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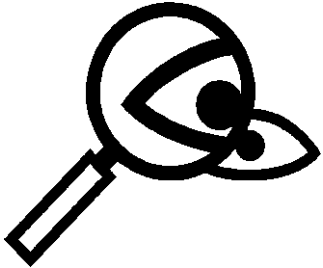
vision on technology

**Accounting the environmental burden of
Europe with a worldwide trans-boundary
perspective
*Life Cycle Assessment***

IMEA workshop – March 20th 2009

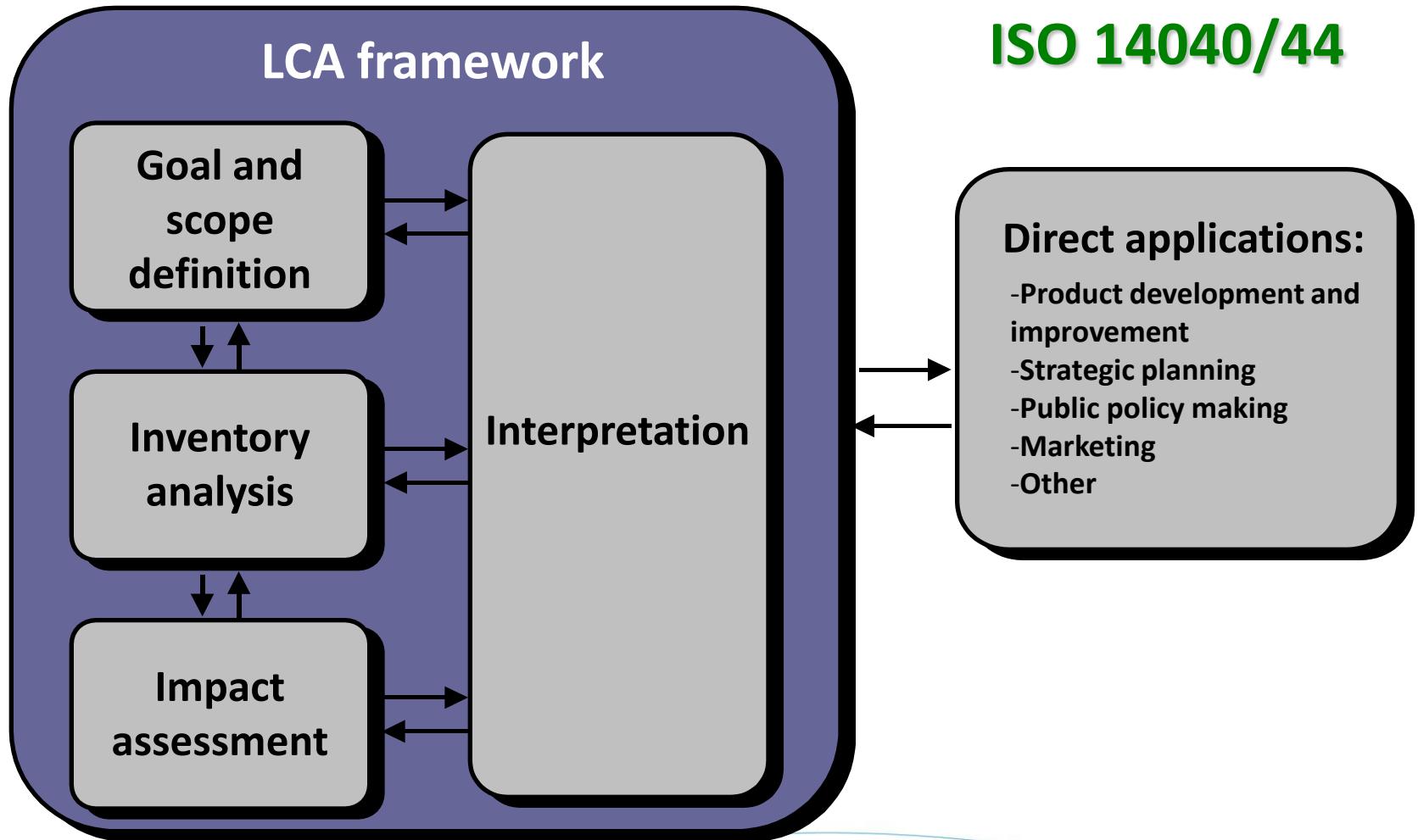
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Outline



- » LCA-methodology – summarized
- » LCA and location-specific issues
 - » Systems - *system boundaries*
 - » Data – *data availability (LCI)*
 - » Computation - *Life Cycle Impact Assessment (LCIA)*
 - » Indicator - *Environmental indicators*
 - » Conclusions
- » Strengths and weaknesses

The LCA-methodology - summarized



The LCA-methodology - summarized

- » LCA considers input-output flows of system, over its entire life cycle

LCI

- » **Input flows:**

- » materials, energy
- » expressed as mass, volume, tkm, ...

- » **Output flows:**

- » Emissions
- » expressed as kg

LCIA

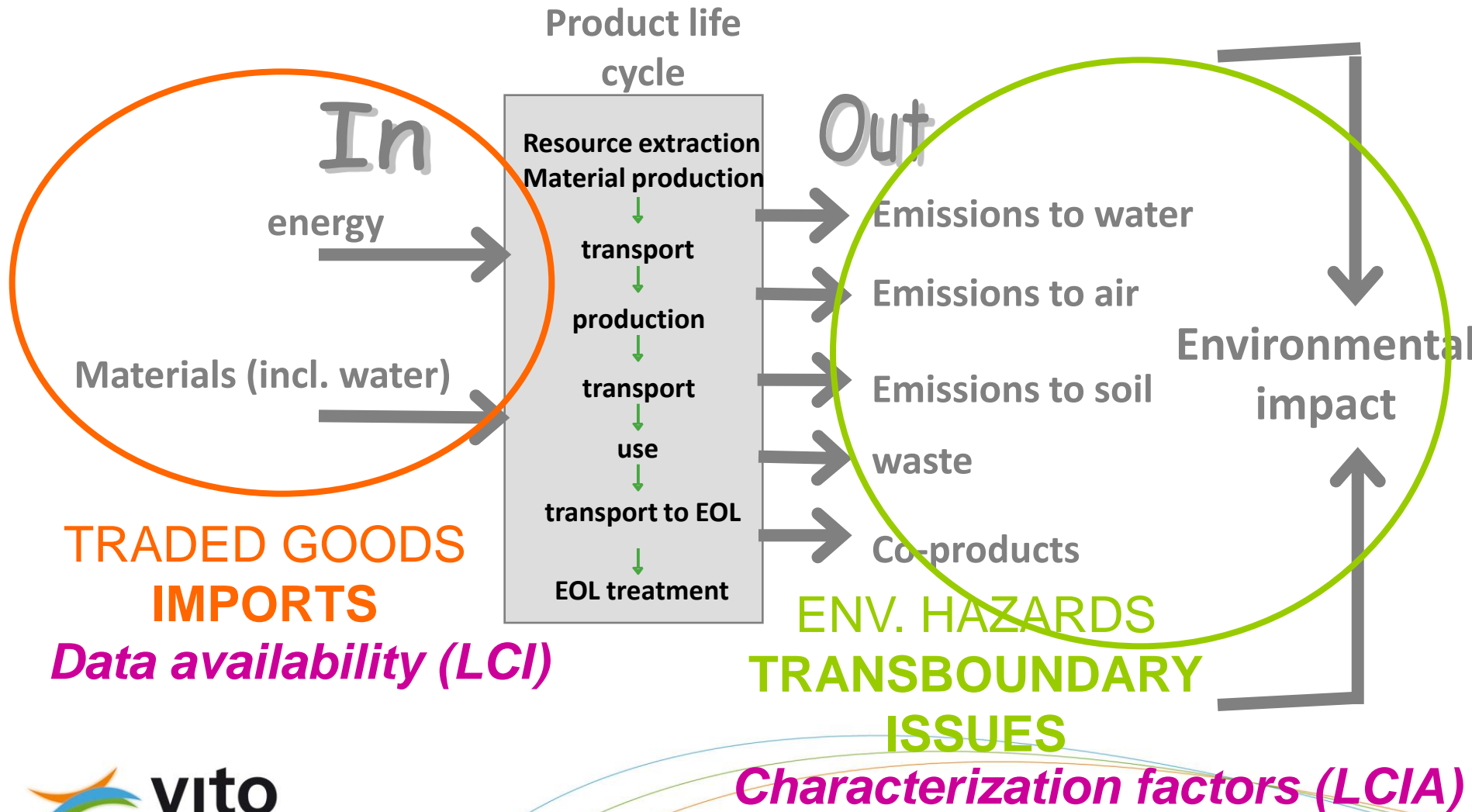
- » **Characterization factors (CF):**

- » to translate inventory data into environmental impact categories
- » depending on environmental impact category and methodology

- » **Objective of LCA:**

- » Assess significance of **potential** environmental impacts of elementary flows of the LCI for each relevant impact category
- » Environmental profile with number of indicators

The LCA-methodology - summarized



Location-specific issues of LCA

- » LCA – in general
 - » provides information on **global** impacts
 - » does not focus on spatial attributes
 - » global tool – **low spatial resolution**
- » Methodological **research** on spatial differentiation
 - » for local impacts e.g. acidification
 - » increased data needs
- » 4 '**dimensions**':
 - » Systems - *System boundaries*
 - » Data - *Data availability (Life Cycle Inventory LCI)*
 - » Computation - *Life Cycle Impact Assessment (LCIA)*
 - » Indicators - *Environmental indicators*

Location-specific issues – System boundaries

- » **Theoretically:**

- » LCA can account for complex/ international life cycle chains
 - » E.g. EOL – waste flows

- » **In practice:**

- » Limited application due to data availability
- » An LCA for each specific traded product/system requires large amount of data

Location-specific issues – Data availability (LCI) ⁽¹⁾

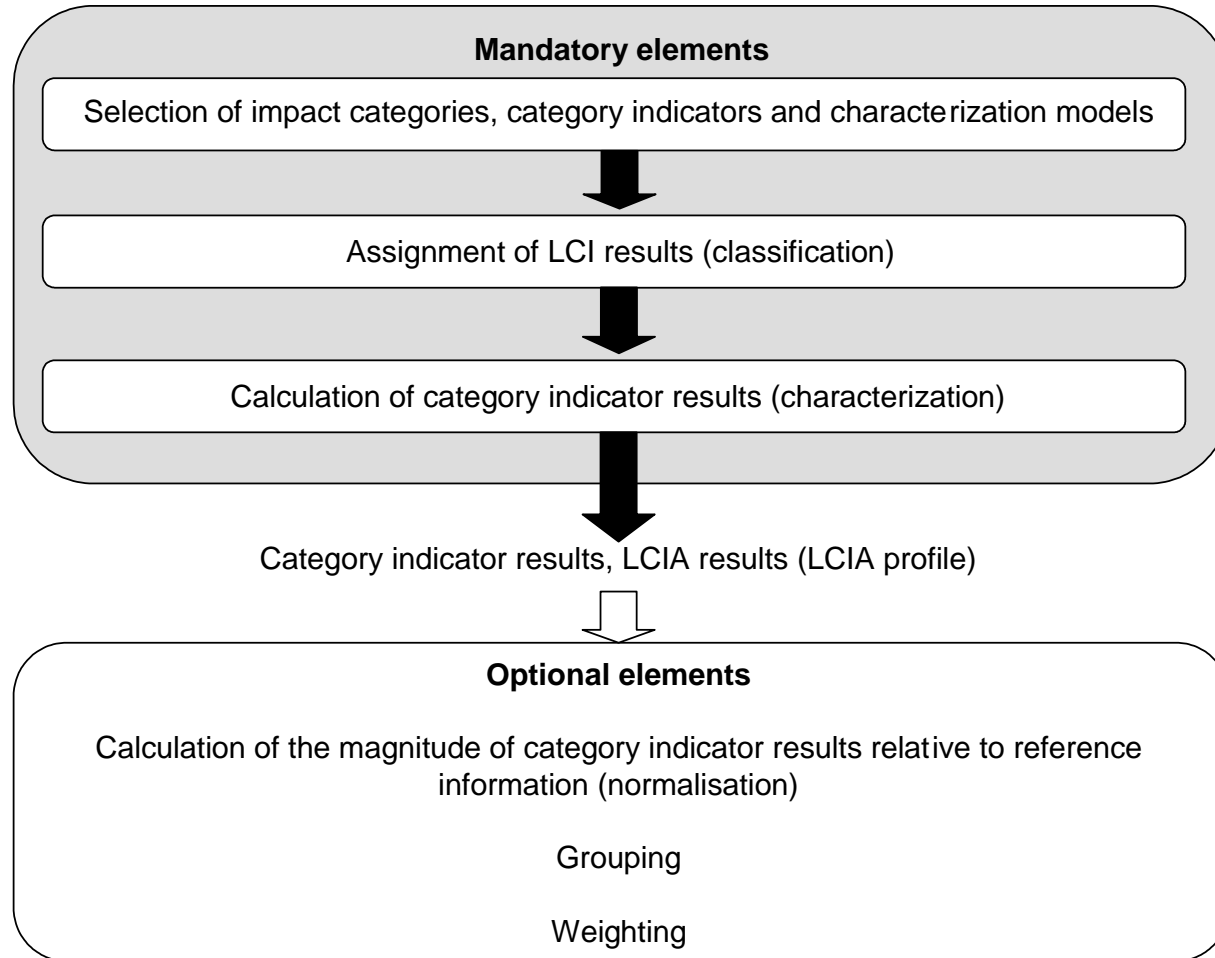
- » **Regional differentiation** partly included in LCI modelling
 - » INPUT flows: partly included
 - » country-specific power grid mixes
 - » resource extraction
 - » transportation
 - » OUTPUT flows: not included
 - » Usually no information on where elementary flows are emitted

- » Data availability:
 - » **average** data versus **regionalized** data -> heterogeneity
 - » **industrialized** countries versus **developing** countries

Location-specific issues – Data availability (LCI) (2)

- » Several **initiatives** to overcome data availability problem:
 - » UNEP-Life Cycle Initiative
 - » Life Cycle Inventory Program
 - » Increasing access to and quality of LCI databases
 - » Global data
 - » European Platform on LCA (JRC)
 - » International Reference Life Cycle Data System (ILCD)
 - » Focus on European data

Location-specific issues – LCIA (1)



Location-specific issues – LCIA (2)

- » ≠ LCIA **methodologies**
 - » Focused on specific regions e.g.
 - » Europe: CML 2001, IMPACT 2002+, EI-99, ReCiPe, ...
 - » US: TRACI
 - » Canada: LUCAS
 - » Japan: LIME
 - » Lack of models for **developing** countries
- » **Characterization factors (CF)**
 - » Generic CF – global impacts
 - » Related to function of product/system, not to where impacts occur (global nature of LCA)
- » Transboundary issues -> Few or no scientifically grounded **normalization** and **conversion factors** are available and embedded in LCA methodology

Location-specific issues – Environmental indicators

- » Resource consumption (minerals and fossil fuels)
- » Land use
- » Climate change
- » Stratospheric ozone layer depletion
- » Human toxicity
- » Aquatic ecotoxicity
- » Terrestrial ecotoxicity
- » Photo-oxidant formation
- » Acidification
- » Eutrophication
- » Ionizing radiation
- » Impacts on ecosystems and biodiversity
- » Respiratory effects caused by inorganics
- » Non-renewable energy
- » Mineral extraction
- » Water use

~~Accidents
Noise
Indoor air quality~~

Location-specific issues – Conclusions (1)

- » Analytical scale of LCA:
 - » **Micro/meso**
 - » Combination of bottom-up LCA-studies can help answering questions raised in studies on macro-scale (e.g. EIPRO)
- » **Lack of spatial and temporal dimensions in LCI**
 - » Loss of detail and uncertainty in LCIA-results
 - » when accounting environmental burden of Europe with transboundary perspective
 - » depending on impact category
 - » No spatial aspects in CF for non-global impacts

Location-specific issues – Conclusions (2)

- » **Hybrid analysis:**
 - » Combination of process-based **LCA and EE-IO**
 - » IO to fill datagaps in LCA
 - » LCA to further disaggregate sectors in IO tables
 - » Combination of both detail and completeness

- » **Tiered hybrid analysis**
 - » Process-based analysis as starting point
 - » IO-data added by linking input to process-based system with corresponding final use group or industry output (IO)
 - » IO-data used to complete upstream/downstream phases not covered by specific process data

Location-specific issues – Conclusions (3)

- » **Embedded or integrated** hybrid analysis:
 - » More advanced hybrid approach
 - » Embedding process-based data in IO-matrix for subdividing industries in IO-matrix
 - » Monetary IO-table fully interconnected with physical product system
 - » At upstream and downstream cut-off points where process data are not available

Location-specific issues – Conclusions (4)

- » LC of goods and services -> **global** in nature
 - » LCA focusses on global issues
- » **Spatial differentiation** can have **added value IF**
 - » LCI data are available
 - » Additional efforts reduce uncertainty of the study
- » Spatial differentiation is not always needed in the same **level of detail**
 - » Continent, country, region-specific
 - » Depending on goal and scope & system boundaries

Location-specific issues – Conclusions (5)

- » Efforts related to regionalization should **focus** on
 1. Identifying what level of regionalization is needed
 2. Developing **guidelines** and solutions for **data** gathering (LCI) and development of situation dependent and geographically differentiated **CF** (LCIA)
 3. On **developing countries**

Strengths & weaknesses (1)

OBJECTIVES	THEMES	DIMENSIONS	STRENGTHS	WEAKNESSES
Environmental Accounting	Relevance	Reporting/ Key issues (RE)	<ul style="list-style-type: none"> -Large coverage of env . issues -Geo-localised reporting is partially possible (transport and energy mix) but need to be implemented with specific procedure -Life cycle perspective 	- Standard LCA is not designed for macro level and consolidation of LCAs at macro level is inducing additivity issue.
	Maturity & Auditability	Coverage (CO)		<ul style="list-style-type: none"> -Databases focused on industrial countries -Data and studies limited to a fraction of products and sectors
		Quality & Reliability (QR)	-ISO Standard: for methodology (procedure), not for databases	<ul style="list-style-type: none"> -Subjective assumptions lead to different outcomes of similar LCAs -Update frequency: typical 1-5 years for technological data in DB
		Quality & Reliability: Transboundary (TT)		- No current specific development

Strengths & weaknesses (2)

OBJECTIVES	THEMES	DIMENSIONS	STRENGTHS	WEAKNESSES
Decision-making ability	Integration potential	Compatibility (CP)	- Fully related to a functional analysis in a life cycle perspective	- No compatibility with NA, no coupling with import/export statistics
		Extensibility (EX)	- Opportunities in using hybrid approach (IO-LCA)	- Requires extensive data collection, GIS integration and specific regional CFs for some env. issues.
	Accessibility	Usability	-Excellent but limited to micro-level (and meso-level) -Wide use of LCA across the world, also in EU environmental policy	
		Analysis	- Systemic analysis enabling identification of trade-offs between scenarios- Through an LCI all Pressures are inventoried. In the impact assessment step LCIA continues the DPSIR Framework, but directly jumping to the Impacts from DPSIR. The State (Physical, chemical, biological) of for instance the different compartments (Water, air, land) are typically not described by LCA indicators.	- Consolidation of LCAs at macro level is inducing an additivity issue.

QUESTIONS???

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