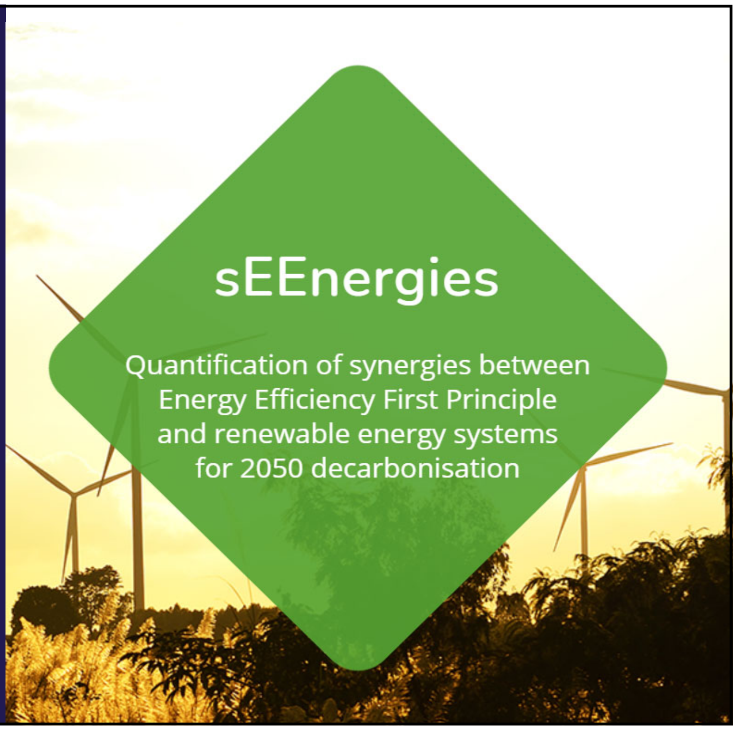
sEEnergies: Energy Efficiency within Transport



sEEnergies

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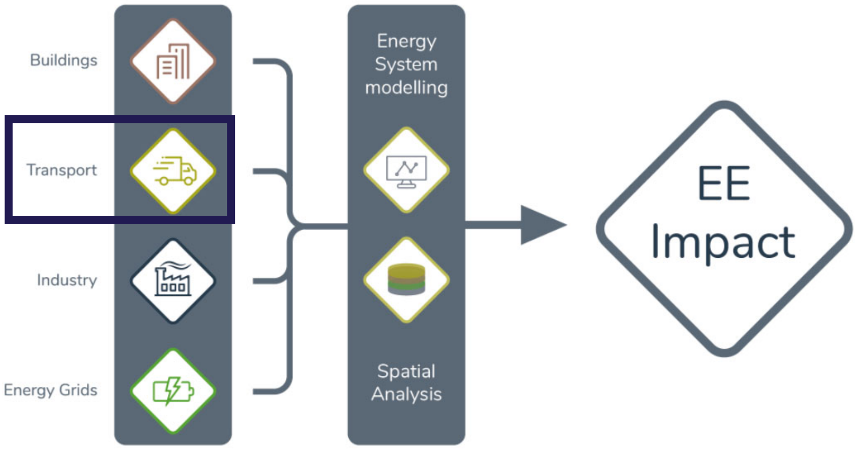

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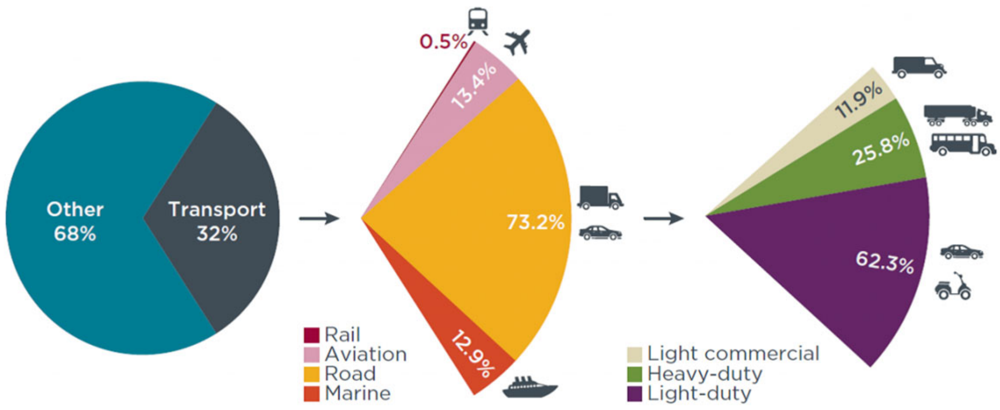
Background: EU28 Transport Sector

3



Distribution of EU28 Transport CO2 emissions by mode of transport 2015 (Source: Clean Energy Wire Factsheet)

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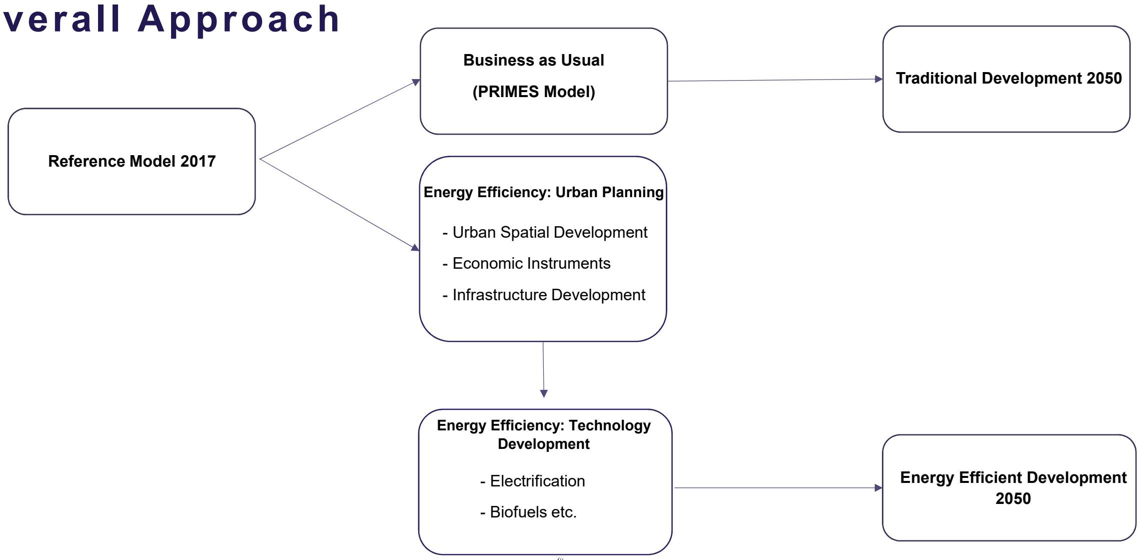
Overall Approach

4



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TransportPLAN

- Originally developed for Denmark (CEESA 2011)
- Bottom-up scenario analysis tool
- Data intensive – high resolution of transport activity data
- Developed for EU28 in sEEnergies
- Data input for EU28 – mostly collected through National Travel Surveys

Coherent Energy and Environmental System Analysis

A strategic research project financed by

The Danish Council for Strategic Research
Programme Commission on Sustainable Energy and Environment

November 2011

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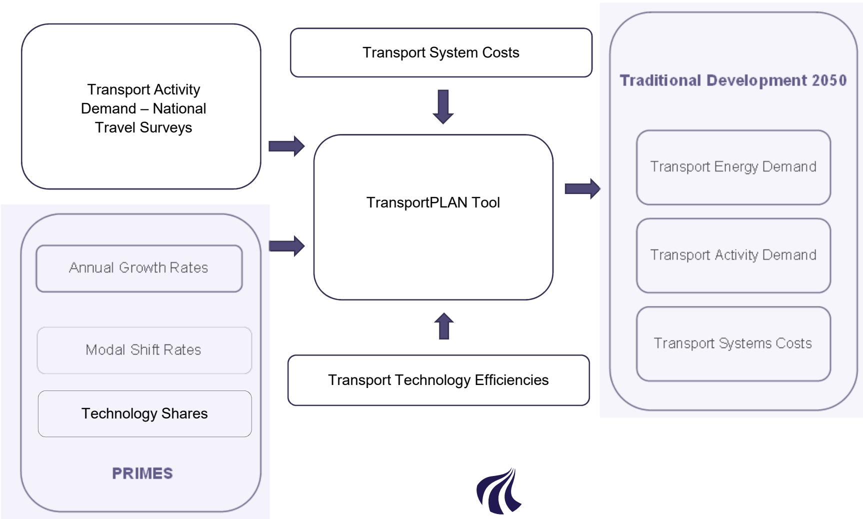
Traditional Development Scenario



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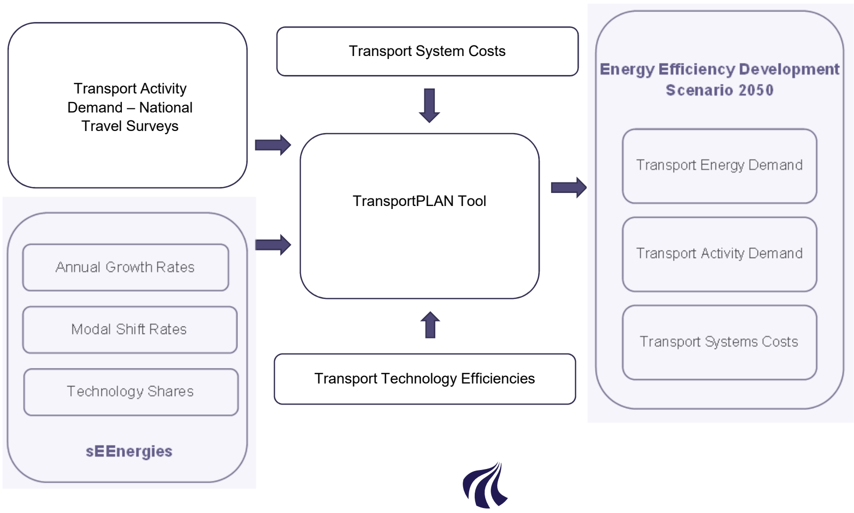
Energy Efficient Development Scenario

7



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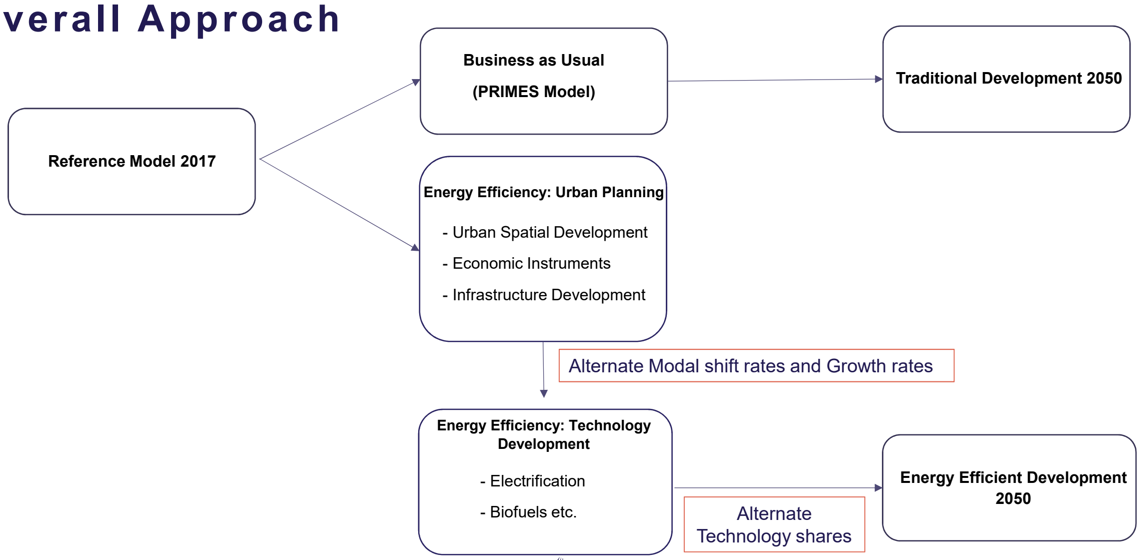
Overall Approach

8



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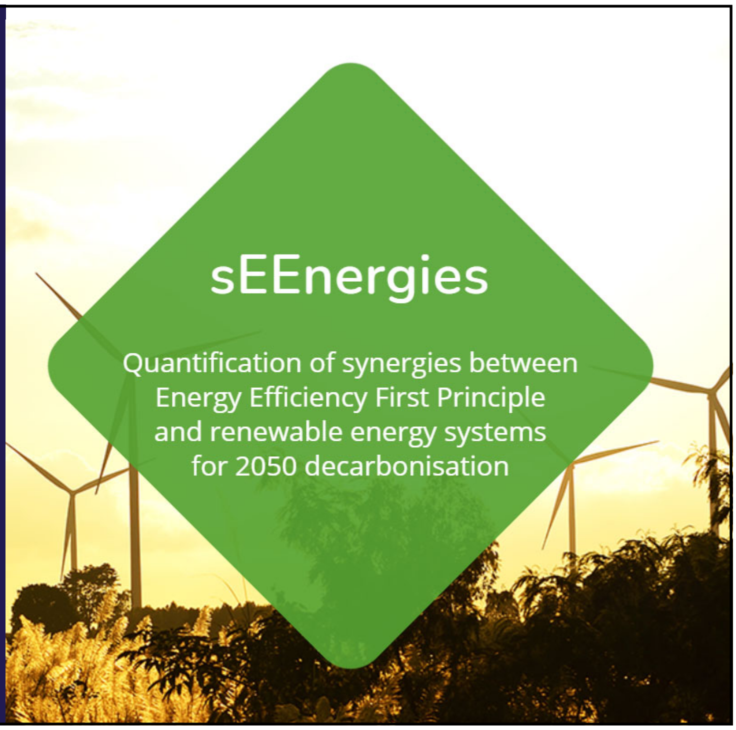
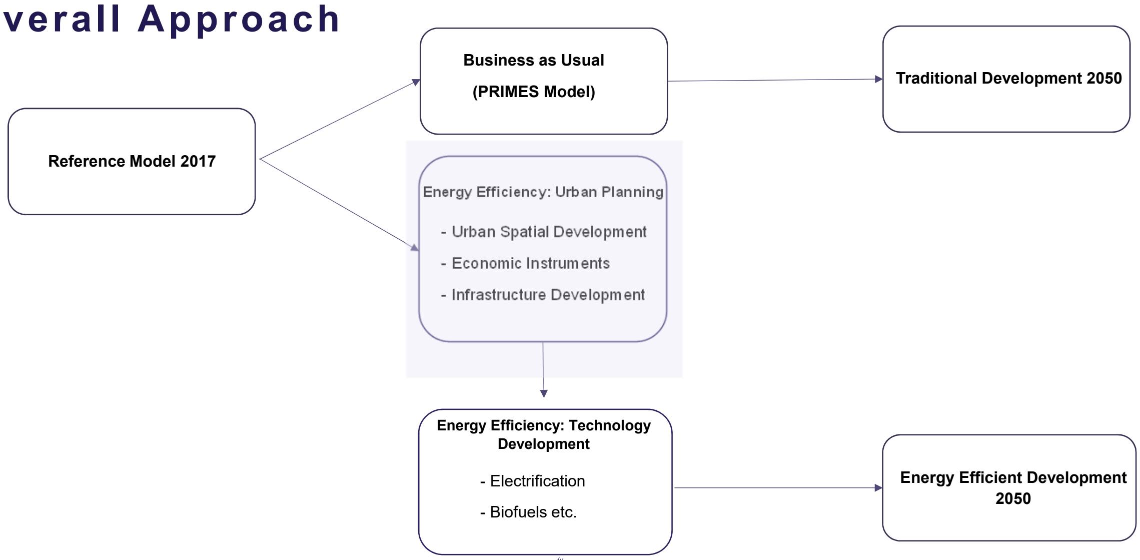
Energy Efficient Urban Development



Overall Approach

10



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EE Development Scenario Assumptions

Changes over the period 2020-2050	Northern Europe		Western & Central Europe		Southern Europe		Eastern Europe	
	BAU	EE	BAU	EE	BAU	EE	BAU	EE
Urban spatial development	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center
Highway capacity increase	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None
Airport construction	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None
Railroad construction	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions
Road pricing and parking fees	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes

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EE Development Scenario Assumptions

Changes over the period 2020-2050	Northern Europe		Western & Central Europe		Southern Europe		Eastern Europe	
	BAU	EE	BAU	EE	BAU	EE	BAU	EE
Urban spatial development	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center
Highway capacity increase	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None
Airport construction	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None
Railroad construction	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions
Road pricing and parking fees	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes

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EE Development Scenario Assumptions

13

Changes over the period 2020-2050	Northern Europe		Western & Central Europe		Southern Europe		Eastern Europe	
	BAU	EE	BAU	EE	BAU	EE	BAU	EE
Urban spatial development	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center	Continuation of trends 2000-2015	Strong densification Reduced residential distance to center
Highway capacity increase	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None	According to TEN-T + other motorway construction	None
Airport construction	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None	To accommodate growth	None
Railroad construction	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions	According to INEA	Intensified in urban regions
Road pricing and parking fees	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes	Very limited	Extensive urban schemes

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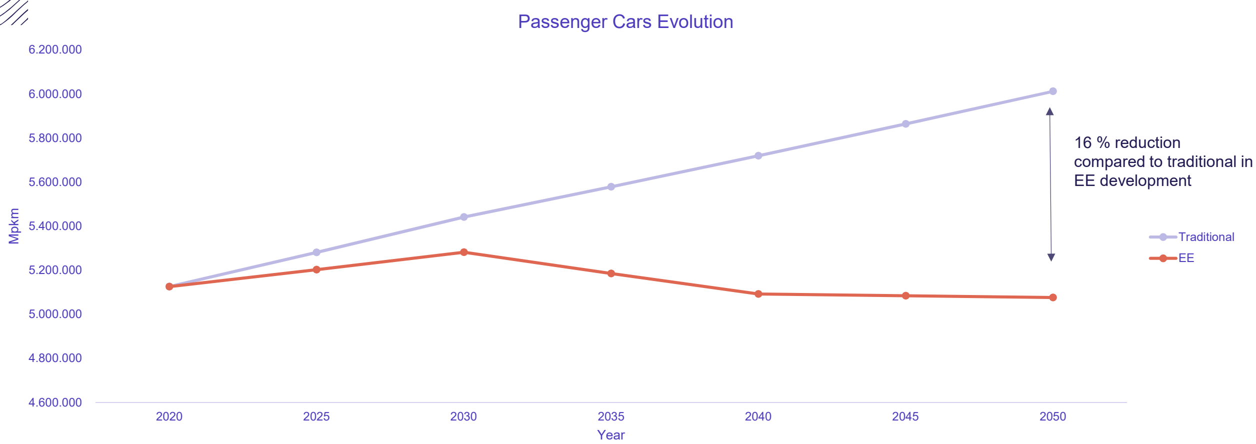
EE Urban Spatial and Infrastructure Development (Annual growth rates and Modal Shift Rates)

14



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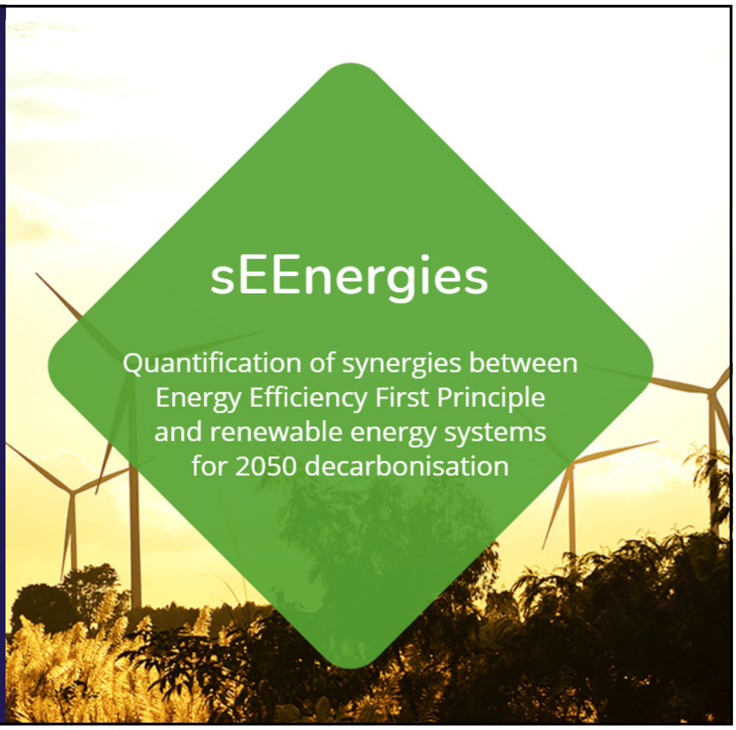
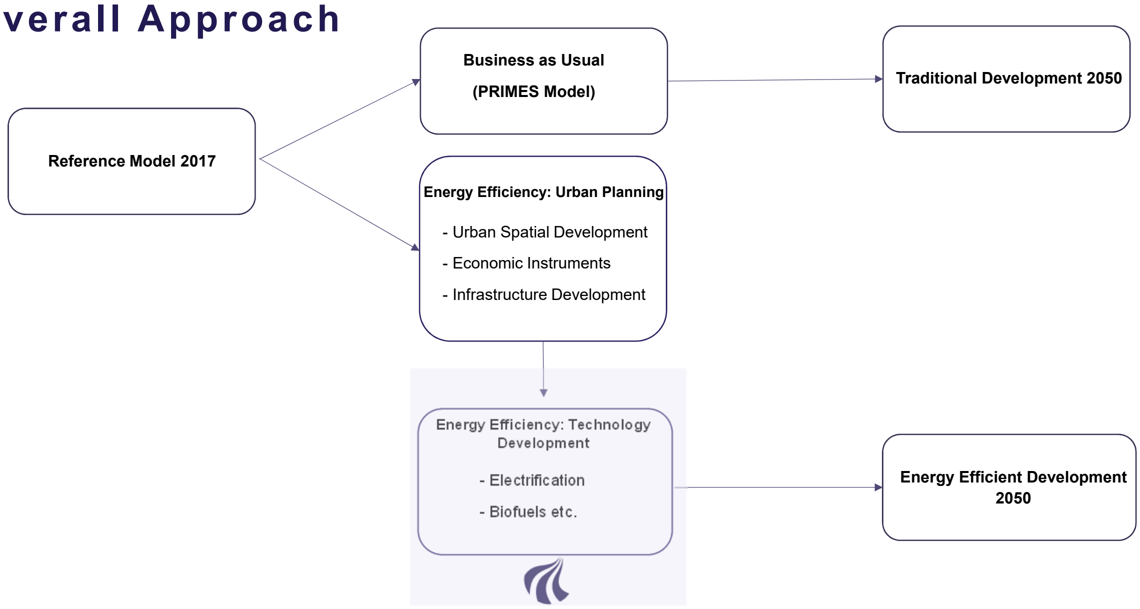
Energy Efficient Technology Development



Overall Approach

16



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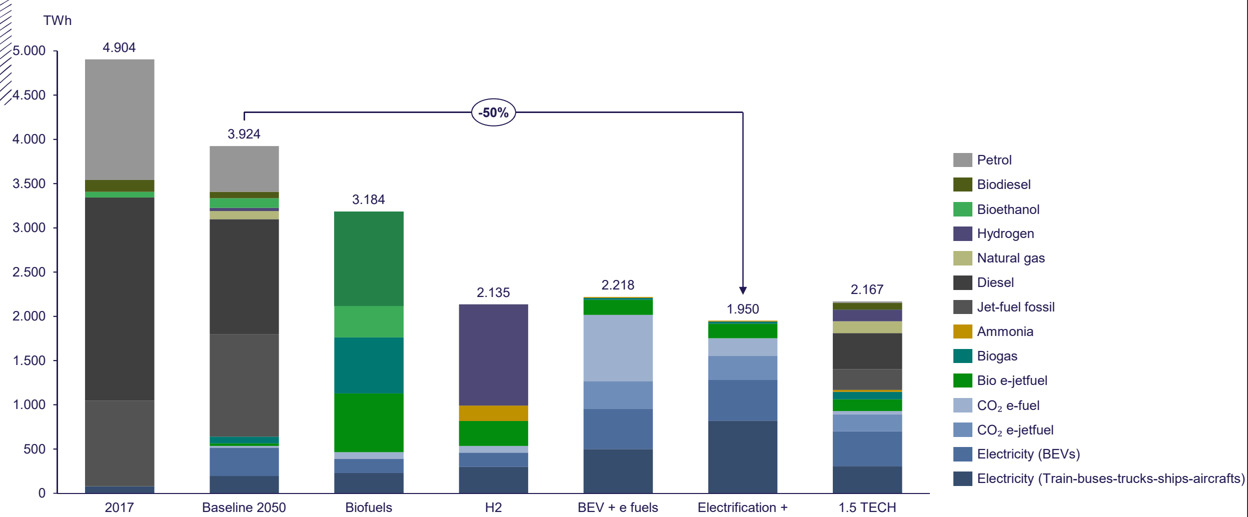
	Baseline	Biofuels	Hydrogen (H2)	BEV + e-fuels	Electrification +
Passenger Cars	35% BEV 19% PHEV 4% FCEV 4% Gaseous 18% Gasoline 20% Diesel	35% BEV 40% Biodiesel 25% Bioethanol	35% BEV 65% FCEV	100 % BEV	100 % BEV
Buses	5% BEV 36% Hybrid 21% Gaseous 38% Diesel	5% BEV 95% Biodiesel	5% BEV 95% FCEV	95 % BEV 5% Electrofuels	95 % BEV 5% Electrofuels
Rail	87 % Electric, 13 % Diesel	87% Electric 13% Biofuels	87% Electric 13% Hydrogen	100% Electric	100% Electric
Aviation	3% bio-jetfuel 97% kerosene jetfuel	100% Bio-jetfuels	50% Bio-jetfuels 50% Hydrogen	20% Electric 80% E-kerosene	20% Electric 80% E-kerosene
Shipping	13% Gaseous 87% Diesel and HFO	100% Biofuels	50% Hydrogen 50% E-methanol	50% Electric 50% e-methanol	50% Electric 50% e-methanol
Trucks	1% BEV 29% Hybrid 18% Gaseous 51% Diesel	50 % Biogas 50 % Biodiesel	1% BEV 99% FCEV	27% BEV 73% E-methanol	27% BEV 73% ERS-BEV
Vans	26% BEV 1% FCEV 19% PHEV 54% Diesel	26% BEV 38% Biodiesel 36% Biogas	26% BEV 74% FCEV	95% BEV 5% Electrofuels	95% BEV 5% Electrofuels
Rail	87 % Electric, 13 % Diesel	87% Electric 13% Biofuels	87% Electric 13% Hydrogen	100% Electric	100% Electric
Aviation	100 % Kerosene jetfuel	100% Bio-jetfuels	50% Bio-jetfuels 50% Hydrogen	100% E-kerosene	100% E-kerosene
Shipp ing	100 % Diesel and HFO	100% Biofuels	50% E-ammonia 50% E-methanol	50% E-ammonia 50% E-methanol	50% E-ammonia 50% E-methanol

Results-Energy Demand (EE Dev)

18



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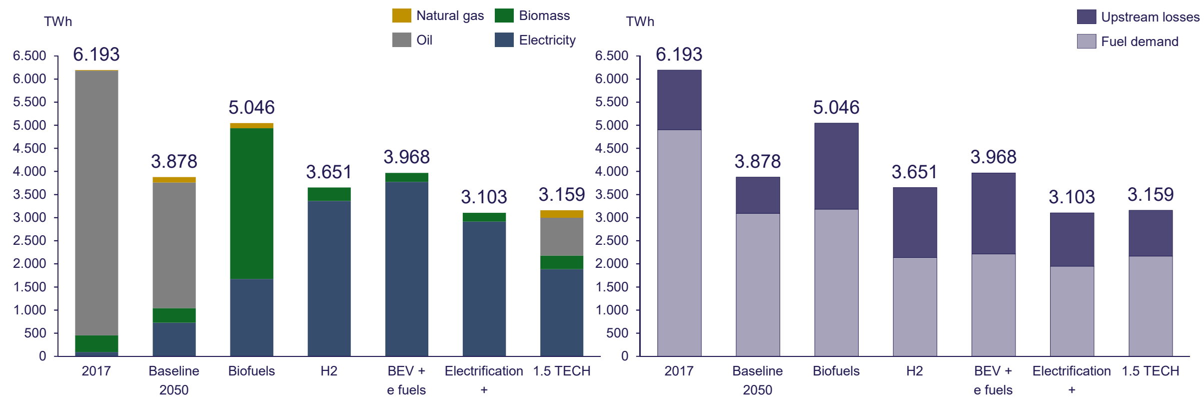
Results-Upstream Energy Demand (EE Dev)

19



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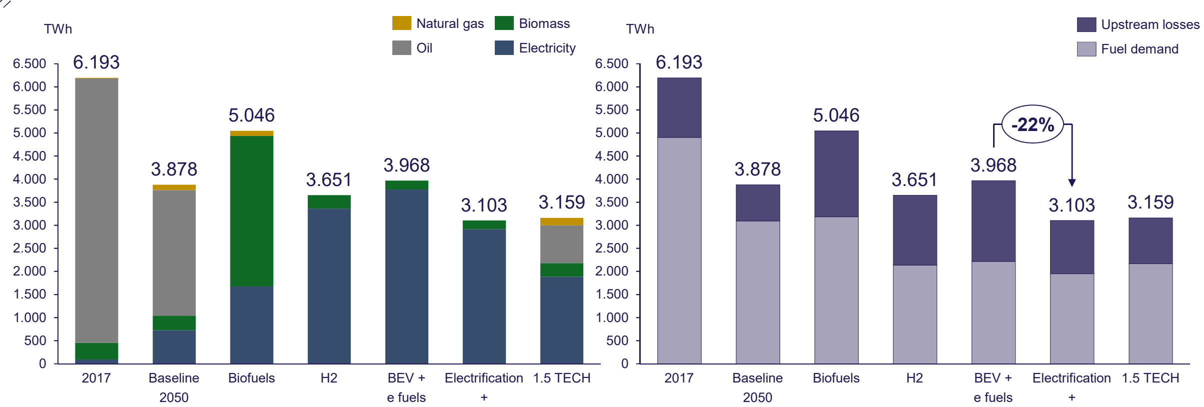
Results-Upstream Energy Demand (EE Dev)

20



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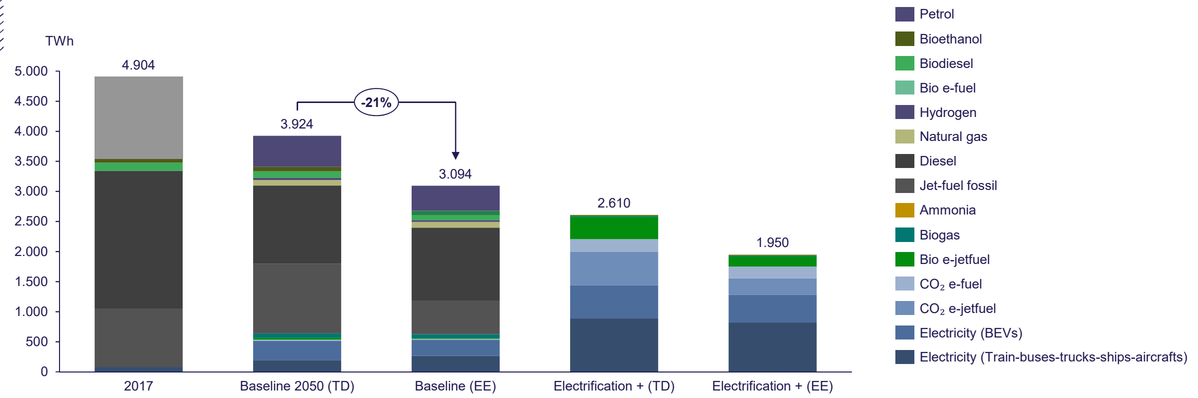
Results-Energy Demand

21



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Results-Energy Demand

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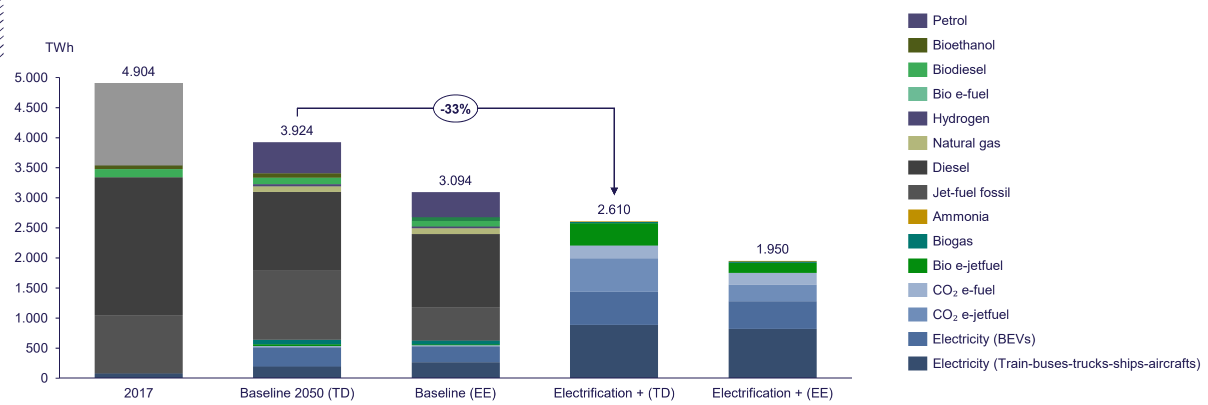

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Results-Energy Demand

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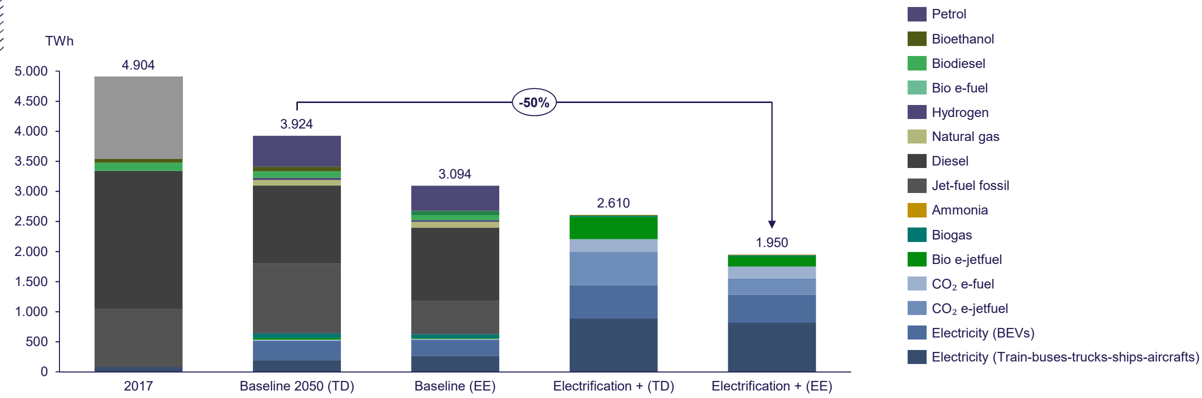

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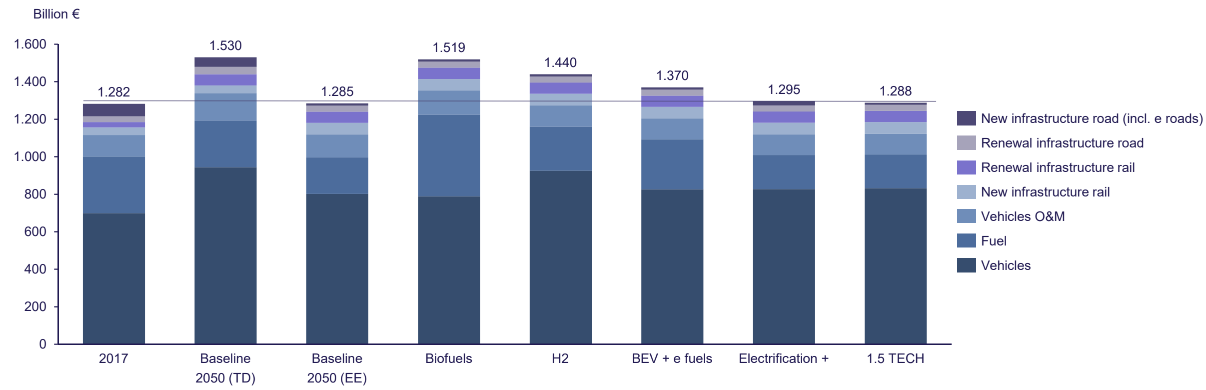
Results Annual costs

24



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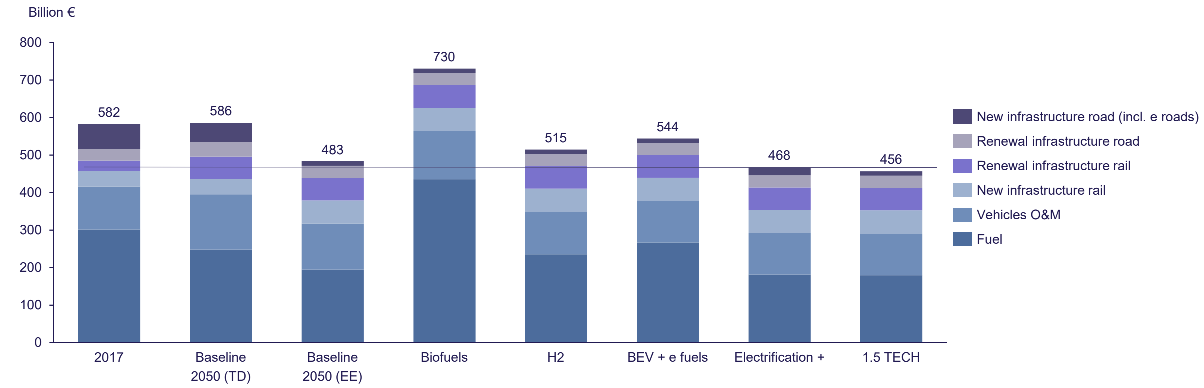
Results Annual costs

25



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Results Annual costs

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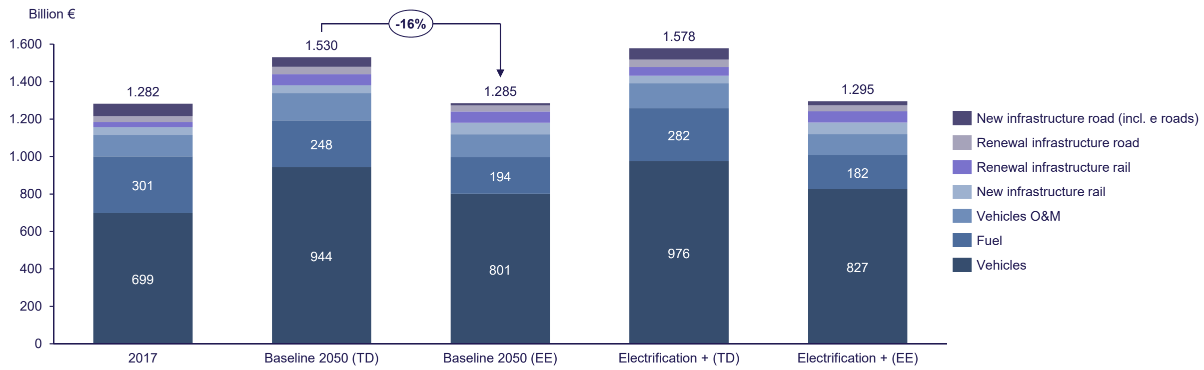

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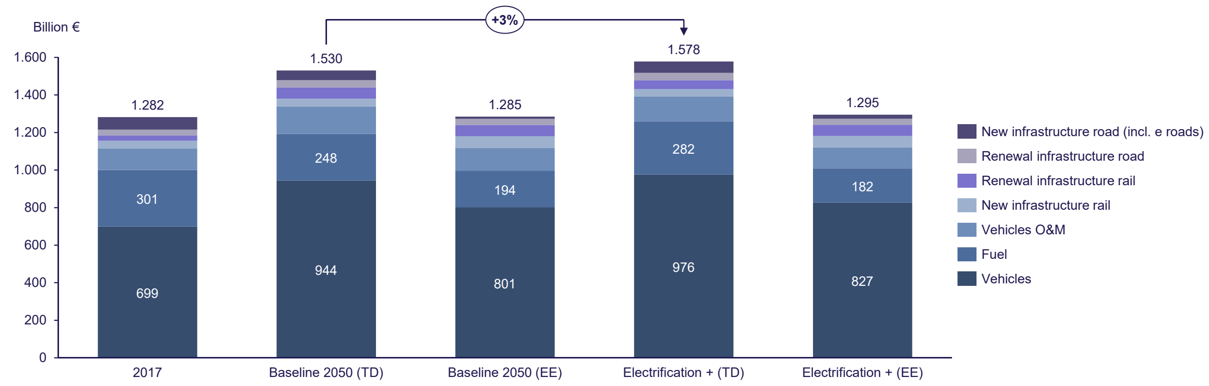
Results Annual costs

27



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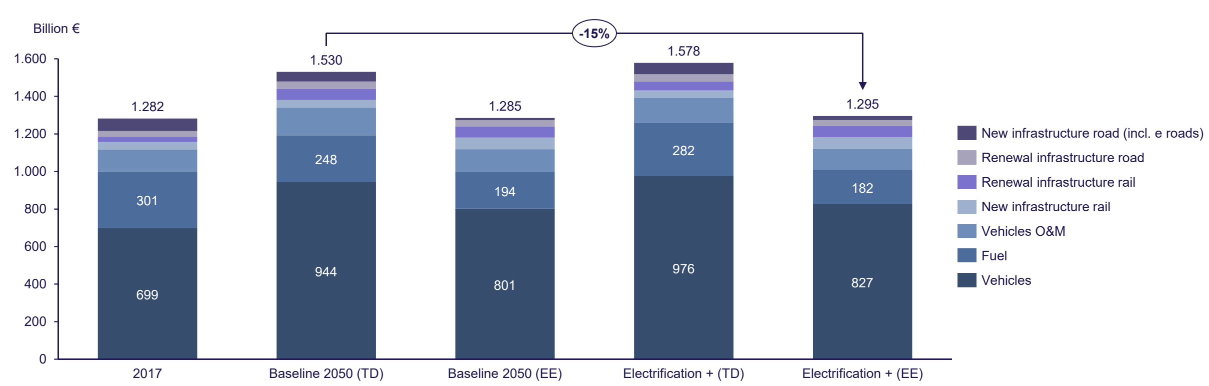
Results Annual costs

28



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Conclusion - part 1

- Energy-efficient urban development will reduce the passenger kilometres driven by a car by 16 % compared to traditional urban development.
- Stop activities generating the basis for more CO_2-emissions and energy inefficient transport: stop urban sprawl, stop the expansion of highways, and stop the expansion of airports
- Concentrate urban development on reusing brownfields in larger cities, and invest in railways – especially concerning the larger cities
- Invest in local transit solutions for commuters

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Conclusion – part 2

Energy-efficient urban development combined with extensive electrification will reduce the primary energy demand for the transport sector in Europe by around 50 % compared to the baseline in 2050

Extensive electrification of transport vehicles, in general, is key for efficiency gains and avoiding additional costs. In 2020 2.7 million passenger EVs were on the streets of Europe, in 2030 it will be 83.6 million and finally in 2050: 254 million Evs

All light-duty transport vehicles shall be electrified

Electrification of the parts of heavy-duty trucks, short-distance navigation and aviation possible

Electric Road Systems (ERS) provide a good alternative for heavy-duty road transport where battery electrification is limited

Electrofuels and other Power-to-X based fuels should be prioritized for navigation and aviation

Electric lorries being charged in London 1907

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And finally:

31

- The proposed development does not only reduce the primary energy use, but there is also a number of non-energy benefits – for instance health benefits by replacing car driving with bicycle riding.
- The transport related health costs in Europe will be reduced from 205.5 billion € in 2015 to 54 billion € in 2050.

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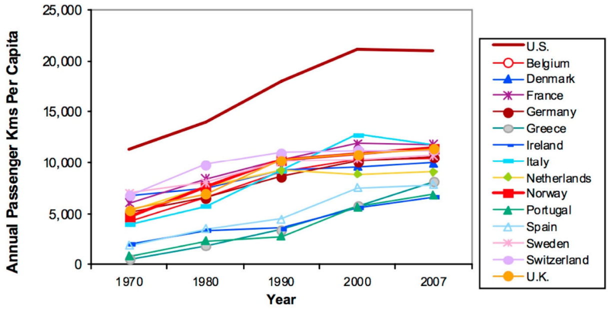
Thank You!

Peak Car Phenomenon

33

- The peak car phenomenon has been observed in some developed economies and it is likely that this phenomenon will occur in most of Europe
- Most likely it will be observed in Western Europe earlier than Eastern Europe



Evolution of car travel per capita in OECD countries (Source: Litman 2009)

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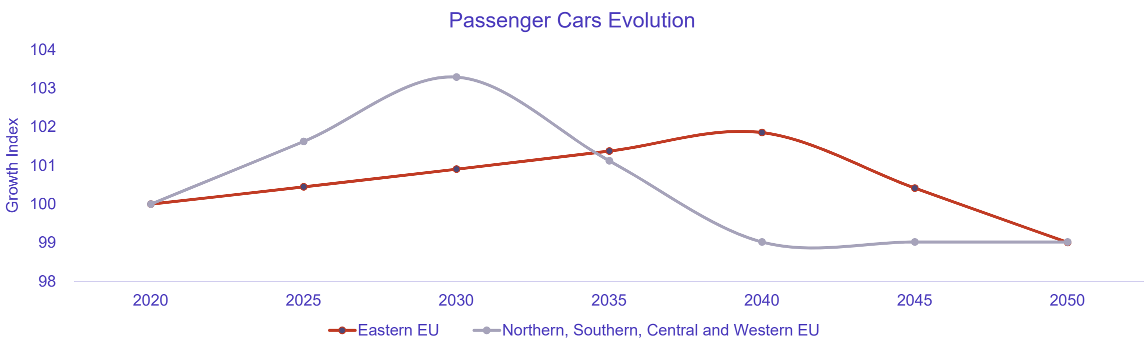
Peak Car Phenomenon

34

- Most likely it will be observed in Western Europe earlier than Eastern Europe



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