Self-driving future

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Content overview


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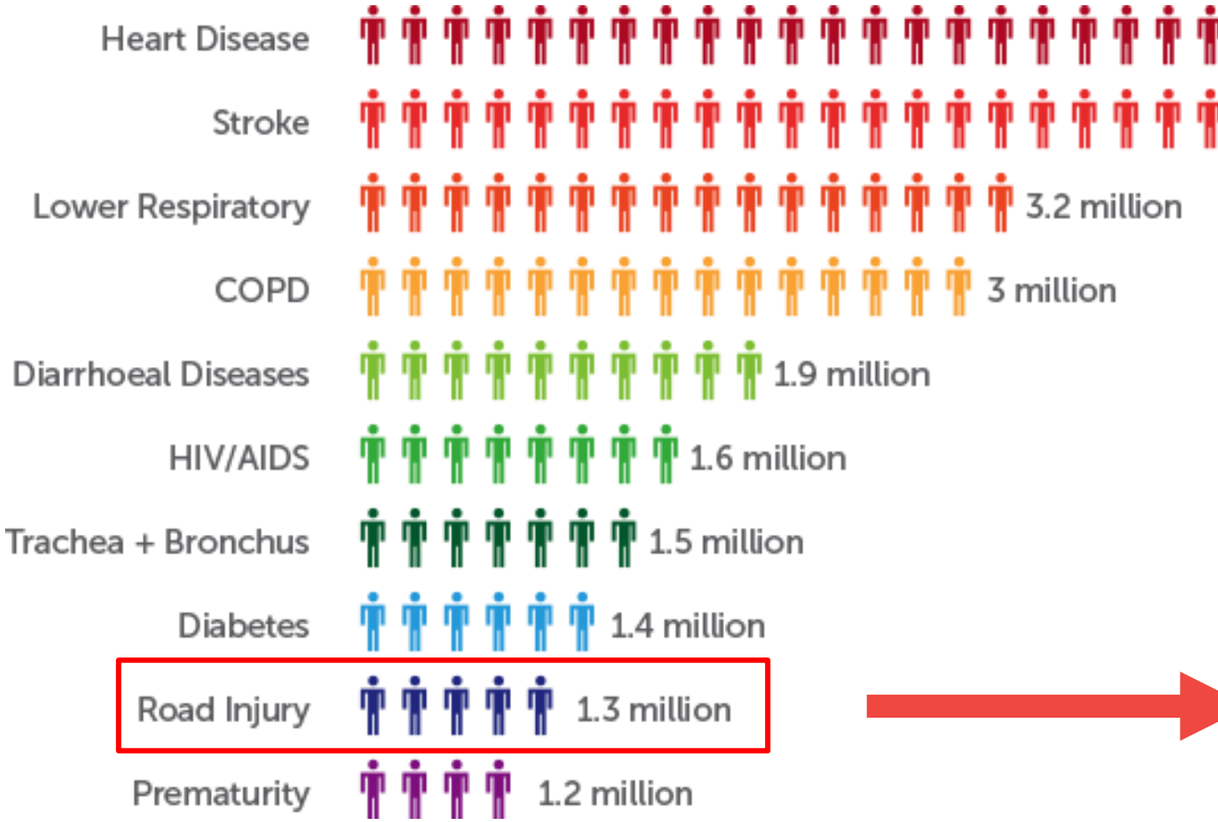
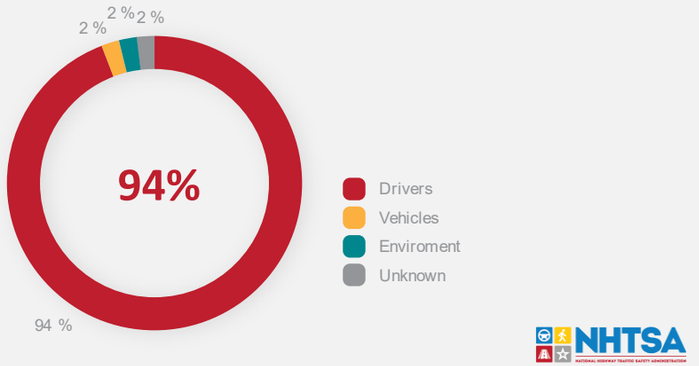
The top 10 causes of death



Drivers are the leading cause of critical pre-crash events



Self-driving car prototype

Camera sensors
Lidar sensors
Radar sensors
Ultrasonic sensors

GNSS unit
IMU sensor
Wheel odometers
Actuators

Central Computer

Vehicle to Everything

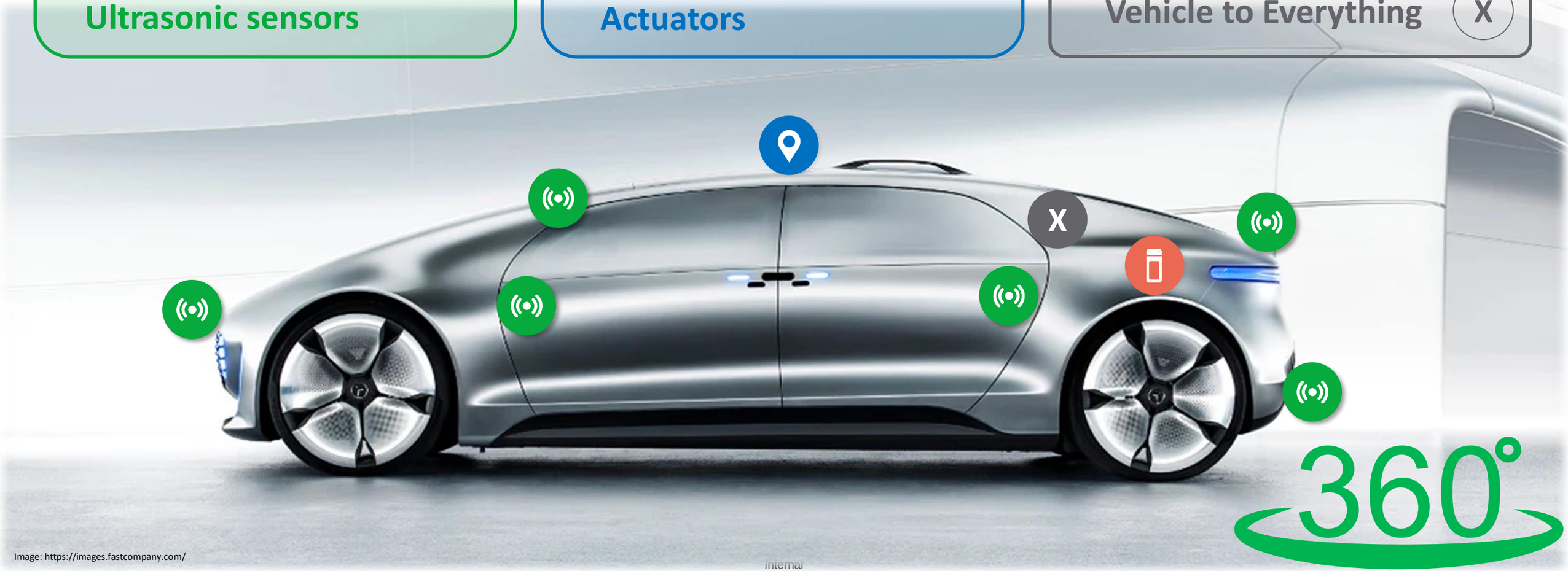


Image: https://images.fastcompany.com/


What else will self-driving technology change?

What will self-driving technology change?

Image: https://williamsonsource.com

Our time

- 2 x 30 minutes a day
- About 30 days of working time per year can be saved

Image: www.shutterstock.com

Image: https://money.cnn.com

New group of car users

- completely new groups of people:
  - elderly
  - disabled
  - too young to drive themselves

Image: www.sites.google.com

What will self-driving technology change?

Image: https://coolhunting.com/

Energy efficiency

- Current car-owning culture replaced with car-sharing culture
- Compact, trip-suited cars could reduce energy demand by 20-40 %.

Image: www.foxnews.com

Image: www.newatlas.com

Parking slots

- A car sits idle 96% of the time
- 1 car needs about 4 parking slots
- In some cities, 20% of land could be freed up by car-sharing culture

Image: www.startribune.com

What will self-driving technology change?

Image: www.iliketowastemytime.com

Roads

- Cities are designed for cars, not for people
- V2X communication
- Controlled, optimized traffic needs fewer roads

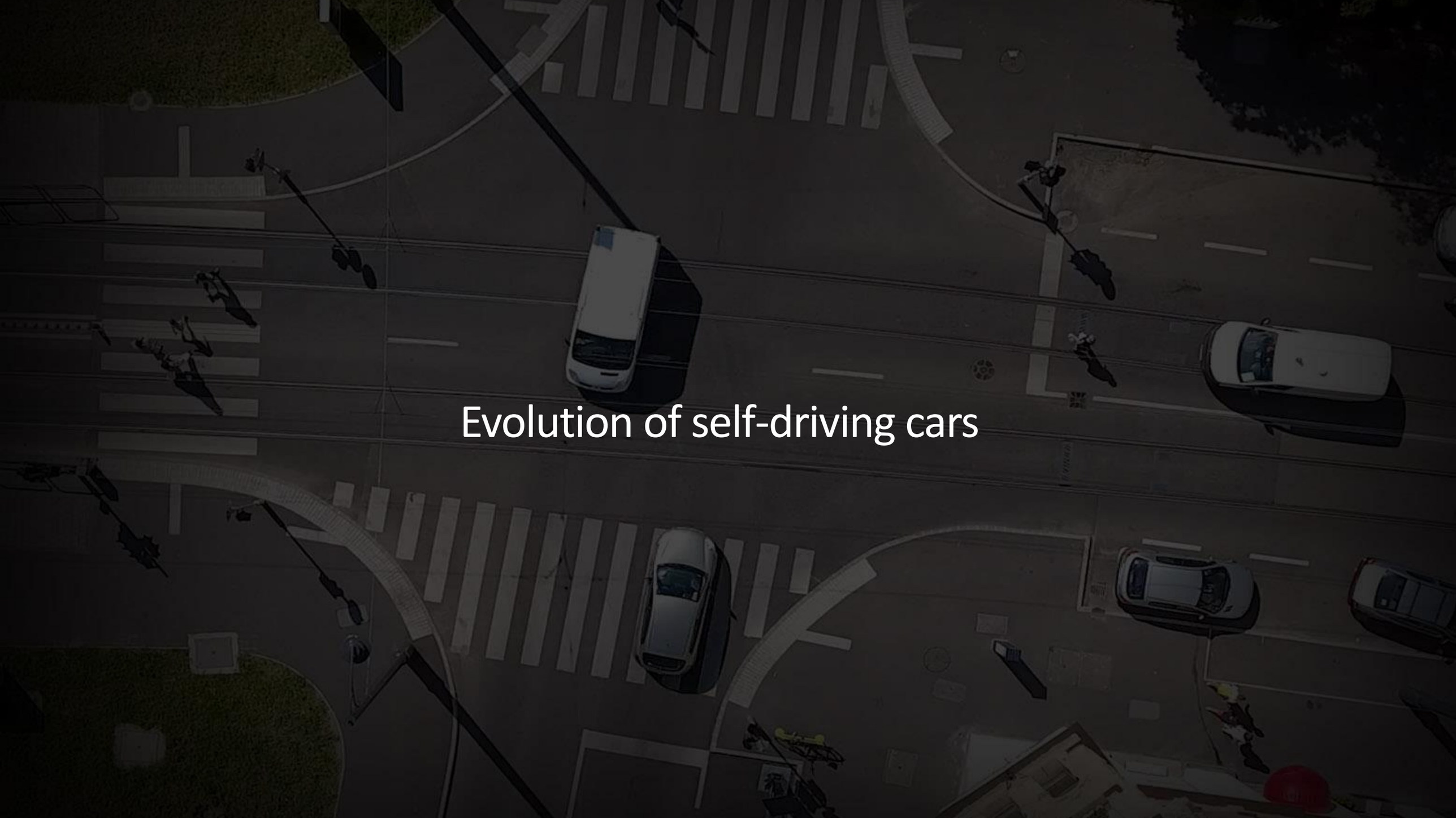
Image: www.greencitytrips.com

Image: www.michellechange.com

Delivery

- Automatic supply chain
- Delivering goods becomes more efficient
- Cheaper goods

Image: www.dreamstime.com


Evolution of self-driving cars

The first „self-driving” cars

Pontiac phantom (1930s)

Image: www.theatlantic.com

Carnegie Mellon University Navlab 1 (1980)

Image: www.pbase.com

First self-driving cars

Eureka PROMETHEUS Project (1995)

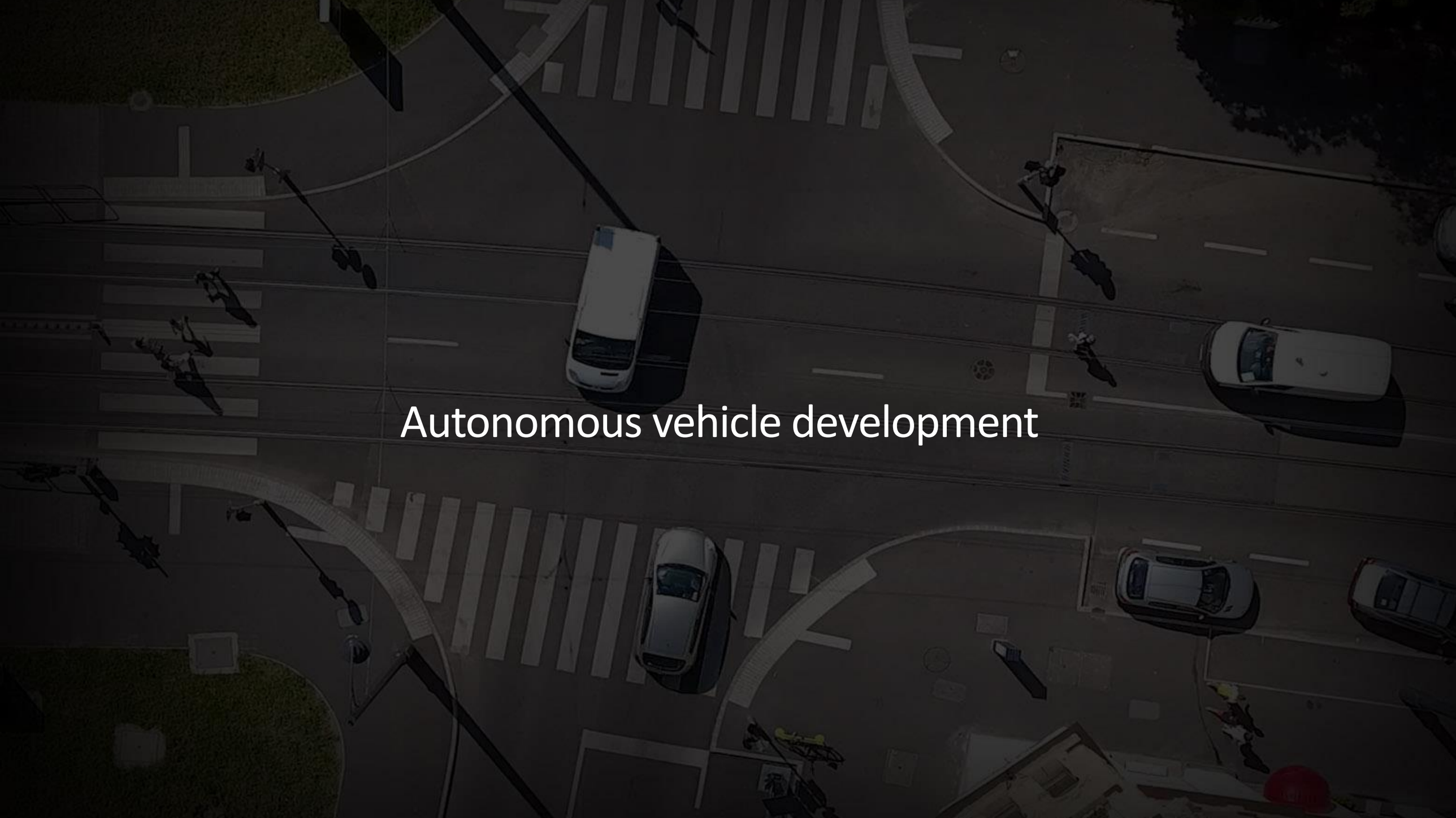
Image: www.autoevolution.com

DARPA Urban Challenge (2007)

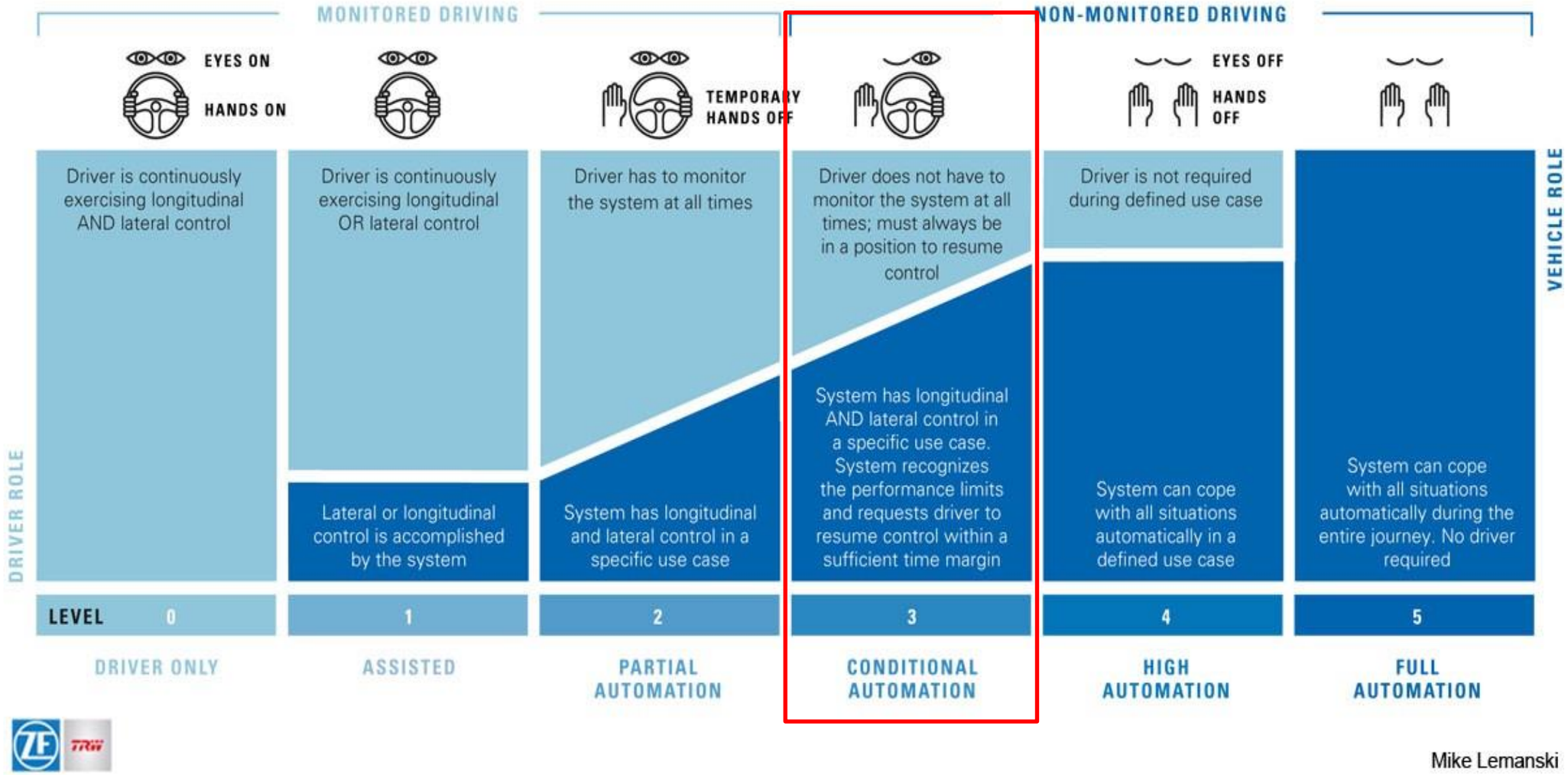
Image: www.roadtalk.worldpress.com

Today

Images: Tesla, Aptiv, Uber, Waymo, Cruise, nuTonomy, Aimotive, Pony.ai, Aurora, Argo AI, Mobileye, Nuro, Baidu Apollo, Zoox, Nvida, WeRide


Autonomous vehicle development

Levels of autonomy



Mike Lemanski

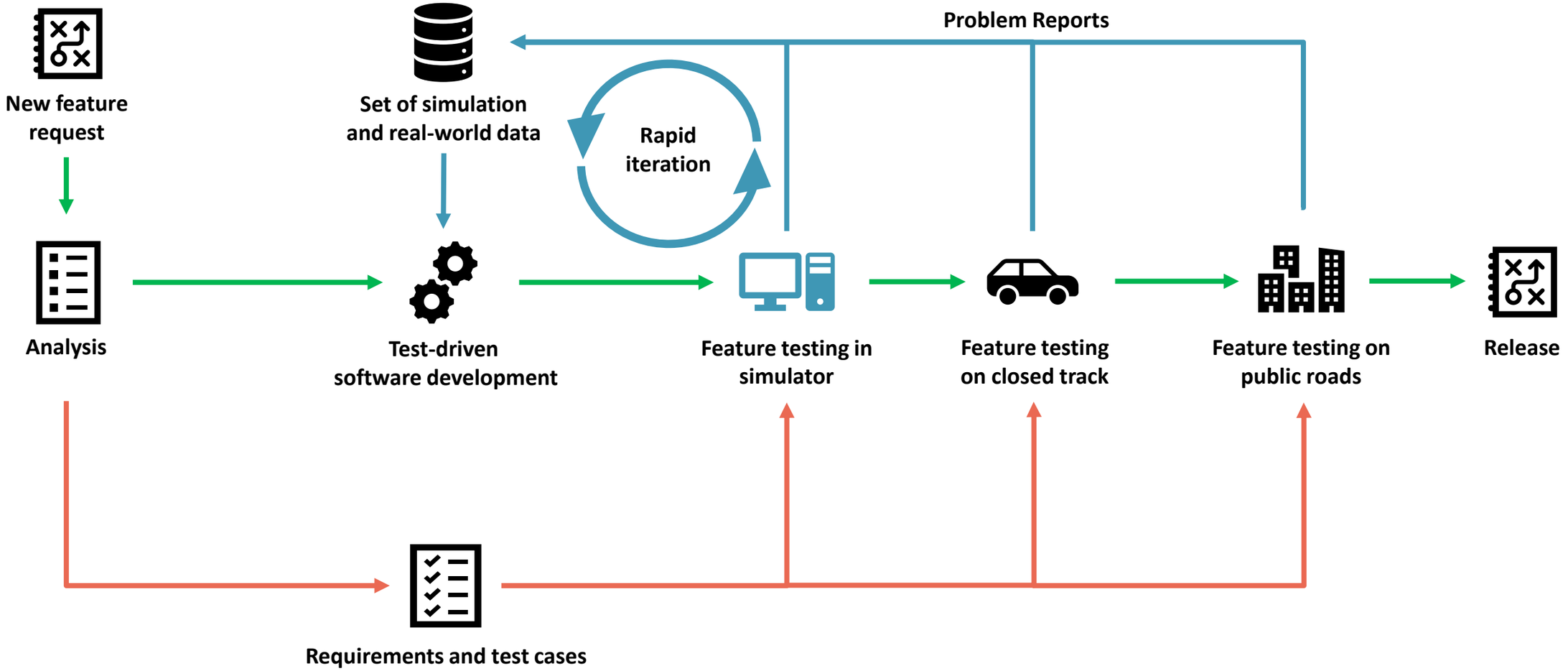
Components of autonomous vehicles

- Perception
- Localization and Mapping
- Prediction
- Planning
- Control

Image: www.shutterstock.com

- Actuation
- Human-Machine Interface
- Safety System
- Redundancy
- Vehicle-to-Everything

Development pipeline

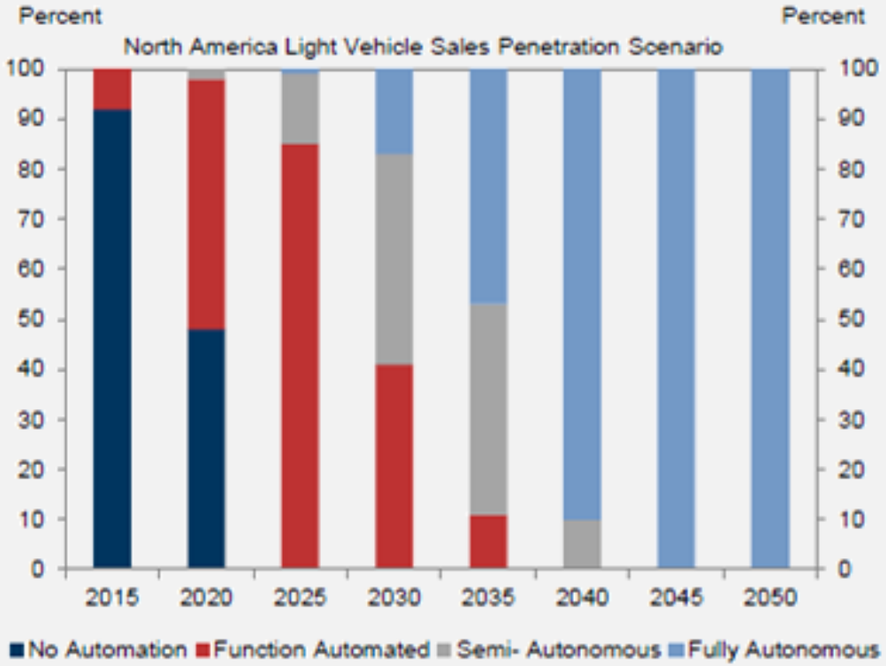



When can the technology be deployed?

Transition

Source: Rocky Mountain Institute

Forecasting the future in 2015

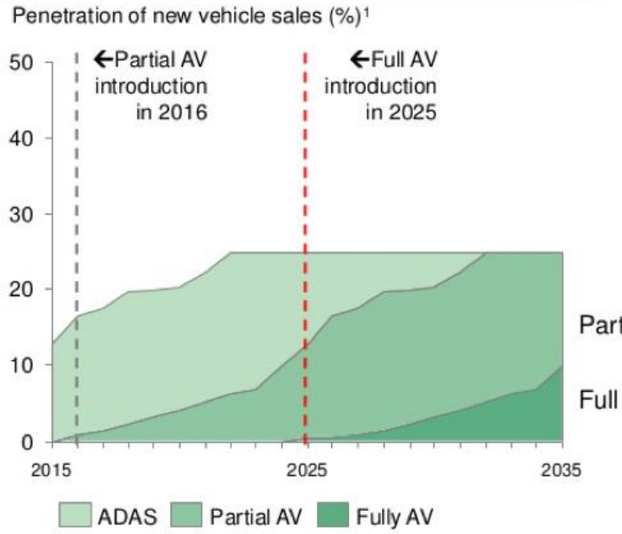


Source: Goldman Sachs Global Investment Research

By 2035, 12 million full AV units could be sold a year globally

Market for partial and full AV features expected to grow from ~$42B in 2025 to ~$77B in 2035

In 2035, 25% of market to be AV sales with 15% partial and 10% full AV systems



Represents 12M full AVs and ~18M partial; ~$77B market for AV features in 2035

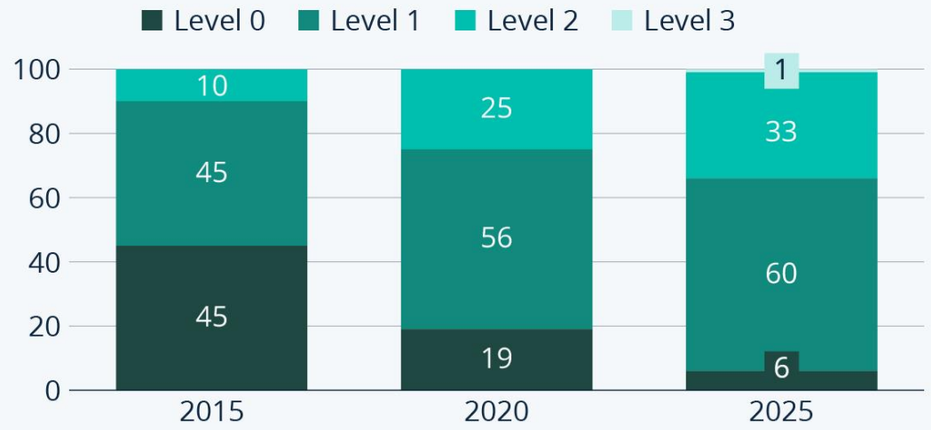
	2025 global sales			2035 global sales		
	Share (%)	Volume (M)	Sales[3] ($B)	Share (%)	Volume (M)	Sales[3] ($B)
	Estimated global new light vehicle sales: ~111M[2]			*Estimated global new light vehicle sales: ~122M[2]*		
Partial	12.4%	13.9	36	15.0%	18.4	38
Full	0.5%	0.6	6	9.8%	12.0	39
Total			$42bn			$77bn

Source: Boston Consulting Group

Forecasting the future in 2023

Cars Increasingly Ready for Autonomous Driving

Estimated share of newly registered cars worldwide by autonomous driving level

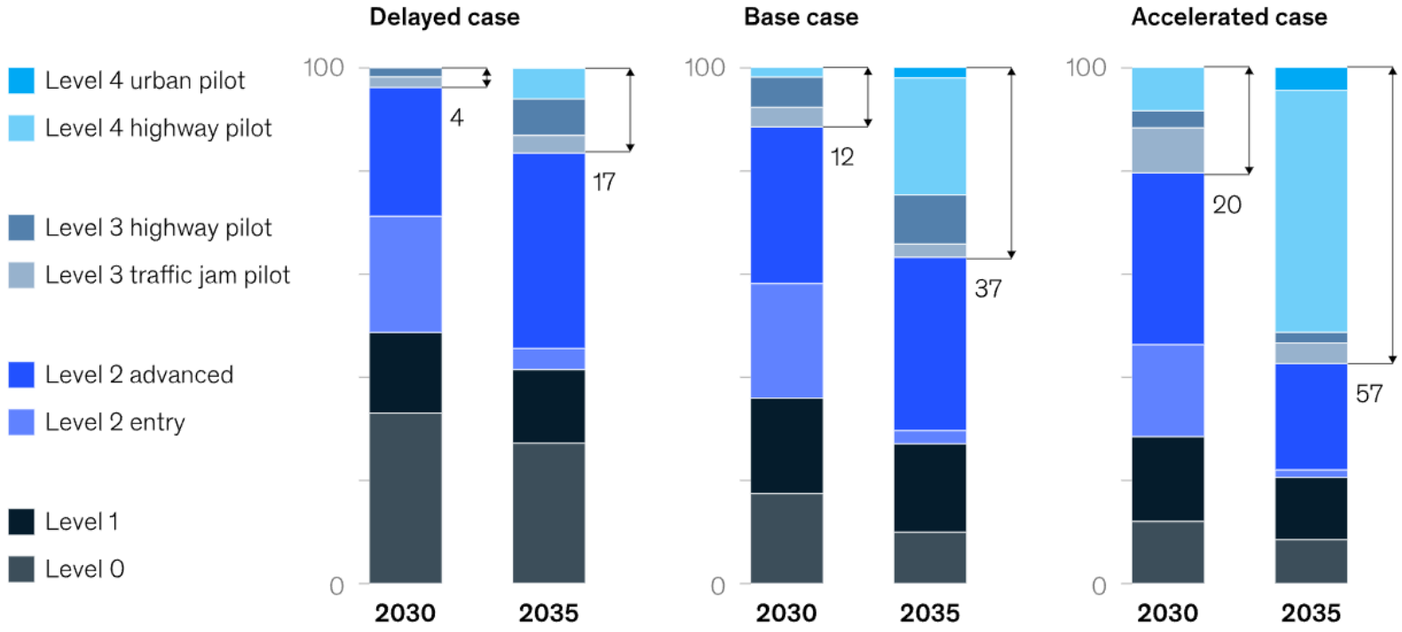


Level 0 = no autonomous driving
Level 1 = partly assisted driving (steering OR braking)
Level 2 = assisted driving (steering AND breaking below 60 km/h)
Level 3 = highly autonomous driving
Source: Statista Market Insights

statista

Three scenarios for autonomous-passenger-car sales in 2030 and 2035 show varying levels of consumer adoption.

Estimated passenger vehicles sold with autonomous-driving technologies installed, %



Source: McKinsey Center for Future Mobility

McKinsey & Company

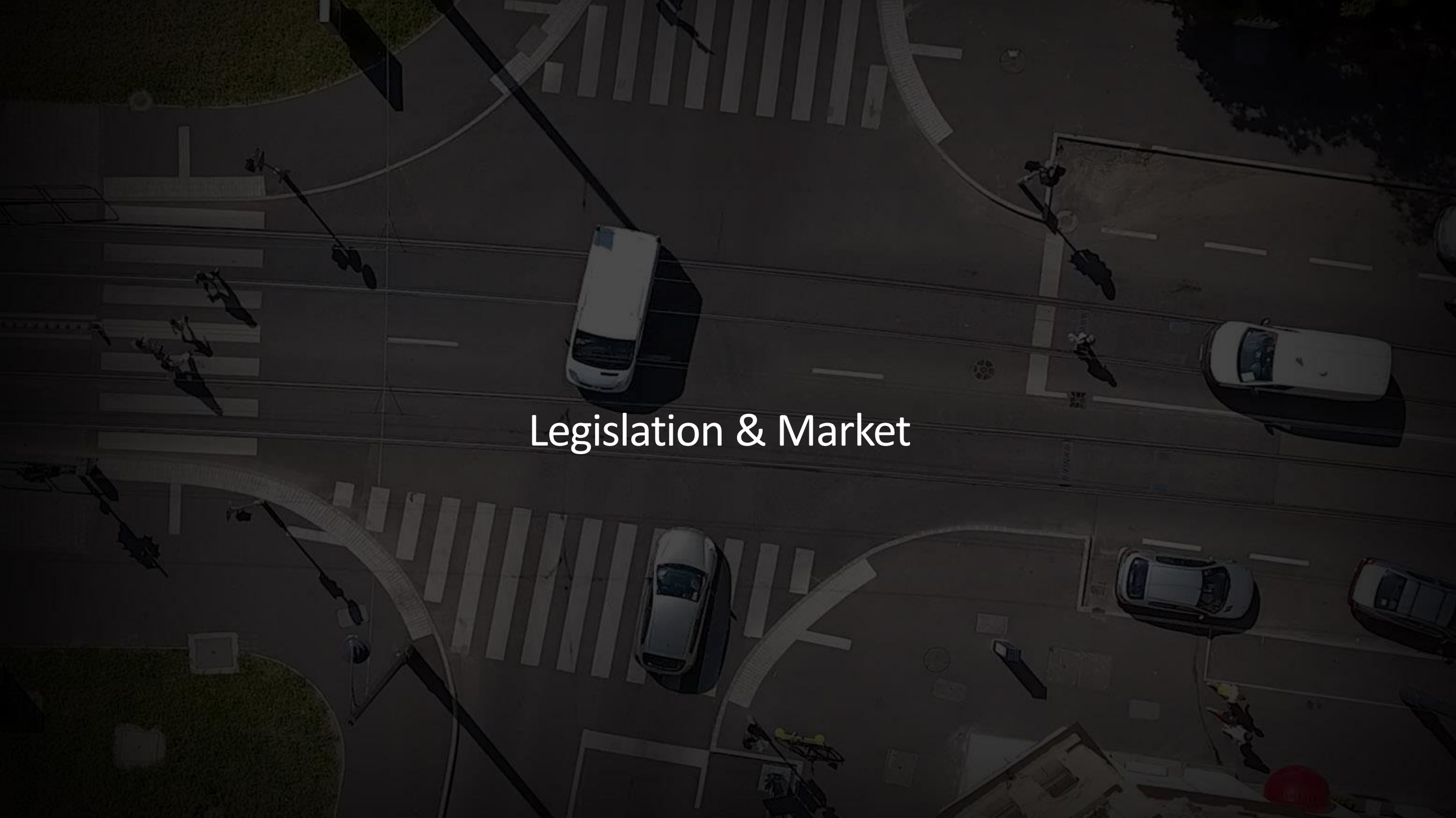
When does it become reality?

Technology

Legislation

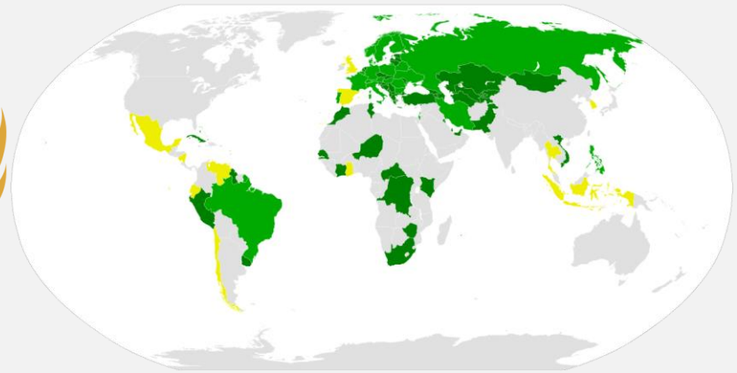
Market

Social acceptance



Legislation & Market

Is self-driving legal?



Vienna Convention on Road Traffic 1968

Driver must always have full control over the vehicle.

2021: modified law in Germany
for new Audi A8 (Level 3) car

Driver can be human as well as software

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

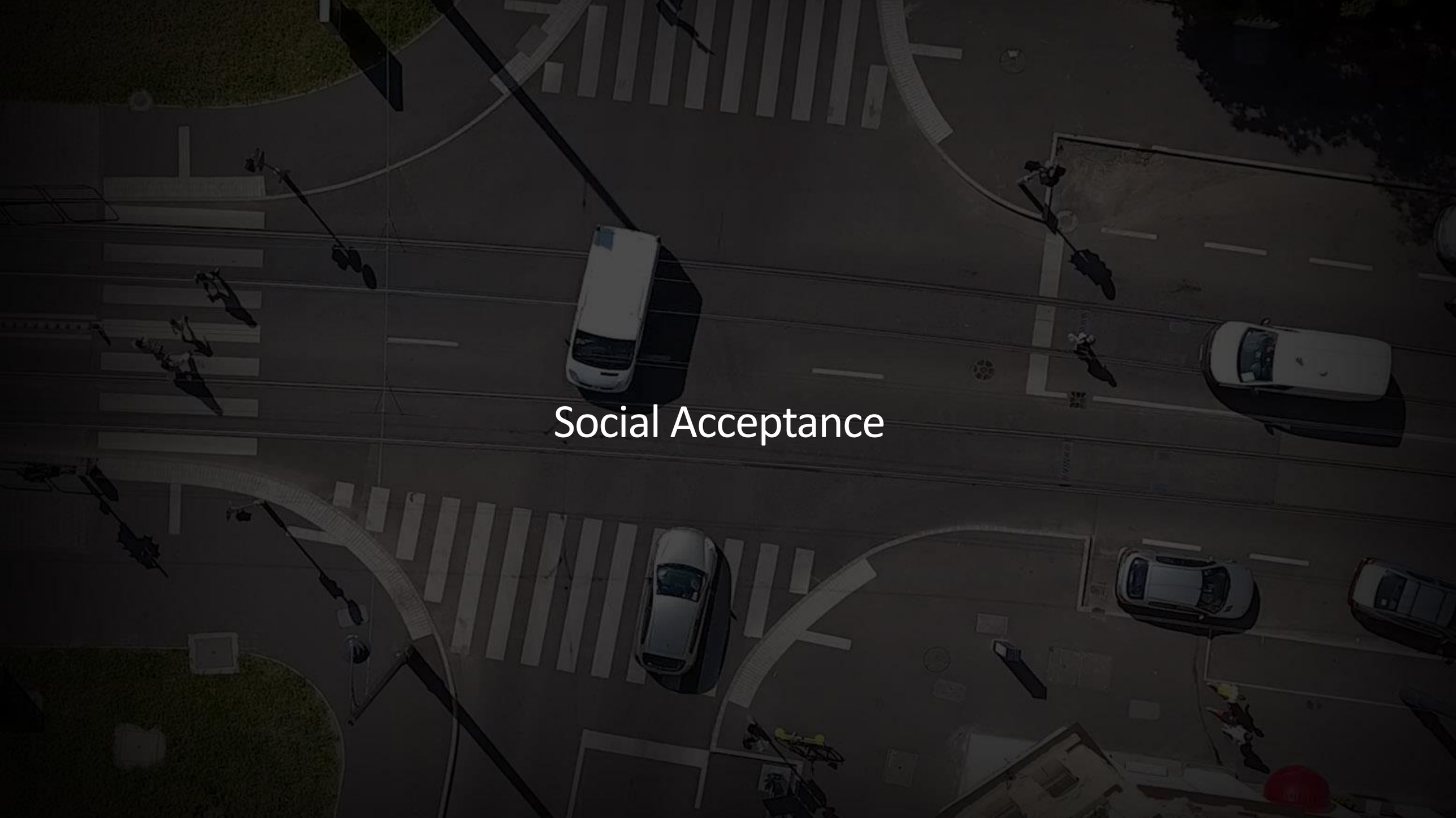
Who takes the responsibility?

- In case of an accident, who takes responsibility?

1. Passenger
2. Vehicle operator
3. Car manufacturer
4. Component manufacturer
5. Technology provider

- Multiple defandants: prosecution based on black box information
- The responsibility of car manufacturers increases
- Increased liability raises the price of self-driving cars and delays their market penetration
- Governmental task: participation in designing insurance policies and liability strategies for faster market penetration
  - England & Wales: Automated and Electric Vehicles Bill
  - Special type of insurance, insurer is always liable

Image: www.wacopersonalinjurylawyer



Social Acceptance

Ethical questions

Will self-driving cars be programmed to make moral decisions?

Image: www.bigthink.com

Ethical dilemma

J. Bentham

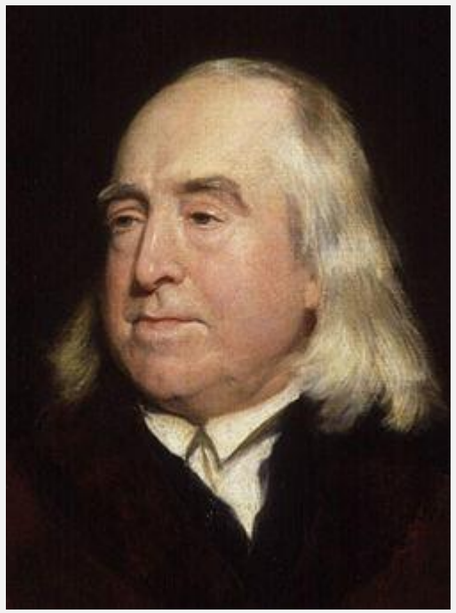
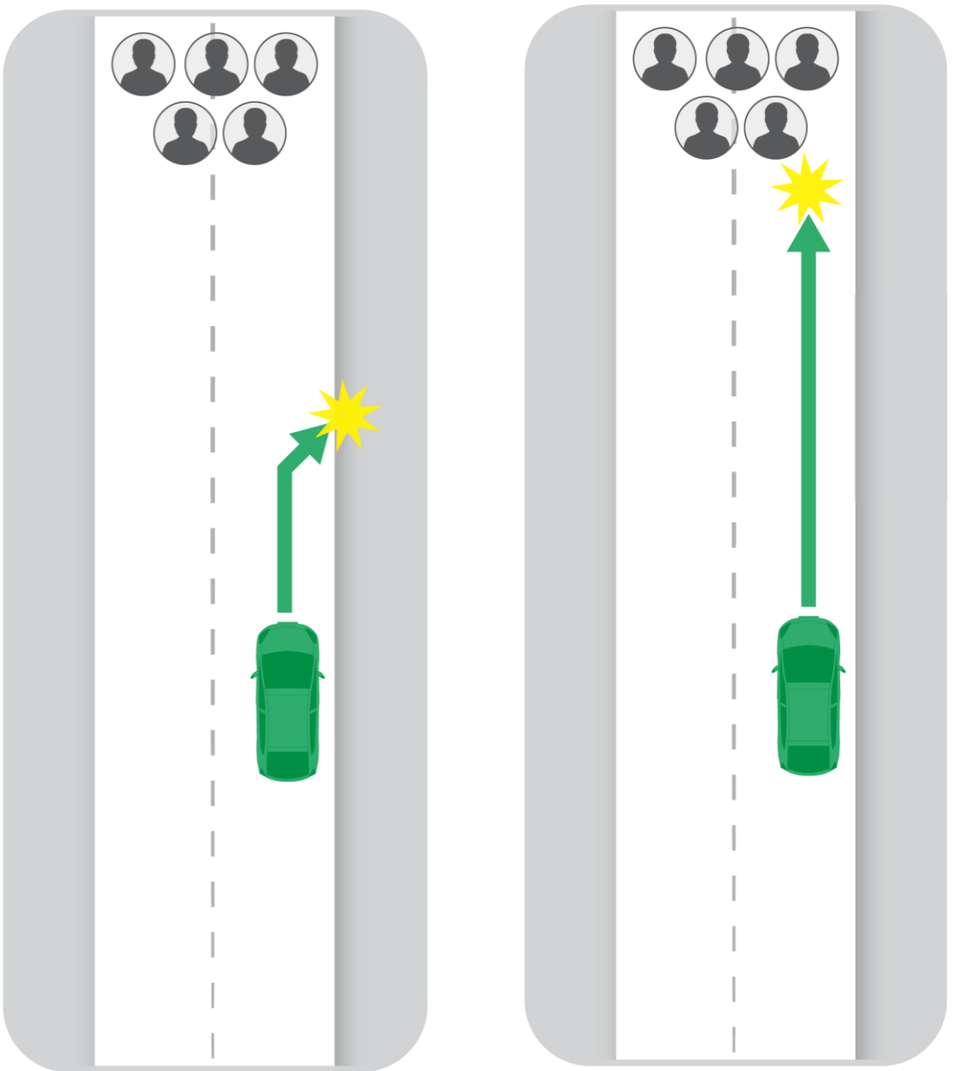
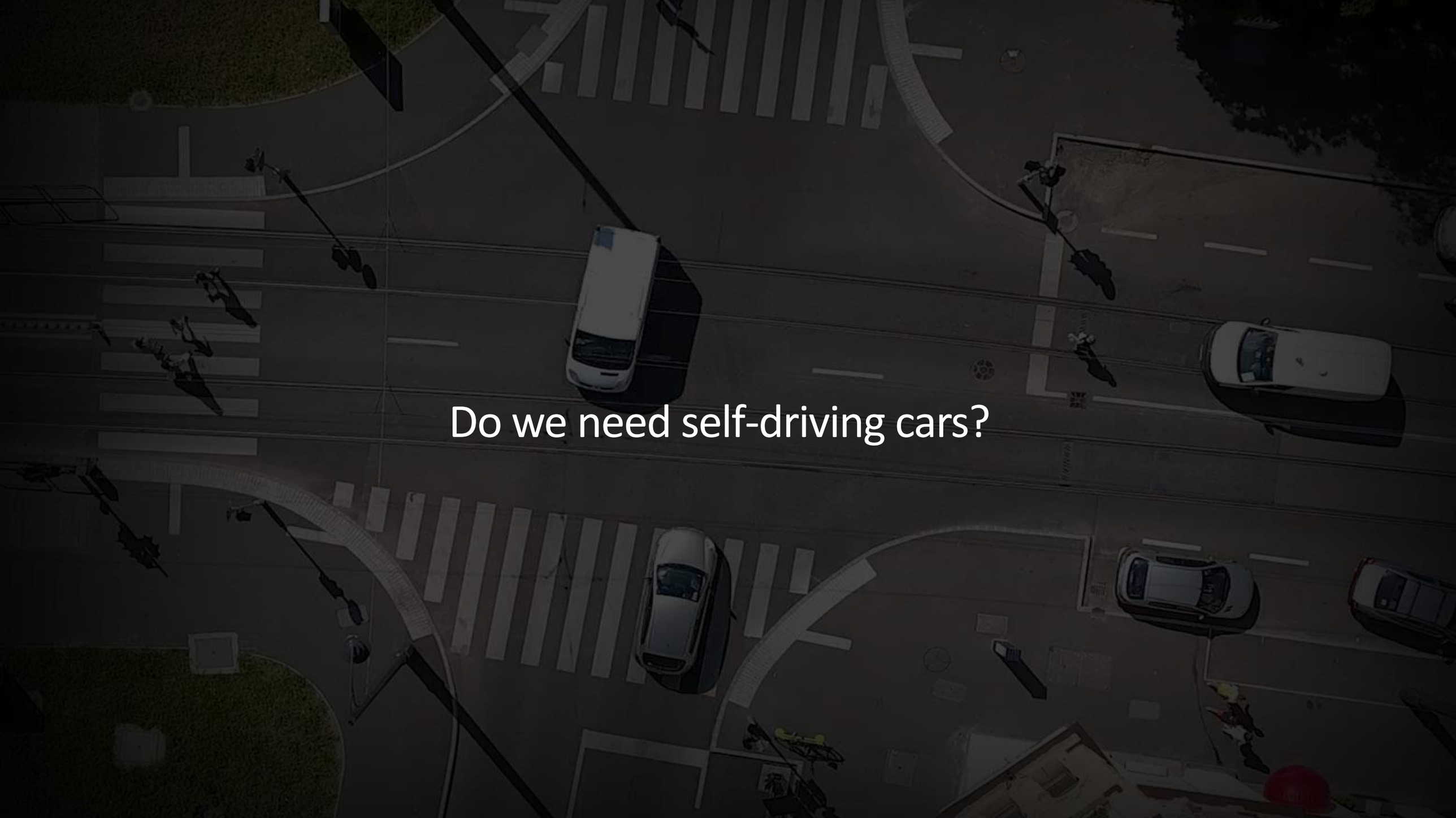


Image: www.wikipedia.org

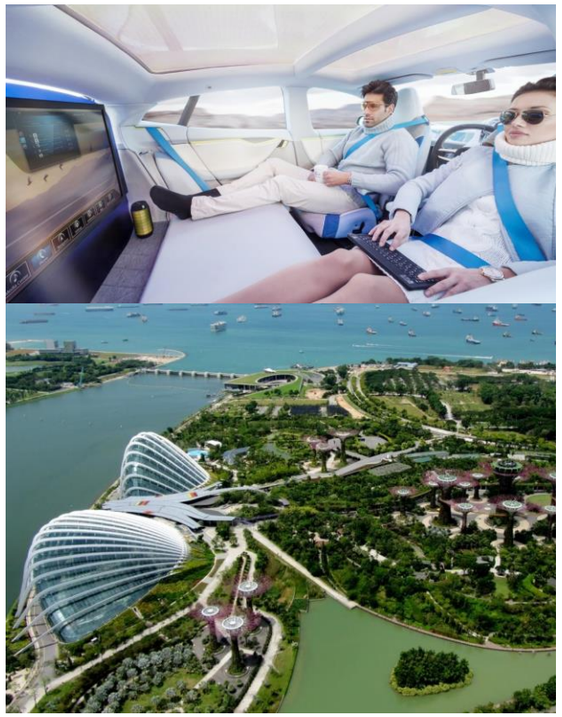


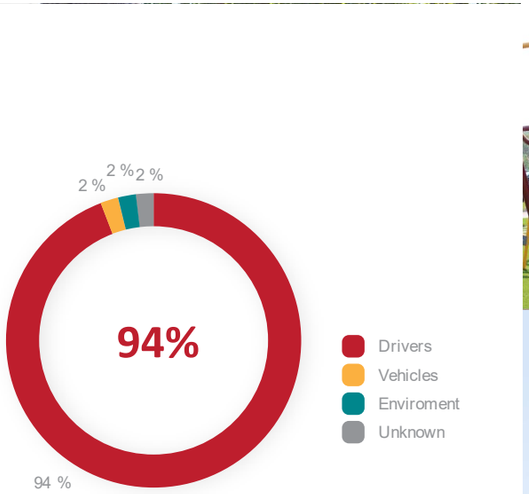
I. Kant

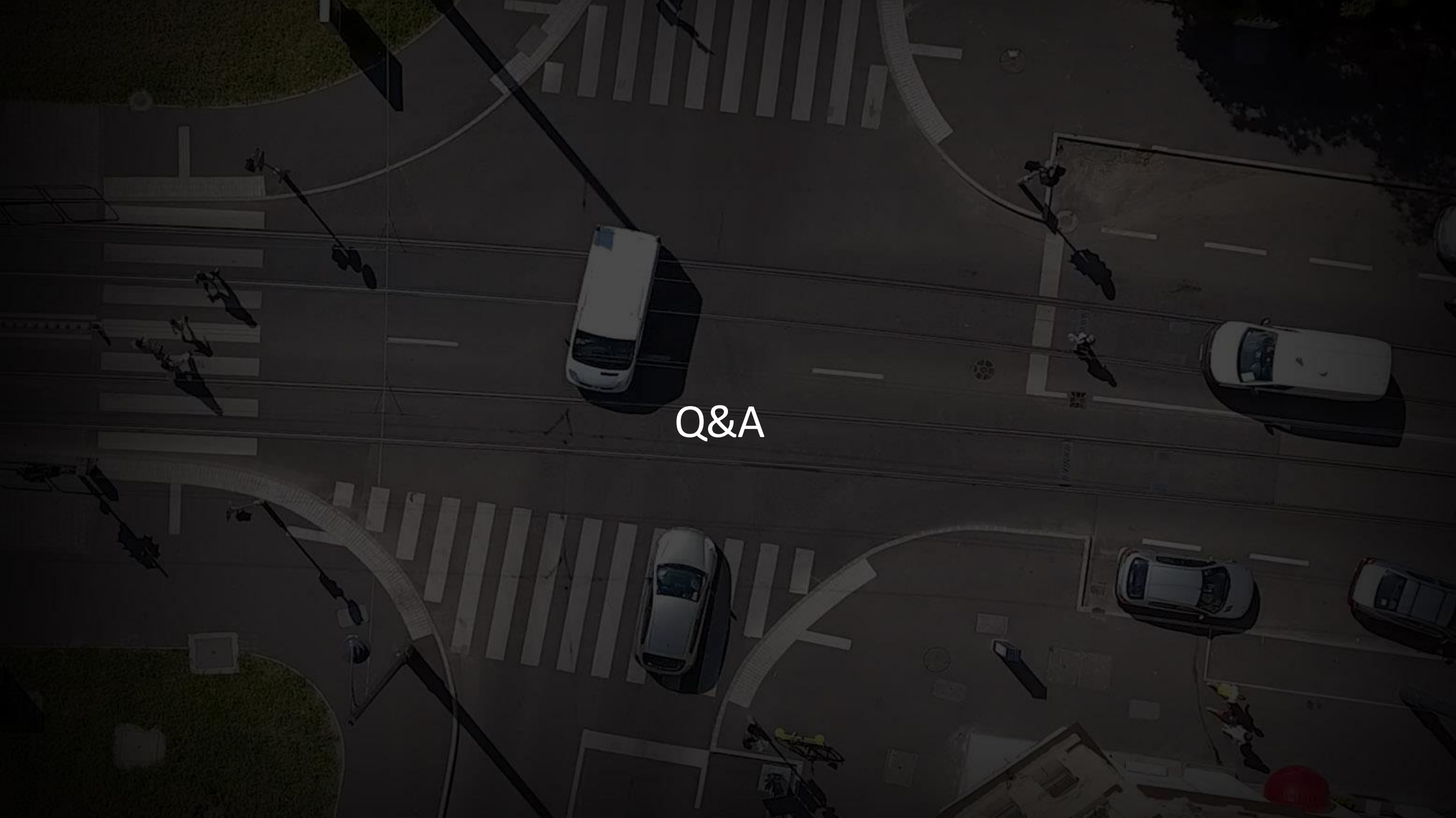
Image: www.wikipedia.org


Do we need self-driving cars?

Take home message






Q&A