



**LRA**Vejmarkering

**GEVEKO** MARKINGS

SARSYS-  
ASFT

**SVEVIA**



**YIT**

LG KONSULT I VBG AB

**Skilte eXpressen**



**Norskilt**

**Vägmarkering AB**

**proceq**



A PART OF  
**FORCE**  
TECHNOLOGY

**BORUM**



**RAMBOLL**

**ColorPoint**

**PROMAX**

**TRYSIL MASKIN**



# Skandinaviska fakta



## Sweden



**Inhabitants**  
10 million  
**Killed in traffic 2017**  
254 (2,5 per 100 000 inh.)

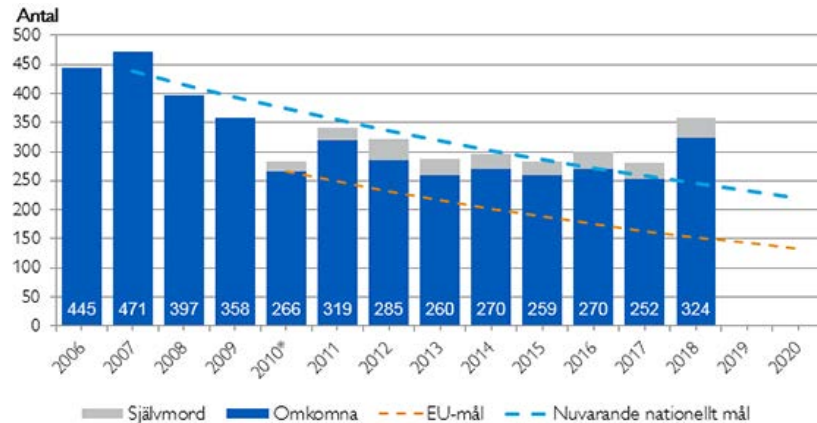


**Highway**  
2 150 km



**Road total**  
215 000 km

Vägmarkering  
statliga vägar ca  
250MSEK (2019)



## Denmark



**Inhabitants**  
5,8 million  
**Killed in traffic 2017**  
175 (3,0 per 100 000 inh.)

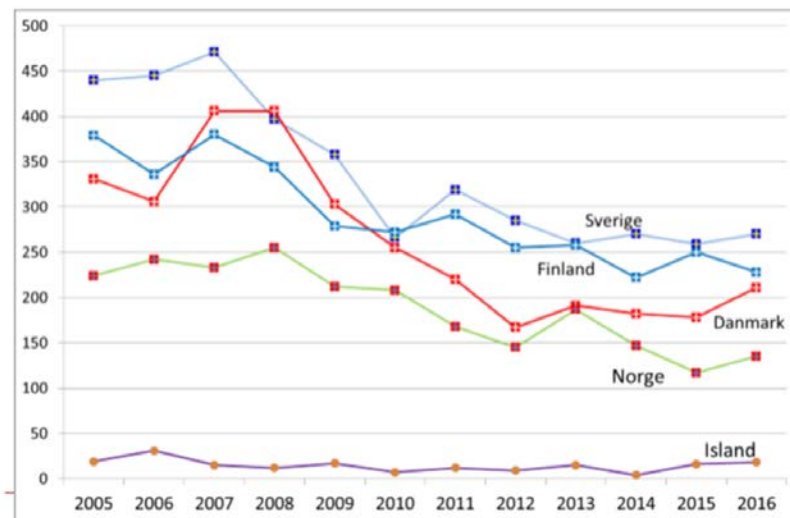


**Highway**  
1 200 km



**Road total**  
75 000 km

Vägmarkering  
statliga vägar  
370MNOK  
(2017)



## Norway



**Inhabitants**  
5,2 million  
**Killed in traffic 2017**  
109 (2,1 per 100 000 inh.)



**Highway**  
999 km

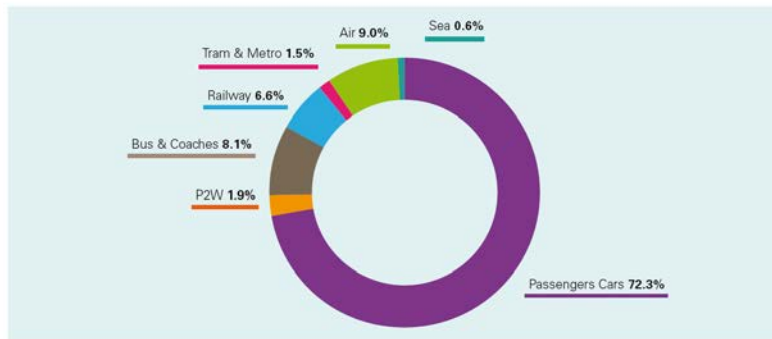


**Road total**  
144 000 km

# Transporter inom EU

## 6.3 Passenger transport modal split in EU 28, 2013 (pkm in %)

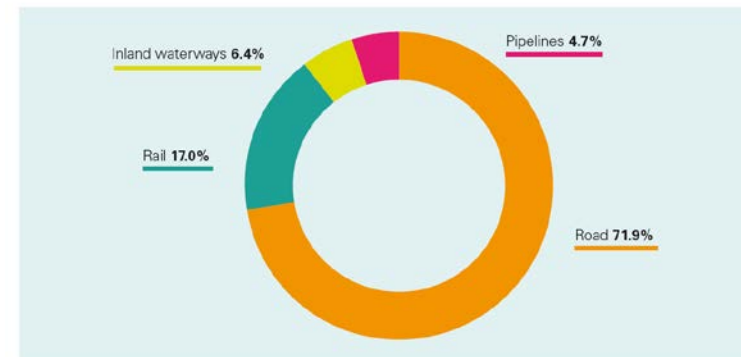
Source: EC



Air and Sea: only domestic and intra-EU 28 transport; provisional estimates  
P2W: Powered two-wheelers

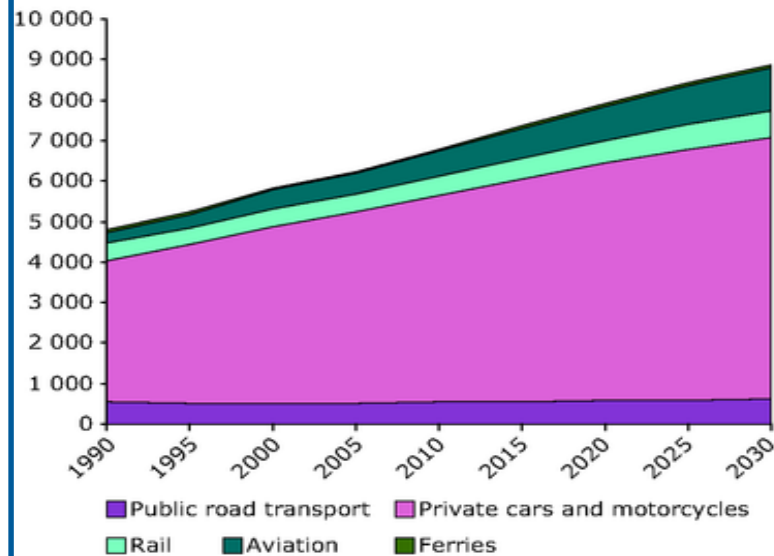
## 5.4 Inland transport modal split in EU 28, 2013 (% of tkm)

Source: EC

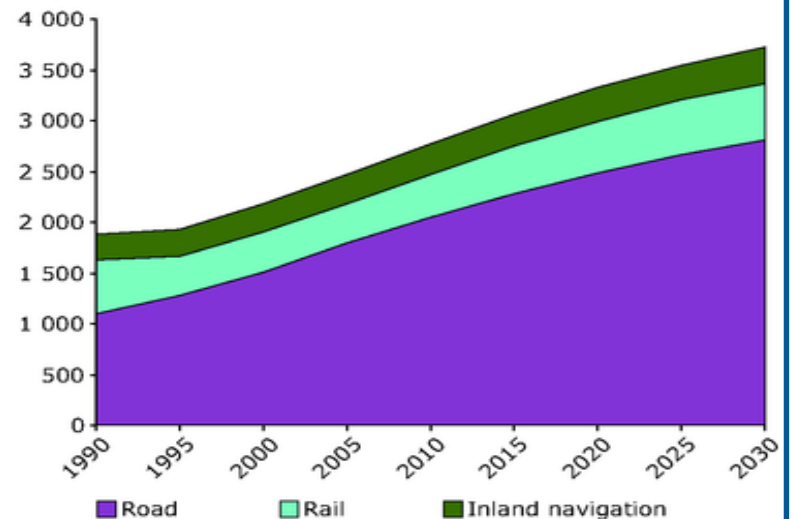


Road: national and international haulage by vehicles registered in the EU 28

## Gpkm (passenger transport activity)

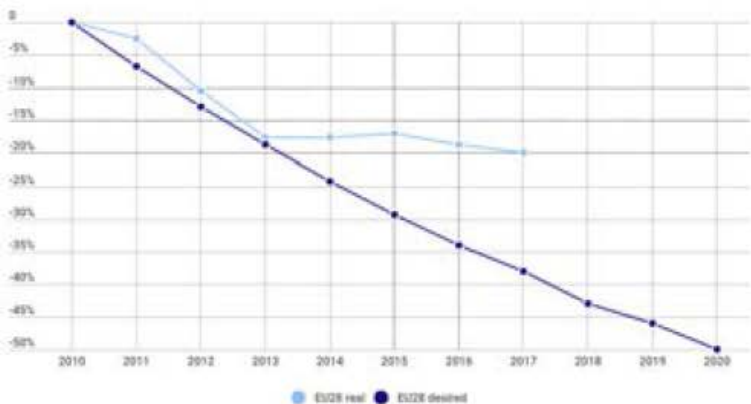


## Gtkm (freight transport activity)



## Motivation

Widening gap between the actual and desired progress towards the EU 2020 target



Source: European Transport Safety Council (ETSC), <https://etsc.eu/euroadsafetydata/>



## European Commission's 3rd Mobility Package

General Safety Regulation (GSR) & Road Infrastructure Safety Management (RISM) Directive to save extra lives (2020 -2030)

### Synergy for Road Safety

- Mandatory ADAS (ELKS and ISA) by 2024 – **Done !**
- Improved infrastructure for both humans and **ADAS: Signs & Lines**



#### General Safety Regulation

- Save 7300 lives
- Prevent 38900 Serious Injuries

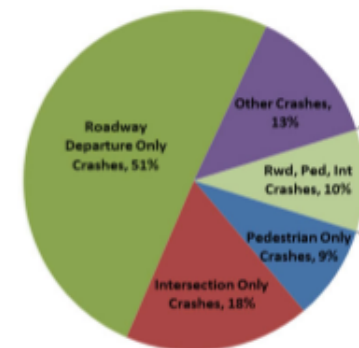
#### Road Infrastructure Safety Management

- Save 3200 lives
- Prevent 20700 Serious Injuries

## Safety Potential of Key ADAS Features

- Lane Departure Warning (LDW)
  - 9,020 fatal crashes (29% of all fatal crashes)
  - 21% of all injury crashes
- Forward Collision Warning (FCW)
  - 800,000 crashes (14% of all crashes) + 750 fatal crashes
- Blind Spot Monitoring (BSM)
  - 267,000 crashes + 280 fatal crashes

**Fatalities (FHWA)**



### References:

- Harper, C. D., Hendrickson, C. T., Samaras, C. *Cost and benefit estimates of partially-automated vehicle collision avoidance technologies. Accident Analysis & Prevention, 95, 104–115. 2016*
- IIHS, *Status Report, Vol. 52, No. 6, August 23, 2017*

# Målsättning för Danmark?

## Targets



**Increase visibility  
for humans and autonomous vehicles**



**Increase safety, comfort and improve  
traffic flow**



**Reduce noise**



**Low costs and  
increase sustainability**

# Målsättning för Sverige?

## Propositionen kring självkörande fordon dröjer

SVMF har lämnat ett remissvar på utredning i förra året. Senaste status från regeringskansliet är att arbetet med propositionen fortgår. De förslag som berör olika former av försök i skarp trafik kommer prioriteras. Men andra delar som också berör internationella regelverk när det gäller självkörande fordon ligger fortfarande långt fram och regeringen kan i dagsläget inte ge någon exakt tidpunkt när en proposition i frågan kommer att läggas.

Från: [lena.erixon@trafikverket.se](mailto:lena.erixon@trafikverket.se) <[lena.erixon@trafikverket.se](mailto:lena.erixon@trafikverket.se)>

Skickat: den 28 oktober 2019 11:04

Till: Göran Fredriksson <[gf@sbsv.se](mailto:gf@sbsv.se)>

Kopia: Thomas Wuopio <[tw@sbsv.se](mailto:tw@sbsv.se)>; [lennart.wahlund@svbrf.se](mailto:lennart.wahlund@svbrf.se);

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[gd-sekreterare@trafikverket.se](mailto:gd-sekreterare@trafikverket.se)

Ämne: Dialog säkerhetsfrågor

Hej Göran,

Precis som du skriver är det viktigt med en fortsatt dialog kring säkerhetsfrågorna. Den planerade workshopen i juni såg jag som ett viktigt steg och en möjlighet att fortsätta det gemensamma arbetet och där lämpliga representanter för Trafikverket skulle delta. Tyvärr blev den inställd. Jag håller med dig om att samtalen ska föras på rätt nivå och har därför bett avdelningschef Ulrika Honauer att se till att den planerade workshopen kommer till stånd vid ett nytt datum. Ulrika har redan vidtalat sin medarbetare Magnus Ljungberg att kontakta er och återuppta planeringen. Därmed är jag övertygad om att samtalen kommer föras vidare på ett bra sätt med rätt personer inom Trafikverket.

Med vänlig hälsning

**Lena Erixon**

Generaldirektör

[lena.erixon@trafikverket.se](mailto:lena.erixon@trafikverket.se)

Direkt: 010-123 20 00

**Trafikverket**

781 89 Borlänge

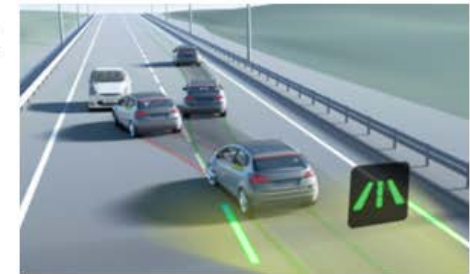
Besöksadress: Röda vägen 1

[www.trafikverket.se](http://www.trafikverket.se)



## EuroNCAP & Lane Keeping

- **UNECE WP29 (Geneva)** develops the official type approvals for ADAS.
- **Lane Keep Assist (LKA)** systems help to correct the course of a vehicle that is gradually veering out of its lane.
- **Emergency Lane Keeping (ELK)** systems intervene much more aggressively, only when a critical situation is detected. For example, ELK will apply a large steering input if it senses that a car is about to run off the road.
- **Euro NCAP** rewards LKA and ELK systems, based on a standard set of tests performed on a test track. Both types of system are tested against various types of road-markings, including solid lines and dashed lines, and in situations where the road edge is not marked by a line.
- Additional points are awarded to cars equipped with a **Lane Departure Warning** system and a **Blind Spot Monitoring** system.



# Emergency Lane Keeping System (ELKS)

## Proposal for alternative approach for dashed lane markings

### Objectives of the GSR with regard to ELK?

- Prevent lane departure when there is a risk of a collision with another road user
- Prevent lane departure towards a road edge
- Keep driver annoyance to a minimum in order to avoid deactivation by the driver

### Current approach

- Allow deactivation of ELK for dashed lane markings when the vehicle is fitted with threat detection on both sides and road edge detection
- Otherwise allow deactivation on the driver's side only

### New approach

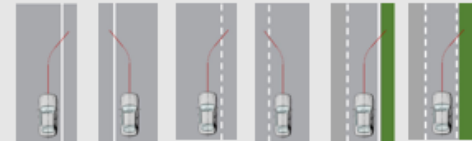
In case of unintended lane departure...

- Mandate an intervention on solid lane markings
- Mandate a warning for dashed lane markings, regardless of whether there is a threat or road edge or not.

### Advantage of new approach

- No need for the Regulation to define necessary performance for threat detection.
- No need for the Regulation to find applicable provisions for road edge description.

### Scenarios that would be covered by the new approach



### Justification, why mandating a warning is sufficient

- Plenty of evidence to show the effect of a warning to the driver
- Warnings are more acceptable to the driver, which would decrease the risk over driver's switching the system off because of unjustified interventions.

### *Better understanding sensors (including their connectivity)*



1. **Lidar** is the master of 3D mapping. Lidar, short for light detection and ranging, is a technology that measures distance using laser light. The technology can scan more than 100 meters in all directions, generating a precise 3D map of the car's surroundings. This information is then used by car to make intelligent decisions about what to do next. The problem with lidar is that they generate a large amount of data and are still quite expensive for OEMs to cheaply implement.
2. **Radar** is the master of motion measurement. Radar, short for radio detection and ranging, is a sensor system that uses radio waves to determine the velocity, range and angle of objects. Radar is computationally lighter than a camera and uses far less data than a Lidar. While less angularly accurate than lidar, radar can work in every condition and even use reflection to see behind obstacles. Modern self-driving prototypes rely on radar and lidar to "[cross validate](#)" what they're seeing and to predict motion.
3. **Cameras** are the master of classification and texture interpretation. By far the cheapest and most available sensor (but not the cheapest processing), cameras use massive amounts of data (full HD means millions of pixel or Megabytes at every frame), making processing a computational intense and algorithmically complex job. Unlike both lidar and radar, cameras can see color, making them the best for scene interpretation.

[https://www.eetimes.com/author.asp?section\\_id=36&doc\\_id=1330069#](https://www.eetimes.com/author.asp?section_id=36&doc_id=1330069#)

# Camera Vision



## What can cameras see?



### Rule of thumb:

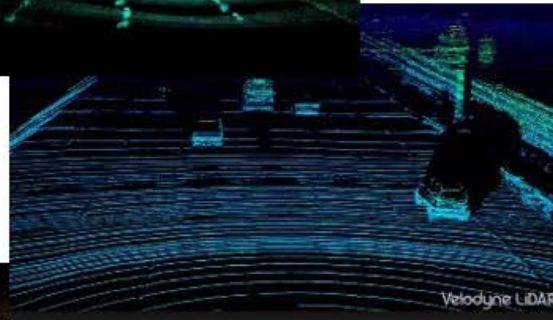
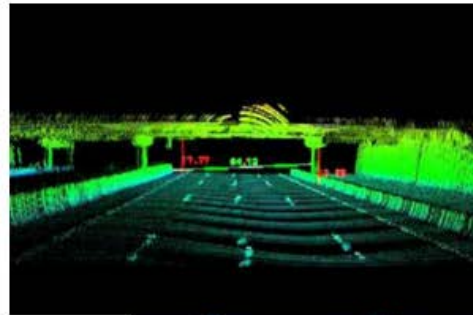
If you can't see it, the camera can't see it either.

(On the other hand if you can see it, the camera doesn't necessarily see it)

- Maintenance (i.e re-painting weak lane marks) is of the utmost importance.
- Robust markings which are visible in various lighting/weather conditions



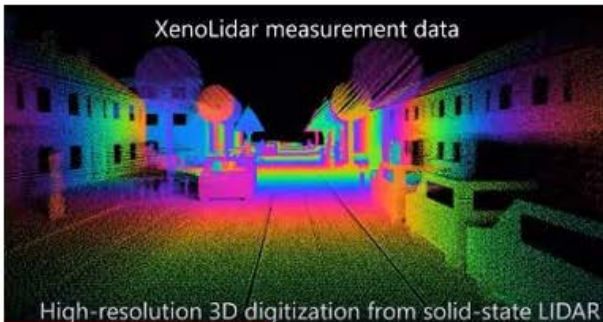
# LiDAR



### XenoLidar Key Features

- true solid-state LiDAR (no moving parts);
- highly compact sensing device;
- integration at various locations including the windshield;
- combining 3D point clouds & 2D images;
- high resolution and superior density;
- resilient to all light & weather conditions;
- long life expectancy and high durability.

- Detection of road markings and other road equipment depends on retro-reflective performance or high diffuse reflectivity.
- Day and night time vision have same principle : based on near-IR laser light emitted by sensor system.



CEN TC 226/WG12 – TG1

*Better understanding sensors (including their connectivity)*



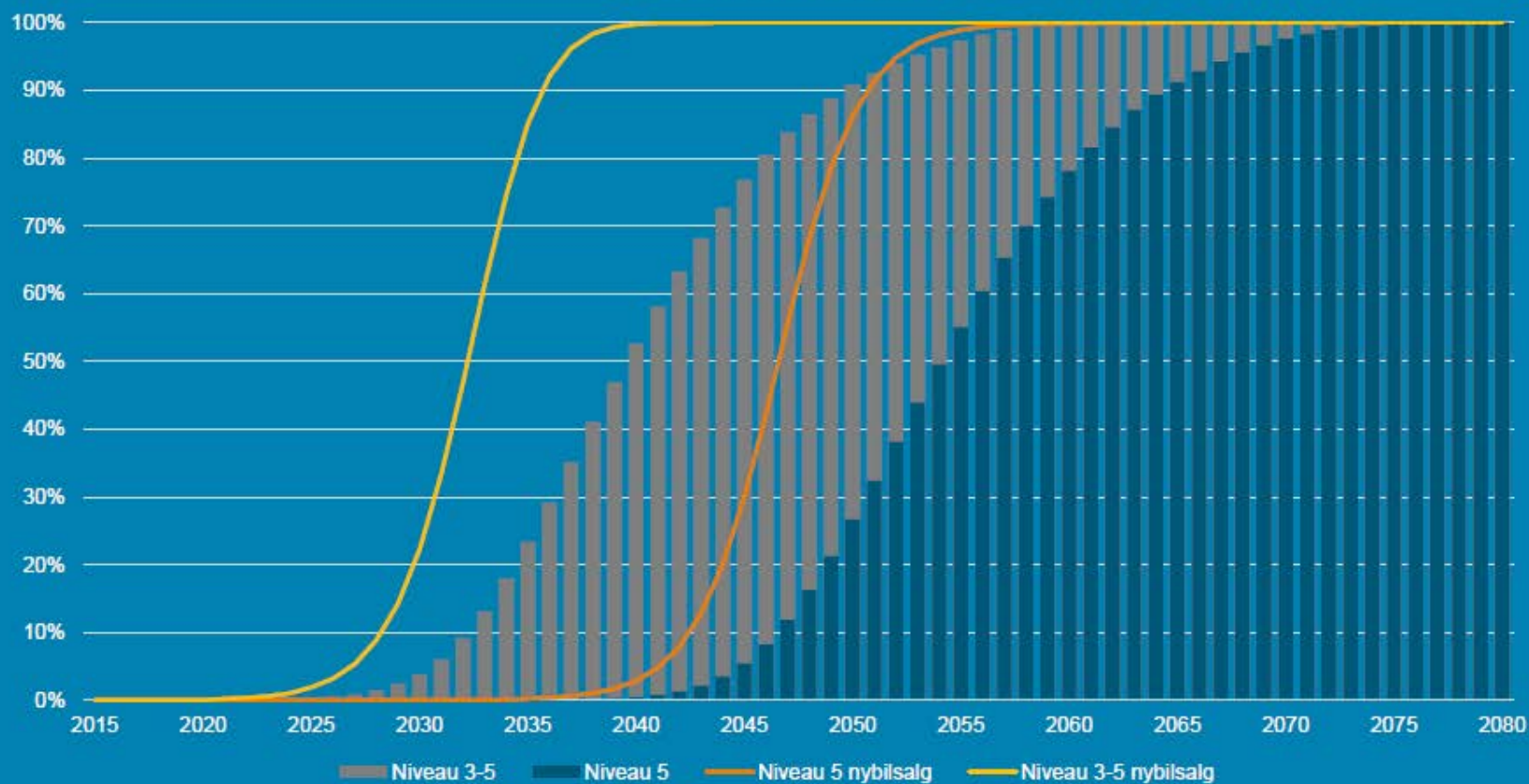
## Interim Conclusions TG1

- EN1436 already covers most aspects for Camera and LiDAR Sensors :
  - Point out the importance of Contrast Ratio
  - RR (Rain reflectivity) performance improves machine readability, but is not commonly tested due to its complexity.

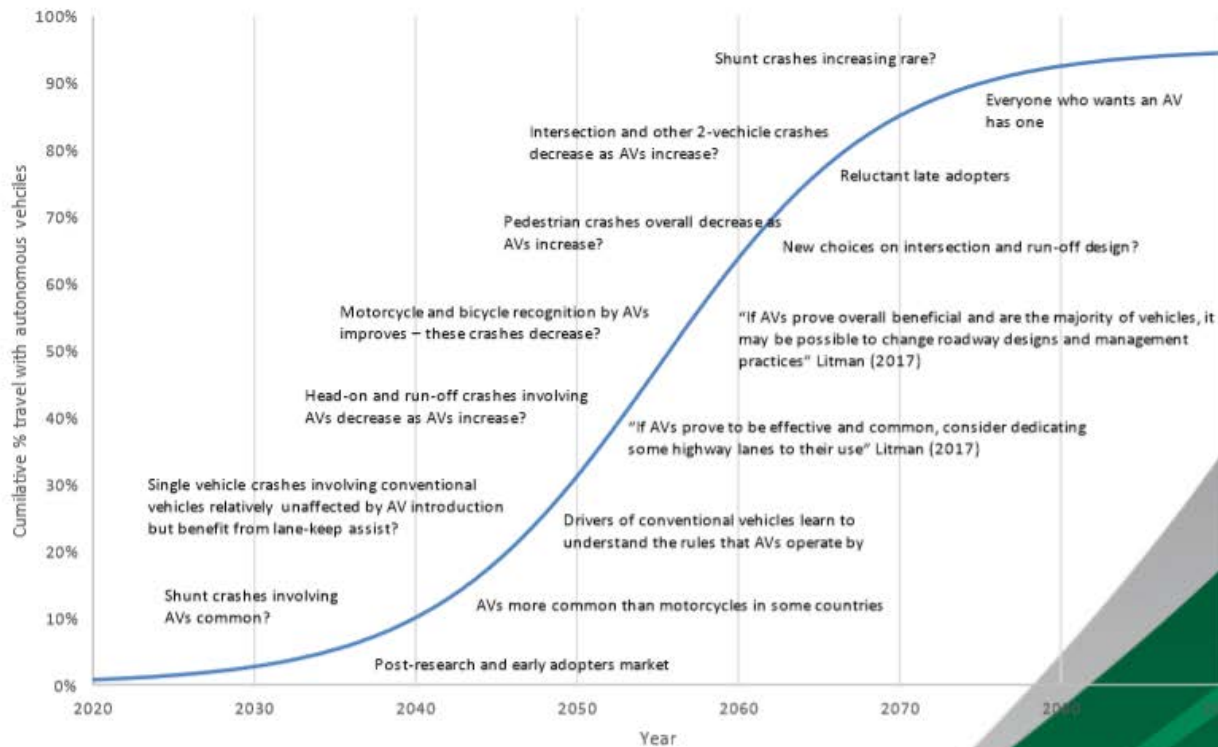
# Prognos på andelen AV



## Share of carpark

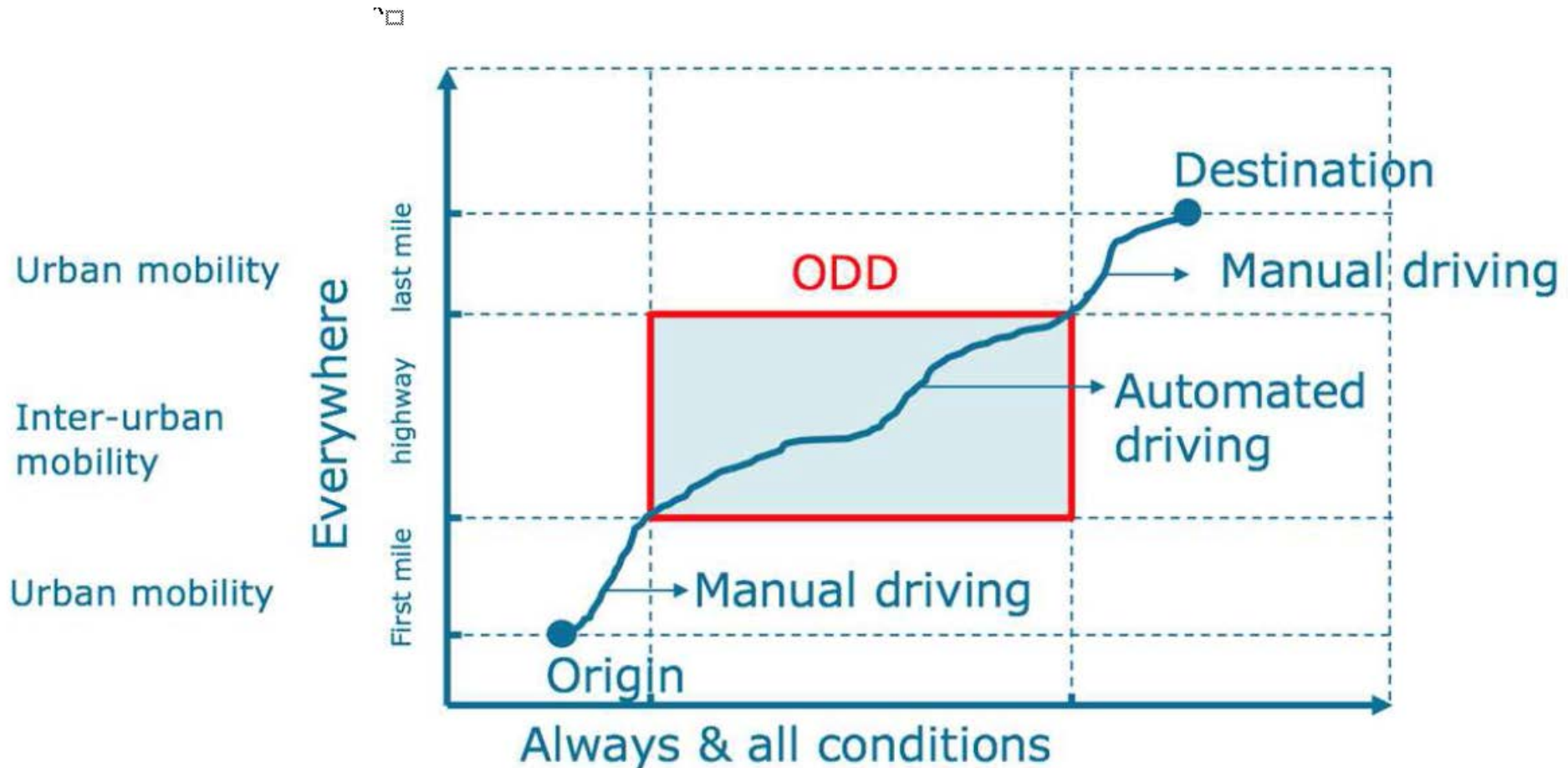


## AVs and Road Safety Roadmap





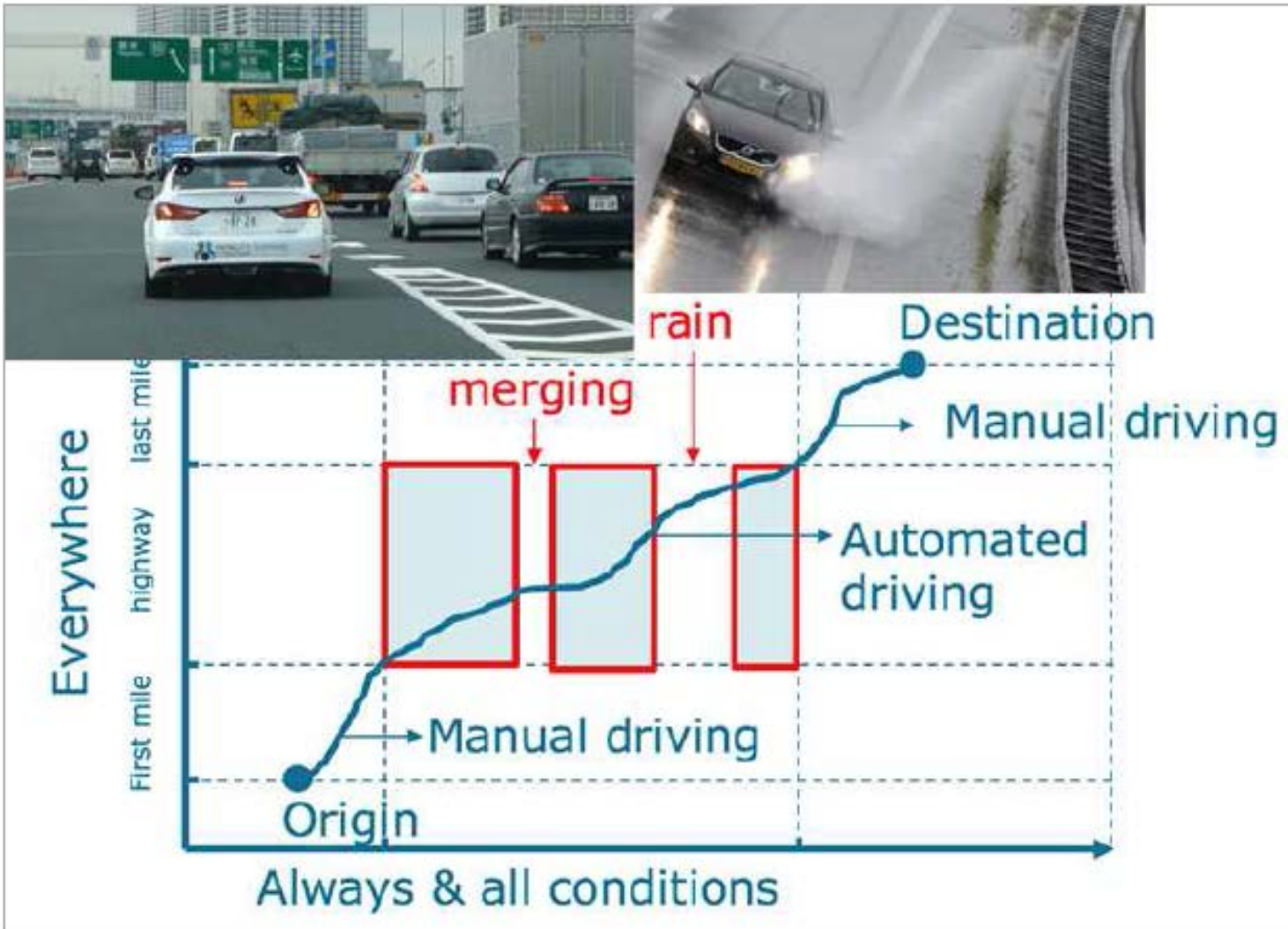
# Kombination av autonom och manuell körning



ODD Operational design domain

Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics". (SAE 2018)

# Kombination av autonom och manuell körning



## Preparing Highways for AV – Step 1

- For decades to come, there will be a mix of conventional vehicles and Automated Vehicles on the roadways
- Adopting a policy for six-inch wide pavement markings provides a solution that benefits both types of “drivers”
- Six-inch wide markings improve safety on rural two-lane highways and prepare roadways for Automated Vehicles

## Key Areas of Pavement Marking Needs

### Uniformity

- Uniform applications - most common challenge
- Pavement markings are the highest priority for today's vehicle technologies, which are building blocks for tomorrow's more fully automated vehicles

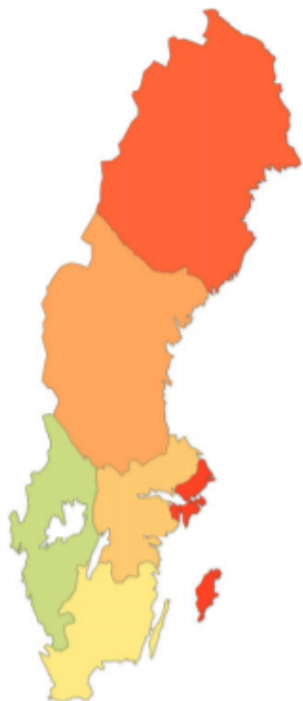
### Design / Quality

- Durable markings that remain visible in wet conditions, low-sun conditions, high-glare conditions, etc.

### Maintenance

- Maintenance criteria for machine vision systems

## SAMMANFATTNING

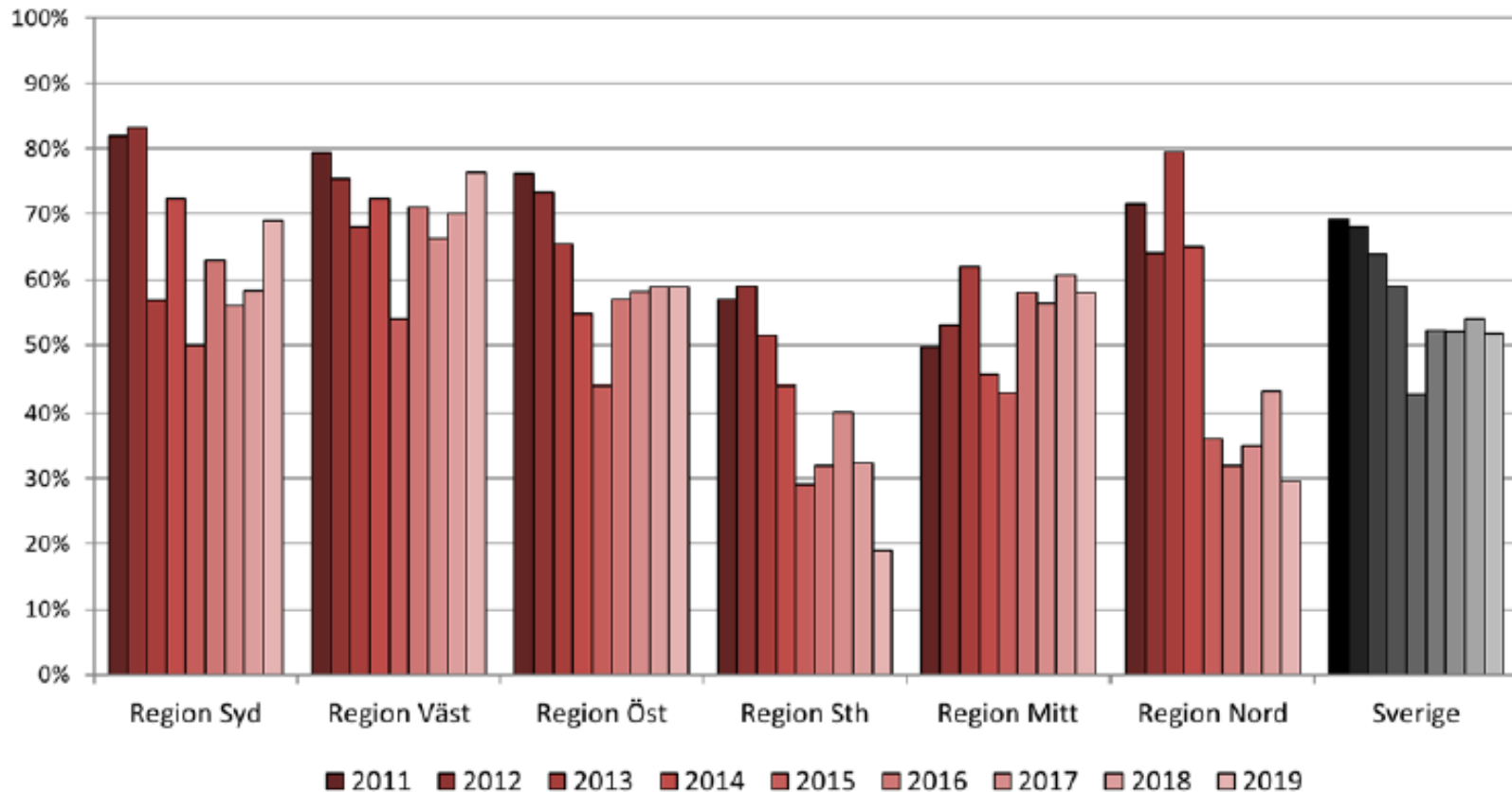


RAMBOLL

- Riket, andel godkänt  
 $Rl_{(torr)}$  49% [50%] (alla väglklasser) [2018]  
 $Rl_{(våt)}$  27% [26%] (där våtkrav gäller)
- Fortsatt uppåt för region Väst och Syd, nivå ca 70 % GK
- Öst och Mitt ligger stabilt på strax över 50 %
- Sämre resultat i region Nord och Stockholm, 28 resp 19% GK
- Ökade skillnader, både mellan regionerna och entreprenadformerna

# Tillståndsmätningar Sverige

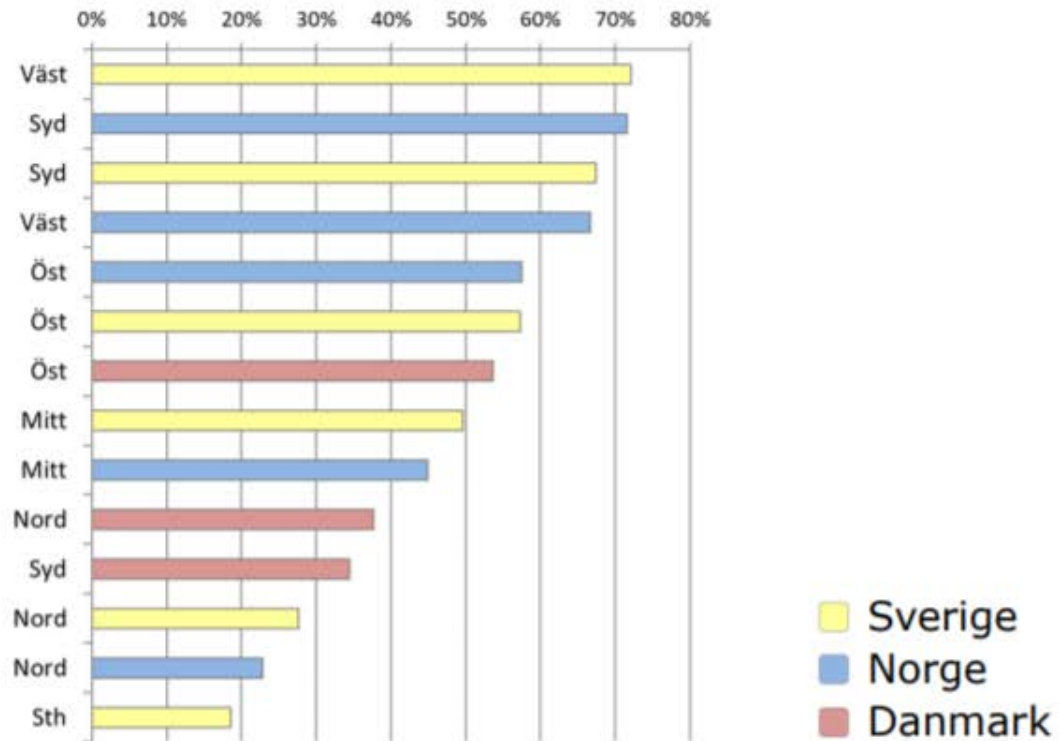
## ***Andel vägmarkeringslängd som uppfyller kraven 2011-2019, vägklass A-C, torr retroreflektion.***



## STATUS NORDEN - REGIONER

**2019  
(preliminärt)**

Andel godkänd  
vägmarkerings-  
längd per region



ERF Working Group Road Markings



## ERF technical recommendations to adapt CAVs - Road Markings

- Road Markings in night visibility should never drop below **150 mcd/lx/m<sup>2</sup> night visibility under dry conditions** and never below **35 mcd/lx/m<sup>2</sup> under wet and rainy conditions** (recent CAVs studies in US and EU also point in even higher performance levels) <sup>3</sup>
- The width of Road Markings should never be less than **15 cm**
- **Ensure a sufficiently high contrast ratio between marking and pavement.** While a contrast ratio of 3:1 appears sufficient, increased reliability can be achieved with a 4:1 ratio, mitigating possible false readings caused by glare and other critical conditions
- The **harmonisation of markings design and layout** across various countries improves the reliability for machine visibility and universality of automated vehicles





## Förslag på arbete till NMF

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- Förtydliga strategin för vägmarkering inom NMF
  - ✓ Produkt certifiering
    - Entreprenör certifiering
    - Asset management
- Initiera Projekt - ADAS förutsättningar i Norden
- Arbeta med SVMF för att skapa relevant databas för registrering av entreprenadarbete (inkl certifierade produkter och mängder)
- Arbeta med konkreta förslag på utformning av vägmarkering i förhållande till CAV's
- Arbeta för 3 års extraordinär budget på vägmarkering för att supportera CAV's och nollvisionen