assistance[1]	Simultaneous use of **Lane Centering Assistance** and **Adaptive Cruise Control** constantly supervise this support feature and maintain responsibility for drivi

[1] Classified as Level 2 Driving Automation by SAE J3016

PARKING ASSISTANCE	
Backup Camera	Displays the area behind the vehicle when in reverse gear.
Surround View Camera	Displays the immediate surroundings of some or all sides of the vehicle while stopped or during low speed maneuvers.
Active Parking Assistance	Assists with steering and potentially other functions during parking maneuvers. Driver may be required to accelerate, brake, and/or select gear position. Some systems are capable of parallel and/or perpendicular parking. The driver must constantly supervise this support feature and maintain responsibility for parking.
Remote Parking Assistance[1]	Without the driver being physically present inside the vehicle, provides steering, braking, accelerating and/or gear selection while moving a vehicle into or out of a parking space. The driver must constantly supervise this support feature and maintain responsibility for parking.
Trailer Assistance	Assists the driver with visual guidance while backing towards a trailer or during backing maneuvers with a trailer attached. Some systems may provide additional images while driving or backing with a trailer. Some systems may provide steering assistance during backing maneuvers.

DRIVER MONITORING	
Indirect Driver Monitoring System[NEW]	Observes vehicle states, motions and/or driver performance indicators to estimate driver distraction, inattention, or misuse. This may include monitoring steering wheel input, vehicle sway within the lane, or a combination of other factors monitored by the vehicle systems. Some systems may provide a warning to the driver and/or limit the use of other features.
Direct Driver Monitoring System[NEW]	Detects the driver's eye and/or head movement to estimate where the driver is looking. Some systems may provide a warning to the driver and/or limit the use of other features.
Driver Re-engagement System[NEW]	A series of escalating warnings and interventions attempting to engage an unresponsive driver. If the driver does not respond, the system brings the vehicle to a full stop while maintaining steering control. Some systems may steer the vehicle to the side of the road and/or make an emergency call if the driver fails to respond.

OTHER DRIVER ASSISTANCE SYSTEMS	
Automatic High Beams	Switches between high and low beam headlamps automatically based on lighting and traffic.
Head-Up Display	Projects information relevant to driving into the driver's forward line of sight.
Night Vision	Improves forward visibility at night by projecting enhanced images on instrument cluster or head-up display.

[1] Classified as Level 2 Driving Automation by SAE J3016

Last Modified 07/25/22

Consumer Reports, 2022
https://article.images.consumerreports.org/image/upload/v1658777041/prod/content/dam/CRO-Images-2022/Cars/07July/Clearing-the-Confusion-7-26-22.pdf

STATE OF THE INDUSTRY

- How prevalent are these systems on today's vehicles?

  The following slides are from the NHTSA Partnership for Analytics in Traffic Safety (PARTS) Initiative.

  Market Penetration Rates for 2015-2020 MY vehicles in the study set, approximately 47 million vehicles.

https://www.nhtsa.gov/parts-partnership-for-analytics-research-in-traffic-safety

ADAS Market Penetration Rates
for Features Examined in PARTS Study

Penetration rates are reported for the following ADAS features

Blind Spot Warning (BSW)

Automatic Emergency Braking (AEB)

Pedestrian Automatic Emergency Braking (PAEB)

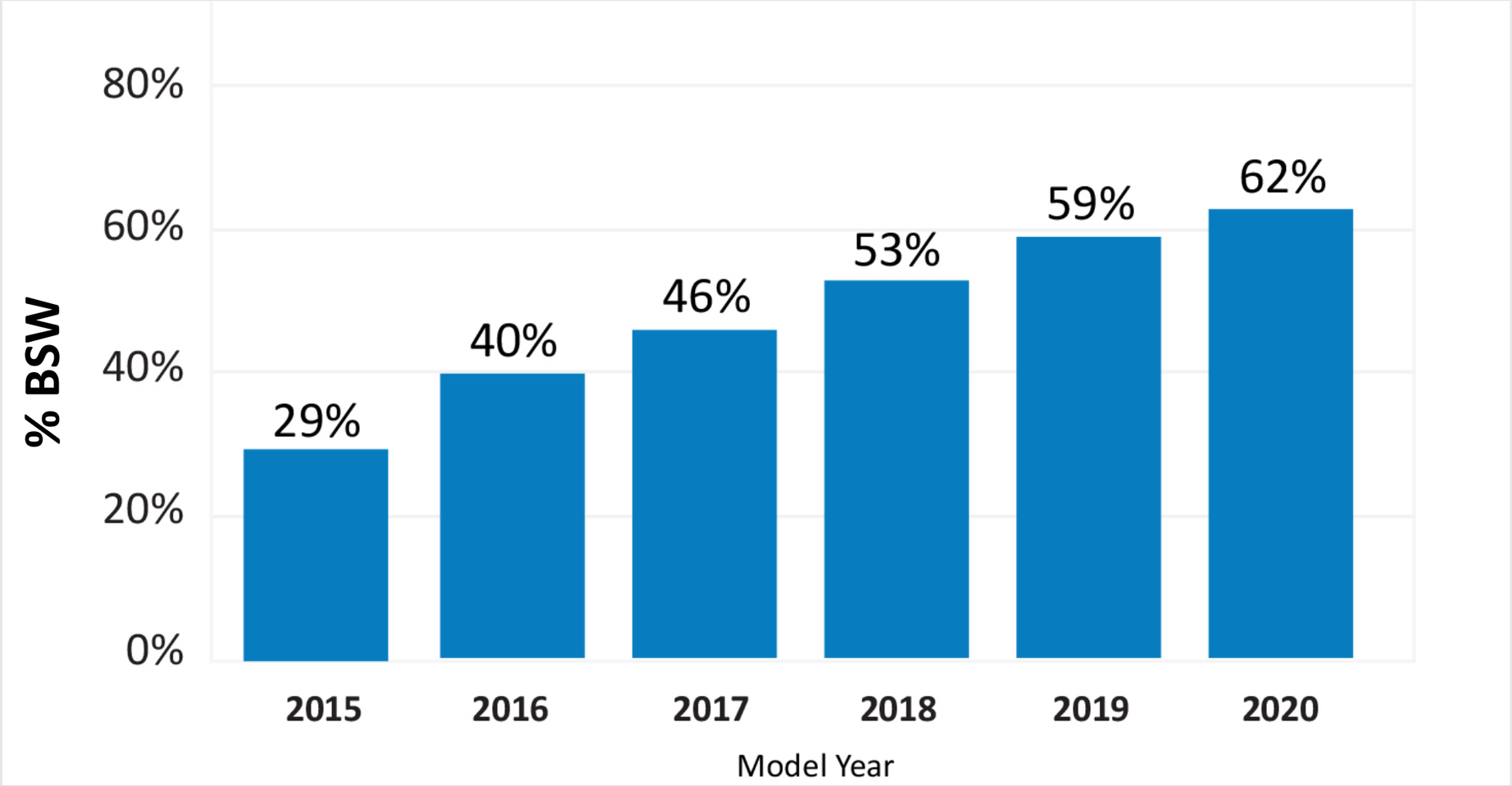
Lane Departure Warning (LDW)

Lane Keeping Assistance (LKA)

Note: Full document available at NHTSA.gov/PARTS

Blind Spot Warning (BSW)

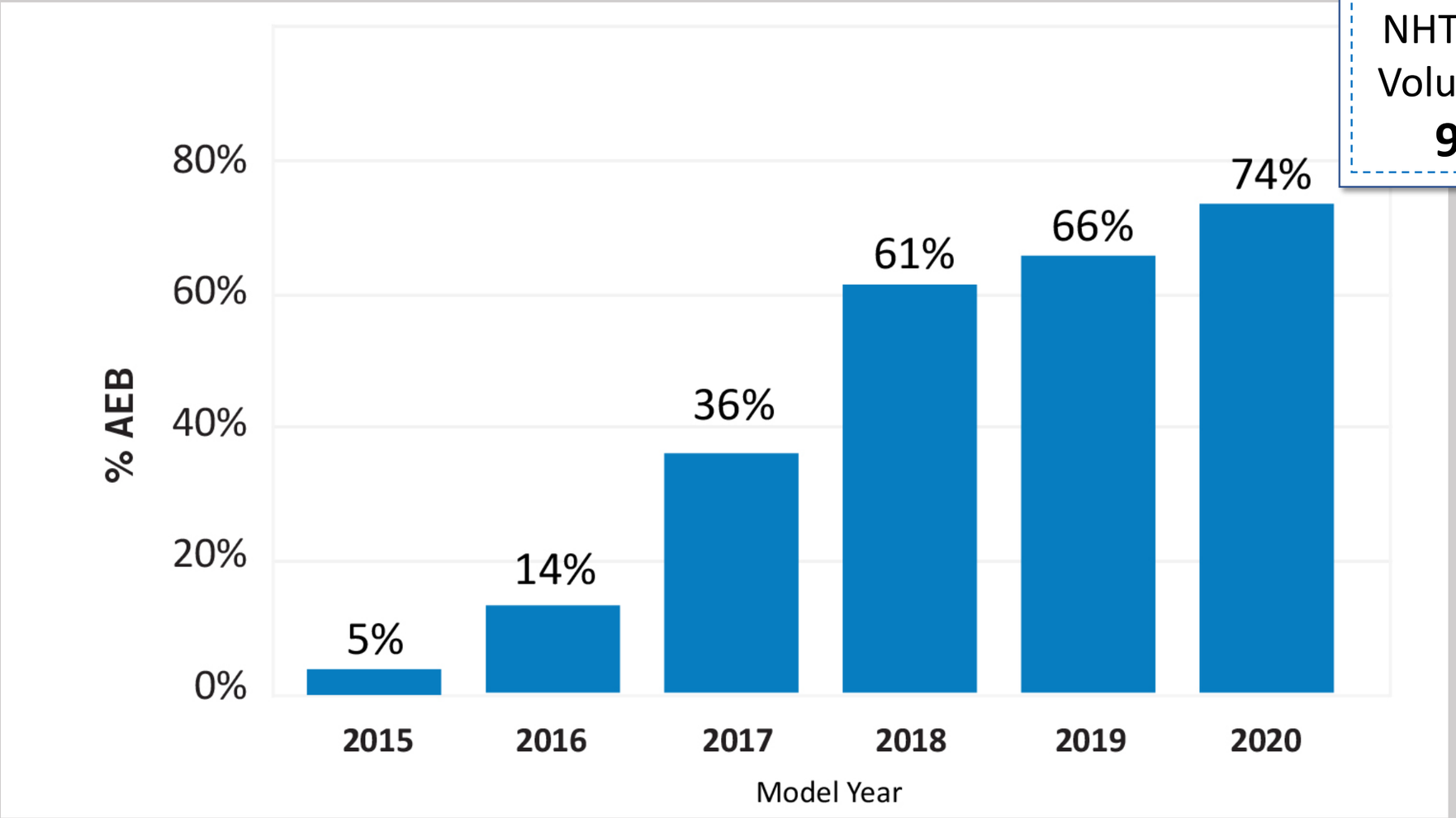
BSW penetration increased from 29% to 62% over 6 years for vehicles in the PARTS study set



Note: *Rates represent a partial view of the U.S. automobile market, both in terms of manufacturers and models. Vehicles in the PARTS study may not be representative of the entire market.*

Automatic Emergency Braking (AEB)

AEB penetration increased from 5% to 74% over 6 years for vehicles in the PARTS study set



NHTSA/IIHS/Industry Voluntary Agreement
95% by 2022

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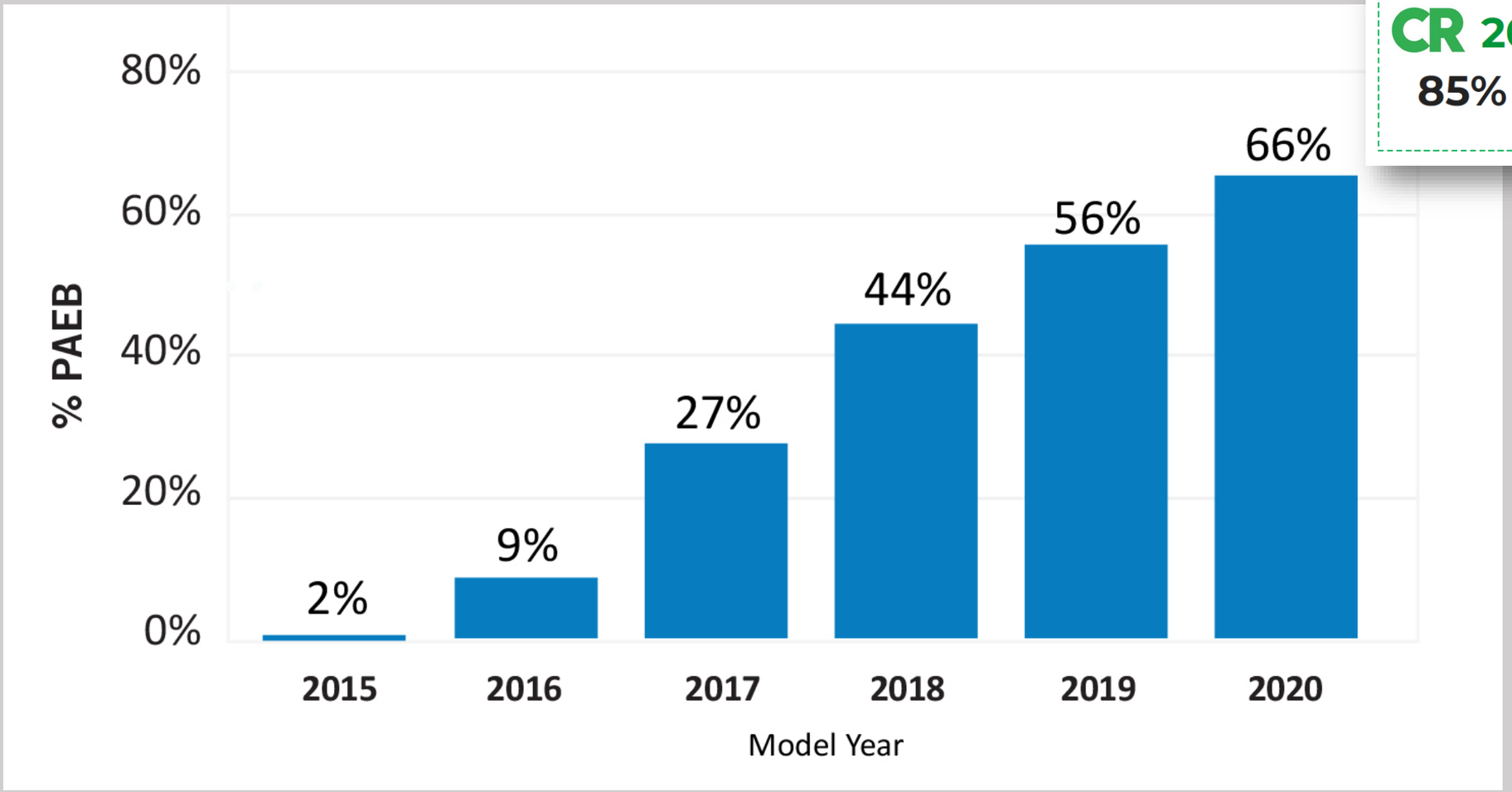
Pedestrian Automatic Emergency Braking (PAEB)

PAEB penetration increased from 2% to 66% over 6 years for vehicles in the PARTS study set



CR 2022
85% of models

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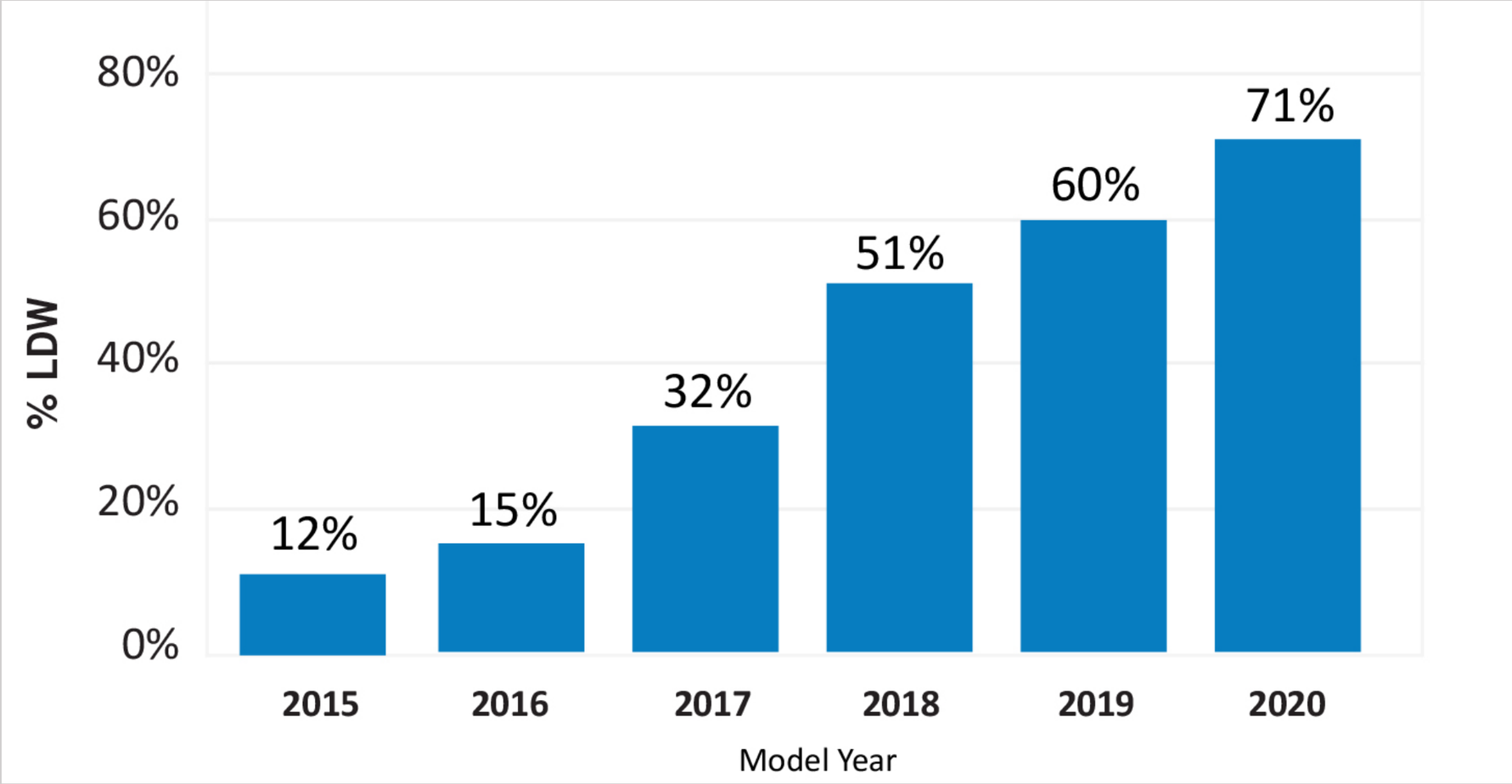
Lane Departure Warning (LDW)

LDW penetration increased from 12% to 71% over 6 years for vehicles in the PARTS study set



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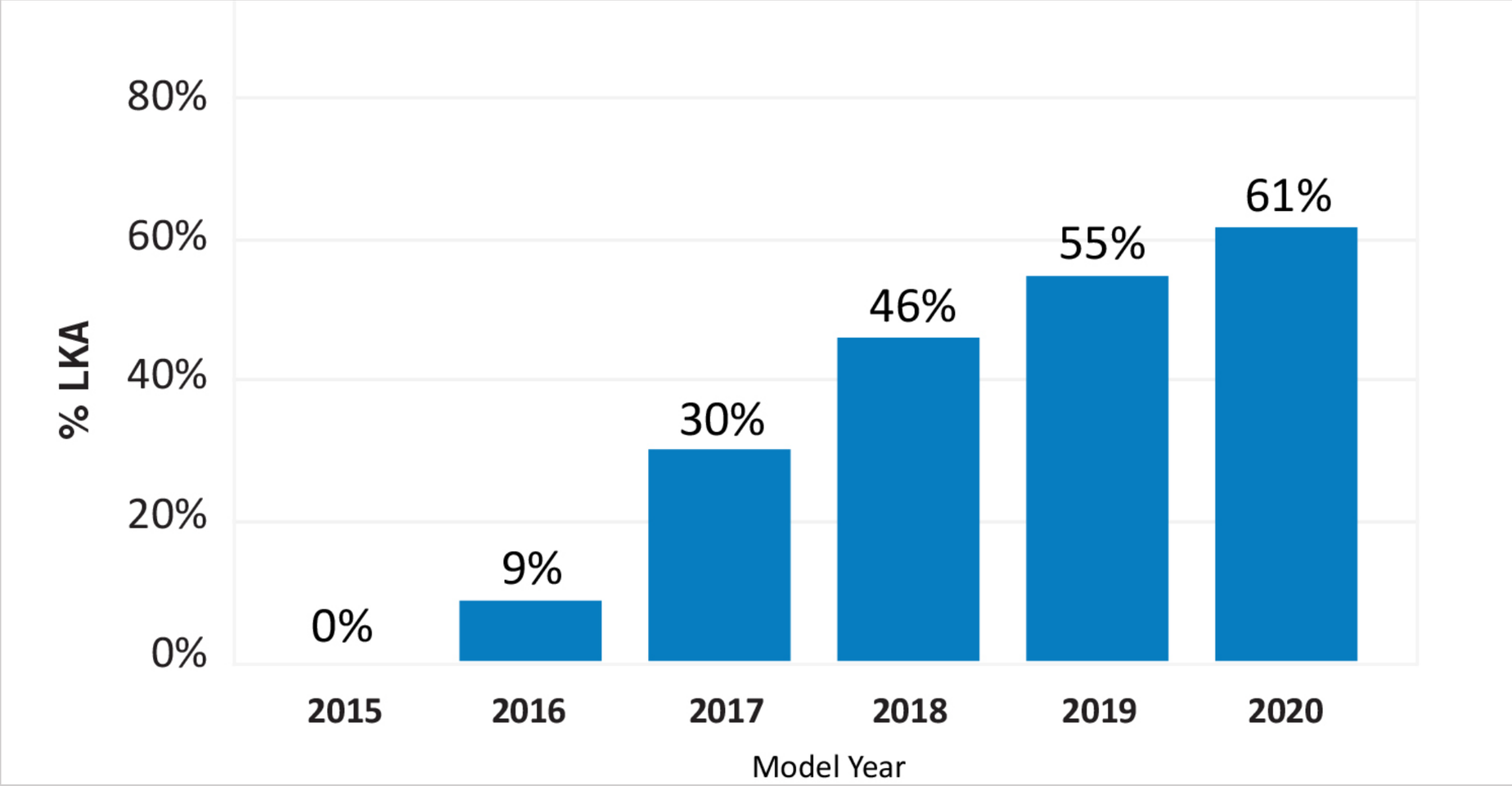
Lane Keeping Assistance (LKA)

LKA penetration increased from <1% to 61% over 6 years for vehicles in the PARTS study set



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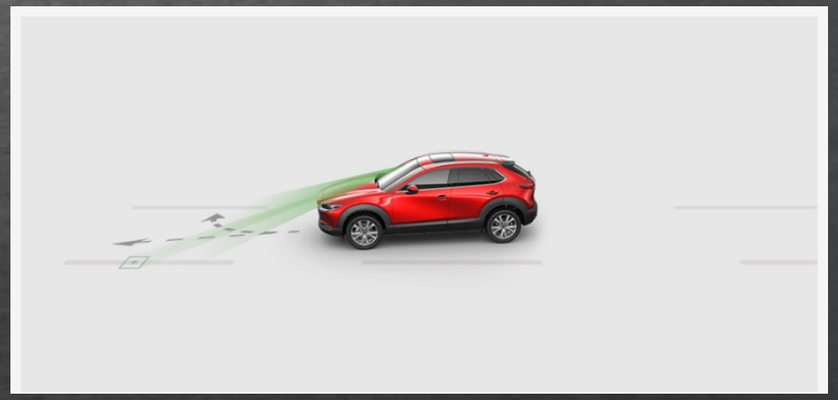
MAZDA'S HUMAN-CENTRIC DESIGN PHILOSOPHY

MAZDA'S DRIVER ASSITANCE TECHNOLOGIES

i-ACTIVSENSE®

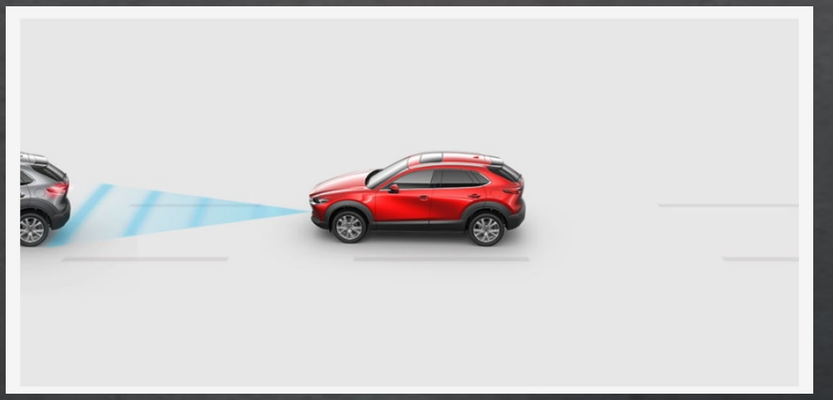
SMART BRAKE SUPPORT

Smart Brake Support helps detect vehicles (above 2 mph), pedestrians and bicyclists (6 - 50 mph) in your path. If an impact is predicted, the system will warn the driver and, if necessary, apply the brakes.



LANE-KEEP ASSIST

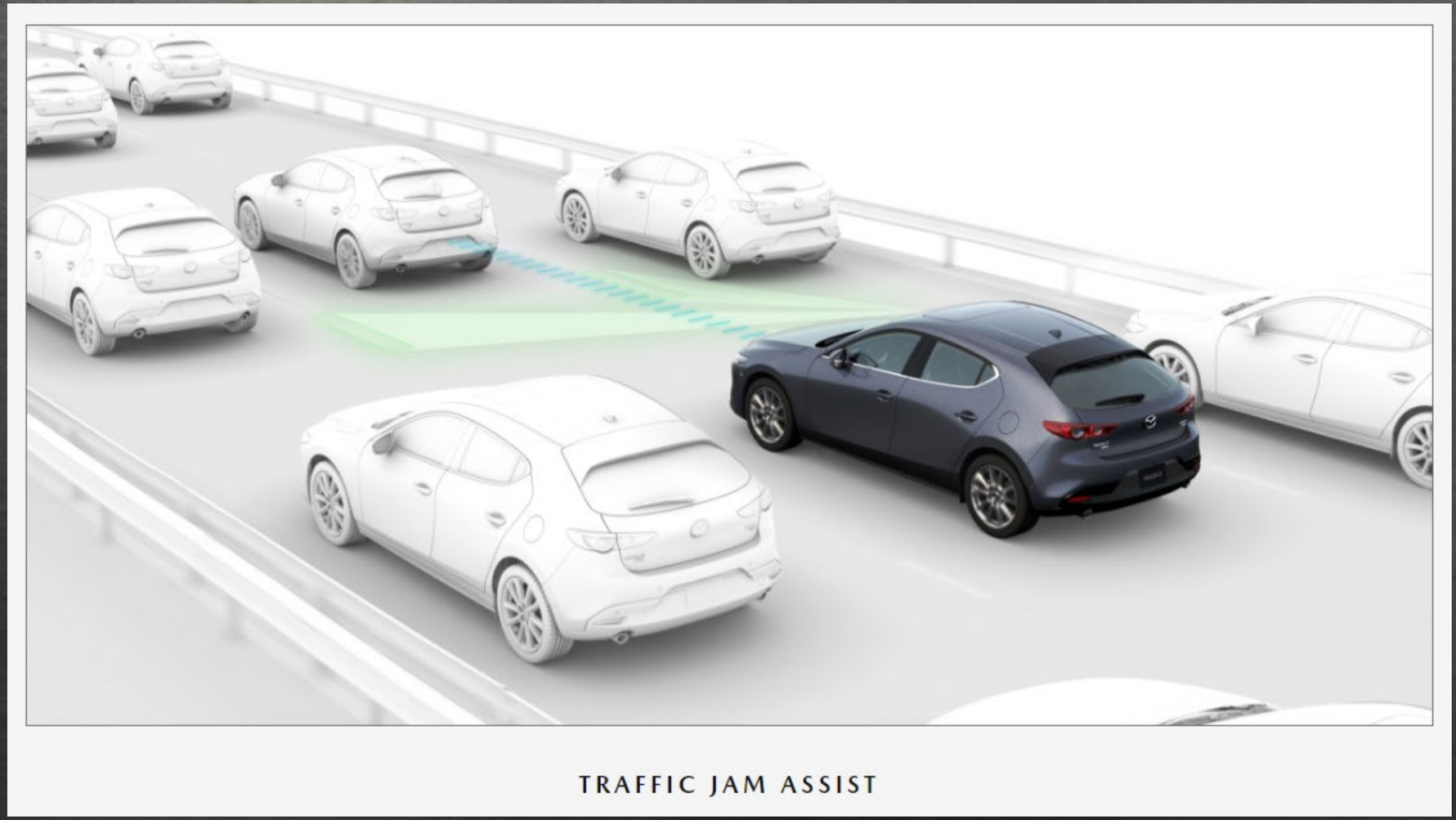
Lane-keep Assist adds to the warnings of the Lane Departure Warning System. When it senses a potential unintentional lane departure at speeds of 40 mph or higher, it will perform minor steering corrections to help prevent your vehicle from exiting the lane.



MAZDA RADAR CRUISE CONTROL WITH STOP & GO

Mazda Radar Cruise Control with Stop & Go maintains a set speed and minimum following distance from the traffic ahead. If the vehicle you're following reduces speed, even down to a stop, your vehicle will automatically slow or stop as needed.

MAZDA'S DRIVER ASSITANCE TECHNOLOGIES



TRAFFIC JAM ASSIST

Enhances cruise control functionality with low-speed lane centering up to about 40 mph.

THANK YOU

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