



Development Strategies at EU and local level.

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- Transport is part of economic system increasing human satisfactory by changing the spatial position of goods and people. The function of transport (incl different transport mode) is in bridging the gaps between producers and consumers.
- The new production methods have created the needs of flexible, safety and environmentally friendly transport system.
- Transport infrastructure includes physical networks, terminals and intermodal nodes, information systems and refueling and electrical supply networks which are necessary for the safe, secure operation of road, rail, civil aviation, inland waterways and shipping.
 - traffic and transport control systems, aimed at ensuring safe, secure, efficient, reliable and resilient transport for all modes of transport;
 - information and communication technologies used for customer information, and for tracking, charging, ticketing and billing
 - Fuel, energy facilities including electrical traction power networks necessary for infrastructure and transport operation

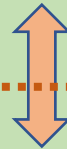
Interaction between Transport and Traffic Management

Cargo flow



Transport Management- the integrity of relations between supply and demand, incl. Regulations + Price of services

Transport service providers



Traffic Management- guidance and control traffic, including pedestrians, bicyclists and all types of vehicles. The aim is to provide for the safe and efficient movement of persons and goods using transport Infrastructure, incl. Regulations + Price of services

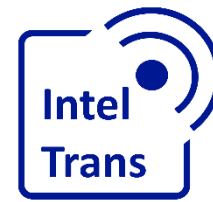
Transport Infrastructure



Transport Policy in EU

- European Union (EU) transport policy aims to ensure the smooth, efficient, safe, and free movement of people and goods throughout the EU by means of integrated networks using all modes of transport (road, rail, water and air).
- EU policy also deals with issues as wide-ranging as climate change, passenger rights, clean fuels, and cutting customs-related red tape at ports.

Source https://eurlex.europa.eu/summary/chapter/transport.html?root_default=SUM_1_CODED%3D32&locale=en



- The main trend in the EU transport policy is to shift the freight from roads to rail and waterborne transport. The most effective for rail is the container transportation. Rail freight is recommended mode for international trade, especially in containers.

*Example: New Norway-Denmark rail service, **Blue Water Shipping will connect Narvik with Padborg.***

Blue Water Shipping intends to make the Narvik-Padborg link a regular, once per week service. The company already projects to ramp it up to three weekly runs in autumn 2022.

According to estimations, the new service will take some 4,000 trucks off Norwegian roads per annum, saving the environment 7,000t of CO2 emissions.

Transport Policy in EU

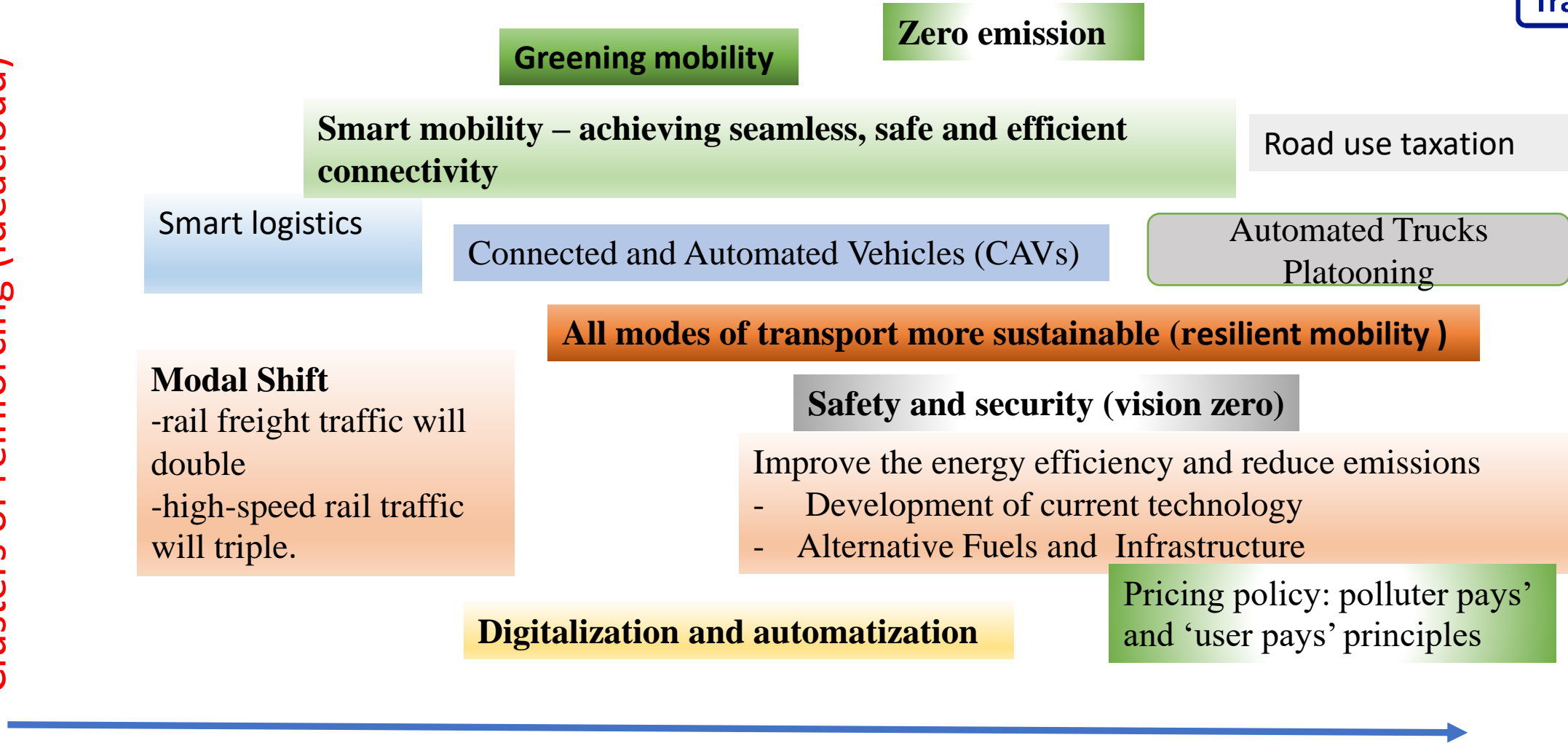
Sustainable mobility: involving an irreversible shift to zero-emission mobility by making all transport modes more sustainable, ensuring wide availability of the most sustainable options and giving users incentives to make sustainable choices;

Smart mobility: supporting sustainable choices by taking advantage of digitalisation and automation to achieve seamless, safe and efficient connectivity;

Resilient mobility: bouncing back from the COVID-19 pandemic by creating a Single European Transport Area that is affordable and accessible for all citizens and businesses and resilient against future crises and safety and security challenges.

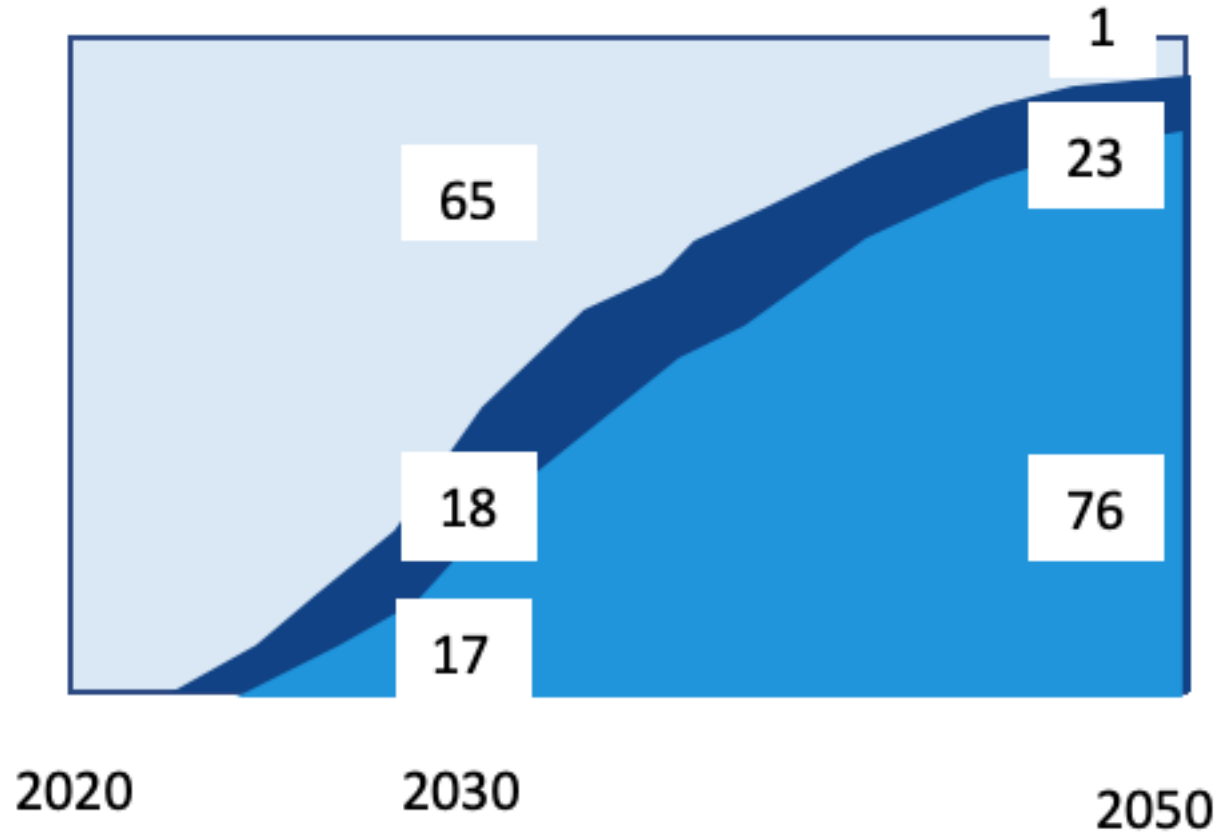
Source: <https://www.2zeroemission.eu/mediaroom/sustainable-and-smart-mobility-strategy-european-transport-on-track-for-the-future/>

Clusters of reinforcing (Ideacloud)



2050

Market share forecast, % (ICE- BEV- FC truck engines)



Source: Unlocking Large-Scale, Long-Term Capital for Sustainable Mobility: Introducing Key Mobility Investment Archetypes, 2021

ICE

BEV

FC

Urban Passenger Transport

Key facts

Urbanisation will increase demand for sustainable transport around the world

2.6x

The right policies can **cut 80% of urban mobility's carbon footprint** by 2050

Private vehicles emit three quarters of CO₂ from urban passenger transport

Main takeaways

Two main strategies can help manage demand and deliver sustainable transport services across the world

Integrate transport policy and land-use planning to **improve accessibility for citizens**

Reducing reliance on cars is critical to decarbonise cities

Regional & Intercity Passenger Transport (non-urban)

Key facts

Demand for regional and intercity travel is set **to grow by up to 114%**, with strong growth in emerging economies in particular

CO₂ emissions from non-urban passenger could **rise by nearly one third** or **fall by more than half** to 2050, depending on policies

2.1x

Main takeaways

Technological improvements offer the most promising path to decarbonising non-urban passenger transport

To ensure a sustainable transition to low-emission vehicles, **increase consumer confidence** and **pursue a clean energy grid**

Source: The ITF Transport Outlook 2021

Freight Transport

Key facts

Freight accounts for **more than 40%** of transport emissions

Road transport is responsible for 65% of freight emissions

Freight CO₂ emissions will **rise 22%** from 2015 to 2050 with current policies



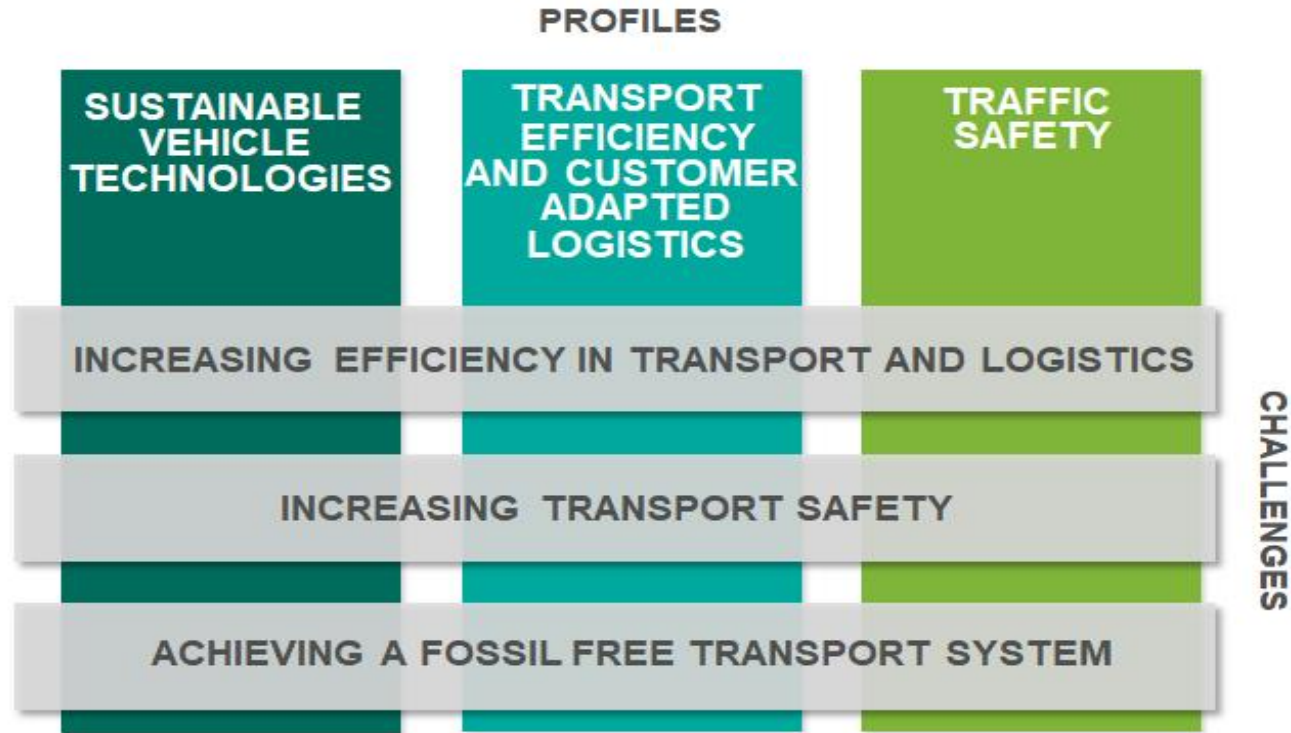
Main takeaways

Scale up ready-to-adopt freight decarbonisation measures quickly. Many measures rely on existing technology and can be implemented soon.

Align price incentives with freight decarbonisation ambitions. Few carriers will invest in low-carbon vehicles if they have to pay more than for conventional fleets or fuels

To reach climate targets, **freight transport must achieve the transition to low- or zero-carbon energy sources.** Covid-19 stimulus packages could play a critical role

- **Logistics:** Further growth of large fleets, trains and trucks is expected, at the same time it is necessary to distribute small parcels. The transport industry continues to moving towards a digital platform ecosystem.
- **Assisted drivers and autonomous driving. ADAS (Advanced Driver Assistance Systems)**
The new ADAC technology is evolving and its use is expanding. While driverless trucks will create significant operating cost savings in the long-run, they won't become reality not very soon.
- **Digitalization:** The evolution of digital technologies will create new use cases, for example in advanced truck and trailer telematics. Artificial intelligence based optimization will drive down congestion, low utilization and costs.
- **Electrification and hydrogen technology** Regulation and low-emission policies will drive electrification and use the hydrogen technology.
- **Connectivity** refers to the use of technologies enabling road vehicles to communicate with each other and with roadside infrastructure (e.g. traffic signals).



Source: <https://ec.europa.eu>

Future transport and mobility trends will be take place at the vehicle level (e.g. car, truck, bus, vans, two-wheelers or totally new equipment) and at the infrastructure level (roads, communication infrastructure, charging stations, specialized parking areas, etc) and the ITS and digitalization level.

Radar- and camera-based driver assistance systems-towards to new generation ADAS Advanced Driver Assistance Systems, which is constantly being developed and offers the following technologies:

ACC- The adaptive cruise control keeps to a speed that was set for the vehicle

AEBS - Advanced Emergency Braking System means a system which can automatically detect a potentially forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding a collision.

LDWS- Lane Departure Warning Systems orients itself on the road markings. If the vehicle gets too close to the markings on the left or right, there is an acoustic or haptic warning

FCW -Forward Collision Warning, warns drivers about travelling or stationary obstacles in front in the lane. There is an optical and acoustic warning.

Multi-function conventional cameras are used in vehicles. However, these are adapted for the use in vehicles. The camera has a chip with a lens in front. In addition, a control unit is also integrated.

Real and expected phase's to transform towards autonomous vehicle's



Phase 0- Driver only

Phase 1- Assisted Driver, lateral and longitudinal control

Phase 2 - Assisted Driver, continuous monitoring, lateral and longitudinal control

Phase 3- Assisted Driver , episodic monitoring be ready to resume control

Phase 4 Conditional automation, Driver “eyes off

Phase 5 Full Automation “Eyes off and hands off ”, no driver

- The core problems or circumstance's related to the implementing period, during these new technologies coexist with conventional vehicles and use the same infrastructure.
- Availability and cost of ICT resources.

AUTOMATED VEHICLES (SAE J3016™ LEVELS)

Automated vehicles can be classified on the basis of SAE J3016™ levels:

- **Level 0** – No Automation: The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems.
- **Level 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 and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.
- **Level 2**–Partial Automation: The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.

AUTOMATED VEHICLES (SAE J3016™ LEVELS)

Automated vehicles can be classified on the basis of SAE J3016™ levels:

- **Level 3**–Conditional Automation: The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene.
- **Level 4**–High Automation: The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene.
- **Level 5**–Full Automation: The full-time performance by an Automated Driving System of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.

REAL TIME TRAFFIC INFORMATION

Road vehicles designed to use real-time traffic information, to be connected and to cooperate with each other, with transport infrastructure and vulnerable road users and to progressively take over driving tasks, in order to improve road safety, traffic efficiency and comfort. Automated vehicles are aimed to be fully integrated in existing fleets, use existing road networks and seamlessly work together with public transport systems

- **Road:** Investments in cooperative intelligent transport systems and connected driving technologies to improve the flow of road traffic on urban roads will result in better movement of goods and people. This includes enhanced **vehicle management** (i.e. from conventional to autonomous vehicles), **vehicle fuel technologies** (i.e. from fossil to alternative fuels), **bicycle and vehicle sharing, public transport, walking and cycling**, especially in large urban areas.
- **Rail:** include improving cross-border sections (especially when using **different signaling and train operating systems**), rail terminals connecting rail with other transport modes (e.g. **advanced rail-rail trans-shipment yards**) and complex and heavily used conventional railway stations for passenger trains in urban areas (e.g. hosting local/high-speed/international/freight traffic).

Is addressing to :

- Policy framework: Long-term stable policies and incentives to improve the
 - manufacturers,
 - transport operators,
 - infrastructure providers and
 - support service providers (e.g leasing models to help truck operators transition to zero-emission)
- Important problems on the decarbonization journey :
 - Current technology development (internal combustion engines and fuels)
 - For example, battery electric vehicles (BEV) run on electricity from the grid, but the carbon intensity of national electrical grids varies by country. In the EU, about 60% of electricity comes from carbon-free sources.
 - hydrogen fuel cell electric vehicles (FCEV) run on a mix hydrogen (incl green hydrogen) To achieve the full decarbonization impact for FCEV vehicle the hydrogen must come from green sources.

The following categories of road motor vehicles are included:

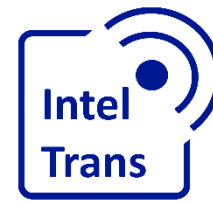
- Petrol vehicle: road motor vehicle using petrol for propulsion containing up to 10 per cent Bioethanol (like E5 up to E10).
- Hybrid petrol-electric vehicle: Road motor vehicle using petrol for propulsion, with in addition one or more electric motors for propulsion, where the electric motor(s) are powered from a traction battery which is charged by a generator driven by the petrol engine. Plug-in hybrid petrol-electric vehicles are not included.
- Plug-in hybrid petrol-electric vehicle: hybrid petrol-electric vehicle where the traction battery can also be charged from an external electricity source (such as an electric socket). Hybrid petrol-electric vehicles are not included.

The following categories of road motor vehicles are included:

- Diesel vehicle: road motor vehicle using diesel for propulsion containing up to 7 per cent Biodiesel (like B2, B5, B7).
- Hybrid diesel-electric vehicle: road motor vehicle using diesel for propulsion, with in addition one or more electric motors for propulsion, where the electric motor(s) are powered from a traction battery which is charged by a generator driven by the diesel engine. Plug-in hybrid diesel-electric vehicles are not included.
- Plug-in Hybrid diesel-electric vehicle: hybrid diesel-electric vehicle where the traction battery can also be charged from an external electricity source (such as an electric socket). Hybrid diesel-electric vehicles are not included.

- Battery only electric vehicle: road motor vehicle using batteries to feed an electric motor for propulsion.
- Natural gas vehicle: road motor vehicle using natural gas for propulsion, either Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG).
- Liquefied Petroleum Gas vehicle: road motor vehicle using Liquefied Petroleum Gas (LPG) for propulsion.
- Hydrogen vehicle: Road motor vehicle using hydrogen for propulsion. Fuel cell vehicles are included.
- Biofuel vehicle: road motor vehicle using bioethanol or biodiesel for propulsions.
- Bioethanol vehicle: road motor vehicle using bioethanol of more than 10 per cent for propulsions. Vehicles using up to 10 per cent are to be defined as petrol vehicles.
- Biodiesel vehicle: road motor vehicle using biodiesel of more than 7 per cent for propulsions. Vehicles using up to 7 per cent are to be defined as diesel vehicles.
- Bi-fuel vehicle: road motor vehicle with a single engine using either diesel or petrol and one of the following: CNG, LNG, LPG or hydrogen for propulsions.

For hybrid or dual-fueled vehicles adapted for using more than one type of motor energy (e.g. LPG and petrol, or electricity and diesel, etc.), the principal type of motor energy should be an alternative fuel.



Nevertheless diesel traction have had serious progress

- In addition the the diesel technology itself is coming much cleaner. New EU Stage V emission standard, which apply to all new engines from 1.1.2021 and offer substantially improved performance over previous.
- Stage V engines limit is 0.015 g/kWh per rail car. For stage IV engines the emission limit is 0.0257Kwh. In some heavily polluted areas the air that emitted from Stage V engines is cleaner than the surrounding atmosphere.

	BEV (Battery electric vehicles)	FCEV (fuel cell electric vehicles)
Powertrain	Fully electric	Fully electric
Main energy storage system	Battery	Liquid or gaseous Hydrogen
Main energy supply system	-Electric chargers -Catenary charging	Hydrogen fill stations
Availability	Several (<10) models currently available	Only 1 model available commercially
Main advantages	-Currently widely available -Compelling TCO when battery size can be minimized —	-High energy density of hydrogen – easier to design for long distance -Fast refueling
Main drawbacks	-Size weight and cost of battery – more pronounced for long range vehicles - Longer recharging times	-Current lack of availability of vehicles -Current high price of hydrogen -Lack of hydrogen infrastructure in Europe

Maker	Activities
Policy-maker	Building on the European Commission’s “Fit for 55” decarbonization goals, member states could prepare to set binding targets on infrastructure build-out and enact supporting measures to push ZE truck sales, adjust road tolls and consider low-emission zones within urban areas. Policy-makers could design a structured – and proactively communicated – policy framework for the roll-out of ZE trucking in Europe and other markets globally.
Transport customers	We expect that a large incentive to decarbonize will come from transport customers demanding more sustainable shipping methods. Transport customers should clarify their commitments to decarbonize and compel their transport providers to follow suit. One effective approach involves cascading sustainability targets down to suppliers to ensure brokers and fleet owners feel pressure to decarbonize.
Logistics players and fleets	Logistics companies with large fleets should pilot ZE truck adoption in clusters, regions and transport lanes, working jointly with others to participate in vehicle and infrastructure financing schemes. Shippers can market low-cost CO2 abatement to end-customers. Freight forwarders can differentiate products to new and existing customers, creating demand for pooled ZE truck fleets.

Energy and infrastructure companies	Energy and infrastructure companies should forge partnerships with truck makers, financial institutions, logistics operators and local governments to plan and deploy primary infrastructure as well as grid upgrades across key emissions-intensive corridors. They should create the right rebates and rate structures to facilitate this deployment.
Financial institutions	Financial institutions could also create environmental, social and governance (ESG) funds focused primarily on supporting the expansion of ZE trucking and infrastructure. Captive and independent financing companies should accelerate the development of innovative leasing models to support fleets across the transition period, through the provision of vehicles, infrastructure and end-to-end support services.
Truck makers	Truck manufacturers should invest in solutions to mitigate ZE truck residual risk, via battery-as-a-service offerings, refurbishment programmes and other approaches. They can develop common standards for highpower charging and establish or support the creation of such charging networks along critical high-use routes.

Cost element	% difference with ICE vehicles	Explanation
Depreciation and interest	+17	EVs have a higher catalogue price due to the added cost of the batteries
Maintenance	-23	EVs have fewer moving parts compared to ICE vehicles so less maintenance is required
Tyres	+2	EVs have, an average higher torque and weight, which results in higher wear and tear on tyres
Insurance	+6	Insurance is often related to the catalogue price of the vehicle and therefore higher for EVs
Taxes	-88	EVs are supported with government incentives in many countries; the effect is clearly visible in the tax costs
Energy	-54	The average cost per kilowatt-hour of electricity is less than for traditional fuels (petrol/diesel)

Digitalization, big data and smart infrastructure to ensure global connectivity

- Intelligent transport systems for road transport have the potential to **improve road efficiency and make mobility safer**. However, their implementation is sometimes complex in local road networks, due to the relatively high cost of installation and management
 - **Digital connectivity** enables people and freight to use transport system in different ways and to gain access to large amounts of real-time dynamic transport data
 - **Communication between vehicles and infrastructure**, and between vehicles themselves, is also crucial to increase the safety of future automated vehicles
 - **Intelligent transport system** for road transport have the potential to improve road efficiency and make mobility safer.
 - The next generation of telecommunication solutions will be key to transforming **how vehicles relate to infrastructure and to other vehicles**.

Environmental protection, including decarbonization, emission reductions and protection of energy supplies

- Ensuring road safety, with a particular focus on vulnerable road users and adaptation of roads to an ageing population.
- **Reducing the impact of roads on the environment**, including GHG emissions, throughout the life-cycle. Reusing and recycling materials.
- **Improving roads to provide services to vehicles** that are powered with alternative sources of energy.
- **Automated roads**: integrating technology and communication networks to provide new services based on data and digitalization.
- **Improving the capacity to reduce congestion**, while avoiding costly large investments in enlarging infrastructure.

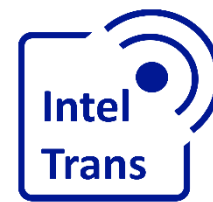


Proposed sustainable mobility investment cases

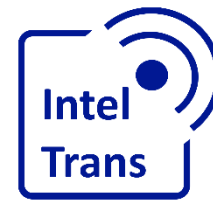
Source: Unlocking Large-Scale, Long-Term Capital for Sustainable Mobility: Introducing Key Mobility Investment Archetypes. World Economic Forum 2021.



1. City buses – Zero-emission buses in major cities via the shift from capital to operating expenditures (capex to opex)
2. School buses – Zero-emission school buses via the change from capex to opex in a specific region
3. Passenger cars – Shared-ride vehicle fleets replaced by electric vehicles (EVs) in a major city
4. Heavy-duty trucks – Joint venture set up to create a zero-emission truck leasing model
5. Last-mile delivery – Joint venture set up to lease short-haul light commercial vehicles to retailers and logistics players in a major urban area
6. Charging infrastructure – Hydrogen refueling station build-up on highways and city mobility hubs for public use.



Toyota – Hydrogen truck may be on market 2021



The profile area Traffic Safety targets high achievements in research, innovation and education within three areas:

Field data collection and analysis

aims at developing a holistic understanding of occurrence and effects of incidents and accidents; including the assessment of risk and benefit in automated systems compared to the safety levels of human drivers.

Accident avoidance and automation

aims at developing new technologies and safety systems as well as developing better understanding of human factors, human behaviour and driver models.

Injury prevention

aims at developing increased crashworthiness, advanced adaptive vehicle structures and protective systems. All collision types and all categories of road users are included.



Connected, Cooperative and Automated Mobility (CCAM)

CCAM solutions have to provide a more user-centred, all-inclusive road mobility, while

- increasing safety,
- reducing congestion, emissions and
- contributing to climate neutrality.

These novel mobility services enable seamless integration with existing services (e.g. public transport, logistics), and higher levels of automation support, transport productivity and efficiency (e.g. transportation of goods at lower speeds to save energy, operational efficiency at logistics hubs and in hub to hub corridors or last mile operations)

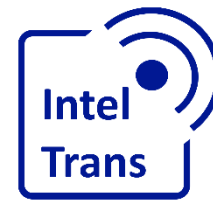


Safe human-technology interaction in the future traffic system

Another challenge for the safety in future transport systems and services is the ever growing and intensified human interaction with ubiquitous digital content.

The overload of various kinds of information from multiple sources can lead to increased driver or unprotected road user distraction and ***have negative impacts on road safety.***

Human machine interfaces (HMI) with adaptive characteristics continue to be developed and new functionalities are continuously added, yet the impacts of those systems on the behaviour of drivers and other road users are ***not sufficiently known.*** Further research on the effects of such technologies in road transport safety is required.



Conclusion

- Three main pillars: **vehicles technologies, transport efficiency and traffic safety;**
- **Communication between vehicles and infrastructure** needs a common approach for a new challenges (interaction between transport units and infrastructure);
- **The applying drivers assistant systems and autonomous driving technologies** depends of the development and the price of the ICT services (GPS, Big data, 5G etc);
- **Risk management / cyber security;**
- **ITS, Digitalization and telematics.** The evolution of digital technologies will create new use cases, for example in advanced truck and trailer telematics;
- **Electrification and hydrogen technology.** Regulation and low-emission policies.
- **Traffic Safety**

The description of Individual work (based of learning materials)

Topics: Sustainable and Smart Mobility Strategy – putting European transport on track for the future. (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789>)

- **OUR VISION**
- **SUSTAINABLE MOBILITY – AN IRREVERSIBLE SHIFT TO ZERO-EMISSION MOBILITY**

Learning outputs: The student is able to refer to the main points of the mentioned chapters in his / her own words



EUROPEAN COMMISSION

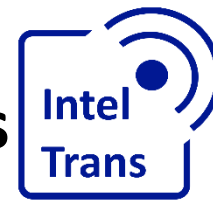
Source: The ITF Transport Outlook 2021

Video: <https://www.itf-oecd.org/itf-transport-outlook-2021> (15 min)

Questions:

If the road freight will continue to dominate surface goods transport and play a main role in transport decarbonization:

1. What kind of transition activity you can see in truck technology?
2. What developments do you think are needed in the field of traffic management?
3. What are the prerequisites for the developments / activities you offered. What needs to be done to create the preconditions?
4. How is transport development reflected in national decarbonization plans. Please give some evidence-based examples?

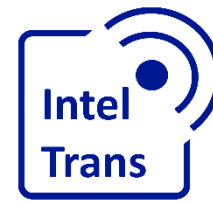


Virtual Zoom meetings with key transportation and logistic experts

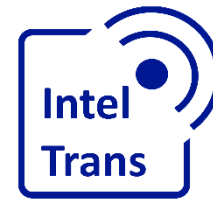
University Turku, Professor Lauri Ojala

WSP Finland Professor Jorma Mäntynen and Jukka Rantala

- At present and coming years (3-4 years?) time the main influencer is the impact of the Corona virus.
- In North Europe the freight volumes have decreased on rail and road ca 10-30%. In general, the decrease of the cargo volume's 10-20% have happened.
- Related to the rail passenger the decrease of volumes was up to ca 50%, intercity rail in Germany, Sweden and Finland is operating in ca 20% level of use of capacity. Regional rail is operating on level 50% of capacity?
- For coming years the new operating environment is how to manage the business in conditions of decreasing volumes' (Decreasing markets).



- Automated fleet of vehicles (road, rail) will be not very near, it will need more time. Some small examples are in operations (Metro or transport between air terminals).
- Prof. Ojala pointed out that in curriculum the game based exercises are very valuable tool.
- For transportation companies the outsourcing of operations and use of leased equipment might help to survive, using of services from renting companies of personal might help.
- Covid 19 pandemia has had impact on supply chains of global trade. If possible the production of products tried to move near to Europe. Trend is to make supply chains more secure and shorter



Group work. The topics based on the interview materials presented above

1. Traffic and transport professionals have somewhat different views on the future of this field. Please find opinions (3) in the literature that reflect the development of this field and analyze their validity and applicability.
2. (Eesti) Transpordi ja liikuvuse arengukava 2021-2035.....