
„Are we moving in the right direction?“ -
Review of and lessons from TERM indicators for environmental impact assessment
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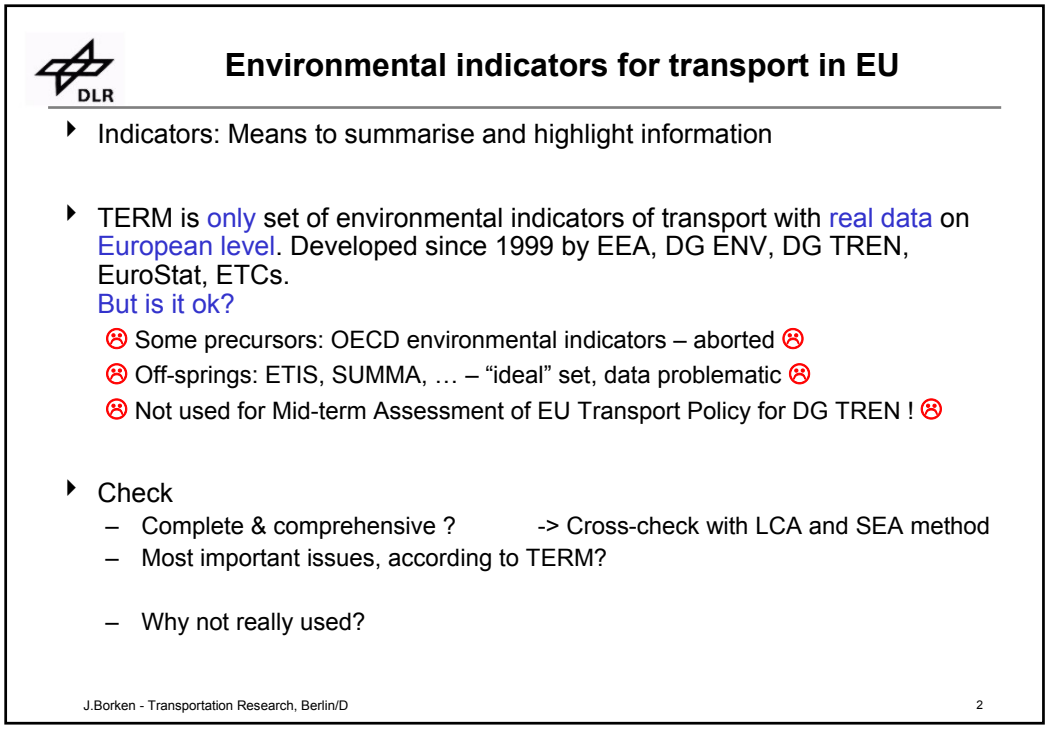
Environmental indicators for transport in EU
Indicators: Means to summarise and highlight information
TERM is only set of environmental indicators of transport with real data on European level. Developed since 1999 by EEA, DG ENV, DG TREN, EuroStat, ETCs.
But is it ok?
Some precursors: OECD environmental indicators – aborted
Off-springs: ETIS, SUMMA, … – “ideal” set, data problematic
Not used for Mid-term Assessment of EU Transport Policy for DG TREN !
Check
– Complete & comprehensive ? -> Cross-check with LCA and SEA method
– Most important issues, according to TERM?
– Why not really used?
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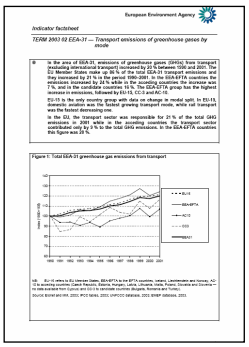
TERM: Transport & Environment Reporting Mechanism

„…to provide policy makers with information that can help to pinpoint problems at an early stage in the development of policy…“ [EEA 2002:3, 4]

Since 1999: 4 TERM reports, ~20 technical reports, ~40-60 indicator fact sheets, …



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24 TERM indicators for explicit environmental impact

Complete: Life Cycle Analysis / Strat. Environm. Assessment

Resource consumption | Climate change | Ecosystem toxicity | Eutrophication | Human toxicity | Acidification | Photosmog | Protection of soil, landscape, nature | Noise | Ozone depletion

- emissions GHG (CO_2, N_2O)
- Consumption:
  - final energy
  - primary energy
- Emissions of
  - NO_x
  - NMVOC
  - SO_x
  - PM_{10} and ozone precursors
- Population exposed to exceedances of air quality standards for
  - PM_{10},
  - NO_2,
  - Benzene,
  - Ozone,
  - Lead,
  - CO
- Fragementation by traffic infrastructure
- land take by traffic infrastructure
- Proximity of infrastructure to designated areas
- % population exposed to and annoyed by traffic noise.
- Number of
  - accidents,
  - fatalities,
  - injured,
  - polluting accidents
- Discharges of oil by ships
  - illegal,
  - accidental.
- Waste from road vehicles
  - end-of-life vehicles
  - used tyres
- *emissions of ozone-depleting substances*

These are just the 24 environmental indicators, there are more indicators on transport demand, infrastructure, costs, vehicle technology and accessibility.
TERM 1999, 2001, 2002.

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Ex 1 - Climate change: Global & long-term impact, linear chain, direct transport share

Greenhouse gas emissions

⇔ transport's impact on climate change

- CO_2, N_2O, CH_4 annual totals
- Road, diesel rail, domestic aviation and navigation
- 1990 – 2001, outlook for road transport until 2010
- EEA31 (EU15, EU10, CC3, EFTA4) and national data
- Fairly accurate and comparable over space and time

OK. Straightforward, directly related to transport, international.

Gaps / problems:

- Fuel life cycle/ provision ~10% missing, 100% missing for electric traction ☹
  => comparing gasoline vs. diesel vs. regenerative vs. electric not reliable
- International aviation ~25% missing
- Vehicle construction ~25% missing.

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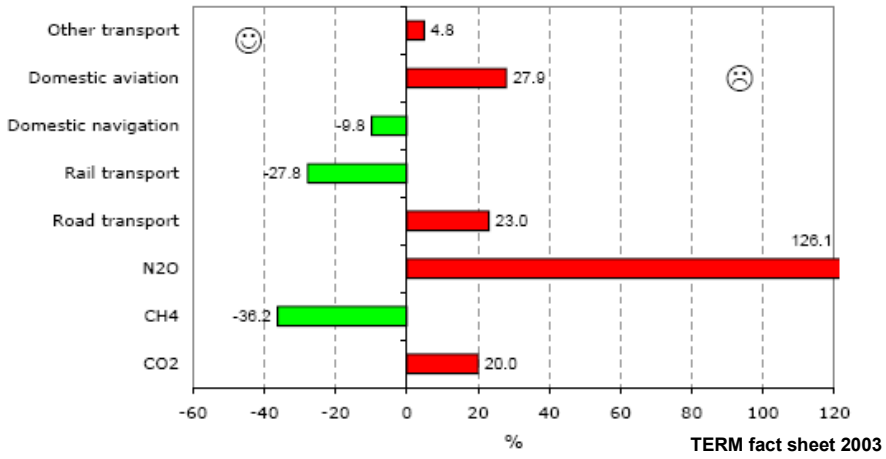
Transport's greenhouse gas emissions

Besides national totals over time,
here a differentiation of change rates by mode and substance:



TERM fact sheet 2003

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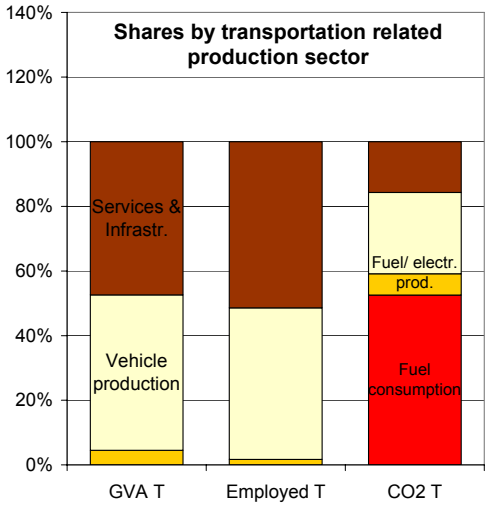
Vehicle production and services have important shares

From input-output analysis, including foreign trade, for Germany 2000:

- For CO_2 emissions: ~60% fuel provision and consumption, ~25% from vehicle manufacture!
- For gross-value added (GVA) and employment: Services and pre-production as important as manufacture of vehicles

Borken et al. 2004, Keimel et al. 2004.



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Ex 2 – Air quality: Regional, acute & long-term impact, indirect chain & transport share

Concentration of air pollutants

⇔ Health and ecosystems impacts: Toxic, ozone, acidification, eutrophication

- NO_2, SO_2, PM_{10}, O_3 annual average and max. concentration
- All sources compounded - not only transport
- Only 2 stations - traffic and background - per capital city in EEA31
- (1996)-2001

Gaps / problems:

- Comprehensive picture over time and space missing
- Ecosystem impacts not covered ⇔ rural pollutant concentrations missing
- Impact in terms of health or eco-system damage not spelled out
- Marine shipping missing ⇔ up to 50% of potential PM_{10} and acidification missing (Borken 2005:59)

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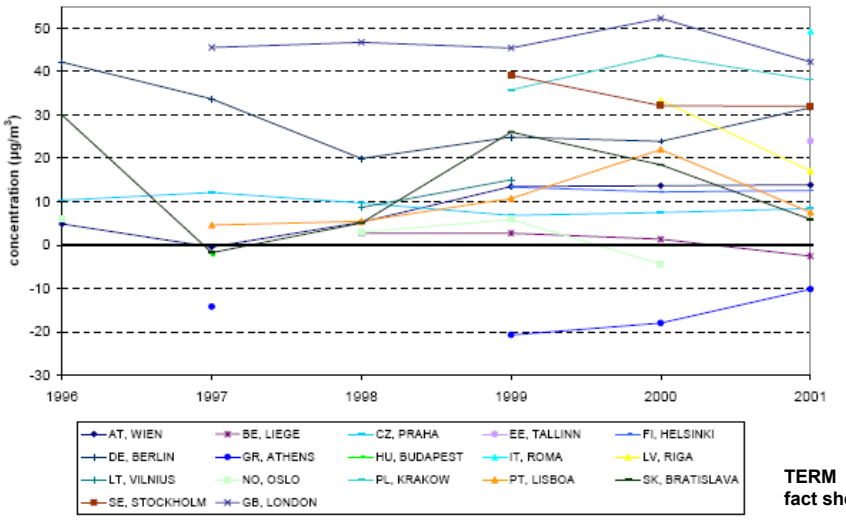
Air quality: Only illustrative data presented

Figure 3: Difference between NO_2 traffic and urban background average yearly values



TERM fact sheet 2003

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Ex 3 – Fragmentation: Local & regional, long-term impact, indirect chain & transport share

Proximity of transport infrastructure to designated areas

⇔ Fragmentation and biodiversity impacts

- Length/density of motorways and (high speed) rail
- EU25 and countries
- 2000

Gaps / problems:

- “Proximity” only illustration, but no cause-effect chain
- Indicator neither sensitive over time nor to action
- Comprehensive over space

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Most data incomplete, imprecise, not comparable

Indicator	Time	Space	Accuracy
Final energy consumption	1	1	<5%
Emissions of climate gases	2	1	<5%
Accident fatalities	1	2	<5%
Accidental oil discharges at sea	1	1	2
End-of-life vehicles	1	1	3
Oil slicks discovered	2	1	30-40%
Emissions: Acidifying pollutants	2	2	30-40%
Emissions: Eutrophication pollutants	2	2	30-40%
Emissions: Ozone precursors	2	2	30-40%
Emissions: Particle precursors	2	2	50%
Accident injured	*a*	*b*	
Proximity to protected areas	3	1	3
non-fragmented areas	3	2	3
Exposure to NO_2, SO_2, O_3	3	3	2
Exposure to PM_{10}	3	3	3
Exposure to traffic noise	*c*	*c*	*30-50%*
Annoyance by traffic noise	*c*	*c*	*30-50%*
Land take	3	3	3
Used tyres	3	3	3

Quality/comparability
Green: Good
Yellow: Medium
Red: Poor

Bold:
Indicators suggested as key representatives.

TERM fact sheets 2002ff or estimated

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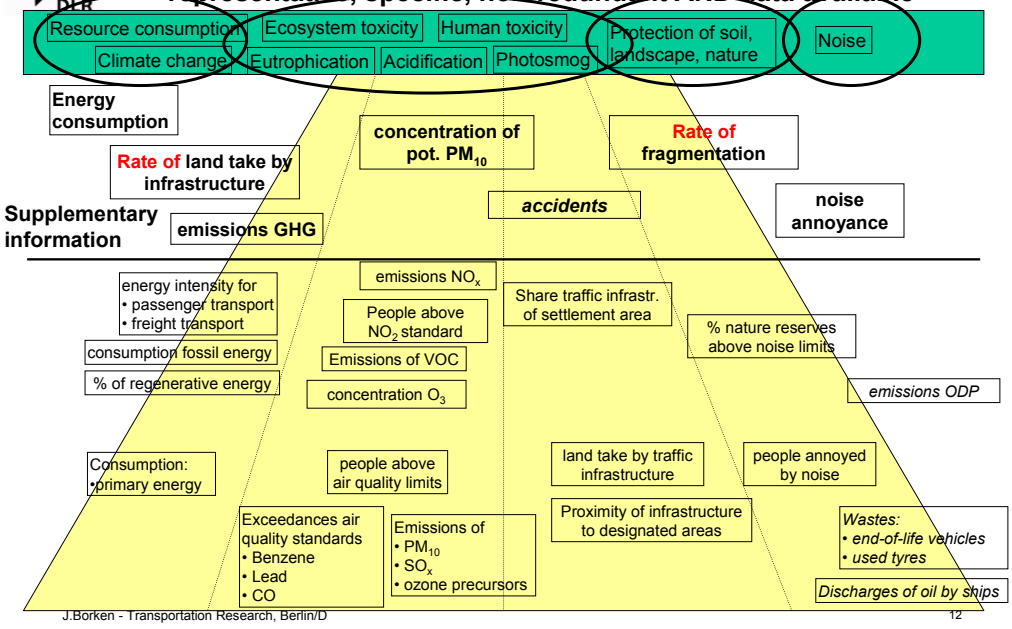
Proposal for key TERM indicators, that are representative, specific, non-redundant AND data available



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Preliminary appraisal of TERM

Ok, all relevant environmental impact categories covered, **BUT should …**

- … include aviation and international shipping,
- … embrace life cycle impacts,
- … eliminate non-pertinent and redundant indicators,
- … focus on dynamics to monitor policy impact,
- … produce trend outlook.

Maybe we are ‚moving in the right direction' **BUT answer:**

- What environmental targets not atteined? => Focus on tasks
- Most important future actions?
- Where is dynamics?
- Where entry point for effective and efficient measures?

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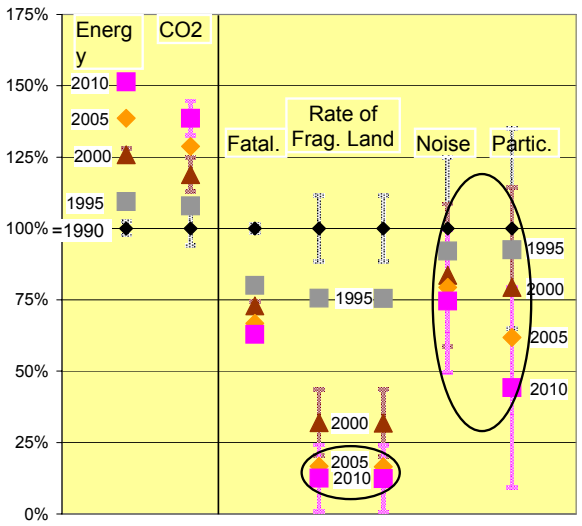
Ex-post & ex-ante assessment of key indiacators with **real** data

Can TERM data be used for an assessment?

Though trend apparent, data too imprecise for
noise + air pollution.

Not sensitive enough for
fragmentation + land take
because inertia too big.



1990=100%, Error bars only for 1990, 2000, 2010.
Data: EuroStat 2001, EEA 2003/4, Samaras 2000

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Interpretation of given TERM data

To improve the environmental performance

- Decrease fossil fuel consumption,
  - decouple fuel consumption from CO_2 emissions;
- Limit extra-urban infrastructure construction,
  - decouple land take from fragmentation.
- Continue efforts to reduce traffic's pollutant emissions and noise.

Does TERM deliver value for money with these conclusions?

Indicators are pointless, unless:

- Integrated in causal chain / explanatory model,
- Focused: Important issues, dynamics, policy levers
- Up-to-date,
- Contextual: For whom, what purpose, what detail required, what objective?

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- Additional slides on MC assessment – when time and needed

Assessment must account for problem

1. Input data and impact estimates are not reliable
   - Account for fuzzyness, don‘t pretend „accuracy“.
2. Sum up heterogeneous effects
   - Compare in pairs, hence natural units, don‘t „sum up“.
3. Conflicting targets and values
   - Identify compromise, make judgements explicit.
4. (Technical treatments put off public and policy maker
   - Simple, discursive approach: Get them involved)

Some lessons from Multi-criteria Decision Aiding theory,
here a particular outranking method ELECTRE applied to EU transport.

2. Compare heterogoneous impacts individually, don't sum up

Begin with performance table – **preference direction: The less, the better**.

Indicator	CO_2-Em.	Accident	Noise	Particle pot.	Fragmentg
unit	Mt CO_2-eq	fatalities	Exposure	kt PM_{10}-eq	Δ(-1%)
Case A	720	56000	High	High	1,20%
Case B	780	45000	High	A bit less	0,90%
Uncertainty	5%	1%	HIGH	HIGH	10%
part. concordance					
Case A at least as good as case B	Yes	No	Cannot say	Maybe	No

Judge the relative performance per indicator and its reliability for all cases in dialogue.

=> Construct a matrix of qualitative reliability judgements per indicator.

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3. Identify values, conflicts and compromise in dialogue

Use value profiles to emulate different positions – derive from dialogue with stakeholders.

Overall objective	Protection of human health			Protection of structure and function of ecosystems		Protection of resources	
Impact category	Accidents	Noise	Air pollution	Biodiversity	Climate change	Energy resources	Land resources
a) Equal weights	33/3	33/3	33/3	33/2	33/2	33/2	33/2
b) Health dominant	50/3	50/3	50/3	25/2	25/2	25/2	25/2
c) Ecosystems dom.	25/3	25/3	25/3	50/2	50/2	25/2	25/2
d) Resources dom.	25/3	25/3	25/3	25/2	25/2	50/2	50/2

Values capture the - explicit and implicit – trade-offs

=> Make discussion transparent.

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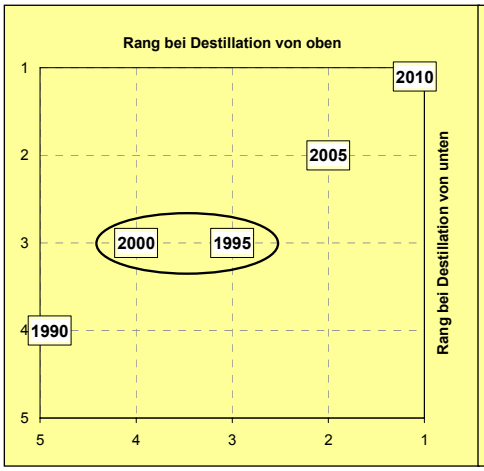
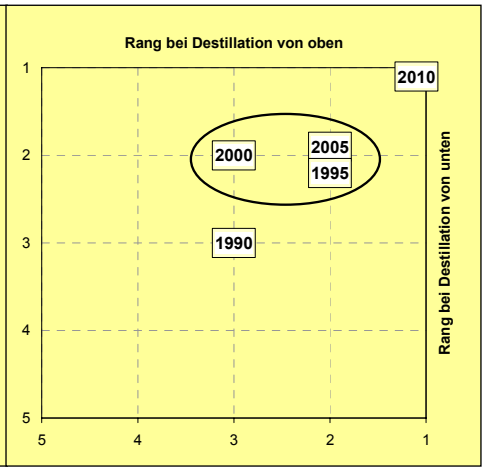
Ranking results for different value profiles

when HEALTH most important:
Safety + noise + air poll.: 50% weight



when ECOSYSTEMS most important:
Biodiversity + climate: 50% weight



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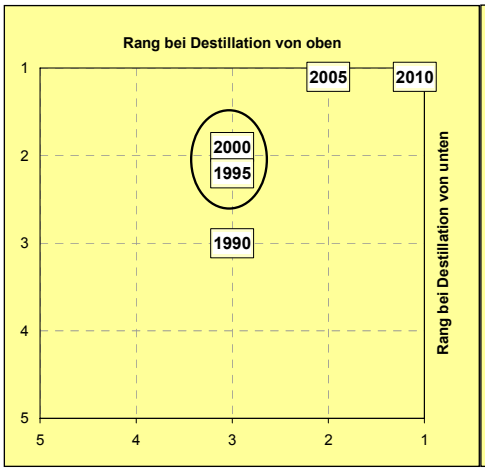
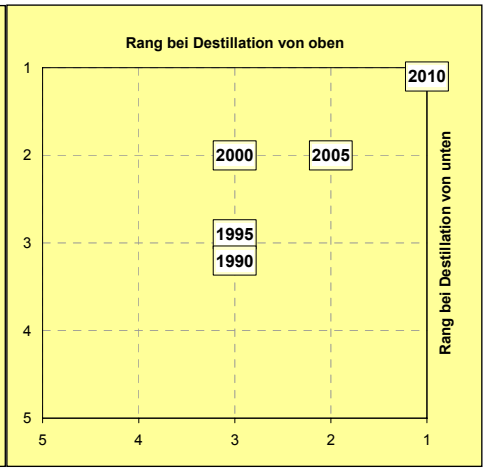
Evaluation (4): Different assessment profiles

when RESOURCES most important:
Land + energy: 50% weight



when ALL EQUAL:



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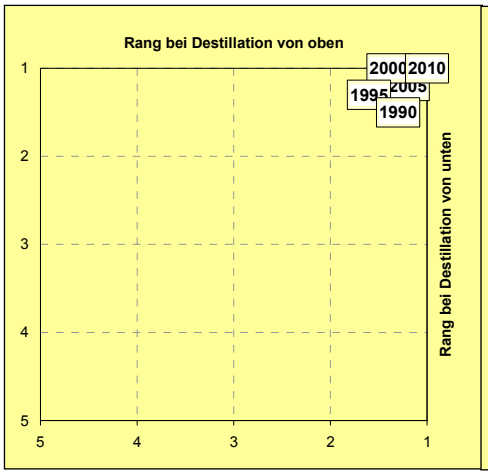
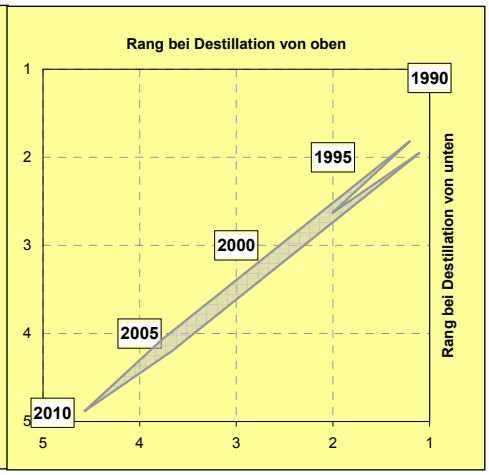
Evaluation (4): Different assessment profiles

Ranking impossible:
CO2 and energy > 40% weight.



Rank reversal:
CO2 and energy > 60% weight.



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Summary (1): Focus on common points

Given TERM's simple data structure

- Other parameters do not influence the order, but its resolution.
- Common assessment:
  Less environmental stress in future from EU road transport

  2010 >> 2005 > (2000/1995) >> 1990
- Other ranking IF AND ONLY IF
  - Single criterion receives a dominant weight,
  - Veto, or
  - Different future development.

- KEY indicators (= relevant + precise + decisive):
  - CO2 emission + energy consumption -> fossil fuel consumption,
  - Land take + fragmentation -> road construction.

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Qualitative assessments can advance in vague contexts

- Qualitative relative assessments can structure and advance discussion
  - Accounts for fuzzyness
  - Treats heterogeneous data
  - Names conflict of values in clear language
  - Can open the door for participation
- Multi-criteria decesion aiding methods can help to identify compromise

Limits:

- Ordinal no cardinal evaluation => „distance“ not defined.
- Fuzzy input -> no precise output
- Compensation excluded
- Of course, the results depend on the method (Arrow‘s theorem)!

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