ECOINVENT 2000 Centre for Life Cycle Inventories in the ETH-Domain

Life cycle inventory modelling in the Swiss national database ECOINVENT 2000

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Environmental Informatics 2001

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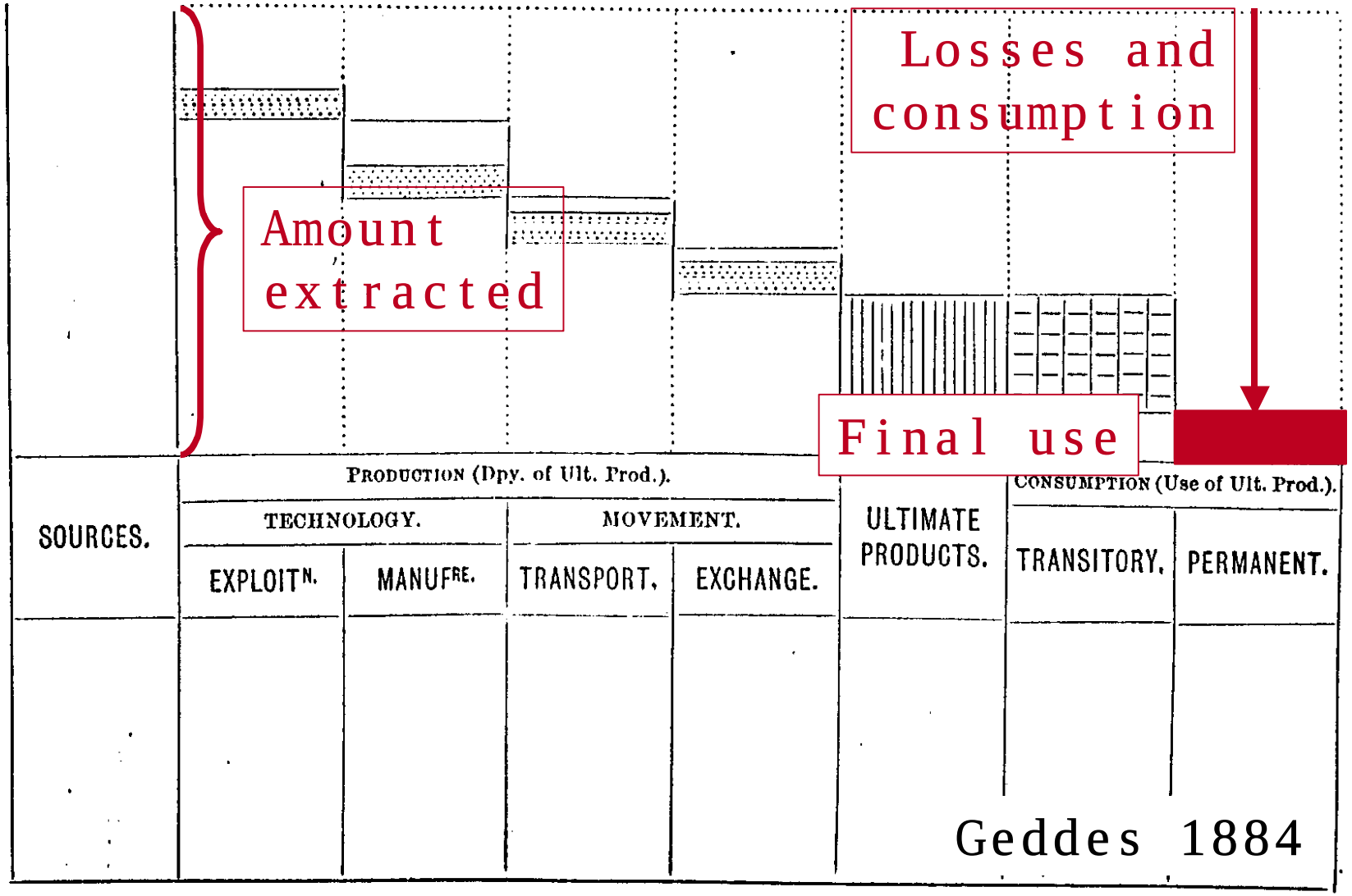
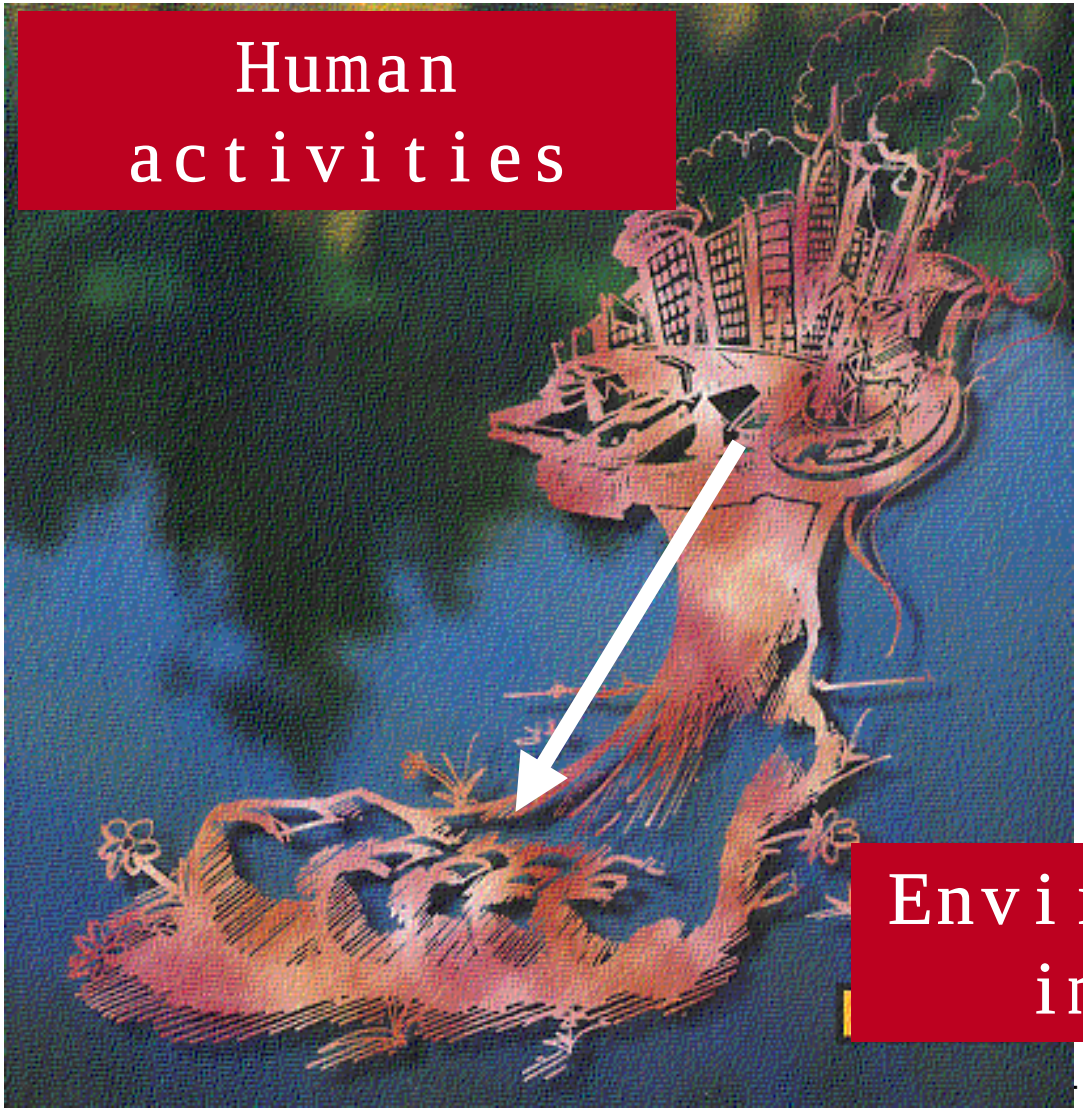
Life Cycle Assessment

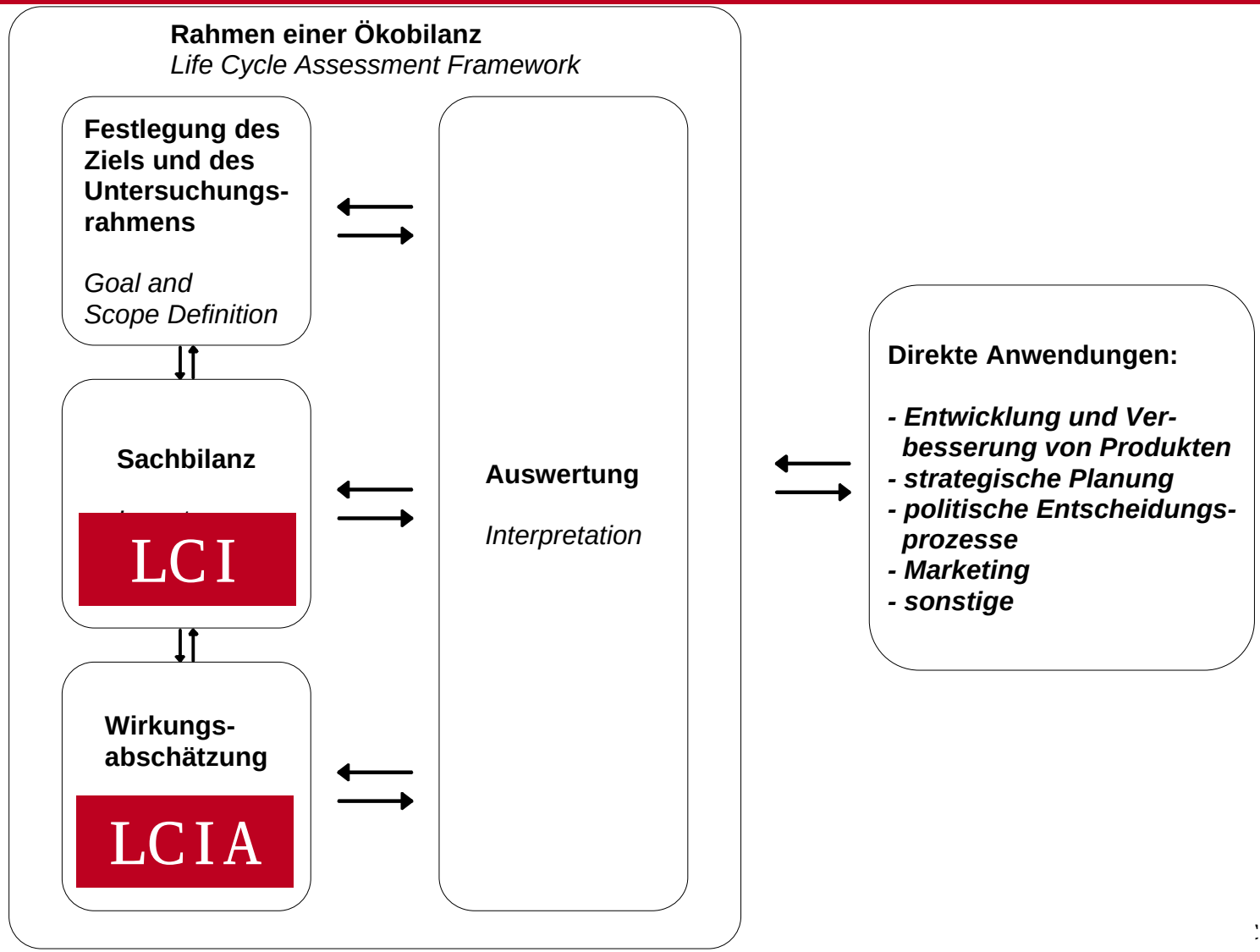


Life Cycle Assessment



Wackernagel & Rees 1997

Life Cycle Assessment



Problem Setting

- Various LCI databases in Switzerland
- Diversity in approaches
- Database maintenance beyond expertise
- Incompatibility between LCI data
- No linkage between LCI data, e.g. energy <-> agriculture

Aims of ECOINVENT 2000

- Centralised, web-based LCI database
- Up-to-date harmonised LCI and LCIA data for Swiss / European LCA applications

Database content

- Energy supply
- Building materials and -processes
- Basic chemicals and plastics
- Transport services
- Waste treatment services
- Graphical Papers
- Detergents
- Agricultural Processes & products

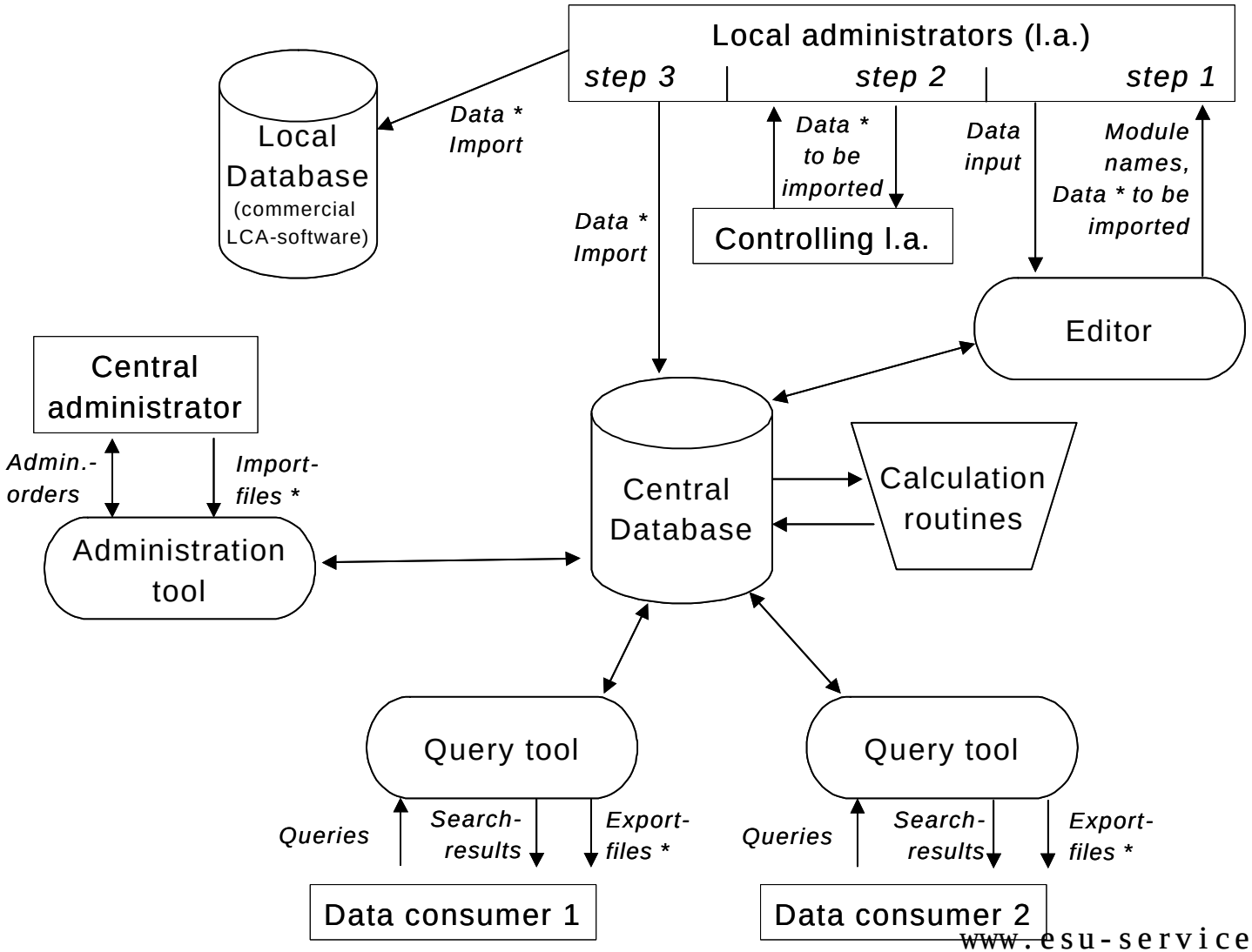
Application of ECOINVENT 2000 data

- Environmental Management Systems
- Integrated Product Policy (IPP)
- Environmental Product Declaration (EDP)
- Design for Environment
- Swiss LCAs on products and services

Project Partners

- ETH-domain:
  EAWAG, EMPA Dü, EMPA SG (chair), EPFL, ETHZ, PSI
- FAL (agriculture)
- Federal Authorities:
  BUWAL, BFE, BLW, BBL, ASTRA
- ESU-services:
  Project lead
- ifu Hamburg:
  Database programming, server hosting

Overview ECOINVENT 2000



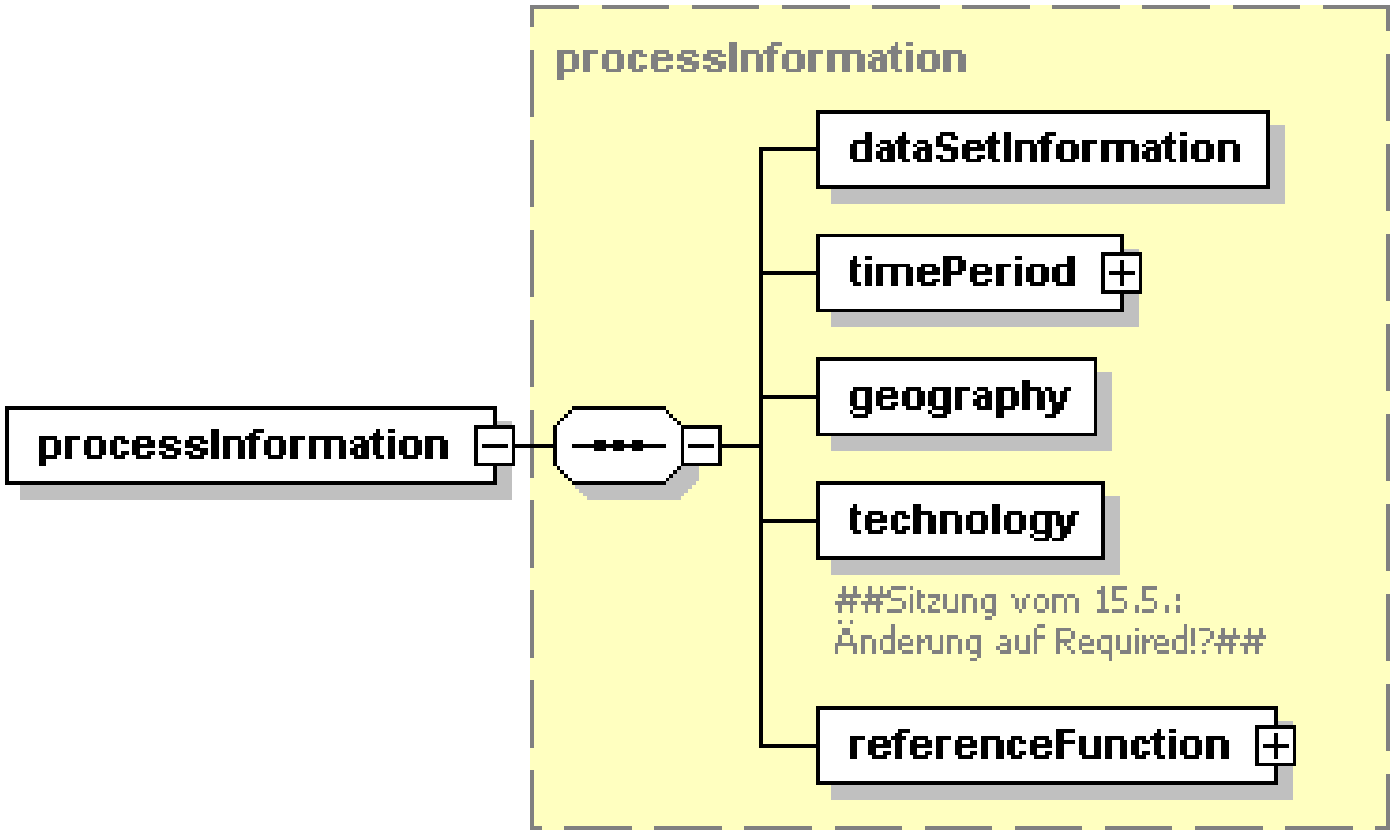
Data (exchange) format: XML-Technology

- XML (Extended Markup Language)
  - adjustable to different requirements
  - downward compatibility
  - using XML schemes instead of Document Type Definitions (DTD)

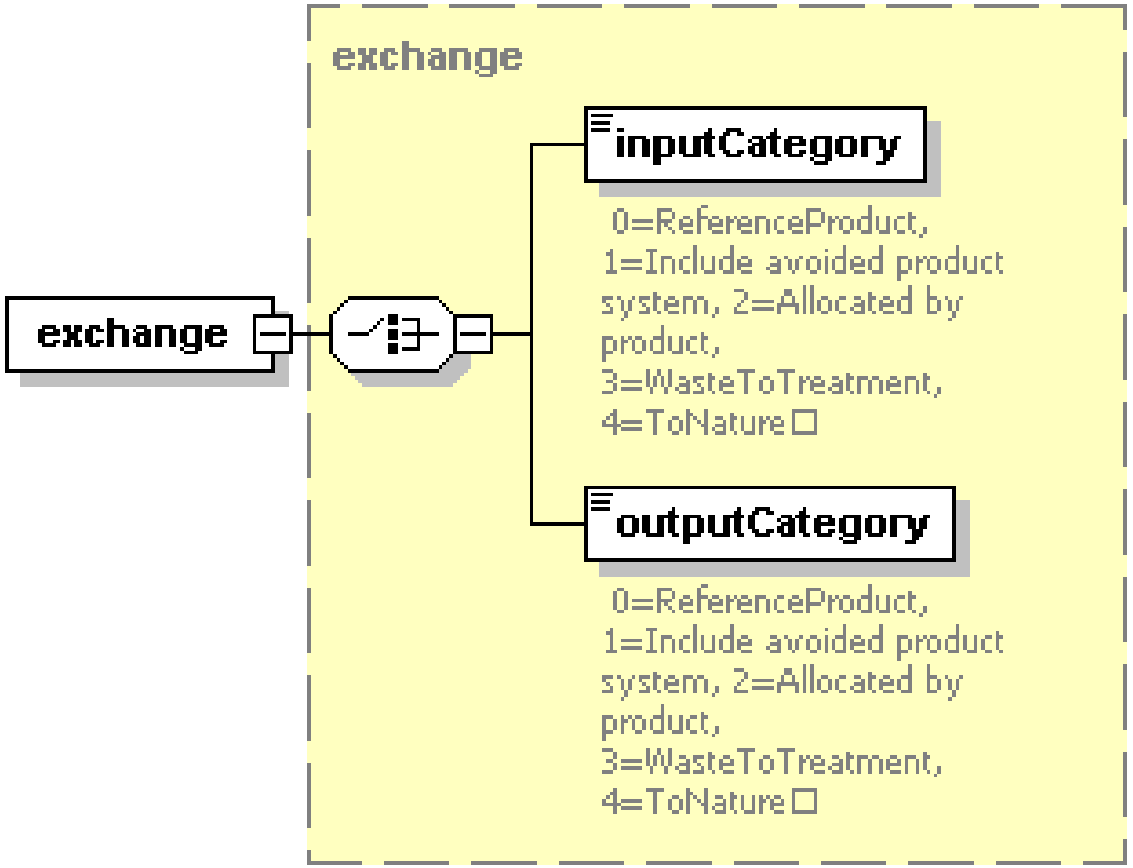
Data (exchange) format: Content

- Meta information
  - process information
  - modelling and validation
  - administrative information
- Flow data:
  - Exchanges (emissions / resource extraction)
  - Allocation

Data (exchange) format: excerpt processInformation



Data (exchange) format: Excerpt exchange



Procedure Data Compilation

- Data supply by individual institutes on a unit process level
- Only direct (in situ) Emissions and requirements

  => Maximum transparency

  => Full compatibility

Unit process data

		Transport by Crude Oil Carrier	Heavy Fuel Oil from Refinery
	unit	tkm	t
Requirements & Product:			
Transport by Crude Oil Carrier	tkm	1	-10'000
Heavy Fuel Oil from Refinery	t	-1.80E-06	1
Emissions:			
CO2, Carbon dioxide	g	5.5	180000
SOX, Sulphur oxides	g	0.13	1000
NMVOC	g	8.30E-04	500

Matrix operations

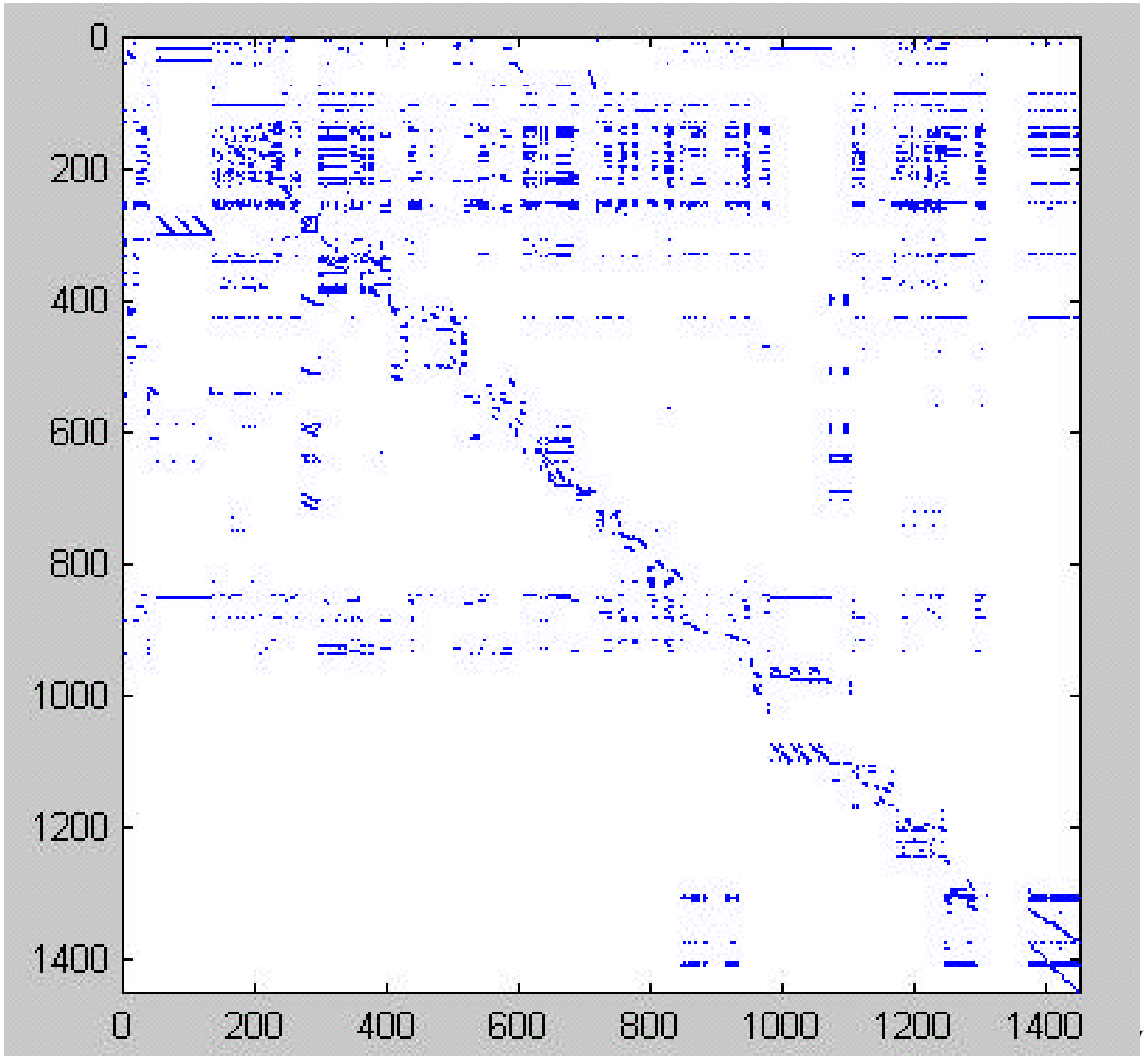
Unit process

$$\begin{pmatrix}\mathbf{a}\\ \mathbf{b}\end{pmatrix}=\begin{pmatrix} a_1\\ \dots\\ a_i\\ \dots\\ a_m\\ b_1\\ \dots\\ b_j\\ \dots\\ b_n\end{pmatrix}$$

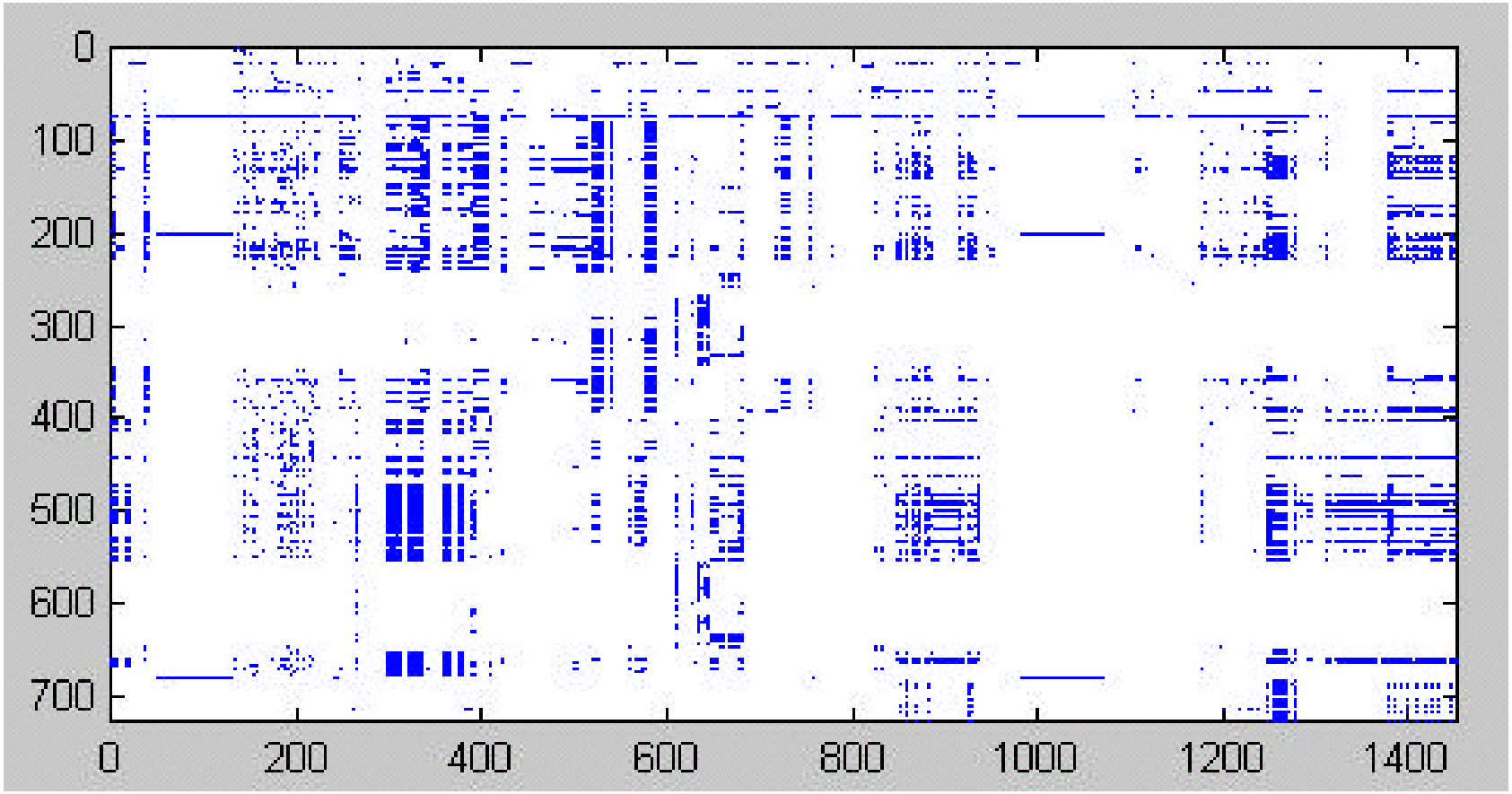
Process system

$$\mathbf{P}=\begin{pmatrix}\mathbf{A}\\ \mathbf{B}\end{pmatrix}=\begin{pmatrix} a_{11} & \dots & a_{1l} & \dots\\ \dots & \dots & \dots & \dots\\ a_{i1} & \multicolumn{2}{c}{\mathbf{A}} & \dots\\ \dots & & & \dots\\ a_{m1} & \dots & a_{ml} & \dots\\ b_{11} & \dots & b_{1l} & \dots\\ \dots & \dots & \dots & \dots\\ b_{j1} & \multicolumn{2}{c}{\mathbf{B}} & \dots\\ \dots & \dots & \dots & \dots\\ b_{n1} & \dots & b_{nl} & \dots\end{pmatrix}$$

Process Matrix A



Emissions Matrix B



Matrix operations

=> square, sparse matrix

Calculation of cumulative results with matrix inversion

Inversion: $$C = A^{-1} = (I - Z)^{-1} = \sum_{k=0}^{\infty} Z^k$$

Cumulative emissions: $$D = BC = B(I - Z)^{-1}$$

Outlook I

- XML to facilitate LCI data exchange between LCA software
- Efficient inversion routines for large sparse Matrices
- Compatibility with international standards

Outlook II

- Regular update of database content
- Continuous improvement of database
- Include additional economic sectors
- Establish Swiss competence center on Life Cycle Assessment

Schedule

- 4.2002: Database software ready
- 7.2002: Data ready for review
- 9.2002: Data ready for calculation
- 1.2003: IPD

  (Initial Placement of Database)