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Development of technology and legislation related to electric and autonomous vehicles

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INTRODUCTION

- Deployment of electric vehicles (EVs) is a potential way to decarbonise road networks, and at the same time, may offer wider benefits for the environment such as reducing air pollution and noise in urban areas
- EVs are gaining momentum due to several factors, including the price reduction as well as the climate and environmental awareness

DEVELOPMENT OF AUTONOMOUS VEHICLES (AVs)

- Fully autonomous vehicles can operate without any human control or supervision, meaning they are capable of driving and performing other tasks independently
- They are referred to as driverless or self-driving vehicles

Google's driverless car had logged more than 300,000 miles in the state of California by August 2012

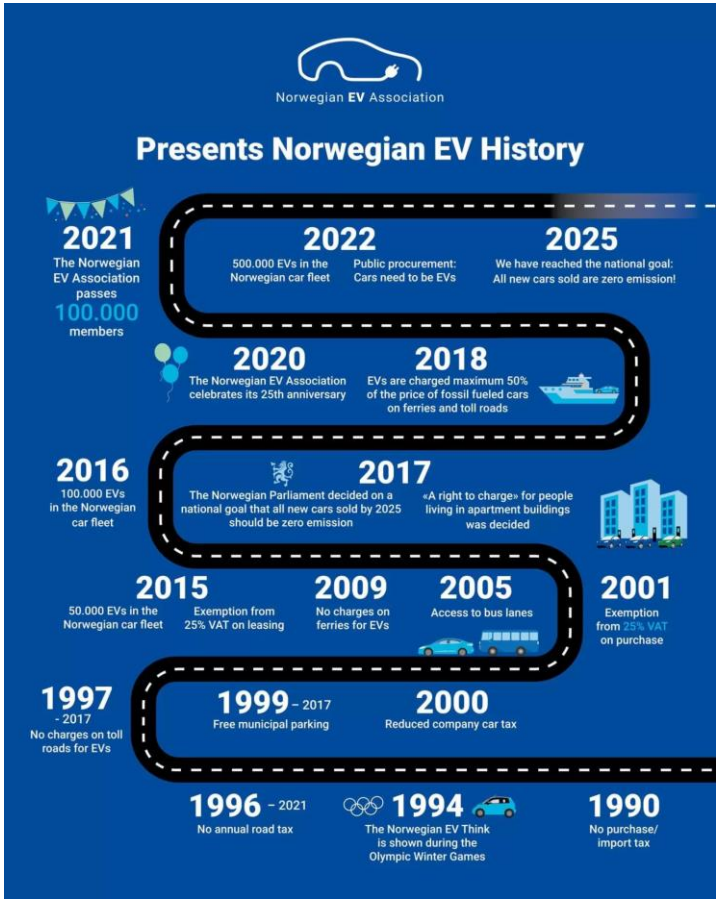
- In 2016, SAE and NHTSA provided an official classification of vehicles based on their level of autonomy, categorizing them into six levels

SAE Level	Type of automation	Steering, acceleration, deceleration	Monitoring the driving enviroment	Fallback performance of dynamic driving task	System capability (driving modes)
0	**No driving automation** The full-time performance by the human driver. Driver controls all aspects of the dynamic driving task, even when enhanced by warning or intervention systems.				n/a
1	**Driver assistance** The driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment. It is expected that the human driver performs all remaining aspects of the dynamic driving task.				Only some driving modes
2	**Partial driving automation** The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using the information about the driving environment. It is expected that the human driver performs all remaining aspects of the dynamic stiving task.				Only some driving modes
3	**Conditional driving automation** The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task. The human driver will respond appropriately to a request to intervene.				Only some driving modes
4	**High driving automation** The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even in cases when human driver does not respond appropriately to a request to intervene.				Only some driving modes
5	**Full driving automation** The full-time performance by an automated driving system od all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver				All driving modes

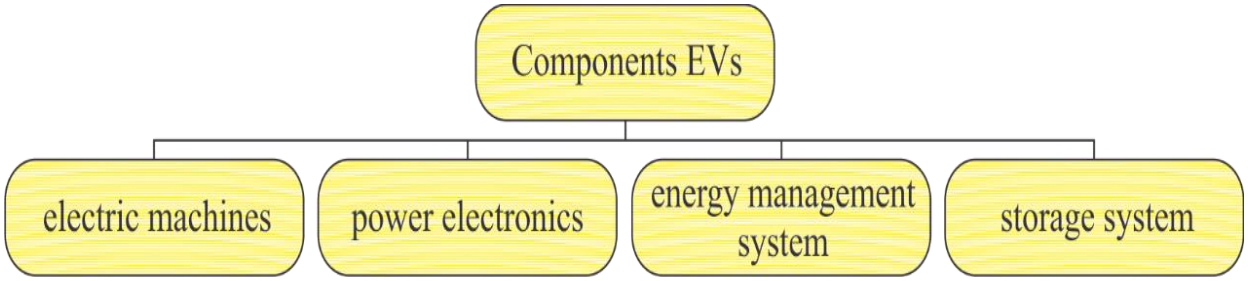
TECHNOLOGICAL DEVELOPMENT OF EVs

- The fastest growth in EV sales is happening in Europe, with Norway being the largest EV market on the continent. In 2021, EVs accounted for nearly 80% of all new vehicles sold in Norway

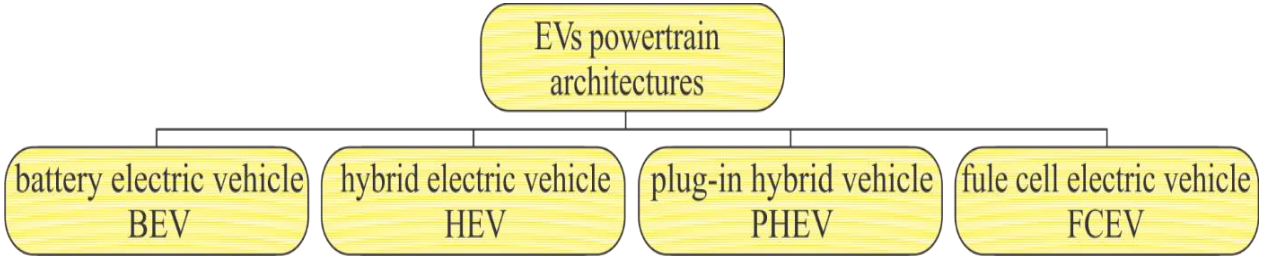
- China still has the largest number of EVs, but Europe has overtaken China as the global driver of EV sales



MAIN COMPONENTS OF EVs



EVs POWERTRAIN ARCHITECTURES



- The drivetrain of a BEV consists of a battery, power converter, electric motor, and gearbox

The BEV/EV drivetrain includes a battery that stores electrical energy, a power converter that manages energy flow, an electric motor that drives the wheels, and a gearbox that adjusts torque and speed

Tesla, Model S

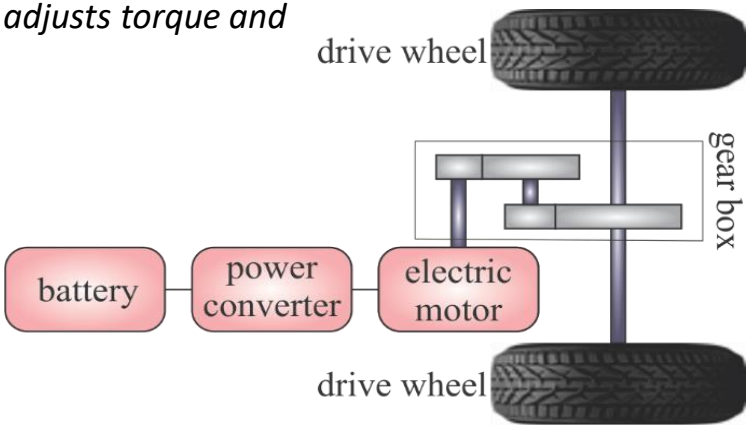


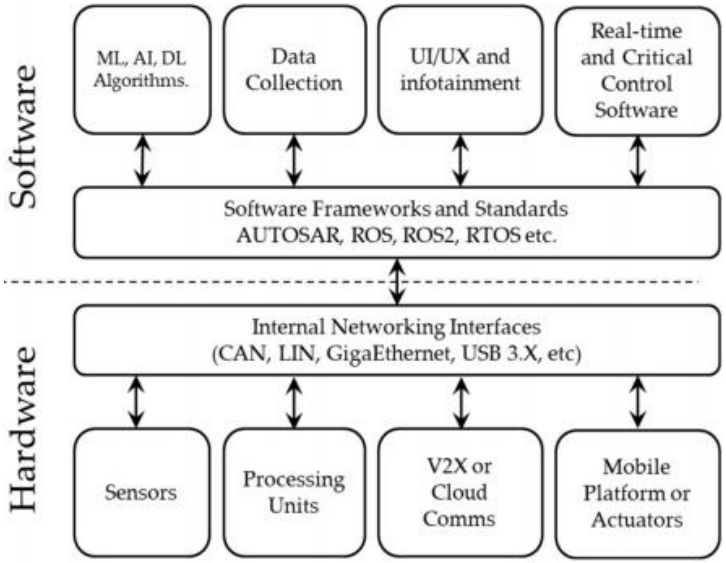
Illustration of BEV/EV drivetrain

TECHOLOGICAL DEVELOPMENT OF AVs

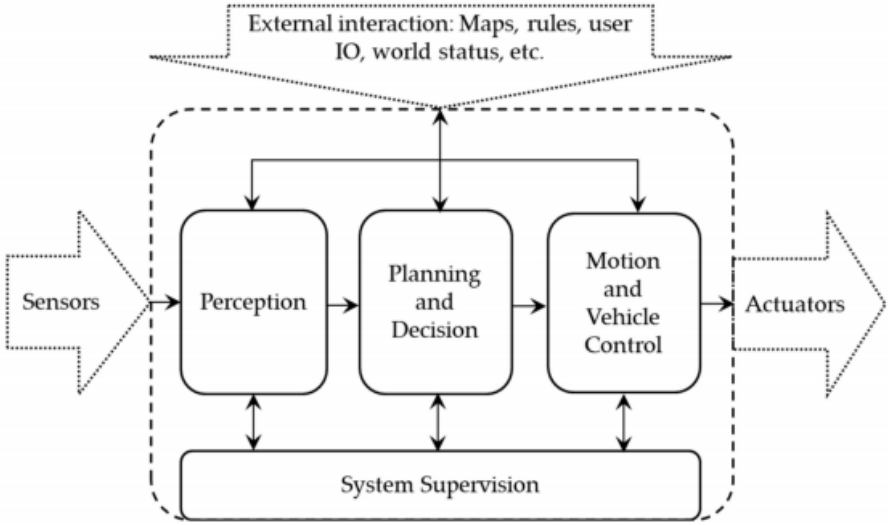
- AVs are based on advanced sensors that collect information about the environment, and on deep multilayer neural networks used to recognize streets, vehicles, objects, and people from sensor data to control the vehicle

Simulation of AV movment in Podgorica (Montenegro)

TECHOLOGICAL DEVELOPMENT OF AVs

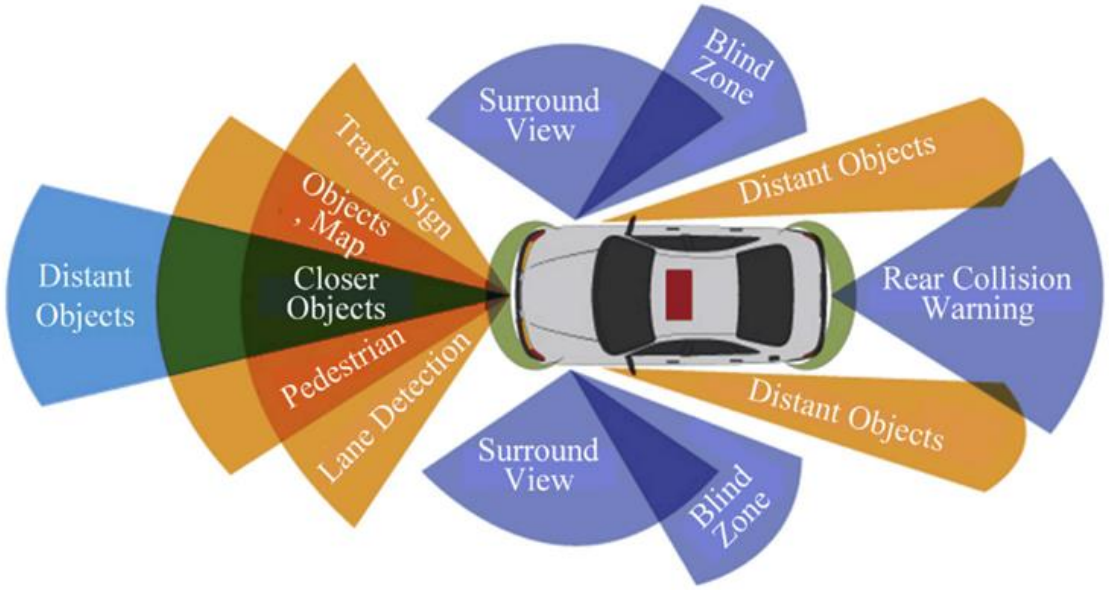


a)



b)

The architecture of autonomous driving systems:
(a) from a technical perspective, which describes the primary hardware and software components and their implementations;
(b) from a functional perspective, which describes the four main functional blocks and the flow of information



- The sensor system consists of multiple different sensors, which are responsible for collecting data from the vehicle's surroundings in real time
- The data gathered by the sensors is used for perception, path planning, calculating the distance from obstacles, or for navigation

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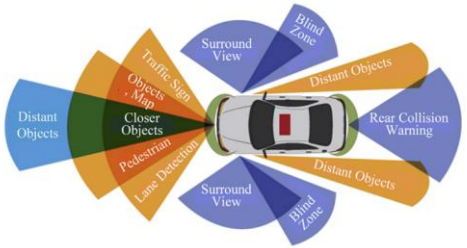
SITUATION IN WESTERN BALKANS COUNTRIES

- Generally, when it comes to vehicle buyers from WB countries, there is less motivation to purchase EVs/AVs

- The main reasons for this lower motivation are their high purchase price, limited number of vehicle models, restrictions related to battery charging and overall infrastructure for their use, their limited/small driving range, lack of information about their capabilities, as well as political and incentive measures for their adoption

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