Navigating the Roadmap for Clean, Secure and Efficient Energy Innovation

SET-Nav
Strategic Energy Roadmap

Case Study:
"Ways to a cleaner and smarter transport sector"

Stephanie Heitel

Stakeholder Workshop

„Accelerating the transition towards sustainable transport"

14th May, 2018, Brussels

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GHG EMISSIONS AND TARGETS FOR TRANSPORT

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EU Roadmap for moving towards a competitive low-carbon economy:

GHG reductions compared to 1990	2005	2030	2050
Total	-7%	-40 to -44%	**-79 to -82%**
By Sector			
Power	-7%	-54 to -68%	-93 to -99%
Industry	-20%	-34 to -40%	-83 to -87%
Transport (incl. aviation, excl. maritime)	**+30%**	**+20 to -12%**	**-54 to -67%**
Residential and services	-12%	-37 to -53%	-88 to - 91%
Agriculture	-20%	-36 to -37%	-42 to -49%
Other non-CO2 emissions	-30%	-72 to -73%	-70 to -78%

Source: Com(2011) 112

In 2015:

- the transport sector accounted for around 28% of the EU GHG emissions,
- 84% of these emissions stemmed from road transport, 15% from aviation,
- road transport emissions were mainly caused by passenger cars (61%), by heavy duty trucks & buses (26%) and by light duty vehicles (12%).

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MAIN STRATEGIES TO DECARBONIZE TRANSPORT

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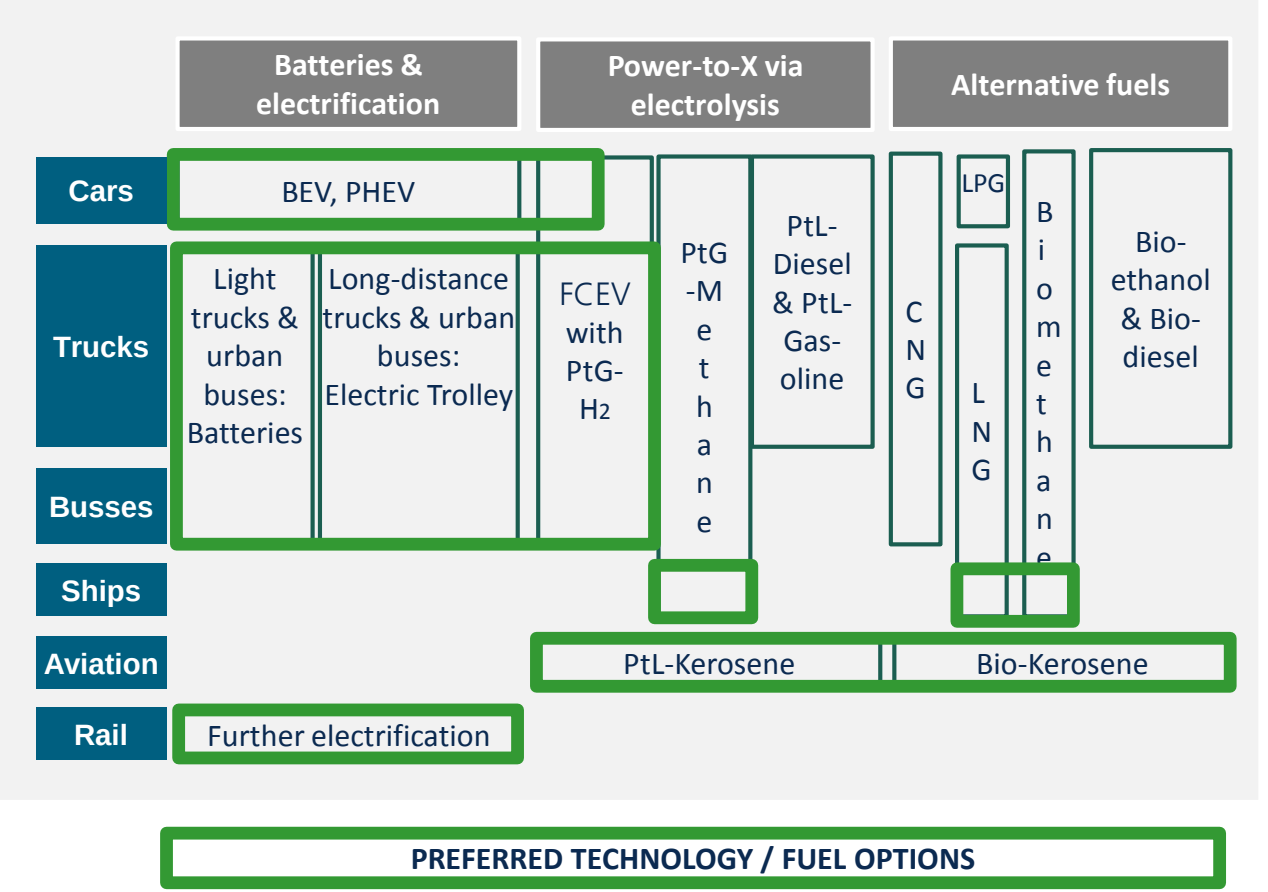
- Shift to more efficient transport modes
- Diffusion of low/zero-emission technologies
- Alternative fuels: bio & synthetic fuels



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MEASURES AND POLICIES TO ENABLE THE TRANSITION

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Modal Shift

- **financial measures** like smart pricing, road infrastructure or congestion charges in cities,
- measures to **improve the infrastructure** of public transport, cycling and walking pathways,
- measures to **improve the accessibility and the use of multi-modal transport**, **bike-, car- and ridesharing services** by better applying digital technologies and
- **regulatory measures** like lower speed limits for passenger cars, prioritised traffic flows of non-motorised modes and public transport on crossings and high parking fees

Low emiss-ion techno-logies & fuels

- **Stricter fuel efficiency or CO_2 standards** until 2030 and beyond
- **Subsidies for electric vehicles** in early market phases
- Vehicle **registration taxes based** on bonus-malus systems related to **emissions**
- Increased **energy taxation** for conventional fuels, **reduced fuel tax** for electricity, biofuels, hydrogen and renewable synthetic fuels
- Spreading **road charges based on CO_2 emissions**
- **Banning** fossil-fuel based cars **from entry into cities**
- Regulating a general **phase-out of pure ICE vehicles** at least for passenger cars

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SCENARIOS

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	Reference Scenario	Policy Scenarios	
		Direct Electrification	Hydrogen
Policies for the diffusion of low/zero-emission technologies and alternative fuels	Passenger car CO2 EC regulation 443/2009	CO2 regulation for new buses and trucks	
		Vehicle taxation via bonus-malus regulation related to CO2-emissions of the vehicle	
	Van CO2 EC regulation 510/2011	Road charging based on emissions	
		Subsidies for electric vehicles in early market phases	
	Renewable Energy Directive 2009/28/EC (10% share of renewable energy in the transport sector final energy demand)		Subsidies and R&D initiatives for market entry of FCEVs
		Increased energy taxation for conventional fuels and reduced fuel tax for electricity, biofuels, hydrogen and PtX fuels	
		Phase-out of new pure diesel and gasoline vehicles for cars, light duty vehicles and urban buses as of 2035	
Filling and charging stations for alternative fuels	As defined by National Policy Frameworks provided by member states as response to the AFID directive 2014/94/EC	Continuously increasing public charging infrastructure (1 charging point per 10 battery-electric vehicles)	
		-	Dense hydrogen infrastructure (1/3 of current petrol stations in 2040)
Trolley truck infrastructure	-	Hybrid Trolley-Truck infrastructure on highly-used motorways in all EU countries	-
Non-road transport	TEN-T guidelines (core network completed by 2030, comprehensive completed by 2050, increasing the competitive advantage of railways and inland waterways)	Increased electrification for railways, emission standards for new aircrafts and ships, higher share of LNG for ships and of bio-kerosene for aviation	
Shift to more efficient transport modes		More intensive efforts to shift traffic from cars to trains, public transport, cycling and walking, e.g. by improving local public transport	
Alternative fuels		Higher share of bio-fuels, supplemented by synthetic PtX-fuels if not enough sustainable biomass should be available	

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METHODOLOGY: MODELLING APPROACH

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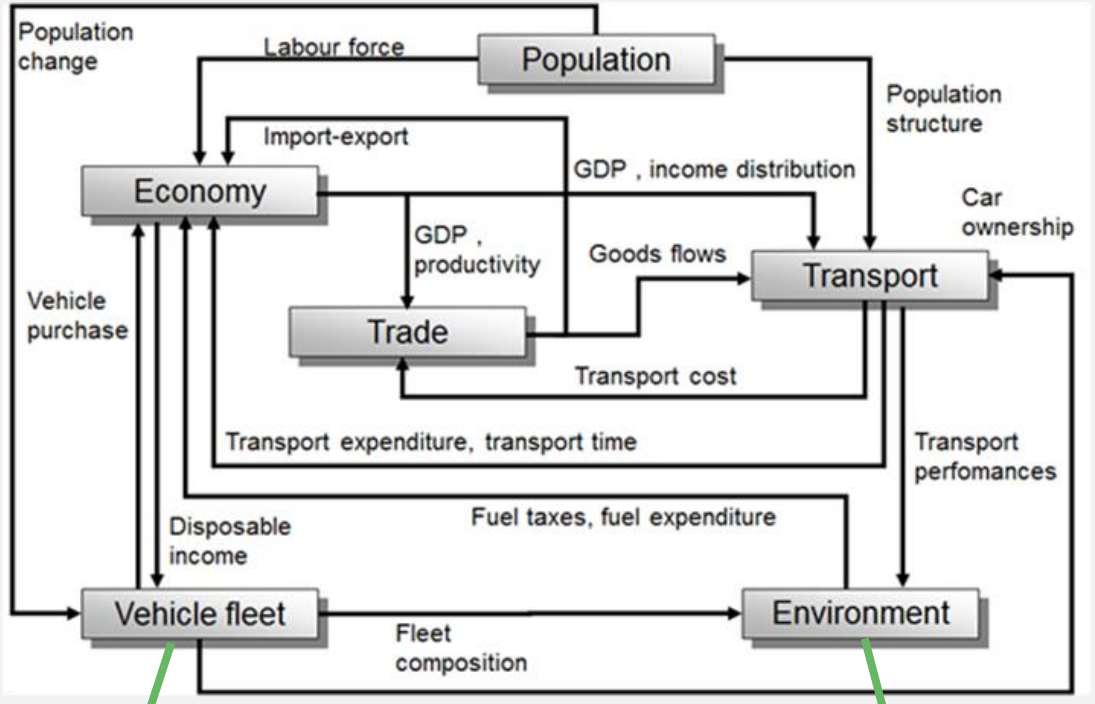
ASTRA - **As**sessment of **Tra**nsport Strategies
www.astra-model.eu

Main characteristics:

- System Dynamics - Vensim® software
- 1995 to 2050
- EU28 + CH/NO
- Modular structure
- Simulation of single policy measures and bundles
- Technology diffusion based on an adapted total cost of ownership approach



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Results: GHG Emissions in Mt CO_2

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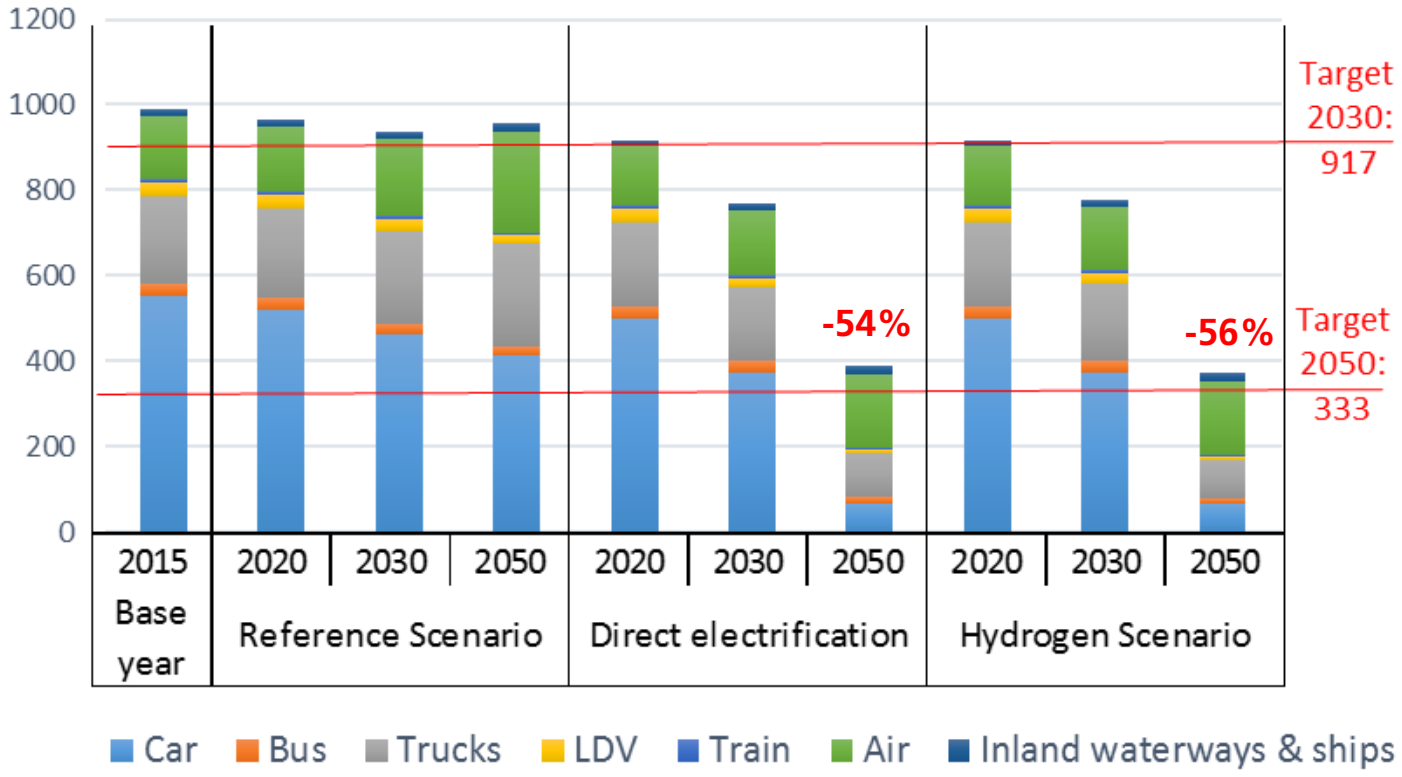

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Results: Fleet Composition

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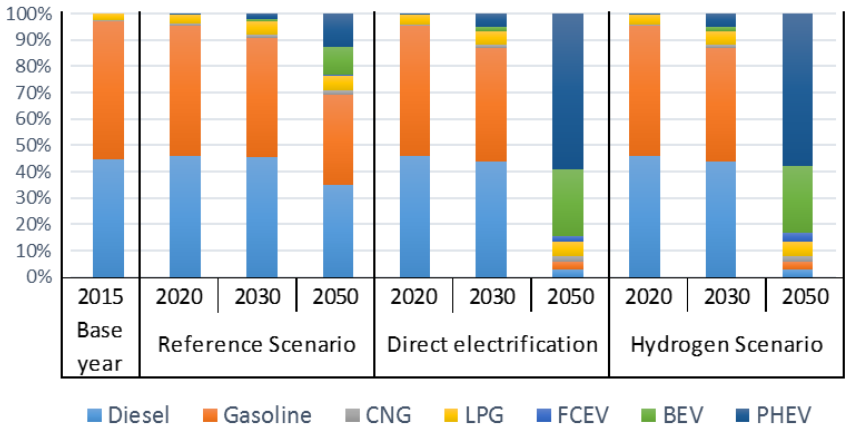
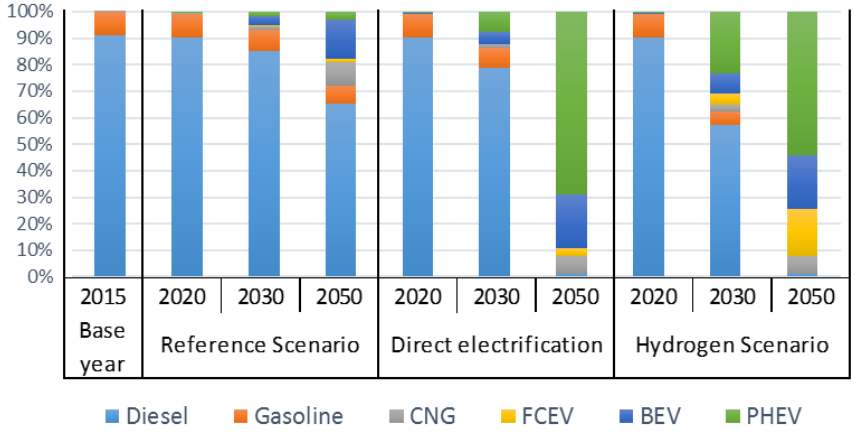
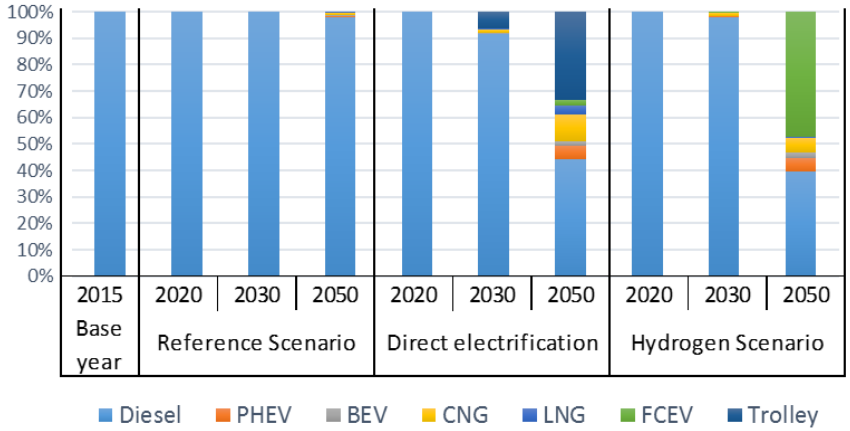
CARS



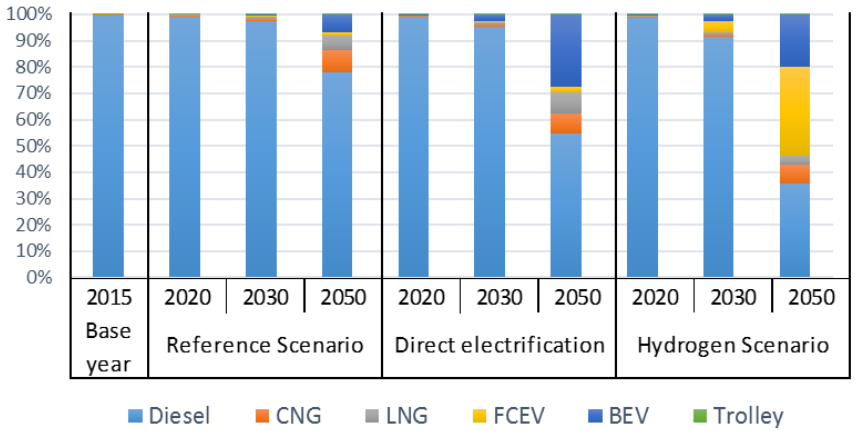
LIGHT DUTY VEHICLES



TRUCKS



BUSES



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Results: Modal Shift & Activity

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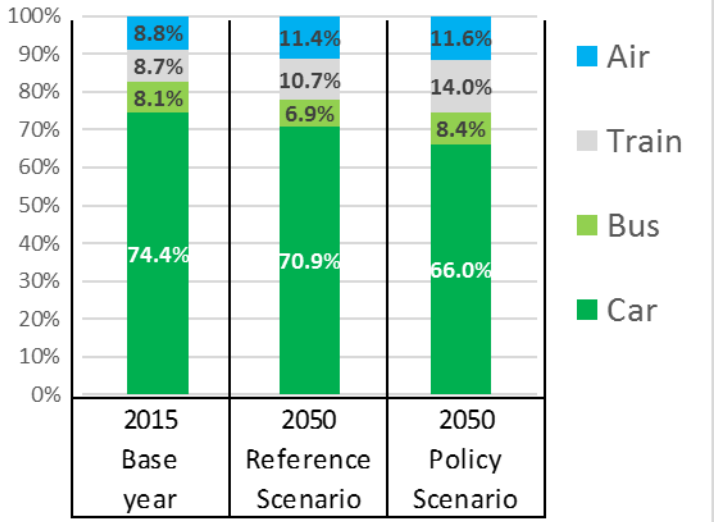
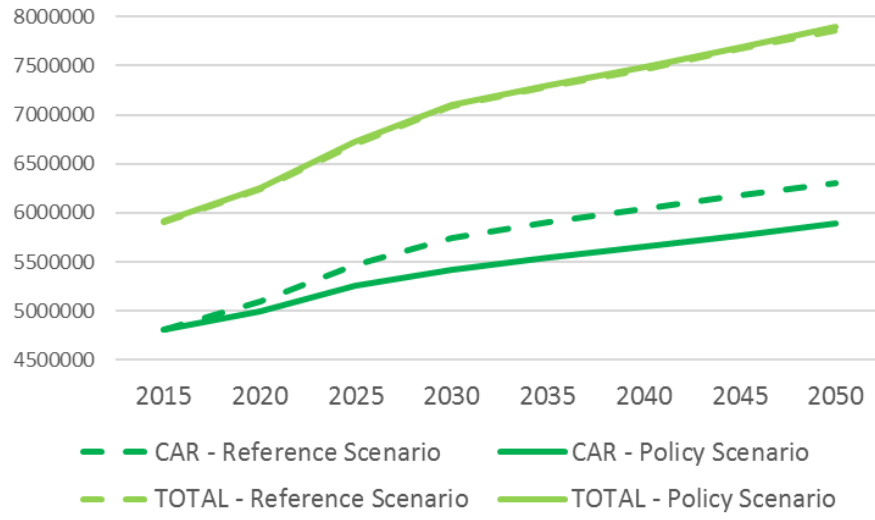
Modal split based on pkm origin country



Passenger land transport demand in Mio passenger kilometers (pkm)



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Results: Link to Power Sector & Overall Efficiency

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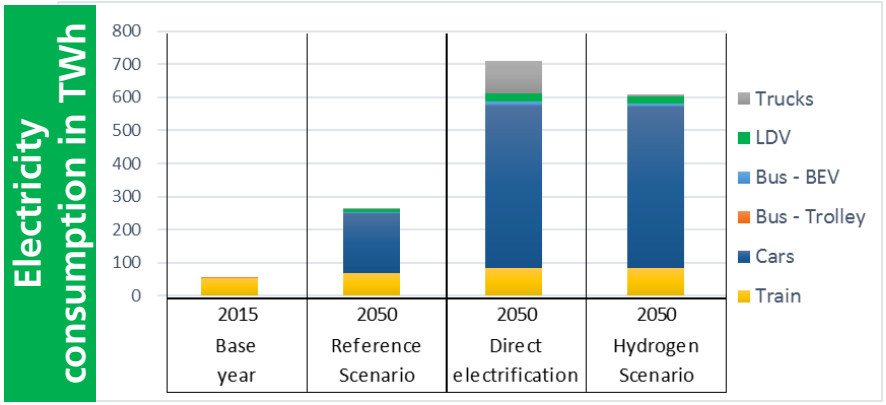
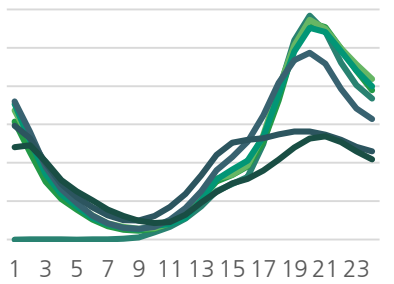
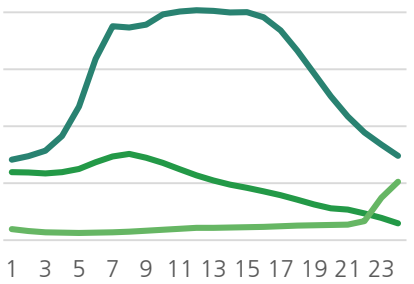
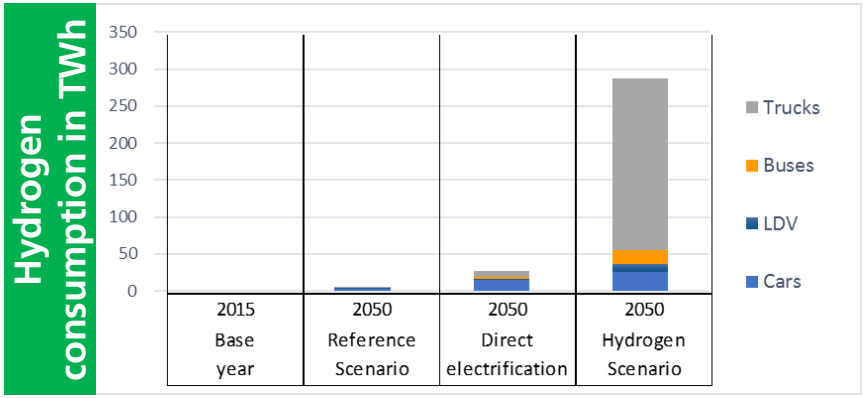


BEV / PHEV



Trolley Trucks





FCEV

- High flexibility potential: Production in times of electricity oversupply
- Lower overall efficiency

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Required investments

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Rough estimates

Trolley truck infrastructure:
for 1/3 of most frequented motorways → ~ 50 Billion EUR

Hydrogen infrastructure:

- Small filling stations ~ 1 Mio. EUR
- Large fillling stations for trucks ~ 10 to 20 Mio. EUR → ~ 50 Billion EUR
- 2500 to 5000 Hydrogen filling stations required

+ additional investments for distribution infrastructure

Production capacities for synthetic fuels:

- Most probably required for overall GHG reduction target of 95%
- LNG, kerosene, diesel and gasoline most probably produced in Non-European countries

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CONCLUSIONS

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- New powertrain technologies for road transport provide a high potential for decarbonizing the transport sector.
- Policies need to be in place soon to drive this transition.
- Flexibility for power sector and overall efficiency to be considered.
- GHG reduction targets might need to be even more ambitious to limit global temperature rise.
- Discussions on the best policy mix on European and national level and on further framework conditions are required.

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Questions for Discussion

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Parallel investments

- Does it make sense to develop and establish a charging, filling station and trolley infrastructure in parallel or would it be sufficient to not follow the pathway of technological openness and focus on the most cost-efficient technology pathway?

Role of synthetic fuels

- Could synthetic fuels be produced in the required amounts in a cost-efficient way in Europe using renewable electricity?
- Should they be prioritised for the use in those modes where there is a lack of alternative fuel options to decarbonise transport?

Adequate policy measures

- Which additional policy interventions are required to get the transport sector decarbonized?
- Which measures should be implemented on EU / national level?
- Which measures might have more positive effects and seem more cost-efficient?
- How could changes in mobility behaviour be achieved under the condition that mobility stays affordable and inclusive?

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Thank you!

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Reference Scenario Fails To Meet CO_2 Reduction Targets By Far

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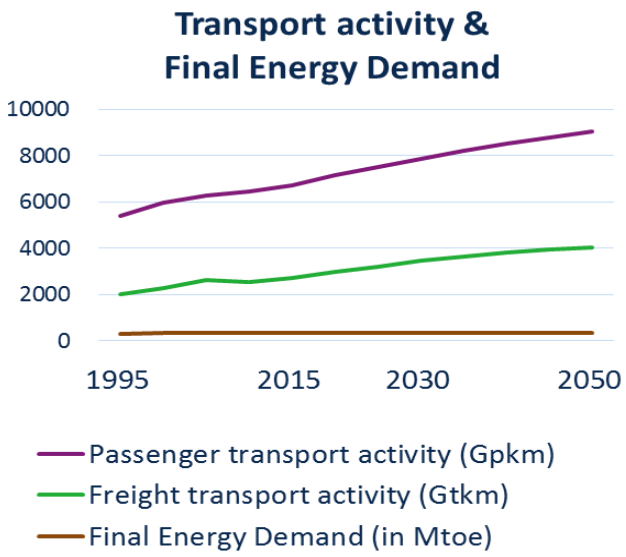

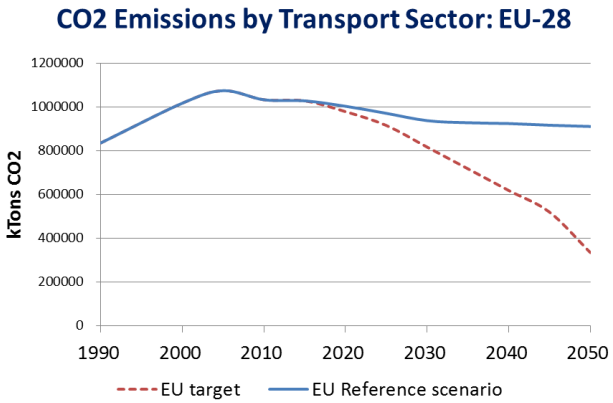

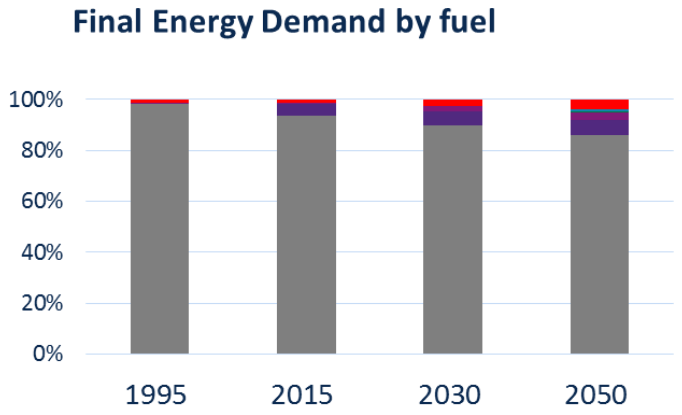

Electricity	53.0	54.2	97.5	160.9	TWh
Hydrogen	0.0	0.0	2.1	27.6	TWh

Methanol & ethanol
Biogas
Gas
Biofuels (liquids)
Oil (LPG, Gasoline, Diesel, Kerosene, others)

based on EU Reference Scenario EU28 for transport

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Comparison of two promising Technologies for Trucks

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Hybrid-Trolley-Trucks	FCEV-Trucks based on PtG-Hydrogen
- No flexibility for the energy system	+ Provides high flexibility for the energy system
++ High degree of efficiency	- Doubling of energy demand compared to Hybrid-Trolley due to transformation losses
o Would require deployment by several European countries to achieve enough cost reduction through economies of scale & learning and to support long-distance trips crossing several borders	+ More use cases: FCEV can also be applied for passenger cars, buses and intermediate trucks
	+ Higher acceptance by truck manufacturers
- Hybrid-technology would be based on fossil fuel to bridge the distance to and from the electrified highways at least until 2030, afterwards a share might use battery technology as extension.	- Market penetration might start later due to more challenges related to the technology, the hydrogen production and its distribution to refuelling stations.

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Scenario Overview

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Goal	**CO_2-Emission reduction**	Low — High	Roadmap COM 1990 - 2050: -54 to -67%
Transport policies	**Efficiency of transport system**	Low — High	by using digital technologies, smart pricing, etc.
	Pushing low-/zero-emission vehicles	Slight — Strong	by fuel and vehicle taxation, CO_2 price, investments in refuelling infrastructure, fuel efficiency standards, etc.
Techno-logies & Fuels	**Trolley Truck infrastructure**	No — Yes	Deployment starting 2020 in all European countries
	Hydrogen filling stations	Few — Many	According to National Policy Frameworks from AFID for Reference & Policy 1
	Charging stations	Few — Many	According to National Policy Frameworks (AFID) for Reference
	Share of Bio and PtX fuels	Low — High	Hydrogen produced via PtG, other fuels mixed production

Reference
Policy 1: Strong electrification
Policy 2: Hydrogen

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Results: Modal Shift & Activity

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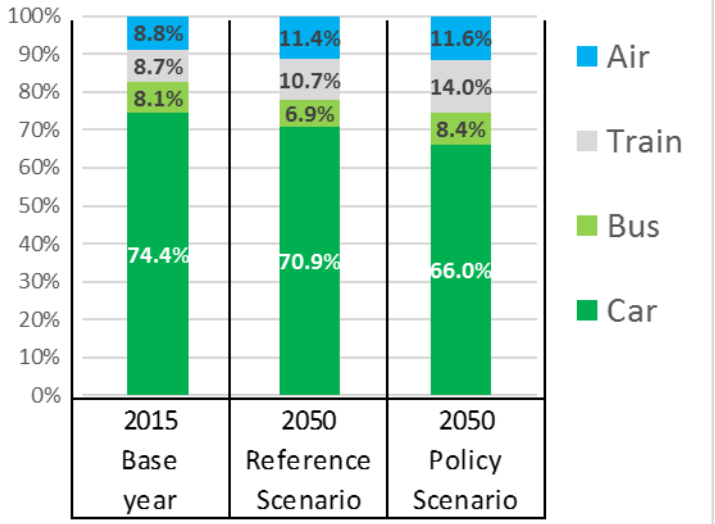
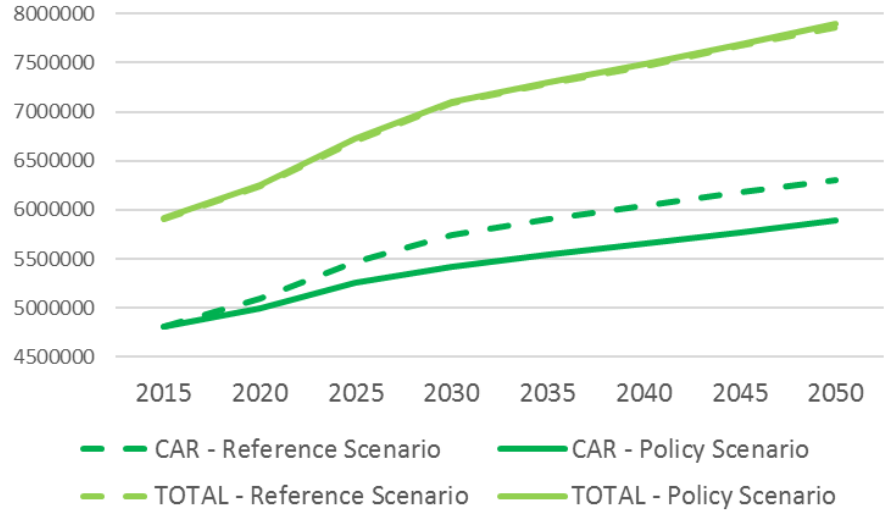
Passenger

Modal split based on pkm origin country



Land transport demand in Mio passenger kilometers (pkm)



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Results: Modal Shift & Activity

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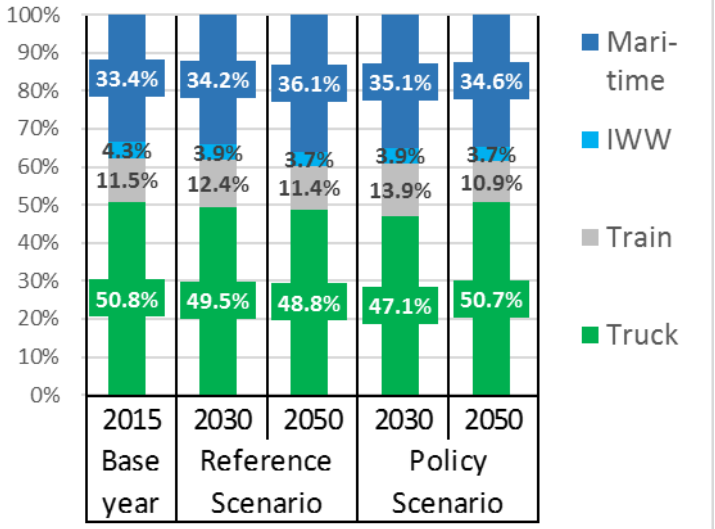
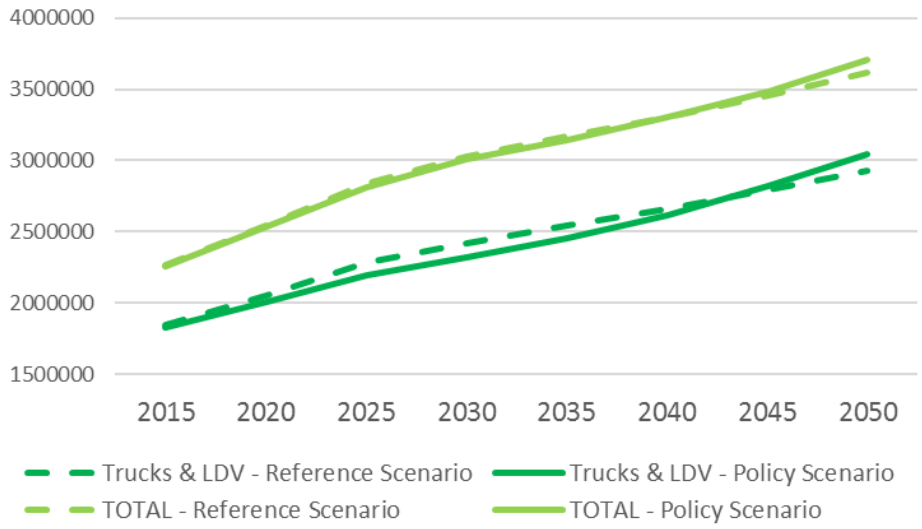
Freight

Modal split based on tkm origin country



Land transport demand in Mio tonne-kilometers (tkm)



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