Impact Assessment 2

What is Impact Assessment?

What is Impact Assessment?

- **Attempt to describe the *environmental consequence* of the activity being studied**
  - **Accomplished by translating inventory into consequence (impact)**

Why Impact Assessment?

Why Impact Assessment?

- **Reduces number of data points against which to make a decision**
  - **If taken to single score, then complementary with decision theory**
  - **Monetized methods may be comparable with other metrics**
- **Adds information**
  - **Provides input from a range of sciences and other stakeholders**

What is Impact Assessment?
ISO Definition

- **Impact Category Definition**
  - **Identify what impacts are of concern and which models will be used to translate inventory to impact**
- **Classification:**
  - **Environmental stressors are correlated with specific impact categories**
- **Characterization**
  - **Quantify amount of impact**
  - **Damage assessment**
    - Aggregate similar impacts
- **Normalization**
- **Valuation**
  - **Possibly weighting impacts to rank or aggregate**

Your thoughts:

What do you see as the key issues?

What is most challenging step?

Issue 1: Relevance

- **Translating from inventory to impact is**
  - **Introduces numerous assumptions**
    - What are examples of assumptions?
  - **Controversial**
  - **Necessity depends on context**
    - Expertise / influence of decision-makers may influence the extent of aggregation required
    - ISO excludes weighting / valuation from comparisons for external distribution

Issue 2: Translating Environmental Impact

- **The impact of pollution is rarely a simple one**
  - **C02 → Increases thermal absorption → Raises Temperature**
    - So what?
  - **Increased temperature →**
    - Ice melting
    - Desertification
    - …
- **Assessment method, must take into account causal chain**

Which Environmental Impacts should we care about?

Issue 3: What Effects to Track?

- **ISO establishes three broad categories of concern**
  - **Resource use**
  - **Human health**
  - **Ecological consequence**
  - **There is debate over whether to include damage to the man-made environment (e.g., acid rain damage to ancient structures)**
    - What about aesthetics? Comfort?
- **Key issue: Double counting**
  - **Boundary between categories is fuzzy**
    - Oil depletion vs. Emissions from oil use

Impact Categories: Many differing approaches

- **Nordic Guidelines**
  - **Resource depletion**
    - Energy & material
    - Water
    - Land use
  - **Human health**
    - Toxicological
    - Non-toxicological
    - Work/living environment
  - **Ecological**
    - Global warming
    - Photochemical oxidation
    - Acidification
    - Ozone depletion
    - Eutrophication
    - Ecotoxicological
    - Bio-diversity
- **Environmental priorities system**
  - **Human health**
  - **Biological diversity**
  - **Ecosystem production capacity (crops…)**
  - **Abiotic resources (metals…)**
  - **Cultural & recreational value (e.g., aesthetics…)**

Example Method 2: Eco-Indicator

- **Commissioned by Dutch Ministry of Housing, Spatial Planning, and the Environment to support goals of Integrated Product Policy**
- **Aimed particularly at influencing design practice**
  - **Extensive documentation for product designers**
- **Fundamental basis / Weighting factor:**
  - **Original (95):**
    - Impact oriented
    - Based on distance to target
  - **Current (99)**
    - Damage oriented
    - Expert panel / differing perspectives
- **Generally represents impacts based on average conditions in Europe**

Characterization

- **Expresses relative contribution of specific impact to the category of impact**
  - **E.g., Impact of CO2 release = 1**
    Impact of methane release = 21
- **Mid point vs end-point**
  - **Increase in acidification vs. Increase in species depletion**
  - **Impact indicator vs. damage indicator**
  - **Less uncertainty vs. easier to value**
  - **Eco-indicator 99 is an endpoint / damage-based method**
  - **Eco-indicator 95 was a midpoint based method**

Characterization: Eco-Indicator Damage Model

- **Fate**
  - **Where does the emission end up**
    - Water soluble → likely in water supply
    - Insoluble → soil
  - **How durable is the emission**
    - Some substances degrade quickly, reducing the opportunity for impact.
- **Exposure**
  - **How many / much are effected?**
    - How much of a specific emission is taken in by persons/ecosystem?
- **Effects analysis**
  - **What does the emission change?**
    - Types and frequencies of certain diseases
    - How many years of disability or years of life lost

- **Damage analysis**
  - **Effects are aggregated and weighted based on system developed by WHO**

Characterization: Specific Emphasis

- **Emissions**
  - **Carcinogens**
  - **Respiratory agents**
  - **Respiratory inorganics**
  - **Climate change**
  - **Radiation**
  - **Ozone layer**
  - **Eco-toxicity**
  - **Acidification / eutrophication**
- **Land use**
  - **Species diversity per unit of typical land (Based on field research)**
  - **Damage occurs due to land use or land occupation**
  - **Potentially disappeared fraction**
- **Resource depletion**
  - **Surplus energy**

Eco-Indicator 95 Weighting factors

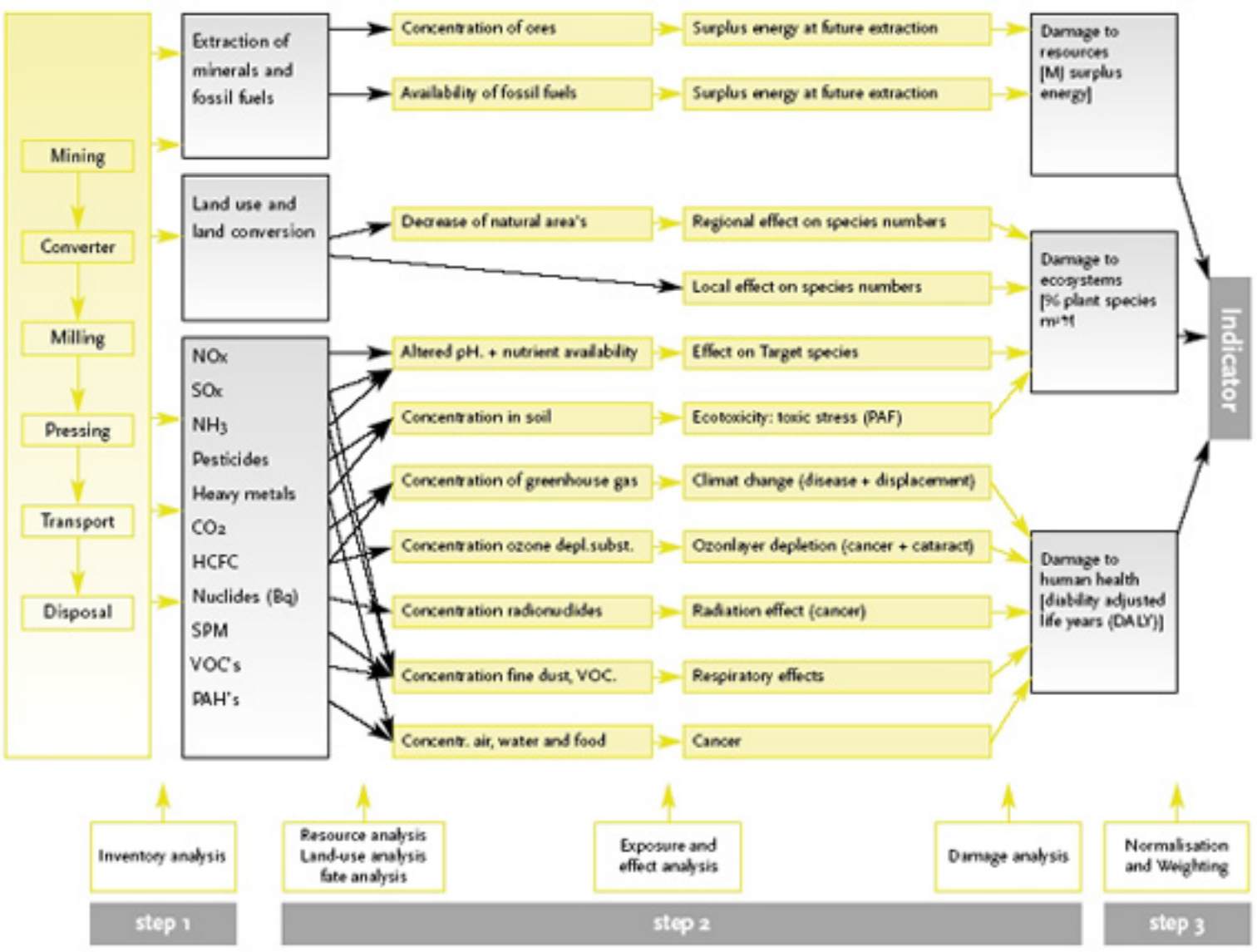
- **Distance to target**
  - **The further away current conditions are to an established target the more serious it is to worsen those conditions**
    - Current CO2 per year vs. Desired CO2 per year: 2.5X
      - Actually for GWP
    - Current Ozone Depletion Potential vs. desired : 100x
  - **The targets are set according to**
    - At target level the effect will cause 1 excess death per million per year
    - At target level the effect will disrupt fewer than 5% of the ecosystems in Europe
    - At target level the occurrence of smog periods is extremely unlikely

Eco-Indicator 95 Weighting factors

	Reduction factor	Criterion
Greenhouse	2.5	0.1° per decade, 95th percentile?
Ozone layer	100	Prob of 1 death per year per million
Acidification	10	95th percentile ecosystems
Eutrophication	5	95th percentile ecosystems
Summer smog	2.5	Prevent smog periods, health complaints
Winter smog	5	Prevent smog periods
Pesticide	25	95th percentile ecosystems
Heavy metals in Air	5	Lead content in blood of children
Heavy metals in H_2O	5	Cadmium content in rivers
Carcinogenic Subst	10	Prob of 1 death per year per million

Eco-Indicator 99

- **Extension of Eco-Indicator 95**
- **Focus is on weighting method**
  - **Don't weigh impact categories**
  - **Weigh only different types of damage**
- **Limits type of damage categories to 3**
  - **Damage to human health**
    - Expressed as number of years of life lost and number of years of life lived disabled
  - **Ecosystem quality**
    - Expressed as species lost over a certain area for a period of time
  - **Damage to resources**
    - Surplus energy needed for future extraction of minerals
- **Specific weighting determined by panel evaluation**



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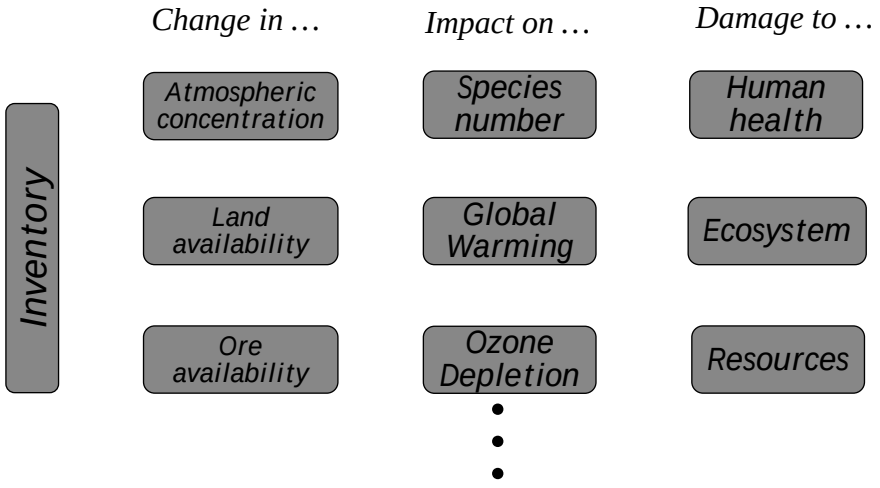
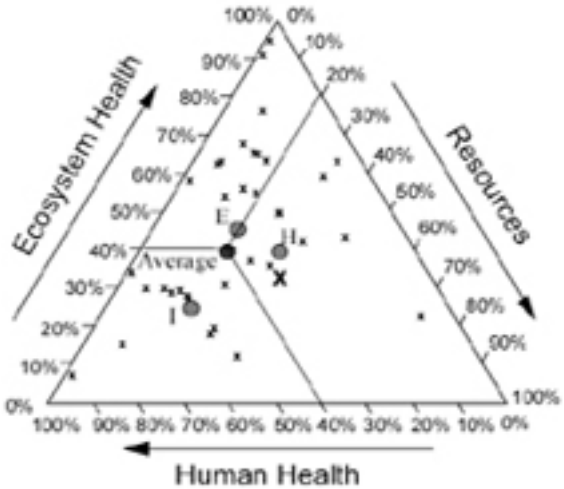
Source: *Eco-indicator 99: Manual for Designers*

Comparing Impact Assessment



Weighting via Panel

- **Surveyed 365 persons**
- **Reviewed Eco99**
- **Rank categories**
- **Provide relative importance of categories**
- **Limited statistical significance**



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Weighting via Panel

	Hierarchist	Egalitarian	Individualist
Human Health	40%	30%	55%
Ecosystem	40%	50%	25%
Resources	20%	20%	20%

Valuation Perspective: Hierarchist

- Long time perspective
- Substances included if there is consensus
  - Class 1 and 2 carcinogens are included
  - Class 3 are excluded
- Damages are excluded if good management could avoid
  - Life lost due to flood
- Fossil fuel substitution is difficult
- No age weighting of DALYs

Valuation Perspective: Egalitarian

- Time perspective: Extremely long term
- Substances are included if there is an indication of impact
  - Classes 1 -3 carcinogens are included to the extent that information is available
- Damages are included if possible
- Fossil fuel cannot be subsituted
  - Cost of replacement is high
- DALYs are not age weighted

Valuation Perspective: Individualist

- Time perspective is 100 years
- Impact from substances is included only when complete proof exists
  - Only Class 1 carcinogens are included
- Damages are assumed to be recoverable
- Fossil fuels cannot be depleted
  - Ignored
- DALYs are age weighted

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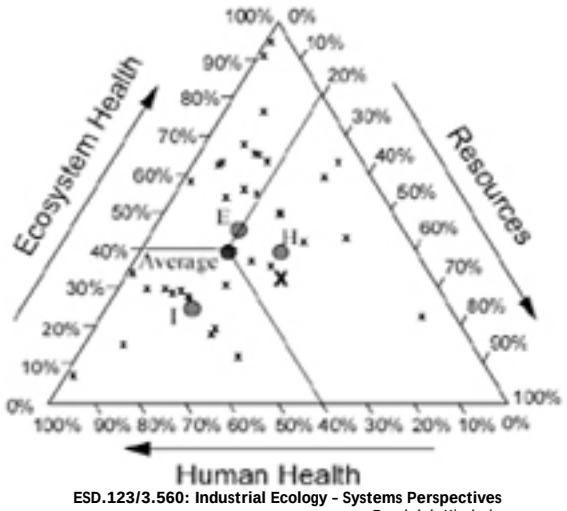

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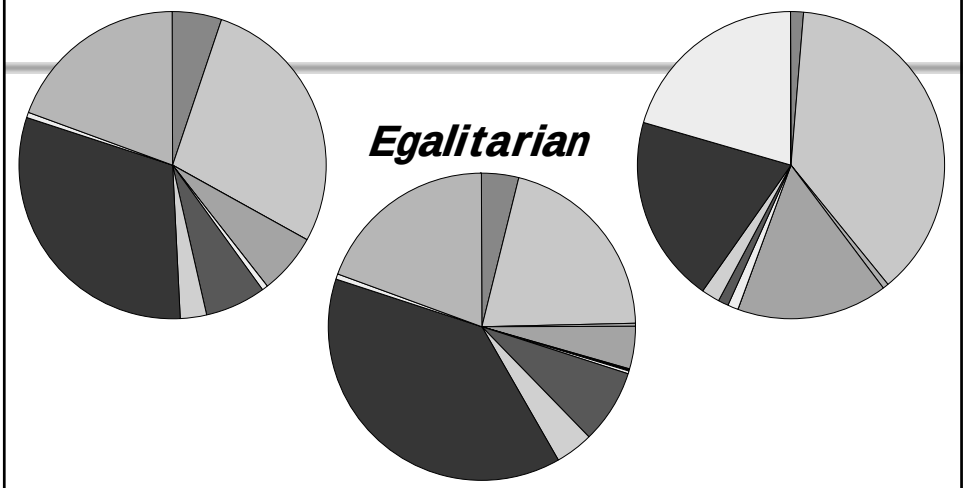
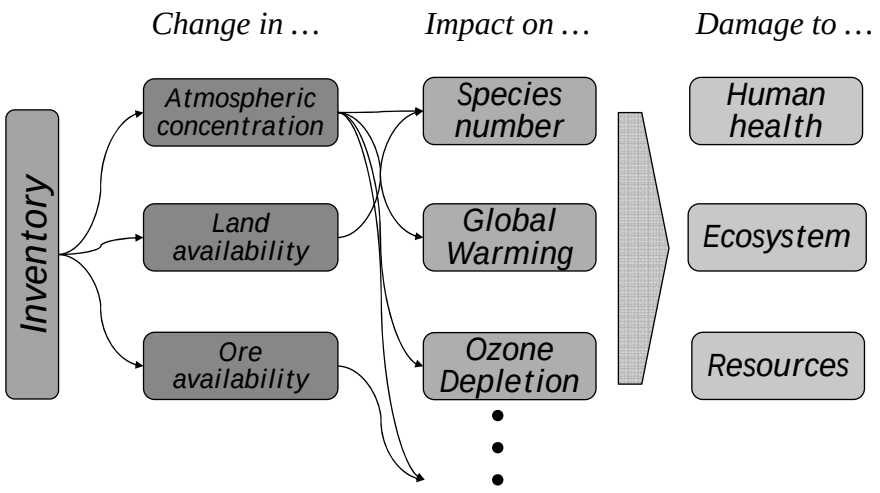


LCA: Slide 117

Issues with Eco-Indicator

- **Weaknesses**
  - **Limited to three impacts**
    - Human health
    - Biodiversity
    - Resource depletion
  - **Highly European focused**
  - **Controversial panel weighting**
  - **Still many inventory items to model**
- **Strengths**
  - **Comparatively comprehensive**
  - **Provides consistent mechanism for weighting**
  - **Well documented**

Comparing Impact Assessment



LCA: Methodology

- **Goal & Scope Definition**
  - **What is the unit of analysis?**
  - **What materials, processes, or products are to be considered?**
- **Inventory Analysis**
  - **Identify & quantify**
    - Energy inflows
    - Material inflows
    - Releases
- **Impact Analysis**
  - **Relating inventory to impact on world**