



# Experience of LCI Database Update – Chemical Processes Case

Cecilia Makishi<sup>1</sup>, Martin Baitz<sup>2</sup>, Harald Florin<sup>2</sup>, Matthias Fischer<sup>1</sup>

<sup>1</sup>LBP, Dept. Life Cycle Engineering at University of Stuttgart

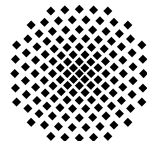
<sup>2</sup>PE Europe GmbH

## Contact:

Email [cecilia.makishi@LBP.uni-stuttgart.de](mailto:cecilia.makishi@LBP.uni-stuttgart.de)

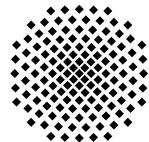
Tel. +49 711 489999-27

Fax +49 711 489999-11



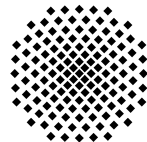


- Motivation
- LCI Database Update procedure
- Data sources and involved parties
- Producer, Consumer and Technology mix
- Level of aggregation and documentation
- LCI of chemical processes
- Conclusion



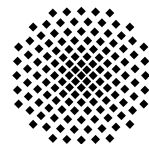


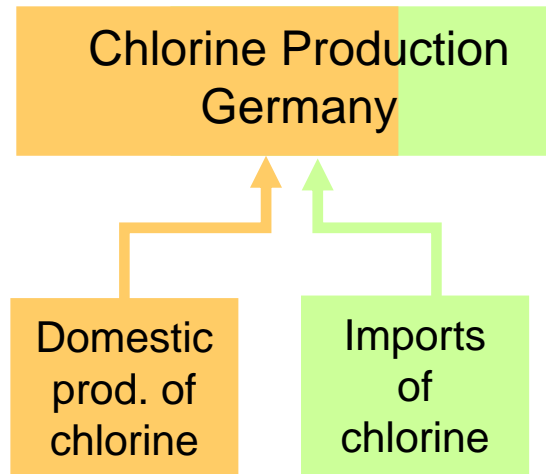
- The group PE Europe and University of Stuttgart work more than 15 years in the software and database development. A database update is performed on a regular basis in order to provide a realistic picture of the reality.
- To secure consistency and effectiveness: As less as possible (effectiveness) and as often as needed, if relevant changes occur (actuality).
- Update of existing processes: at the moment more than 2000 processes of various fields (chemicals, plastics, energy, transport, etc.) are available.
- Inclusion of additional datasets
- Technology improvement, emission and disposal laws changes happen along the years.



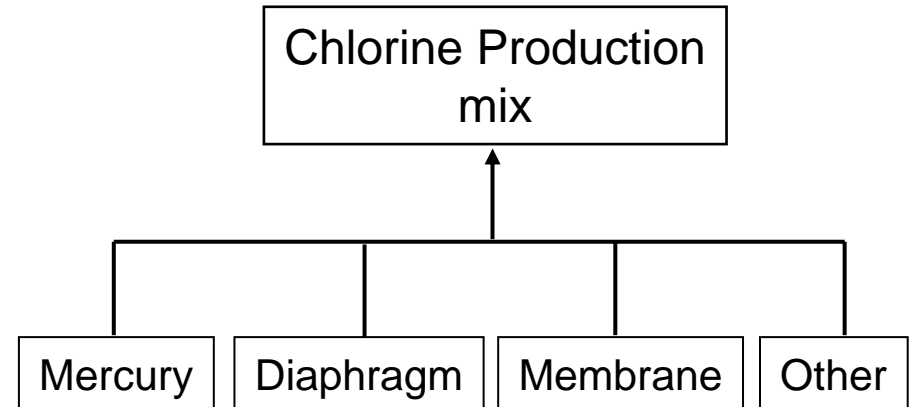


- Literature review, BAT (Best available technology) studies, latest public available databases and environmental laws and producers list
- Chemical processes: stoichiometric reactions
- Support from stakeholders: industry, government and academia at an early process stage should be looked for, as it is essential to ensure the success of the work.
  - Industry's support can provide a realistic view of the process
  - The government can support the work by bringing laws into force and by motivating industry and research institutes in this issue, specially in the case of national database.
  - Academia can provide better knowledge of the environmental performance of industrial processes and bring updated information about LCA research development.

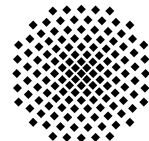




### Technology mix

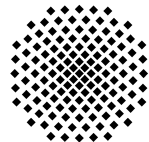


- Definition of ,mix' should be clear stated
- Users and purpose of the DB decide the approach
- Depending on the approach chosen, different country specific information is necessary





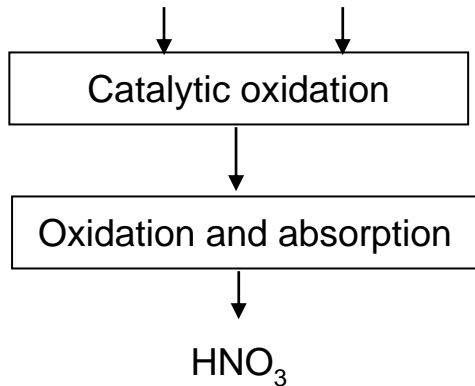
- Level of aggregation depends very much on the confidentiality agreements.
- Access to unit process level must be ensured → quality control.
- Experts can produce up-to-date process units and then aggregate them to the desired approach.
- If enough experience is available, experts are able to check the quality of aggregated data.
- Documentation regarding the technology and process used is essential.
- Documentation should follow international standards, so that it can be used by other parties and consistency with other databases is assured.





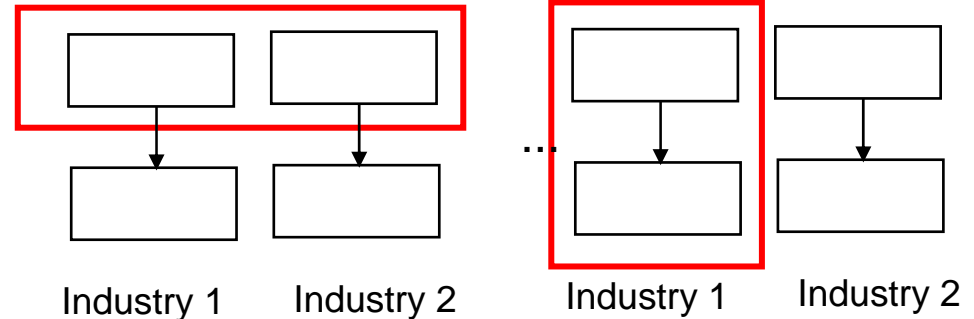
## Unit process level

e.g.



- Detailed analysis of the process possible.
- Transparency of confidential data.

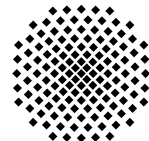
## Averaged process level



„Horizontal average“

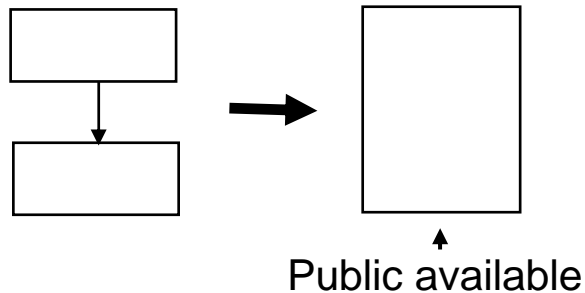
Vertical average“

- Data from at least 3 companies running the same process are needed.
- Unless very specific inputs are needed, transparency of confidential data is not provided.

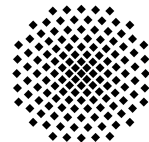




## 'Cradle to gate' process



- No access to unit process and therefore industry data are protected.
- Only environmental impact of material production possible.
- This kind of aggregation in combination with a detailed and transparent documentation helps to provide a substantial LCI database for various applications.





### 1. Technology changes? New technologies introduced?.

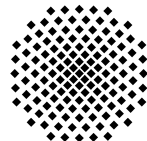
E.g.

- Drastic reduction of N<sub>2</sub>O emissions in the adipic acid process since 1996 through the implementation of N<sub>2</sub>O Abatement technologies, e.g. Non-selective catalytic reduction (NSCR), BASF N<sub>2</sub>O Decomposition (catalytic destruction), thermal destruction, etc.
- Production from Propylene Oxide from the chlorohydrin process and from oxirane process
- etc.

### 2. Changes in laws?

E.g.

- According to the Landfill Directive in Germany, waste to landfill may from 2005 contain a maximum of 5%TOC or 18% for mechanically and biologically pre-treated waste.





### 3. Determine geographical area and technologies under investigation

### 4. Literature survey

### 5. Industry involvement

### 6. Unit process modeling

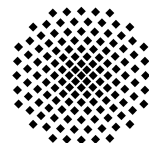
In the case of chemical processes, no generic models can be generated, since processes differ a lot from each other. No parameters can be set, as the input flows always varies. Even in the case of different countries, no proportional relationship can be established, as quantities, process efficiency, emissions treatment and energy consumption can vary.

### 7. Process chain → upstream processes + downstream (EoL-processes)

End-of-life of the processes must be considered: air, water and waste treatment.

### 8. Aggregation of data according to database objectives.

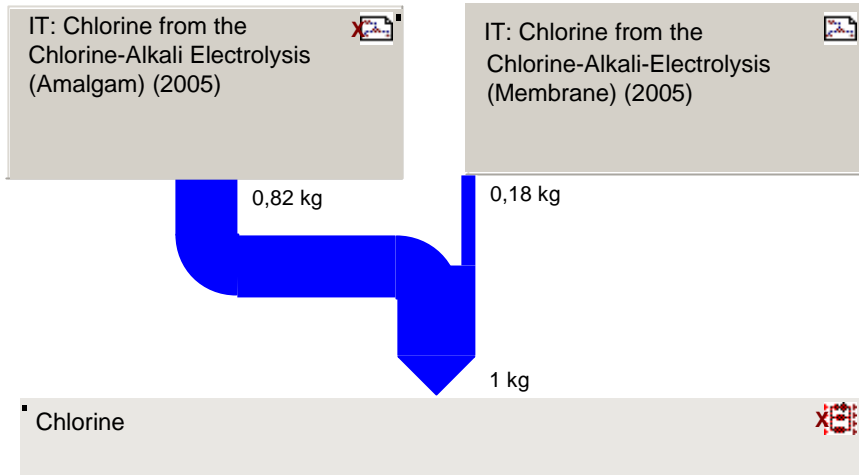
### 9. Documentation according to international standards.





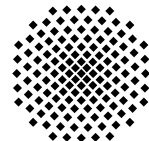
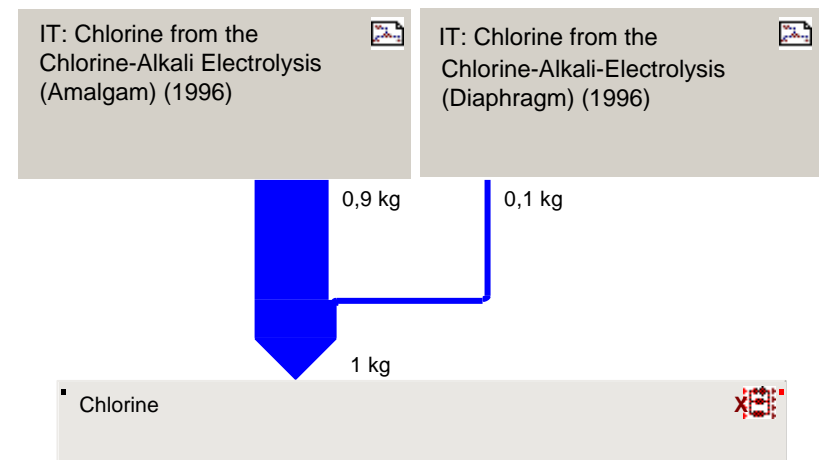
### IT: Chlorine Mix (2005)

GaBi 4 Process plan: Mass



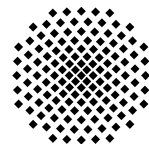
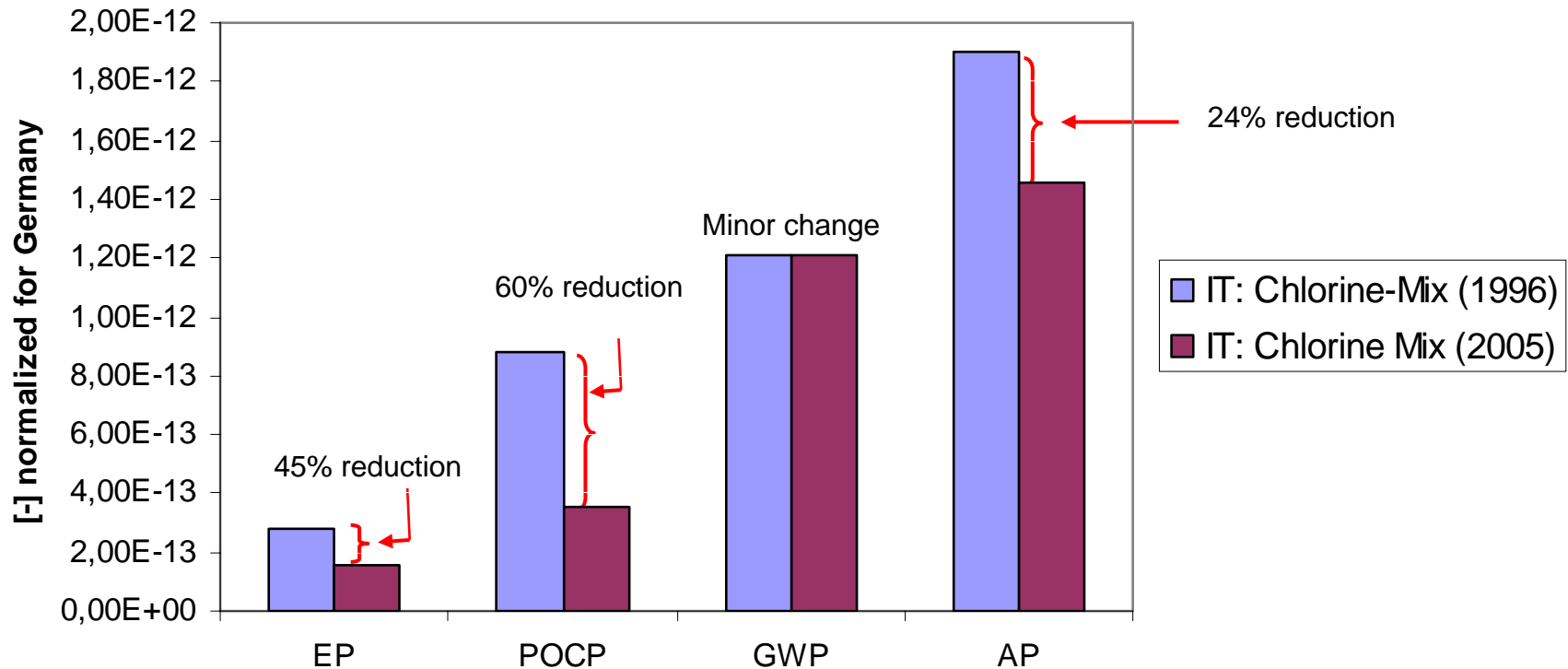
### IT: Chlorine Mix (1996)

GaBi 4 Process plan: Mass



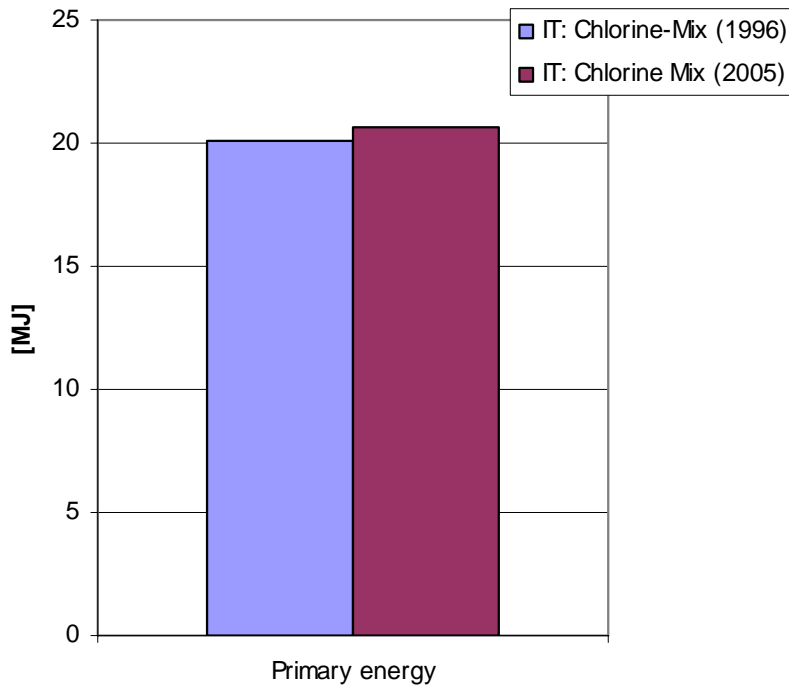


### Comparison between Italian Chlorine Datasets from 1996 and 2005



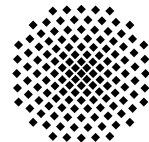


Primary Energy



### Comments:

- It must be considered, that the updated processes contain also updated upstream processes (e.g. power grid mix), influencing also the final result.
- Technology transfer do cause differences in the environmental profile along the time, making an update process essential.
- Improvement in some impact categories, i.e. reduced emissions does not always implies reduction in primary energy consumption. In other words, improvements can be performed without relevant primary energy consumption increase.
- Improvements were reached due to change of technology, rather than to more End-of-pipe ensures.



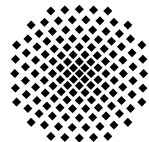


## General:

- Steps imposed by an LCI Database update processes are basically very much the same as the methodology used for the database creation process.
- Involvement of stakeholders (industry, government and academia) is essential for the success of the work.
- Database approach must take users and purpose of its use into consideration.

## Chemical processes:

- Update on unit process level.
- When different countries are considered, relevant processes used in each place must be taken into account.
- Changes in the emission and disposal laws must be checked.
- New technologies or technology transfer do make the difference in terms of environment, e.g. Chlorine mix, Adipic acid with the NSCR, inclusion of Andrussov process for the manufacture of hydrogen cyanide (HCN)





Thank you very much for your time and attention !

---

email: [cecilia.makishi@LBP.uni-stuttgart.de](mailto:cecilia.makishi@LBP.uni-stuttgart.de)

