Economic analysis of benefits and cost in different countries

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Comparing and uniforming socio economic analyses in different countries

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The HEATCO project

- **Developing *H*armonised *E*uropean *A*pproaches for *T*ransport *Co*sting and Project Assessment**
- **Concentrated on financial input CBA**
- **Project in finished in 2006**
- **Multi-disciplinary team**
- **a first comparison between methods in different countries for the year 2002**
- **Recommendations for Europe wide CBA**
- **Updating is necessary**

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The Problem

- **Transport is of vital importance for economy and welfare, however causes costs, time losses and environmental, health, and social impacts.**
- **When making decisions about transport projects, all relevant economic, environmental and social impacts should be taken into account.**

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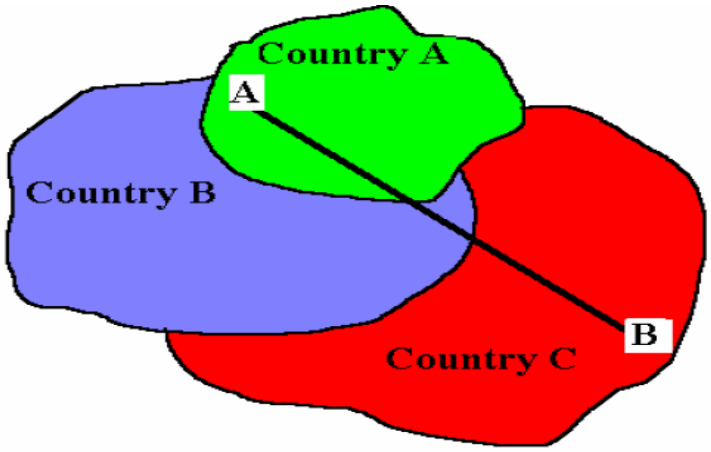
The Problem

- **More and more projects are cross border and involve more than one state**



- **More and more are projects compared internationally in IFI financing such as EIB but also for in socio economic evaluation such as ERA**

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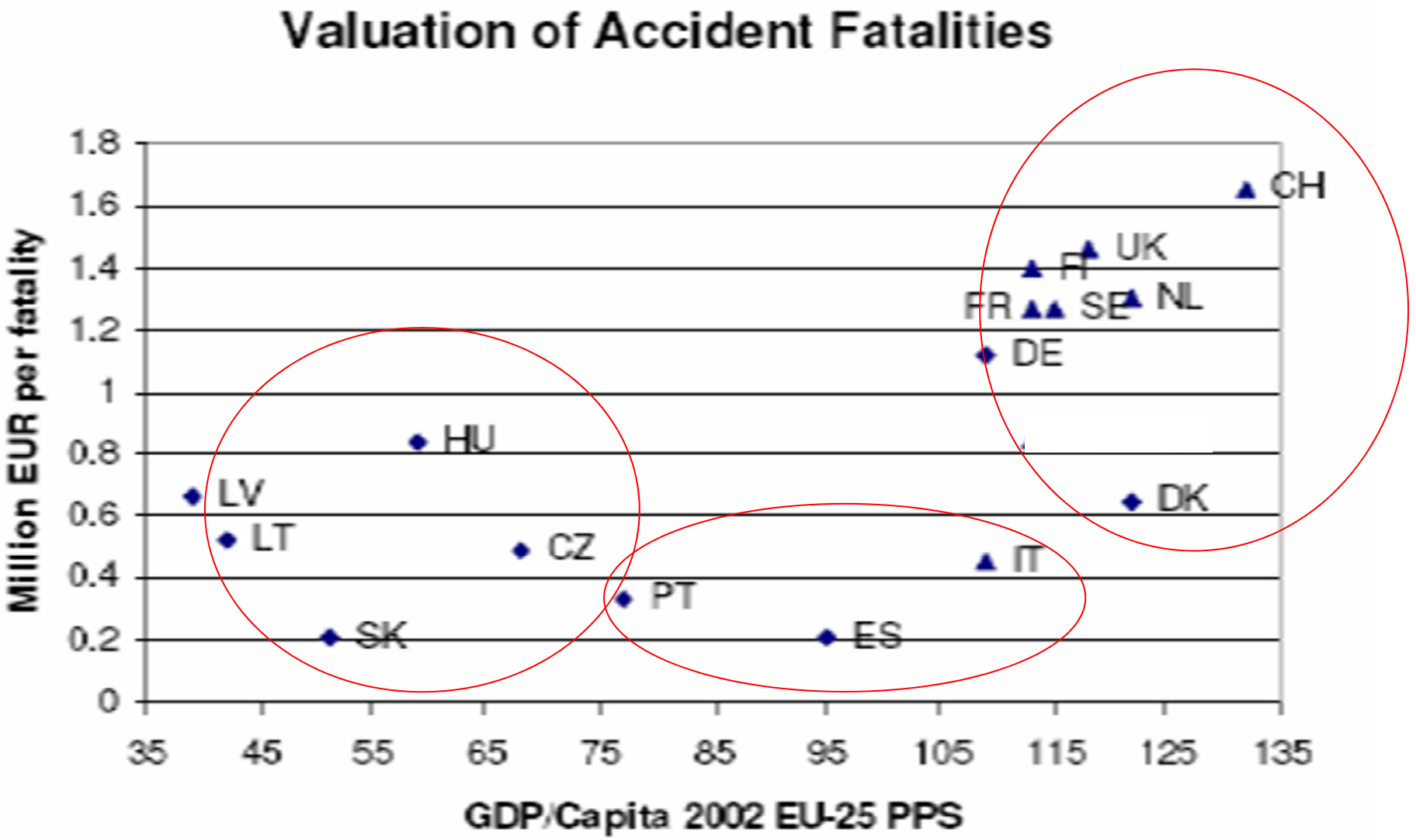
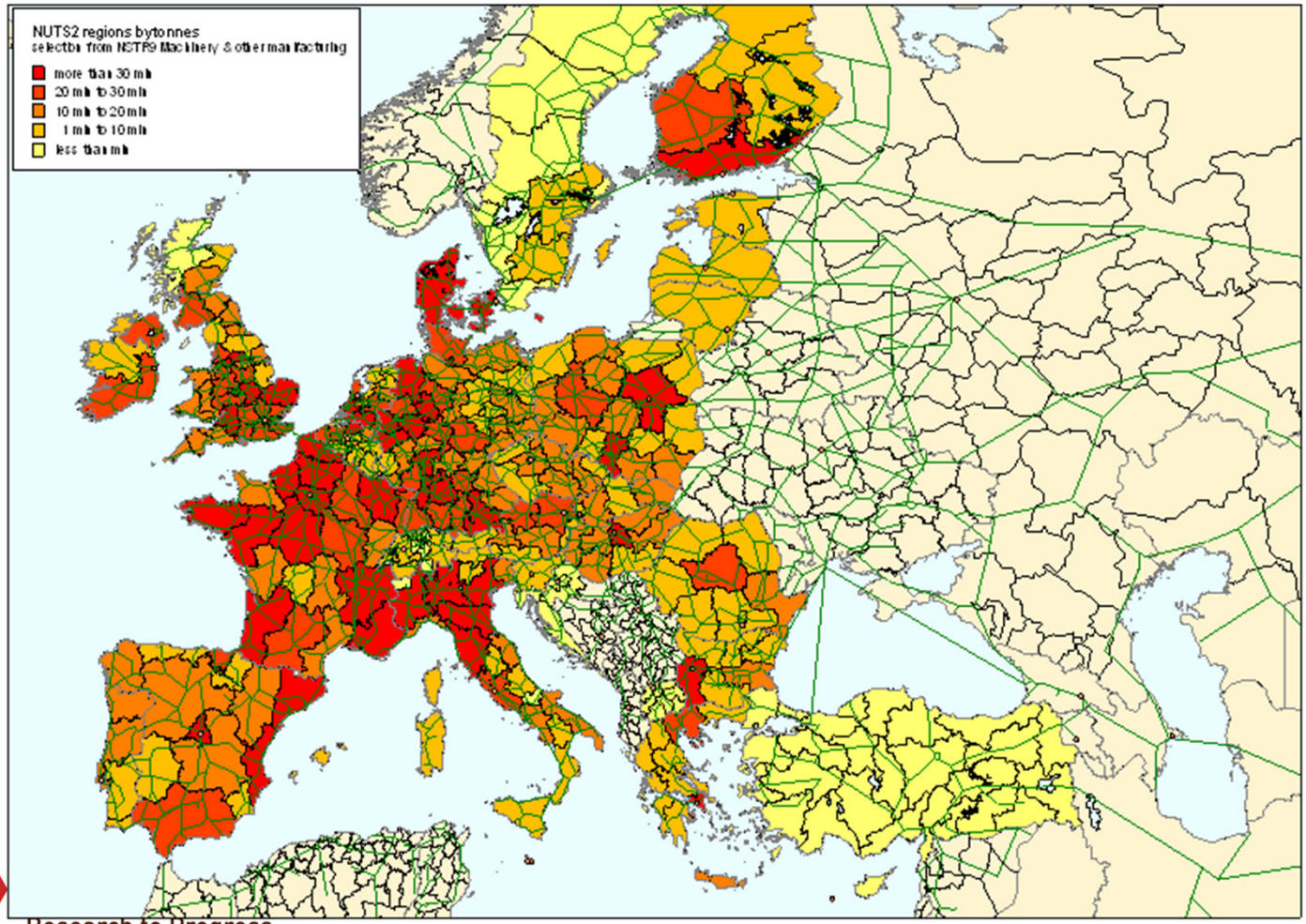
The HEATCO Approach for Transport Project Assessment: methods in different countries before 2002



	Passenger VTTS		Commercial Goods Traffic	
	Work	Non-work	Road	Rail
North/West				
Austria	HEATCO	HEATCO	National guidelines	National guidelines
Belgium	HEATCO	HEATCO	HEATCO	HEATCO
Denmark	National guidelines	HEATCO	National guidelines	HEATCO
Finland	National guidelines	HEATCO	National guidelines	HEATCO
France	National guidelines	HEATCO	National guidelines	National guidelines
Germany	National guidelines	National guidelines	National guidelines	HEATCO
Ireland	National guidelines	HEATCO	National guidelines	HEATCO
Luxemburg	HEATCO	HEATCO	HEATCO	HEATCO
Netherlands	National guidelines	National guidelines	National guidelines	National guidelines
Sweden	National guidelines	National guidelines	National guidelines	National guidelines
Switzerland	HEATCO	National guidelines	National guidelines	HEATCO
UK	National guidelines	National guidelines	National guidelines	HEATCO
East				
Czech Republic	HEATCO	HEATCO	National guidelines	HEATCO
Estonia	HEATCO	HEATCO	HEATCO	HEATCO
Hungary	HEATCO	HEATCO	National guidelines	HEATCO
Latvia	National guidelines	HEATCO	National guidelines	HEATCO
Lithuania	HEATCO	HEATCO	National guidelines	HEATCO
Poland	HEATCO	HEATCO	HEATCO	HEATCO
Slovak Republic	HEATCO	HEATCO	National guidelines	HEATCO
Slovenia	National guidelines	HEATCO	National guidelines	HEATCO
South				
Cyprus	HEATCO	HEATCO	HEATCO	HEATCO
Greece	National guidelines	National guidelines	National guidelines	HEATCO
Italy	HEATCO	HEATCO	HEATCO	HEATCO
Malta	National guidelines	HEATCO	National guidelines	HEATCO
Portugal	HEATCO	HEATCO	HEATCO	HEATCO
Spain	HEATCO	HEATCO	National guidelines	HEATCO

Besides financial harmonisation also harmonisation on transport information TRANS-TOOLS funded by the EC



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The HEATCO Approach for Transport Project Assessment

Aid for answering the question:

- Is a transport project worthwhile from an overall social point of view?
- Which of several alternative projects should be chosen?

- Define a ‘do minimum’ case and a case with project, determine differences
- Carry out a cost-benefit-analysis (CBA) for those effects, that can be monetized:
- Benefits – Costs > 0 ?

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The HEATCO Approach for Transport Project Assessment

Costs and benefits include:

- Consumer surplus
- Time gains/losses
- Accident risks
- Air pollution
- Noise
- Greenhouse gas emissions
- Fees, tolls, private costs including distribution of costs

All without VAT!

Indirect effects recommendations

For carrying out a cost benefit analysis, these parameters have to be transformed into monetary values. How?

The Problem

- **Methodologies for an integrated assessment of transport projects should be harmonized and quantitative to ensure consistency and transparency.**

Thus, guidelines for assessing large transport projects have been developed within the research project HEATCO –financed by the EC.

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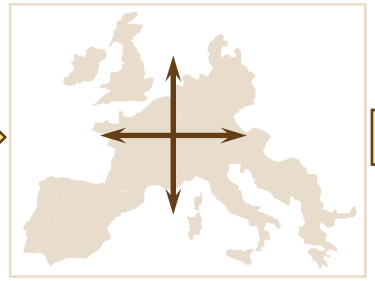
The Problem

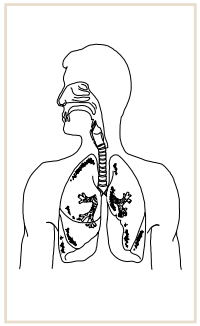
Environmental Impacts: The Impact Pathway Approach

Pollutant/Noise Emission

Transport and Chemical Transformation



Physical Impacts



Monetary Valuation

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Value impacts, not quantitavie pressures

Impacts included (I)

Impact Cat.	Pollutant / Burden	Effects
Human Health mortality	PM_{10}	Reduction in life expectancy due to short and long time exposure
	SO_2, O_3	
	Benzene, BaP, 1,3-butad., Diesel part., cadmium	Reduction in life expectancy – fatal cancer
	Noise	Reduction in life expectancy due to long time exposure
Human Health morbidity	PM_{10}, O_3, SO_2	Respiratory hospital admissions
	PM_{10}, O_3	Restricted activity days
	PM_{10}, CO	Congestive heart failure
	Benzene, BaP, 1,3-butad., Diesel part., cadmium	Cancer risk (non-fatal)
	PM_{10}	Cerebrovascular hospital admissions, cases of chronic bronchitis, cases of chronic cough in children, cough in asthmatics, lower respiratory symptoms
	lead	IQ loss in children
	O_3	Asthma attacks, symptom days
	Noise	Myocardial infarction, angina pectoris, hypertension, sleep disturbance

Impacts included (II)

Impact Category	Pollutant / Burden	Effects
Building Material	SO_2, Acid deposition	Ageing of galvanised steel, limestone, mortar, sand-stone, paint, rendering, and zinc for utilitarian buildings
	Combustion particles	Soiling of buildings
Crops	SO_2	Yield change for wheat, barley, rye, oats, potato, sugar beet
	O_3	Yield change for wheat, barley, rye, oats, potato, rice, tobacco, sunflower seed
	Acid deposition	Increased need for liming
	N, S	Fertilising effects
Amenity losses	Noise	Amenity losses due to noise exposure
Ecosystems	SO_2, NO_x, NH_3	Eutrophication, Acidification

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The HEATCO approach: Environmental Impacts

General Approach

- Assessment of impacts is based on the (measured) preferences of the affected well-informed population
- E.g. use of contingent valuation studies (WTP), choice experiments,…
- Benefit transfer of unit values e.g. with income adjustments
- Increase of monetary values with time: income elasticity of 0.7-1.0

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The HEATCO Approach: Air Pollution

Impacts of air pollution from transport (years of life lost per 1000 t of emission)					
Pollutant emitted	**NOx**	**NM VOC**	**SO2**	**PM2.5**	**PM2.5**
Effective pollutant	**O_3, Nitrates**	**O_3**	**Sulfates, Acid depos.**	**PM2.5**	**PM2.5**
Local environment				**urban**	**non-urban**
Czech Republic	**50**	**1**	**58**	**5 900**	**1 180**
Finland	**11**	**0,2**	**9**	**5 100**	**450**
Belgium	**57**	**1**	**81**	**6 200**	**1 470**

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The HEATCO Approach: Air Pollution

Fall-back Values for air pollution from transport ($€_{2002,PPP}$ per tonne pollutant emitted)					
Pollutant emitted	**NOx**	**NMVOC**	**SO2**	**PM2.5**	**PM2.5**
Effective pollutant	**O_3, Nitrates**	**O_3**	**Sulfates, Acid deposition**	**PM2.5**	**PM2.5**
Local environment				**urban**	**non-urban**
Czech Republic	**3,200**	**1,100**	**4,100**	**270,000**	**76,000**
Finland	**900**	**200**	**600**	**360,000**	**30,000**

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The HEATCO approach: Noise Impacts

Methods for monetary valuation of noise levels:

- Recommended central values: health and direct WTP for reducing annoyance based on 'stated preference' studies
- Sensitivity 'new approach': health and annoyance based on exposure response functions and results of the HEATCO survey
- Sensitivity 'high values': health and WTP for reducing *annoyance* based on 'hedonic pricing'-studies

The HEATCO approach: Noise Impacts

Monetary values €2002,PPP for different noise levels (Germany)

	central (SP)			new approach			high (hed.)		
L_{DEN} dB(A)	road	rail	air	road	rail	air	road	rail	air
43	0	0	0	5	2	8	0	0	0
51	9	0	14	11	6	18	20	0	31
60	88	44	136	21	12	29	200	100	310
75	291	248	412	113	98	119	573	473	848

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The HEATCO Approach: Accident Risks

Cost components:

***Value of safety per se*: WTP to reduce accident risks**

requirement: values from up-to-date stated preferences studies

***Direct cost*: medical and rehabilitation cost, legal cost, emergency services and property damage cost.**

***Indirect cost*: production capacity lost for economy**

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The HEATCO Approach: Accident Risks

Fall-back Values for Casualties ($€_{2002}$ per case)

Country	Fatality	Severe injury	Slight injury
	(1000 $€_{2002,PPP}$, factor prices)		
Czech Republic	932	125	9,1
Finland	1,548	206	15,4
Germany	1,493	207	16,7
Greece	1,069	140	10,7

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The HEATCO Approach: Global Warming

Shadow Prices for Reducing Global Warming (€2002/tonne CO2-equiv.), factor prices)

Watkiss et al. (2005b) derive
shadow price values, taking into account the expected future development of damage costs and abatement costs

	Central guidance	For sensitivity analysis	
Year of emission		Lower central estimate	Upper central estimate
2000 – 2009	**22**	14	51
2010 – 2019	**26**	16	63
2020 – 2029	**32**	20	81
2030 – 2039	**40**	26	103
2040 – 2049	**55**	36	131
2050	**83**	51	166

Approach for Evaluating Time

Trip category	Minimum approach
Passenger – work	Cost saving (meta-analysis)
Passenger – non-work	Willingness to pay (meta-analysis)
Commercial Goods traffic	Cost saving (meta-analysis)

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Value of Travel Time – Recommended Default Values for the Czech Republic, Passenger Transport (€2002 PPP per passenger per hour, factor prices)

	Air	Bus	Car, Train
Business	37	21	27
Other long dist.	17	8	12
Commute short	16	8	11

Walk time: 2 * in-vehicle time; wait time: 2,5 * in-vehicle time; standing: 1,5 * in-vehicle time.

Value of Travel Time– freight trips (€2002 PPP per freight tonne per hour, factor prices)

Road	Rail
3,8	1,6

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Indirect effects

- Recommendations: indirect effects and the CBA process
- Step 1 Gain a first, qualitative understanding of expected indirect effects and dominant mechanisms
- Step 2 Decide whether expected magnitude of additional, indirect effects are sufficient to warrant an in-depth study
- Step 3 Identify available resources (including time, money, data models)
- Step 4 Decide on need for quantitative study
- Step 5 Decide on methodology modelling (various options)

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Indirect effects

Project type	Transport model	Wider economy model	How to measure benefits
Incremental infrastructure improvement – small to moderate Δ in GC	Good quality transport model	Qualitative market research	Transport Cost Benefit Analysis
Step-change in regional accessibility OR pricing policy reform = large Δ in GC	Good quality transport model	Spatial CGE/ macro model**	Equivalent variation at household level / aggregate GDP change

- Different models: SCGE (Broecker), SASI (Wegener), EDIP model (TML)

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Discount rate

- recommended risk premium-free rate or
- weighted average of the rates currently used in national transport project appraisals in the countries in which the TEN-T project is to be located.
- The rates should be weighted with the proportion of total project finance contributed by the country concerned.
- In lower-bound sensitivity analyses, in order to reflect current estimates of the social time preference rate, a common discount rate of 3% is recommended to be used.
- For damage occurring beyond the 40 year appraisal period (intergenerational impacts), e.g. for climate change impacts, a declining discount rate system is recommended.

Discount rate

Discount rate	No. of countries
< 4%	4
4-7%	17
> 7%	3

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Link Across the Fehmarn Belt

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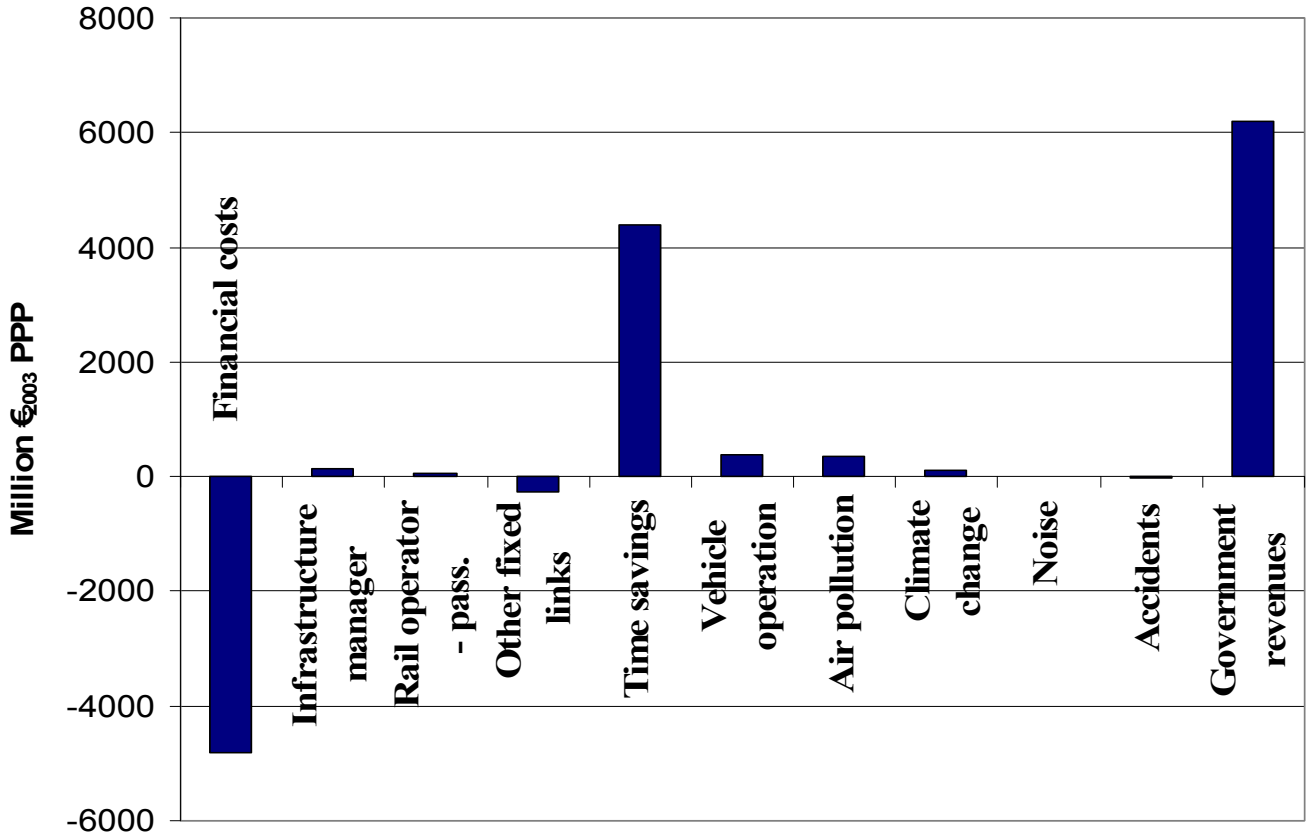
Net Present Value for Different Cost Categories: Link Across Fehmarn Belt



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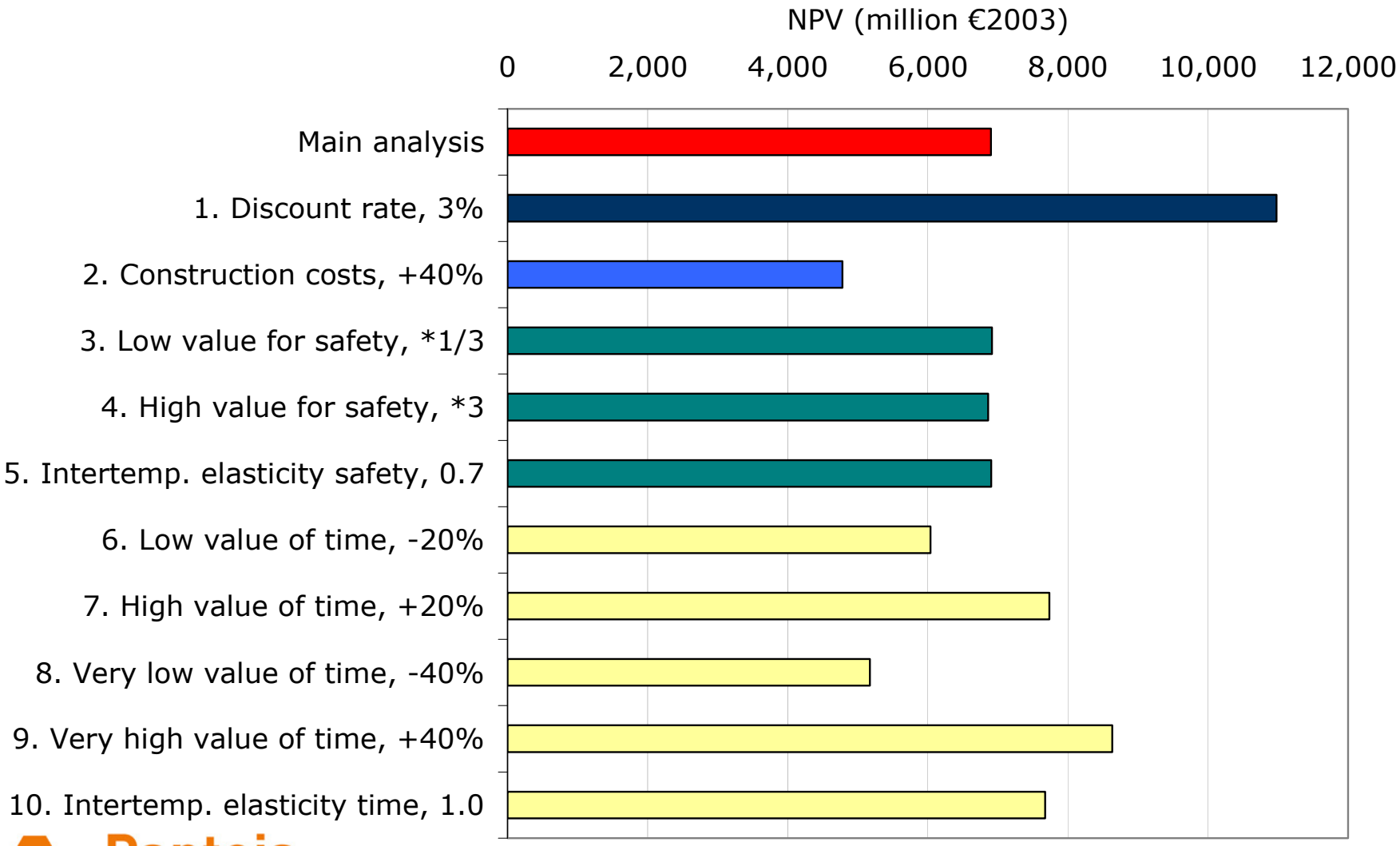
Sensitivity tests (I)



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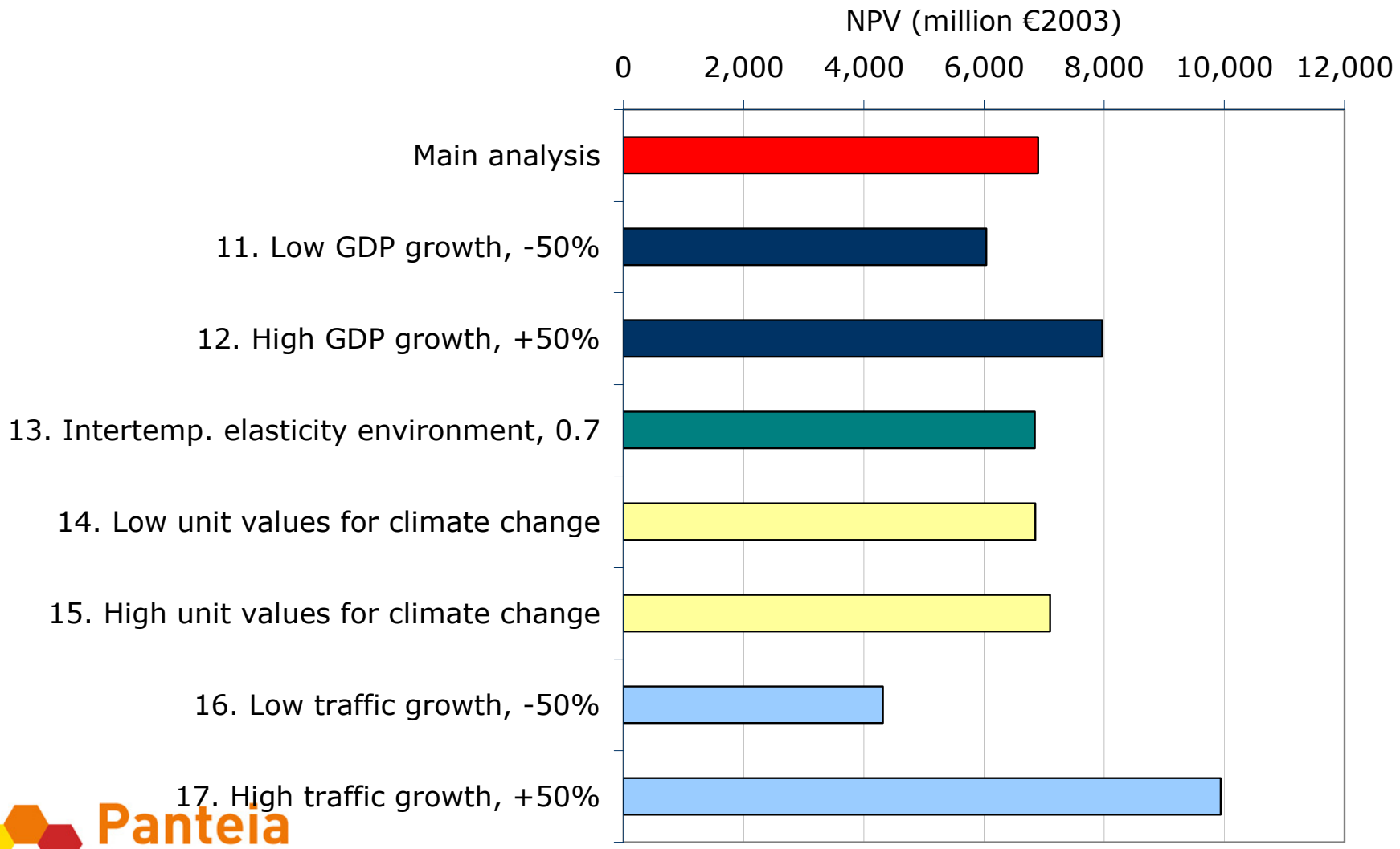
Sensitivity tests (II)



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Updates within HEATCO are necessary

- Value of time was updated, this has the biggest impact on benefits
- However in other areas such as emissions and noise progress has been made in terms of methodology and reassessment is necessary

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Updated value of time (Significance) for 2010 carried out for EIB

Country	Car Commuter						Car Business						Car Other					
	RAND	S&deJ	5	25	100	250	RAND	S&deJ	5	25	100	250	RAND	S&deJ	5	25	100	250
Albania	0.08	-	0.02	0.02	0.03	0.03	0.20	-	0.04	0.05	0.06	0.06	0.06	-	0.02	0.02	0.03	0.03
Austria	0.17	0.23	0.03	0.04	0.05	0.06	0.56	0.60	0.08	0.10	0.12	0.13	0.12	0.18	0.03	0.04	0.04	0.05
Belgium	0.16	0.22	0.12	0.15	0.19	0.21	0.54	0.58	0.28	0.35	0.43	0.49	0.11	0.17	0.10	0.13	0.16	0.18
Bosnia	0.08	-	0.02	0.03	0.03	0.04	0.21	-	0.04	0.05	0.07	0.07	0.06	-	0.02	0.02	0.03	0.03
Bulgaria	0.10	-	0.03	0.04	0.04	0.05	0.27	-	0.06	0.07	0.09	0.10	0.08	-	0.02	0.03	0.04	0.04
Croatia	0.10	-	0.05	0.07	0.08	0.09	0.28	-	0.11	0.14	0.17	0.19	0.08	-	0.04	0.06	0.07	0.08
Cyprus	0.12	0.20	0.09	0.11	0.14	0.16	0.38	0.47	0.20	0.25	0.31	0.35	0.09	0.19	0.08	0.10	0.12	0.13
Czech Republic	0.10	0.20	0.06	0.08	0.10	0.11	0.31	0.38	0.14	0.17	0.21	0.24	0.08	0.15	0.06	0.07	0.08	0.10
Denmark	0.19	0.26	0.15	0.19	0.23	0.26	0.64	0.67	0.35	0.43	0.53	0.60	0.13	0.20	0.13	0.16	0.19	0.22
Estonia	0.11	0.18	0.05	0.07	0.08	0.09	0.32	0.36	0.11	0.14	0.17	0.20	0.09	0.14	0.05	0.06	0.07	0.08
Finland	0.16	0.22	0.12	0.16	0.19	0.22	0.55	0.59	0.29	0.36	0.44	0.50	0.12	0.17	0.11	0.13	0.16	0.19
France	0.15	0.26	0.11	0.14	0.17	0.20	0.51	0.57	0.26	0.33	0.40	0.45	0.11	0.23	0.10	0.12	0.15	0.17
Germany	0.16	0.21	0.12	0.15	0.18	0.20	0.52	0.57	0.26	0.33	0.40	0.46	0.11	0.16	0.10	0.12	0.15	0.17
Greece	0.13	0.18	0.09	0.11	0.13	0.15	0.40	0.45	0.19	0.24	0.29	0.33	0.09	0.18	0.07	0.09	0.11	0.13
Hungary	0.12	0.16	0.05	0.06	0.08	0.09	0.37	0.34	0.10	0.13	0.16	0.18	0.10	0.13	0.04	0.05	0.06	0.07
Ireland	0.15	0.22	0.13	0.16	0.20	0.23	0.51	0.58	0.30	0.38	0.46	0.52	0.11	0.17	0.11	0.14	0.17	0.19
Italy	0.13	0.23	0.08	0.09	0.12	0.13	0.42	0.52	0.17	0.21	0.26	0.29	0.10	0.21	0.06	0.08	0.10	0.11
Latvia	0.11	0.19	0.04	0.05	0.07	0.08	0.31	0.39	0.09	0.11	0.14	0.15	0.09	0.15	0.04	0.05	0.06	0.06
Lithuania	0.10	0.17	0.04	0.06	0.07	0.08	0.27	0.34	0.09	0.11	0.14	0.16	0.08	0.13	0.04	0.05	0.06	0.07
Luxembourg	0.27	0.38	0.24	0.30	0.36	0.41	0.96	0.87	0.58	0.73	0.89	1.02	0.18	0.26	0.20	0.26	0.31	0.35
Macedonia	0.08	-	0.02	0.03	0.03	0.04	0.21	-	0.04	0.05	0.07	0.07	0.06	-	0.02	0.02	0.03	0.03
Malta	0.11	0.17	0.07	0.09	0.11	0.12	0.32	0.42	0.15	0.19	0.23	0.26	0.08	0.17	0.06	0.07	0.09	0.10
Netherlands	0.17	0.22	0.17	0.21	0.26	0.30	0.56	0.58	0.39	0.49	0.60	0.68	0.12	0.17	0.15	0.18	0.22	0.25
Poland	0.10	0.18	0.05	0.06	0.07	0.08	0.31	0.35	0.10	0.12	0.15	0.17	0.08	0.14	0.04	0.05	0.06	0.07
Portugal	0.11	0.16	0.07	0.09	0.11	0.13	0.35	0.39	0.16	0.20	0.24	0.27	0.08	0.16	0.06	0.08	0.10	0.11
Romania	0.11	-	0.03	0.04	0.05	0.06	0.29	-	0.07	0.08	0.10	0.12	0.09	-	0.03	0.04	0.04	0.05
Slovakia	0.11	0.16	0.06	0.07	0.09	0.10	0.31	0.32	0.12	0.16	0.19	0.22	0.08	0.12	0.05	0.06	0.08	0.09
Slovenia	0.13	0.25	0.08	0.10	0.12	0.13	0.42	0.44	0.17	0.21	0.25	0.29	0.10	0.17	0.07	0.08	0.10	0.11
Spain	0.13	0.21	0.13	0.16	0.19	0.22	0.42	0.49	0.28	0.35	0.43	0.49	0.10	0.20	0.11	0.14	0.17	0.19
Sweden	0.16	0.24	0.13	0.17	0.21	0.23	0.54	0.62	0.31	0.39	0.47	0.54	0.11	0.18	0.11	0.14	0.18	0.20
Turkey	0.12	-	0.04	0.05	0.06	0.07	0.34	-	0.08	0.11	0.13	0.15	0.10	-	0.04	0.04	0.05	0.06
UK	0.12	0.21	0.07	0.09	0.11	0.13	0.39	0.57	0.16	0.20	0.25	0.28	0.09	0.16	0.06	0.08	0.09	0.11
Serbia	0.12	-	0.03	0.03	0.04	0.04	0.33	-	0.05	0.06	0.08	0.09	0.10	-	0.02	0.03	0.03	0.04
Switzerland	-	0.29	0.23	0.39	0.62	0.84	-	0.70	0.55	0.93	1.47	1.98	-	0.21	0.20	0.34	0.53	0.72

HEATCO webpage:

http://heatco.ier.uni-stuttgart.de

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