A NEW REALITY
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DIGITAL EVENT

Transport Electrification Scenarios for Decarbonization of the European Transport Sector by 2050

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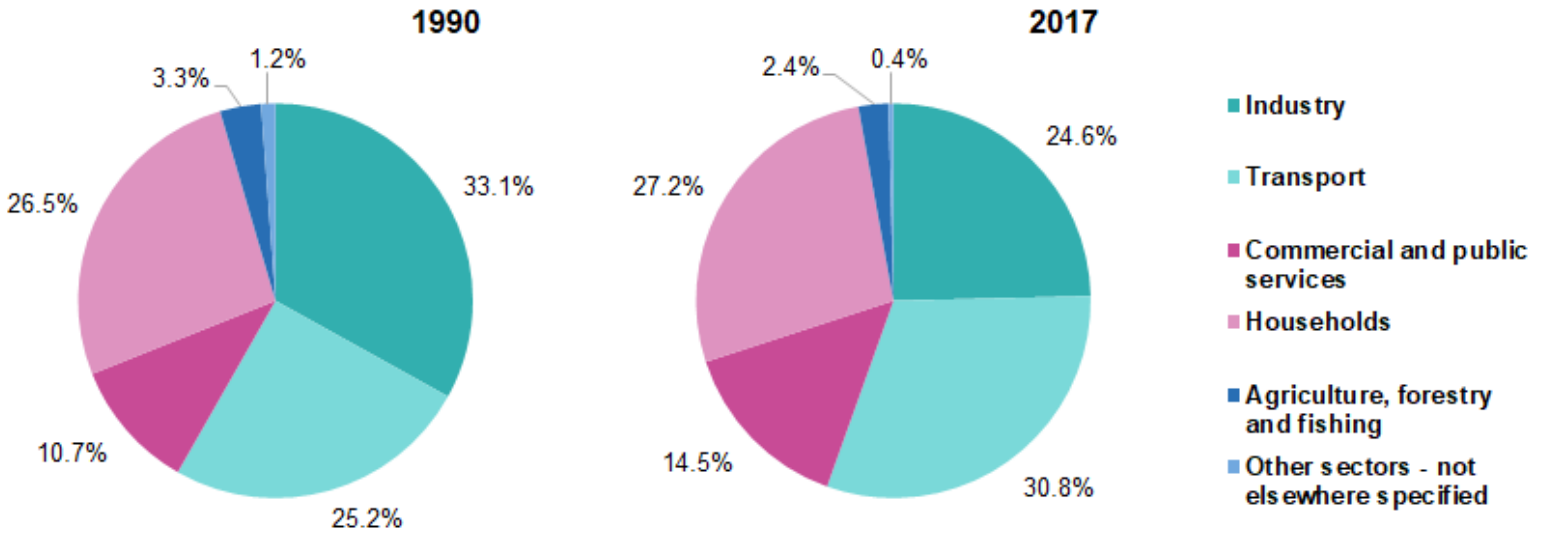
Background: Why Energy Efficiency?

"Efficiency First is the fundamental principle around which the EU's energy system should be designed. It means considering the potential value of investing in efficiency (including energy savings and demand response) in all decisions about energy system development – be that in homes, offices, industry or mobility."

– Fundamental principle of the EU's energy system, according to the European Climate Foundation the Energy Union EEFP –

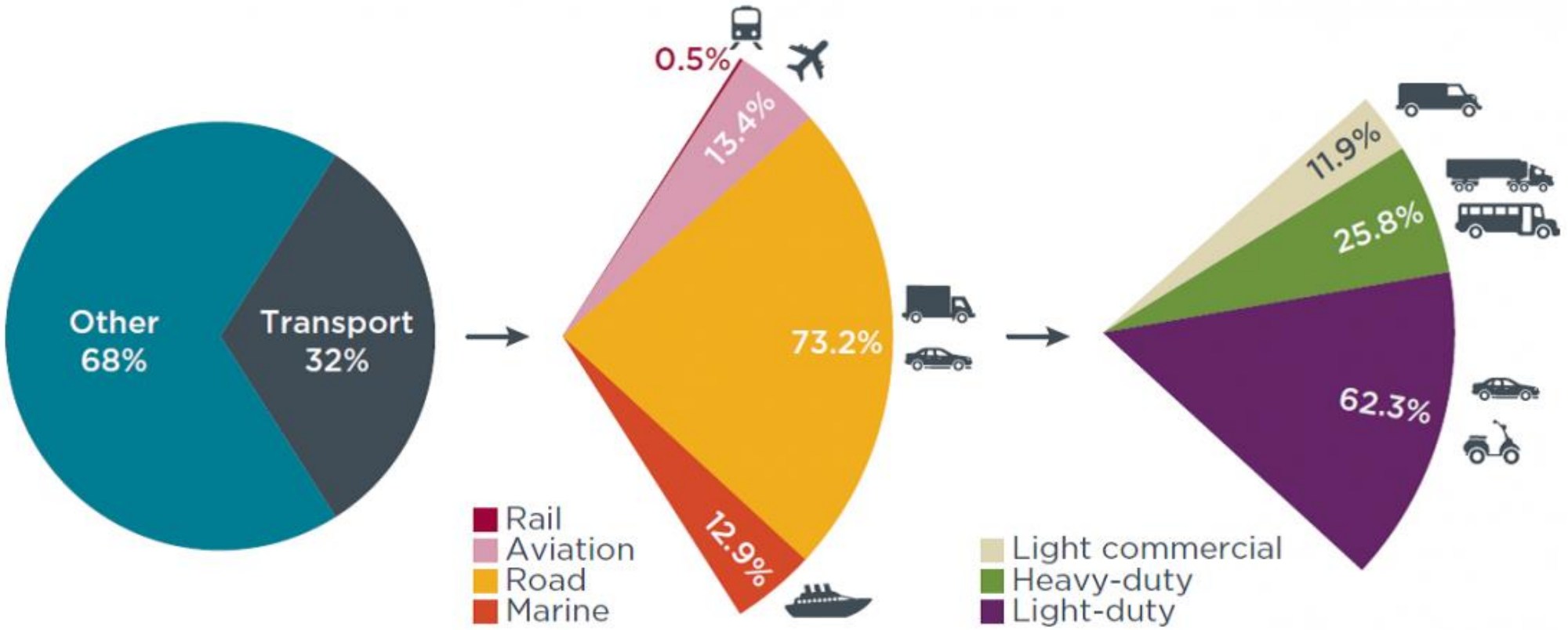
sEEnergies

Background: EU28 Transport Sector



Final energy consumption by sector – EU28 1990 and 2017 (Source: Eurostat)

Background: EU28 Transport Sector



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

Background:Why Electrification?

Electric lorries being charged in London 1907

- Direct electrification: most energy efficient of all known transport technologies
- Well to wheel efficiency: BEV 73 % vs ICE 13 % (Transport and Environment)
- Advancements in battery technology development
- Advancements in power electronics

Background:Indirect Electrification

Source: Pexels

Source: Mediterranean Shipping Company

- Low energy density of electric batteries as compared to HFO and Jet fuel
- Dead Weight Tonnage and Maximum Take off Weight constraints for shipping and aviation respectively
- Renewably sourced drop in electro-fuels with similar energy densities could be cleaner alternatives

Transport Electrification Scenarios for Decarbonization of the European Transport Sector by 2050

Research Questions:

- What are the costs and energy demands associated with electrification of the European transport sector by 2050 as compared to the PRIMES baseline (business as usual) scenario?
- Which mode of electrification is better suited for heavy duty trucks (direct or indirect electrification)?

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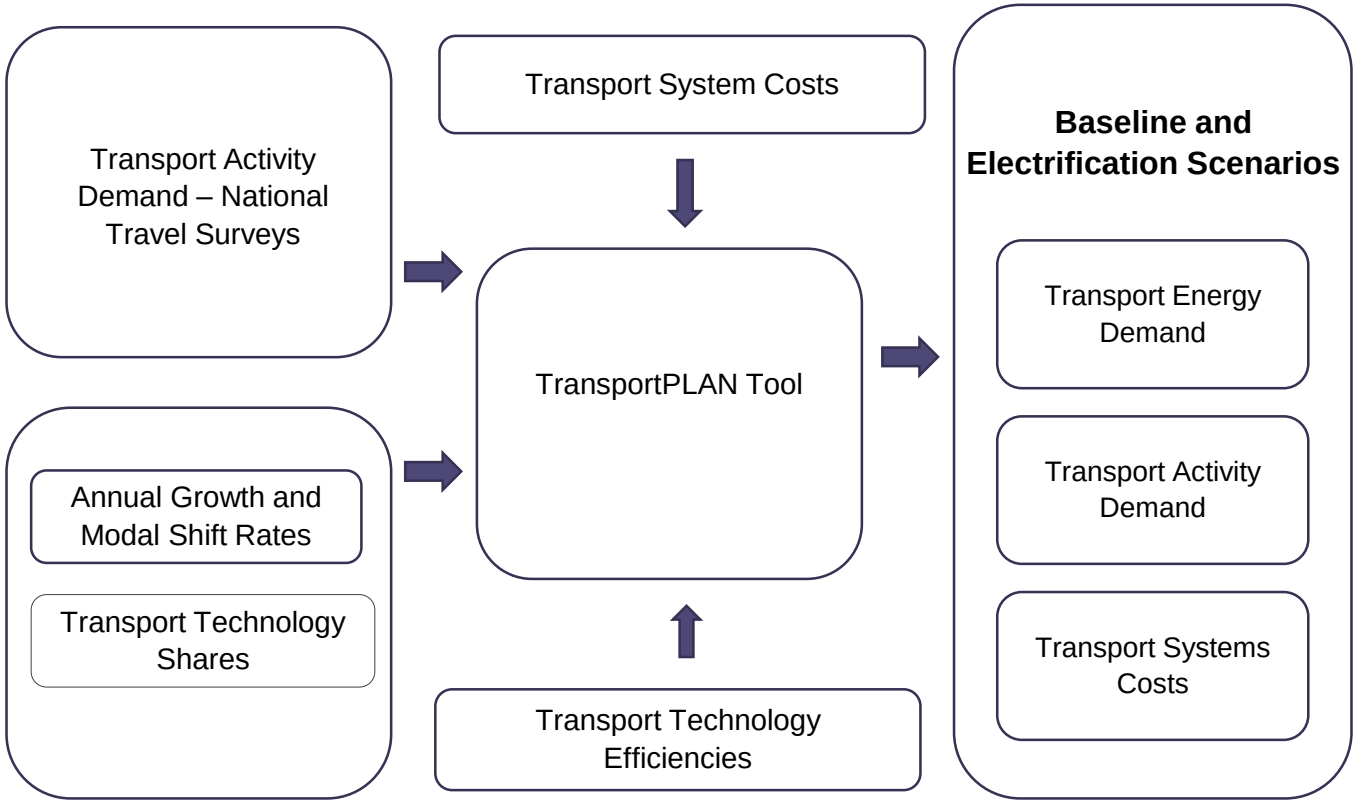
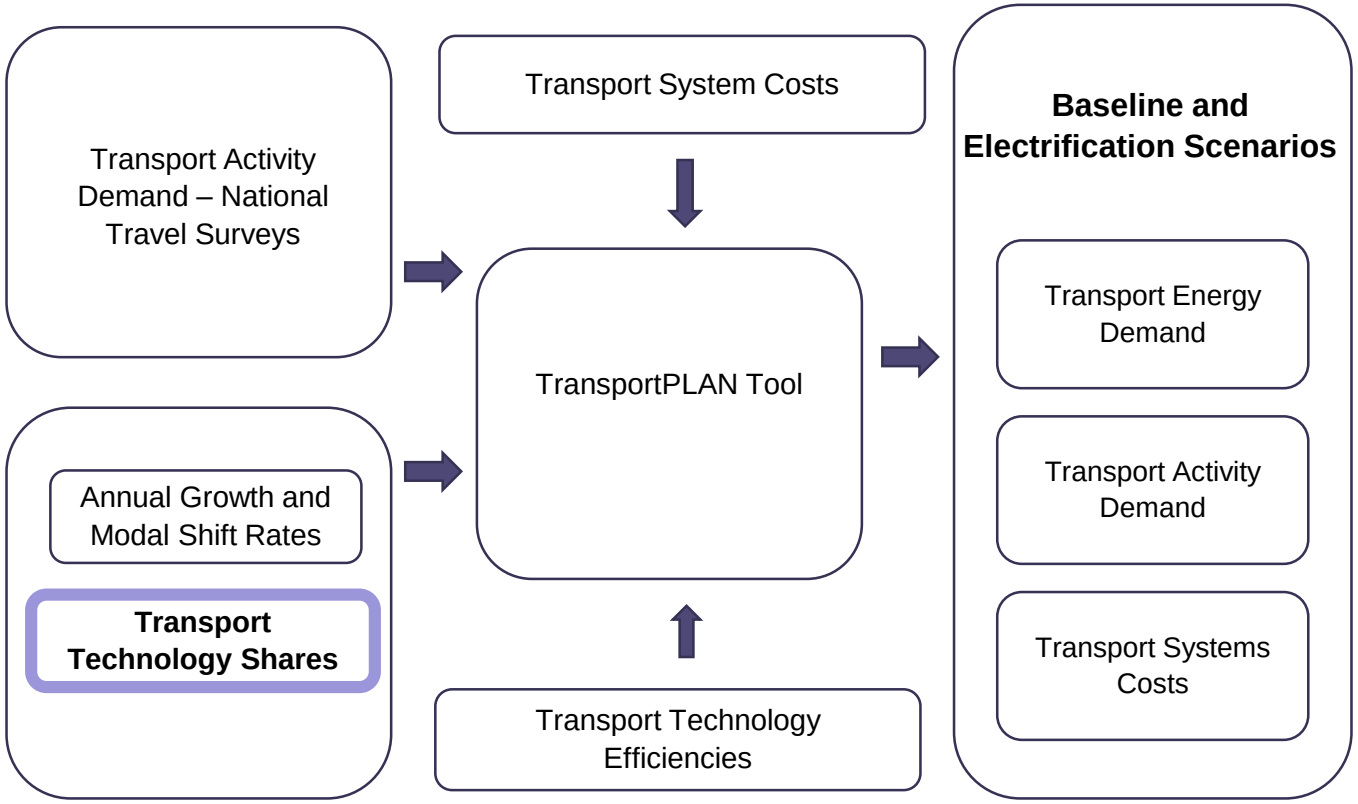
TransportPLAN- EU28



TransportPLAN- EU28



	PRIMES Baseline	Electrification and e-fuels	Electrification +
Passenger Transport			
Passenger Cars	35% BEV 19% PHEV 4% FCEV 4% Gaseous 18% Gasoline 20% Diesel	95 % BEV 5% Electrofuels	95 % BEV 5% Electrofuels
Buses	5% BEV 36% Hybrid 21% Gaseous 38% Diesel	95 % BEV 5% Electrofuels	95 % BEV 5% Electrofuels
Rail	87 % Electric, 13 % Diesel	100% Electric	100% Electric
Aviation	3% bio-jetfuel 97% kerosene jetfuel	19% Electric 81% E-kerosene jetfuel	22% Electric 78% E-kerosene jet fuel
Shipping	13% Gaseous 87% Diesel and HFO	50% Electric 50% e-methanol	50% Electric 50% e-methanol
Freight Transport			
Trucks	1% BEV 29% Hybrid 18% Gaseous 51% Diesel	27% BEV 73% Electrofuels	27% BEV 73% ERS-BEV
Vans	26% BEV 1% FCEV 19% PHEV 54% Diesel	95% BEV 5% Electrofuels	95% BEV 5% Electrofuels
Rail	87 % Electric, 13 % Diesel	100% Electric	100% Electric
Aviation	100 % Kerosene jetfuel	100% E-kerosene jetfuel	100% E-kerosene jetfuel
Shipping	100 % Diesel and HFO	50% E-ammonia 50% E-methanol	50% E-ammonia 50% E-methanol

	PRIMES Baseline	Electrification and e-fuels	Electrification +
Passenger Transport			
Passenger Cars	35% BEV 19% PHEV 4% FCEV 4% Gaseous 18% Gasoline 20% Diesel	100 % BEV	100 % BEV
Buses	5% BEV 36% Hybrid 21% Gaseous 38% Diesel	100 % BEV	100 % BEV
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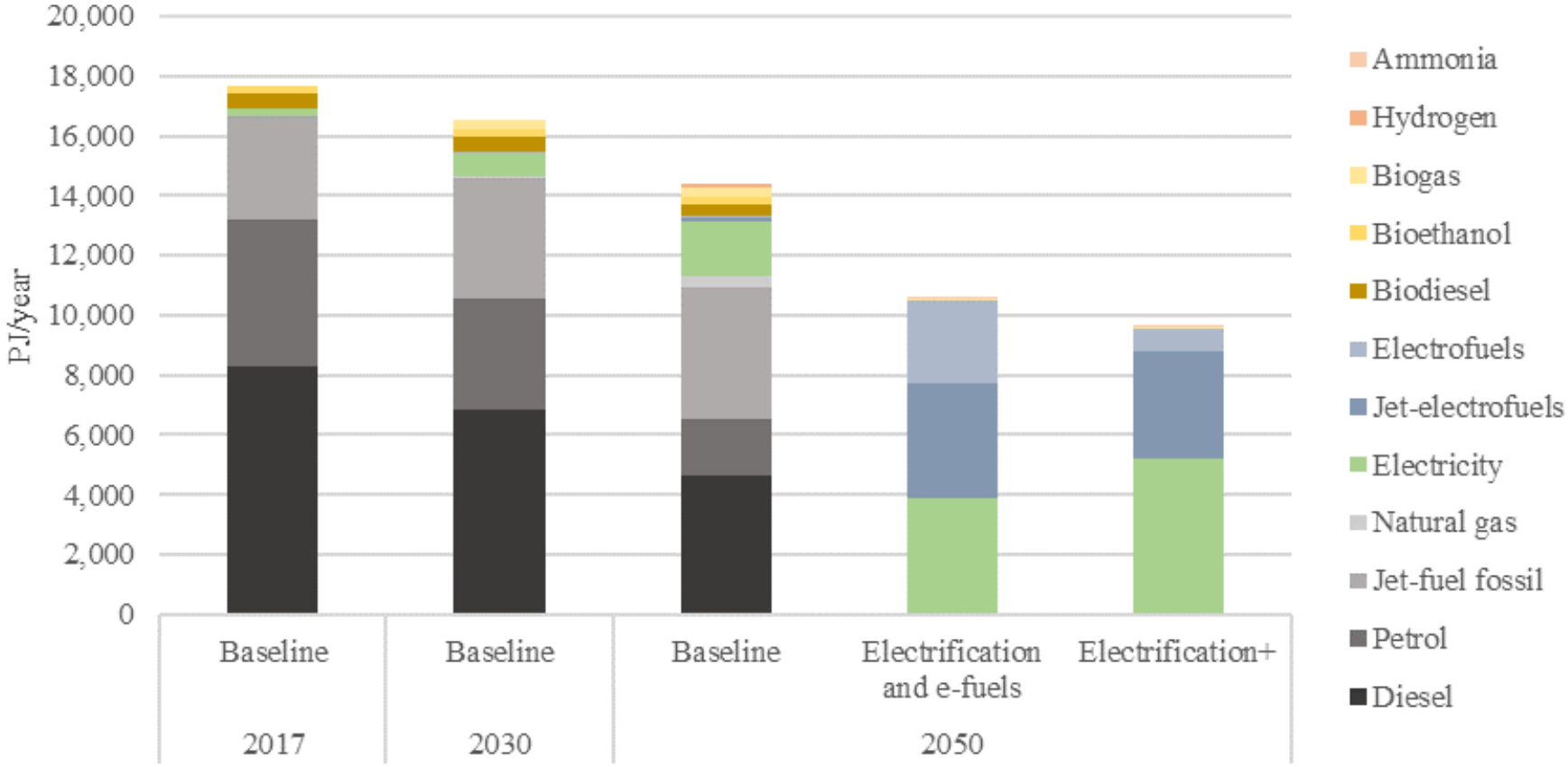
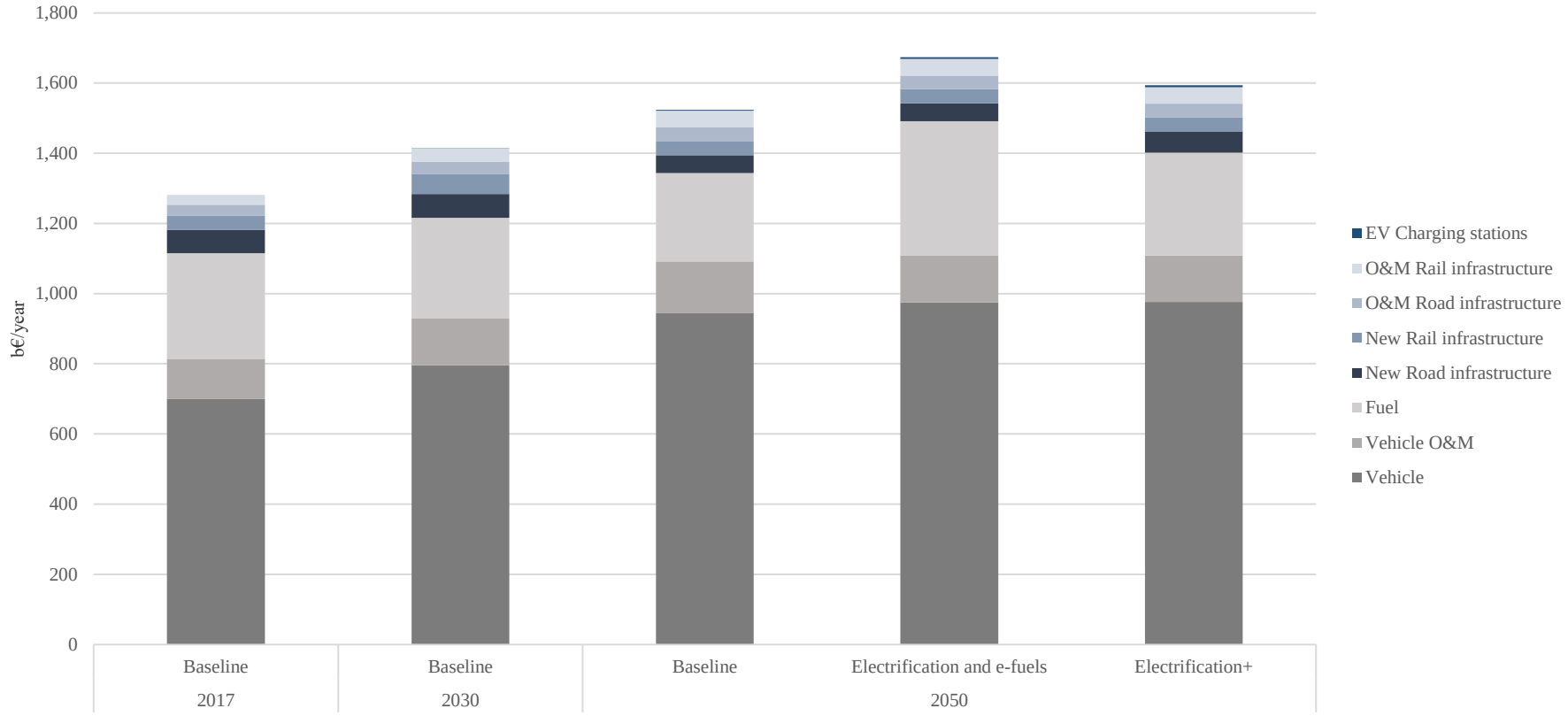
Shipping	100 % Diesel and HFO	50% E-ammonia 50% E-methanol	50% E-ammonia 50% E-methanol

Results: Energy Demand



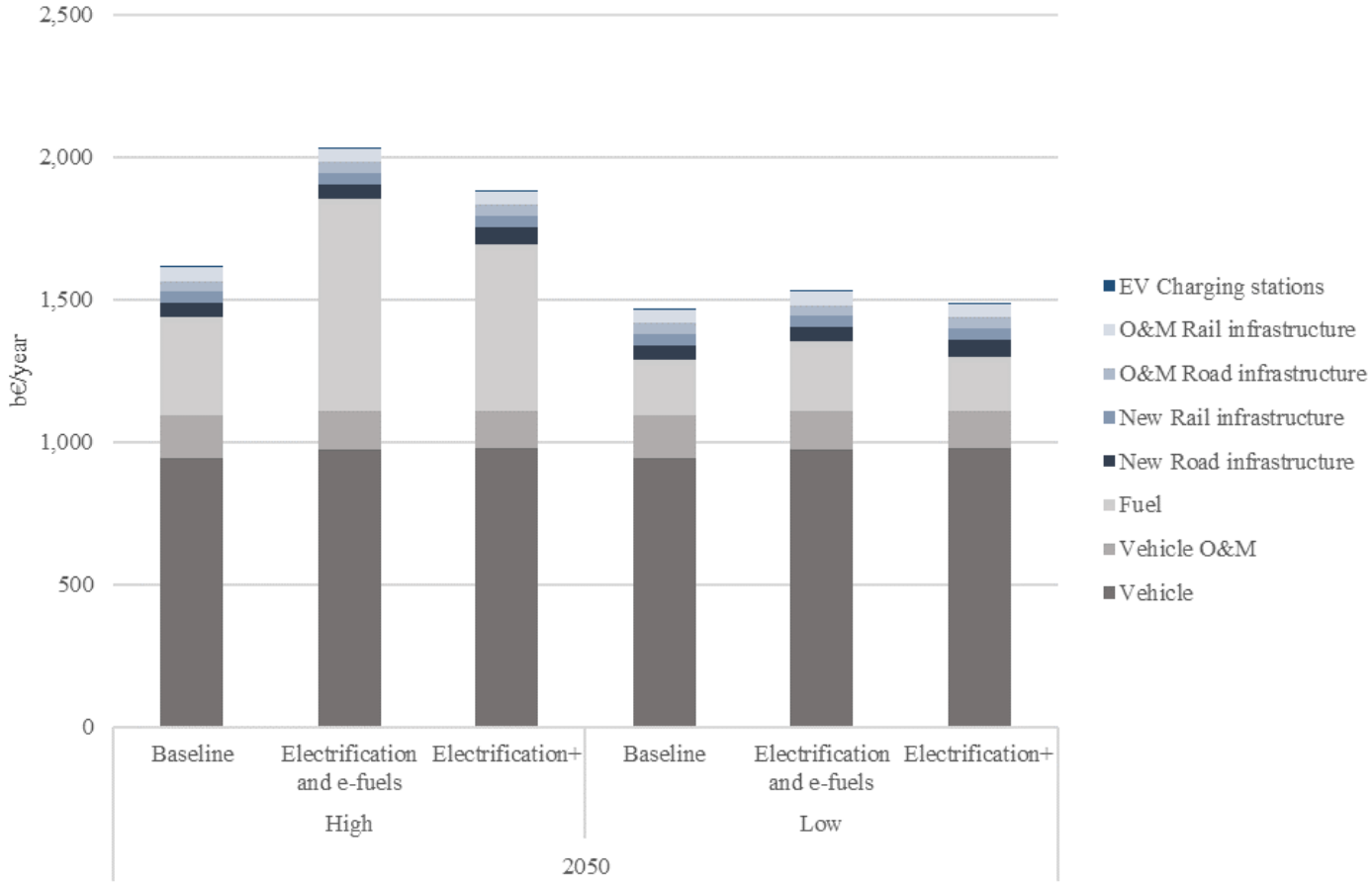
Annual transport energy consumption by fuel type in the Baseline scenario compared to the Electrification and e-fuels scenario and Electrification+ scenario in 2050

Results: Transport Systems Costs



Annual transport energy system costs divided by cost in the Baseline scenario compared to the Electrification and e-fuels scenario and Electrification+ scenario in 2050

Results: Fuel Costs Sensitivity



Fuel cost sensitivity impact on total annual transport system cost

Conclusion

- Extensive electrification key for achieving energy efficiency in the transport sector without incurring huge additional costs
- Electric Road Systems (ERS) provide good alternate for heavy duty trucks where battery electrification limited
- Electro-fuels should be reserved for the shipping and aviation sector
- The overall effect on the whole energy system should be studied in synergies with other sectors (heat, industry, buildings etc.)

Thank you! Questions?