



CASES Workshop

Social Costs of Electricity Generation

Rainer Friedrich

Institute of Energy Economics and Rational Use of Energy (IER),
Universität Stuttgart

Brussels, February 18th 2008

Social Costs

= total costs associated with an economic activity – in our case electricity generation
= sum of private and external costs

Objective:

Technology assessment, comparison of technologies and support of decision about energy and environmental policies (research needs, instruments to support, subsidize or penalize technologies)

Private Costs

- **private costs = all costs borne by the electricity producer**
- **-> average costs per kWh produced for plants built now,**
- **-> estimation/projection of costs 2020 and 2030**
- **includes investment, operation and maintenance, fuel, supplies and services, dismantling, waste disposal**
- **but: factor prices, i.e. without taxes like VAT;**
- **without subsidies**
- **back-up costs (provision of reserve capacity) included**

External Costs

Externalities arise, when the social or economic activities of a participant in the economy have negative or positive impacts on another participant and these impacts are not fully accounted for or compensated by the first participant.

External costs are externalities, that are transformed into monetary values to allow a comparison between externalities and with private costs.

Externalities of all stages of the production process have to be considered, including construction, dismantling, fuel cycle.

Which External Costs Are Included ?

Environmental externalities: the release of a substance or energy (noise, radiation) into environmental media (air, indoor air, soil, water) causes - after transport and transformation - considerable (not negligible) harm to ecosystems, humans, crops or materials.

Includes global warming impacts: damage costs and avoidance cost approach used.

Accidents: Public and partly occupational risks caused by accidents (use of expectation value).

Insecurity of energy supply: Unexpected changes in availability and prices of energy carriers may lead to a reduction in economic growth and other problems

Which Effects Are Not Included ?

- **Effects on Employment**
 - **Depletion of non-renewable resources (oil, gas, silicon, copper, ...)**
 - **Income distribution**
 - **Local ecosystem damage (however addressed and at least partly compensated within the Environmental Impact Assessment)**
-
- **Treatment of Damocles risks**
 - **Risk of terrorism and proliferation**
 - **Visual Intrusion**

Estimation of Environmental External Costs: The Impact Pathway Approach

Basic principles

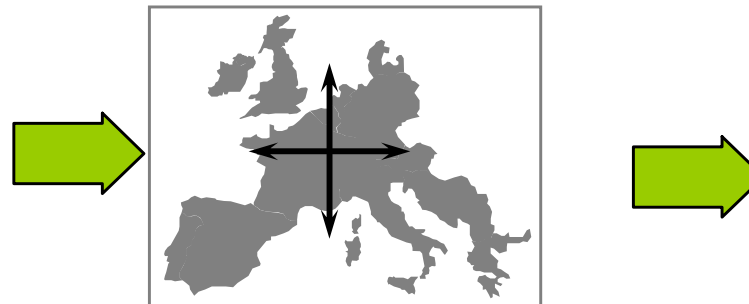
- 1) Pressures (e.g. emissions of substances to environmental media) have to be estimated, including LCI
- 2) Assessment of effects/damage (e.g. health risk), not of pressures (e.g. emissions of pollutants)
 - > relation between pressure and impact is in general non-linear and
 - > impacts depend on time and site of activity
 - > -> *Bottom-up approach needed for the complex pathways: the 'impact pathway approach'*

Impact Pathway Approach – Part 1

Pollutant/Noise Emission

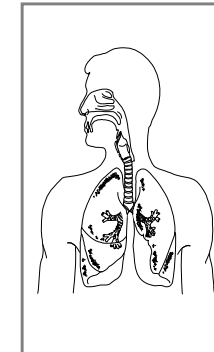


Transport and Chemical Transformation; Noise Propagation



Calculation is made twice: with and without project!

Differences of Physical Impacts





Impacts included (I)

Impact Cat.	Pollutant / Burden	Effects
Human Health mortality	PM₁₀	Reduction in life expectancy due to short and long time exposure
	SO₂, O₃	Reduction in life expectancy due to short time exposure
	Benzene, BaP, 1,3-butad., Diesel part., radioact.,HM	Reduction in life expectancy due to long time exposure
	Noise	Reduction in life expectancy due to long time exposure
	Accident risk	Fatality risk from traffic and workplace accidents
Human Health morbidity	PM₁₀, O₃, SO₂	Respiratory hospital admissions
	PM₁₀, O₃	Restricted activity days
	PM₁₀, CO	Congestive heart failure
	Benzene, BaP, 1,3-butad., Diesel part.,radioact.,HM	Cancer risk (non-fatal)
		Osteoporosis, ataxia, renal dysfunction
	PM₁₀	Cerebrovascular hospital admissions, cases of chronic bronchitis, cases of chronic cough in children, cough in asthmatics, lower respiratory symptoms
	O₃	Asthma attacks, symptom days
Noise	Myocardial infarction, angina pectoris, hypertension, sleep disturbance	
	Mercury	Loss of IQ of children

Impacts included (II)

Impact Category	Pollutant / Burden	Effects
Building Material	SO ₂ , Acid deposition	Ageing of galvanised steel, limestone, mortar, sandstone, 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 N, S	Increased need for liming Fertilising effects
Global Warming	CO ₂ , CH ₄ , N ₂ O	World-wide effects on mortality, morbidity, coastal impacts, agriculture, energy demand, and economic impacts due to temperature change and sea level rise
Amenity losses	Noise	Amenity losses due to noise exposure
Ecosystems	SO ₂ , NO _x , NH ₃	Eutrophication, Acidification
Land Use Change		'PDF' of species



Basic Approach of NEEDS/ExternE

Assessment of impacts is based on the (measured) preferences of the affected well-informed population

This implies:

- Available information should be explained before measuring preferences

Basic Approach

Preferences are expressed in (i. e. effects are transformed into) monetary units (e.g. €₂₀₀₅)

-> allows transfer of values (benefit transfer), units are conceivable, direct use of results in CBA and for internalising via taxes possible

-> however: 'utility points' would give the same results

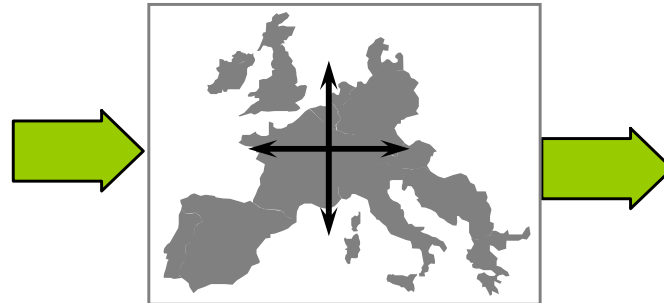
The Impact Pathway Approach

Differences of Physical

Pollutant/Noise Emission

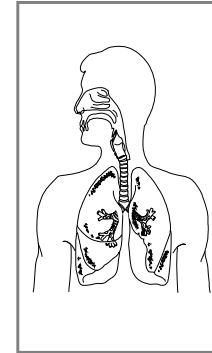


Transport and Chemical Transformation; Noise Propagation



Calculation is made twice: with and without project!

Impacts



Monetary Valuation



Valuation methods for non-market goods

Revealed Preference (RP)
behaviour (shown in the past)

Stated Preference (SP)
surveys (about future
behaviour)

Indirect valuation

assesses costs or efforts that
can be linked to the non-
market good

- Hedonic Price Method
- Averting Behavior Method
(including past decisions
about abatement policies)
- Travel Cost Method
- Contingent Behavior Method

Direct valuation

- Contingent Valuation
Method (CVM)
- Attribute Based Choice
Modeling (ABCM)
- Participatory approaches
- Surveys for preferences of
public decision makers

Discounting

- **Private costs: 5%/a; sensitivity 10%/a**
- **External costs: declining discount rate = social time preference rate (Weitzman discounting):**

1-25 years: 3 %

25-75 years: 2 %

75-200 years: 1 %

> 300 years: 0 %

Future Costs

- **Investment and LCI: estimation taking into account technological change, economies of scale, learning curves; (future LCI for wind, PV and nuclear still under revision)**
- **Fuel: projection from EUSUSTEL project**
- **Monetary values of risks and damage to human health and ecosystems: increase with anticipated economic growth rate (1,5%/a)**
- **Marginal avoidance costs for GHGs: increasing according to increasing reduction aim**