



# Deliverable 1: Accounting framework

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### **Workpackage 1: Accounting framework for the analysis of the cost structure of door to door intermodal freight transport service**

- I. General methodological framework for accounting for accounting real costs of intermodal transport
- II. Internal (resource) costs: Methodology for data collection and cost calculation
- III. External costs: Methodology for data collection and cost calculation



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# Principles of cost-benefit analysis (CBA)

- CBA as an instrument for **decision finding**  
(in case of RECORDIT: less policy or investment decision than comparison between freight transport alternatives)
- Based on **quantitative analysis** instead of qualitative
- Maximisation of **net-benefit**

$$\text{Net present value} = \sum_t \frac{b_t}{(1+r)^t} - \sum_t \frac{(c_{\text{int},t} + c_{\text{ext},t})}{(1+r)^t}$$

- All costs ( $c_t$ ) and benefits ( $b_t$ ) have to be discounted on **one and the same period**
- Discount rate in RECORDIT:  **$r = 3\%$**



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## Extensions of the cost-benefit analysis

- In absence of market prices (in case of externalities) the economic value is calculated due to:
  - a) **willingness to pay** (WTP)
  - b) **willingness to accept** (WTA)
- High uncertainty of values and calculation steps  
=> **Sensitivity analysis**
- RECORDIT aims to calculate **marginal** costs and benefits
- **Bottom-up approach** (based on micro data)  
Vs.  
**Top-down approach** (based on average data)  
=> RECORDIT is based on a bottom-up approach



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# Differentiation of means of transport, LU and goods

**Means of transport (MoT):** - truck

- train

- barge/vessel

- maritime ship

**Loading units (LU):**

- 20ft container

- 40ft container

**Transported goods:**

- a) perishable

- b) hazardous

- c) high value general cargo

- d) low value general cargo



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## Cost blocks

### Balance sheet

- **Personnel:** gross wage, salary of driver/worker
- **Fixed assets / Maintenance of assets:** container / swap body / trailer - investment depreciation, interest, maintenance and repair
- **Energy, telecommunication and other consumption material:** fuels, electricity
- **Insurance, taxes, charges:** insurance of vehicles

### Transport process

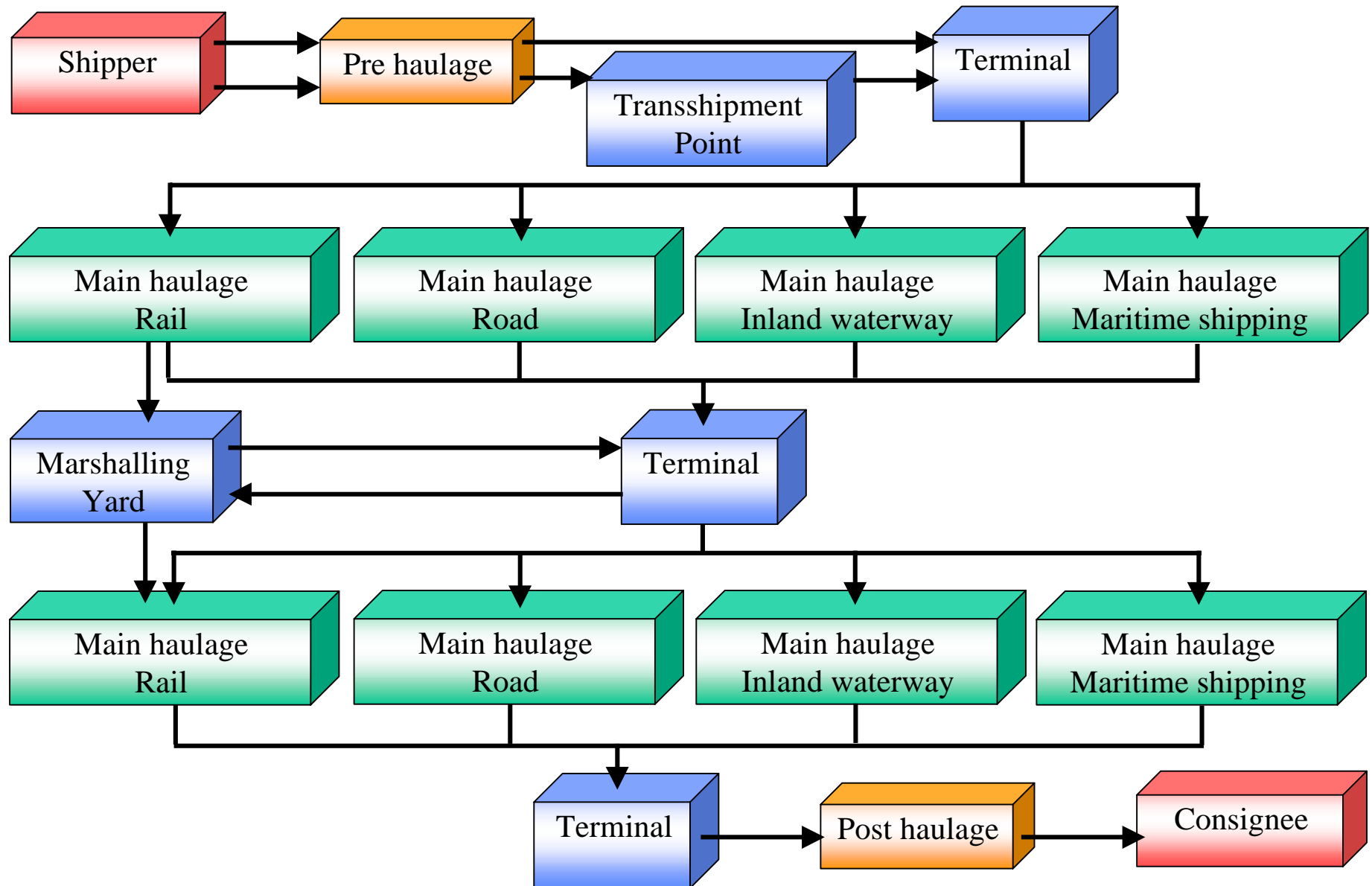
- **Organisation costs:** management, transaction, monitoring
- **Stock turn / goods handling:** (un)loading, shunting, marshalling, rearrangement
- **Time:** transport time, stock-room time, waiting time
- **Costs with internal and external parts:** time due to congestion, scarcity, slot allocation

External costs: accidents, air pollution, noise, climate change



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## Transport blocks





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## Level of detail for cost categories

	Shipper / Consignee	Pre and post haulage	Transship Point	Terminal	Marshalling	Haulage Road	Haulage Rail	Haulage waterway	Haulage Maritime
<b><i>Personnel</i></b>									
Gross wage / salary -of driver		X			X	X	X	X	X
- of worker	X		X	X	X				
Expenses incurred by the driver		X				X	X	X	X
Social security	X	X	X	X	X	X	X	X	X
Overhead	X	X	X	X	X	X	X	X	X
Administration	X	X	X	X	X	X	X	X	X
Profit / opportunity	X	X	X	X	X	X	X	X	X
Advertising, PR	X	X	X	X	X	X	X	X	X
Advocating / Consulting	X	X	X	X	X	X	X	X	X
<b><i>Fixed assets / maintenance of assets</i></b>									
Container/swap body/trailer – investment: depreciation and interest.	X	X	X	X		X	X	X	X
- maintenance	X	X	X	X		X	X	X	X
- repair	X	X	X	X		X	X	X	X
Means of transport – inv.: dep. and interest		X				X	X	X	X
- maintenance		X				X	X	X	X
- repair		X				X	X	X	X
Technical asset – inv.: depreciation and interest			X	X	X				
- maintenance and repair			X	X	X				
Building – inv.: depreciation and interest	X		X	X	X				
- maintenance and repair	X		X	X	X				
Property/site/development – inv.	X		X	X	X				
Infrastructure – invest.: depreciation and interest		X	X	X	X	X	X		
- maintenance and repair		X	X	X	X	X	X	X	X



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## Classification and categorisation of cost items

- Classification due to:
  - **internal**      Vs.      **External**
  - **fixed**         Vs.         **Variable**
  
- All cost items should be presented in **EURO/LU**  
 => a conversion of cost items is needed

Cost items	Measurement unit	Fixed costs	Variable costs	Conversion
<i>Fixed assets</i>				
Means of transport – depreciation, interests	EURO/year	Internal		$\frac{\text{EURO}}{\text{year}} / \frac{\text{LU}}{\text{year}} = \frac{\text{EURO}}{\text{LU}}$
<i>Energy, other consumption material</i>				
Fuel, diesel	EURO/vkm		internal	$\frac{\text{EURO}}{\text{vkm}} / \frac{\text{LU}}{\text{MoT}} \times \text{km} = \frac{\text{EURO}}{\text{LU}}$



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## Time costs for intermodal transport

- Internal Vs. External time costs
- Time dependent costs Vs. Time costs

### Components of time costs (for different kind of goods)

<i>Time Costs (in Euro)</i>	Non perishable goods		Perishable goods	
	Scheduled Travel Time	Delay	Scheduled Travel Time	Delay
IC = Inventory costs	✓	✓	✓	✓
LC = Loss of value to the user	–	✓	–	✓
SC = Spoilage costs	–	–	–	✓



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### Internal quality aspects

- **Reliability** => two approaches to estimate reliability:
  - a) calculating the lack of reliability (damage of the good)
  - b) calculating the insurance costs for the good => used in RECORDIT
  
- **Flexibility**  
depends on a variety of organisational constraints, mainly referring to time (access, disposition, etc.) and loading unit  
=> in an ideal world flexibility does not need to be accounted separately (it is included in the real costs)
  
- **Security**



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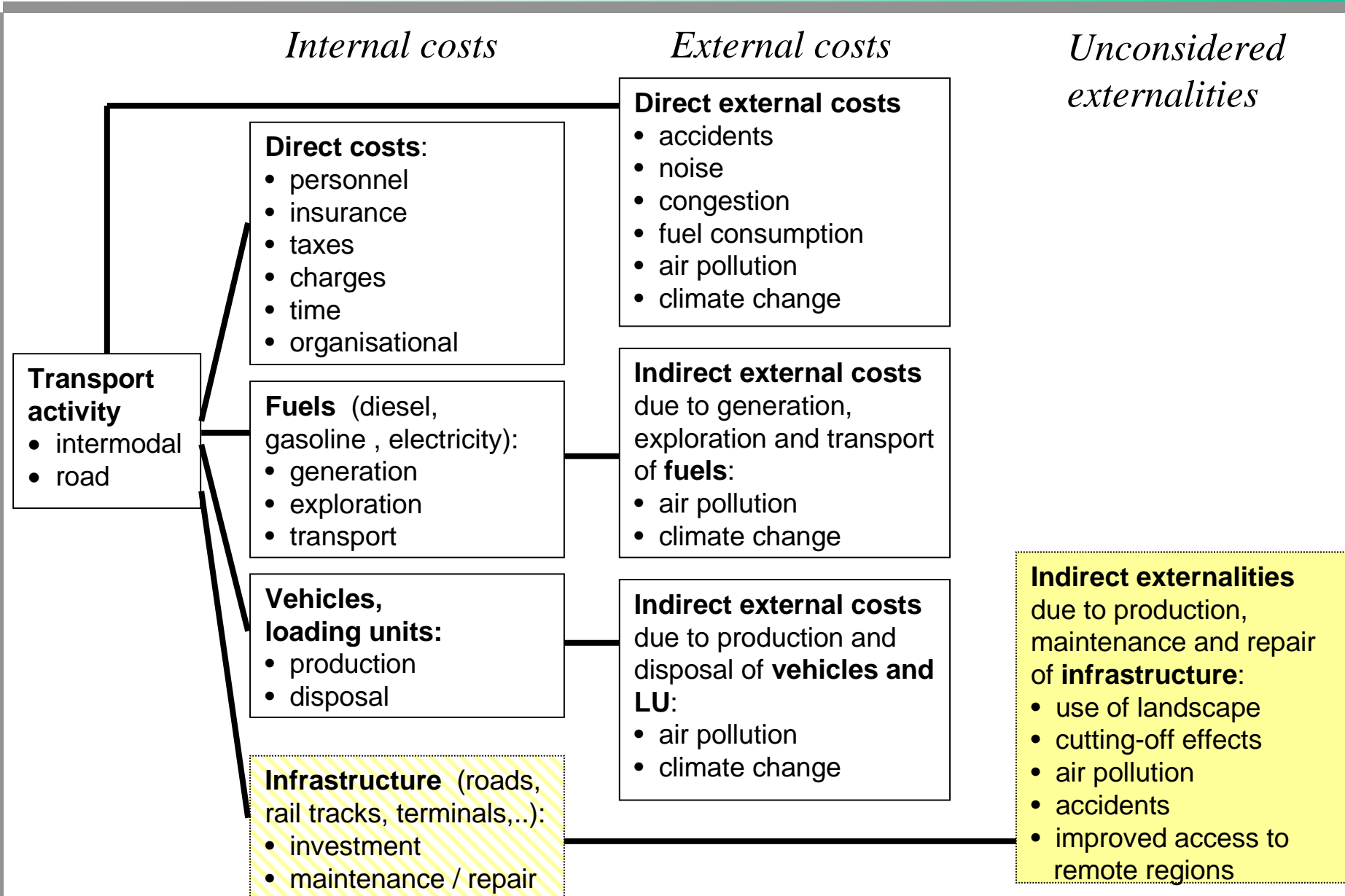
### Definition and classification of transport externalities

- **Externalities** are changes of welfare which are caused by activities without being reflected in market prices
- Externalities can be positive (external benefits)  
Externalities can be negative (**external costs**)
- Pricing rule: price = **social marginal costs** (SMC)  
with:  $SMC = \text{internal marginal costs} + \text{external marginal costs}$
- In RECORDIT:
  - External benefits are negligible
  - Only external costs due to the **use of infrastructure** are included in the study



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## Up- and Downstream Process





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## Impact pathway approach

### Impact assessment

Activity

Emissions



Transport and chemical  
conversion

Concentration / Deposition



Response of receptors  
(humans, flora, material)

Physical impact

### Valuation

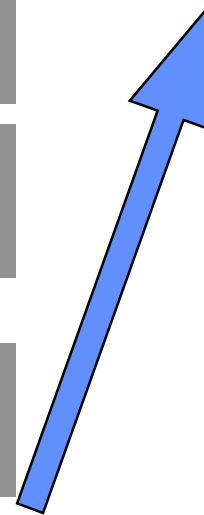
Change in utility

Welfare loss



Monetarization

Costs





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### Monetary values for mortality and morbidity

<b>Impact</b>	<b>Monetary value</b>
- Value of statistical life (acute mortality)	3.360.000 Euro <sub>2000</sub>
- Life lost due to lung cancer	2.159.380 Euro <sub>2000</sub>
- Year of life lost (acute mortality) $r = 3\%$	165.700 Euro <sub>2000</sub>
- Cerebrovascular hospital admission	16.730 Euro <sub>2000</sub>
- Asthma attack	75 Euro <sub>2000</sub>
- Cough	45 Euro <sub>2000</sub>
- Crops	
Wheat – yield loss in 0,1 tonnes	9,6 Euro <sub>1991</sub>
- Materials – maintenance costs per m <sup>2</sup>	
Sandstone	245 Euro <sub>1991</sub>



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## Noise

- **Unwanted sound** that causes negative effects
- Different sound sources have different effects
  - a) **road**: sound is mainly made by propulsion system and sound off rolling
  - b) rail: sound is mainly produced by rolling steel wheel on steel track
- Most important **effects of noise** are:
  - a) interference with speech communication
  - b) sleep disturbance
  - c) ischaemic heart disease and annoyance
- Level of sound is a **logarithmic function** of traffic volume
- Cost function could be a **exponential function** exceeding a threshold
- Most popular valuation method: **hedonic pricing**



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### Accident

- **Marginal external accident costs** are the incremental costs of an accident born by society, including victims, family and friends, imposed by those who causes the accident.
- The life of a person involved in an accident is not valued but the **changes in accident risk**
- **2 valuation approaches:**
  - a) output-based approach
  - b) social welfare approach
- **Cost items** of an accident:
  - a) cold-blooded material costs
  - b) warm-blooded material costs
  - c) net production loss
- Accident costs of the **MoT driver** are internalised in the **gross wage**



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## Congestion

- Congestion arises when traffic is delayed because of the **presence of other vehicles**
- The clearest manifestation is the **traffic jam**
- **Marginal congestion costs** are equal to the extra money plus time costs to all other vehicles imposed by one additional user
- Method to estimate the short run marginal external congestion costs: **“speed-flow function”**
- Internal time costs and congestion time costs should be calculated with the same **value of time**
- **Scarcity** and **slot allocation** are the synonyms for congestion on **rail**



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## Sustainable transport system

### - **Weak sustainability:**

- a) external costs have to be internalised (polluter pays principle)
- b) compensation of critical elements of natural capital by artificial capital is allowed

### - **Strong sustainability:**

- a) focus on the limitation of substitutability and restricted capability of the earth to absorb pollutions
- b) a typical example: CO<sub>2</sub> emissions

### **Modern Cost-Benefit Analysis**

Internal CBA

External CBA

### **Traditional Cost-Benefit Analysis**

Cost-Effectiveness Analysis

Multicriteria Analysis

**Sustainability criteria - e.g. Kyoto-Targets-CO<sub>2</sub>**



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## Climate change

- In RECORDIT the **damage costs approach** is not used due to
  - special theoretical valuation problems: **equity** (long term discounting), irreversibility and **uncertainty**
  - estimates vary by orders of magnitudes (0,05 - 200 EURO/t CO<sub>2</sub>)
- Alternative approach: **strong sustainability** criteria included in a modern concept of cost-benefit analysis
- Definition of a **reduction target**:
  - a) world-wide target
  - b) **EU-wide target** => applied in RECORDIT
  - c) national target
  - d) sector-specific target
- **Shadow values**: based on an avoidance cost approach  
=> 37 EURO/t CO<sub>2</sub> for 5,2% reduction of CO<sub>2</sub> (EU-target)
- **Sensitivity analysis**: up to 135 EURO/t CO<sub>2</sub> for 50%-target (IPCC)