# Volvo Vision 2020

Anders Eugensson, Director Governmental Affairs
Volvo Car Corporation

# We all know the picture:

- 1.2 million deaths annually worldwide
- Disables 50 million people annually
- Exceedance of pollution levels for ambient air quality standards
- Increasingly high $CO_2$ emissions
- Congestion problems

- *Transportation is the backbone of modern society*

# *Our Heritage*

"Cars are driven by people.

The guiding principle behind everything we make at Volvo, therefore, is and must remain - safety."

*Assar Gabrielsson & Gustaf Larson,*
*the founders of Volvo*


Our Vision is that no one is killed or injured in a Volvo by 2020
Our Future

# Vision 2020

- Can it be done?
- How?
- What will be necessary?
- What will be the obstacles?
- What will help to make this happen?

# Volvo Vision 2020

Our Vision is that no one is killed or injured in a Volvo in the year 2020

***2020/ The Challenges of the vision***

•Only 11 years of development left
•Two vehicle generations
•We are facing a step learning curve in the development of preventative safety systems
•Further development still needed for protective safety
•Is it possible to find solutions in time?
•Will our technical knowledge be enough?

*•We cannot solve this on our own -> co-operations necessary!*

# Volvo Vision 2020/  Need for interpretations

What do we mean by no deaths or injuries?

For what accidents?

For what categories?

What are the boundary conditions?

What will be the likely development of the environment surrounding the vehicles?

- Replacement/ development of the vehicle fleet
- Changes in the infrastructure
- Developments of the legal requirements
- Driver behaviours

Differences depending on markets

# Volvo Vision 2020/ What is necessary?

Establish strategies/ approaches

A new outlook on the roles of the stakeholders

- Drivers/ vehicles/ infrastructure
- Governments/ industry/ academia/ insurance companies

Increased knowledge through, e.g. research

- Requirements for broader knowledge than before
- Requires research across more disciplines

Co-operations essential

- Agreement on co-operation with SRA

Support from incentives and other drivers necessary in order to create better possibilities for penetration of new technologies.

# Volvo/ Swedish Road Administration – Letter of Intent on Co-operation

Establish interfaces and boundaries for:

- Vehicles and Infrastructure
- Vehicles and legislation
- Vehicles and road safety stakeholders

Identify criteria and levels of quality in order ti improve the functionality – interaction vehicles and infrastructure.

- Basic requirements and expectations on driver performance and driver limitations.
- Basic requirements on the driver's area of responsibility.
- Areas of technology and criteria and support for implementation for the safe use of the technologies.
- The passive level of protection of the road, e.g. protective railings and side areas and the design of intersection in relation to vehicle speeds.
- Generic design of streets and adjacent areas
- The location and design of road markings and street signs.
- Intelligent transfer of data betwee the vehicles and infrastructure.
- Standards for use of roads, e.g road friction.

# Volvo/ Swedish Road Administration – Letter of Intent on Co-operation

Follow-up on results for improvements vehicles/ Infrastructure.

- Learning process

Interchange on data on quality at the interfaces vehicles/ Infrastructure

Together with other stakeholders actively support the goal achieving a safe use of the road transport system.

Contribute to the aim that all driving is done within the boundaries of the system.

Any standards for technologies must support:

- Sober driving
- Driving within the legal framework

Any requirements on driver performance must be well ommunicated and understood.

Issue of anual status report stating achievements within the co-operation.

Co-operation necessary also with other manufacturers/ manufacturers of heavy vehicles.

Creation of a governing group and a set of working groups linked to the interst areas..

# Vision 2020 will require …

- Shared responsibilities of all road safety stakeholders.
- Substantially increased knowledge through research
- Co-operations industry – governments – academia
- Support by offers, e.g tax incentives, insurance premium discounts and consumer information in order to have rapid penetration of new advanced safety systems.

# Modern View on the Role of Car Companies

- Brand image more important
- More focus on corporate social responsibilities (CSR)
- Prepared for open public statements
- Market willingness for safety

**Car companies are now willing to take a larger responsibility**

# To Reach the Visions we need -

**Co-operation between different stakeholders:**

- Vehicle manufacturers
- Governments/ authorities
- Standardization organizations
- Interest organizations
- Researchers

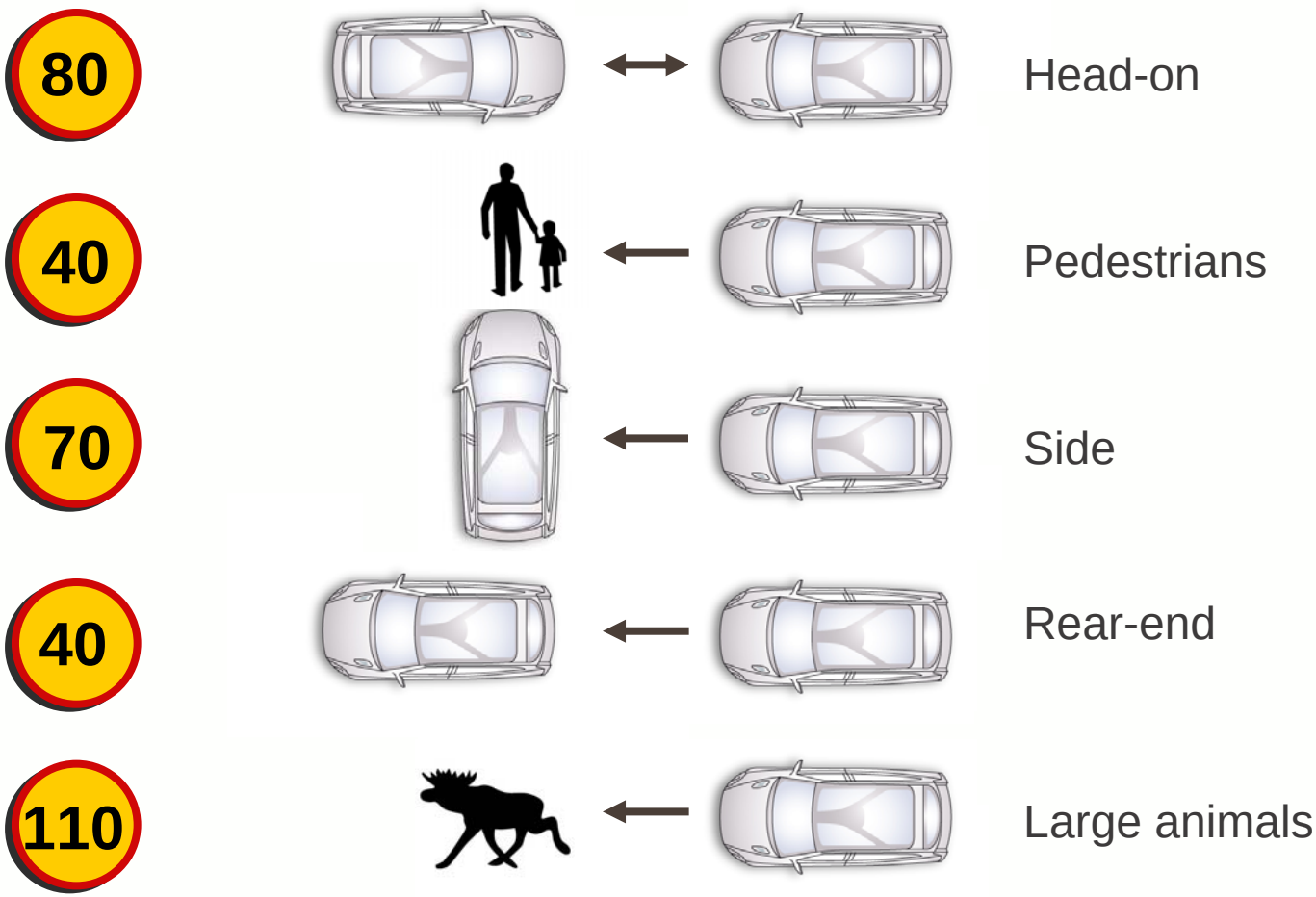
# Co-operation Between Different Stakeholders:

- Shared view on the strategies forward
- Agreements on division of responsibilities
- Shared view on interfaces between car safety systems and infrastructure
- Data sharing
- Standards for interfaces and communication systems

# Division of Responsibilities

**Car manufacturers, governments and local authorities need a common view on the division of responsibilities.**

# Division of Responsibilities/ Boundary Conditions



# Division of Responsibilities/ Boundary Conditions

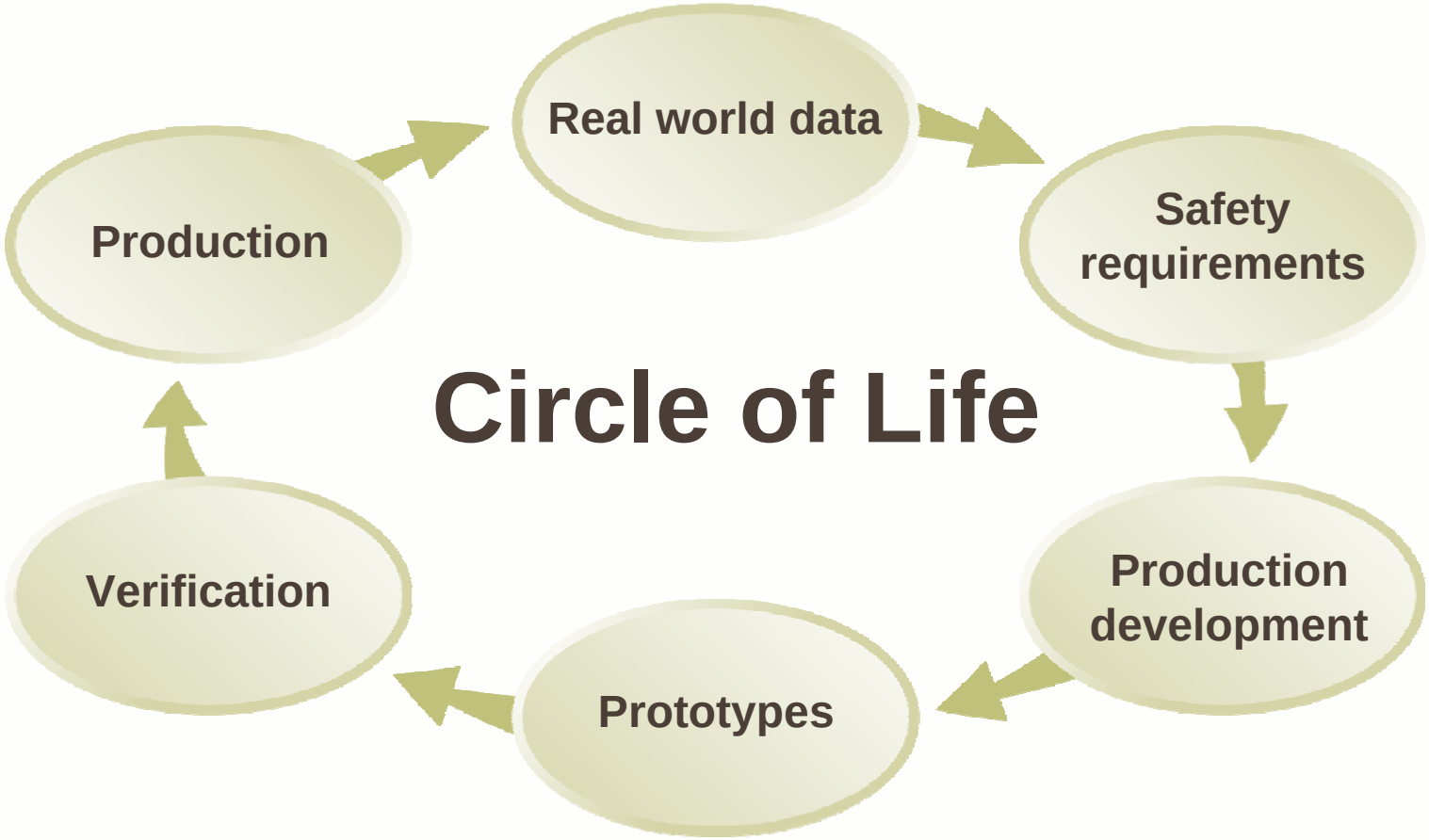
Example: traffic separation for avoiding head-on collisions > 80 km/h

**<80 km/h**

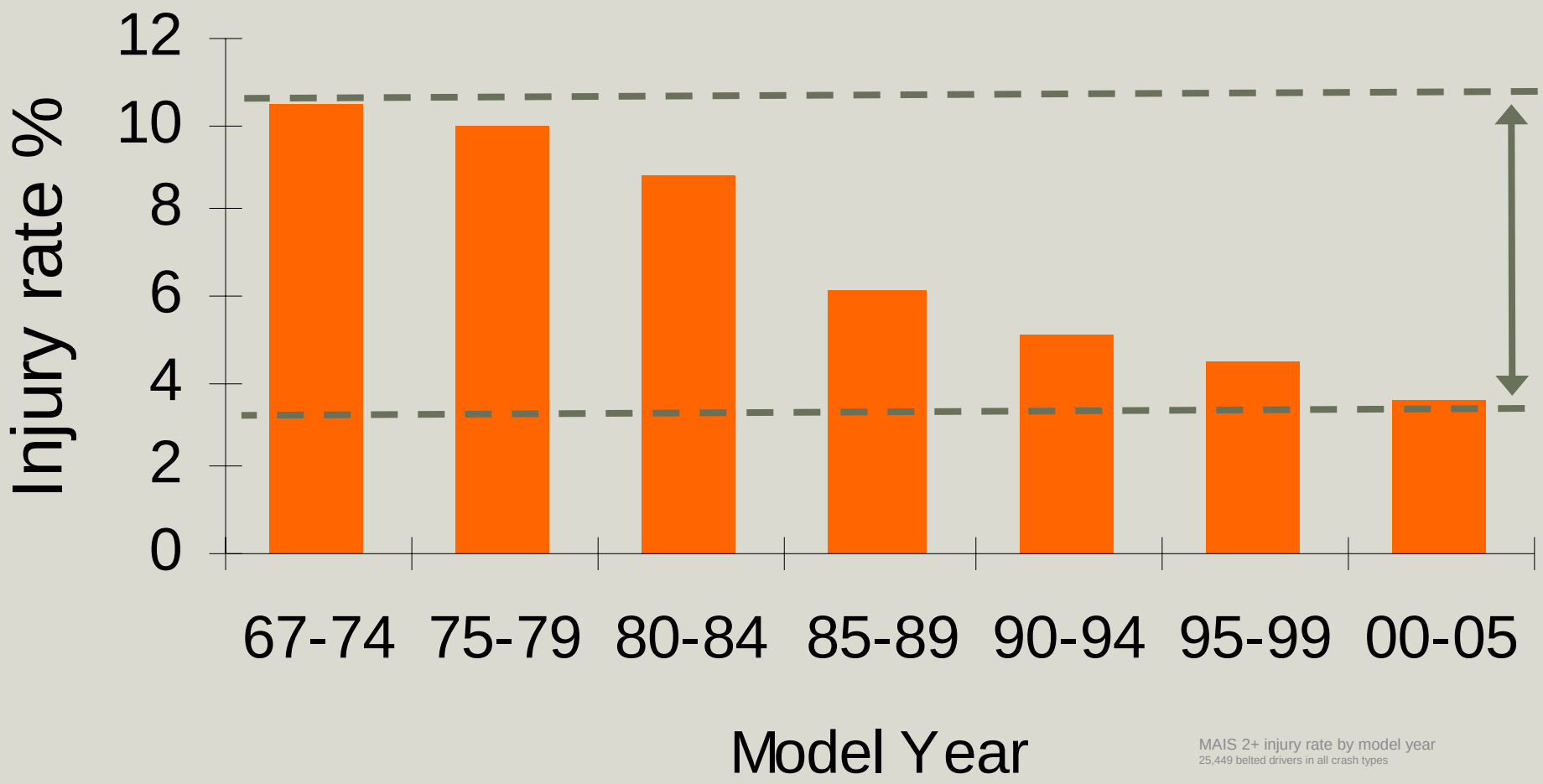
**+80 km/h**

# Our brand pyramid

# The Base – An In-Depth Knowledge of Real-World Safety



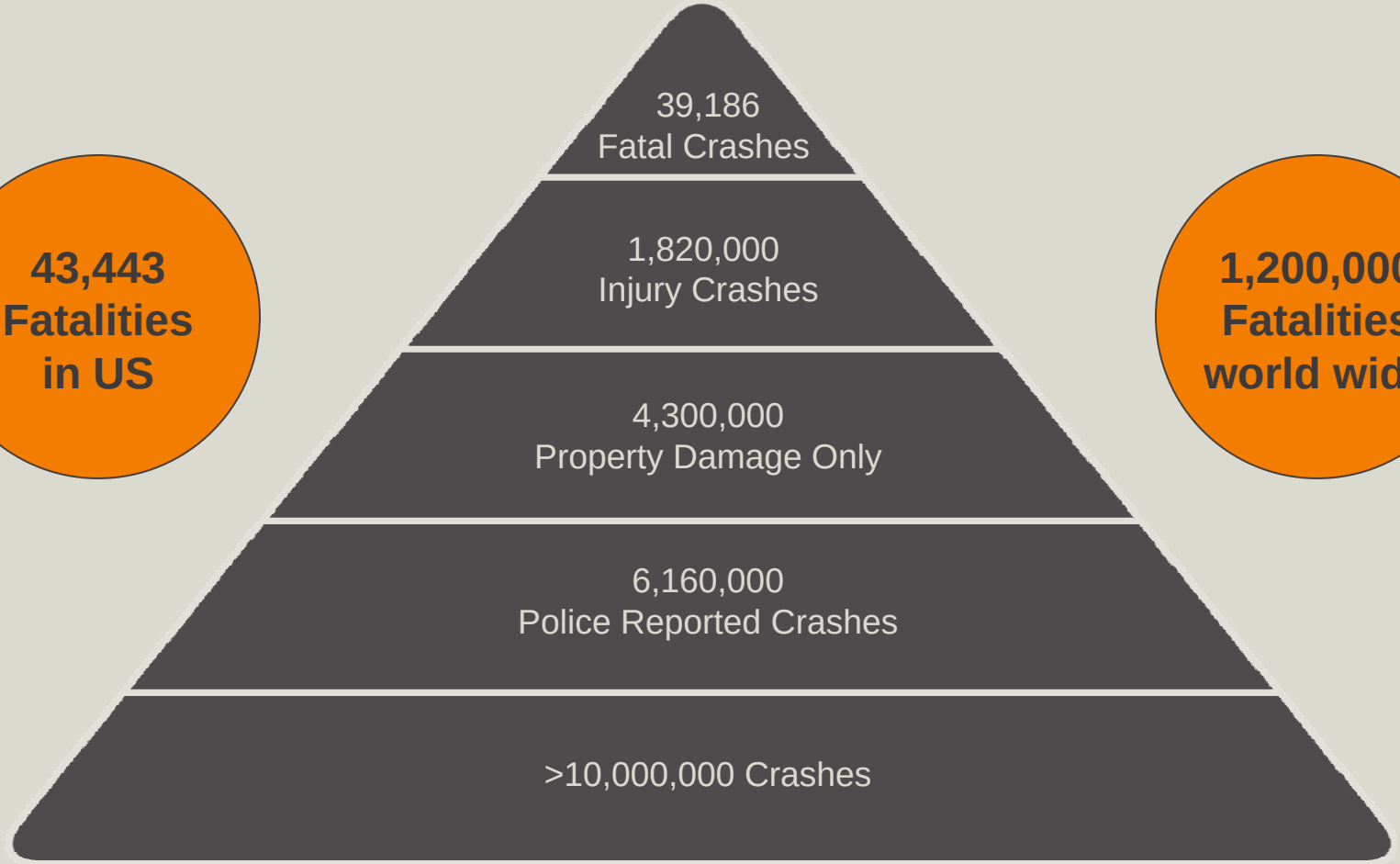
# Knowledge-driven performance




MAIS 2+ injury rate by model year
25,449 belted drivers in all crash types

# Crash distribution

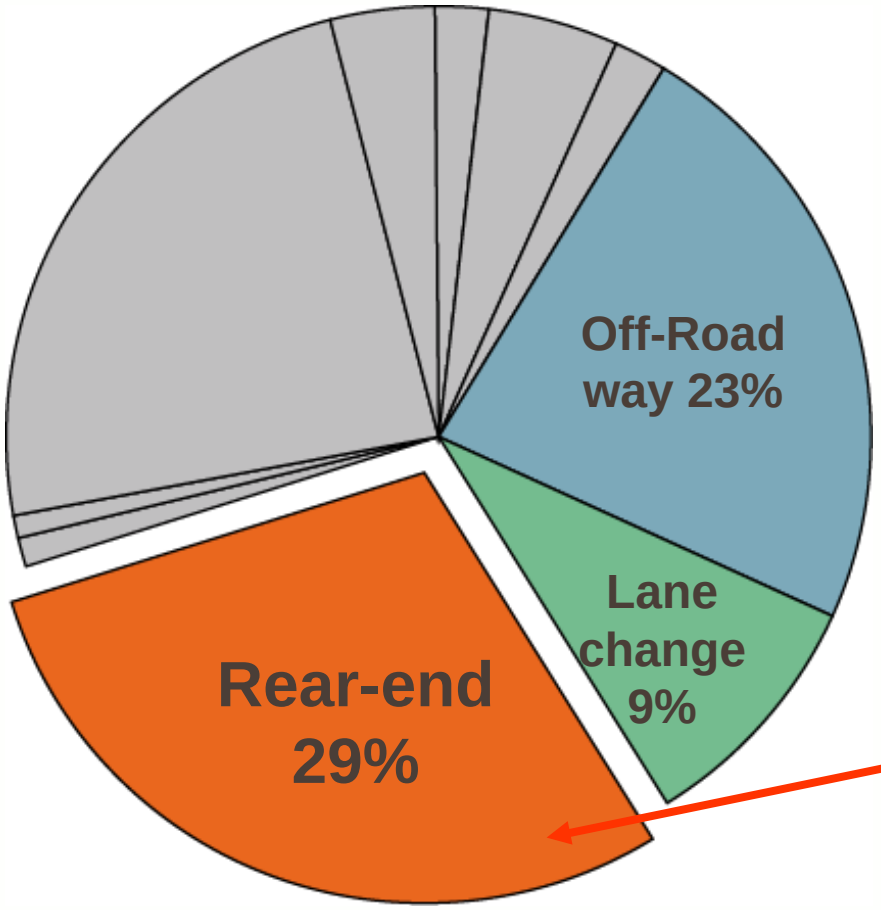
**43,443 Fatalities in US**




**1,200,000 Fatalities world wide**

Sources: NHTSA, NCSA 2005, WHO

# Protective to Preventive Safety
# Driving Scenarios: Rear–end Collisions

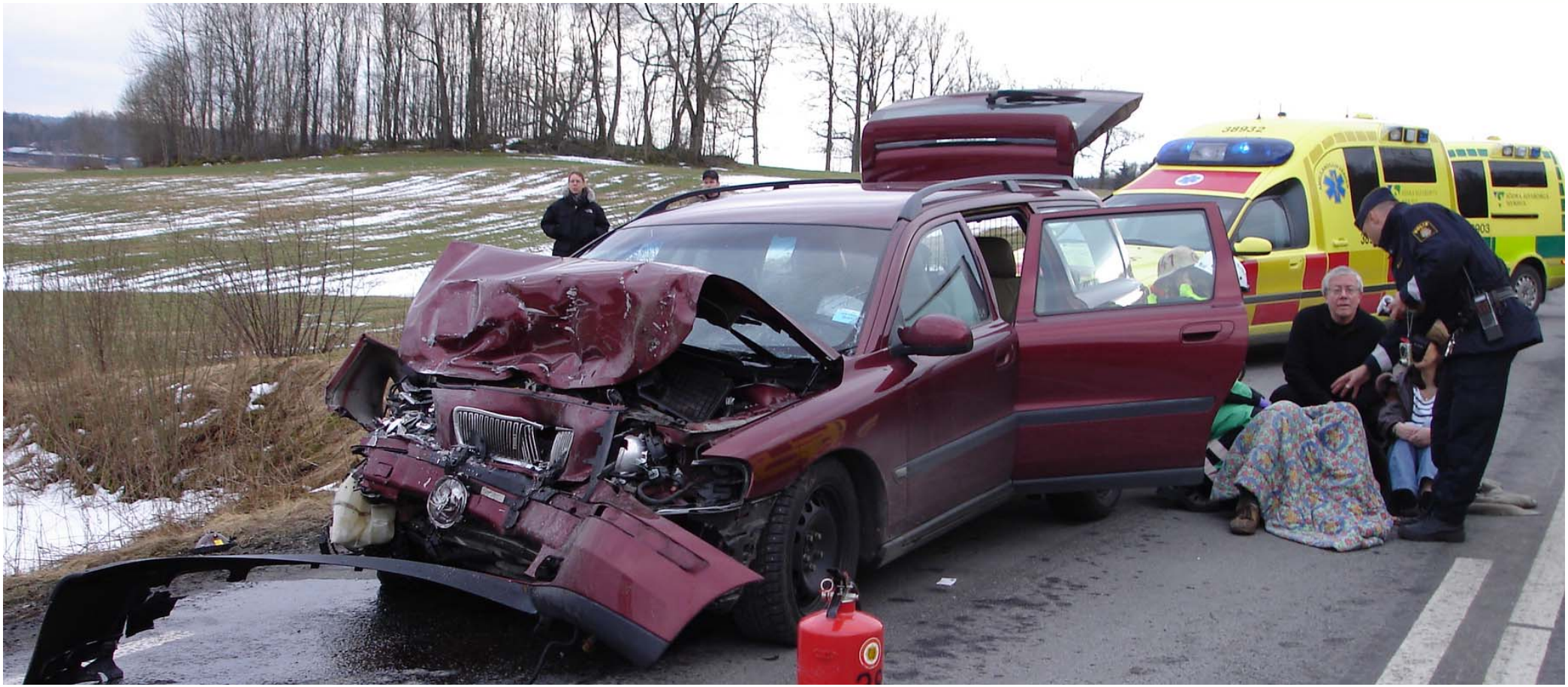



- Keep safe distance
- Reduce workload – reduce distractions
- Make driver aware of potential conflicts
- Warn driver if potential conflict
- Prepare for a potential collision
- Reduce impact severity
- Reduce injury risks

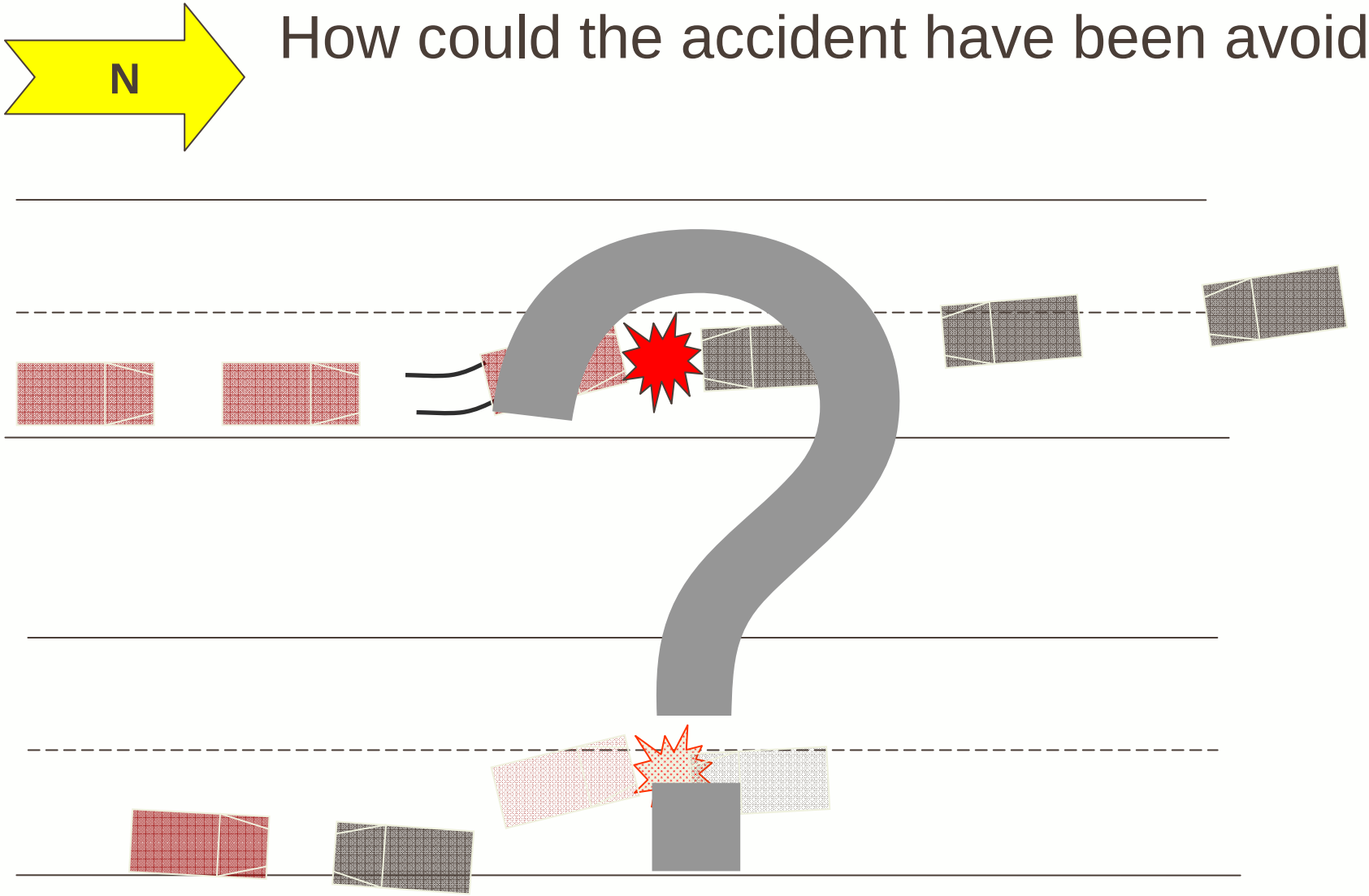
* Source: 2002 GES

6,304,000 police-reported crashes
Distribution by Crash Type

# The collision is a fact



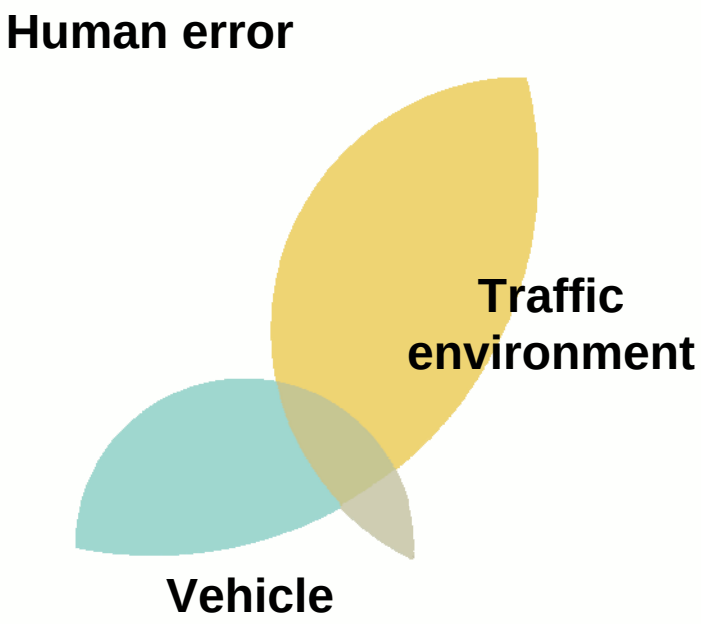
# How could the accident have been avoided?



# Drive towards Zero Injuries, Fatalities and Emissions

**’Technologies for meeting the goal of zero injuries and fatalities are basically known today – it is a matter of how to apply, finance, distribute and activate.’**

# What Causes Accidents?




**The four D's:**

Distraction

Drowsiness

Driving while intoxicated

Driver capabilities

Source: Virginia Transportation Institute

**“Any system which depends on human reliability is unreliable.”**

Gilb’s Second Law of Unreliability

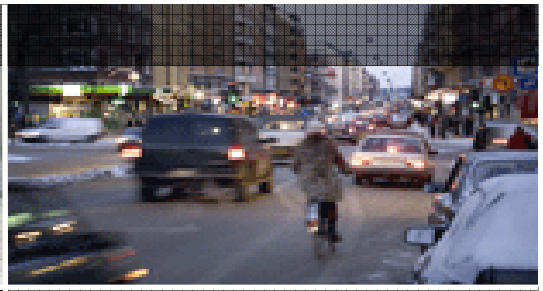
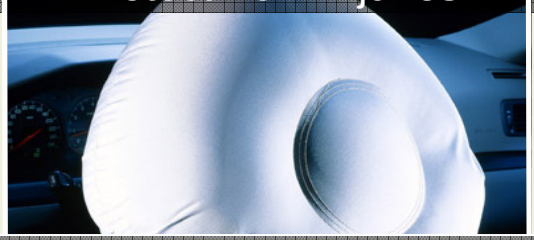



**’When setting the targets for the drive towards zero injuries and fatalities, no condition for further restricting the access to the the transportation sector will be acceptable’**

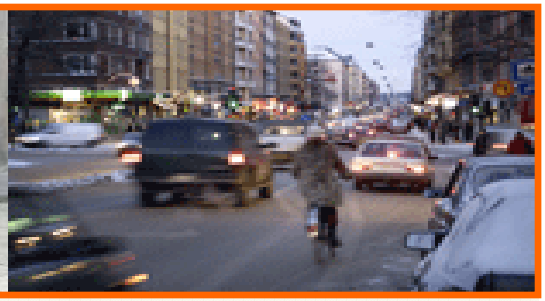



Volvo Vision 2020

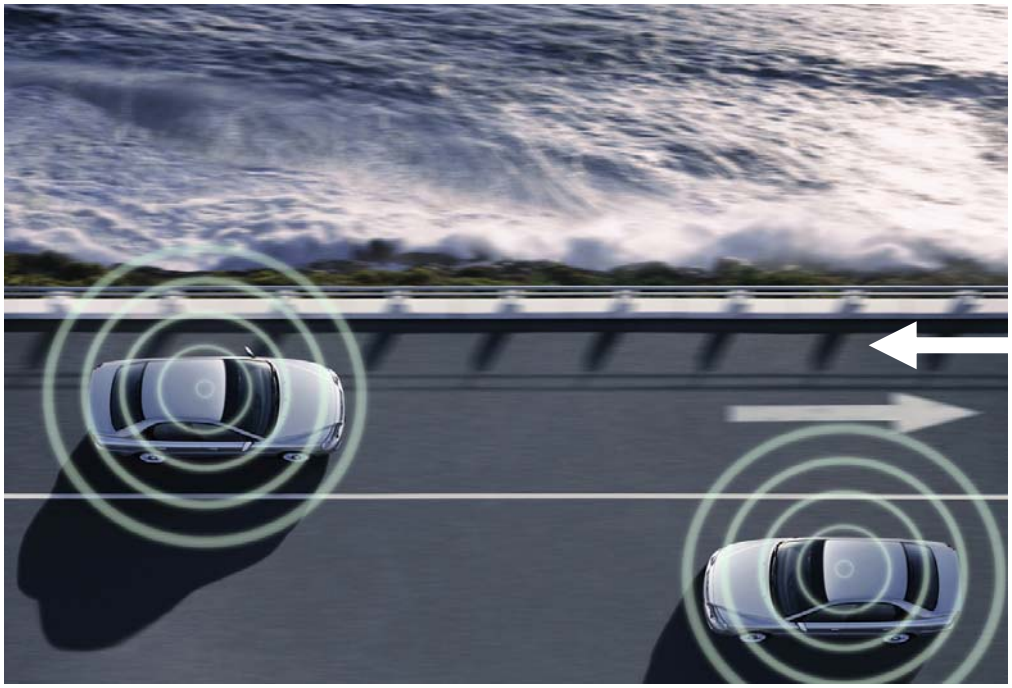
# The Haddon Matrix

| | People | Vehicle | Infrastructure |
|---|---|---|---|
| Before |  | Avoiding Accidents  |  |
| During | | Protect from Injuries  | |
| After | | Reduce Effects |  |

# The Haddon Matrix in the Future

| | People | Vehicle | Infrastructure |
|---|---|---|---|
| Before | **No Driver Dependance** |  |  |
| During | **Accidents Eliminated** | | |
| After | | | |

# To Reach the Visions We depend upon -




Vehicle to vehicle and vehicle to infrastructure communication

# Important First Steps towards Zero injuries and Fatalities:

Actions for:

**Speed management**

- Intelligent speed adaptation
- Support systems for assisting drivers

**Increased belt usage**

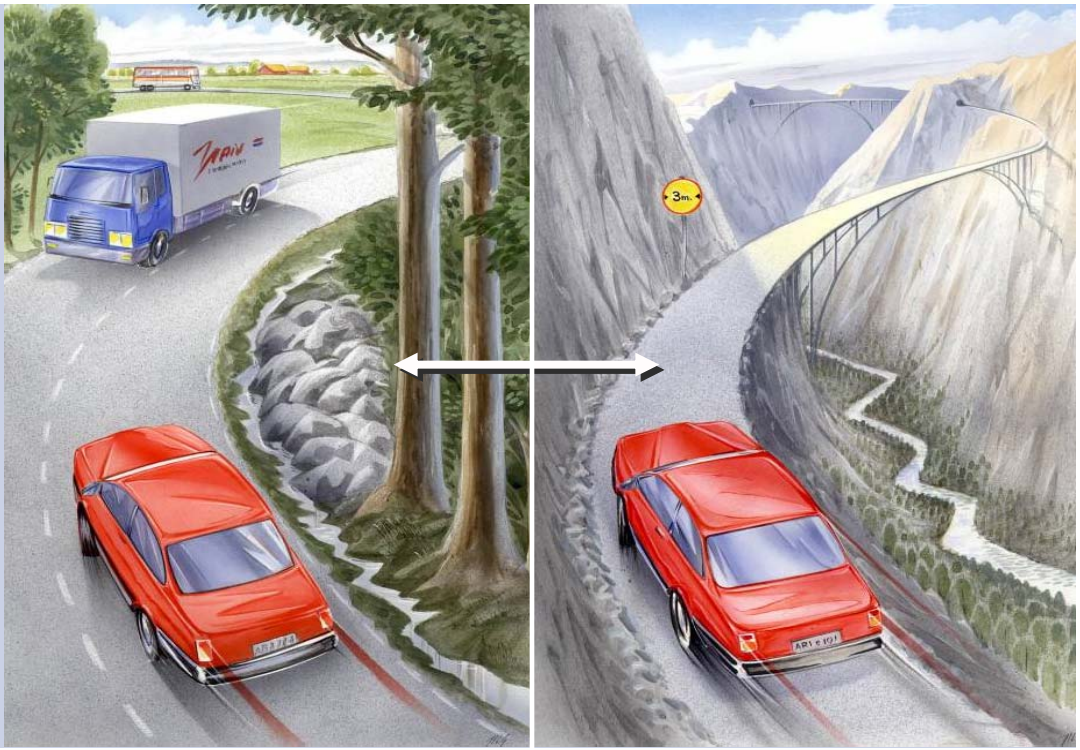
- Belt reminders

**Preventing Driving While Intoxicated**

- Alcohol interlocks

# Speed Management

- Kinetic energy (speed) is the problem! People are blind to kinetic energy!
- Humans have not been programmed to understand risk with speed.



# Speed Management

**Requirements for speed limitation of vehicles**
**Advantages:**

- Reduced weights
- Reduced rating of tires
- Reduced engine performance

**Technologies exist**

- Youth/ Restricted key ’Cinderella key’
- Programmable speed
- Intelligent Speed Adaptation ISA
- Speed Sign Recognition systems

# Increased Seat Belt use

In August 2009, 50 year anniversary of factory installed 3-p belt

Continues to be the single most efficient safety device

Substantially improved over the years:

- Pre-tensioners
- Load limiters
- Improved comfort and convinience

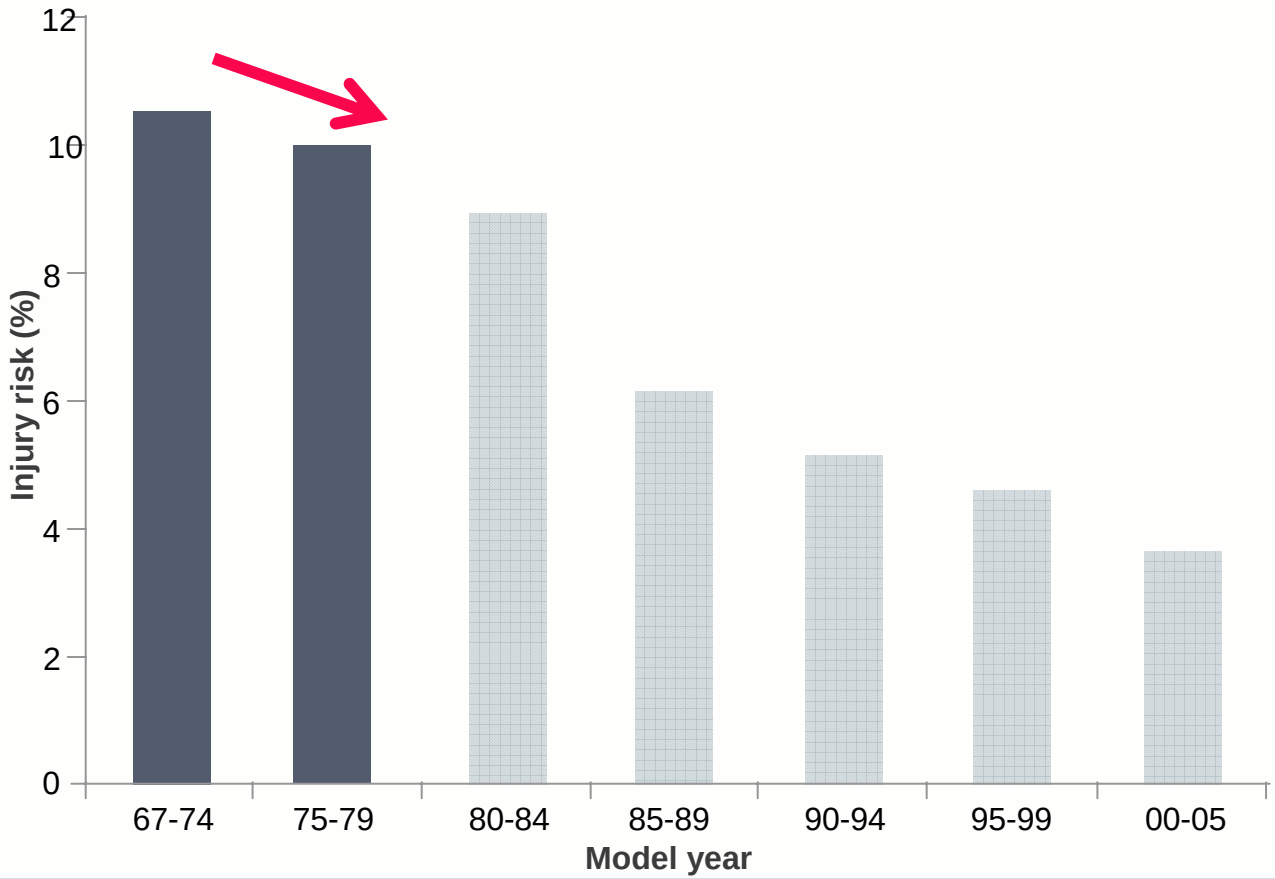
Belt reminders efficient to convince occupants of buckling up

# Preventing Driving While Intoxicated

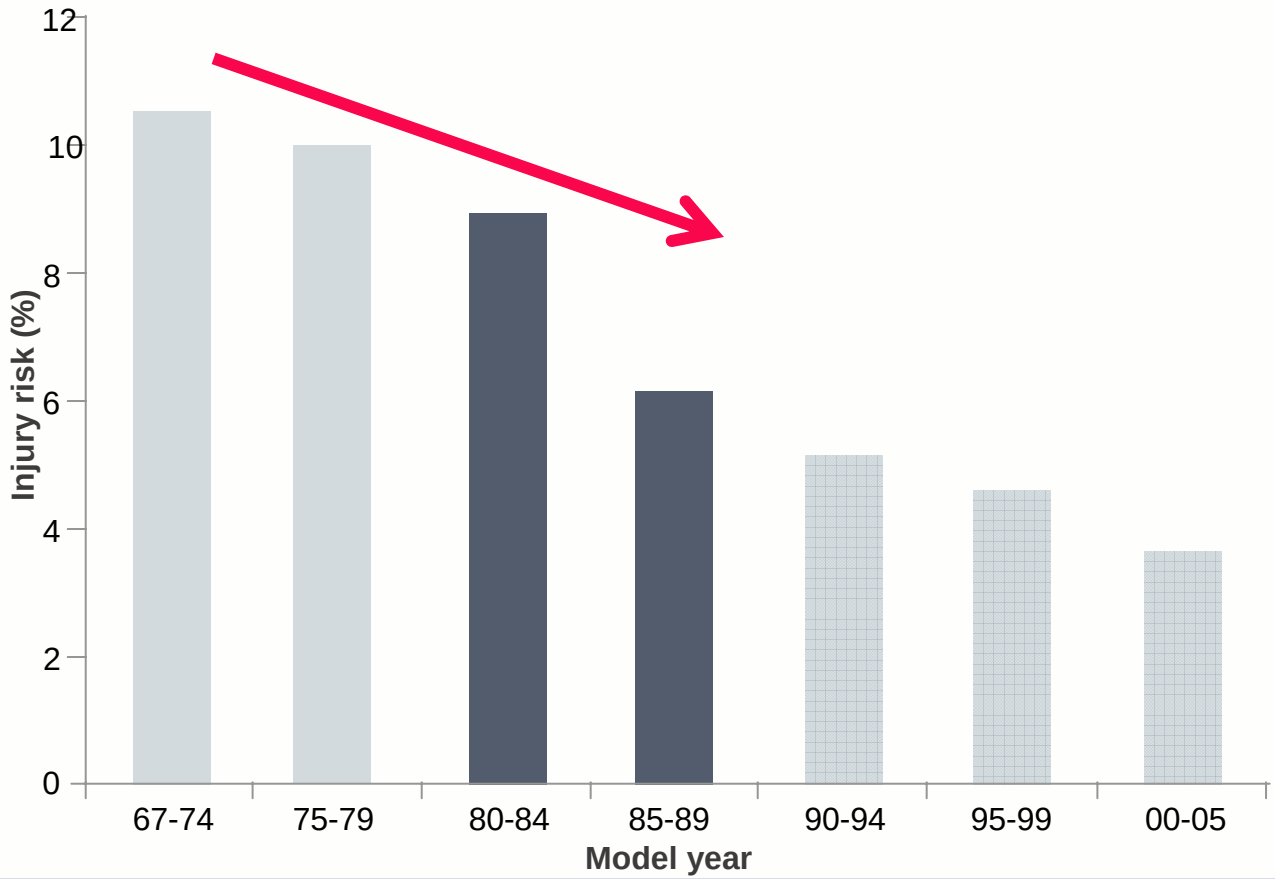
- Alcohol related fatalities represent one third to 40% of all road traffic fatalities.
- Issue is taken seriously within the industry
- Technologies are being developed for restricting DWI
- Goal**:** Systems that are:
  - Totally transparent
  - Reliable
  - Long calibration intervals
  - Inexpensive
  - Comfortable

# Preventing Driving While Intoxicated

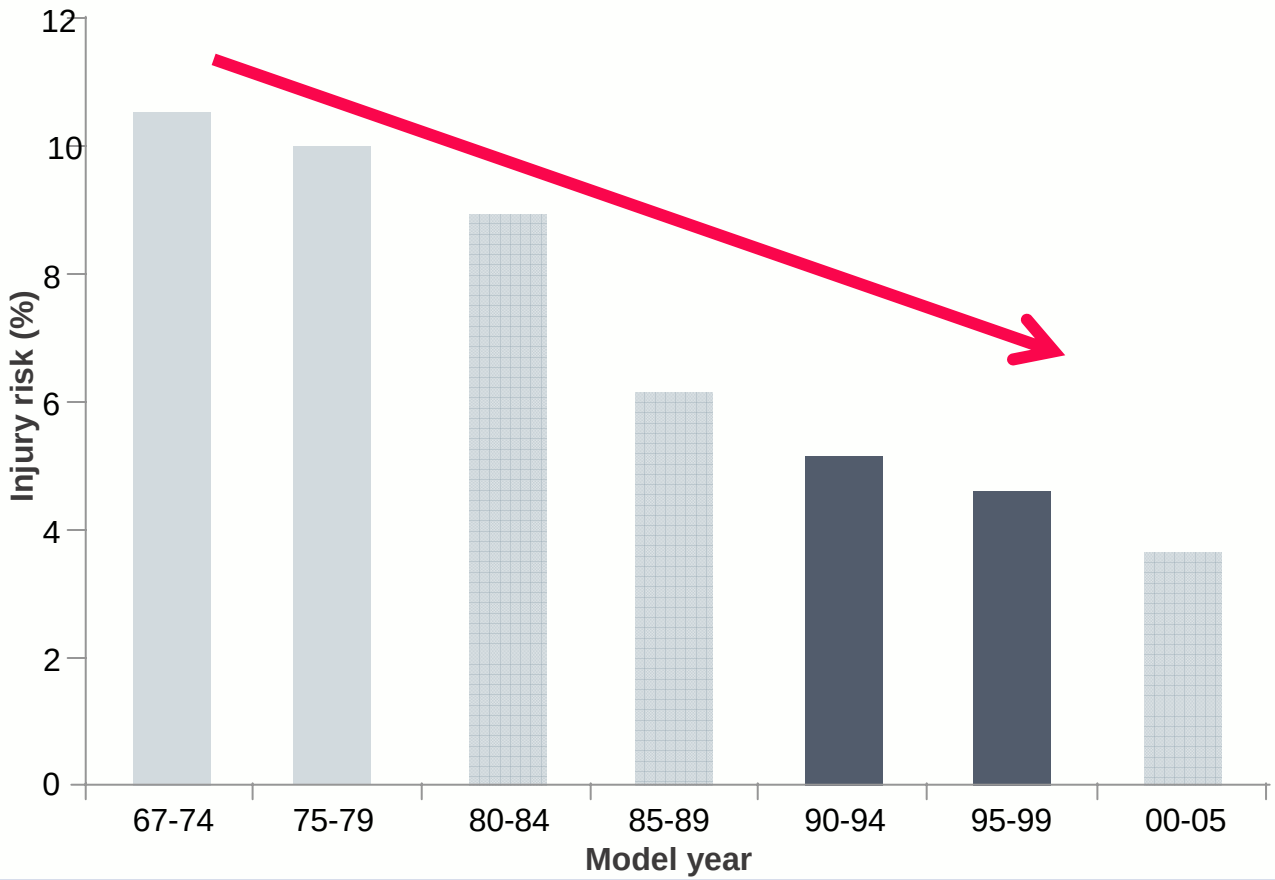

# Future Safety Offer –
# The Development is ongoing

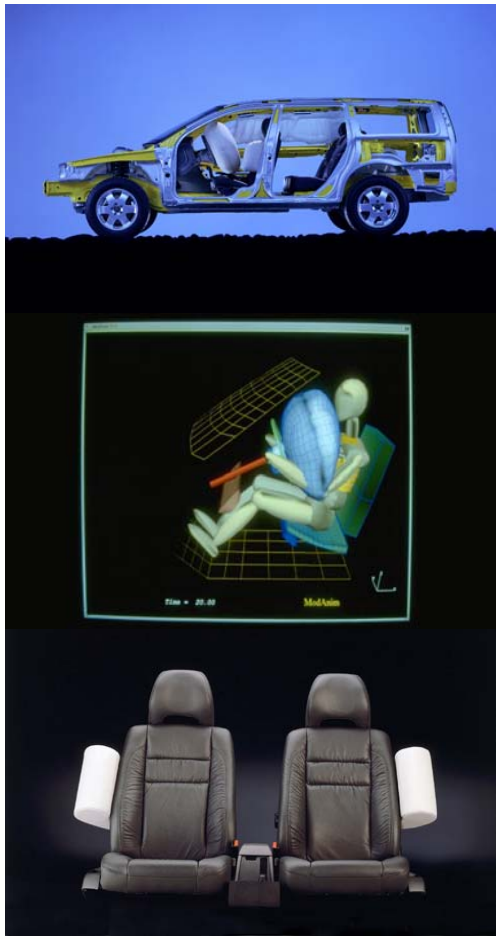



# Future Safety Offer – The Development is Ongoing




# Future Safety Offer –
# The Development is Ongoing



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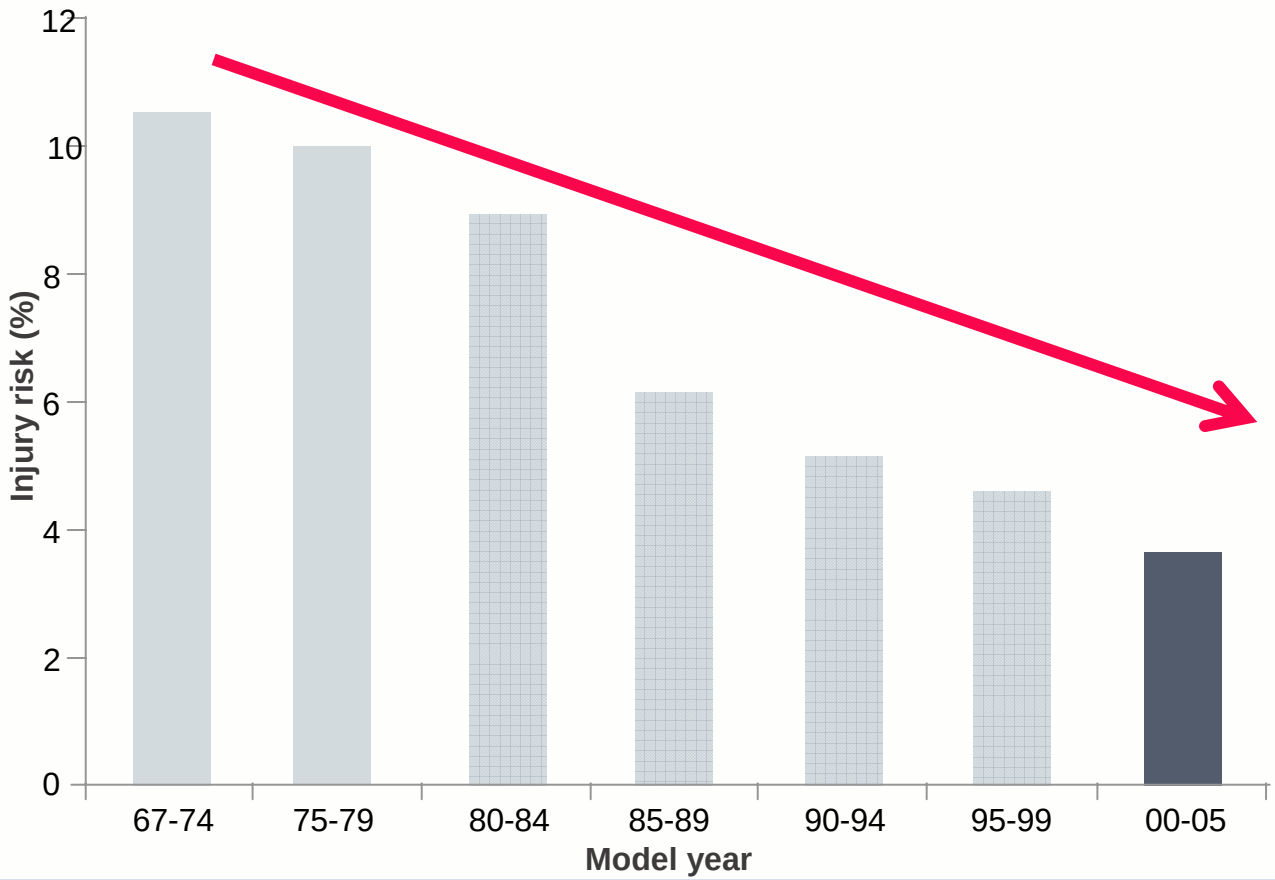


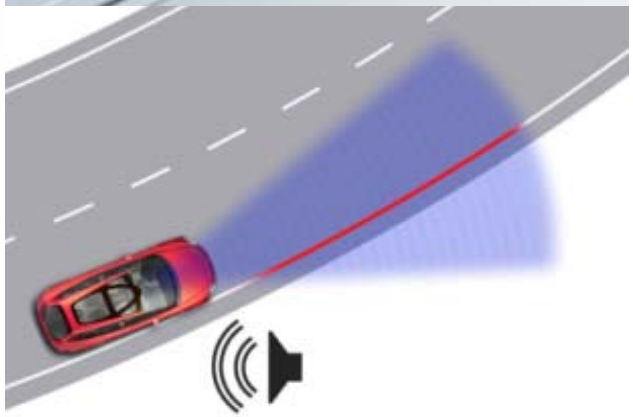

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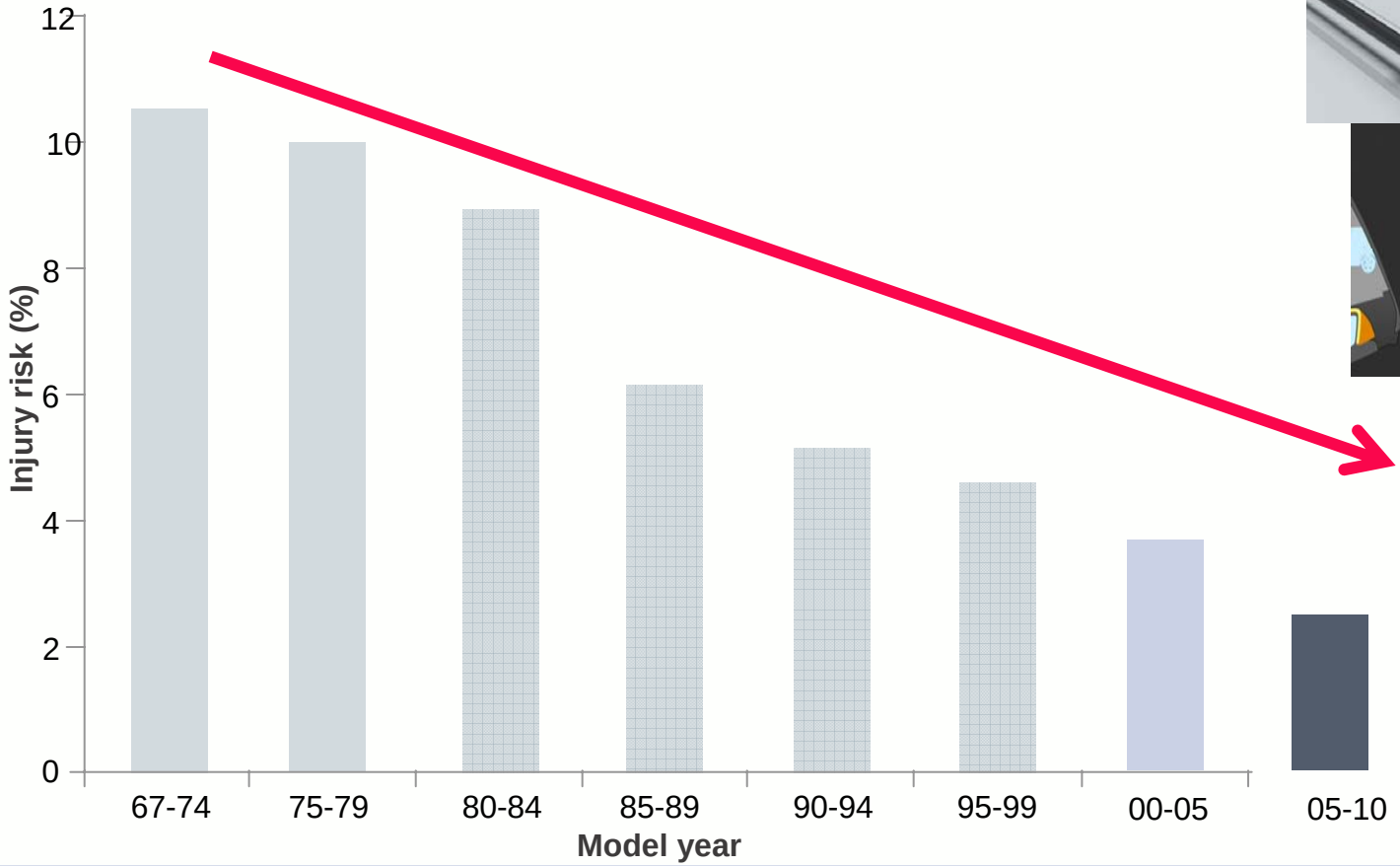


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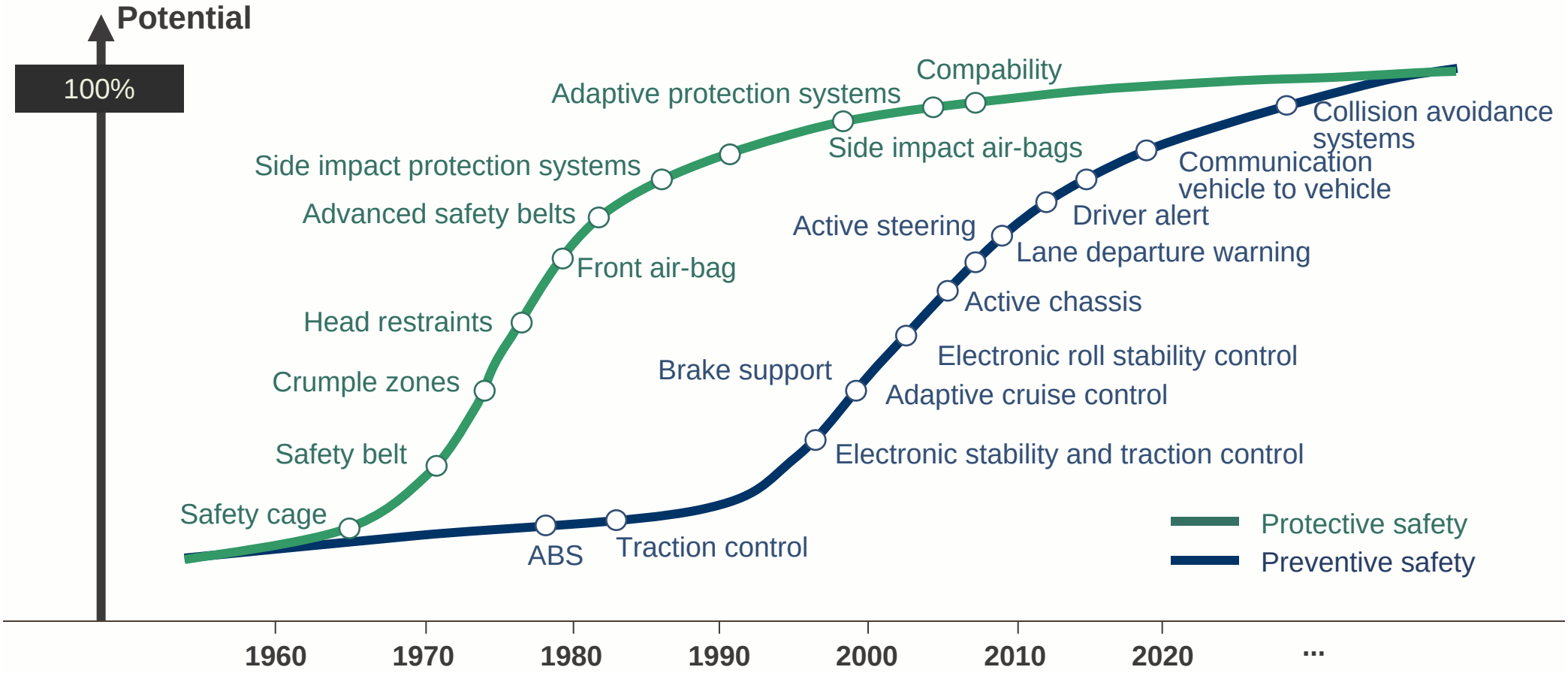
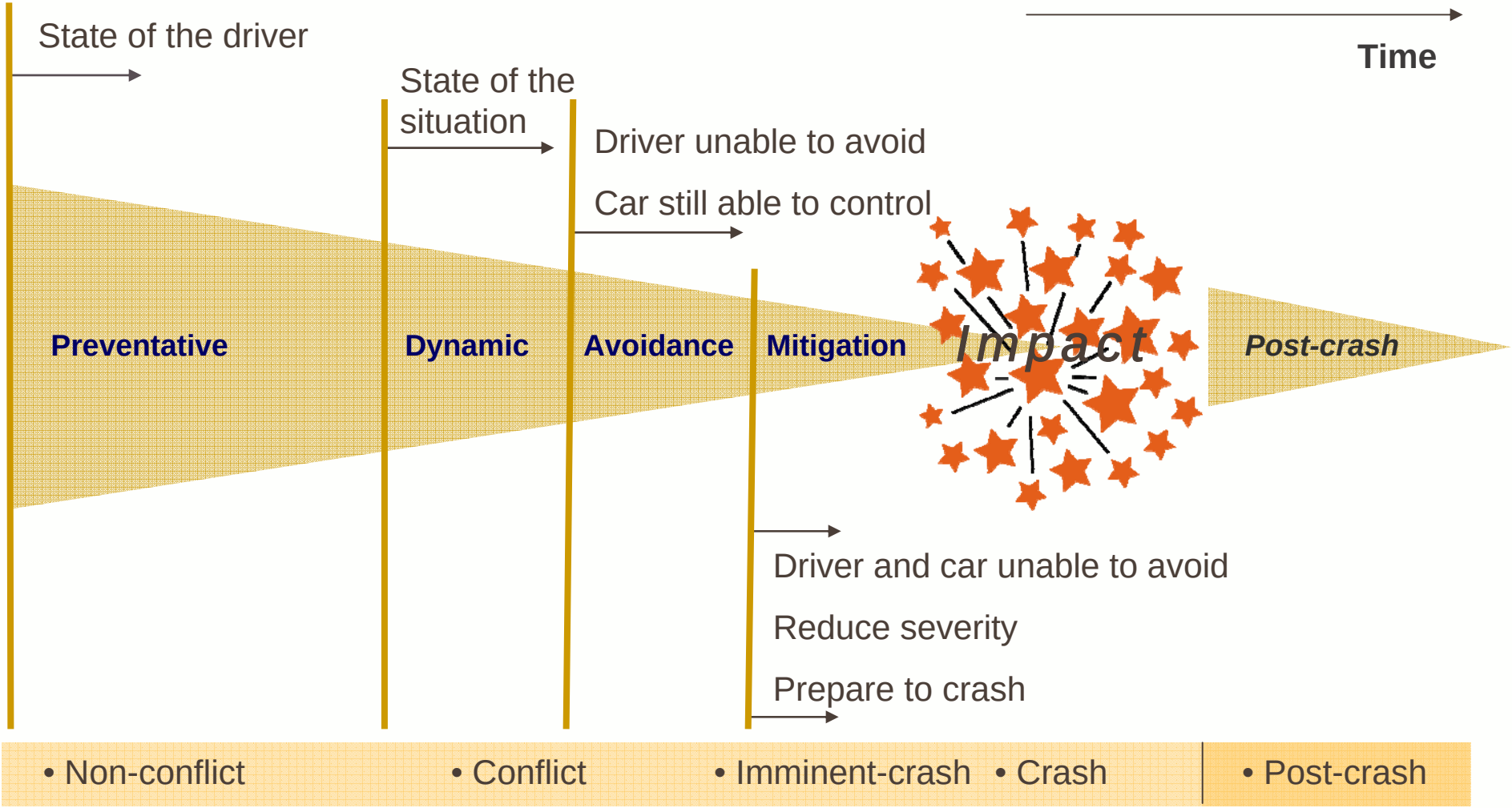
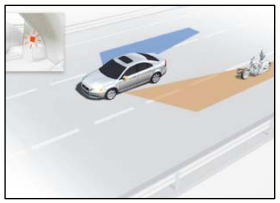
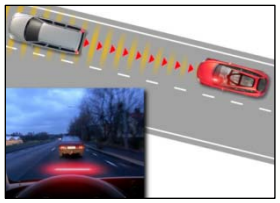
# Development and Penetration of New Advanced Safety Systems



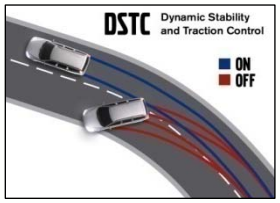
# Holisitic View on Safety

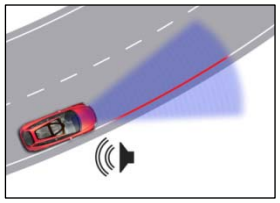


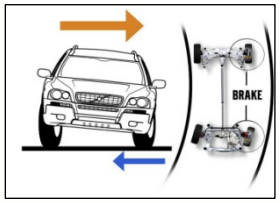
# Strategy for Holistic Safety

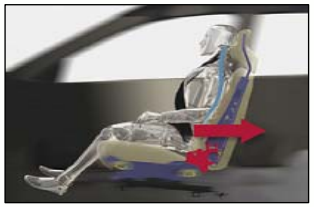







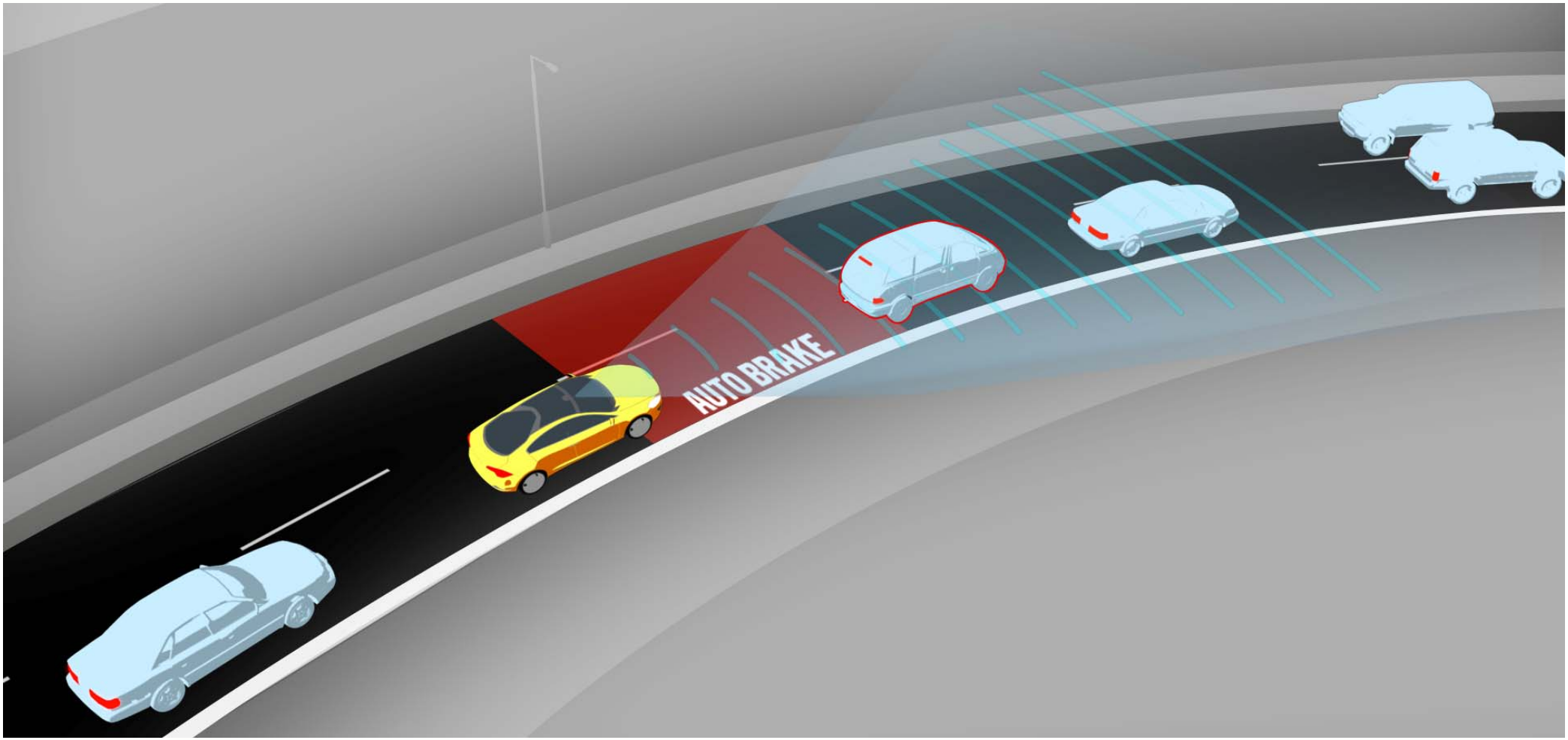


**Preventative** → **Dynamic** → **Avoidance/Mitigation** → *Impact* → ***Post-crash***

# Development of New Advanced Safety Systems

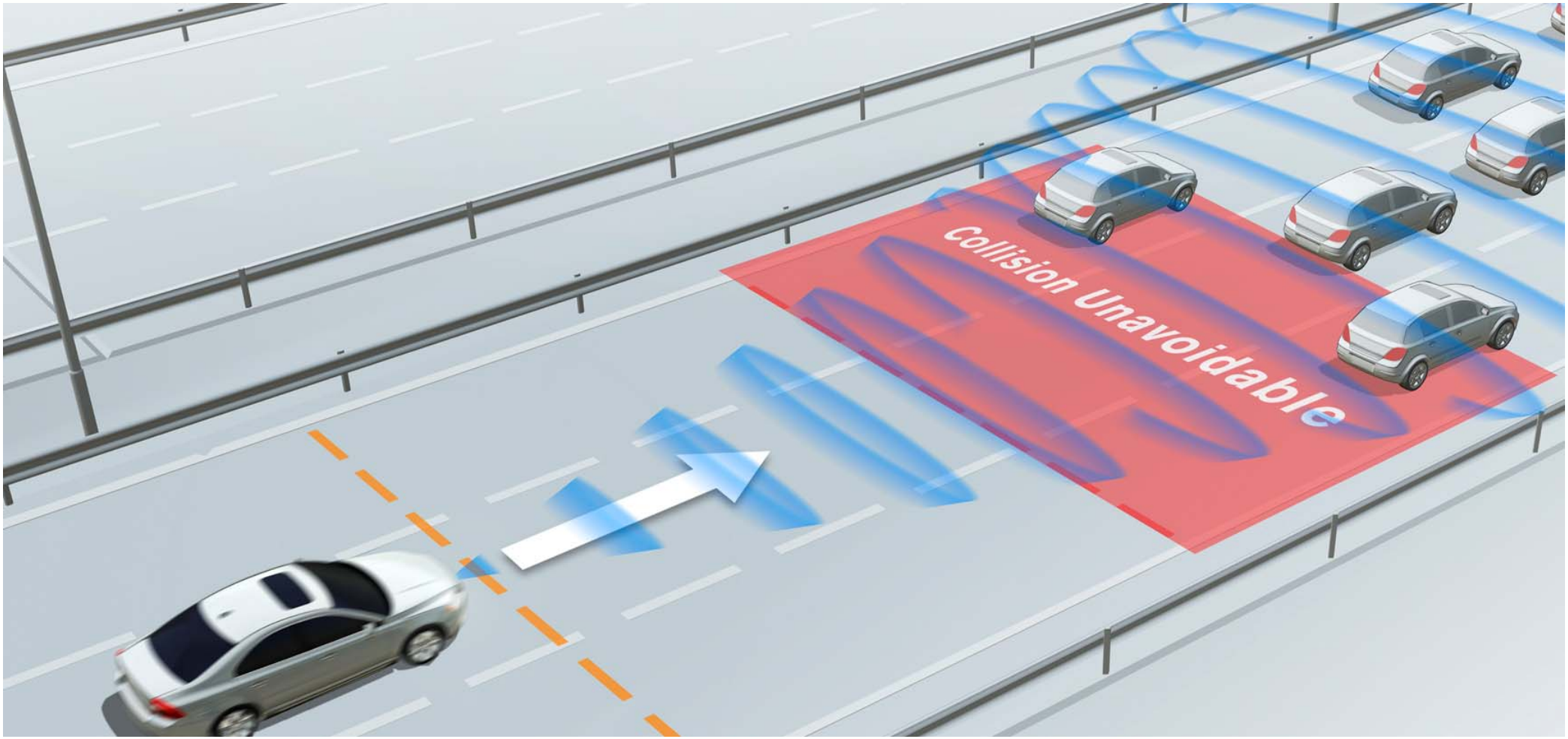



Volvo Vision 2020

# Autonomous Braking Systems: Low Speed

Volvo Vision 2020

# Autonomous Braking Systems: High Speed

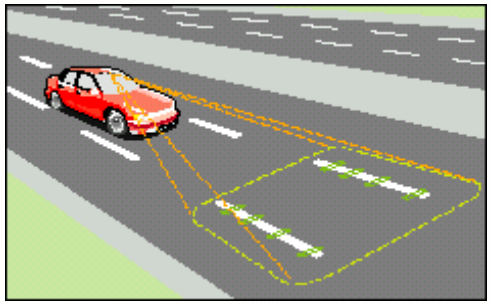


# Lane Departure Warning (LDW)

**Why?**

About 33% of all accidents involve an initial road departure.

Of these, 75% occur on roads with speed limits of 70 km/h and above. Many of these accidents are connected to serious personal injuries.



**How?**

Warns the driver when the vehicle crosses a lane marker while the turn indicator is not used.

Active above 65 km/h.

Information displayed in the trip computer.

On/off via a button located in the centre stack.

Camera mounted on the inside of the windscreen.

# Driver Alert Control (DAC)

**Why?**

About 20 % of the fatal highway accidents are caused by driver fatigue.

>100,000 accidents are caused by driver fatigue in the US every year, in which 1,500 people are killed and another 71,000 are injured.

**How?**

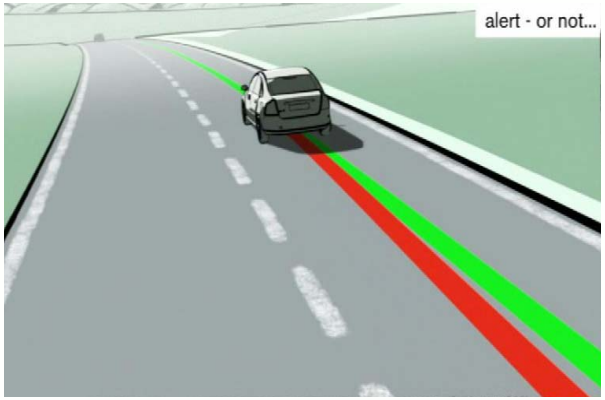
Analyses the driving behaviour.

Driver alerted via an audible signal "Time for a break" is shown.

Information displayed in the trip computer.

Active when the vehicle speed passes 65 km/h.

Camera mounted on the inside of the windscreen.




# Adaptive Cruise Control (ACC)

**Why?**

Helps the driver to keep distance, which enhances safety.

ACC contributes to relaxed driving, even when the traffic flow is uneven.

**How?**

The system automatically adapts the speed to keep the distance.

ACC is active between 30 and 200 km/h.

ACC uses a radar sensor.


# Distance Alert (DA)

**Why?**

30% of all accidents are rear end collisions.

Distance Alert (DA) helps keeping proper distance.

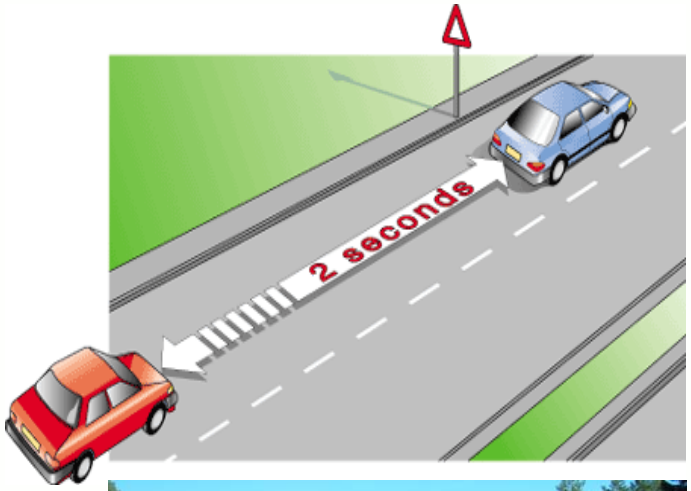
Easier to keep local regulations compared to other methods (i.e. counting road markers).

**How?**

When the distance is too short, the middle segment of the Head-Up Display is lit.

DA is active above 30 km/h and ACC is not active.

DA uses the radar sensor.




# Collision Warning with Auto Brake (CWAB)

**Why?**

30 % of all accidents are rear-end collisions.

In 50% of these accidents, the driver does not brake at all.

50 % of the rear-end collisions are towards stationary vehicles

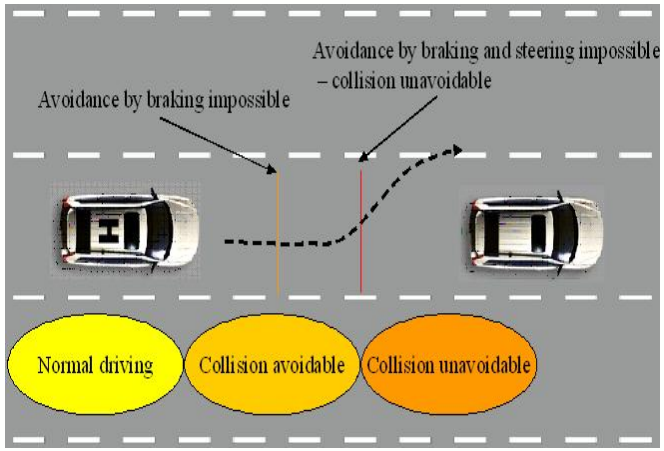
**How?**

An intuitive audible and visual warning by flashing the Head Up Display.

Prepares the brake system by precharging it.

When a collision is unavoidable, Auto Brake will brake autonomously.

CWAB uses a radar and a camera to monitor the area in front of the car.



# City Safety – avoid low-speed collisions

City Safety will brake automatically just before a collision, and avoid collisions up to 15 km/h.

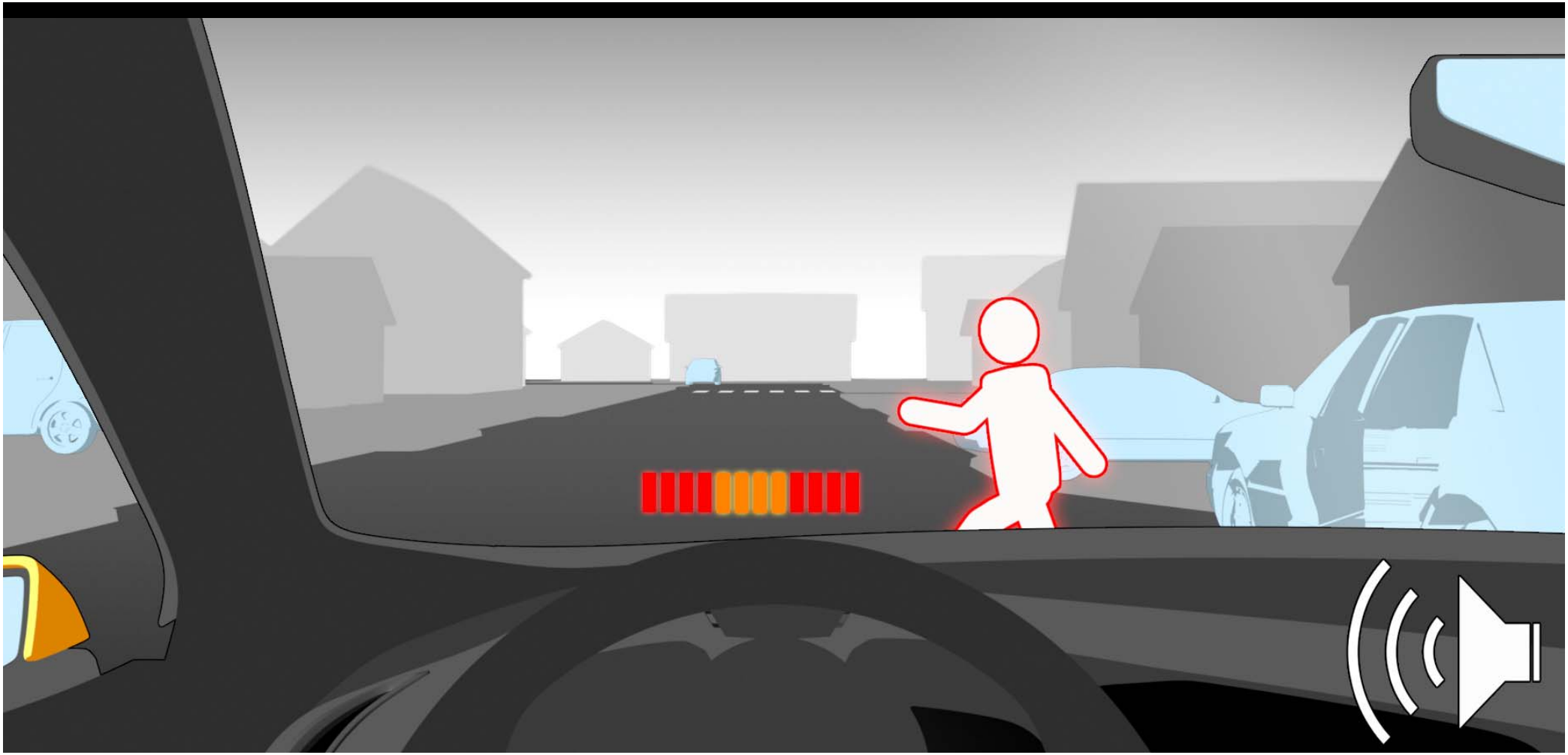
It will also reduce the severity of collisions up to 30 km/h.

**Customer Benefit:**

- Avoided collisions
- Reduction of insurance costs
- Partner Protection – Whiplash
- Cost-efficient

# Drowsiness Preventention Systems

# Pedestrian Detection and Braking Systems



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# Pedestrian Detection and Full Autonomous Braking System

## Collision causes

*"**Inattention**, was a contributing factor for **93 percent** of the conflict with lead-vehicle crashes and minor collisions." **

*"The **inattention** to the forward roadway .. may explain why almost half of the drivers **(47 percent)** had no avoidance reaction." **

*****"The 100-Car Naturalistic Driving Study", T. A. Dingus et al, NHTSA, DOT HS 810 593, April 2006. The study involved 100 cars, 241 drivers, and 43 000 hours of data. 85 real collisions were recorded and analysed.


# Pedestrian Detection and Full Autonomous Braking System

## The Pedestrian Safety Problem

Sweden: 16 % of traffic fatalities. 11 % of seriously injured.

Vägverket, 2008 (Swedish Road Authority)

USA: 11 % of traffic fatalities (4,700 people). 3 % of seriously injured.

(Traffic Safety Facts 2007, NHTSA, DOT HS 810 994)

Germany: 13 % of traffic fatalities.

(2002 SAE paper 2004-21-0056)

# Pedestrian Detection and Full Autonomous Braking System

The radar and camera scan the area in front of the car

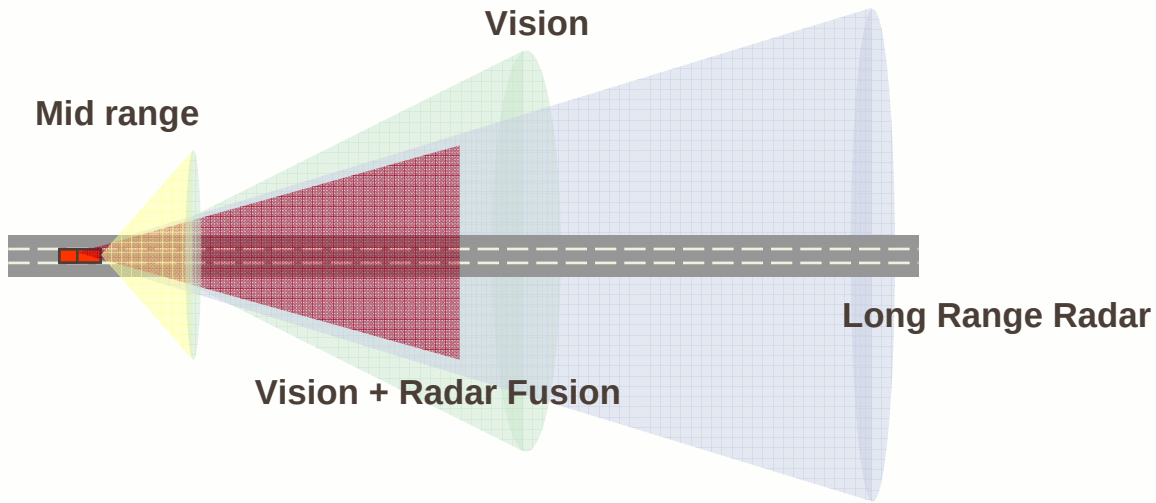
If the situation becomes critical - red warning flashes on the windscreen

If you don’t react to that warning, the car activates full braking power automatically

Pedestrian accidents can be avoided for vehicle speeds lower than 25 km/h

For higher speeds, impact speed can be reduced by 25 km/h

# Pedestrian Detection and Full Autonomous Braking System





**New Radar**
**Wider field of view**

**Upgraded camera**

**New control unit**

**Upgraded Head up display**

# Pedestrian Detection and Full Autonomous Braking System

## Challenges during development

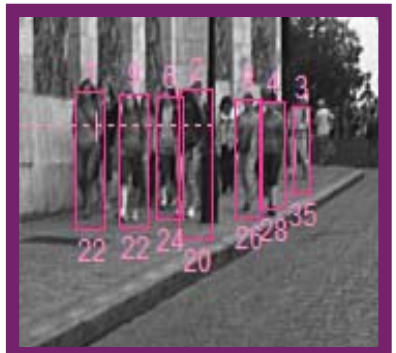
Pedestrian detection of head, neck, legs or shoulder

Weather, light and clothing influence image contrast and hence performace

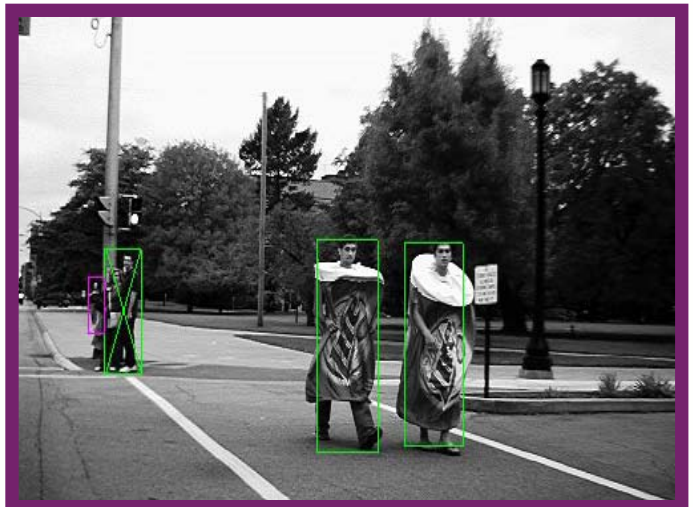
Physical limitations such as pedestrians running to cross the road but hidden by a parked lorry until the last moment

Rule of thumb - the camera is similar to the human eye – what you as a driver cannot see, the camera cannot see either

Sitting pedestrian



Pedestrian Crowd



Odd shape


DPH
Scan: 3669
LLane:-0.7m (1)
RLane: 2.9m (1)
Frame No 421 Idx:122698;Time:10019475;ImgAve:54;Tint:5;Gamma:6;


DPH
Scan:10874
21
16
37
LLane:-0.9m (1)
RLane: 3.4m (0)


Scan:35084
LLane:-2.2m (1)
RLane: 0.6m (1)
Frame No 2859 Idx:54999;Time:5037133;ImgAve:79;Tint:55;Gamma:15;

# Preventing Distraction

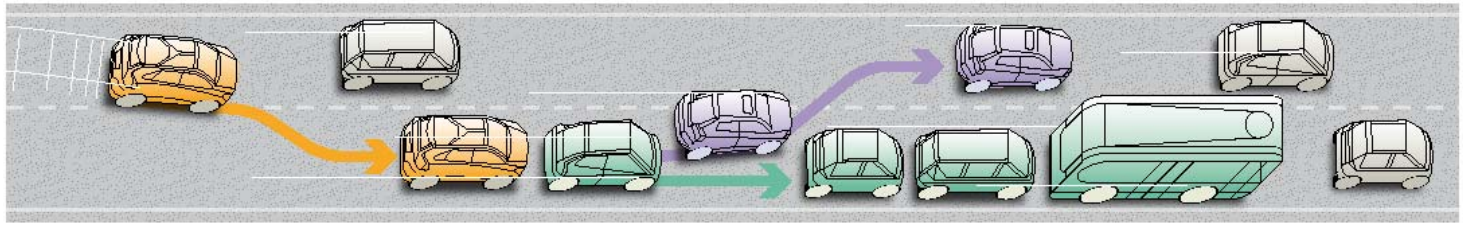
Monitoring of driver attention helps for car to decide on appropriate measures.



Eye and field of view tracking

# Platooning

Estimation: 40% reduction in energy use and $CO_2$ emissions
Increases safety and comfort and reduces risk for congestion

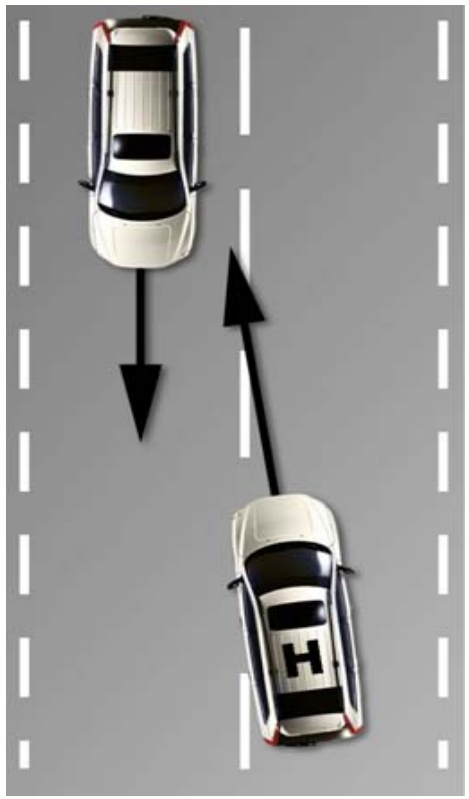


**SARTRE project:**
SAfe Road TRains
for the Environment

# Future - Collision Avoidance by Auto Steering

- Helps the driver prevent collisions with oncoming vehicles.
- Intervenes with steering to get back into safe lane when collision risk is detected.
- The driver can over-rule the intervention by steering resolutely.

no action

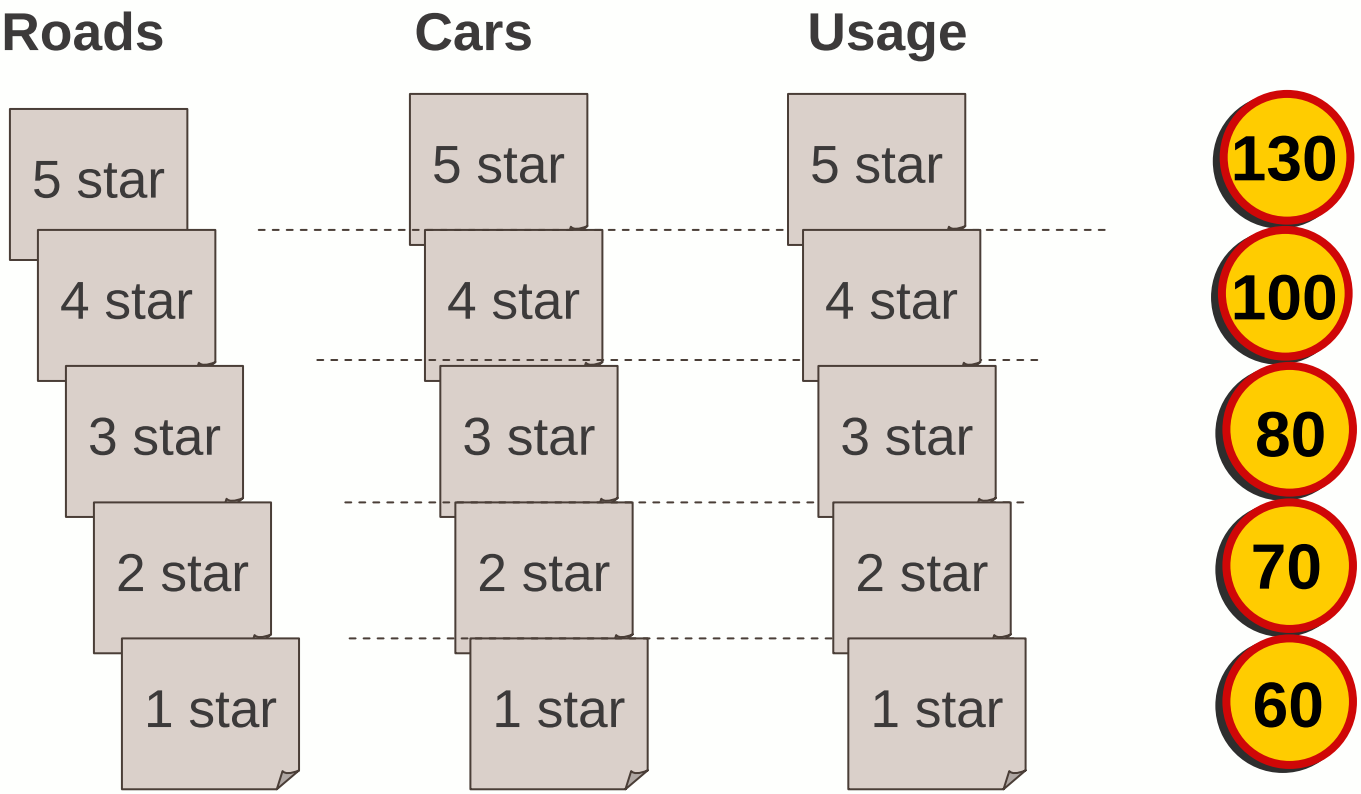


Intervention

# Development challenges

- Low occurence of false alarms
- Low risk of missed alarms
- Minimal “risk compensation”
- Intuitive driver interface
- Robust to variation in driving style and environment
- High efficiency in real life

# 5 Star Vehicles on 5 Star Roads with 5 Star Usage



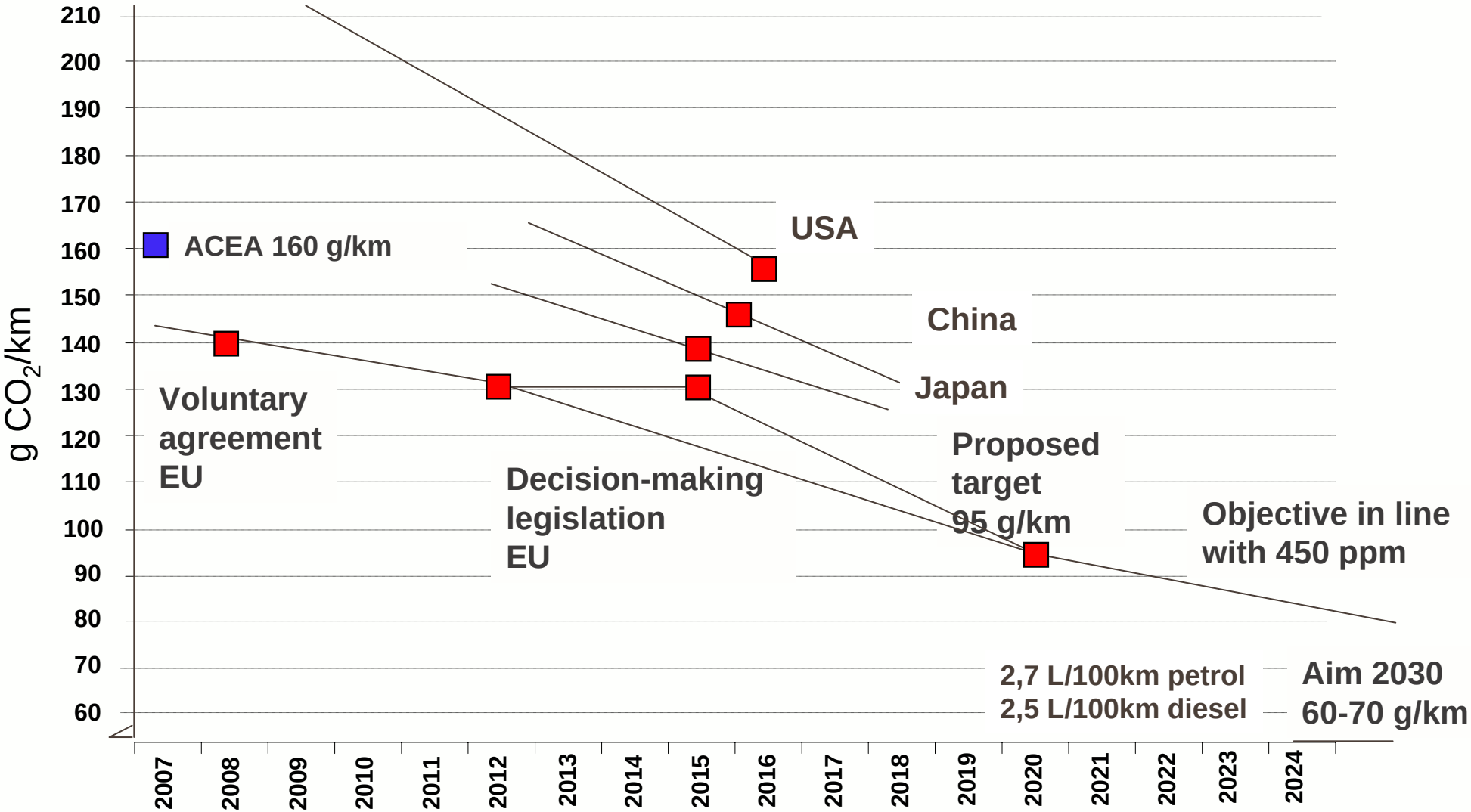

Lowest rating sets limit

# $CO_2$-free transportation sector
# - Requires a broad technology strategy

Engine Transmission Electrification Alternative Fuels

Rolling resistance Weight Energy Losses Aerodynamics

# $CO_2$ Legislation




Volvo Vision 2020

| Volvo | liter/mil | $CO_2$ g/km | mpg |
|---|---|---|---|
| C30 | 0,39 | 104 | 60 |
| S40 | 0,39 | 104 | 60 |
| V50 | 0,39 | 104 | 60 |
| V70 | 0,49 | 129 | 48 |
| S80 | 0,49 | 129 | 48 |
| XC60 | 0,60 | 159 | 39 |
| XC70 | 0,60 | 159 | 39 |

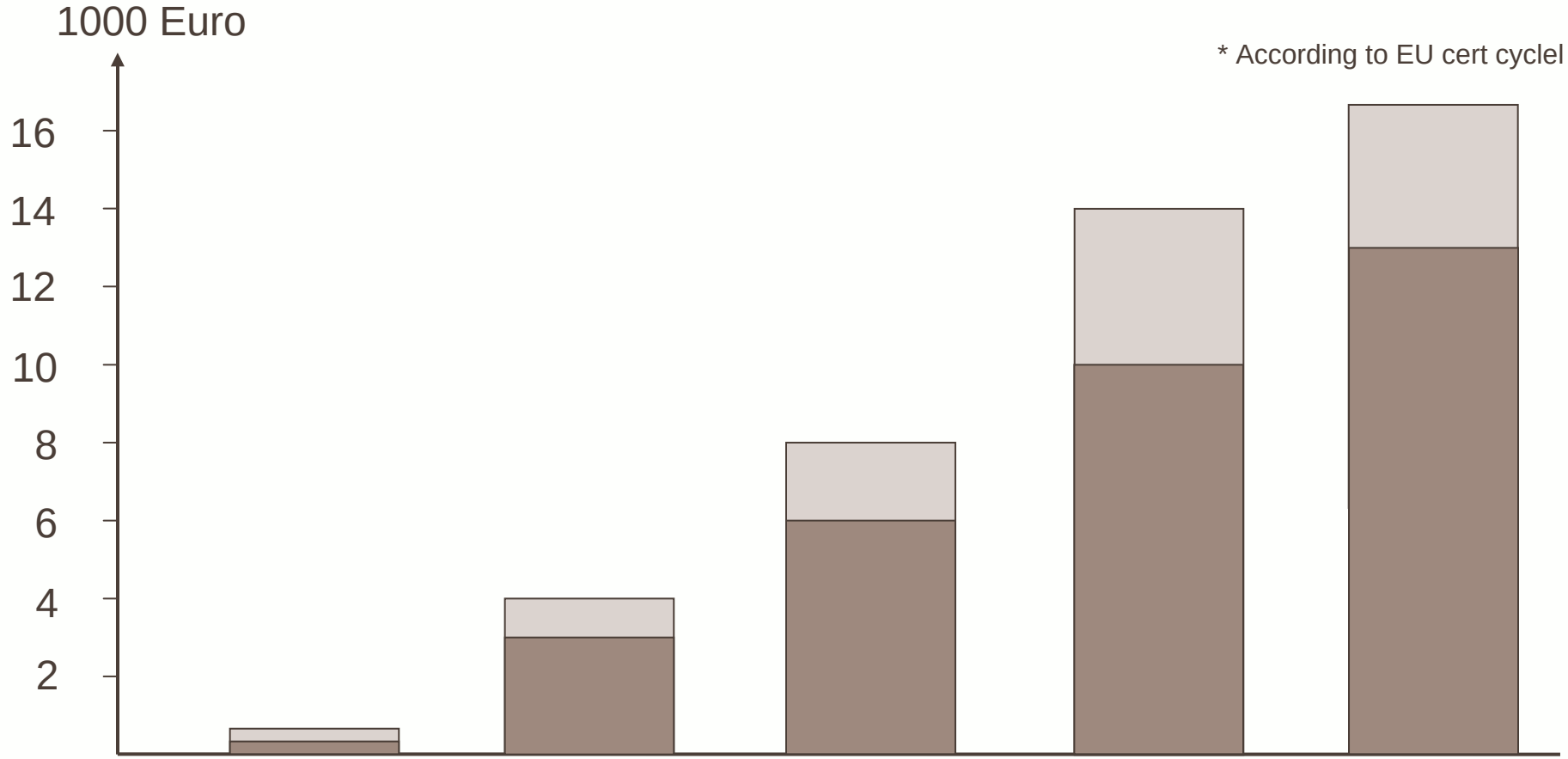
**Achieved through:**

- Smaller engines
- Aerodynamic changes
- Software changes for drive trains
- Tires with low roll resistance
- Weight reductions
- Start and stop systems

# Plug-in Hybrid

- Diesel or gasoline engine combined with electric engine
- Range on electricity 50 km – appr. 5 hours charging
- <50 g/km $CO_2$ - 1,9 l/100km – 124 mpg

# Cost of Electrification of Passenger Cars



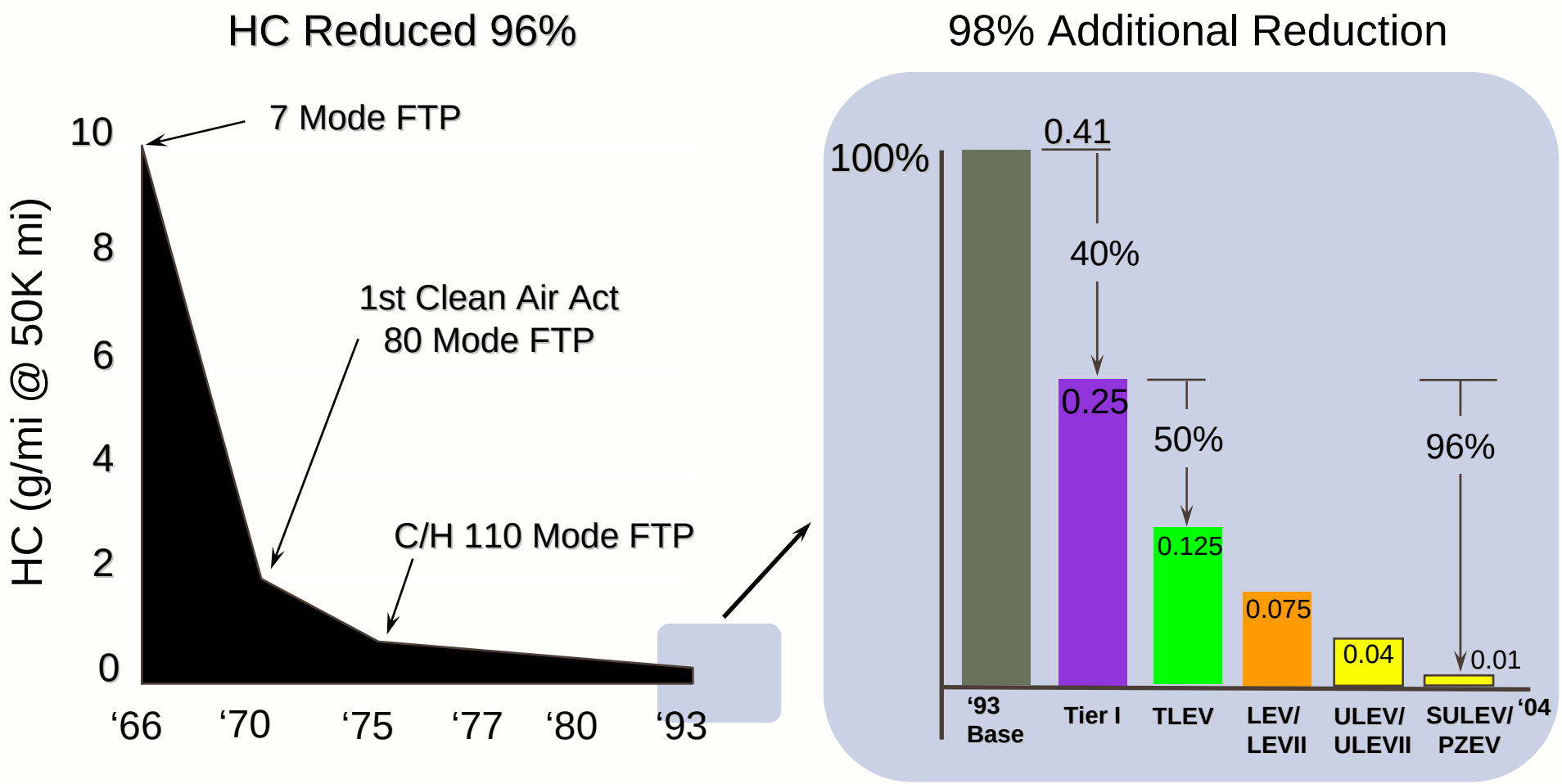

| | Mikrohybrids | Mild hybrids | Full hybrids | Plug-in hybrids | Electric veh. |
|---|---|---|---|---|---|
| $CO_2$ Reduction* | ~ 5% | ~10% | 20-25% | ~70% | ~100% |

# Safety and Quality Issues

# Pros and Cons for Electric Cars?

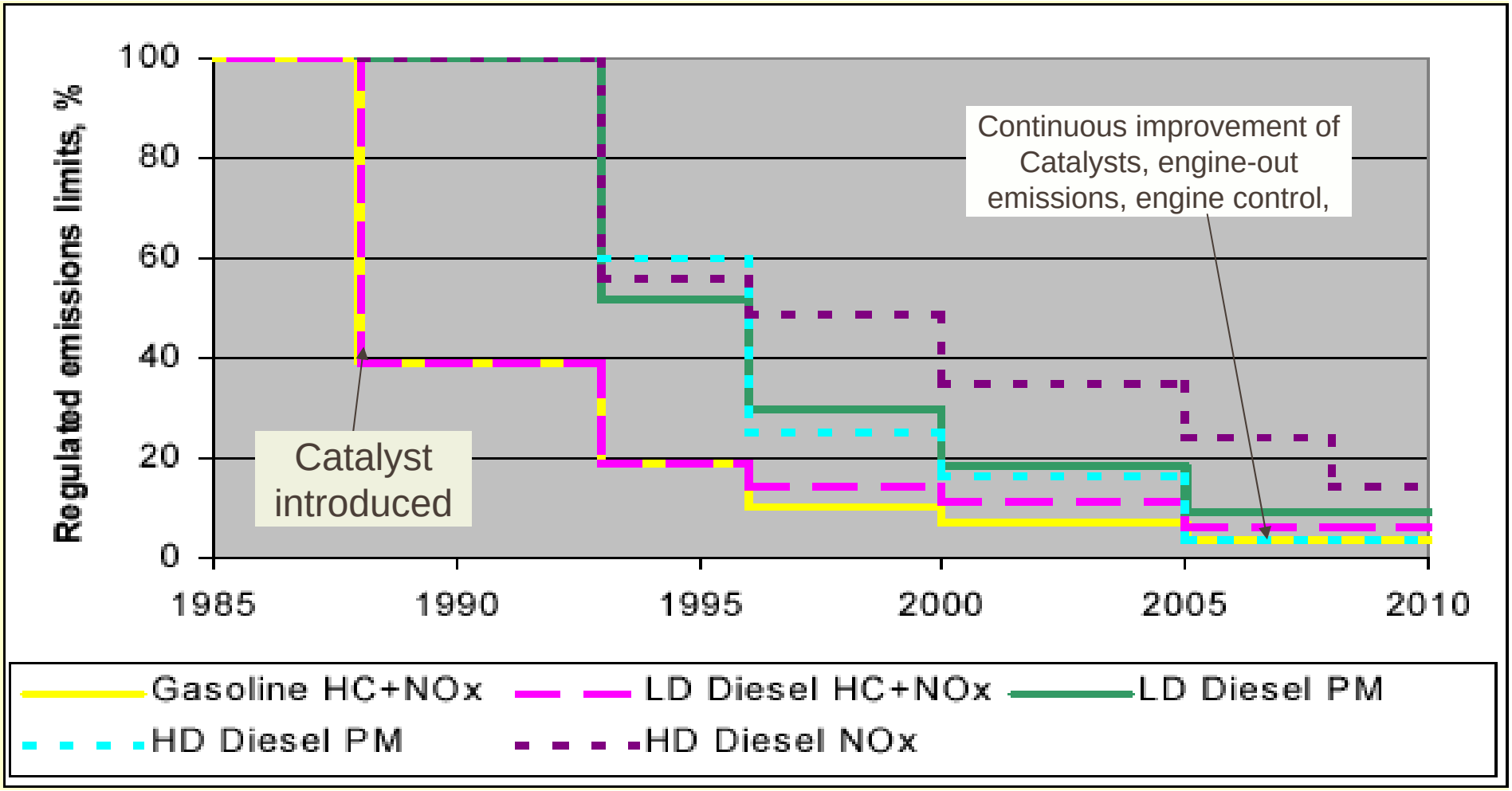
- Electric cars have a lot of advantages: low $CO_2$, low cost of fuel, efficient drive train.
- Battery perfomance and cost are the largest obstacles for a large scale market introduction.
- The customer wants the same performance in the electric car as in other cars – even preferably better.
- Incentives and research support needed in order to get the market activated.

**Evolution of U.S. Hydrocarbon Emission Standards**
**Passenger Cars**




PZEV's: 99,9% Overall or 1000 times higher HC emissions in the '60s

## Vehicle tailpipe legislation – historical view Eu



# Drive towards Zero Injuries, Fatalities and Emissions

- No giant leaps but continue the steps forward.
- Car manufacturers are prepared and willing to take on more responsibility
- Co-operations and standards will be essential
- Incentives and good customer offers are needed.
- Technologies to gradually become cheaper and cascade into less expensive vehicles.


Thank You!