# Future Transport Systems – opportunities and challenges for innovations

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# Presentation outline

- Global (mega)trends affecting the future of transport
- Transport visions, scenarios and strategic choices
  - Low-carbon
  - Connected-Automated
  - Smart & sustainable
- Opportunities and challenges for transport innovations within systemic transitions
  - Multi-actor environment
  - New technolgies and services vs. sustainability

# Today’s Five Major Themes in Transport*

Digitalisation

Connectivity

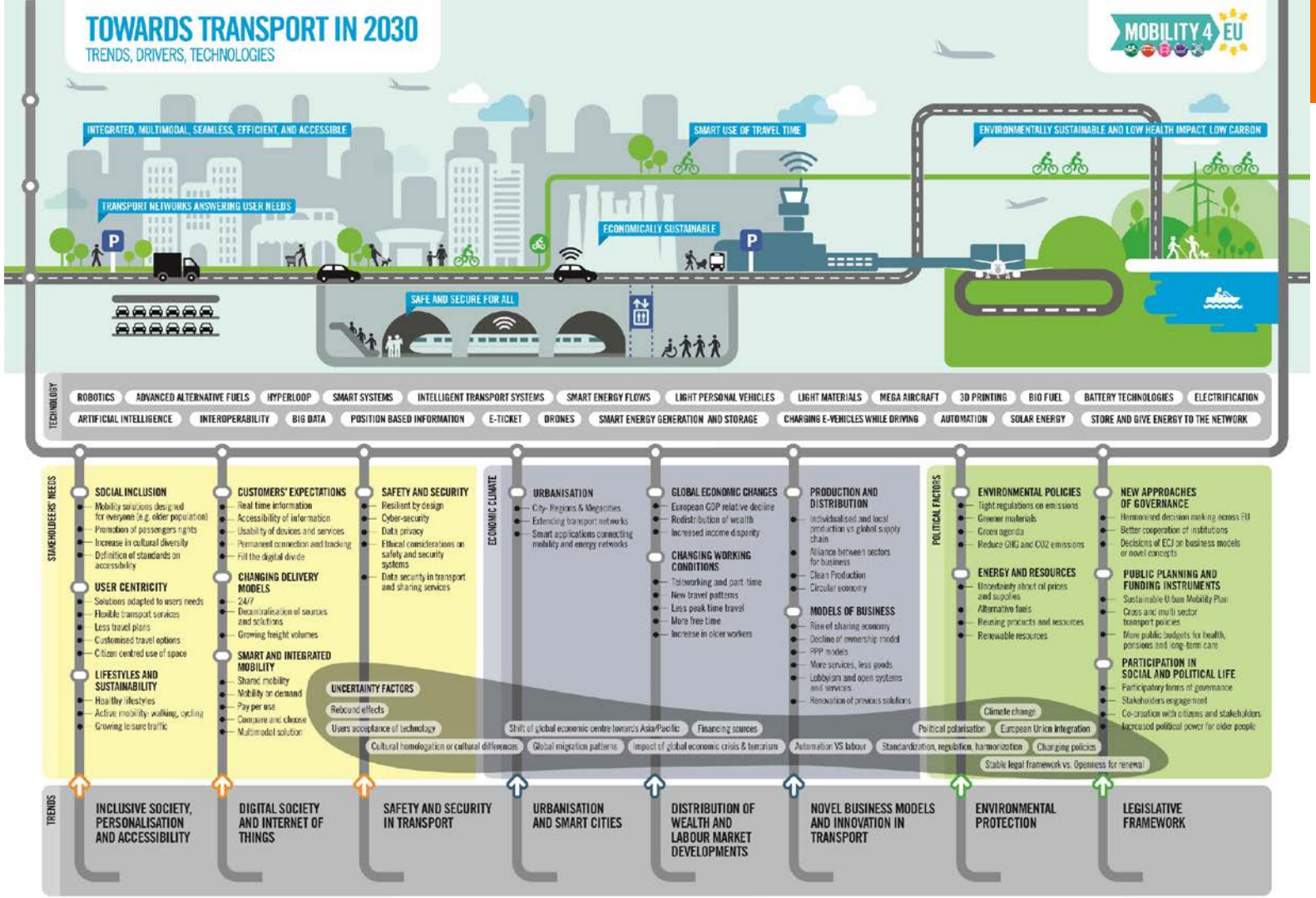
Safety &
Security

Universal
Access

Decarbonisation



*ITF International Transport Forum https://www.itf-oecd.org/


TOWARDS TRANSPORT IN 2030
TRENDS, DRIVERS, TECHNOLOGIES
MOBILITY 4 EU
INTEGRATED, MULTIMODAL, SEAMLESS, EFFICIENT, AND ACCESSIBLE
TRANSPORT NETWORKS ANSWERING USER NEEDS
SMART USE OF TRAVEL TIME
ECONOMICALLY SUSTAINABLE
ENVIRONMENTALLY SUSTAINABLE AND LOW HEALTH IMPACT, LOW CARBON
SAFE AND SECURE FOR ALL
TECHNOLOGY
ROBOTICS
ADVANCED ALTERNATIVE FUELS
HYPERLOOP
SMART SYSTEMS
INTELLIGENT TRANSPORT SYSTEMS
SMART ENERGY FLOWS
LIGHT PERSONAL VEHICLES
LIGHT MATERIALS
MEGA AIRCRAFT
3D PRINTING
BIO FUEL
BATTERY TECHNOLOGIES
ELECTRIFICATION
ARTIFICIAL INTELLIGENCE
INTEROPERABILITY
BIG DATA
POSITION BASED INFORMATION
E-TICKET
DRONES
SMART ENERGY GENERATION AND STORAGE
CHARGING E-VEHICLES WHILE DRIVING
AUTOMATION
SOLAR ENERGY
STORE AND GIVE ENERGY TO THE NETWORK
STAKEHOLDERS' NEEDS
SOCIAL INCLUSION
Mobility solutions designed for everyone (e.g. older population)
Promotion of passengers rights
Increase in cultural diversity
Definition of standards on accessibility
USER CENTRICITY
Solutions adapted to users needs
Flexible transport services
Less travel plans
Customised travel options
Citizen centred use of space
LIFESTYLES AND SUSTAINABILITY
Healthy lifestyles
Active mobility: walking, cycling
Growing leisure traffic
CUSTOMERS' EXPECTATIONS
Real time information
Accessibility of information
Usability of devices and services
Permanent connection and tracking
Fill the digital divide
CHANGING DELIVERY MODELS
24/7
Decentralisation of sources and solutions
Growing freight volumes
SMART AND INTEGRATED MOBILITY
Shared mobility
Mobility on demand
Pay per use
Compare and choose
Multimodal solution
SAFETY AND SECURITY
Resilient by design
Cyber-security
Data privacy
Ethical considerations on safety and security systems
Data security in transport and sharing services
ECONOMIC CLIMATE
URBANISATION
City- Regions & Megacities
Extending transport networks
Smart applications connecting mobility and energy networks
GLOBAL ECONOMIC CHANGES
European GDP relative decline
Redistribution of wealth
Increased income disparity
CHANGING WORKING CONDITIONS
Teleworking and part-time
New travel patterns
Less peak time travel
More free time
Increase in older workers
PRODUCTION AND DISTRIBUTION
Individualised and local production vs global supply chain
Alliance between sectors for business
Clean Production
Circular economy
MODELS OF BUSINESS
Rise of sharing economy
Decline of ownership model
PPP models
More services, less goods
Lobbyism and open systems and services
Renovation of previous solutions
POLITICAL FACTORS
ENVIRONMENTAL POLICIES
Tight regulations on emissions
Greener materials
Green agenda
Reduce GHG and CO2 emissions
ENERGY AND RESOURCES
Uncertainty about oil prices and supplies
Alternative fuels
Reusing products and resources
Renewable resources
NEW APPROACHES OF GOVERNANCE
Harmonised decision making across EU
Better cooperation of institutions
Decisions of ECJ on business models or novel concepts
PUBLIC PLANNING AND FUNDING INSTRUMENTS
Sustainable Urban Mobility Plan
Cross and multi sector transport policies
More public budgets for health, pensions and long-term care
PARTICIPATION IN SOCIAL AND POLITICAL LIFE
Participatory forms of governance
Stakeholders engagement
Co-creation with citizens and stakeholders
Increased political power for older people
UNCERTAINTY FACTORS
Rebound effects
Users acceptance of technology
Cultural homologation or cultural differences
Global migration patterns
Impact of global economic crisis & terrorism
Shift of global economic centre towards Asia/Pacific
Financing sources
Automation VS labour
Standardization, regulation, harmonization
Changing policies
Political polarisation
European Union integration
Climate change
Stable legal framework vs. Openness for renewal
TRENDS
INCLUSIVE SOCIETY, PERSONALISATION AND ACCESSIBILITY
DIGITAL SOCIETY AND INTERNET OF THINGS
SAFETY AND SECURITY IN TRANSPORT
URBANISATION AND SMART CITIES
DISTRIBUTION OF WEALTH AND LABOUR MARKET DEVELOPMENTS
NOVEL BUSINESS MODELS AND INNOVATION IN TRANSPORT
ENVIRONMENTAL PROTECTION
LEGISLATIVE FRAMEWORK

# Societal trends that will change how we travel…

- Demographics: ageing population, emigration, urbanization vs. urban sprawl
- Speeding up of life…but what about the COVID19 implications?
- Personalization and individualization
- Health, Wellness and Well-being
- Collaborative Consumption; Sharing economy
- Peak car, Mobility preferences of Millennials
- Digital communities, Geo-Socialization through social media
- E-commerce, last mile problem
- Increasing safety & security concerns
- Connectivity, convergence, Internet of Everything (IoE), big Data

# How will we be moving in our cities in the future (2050)?*

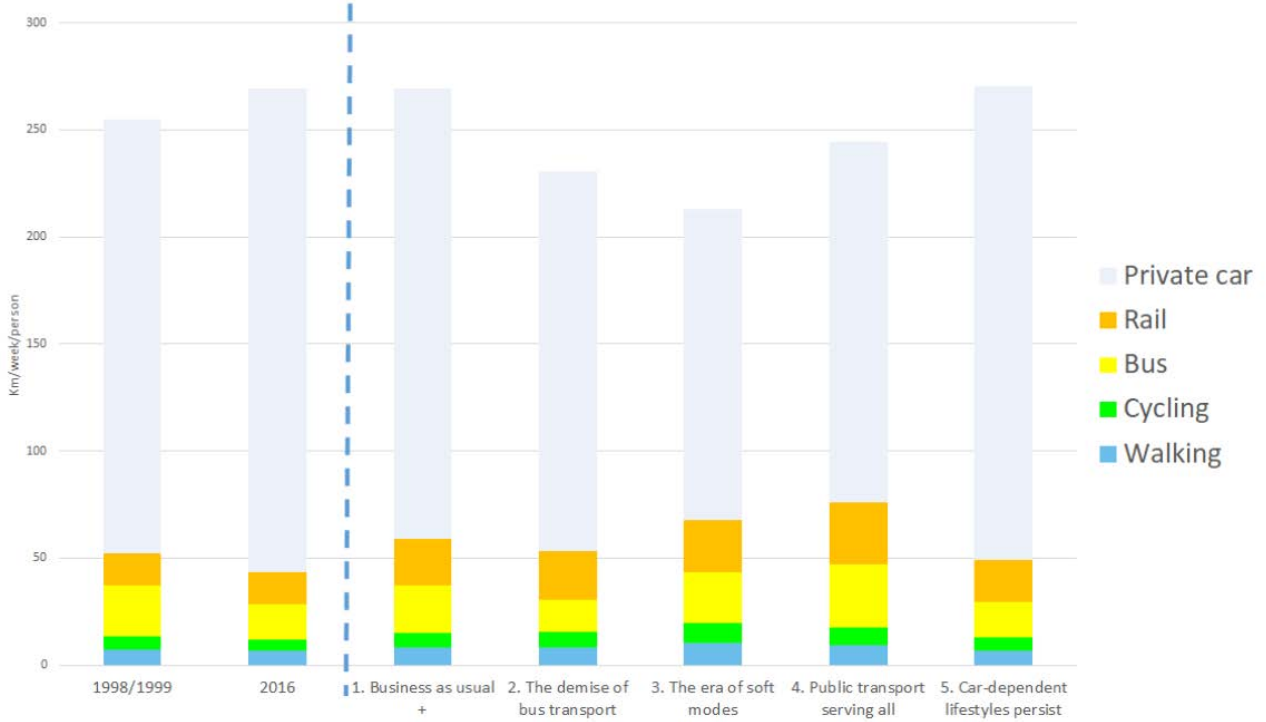
1. Innovative and more efficient vehicle types will be promoted
2. Traffic will be more self-organized and self-organizing
3. Inner cites will be almost free of big motor vehicles
4. Inner-city streets will become livable spaces
5. Bicycles will become the main mode of transport
6. Sharing will be the new owning
7. Everybody will be a mobility provider
8. Transport of goods will be mostly local
9. Freights and passengers will go together
10. The end commuting: suburbia will become proper urban centers
11. Our cities will offer mobility experimental zones

*Vincent Callebaut's 2050 Vision of Paris as a "Smart City"*



*Nextmobility initiative http://www.tea-after-twelve.com/all-issues/issue-01/issue-01-overview/chapter1/future-of-mobility/

# Walking and cycling in 2034: Five scenarios*




*Liikunnallinen elämäntapa kestävän kasvun aikaansaajana (STYLE)
https://www.styletutkimus.fi/

# Transport and Health

- We are living longer, but are we also living longer in good physical condition? − Not if the current trends (even pre-covid) continue!
  - The share of walking and cycling on daily trips has decreased from 34% to 30% in the past twenty years
  - Less than half of FI adults are physically active enough to stay healthy, 25% are basically not physically active at all!
  - 10−20% of school children are physically active in a way that is required for normal physical development
- How can holistic transport planning support a healthy lifestyle?
  - “Build them a cycle lane and they will come…”
  - Walking and cycling to work and with children – experiments and best practices
  - Increase in walking and cycling by 20% would generate health benefits worth around 500 M€/year*



* LVM: Kävelyn ja pyöräilyn edistämisohjelma 2018

# Low Carbon Mobility

- Clean
- Multimodal
- Intermodal
- Healthy
- Safe
- Shared…


Photo: STT

# EU-level strategic choices in mobility: Green, Efficient, Low-Carbon, Digital

- The European Commission's "Green Deal" (2020) Targets to reduce transport-related greenhouse gas emissions by 90% by 2050 with a help of a Strategy for a Sustainable and Smart Mobility (EC 2020)
- New ambitious target (2020) of the European Union is to reduce greenhouse gas emissions at least 55% below 1990 levels by 2030

- Finnish National target: to halve GHG emissions from transport by 2030 (compared to 2005) → 13% (1,65Mt $CO_2$) additional reduction compared to the baseline scenario; Carbon free transport by 2045.

# EC Smart and Sustainable Mobility Strategy (2020)

- Greening mobility must be the new licence for the transport sector to grow
- Mobility in Europe should be based on an efficient and interconnected multimodal transport system
- The three pillars of our future actions to achieve this systemic change:
  1. make all transport modes more sustainable
  2. make sustainable alternatives widely available in a multimodal transport system
  3. put in place the right incentives to drive the transition.

# EC Smart and Sustainable Mobility Strategy key milestones

**By 2030:**

- At least 30 million zero-emission cars will be in operation on European roads
- 100 European cities will be climate neutral
- High-speed rail traffic will double across Europe
- Scheduled collective travel for journeys under 500 km should be carbon neutral
- Automated mobility will be deployed at large scale
- Zero-emission marine vessels will be market-ready

*Vincent Callebaut: Paris 2050 The smog eating city of the future.*

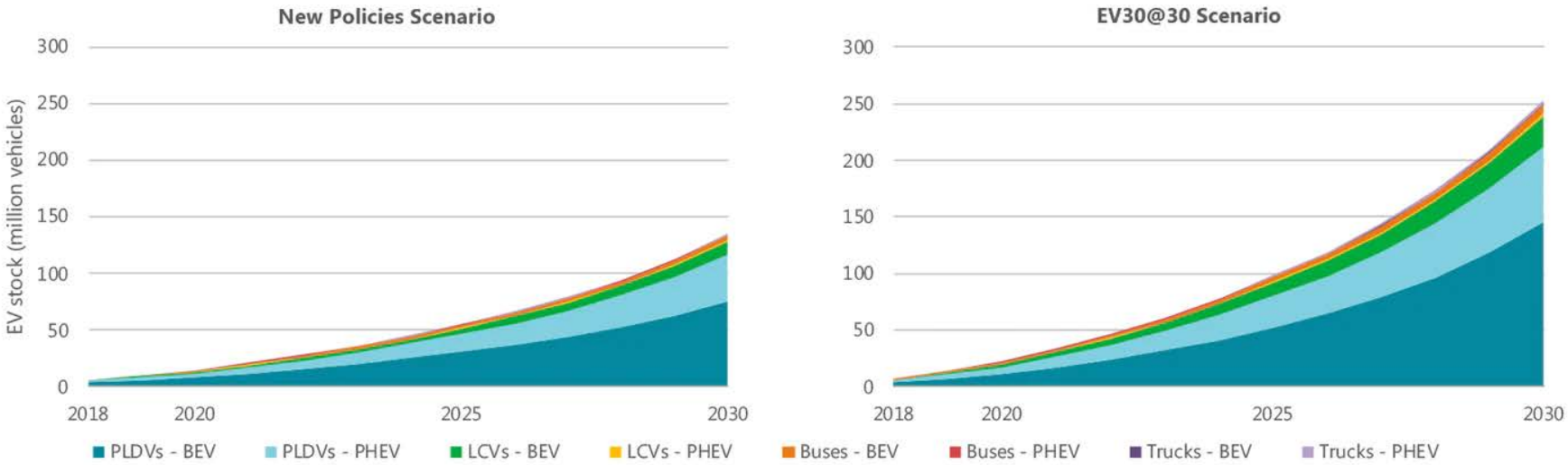
**By 2035:**

- Zero-emission large aircraft will be market-ready

**By 2050:**

- Nearly all cars, vans, buses as well as new heavy-duty vehicles will be zero-emission
- Rail freight traffic will double
- A fully operational, multimodal Trans-European Transport Network (TEN-T) for sustainable and smart transport with high speed connectivity

# EV stock scenarios by IEA*

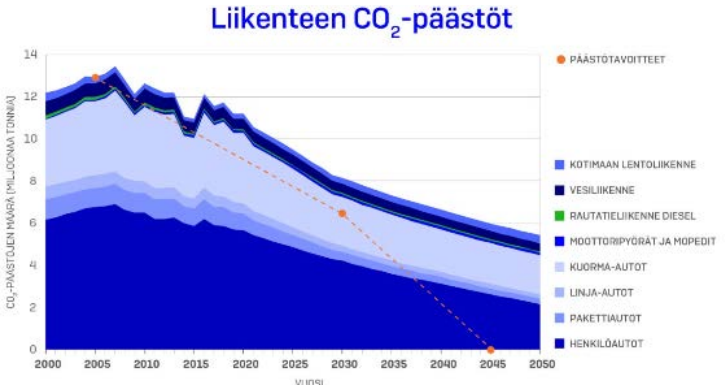


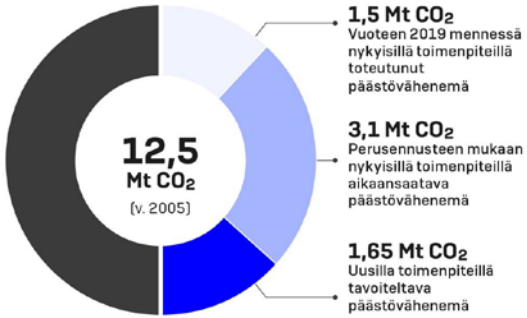



*International Energy Agency https://www.iea.org/

# Measures to reach the transport CO2 target in Finland

- Replacement of fossil fuels
- Renewal of the vehicle fleet
- Improvement of the energy efficiency of the transport system
- (Transport pricing measures)



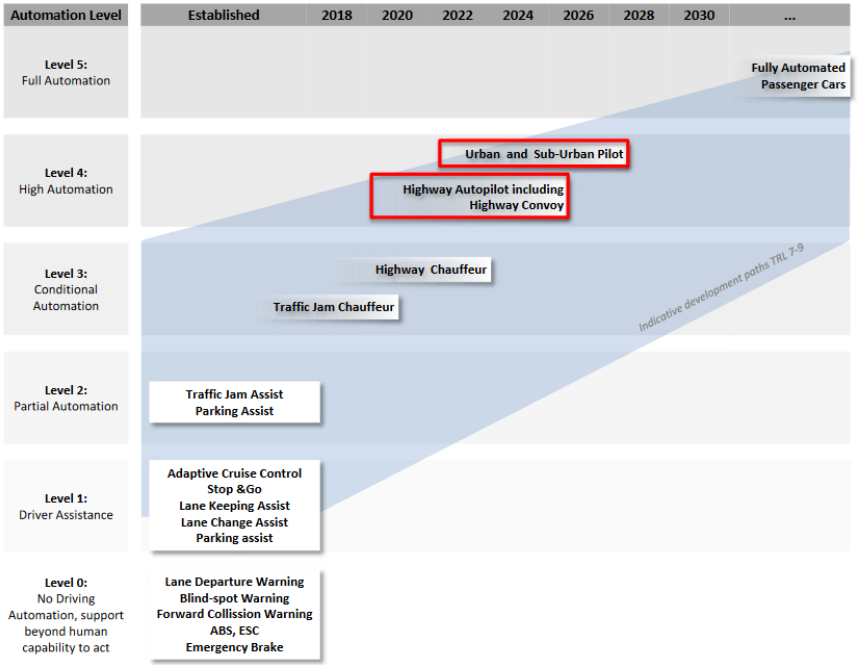



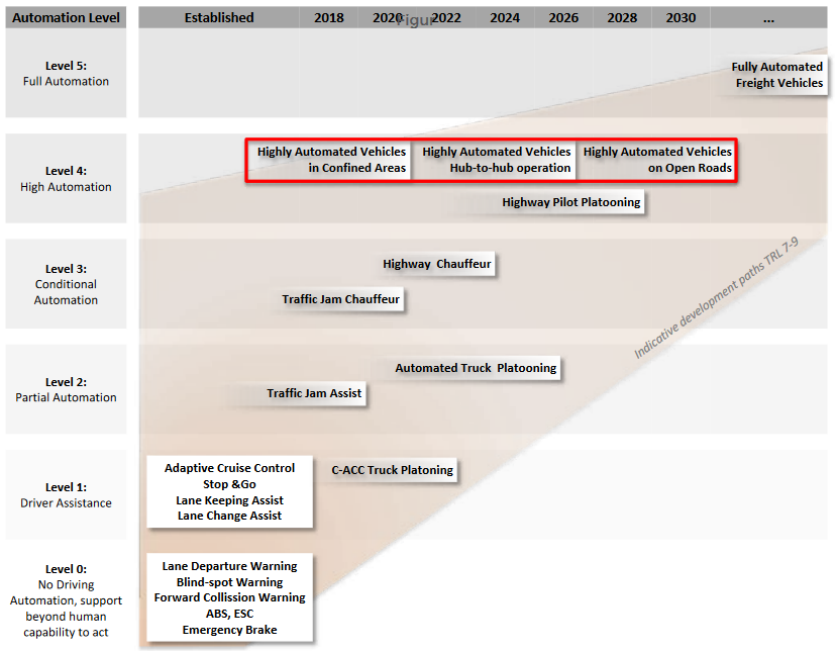

Liikenne- ja viestintäministeriö 2021. Fossiilittoman liikenteen tiekartta – Luonnos valtioneuvoston periaatepäätökseksi kotimaan liikenteen kasvihuonekaasujen vähentämisestä. https://valtioneuvosto.fi/hanke?tunnus=LVM050:00/2019

# Connected, Automated Mobility

- Safe
- Flexible
- Affordable
- Connected
- User-centric
- Inclusive
- Seamless…

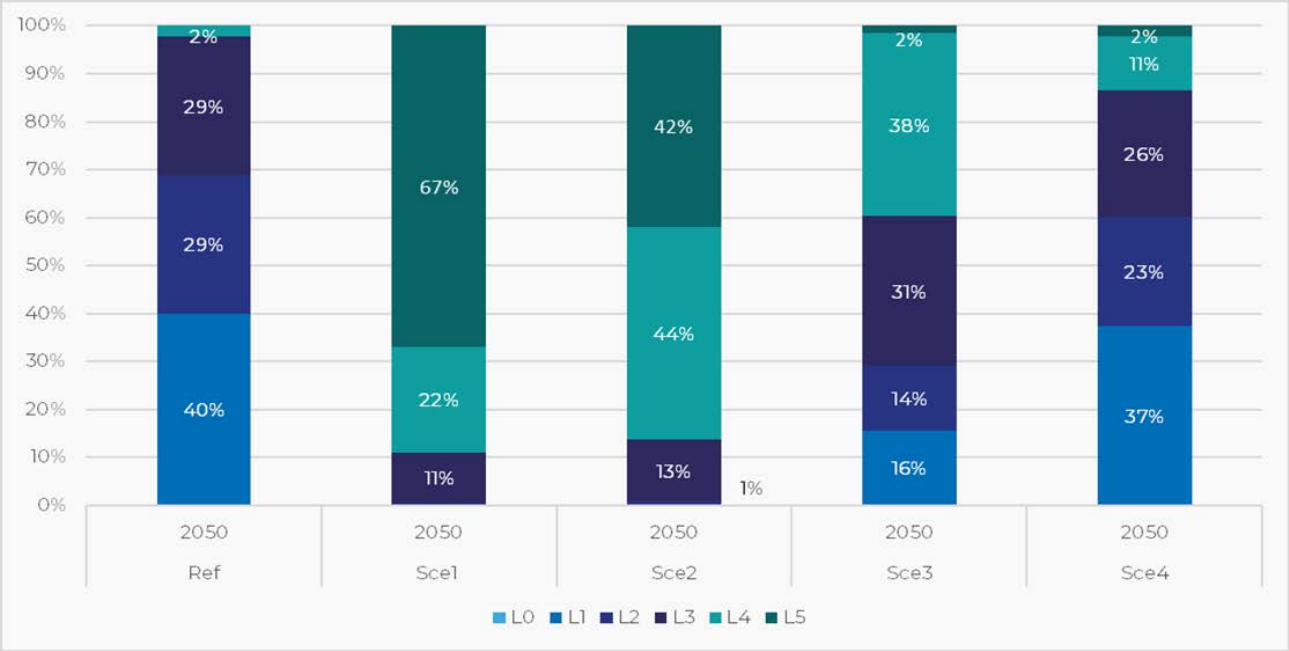
# The Automated Driving development path for passenger and freight vehicles




ERTRAC Connected Automated Driving Roadmap
https://www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf

# Estimated composition of car fleet by automation level in 2050 – EU 27*




Scenario 1: Fast, private, unrestricted and partially distributed (Maximum uptake)

Scenario 2: Fast, private, restricted and partially distributed (Intermediate uptake)

Scenario 3: Moderate, shared, restricted and limited distribution (Moderate uptake)

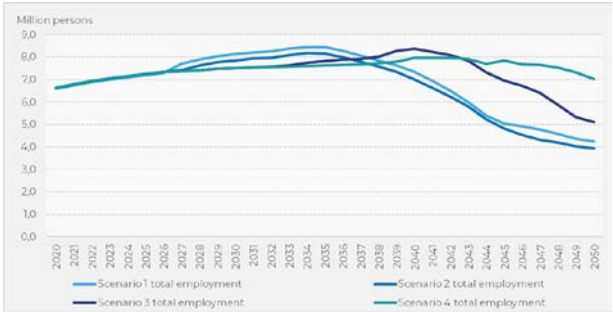
Scenario 4: Slow, shared, restricted and limited distribution (Low uptake)



* EC Study on exploring the possible employment implications of connected and automated driving, 2020

# Socio-economic implications of CAD

- Significant employment declines in transport services driver employment; other jobs in transport services are not as directly impacted
  - For freight transport: mobility operators will be needed (until SAE-level 4)




- Job growth in manufacturing, construction and other services due to the demand for new, more valuable vehicles, components, and infrastructure

# Smart, Shared, Sustainable Mobility

- Multimodal
- Intermodal
- Clean
- Safe
- Flexible
- Affordable
- User-centric
- Connected
- Inclusive
- Shared
- Healthy
- Seamless…

Green transportation pyramid




Figure: Share North project

# What is smart, shared Mobility?

Core elements of smart mobility (Docherty et al. 2018):

1. A transition from ownership to usership
2. A renewed mobility marketplace as the traditional business model for public-private allocation of tasks across the mobility system evolves
3. A transition from a modal-centric to a user-centric system, where the users' needs will get the main focus in future developments instead of the various modes of transport
4. A new role of the citizen in the transport system both as a source and recipient of information and services.

Docherty, I., Marsden, G. & Anable, J., 2018. The governance of smart mobility. Transportation Research Part A: Policy and Practice, 115, 114-125. https://doi.org/10.1016/j.tra.2017.09.012

# Challenges of smart Mobility

- The tension between supporting the uptake of innovations, which offer **benefits in the short-run**, but which may create bigger governance **challenges as they scale**
- Management of the **taxation** of the transport system to reduce e.g. negative externalities like congestion and local pollution as the **actors' roles change**
- **Data as a critical asset** to control and have power over the mobility marketplace - open data offers many opportunities to different actors, but **shifts in the control of data** will make governing mobility difficult.
- **Equity and inclusion** and the fact that a smart mobility transition will not occur at the same pace or degree **across different areas**.

# E-scooters marketed as a sustainable and joyful means of transport for active citizens, but there are trade-offs …

- Service providers generating as much transport as possible to maximise returns on their investment and wide market entry **vs.** long term sustainable urban mobility targets of the municipalities
- More scoots, more use and profit, better user satisfactions, but crowding very central areas **vs.** convenient last mile mode to support public transport if located properly; may even reduce vehicle congestion
- No regulation on market access, fees, speed, safety like other modes
- Safety, conflicts with other modes, security
- Sustainability of the business model (value proposition, creation, delivery capture and value transfer)
- eScoot data collection/sharing for the benefit of the whole system - opportunities **vs.** challenges in the data control
- Services first emerging in central high density areas **vs.** social equity

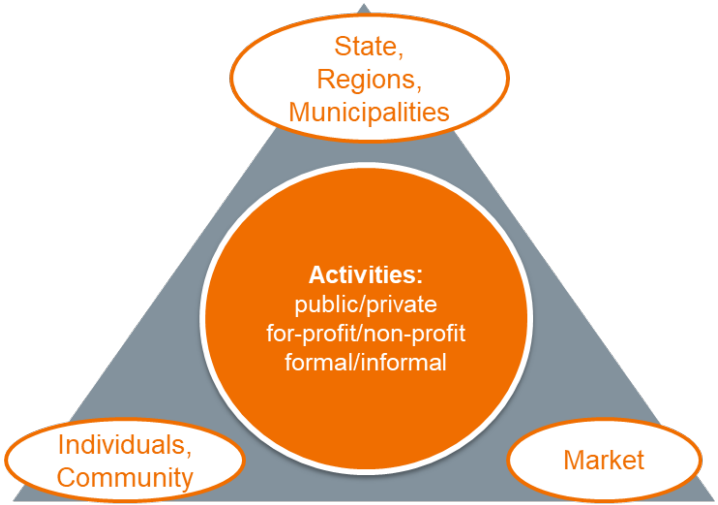


https://www.styletutkimus.fi/sahkopotkulaudat-osana-kestavaa-kaupunkiliikkumista-totta-tarua-vai-tulevaisuutta/

# Opportunities and challenges for transport innovations within systemic transitions

# Multiple actors and interests in socio-technical transitions

- The smart sustainability transition in urban transport is a joint effort of multiple actors, but the roles are not always clear
- The smart sustainability transition requires
  - planning vision with clear targets
  - packages of measures with multiple benefits
  - cross-sectoral approaches
  - renewal of regulatory frameworks
  - balance between pricing and social inclusion



# Technological Innovation System (TIS)

- An approach for analysing the uptake and conditions of new technologies and solutions (Hekkert et al., 2007).
- Technological Innovation System (TIS)
  - “a network of agents interacting in the economic/industrial area under a particular institutional infrastructure”
- Seven functions of TIS affect the performance of the system (Bergek et al., 2008) and are ***highly important for well performing innovation systems***

Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological forecasting and social change, 74(4), 413-432.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research policy, 37(3), 407-429.

# Seven functions of Technological Innovation System (TIS)

1. Knowledge development and diffusion
2. Influence on the direction of search: e.g. guidance of resources and incentives towards adopting certain technologies
3. Entrepreneurial experimentation: testing of new solutions or markets
4. Market formation: creating markets and aim to create demand for the new solutions
5. Resource mobilization: practical allocation of financial or human resources
6. Legitimation: efforts to overcome resistance and established practices and develop acceptance
7. Development of positive externalities: spillovers that can benefit e.g. new actors and benefit the renewal and development of the system

# Mobility-as-a-Service (MaaS) – Experiences*

- Early engagement with technology
  - basis for the rest of the solution
  - users have difficulties to understand the benefits – the first use case!
- Interoperability
  - flexibility with regards to implementation of different operators' services
- Clear regulation over new modes
- Public authorities as bodies overseeing transition
- Organisations to work together to deliver new services, open engagement
- Challenges
  - lacking standards and interoperability (data, interfaces, systems)
  - communication and supervision of the requirements and market situations
  - terms of ticket sales
  - potential generation of additional travel and externalities

© POLIS network



http://www.maas4eu.eu/

*Regsmart project of the Norwegian research council

# Other known rebound effects and conflicting interests

- More asphalt (e.g. Kehä II)
  - Less congestion on the residential areas around (short-term impact)
  - More traffic overall (= attracts more car traffic) (long-term impact)
- Intelligent parking guidance in the cities
  - Less car traffic searching for a free parking lot (positive immediate impact)
  - More appealing to choose a private car to get to the city (negative long-term impact)
- Opening-up the bus lanes to eVehicles
  - More eVehicles → less emissions per car
  - Less cars on the "normal lanes" → less emissions from each vehicle
  - More and more eVehicles → bus lanes get congested – travel times per bus increases → less attractive to use public transit
- New shared modes
  - From which mode are people switching to these or are the trips generated totally new?
- Promotion of active modes
  - Mainly positive overall impacts on fluency, environment, health
  - Safety in numbers -effect

# The Future

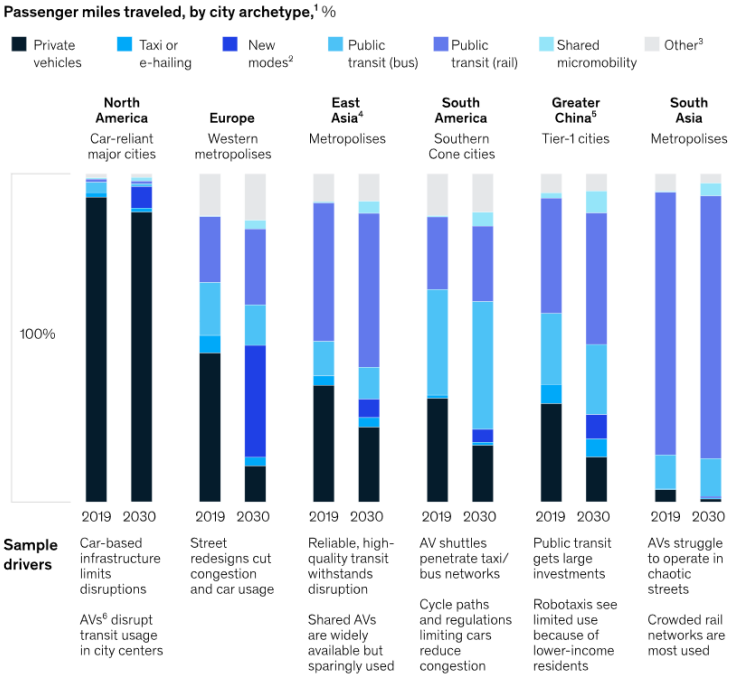
# Mobility in large cities after COVID-19

**Mayor Anne Hidalgo gives green light to £225m-scheme to transform French capital's most famous avenue**

▲ An image from the architectural firm PCA-Stream showing the planned changes to the Champs-Élysées area. Photograph: PCA-Stream

https://www.theguardian.com/world/2021/jan/10/paris-approves-plan-to-turn-champs-elysees-into-extraordinary-garden-anne-hidalgo

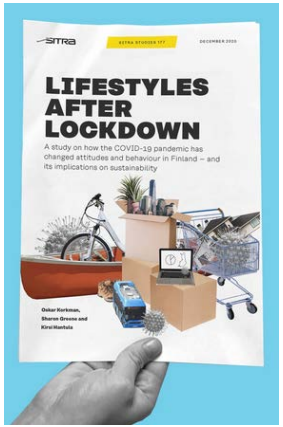
**Comparing large global cities highlights significant differences in expected regional mode-share shifts through 2030.**




McKinsey & Company: Five COVID-19 aftershocks reshaping mobility's future
https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/five-covid-19-aftershocks-reshaping-mobilitys-future

# SITRA:
# Lifestyles after lockdown

- The demand for solutions that help people to live a sustainable good life is there, but companies and institutions have been slow to lead
  - There is clear evidence that people are ready to move, but society, institutions and companies are lagging behind in finding the ways to respond to the new demands
- Companies and institutions developing solutions for a more sustainable lifestyle need to have a deep understanding of people's everyday life
  - This will require new capabilities, ecosystems and knowledge of how to best respond to and accelerate the existing demand




https://www.sitra.fi/en/publications/lifestyles-after-lockdown/

# Future transport innovations?


The Doughnut of social and planetary boundaries (Kate Raworth 2017)

# Transport system is a complex socio-technical entity

- There are numerous societal and technological trends and developments affecting and changing the way we travel
- Strate[illegible]ectives a[illegible]licy targe[illegible]
  syste[illegible]nen[illegible]
- Impa[illegible]vidual[illegible]ment r[illegible]getic or conflicting
- Transition to smart sustainable transport system is a joint effort of multiple actors - collaborative learning and capacity building

# Thank you!

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