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Promoting sustainable energy use in the transport sector of the Danube Region

– Towards a uniform policy assessment methodology –

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REKK

5th Stakeholder Seminar of the Priority Area 2

Budapest, 5 December 2018

The outline of the study

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TRANSPORTATION IS THE ONLY MAJOR GHG EMITTERS WHICH INCREASES ITS EMISSION

Transport related GHG emission **grows even faster in the Danube Region**

▼

Promoting **sustainable energy** in **international freight transportation** in the DR

PLENTY OF WAYS AND POLICIES TO PROMOTE SUSTAINABLE ENERGY

Infrastructure investments
Financial incentives
Regulatory restrictions
Removal of bottlenecks

▶

Alternative fuels in road transport

Modal shift to rail or ship

NEED FOR A UNIFORM POLICY ASSESSMENT METHODOLOGY

▶ Defining valuation criteria, analytical framework
Model-based cost-benefit analysis to compare possible policy actions

▶ Illustrative assessment with demonstrative purposes

Transport related GHG emission

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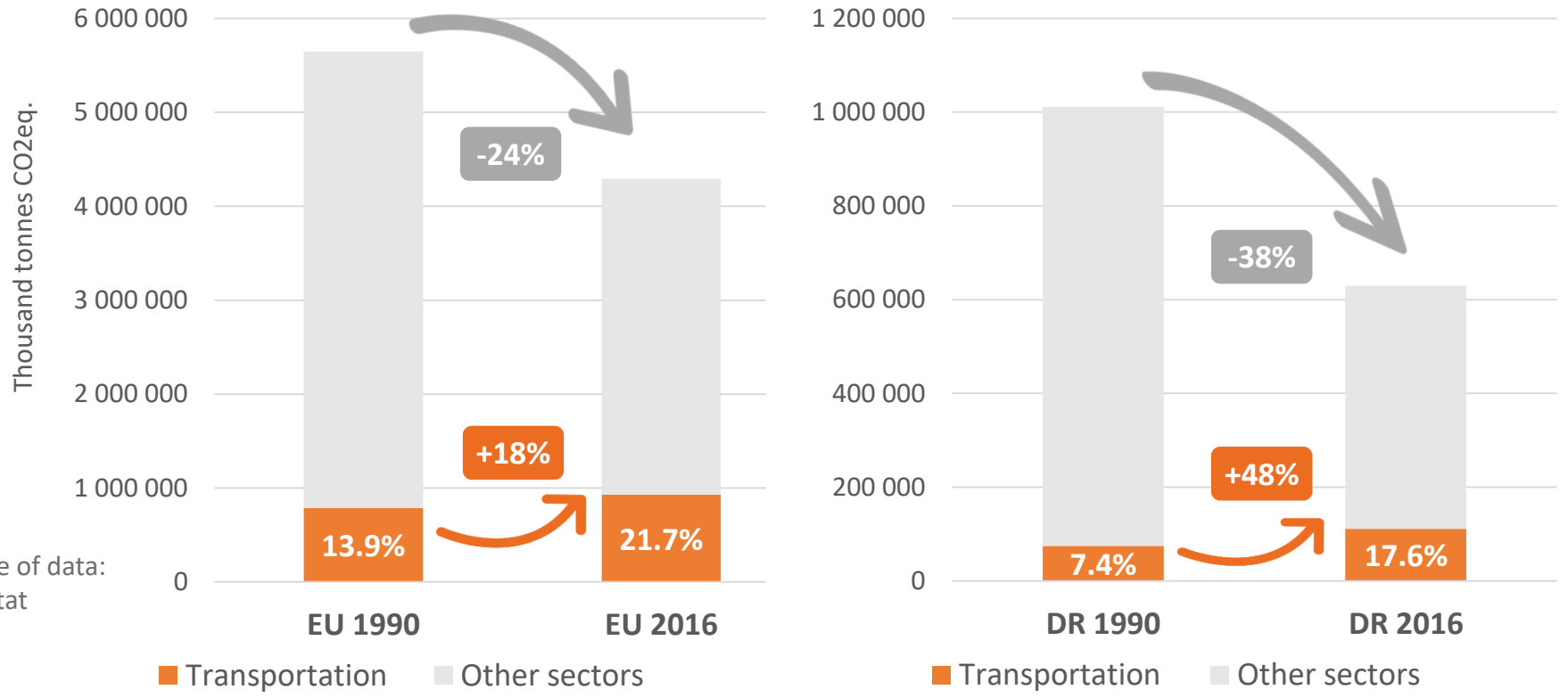
Greenhouse gas emission of transportation and all sectors, EU and Danube Region (excl. DE, UA)

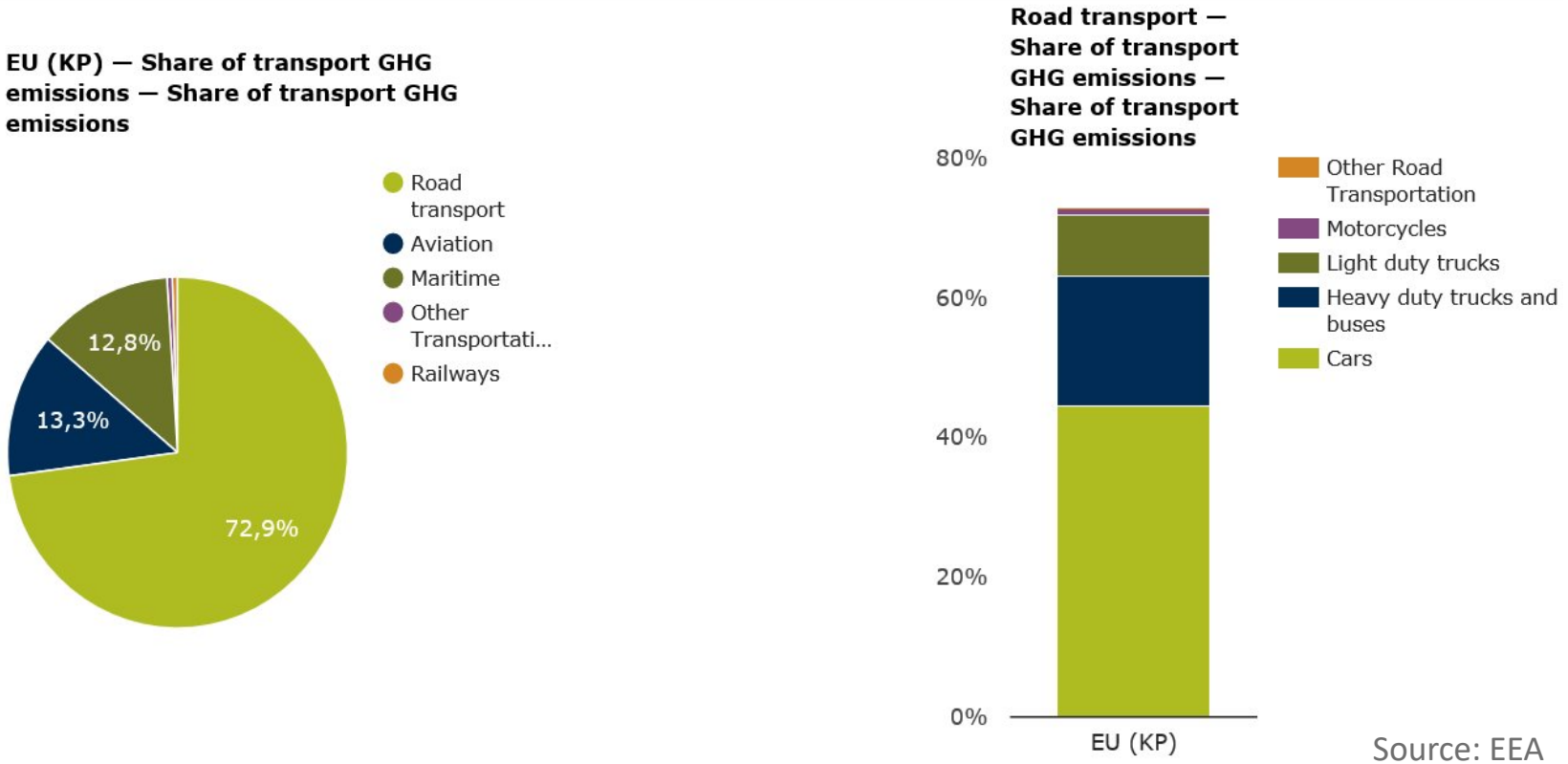


Source of data: Eurostat

Transportation accounts for a growing share of GHG emission (21.7% in 2016 in EU without aviation and international navigation). Emission grow even faster in the Danube Region.

Transport related GHG emission

Share of transport modes in European greenhouse gas emissions, EU



Source: EEA

Road transportation is by far the biggest emitter (accounting for more than 70% of all GHG emissions from transport if including international shipping and aviation, 95% without them). Within road transportation, **passenger cars** and **heavy duty vehicles** are responsible for 87%.

Transport related GHG emission

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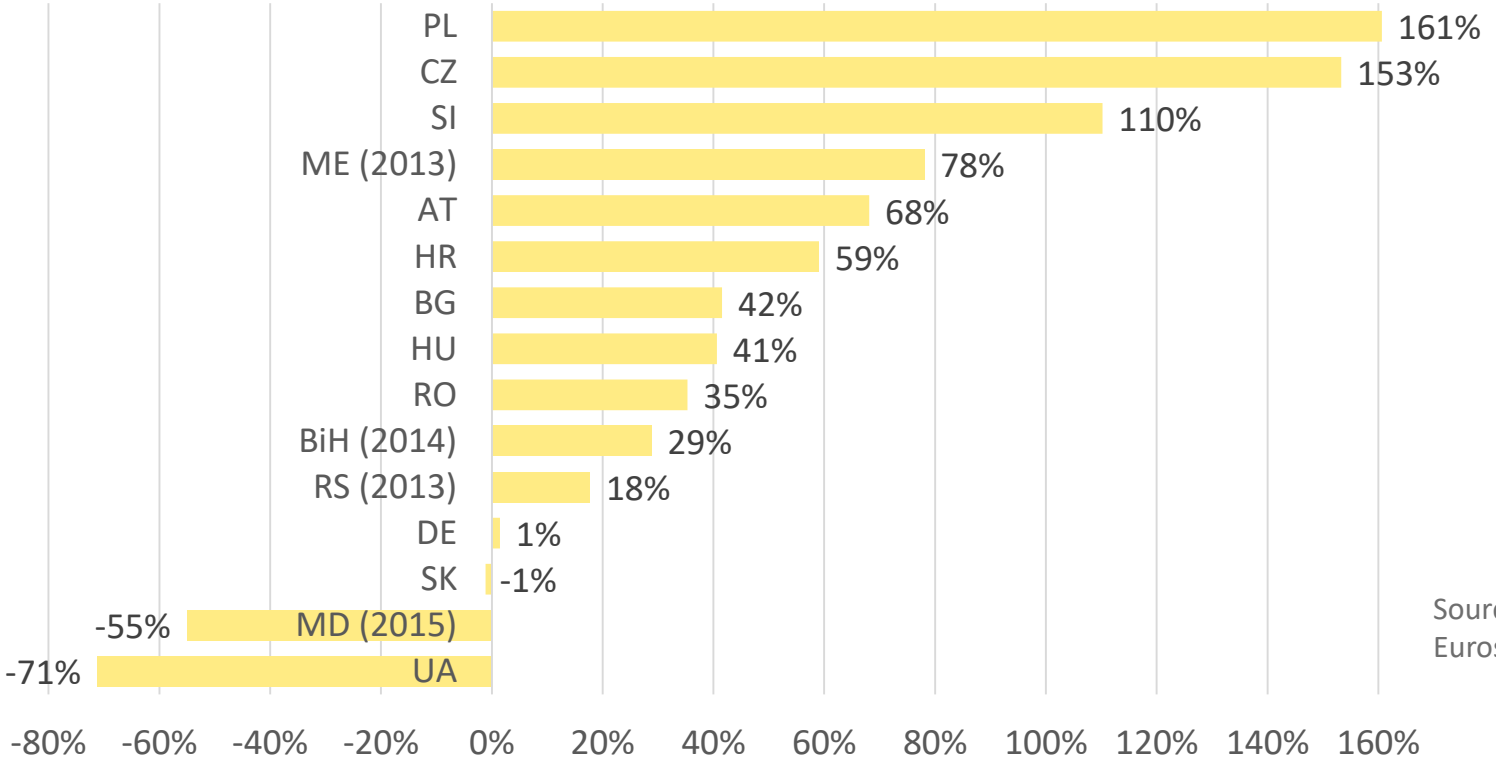
Change in GHG emissions from transportation (1990-2016), Danube Region



Source of data: Eurostat

Transport-related GHG emissions have **increased significantly** in most of the DR countries since 1990.

Transport related other emissions

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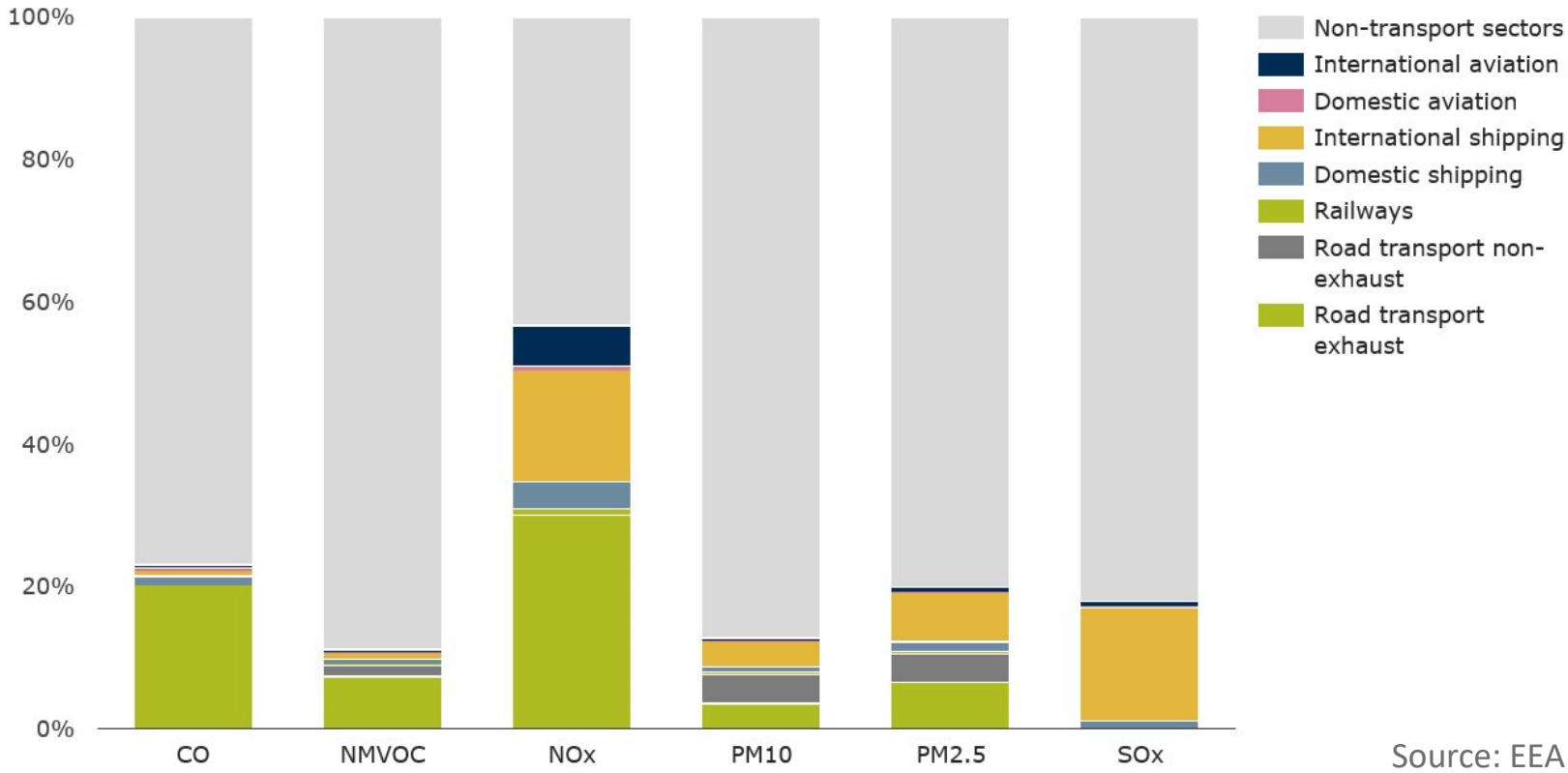
Contribution of transport sector to total emissions of selected air pollutants in the EU (2015)



Source: EEA

The transport sector is the **largest emitter of nitrogen-oxides**, contributing to more than half of NOx emissions in the EU (and also globally), mainly due to road-transportation and navigation.

Transport related other emissions

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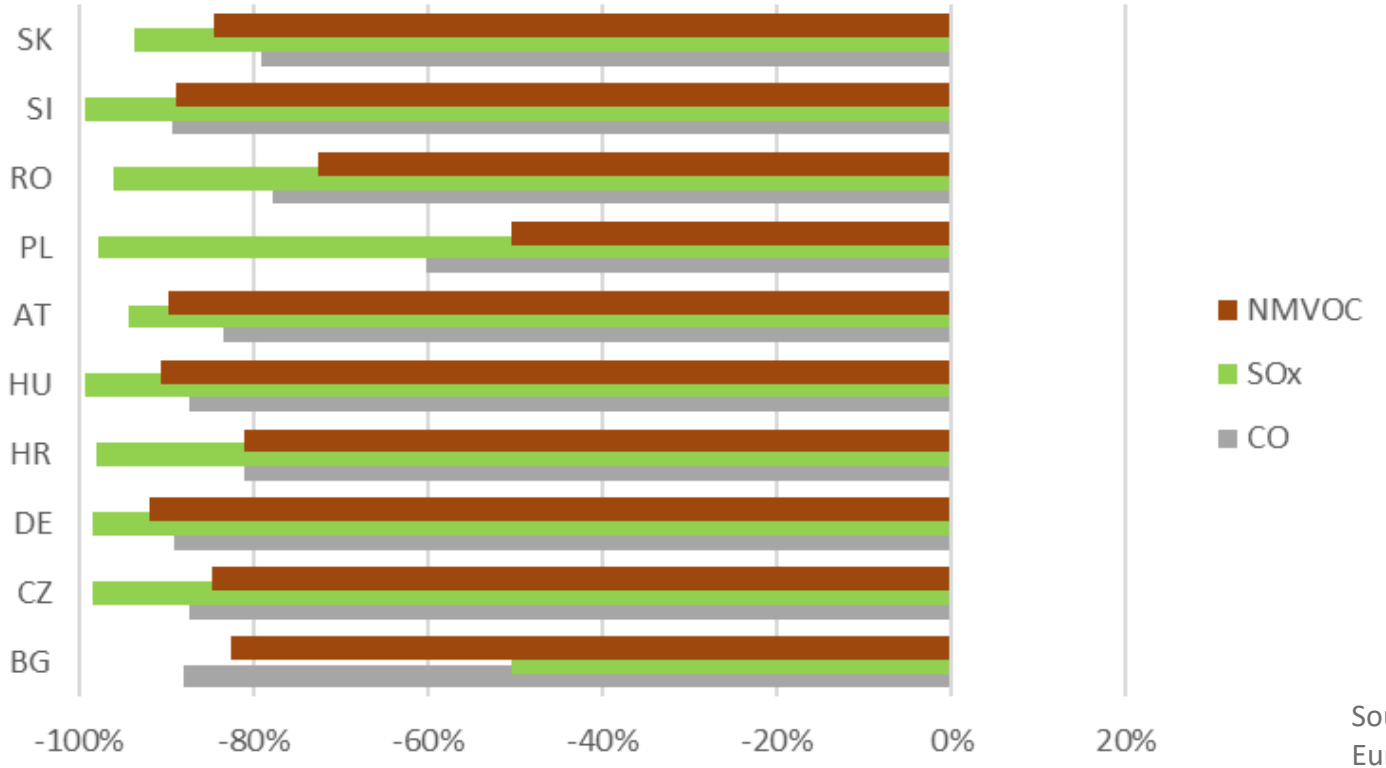
Change in NMVOC, SOx and CO emissions in DR countries belonging to the EU



Source of data: Eurostat

SOx emissions declined by more than 90% in all countries but Bulgaria. NMVOC (non-methane volatile organic compounds) and CO emissions also fell substantially in all countries.

Transport related other emissions

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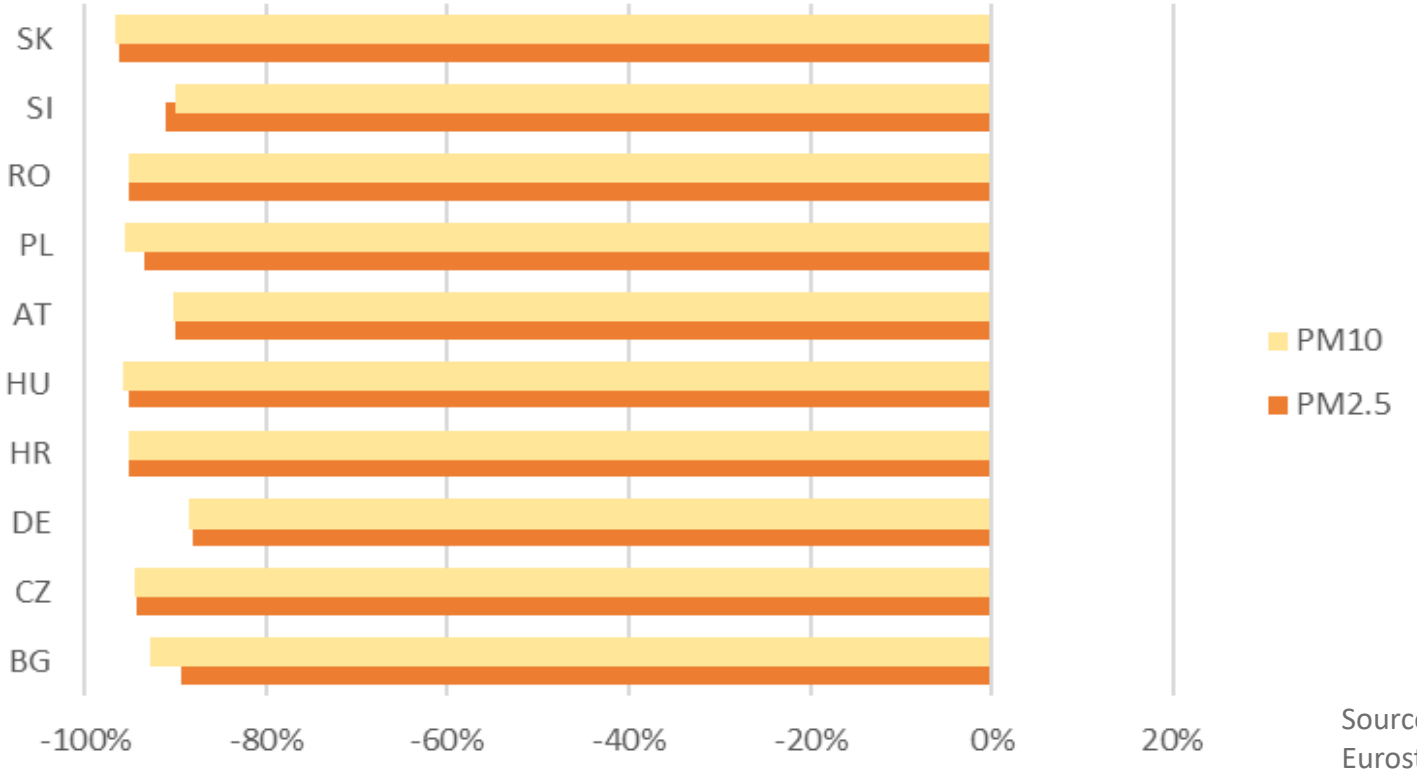
Change in PM10 and PM2.5 emissions in DR countries belonging to the EU



Source of data: Eurostat

Particulate matter emissions from transportation decreased by more than 90% in DR countries belonging to the EU. Emission of particulate matter increased is several non-EU DR countries.

Transport related other emissions

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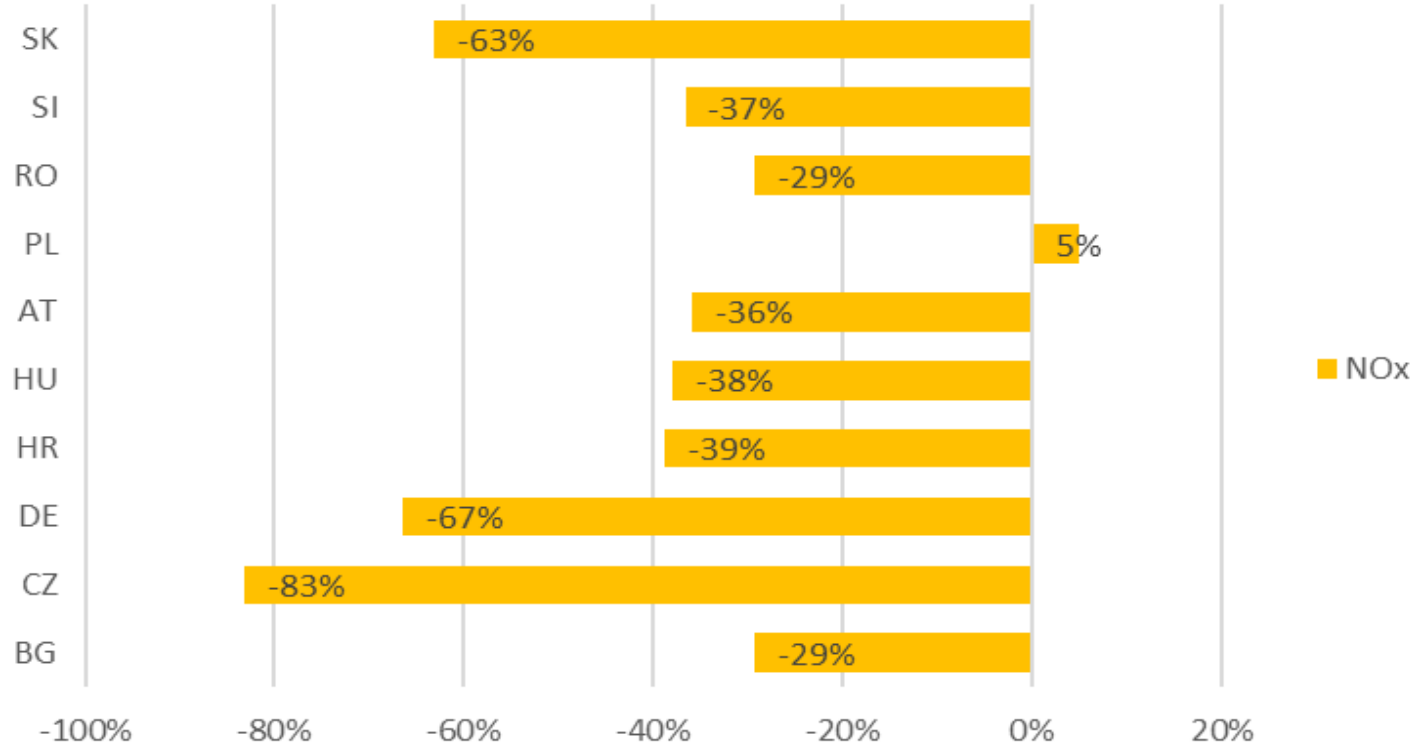
Change in NOx emissions in DR countries belonging to the EU



Source of data: Eurostat

Nitrogen oxides emitted from transportation have decreased to a less extent by 2016 compared to other pollutants in EU member DR countries, and even slightly increased in Poland.

Main reasons of rising GHG emission

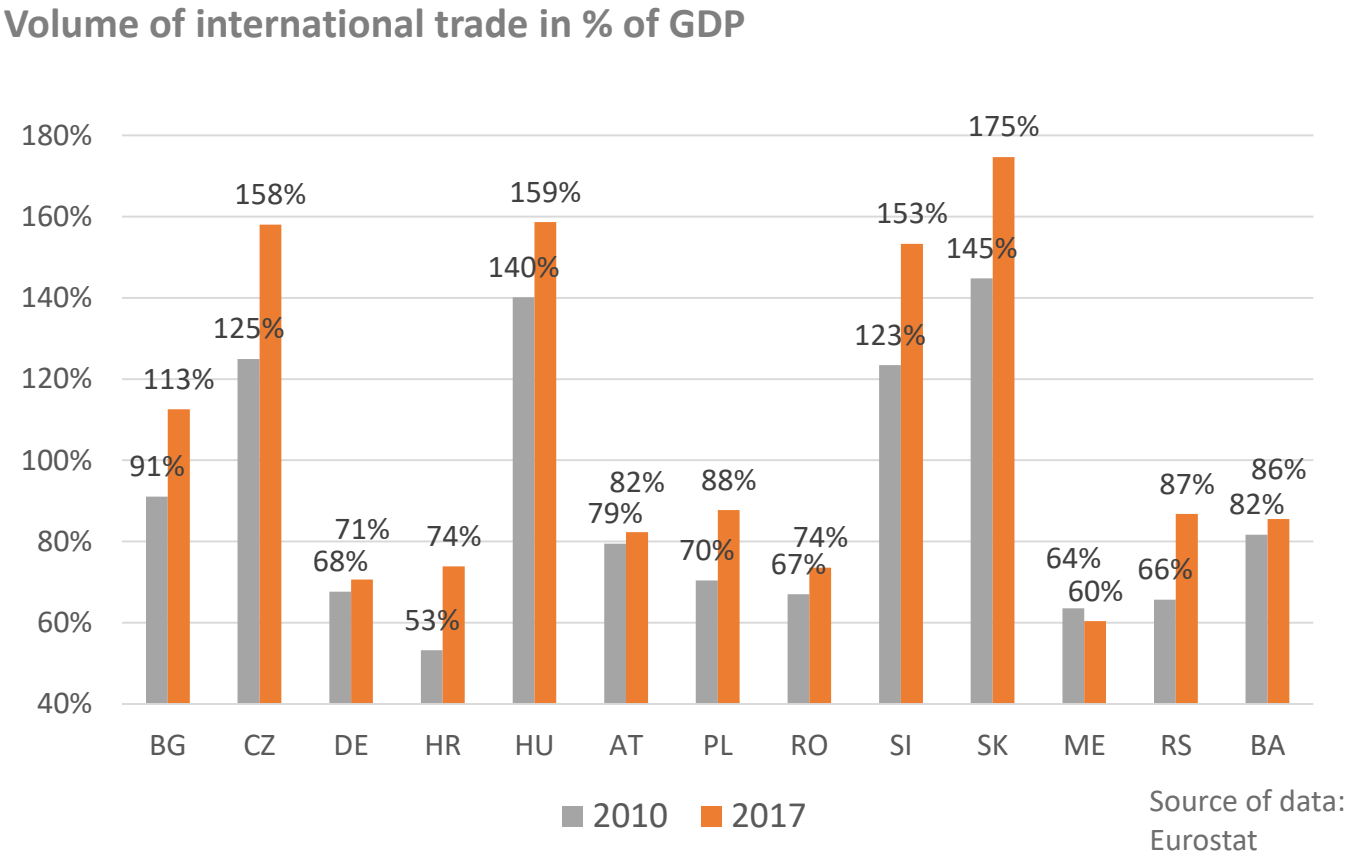
Economic grow (GDP/capita)

Growing trade intensity

Growing motorization (passenger cars)

Modal split change in favour of road transportation

Renewable energy use is low (mostly below targets)



Source of data: Eurostat

The **international trade increases more rapidly in the Danube Region than the economic grow** as richer countries consume more import good.

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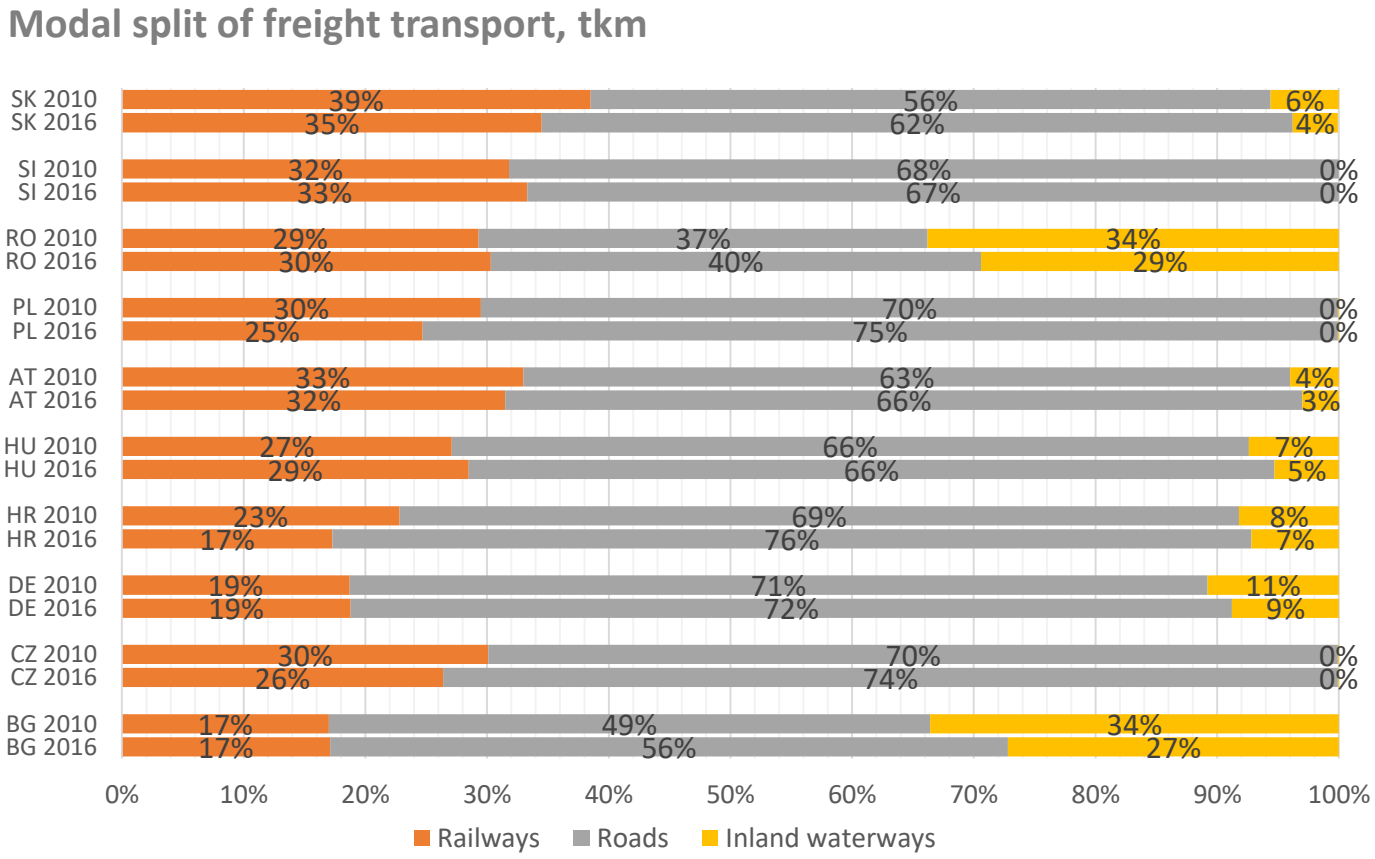

Source of data: Eurostat

Road transportation further increased its share in allmost all DR countries. Share of rail transportation decreased in most of the countries, while share of inland waterways decreased in every country.

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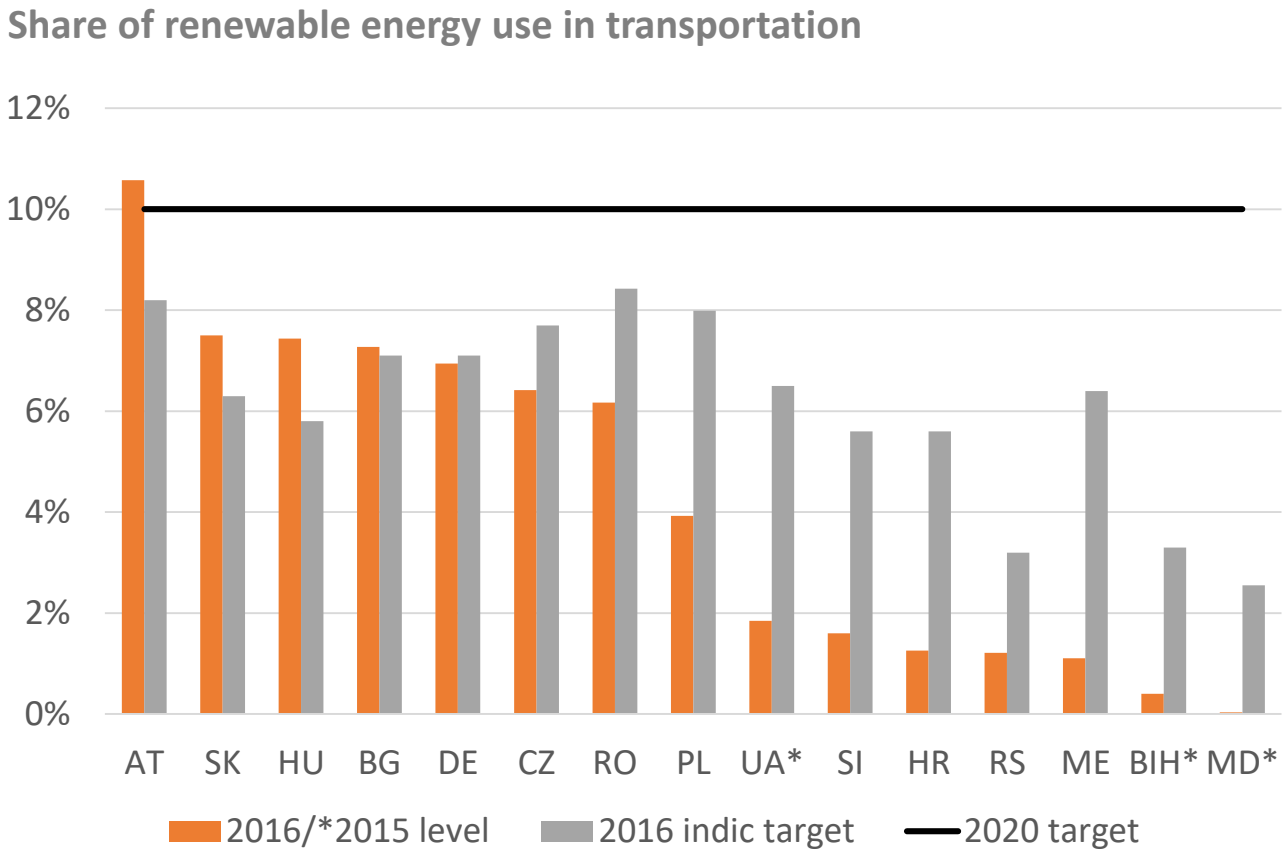

Source of data: Eurostat SHARES

Only four EU member states of the region seem to be on track to reach their 2020 targets.

Policy approaches and measures

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TWO MAIN POLICY APPROACH OF SUSTAINABLE ENERGY IN TRANSPORT

Incentivising the use of alternative fuels within road transportation

LNG suits only heavy duty vehicles currently as a bridge to low-carbon transportation

Long-term perspective: liquified biogas or bio-synthetic gas (**LBG**)

Diverting the road transportation into less carbon-intensive transport modes

From road to rail: diesel is already largely replaced by electricity in rail transportation

Long-term perspective: increasingly share of renewables in power generation

SIMILAR POLICY MEASURES FOR BOTH APPROACHES

Infrastructure investments
LNG filling stations (corridors)
Railway electrification and speed-up

Financial incentives
Vehicle purchase subsidy (LNG truck)
Emission-based taxation
Tolls and network access fees

Regulatory restrictions
Emission standards
Emission-based restrictions
Obligation to use (eg. biofuels)

Removal of non-physical bottlenecks
Harmonization of regulation
Reliability and management

Policy assessment methodology issues

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STRUCTURING PHASE

- Valuation objectives and goals
- Analytical framework: **CBA** or MCA
- Collection of relevant indicators
- Research framework: Use of **models** in assessment

WEIGHTING

- Time-related weights (discount rate in monetized terms)
- **Equal** or different weights for measuring the externalities
- Single criterion (**monetary terms**) vs. multiple criteria

ASSESSMENT OF ALTERNATIVES

- Strategic option analysis
- With and without the project
- "do minimum" vs. proposed project

EXPLORATION

- Sensitivity analysis
- Qualitative risk assessment
- Probabilistic risk analysis

ASSESSED ENVIRONMENTAL BENEFIT CATEGORIES IN TRANSPORT SECTOR

- Climate change
- Air pollution
- Noise
- Accidents
- Congestion

Modelling tools for transport policy assessment

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Four-step transportation modelling framework and related model types

PRODUCTION AND ATTRACTION	Trend and time series models
	System dynamics models
	Zonal trip rate models
	Input-Output models
DISTRIBUTION	Gravity models
MODAL SPLIT	Elasticity based models
	Aggregate modal split models
	Neoclassical economic models
	Econometric direct demand models
	Disaggregate modal split models
	Micro-simulation models
	Multi-modal networks
ASSIGNMENT	Models with separate assignment stage

Categorisation of existing models in transportation

Flow representation models

TRANSTOOLS, SCENES

- Focus on modelling of transportation flows
- Very detailed, separate assessment modules

Impact assessment models

ASTRA, HIGH-TOOLS

- High-level policy analysis tools
- The outcome of the model is the assessment

Multi-dimensional models

SASI, CGEUROPE, RHOMOLO

- Transportation is not the main focus just an important sector of the models
- Wide-range interaction with other models

Illustrative assessment - Methodology

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AIM OF THE ASSESSMENT	► to demonstrate the main steps and challenges of such estimation ► to illustrate the main environmental related benefit categories
ASSESSED SCENARIOS	**LNG trucks** instead of EURO VI diesel trucks sensitivity: penetration rate (5-20-40%), liquified local biogas **From road to rail** EURO V trucks to train sensitivity: full electrification and increased RES-E (50% carbon-intensity)
ASSESSED BENEFIT CATEGORIES	Congestion, accidents, air pollution (local emission), noise, climate change (local emission) and well to tank air pollution and climate change (WTT)
METHODOLOGY	**Calculation of the external benefits of a given change in transportation volumes** ► **On a given route**: Danube Region part of the Orient-East/Med TEN-T corridor (From GR/BG border trough RO-HU-SK to CZ/DE border) ► **Based on external unit cost** of Ricardo-AEA et al. (2014) ► **Main inputs:** length of route, transported volume, electrification rate, average payload weight (rail, truck), external unit costs, investment costs, discount rate ► **Outputs:** External yearly benefits (2018 prices) and NPV (for LNG scenarios)

Illustrative assessments - Results

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Summary of the results of the illustrative assessment (base and sensitivity scenarios)

	EXTERNAL YEARLY BENEFITS OF THE POLICY (AVOIDED COSTS) €(2018)				
Scenarios	**LNG trucks (20% switching)**		**From road to rail (10% switching)**		
Benefit categories	Main scenario	LBG from local biogas	Main scenario	RO 100% electrification	Increased RES-E
Congestion	0	0	1 065 729	1 065 729	1 065 729
Accidents	0	0	2 149 575	2 149 575	2 149 575
Air pollution (local emission)	1 889 878	1 889 878	4 144 050	4 848 396	4 144 050
Noise	0	0	2 871 820	2 871 820	2 871 820
Climate change (local emission)	1 303 845	6 695 228	6 540 679	6 695 228	6 540 679
Well-to-tank air pollution + climate change	3 795 102	4 482 401	-1 741 297	-1 572 444	386 169
Sum	**6 988 825**	**13 067 508**	**15 030 556**	**16 058 304**	**17 158 022**

- LNG trucks would reduce only effects on climate change and air pollution. Using local biogas would bring significant additional benefits. Modal shift to rail would result significant benefits in every category (with increased RES-E).

Illustrative assessments - Results

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Net present value calculation for LNG scenarios

LNG scenarios	DISCOUNTED EXTERNAL BENEFITS AND COSTS (2020-2045) €(2018)			
	Fuel	Switching rate		
	LNG / LBG	5%	20%	40%
Discounted external benefits	LNG trucks	31 872 708	127 490 834	254 981 667
	LBG trucks	59 598 250	238 393 000	476 786 000
Number of LNG filling stations		13	19	24
Infrastructure costs		13 000 000	19 000 000	24 000 000
Net present value	LNG trucks	**18 872 708**	**108 490 834**	**230 981 667**
	LBG trucks	**46 598 250**	**219 393 000**	**452 786 000**

Investing in LNG infrastructure has a great potential regarding social welfare gains. NPV values are proportionally higher with higher penetration rates as utilisation rates are assumed to be higher too.

Suggested developments of existing high-level policy assessment models

DIRECTIONS OF DEVELOPMENT	CURRENT STATE	GOAL OF THE DEVELOPMENT
Geographic scope	Focus on EU member countries (country or NUTS2 level)	Cover the **whole territory of the Danube Region** with the same level of detail.
Relationship with energy markets	No direct relationship (input prices are exogenous).	Consider **interactions of the transportation and the energy (electricity, gas) markets** to have more reliable information on prices, accessibility issues and environmental effects (eg. carbon-intensity).
Evaluable policy instruments	Broad set of pre-defined instruments but too general options for infrastructures (spending).	Allow **more detailed representation of infrastructure deployment** or upgrade in the set of analyzable policies.
Assessed benefit categories	Modelled transportation volumes in non-monetary terms; Effects on climate change, air pollution and accidents are monetized.	All internal (transportation) and external (environmental) **effects should be monetized**. **Assessed external effects should be broaden** to cover effects on noise and congestion.

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Thank you for your attention!

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