BELGIAN SCIENCE POLICY

Vrije Universiteit Brussel

Clean Vehicle Research: LCA and Policy Measures (CLEVER)

(Report of task 2.1)

LCA software selection

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1. Introduction

CLEVER (Clean Vehicle Research) is a research project sponsored by the Belgian Science Policy which aims at promoting the purchase and use of clean vehicles in a Belgian context. In this project, an overall assessment will be carried out on the basis of the results of several assessments:
-A life cycle assessment will allow quantifying the environmental impacts of different vehicles types from cradle-to-grave
-A life cycle cost assessment will determine the cost per kilometre for the life cycle of the car and will include purchase cost, estimated salvage value, costs of licenses and inspection, insurance, taxes and estimated maintenance costs.
-The social barriers and the fleet analysis will reveal the obstacles confronting new vehicle technologies and limiting the purchase and/or use of clean vehicles.
-The influence of fiscal and other policy measures will be assessed in order to investigate possible policies towards a more sustainable car choice.
To achieve the life cycle assessment it's necessary to use software which can accommodate all of the project requirements. The objective of this report is to describe the selection process of an LCA software that will be able to carry out a full environmental assessment of vehicles with alternative and conventional fuels (LPG, CNG, alcohols, biofuels, biogas, hydrogen) and/or propulsion systems (battery, hybrid and fuel cell electric vehicles). The Vrije Universiteit Brussel, ULB and VITO have already developed the Ecoscore, a well-to-wheel environmental vehicle rating tool. The Ecoscore methodology is a pragmatic LCA tool, which only takes into account the environmental impact associated with the production, distribution and use of the fuel or energy in the vehicle. In the CLEVER project, the Ecoscore method will be extended to the cradle-to-grave emissions (including production and end-of-life of the vehicle). Recent developments in fuel production processes and new vehicle technologies will be taken into account.
A first important step in the development of this LCA tool is the selection of the LCA software.
The selection has been carried out in two stages. The first stage allows to remove a series of software tools not considered in conformity with our study, according to a list of criteria. The second stage allows choosing among four preselected software tools, more in adequacy with the needs of this LCA study. The selection concerns in particular the time to master the software, its intuitive use as well as its user-friendliness.

2. The preselection

The first step of the selection of the LCA software is a preselection of different software tools, according to the following criteria:

- Is the software commercially available?
- Is the software developed in a European country?
- Is the software specialized for a specific product category? Or it is a general tool?
- Is the software already used by some companies? Universities? Consultants?

After this preselection, four software tools were retained: Gabi (PE Consulting group), SimaPro (PRé Consultants), TEAM (PricewaterhouseCoopers - Ecobilan) and RangeLCA (RDC-Environment). Further selection will be carried out between these preselected tools.

3. The selection

The selection of the LCA software has been carried out after an analysis consisting of a questionnaire, a thorough testing of the demonstration versions and comments from some software users.

3.1. The questionnaire

A questionnaire was sent to the four software providers (SimaPro, Gabi, TEAM and RangeLCA). It was built on three sets of technical questions, namely: service (maintenance and training), functionality and database content, and on specific questions related to the use of the software for similar LCA studies, the reference users, the principal assets of the software and an estimation of the license cost.

Fields covered by the questions:

- *Service provided :*

  o *Does the software provider offer after sales services (e-mail support, hotline service, and update)?*
  o *Do you propose a training (via seminar or personalised)? What would be the cost of the training? Are the trainings being organized on a regular base? Weekly? Monthly? Yearly? What is the maximal waiting period between the trainings?*

- *Functionality :*

  o *Compatibility with PC and capacities required of the computer (processor, RAM...)?*
  o *working under Microsoft Windows operation system?*
  o *Are the size and the complexity of the models a limit to the software performance?*
  o *supporting inventory and impact assessment?*
  o *Does the software have a graphical editor or is the graphical interface implemented?*
  o *Import and export possibilities (from/to MS Office tools? Others?)*
  o *possibility to change impact factors?*
  o *possibility to change reference value (normalization)?*
  o *possibility to change weighing factors?*
  o *Speed of calculation according to capacities of the computer?*
  o *Time to master the software?*
  o *Possibility to carry out other types of analysis (costs, socio-economic impacts...)?*
  o *User-friendliness?*

- *Database :*

  o *Are data on raw materials, power generation, transport and disposal included in databases?*
  o *Are the data regularly up-dated?*
  o *Do the data have a European and international validity?*
  o *Are databases adjustable?*

- *Has this software been used for a similar LCA study as ours? Could you provide us with a few examples of some organisations using your software? Is your software widely accepted as a reference tool?*
- *Which are the main assets of your software compared with the other software tools suggested on the market (SimaPro, TEAM, Gabi 4 and RangeLCA)? What are the main disadvantages/problems encountered using the other software tools on the market?*
- A full estimation of the price for an academic multi-user license of the software and possibilities of various "packs" (database, training, service hotline, upcoming version upgrade...)

3.2. Synthesis of the answers

Regarding the services (table 1), the four preselected companies provide more or less the same services. An important difference exists for the TEAM software: the first year of the service is not free and is limited to 8 hours. The four companies propose a training at home. A wide range of prices for these trainings is displayed (see appendix).

Table 1: Answers to the questions about « service » (+: yes)

Service				
	Gabi 4	**SimaPro 7**	**TEAM 4**	**RangeLCA 2.1**
Updating	Free	Service contract (free the first year)	Contract maintenance	Free
Service hotline	Free	Service contract (free the first year)	Contract maintenance (8h)	Free
Training	+	+	+	+

Regarding the functionality of these four software tools (table 2), they are almost similar. Large differences appear nevertheless in the type of files which can be imported and exported and, in the other types of impact studies which each software can carry out. RangeLCA and TEAM, make it possible to carry out a cost analysis.

Table 2 Answers to the questions about « functionality » (+: yes, - : no and nc: not communicated)

Functionality				
	Gabi 4	**SimaPro 7**	**TEAM 4**	**RangeLCA 2.1**
Recommended requirements	PC 400 MHz 128 RAM 100 MB free hard disk	PC Pentium IV 2 GHz 96- 288 RAM 1 GB free hard disk	PC Pentium class 128 RAM or more	P III 800 MHz 128 MB RAM 20 GB free hard disk (included the Database)
Compatibility with Microsoft operation system	Windows 95,NT,2000,XP	Windows 98,ME, NT 4, 2000, XP,2003 server	Windows 95 or NT 3.51, NT 4.0, 2000, XP	Windows 98, 2000, Millenium, XP
Limitation in size and complexity	no limit	no limit	no limit	no limit
Inventory and impact assessment	+	+	+	+
Import/export options	l Import: Excel	l Import: CSV (create via Excel), Spold99, SimaPro database	l Import: txt files (TEAM and Spold format), Ecoinvent 2000 formatted data	l Import: Excel, Ecoinvent Format xml (will be available in summer 2007)

	▎ Export: Excel	▎ Export: CSV, txt, Spold99, SimaPro database format, Copy and paste of results to Office applications	▎ Export: txt files (TEAM and Spold format)	• Export: Excel, Ecoinvent Format xml (will be available in summer 2007)
Changes in impact factors	+	+	+	+
Changes in reference value (normalisation)	+	+	+	+
Time to master the software	Depends on the complexity of the models analysed	2 days to one week	2 days to one week	3 days to one week
Other types of analysis	+ (cost consideration and social conditions)	-	+ (cost analysis: fixed and variable)	+ (Cost analysis)
User-friendly	+	+	±	+

Concerning the databases (table 3), each provider offers a great choice. Moreover, they all have an interface with the Ecoinvent database. The Ecoinvent database costs 1200€ (plus VAT)

Table 3: Answers to the questions about the « database » (+: yes)

Database				
	Gabi 4	**SimaPro 7**	**TEAM 4**	RangeLCA 2.1
Type of data (raw materials, power generation, transport and disposal)	+ (see appendix)	+ (see appendix)	+ (see appendix)	+ (see appendix)
Updating	+	+	+	+
Valid for Europe	+	+	+	+
Adjustability	+	+	+	+

Concerning the reference users (table 4), it seems that various studies were undertaken with each software. The reference users listed hereafter comprise only the companies quoted in the answers. In the appendix, other names of companies coming from the website of each software are shown.

Table 4: Answers to the questions about the « similar LCA study, users references » (+: yes and nc: not communicated)

LCA study – reference				
	Gabi 4	**SimaPro 7**	**TEAM 4**	**Range LCA**
Similar study to CLEVER	Life Cycle Assessment for the Environmental Certificate of the Mercedes-Benz S-Class (7 pp)	nc (studies are confidential)	+ Several vehicles component LCA	In many LCAs performed by RDC-Environment, Range LCA was used to model the using phase of vehicles

User's reference	Bayer, BP Chemical, DaimlerChrysler, DuPont, EMPA, General Motors, Motorola, Nokia, Siemens, Solvay, Toyota, Volkswagen	Philips, Lear Automotive, Gaz de France, TNO, VITO, United technologies, AgfaGevaert…	EDF, Corus Steel, Arcelor, Unilever, …	DANONE, ATLAS-COPCO, TYCHO, SEGHERS Engineering, TEST-ACHATS…

Table 5 synthesizes the answers to the question about "the main assets". It is thus suggested to refer to the appendix for further information. Let us note that the companies' answers are limited to advertising. These answers are thus not always objective.

Table 5: Answers to the question about « the main assets »

Principal assets	
Gabi	Easy to understand structure and intuitive user interface
	Possibility to use parameters for the calculation
	Implemented sensitivity analysis tool (Monte-Carlo Analysis), scenario analysis, parameter analysis
	Possibility to create different types of diagrams
	High quality LCI database, professional database, wide range data sets cover many industrial branches (metals, organic and inorganic intermediate products, plastics, mineral materials, energy supply, end of life, coatings, manufacturing and electronics)
	Most used in the automobile and electronic industry
SimaPro	Intuitive interface
	Very quickly learn how to work
	Comparison of two or more products and immediately analyse the difference
	Sophisticated impact assessment and analysis options
	Real-time analysis of impact assessment results
	Support damage categories in impact assessment methods
	Possibility to create easily his methods
	Parameterized modelling
TEAM	Implementation of global and local variables in the model so that it is possible to make easily sensitivity analysis using a control panel that runs as many simulation in batch as the user wish
Range LCA	Modeling of all the scenarios with a single model. It gives more flexibility in the modeling and ensures the identification of all the important parameters
	Situations diversity is taken into account by using statistical variables for environmental data A discernability analysis by a statistical approach to differentiate common variability from the variability due to specific values
	Sensitivity analysis

Table 6 shows the drawbacks which the providers accepted to communicate about their software.

Table 6: Answers to the question about « the drawbacks» (nc: not communicated)

Drawbacks	
Gabi	multi user capability of the software not available
SimaPro	scenario analysis not supported
TEAM	nc
RangeLCA	nc

The cost of the various software tools shows strong differences between the purchase of an academic license "university" (education, small-scale research project) and a professional license (consulting companies, large-scale research project, etc.)

For SimaPro, an academic license for one year and one user costs 900 € for the PhD version and 1800 euros for the faculty version. The classroom version (40 users client version) costs 1500 € per year. Educational versions may only be used by academic institutes for teaching purposes and cannot be used for commercial activities or paid research.

A One year license for one user costs 5300 € for TEAM. The cost for the same product is intermediate for Gabi. A Four years license including updates and service costs 10000 € for RangeLCA.

The prices are also very different for the professional license. For one user and one year of service, the least expensive remains SimaPro with 4800 € (developer version), followed by Gabi with 7 500 €. The cost for one professional license for TEAM and for the service is 10 000 € per year! For TEAM, the prices for two licenses haven't been asked because of the high price of one license.
After consultations with the providers, the license necessary for our study is a professional one.

Table 7: License cost estimation (2007)

Estimation (taxes not included)				
	Gabi 4	**SimaPro 7**	TEAM 4	RangeLCA 2.1
Academic license	3750€	900€(PhD), 1500€ (classroom,) 1800€(Faculty)	2000 €	
Additional license	Free	nc	1000 €	
Service	Free	Free the first year 400€ (single user) 800€ (multi user)	2300 € (contract maintenance)	Free
Professional license	7500€	1800€ (compact), 3000€ (analyst) 4800€ (Developer)	10000 € (consultant) per year	10 000 €/ 4 years
Additional license	Free	1800€	nc	
Service	Free	Free the first year 1200€ (1800 € for 2 and 600€ for each extra user)	Included (first year)	Free

From the results of the questionnaire, it appears that the four software tools show many similarities but they also comprise some specific characteristics. The major differences are the possibility to carry out other types of analyses than environmental ones, the type of file for import and export and the cost of the software tools.
As a conclusion, at this stage, it is difficult to select an LCA software on the basis of the answers to the questionnaire only. The test of the software's demonstration versions and the comments must allow to determine the most adequate software and to improve judgement.

3.3. Demonstrations

Besides the questionnaire, the selection of the software has been based on the test of the software demonstration versions. The comparison is not easy since each demonstration software possesses its own characteristics.

Some demonstrations, like Gabi and SimaPro, propose to conceive an LCA following a specific tutorial. The software's demonstration provided by SimaPro presents a complete study of a simple wooden shed (time of the realisation: more than two hours) and an exploration of an example of LCA. The Gabi's demo on the other hand is much briefer (time of using is approximately 20 minutes).However The TEAM software's demonstration doesn't allow undertaking an LCA. It only shows the stages of an LCA's realisation.

As RangeLCA is developed for internal use; it doesn't have a demonstration version. We made a trial with the complete software.

Thus, no unbiased comparison could emerge from the use of the three demonstrations tests. Moreover, any comparison starting from a random and easy LCA, imagined at the ETEC department, could not be realised. Indeed, each demonstration exercise has specific limitations of use.

In spite of these restrictions, some comments can be proposed. They can sometimes refute the answers to the question related to the "principal assets" (see table 5).

3.3.1.   Gabi

- no intuitive use
- good visibility of the process tree
- lack of visibility in the fitting of the running windows
- no modification existence in the event of error in the architecture of the processes?

3.3.2.   SimaPro

- intuitive use
- good visibility of the fitting of the running windows
- good visibility of the process tree
- construction of the software seems rigid

3.3.3.   TEAM

- intuitive use
- good visibility of the fitting of the running windows
- good visibility of the process tree
- seems to have an important series of tools for the study

3.3.4.   RangeLCA

- intuitive use
- good visibility of the fitting of the running windows
- good visibility of the process tree
- very good statistical skills
- high reliability of the outcomes
- recognition of the diversity of the individual cases
- automatic sensitivity analysis of all the parameters

From this test, the selection focuses on three software tools: SimaPro, TEAM and RangeLCA.

4. Conclusion

The selection of the LCA software is not easy to achieve. After a preselection, four software tools (SimaPro, TEAM, Gabi and RangeLCA) were held and analyzed on the basis of the responses to the questionnaires, as well as on the demonstration version tests proposed by the companies.

After the preselection, RangeLCA seems to be the most adequate software for this study. Indeed, RangeLCA has innovating characteristics and many assets, compared to other LCA softwares. The outcomes show the diversity of the individual cases and integrate automatically the sensitivity analysis of the parameters. Its produced results integrate a set of possible combinations for the various parameters and data in order to take into account possible synergy and compensation effects. However, it is important to note that Gabi has interesting references in the automotive industry (Daimler Chrysler, General motors and Toyota) but it was eliminated due to the lack of user-friendliness. TEAM also has interesting features .but they are less appropriate for the project.

Cost estimation was requested at Price Waterhouse Coopers-Ecobilan for TEAM, at PRé Consultants for SimaPro and at RDC-Environment for RangeLCA.

Table 8: Final cost estimation of the softwares (na: not asked; include a one day in-house training for the CLEVER project, travel costs not included).

Cost estimation (tax not included)			
	SimaPro	TEAM	RangeLCA
Professional License (1 user) + database	4800€	10000€	10000€/4 years
Service (one year)	included	included	Included
Ecoinvent database	Included	1200€	1200€
One day in house training	5000€	1160€	free€
Total for 1 license	9800€	12360€ *	11200€/4 years

After the comparison of the main assets of the three software packages and after cost consideration, RangeLCA remains the most adequate software. RangeLCA includes a powerful statistical tool which allows taking the diversity of all the analysed situations into account. Moreover as the duration of the project will be 4 years, RangeLCA has the lowest license and service costs, and the location of the company makes interactions much easier during the course of the project.

Appendix: Questionnaire

1. Overview

The appendix contains the responses to the questionnaire sent to the LCA software developers. The questions asked to them include the after-sales services provided (online and phone support, training), the software functionality and the databases quality (the Content, the Updating options, European and international validity). A few examples of organizations using the different software packages and having performed LCA studies similar to ours with the software the different software packages were also asked to the program developers.

2. Supported

2.1. Supported, updated

The question: *Does the software provider offer after sales services (e-mail support, hotline service, and update)?*

2.1.1. Gabi 4

Software updates are released if required and are free of charge. Updates can be downloaded from our website. Naturally the Gabi software is prepared for all future updates of process data and impact assessment data.

2.1.2. SimaPro 7

Software and database updates are included in the service contract; this also applies to new versions. A free first year service contract is included in indefinite licenses.
At the beginning of the summer a new version is expected to be released.

2.1.3. TEAM 4.0

Yes, if the customer subscribes to the maintenance contract (2300 euros). The contract includes 8 hours hot line and updates (if any) for one year.

2.1.4. RangeLCA 2.1

Software update and service are included in the license contract.

2.2. Service hotline

2.2.1. Gabi 4

As a Gabi customer you have free access to email and hotline support from PE Europe. No additional fee has to be paid.

2.2.2. SimaPro 7

Hotline, e-mail, phone and fax support are included in the service contract.

2.2.3. TEAM 4.0

See 2.1.3

2.2.4. RangeLCA 2.

Included in the license contract.

2.3. The training

The question: "*Do you propose a training (via seminar or personalised)? What would be the cost of the training? Are the trainings being organized on a regular base? Weekly? Monthly? Yearly? What is the maximal waiting period between the training(s)?*"

2.3.1. Gabi 4

We offer our customers training on site as well as training sessions at PE Europe. The price is depending on the content of the training within the range of 400€ for one day training to 1100€ for a 2 days expert training at PE Europe.
Training sessions at the customer's office are charged with 900€ per day excluding expenses. The content of an on site training is variable from introduction courses to personalized training sessions regarding specific questions.

2.3.2. SimaPro 7

PRé Consultants can organize in-company trainings. A major benefit of the in-company training is the freedom to modify the content of the training to meet your individual needs.
Customization allows you the flexibility to emphasize the most relevant issues and to minimize those not as relevant. It is an excellent occasion for the persons involved to share the same knowledge at the same time. The kick-off of a LCA program might be a good example.
The fee for a one day in-house training is 5000 Euro. For two or three days the fee will be 8000 Euro or 10.000 Euro respectively.
This fee includes a review of one LCA study (taking maximum 8 hours of our consulting staff). Travel costs and VAT (where applicable) are not included.
We assume the in-company training will be attended by 5 people maximum.

We organize regular training courses in Amsterdam, about every 3-4 months, dependent also on the interest. The next training is scheduled at the end of May (2007) Personalized courses can be arranged but are more expensive.

    a.   Topics
The training will contain the following elements:
- Introduction in LCA terminology: what is goal and scope, system boundary, allocation etc?
- Structure of SimaPro: libraries and projects.
- Modelling in SimaPro: processes and product stages, waste scenarios.
- Documentation.
- Backgrounds of inventory data and methods in SimaPro.
- Introduction in inventory (data collection).
- How to analyze results.
- Using Wizards.
- Data management: import/export, append substance names.
- LCA in practice, including your own specific questions.

Further we will give a preview of new SimaPro features you can expect soon.

b. Trainers

The training will be given by two of our experienced consultants, who have done numerous LCA projects and use SimaPro on a daily basis.

c. Optional LCA support and review package

We offer an optional follow-up module where we provide you with 8 hours extended support and reviews of your LCA project within a 6 month period.

d. Date and Location

The next training day is Wednesday 9 May 2007. The location of the course is the NH Barbizon Palace, in the center of Amsterdam opposite Central Station.

e. Prerequisites

The attendees need a basic understanding of LCA and the operation of Windows software. Further they are expected to have read the SimaPro demo manual as well as part of the SimaPro user manual.

f. Conditions

All training sessions and documentation are in English.

The maximum number of participants for each training is 10. If the course is fully booked you can be put on a waiting list.

PRé Consultants reserves the right to make changes in the program, date, location and trainers or to cancel the training if enrolment criteria are not met or when conditions beyond its control prevail. In such cases, every effort will be made to contact each trainee and an alternative will be offered. If training is cancelled for any reason, PRé Consultants is limited to refund the training fee only.

g. Next training

Date: Monday/Tuesday May 24-25, 2007.
Location: NH Barbizon Palace in the centre of Amsterdam, opposite Central Station.
Costs:
- 1500 Euro for 2 days training, including lunch and evening event, excluding VAT, travel. arrangements and insurance.
- 1200 Euro for optional LCA review package.

2.3.3. TEAM 4.0

Tutorials are organised on customers demand. There is no waiting period except if no engineer is available at the time.

2.3.4. RangeLCA 2.1

Trainings are organised when e-mail and telephone supports can't solve the problem. It is included in the license contract. Trainings are organised in the week on the demand of customers unless the engineers are not available.

3. Functionality

3.1. Minimal requirements

The question: *"Is the software compatible with PC and which are the capacities required of our computer (processor, RAM...)?"*

3.1.1. Gabi 4

The system requirements of Gabi are: PC with at least 400 MHz, 128 MB RAM, 100 MB free hard disk space (the actual hard disk storage depends on the size of the databases created).

3.1.2. SimaPro 7

SimaPro is developed to run optimally on Windows PC's with a Pentium 4 processor.
You may run SimaPro on a Macintosh/Unix computer using Windows emulation software. We regret that however we cannot give technical support for these systems.
Processor
Minimum requirement: Pentium III or equivalent. For optimal performance we recommend Pentium 4 (equivalent) 2.0 GHz or better.

Internal memory
The table below shows the minimum and recommended memory requirements for the operating system plus SimaPro.

Operating system	Recommended (MB RAM)
Windows 2003 server	512
Windows XP	512
Windows 2000	512
Windows NT 4	256
Windows ME	256
Windows 98	256

If you use other software applications simultaneously with SimaPro, add the required memory for these applications.

Hard disk

A minimum of 1 GB of free hard disk space is required. For larger databases you will need more space.

Monitor

SimaPro can be run at a resolution of 800 x 600. A higher resolution is recommended.

CD-ROM

A CD-ROM drive is needed to install the software. No installation on diskettes is available. As alternative you may download and register the full demo version to install as a single user.

Internet

An internet connection is needed to check for availability of software and database updates on-line. See in the SimaPro menu bar under Help, Check for update.

3.1.3. TEAM 4.0

The software is compatible with PC (memory: minimum 64 MB of RAM, recommended 128 MB or more, processor: Pentium class processor).

2.1.4 RangeLCA 2.1

Technical requirements of the software:
>
> Minimum P III 800 MHz, PIV 2GHz is recommended
> Minimum 128 MB RAM, 512 to 1024 MB are recommended
> 20 GB of hard disk (included database)

3.2. Microsoft Windows operation system

The question: "*Intend to work under Microsoft Windows operation system?*"

3.2.1. Gabi 4

Gabi 4 is a 32-bit application that was developed for Windows95™, Windows.NET™, Windows2000™ and Windows™.

3.2.2. SimaPro 7

SimaPro 7 is a 32-bit Windows application which runs under Windows 98, Windows ME, Windows NT 4.0, Windows 2000, Windows XP and Windows 2003 server. It is recommended to have the latest service packs installed.
Under certain circumstances the Administrator right may be required for installation under Windows 2000, XP, and 2003 server.

Multi-user version
The multi-user version runs as a client-server system over TCP/IP networks. The SimaPro Server must be installed on a computer with a Windows operating system, Novell servers are not supported.
Multi-user installation should be done by your system administrator/IT department.

3.2.3. TEAM 4.0

Yes

3.2.4. RangeLCA 2.1

Range LCA runs under Windows 98, 2000, Millennium and XP.

3.3. The size and the complexity of the process model

The question: "*Is the process model unlimited in size and complexity?*"

3.3.1. Gabi 4

Yes, within Gabi you can model systems with a huge number of sub-systems and used processes. One of our biggest systems is built up out of more than 25.000 plans containing about 300.000 processes and is still easy to understand due to the Gabi structure.

3.3.2. SimaPro 7

Yes, note that non-linear functions are not supported.

3.3.3. TEAM 4.0

The maximum size of the database depends of your machine capacity. We work on large-size databases (for more detail contact Anis Ghoumidh) and have no problem. There is no limit to the complexity of the database (from our experience). The tool is intended for life cycle assessment and is compatible with ISO 14040-41-42-43 standards.

2.3.4 RangeLCA 2.1

There is no size limit for system modelling. Models of 400 processes have already been performed.

3.4. Inventory and impact assessment

The question: *"Does the software support inventory and impact assessment?"*

3.4.1. Gabi 4

Yes, Gabi supports inventory as well as impact assessment.

3.4.2. SimaPro 7

Yes

3.4.3. TEAM 4.0

Yes, the tool supports inventory and impact assessments.

3.4.4. RangeLCA 2.1

Yes

3.5. Graphical interface

3.5.1. Gabi 4

Processes are arranged in Sankey diagrams, allowing a quick overview of mass, energy or even cost flows shown as proportional to quantity. It is up to the user to determine which additional flow quantities one wishes to depict in this sophisticated manner. Furthermore the process names and quantities can be displayed. The display of user defined process images makes the presentation and the understanding of complex processes easier.

3.5.2. SimaPro 7

From the graphics (results) you can get to the editors, but we do not have a graphical editor. As the models we work with can get very complicated, a graphical interface does not make much sense. However the system as it is implemented will give you full access to all you could need and works as good as a graphical editor. If you need further explanation let me know.

3.5.3. TEAM 4.0

Yes

3.5.4. RangeLCA 2.1

Yes

3.6. Import and export possibilities (from/to MS Office tools? Others?)

The question: *Is it possible to import and export data from/to MS Office tools? Others.*

3.6.1. Gabi 4

Export to Excel:
Exporting Gabi processes to Excel is completed just as simply and quickly as importing. With the simple copy and paste function, such as known from Microsoft, you can copy a Gabi process in an Excel table sheet. Further you have the possibility to drag & drop any kind of database object (balances, plans, processes, flows, quantities or whole projects) from one **Gabi 4** database to another via the Drag-and Drop-functionality

Import from Excel:
To be able to import processes from MS Excel, the table format can be adapted to the requirements of Gabi. Hence the import of data from Excel is very easy. The export and import to/from Excel is also possible to other Gabi objects, such as flows and balances for example.

3.6.2. SimaPro 7

Import via CSV, Spold99, ECOSpold (soon) and SimaPro database format. CSV file can be created via Excel. Export to CSV, txt, XLS, Spold99, SimaPro database format and various graphical formats for graphs. Copy and paste of results to Office applications is fully supported.

3.6.3. TEAM 4.0

Yes via txt files (TEAM format and SPOLD format), import of any Ecoinvent 2000 formatted data. From MS office, copy and cut, and save (as Excel format) are available.

3.6.4. RangeLCA 2.1

Yes Import/export via excel files. Import/export via XML files option will be available in the summer of 2007.

3.7. Possibility to change impact factors

3.7.1. Gabi 4

Gabi 4 allows users to create individual performance indicators for the evaluation of the systems. Impacts of substances with respect to internationally discussed impact categories such as global warming potential, acidification potential, toxicity potentials, ozone depletion potential and more comply with recommendations of ISO, SETAC, WMO and IPCC. These features provide quick and transparent

evaluation of the environmental, technical, economic or social performance of your plants, processes, services or products.

Changing impact factor view on results:
In Gabi it is very easy to switch between mass or energy balance and even impact results or one-point indicators. You can change the displayed impact factors within a Gabi balance with just one click.

Edit impact factors:
The open structure of Gabi gives you a maximum freedom of changing, creating and deleting all kinds of objects used in Gabi.
If you want to add flows to an impact factor or delete flows, create your own impact factor.

3.7.2. SimaPro 7

Yes.

3.7.3. TEAM 4.0

Yes.
3.7.4. RangeLCA 2.1

Yes it is possible to change impact and normalization factors. For the moment it is done by RDC-Environment on customer's demand.

3.8. Possibility to change weighting factors

3.8.1. Gabi 4

You can change the displayed impact factors within a Gabi balance with just one click.

3.8.2. SimaPro 7

Yes. Our impact assessment methods are fully flexible. You can also copy a method and change it, or create your own methods. SimaPro is the only tool to support damage assessment.

3.8.3. TEAM 4.0

You can change the reference flow and the reference value for the functional unit. Normalisation methods can be created and applied but do not exist as such.

3.8.4. RangeLCA 2.1

Yes, see 2.7.4.

3.9. Possibility to change reference value (normalisation)

3.9.1. Gabi 4

As easy as the change of weighting factors, you can apply different normalisations to your results with one click. As a matter of fact, it is also possible to edit these normalisation factors as explained for the impact factors.

3.9.2. SimaPro 7

Yes.

3.9.3. TEAM 4.0

If it is for normalisation, see 2.8.3.

2.9.4 RangeLCA 2.1

Yes see 2.7.4

3.10. The speed of calculation

3.10.1. Gabi 4

If you work with a computer fitting to the system requirements, Gabi is able to handle very huge systems at a very comfortable calculation time.

We run some calculations to test the performance of Gabi:
A computer running Win XP, with 2.4 GHz and 512 MB needs only 32 seconds (!) to calculate a balance out of 19.500 systems and 310.000 processes. A system with 7.000 plans and 115.000 processes needs approximately 17 seconds, and a smaller system with 16 plans and 330 processes need about 1 second to calculate a balance.
Within a Gabi balance you can do several kinds of analysis. For example applying a parameter variation within a Monte-Carlo analysis of a medium sized system structure of about 100 modelled processes takes in a Monte-Carlo simulation (1000 simulation runs) about 60 seconds to calculate all possible impact systems.

3.10.2. SimaPro 7

This cannot be answered as it is not only dependent on the PC configuration but also on the model you are analysing.

3.10.3. TEAM 4.0

It depends on the machine.

2.10.4 RangeLCA 2.1

One of RangeLCA's main assets is its calculation speed. To calculate 300 processes, Range LCA will need 45 seconds and that for 1000 calculation iterations.
Better calculation speeds are expected with Intel Core 2 Duo processor and high speed RAM (667 MHz and more).

3.11. Time to master the software

3.11.1. Gabi 4

This depends on the complexity of the models you want to analyze. For a non complex modelled system it is possible to get results after the first day. Hence the complexity of modelling in Gabi can be increased to a maximum level of detail, if the problem you want to solve requires so. Developing complex process models Gabi provides several modelling possibilities which need some experience in the work with Gabi. Due to the complexity of the modelling, your experience will increase and Gabi will never set any border to the possibility of modelling.

3.11.2. SimaPro 7

2-5 Days. We offer a tutorial to learn the basics of the operation of SimaPro. See 1.3.1.

3.11.3. TEAM 4.0

Two days to one week.

3.11.4. RangeLCA 2.1

3 days to one week.

3.12. Other types of analysis (costs, socio-economic impacts...)

3.12.1. Gabi 4

Cost Considerations:
Gabi4 enables consideration of different cost factors connected to the processes or the lifecycle of products. Users are supported by advanced wizards when keying in various cost types. Gabi 4 then automatically computes costs related to individual processes, material or energy flows from the user's details.

Social Conditions:
The quality of work environment can be computed and evaluated along the value chains by newly developed features.

3.12.2. SimaPro 7

No, if you are looking for predefined methods and a ready made setup. Yes, if you are prepared to put some effort in defining the methods to do so. Note we are working on these issues.

3.12.3. TEAM 4.0

Cost analysis can be carried out if costs data are available. TEAM takes into account both fixed and variable costs.

3.12.4. RangeLCA 2.1

Since 2004, RDC-Environment is working on Impact monetarisation.

3.13. User-friendliness

3.13.1. Gabi 4

The user-friendly Windows interface of the Gabi 4 system makes it easier to handle thanks to the flexible and graphical user screen windows. The multiple windows technology provides you with flexibility, allowing you to have your own individual working style. Clear dialog boxes, drag & drop technology and the use of symbols improve one's ability to operate the system in terms of software ergonomics.
The structure of Gabi is geared towards the use of the functionality of the Windows™ Explorer. So the user will be very familiar with the usage of the Gabi software.

3.13.2. SimaPro 7

A hint: in SimaPro you need only a few mouse clicks to define a flow, and it is very easy to analyse the results in detail. Further we have an LCA Wizard that will help you modelling (see the guided tour in our demo).

3.13.3. TEAM 4.0

Many customer say yes. Other thinks it is a bit complicated (as life cycle assessment is!)

3.13.4. RangeLCA 2.1

Range LCA is developed for internal use, so there is no users guide or manual. Modelling on Range LCA is done by process tree, which makes it user-friendly. The fact that you can model several systems in one model avoids you to repeat the modelling of common parts.

4. Database

4.1. The data collection

The question: *"Does the database contain data on raw materials, power generation, transport and disposal?"*

4.1.1. Gabi 4

The Gabi database have a clear and comprehensible structure and can be extended easily by the user. Metals, plastics, energy carriers, auxiliary substances, transport processes, chemical intermediates, mineral substances, building materials, parts and papers, etc. may not be everything, but in comparison with competitors, they offer a convincingly high coverage off the most important fields and a high level of data quality – this makes up the difference.
GaBi 4 Professional database includes approx. 650 sets of data (cradle to gate), generated by IKP/PE. This data is based on information from patent/specialist literature and industry which makes GaBi 4 to one of the leading databases in the world. These data sets include the decisive areas of the pre-chains to metals (steel, aluminium and non-ferrous metals), organic and non-organic pre-products, synthetics, mineral materials, provision of energy (steam, thermal energy, electricity mixes and power stations), end of life and disposal and   processing   with.
Nevertheless, specific data demand may exist. Your own inquiries are often time consuming and therewith

quite expensive. PE Europe can provide you with individual customized data on demand, either from our stock or individually generated.

4.1.2. SimaPro 7

- ETH-ESU 96

Focus: **Energy**. **Electricity generation** and related processes like **transport**, **processing**, **waste treatment**. Includes 1200 unit processes and 1200 system (results) processes. Extensive documentation provided.
Source: ETH-ESU. Licensed database.
Availability: Included in standard database (commercial and educational versions).

- Dutch Input-Output database

Focus: Economic Input-Output database, for us on its own or in hybrid LCA studies.
Starting point was an overview of how the average consumer distributes its spending over 350 categories, such as buying tomatoes, driving to work and maintaining the garden. A link was made between these categories and the economic sectors. The economic input output table was used to trace the trade flows between these sectors.
We also introduced foreign input-output tables for the OECD and non-OECD regions. This allows us to actually trace the impact of goods produced outside the Netherlands.
Source: own data collection, as part of a project
Availability: Included in standard database (commercial and educational versions).

- BUWAL 250 database

Focus: Packaging materials (plastic, carton, paper, glass, tin plated steel and aluminium), energy, transport, waste treatments.
Source: BUWAL 250, 2nd edition. Fully documented and licensed database.
Availability: Included in standard database (commercial and educational versions).

- INDUSTRY DATA

Focus: Inventory data provided by industry associations. Mostly cradle to grave data.
Source: various, APME.
Availability: Included in standard database (commercial and educational versions).

- IDEMAT 2001 database

Focus: Engineering materials (metals, alloys, plastics, wood), energy and transport.
Source: Data collection from various sources supervised by Dr. Han Remmerswaal, Faculty of Industrial Design Engineering, Delft Technical University, The Netherlands.
Availability: Included in standard database (commercial and educational versions).

- FRANKLIN US LCI database

Focus: North-American inventory data for energy, transport, steel, plastics, processing.
Source: Data collected by Franklin Associates, USA. Fully documented and licensed database.
Availability: Included in commercial versions. Must be purchased separately for educational versions.

- Data archive

Focus: Materials, energy, transport, processing, waste treatment.
Source: Variety of older public sources (PWMI, BUWAL 132, ETH, SPIN, Chalmers, Kemna).
Availability: Included in standard database (commercial and educational versions).

- Dutch Concrete database and scripts

Focus: Dutch data related to all aspects of concrete production and use. Can be used in combination with scripts. Data and scripts are in Dutch.
Source: Betonplatform, the Netherlands.

Availability: Free for Dutch users with service contract. Available on request for other customers with service contract, however no language support is given. This database is protected against copying and export.

- IVAM 4.0 database
Focus: Materials, transport, energy and waste treatments. Mostly focused on Dutch data.
Source: Data collected by IVAM Environmental Research, Amsterdam, the Netherlands. Also ETH/BUWAL and PRé data included.
Availability: Purchase from IVAM Environmental Research. The price is 1575 Euro, excluding VAT.

- FEFCO database and scripts
Focus: European data on corrugated board production, partially based on BUWAL 250. Includes scripts to model the production and life cycle of corrugated board.
Source: FEFCO, European Association of Corrugated Board Manufacturers, Belgium.
Availability: Only together with SimaPro Light license through FEFCO. The accompanying report is available free of charge.

- Eco-invent data
The ecoinvent 2000 database is an up-to-date, consistent dataset of 2500+ generic processes for the Swiss and Western European area. With the release of this database by the Swiss Centre for Life Cycle Inventories, a major update for the BUWAL 250 and ETH-ESU 96 databases has been delivered.
PRé Consultants recognizes the value of this database and had become reseller of ecoinvent licenses. Currently we are making the database available in SimaPro format.
The ecoinvent 2000 database covers a broad range of processes in the following sectors:
- Energy
- Transportation
- Waste Management
- Building Materials
- Chemicals
- Washing agents
- Paper & board
- Agriculture

4.1.3. TEAM 4.0

Yes. Basic data are available in the TEAM package. Specific ones can be ordered.

4.1.4. RangeLCA 2.1

Yes. RDC-Environment developed its own database based on the different LCA projects they have performed. They continue to develop this database with the results of their new projects. It is recommended to buy the Ecoinvent Database for RangeLCA.

4.2. Up-to-date

4.2.1. Gabi 4

The professional database is based on the years 2002 to 2004. The new land use databases, released in spring 2007, will be delivered free of charge to all current Gabi users and will be an integral part of the standard Gabi package for new users.

4.2.2. SimaPro 7

The ecoinvent V2 version will be available in the summer of 2007.

4.2.3. TEAM 4.0

We depend on public data and project availability

4.2.4. RangeLCA 2.1

The RangeLCA database is under development.

4.3. European and International validity?

The question: *Do the data contained in the databases have an European and International validity?*

4.3.1. Gabi 4

• The database documentation format conforms to the ELCD (European Reference Life Cycle Data system) standards and all documentation is now based on the standards defined for European LCI database.
60 additional country specific power grid mix modules and the possibility to set up individual power grid mixes make GaBi 4 the most comprehensive LCA database on energy systems world-wide.
• All 110 ELCD data sets of the first European LCI database are included. The basis of these data is information from the participating industry (EAA, ECI, EUROFER, FEFCO and PlasticsEurope) and PE/LBP background data. PE International, LBP (University of Stuttgart) and other their partners enjoyed the confidence of the EU Commission in being chosen to set up of the first European LCI database.

4.3.2. SimaPro 7

Yes

4.3.3. TEAM 4.0

Most data are valid for Europe as most data are published in Europe.

4.3.4. RangeLCA 2.1

Yes

4.4. Adjustable

4.4.1. Gabi 4

All datasets using parameters are free for new settings entered by the user. As a matter of that any database object can be edited by the user.

4.4.2. SimaPro 7

Yes

4.4.3. TEAM 4.0

Yes, a module can be copied and pasted and the copy can be modified.

4.4.4. 'RangeLCA 2.1

Yes, a process can be removed from the database and it can be modified afterwards.

5. Similar LCA

The question: "*Has this software been used by a similar LCA study as ours?*"

5.1. Gabi 4

The Gabi software was especially designed for the use of LCA studies. Therefore Gabi has been used for LCA studies of all kinds of products (also vehicles) during the last 10 years.

5.2. SimaPro 7

We do not keep track of SimaPro by our users, often studies are confidential.

5.3. TEAM 4.0

Yes we modelled the life cycle of a vehicle, electronics equipment, eco-design etc.

5.4. RangeLCA 2.1

Yes, but only for the using phase of a vehicle

6. Organizations using the software?

The question: "*Could you provide us with a few examples of some organisations using your software?*"

6.1. Gabi 4

Clients come from all branches with a focus on materials, chemical, energy, automobile and electronics industry, e.g. Alcan, Asahi Kasei, Bayer, BP Chemical, DaimlerChrysler, DuPont, EMPA, General Motors, Motorola, Nokia, Rio Tinto, Siemens, Solvay, Sydney Waters, Toyota, Volkswagen, etc.
Universities using Gabi: Ecole Polytechnique de Montreal, Universität Jena, Norwegian University of Science and Technology, Forschungszentrum Karlsruhe, RWTH Aachen, Universität Wien, Deakin University, Tokyo University, National Taipei University etc.

6.2. SimaPro 7

Philips, Lear Automotive, VITO Belgium, AkzoNobel, Sara Lee, United Technologies, Gaz de France, TNO, TU Delft, AgfaGevaert, Heineken, FEFCO, Pfizer and various universities in Belgium.

6.3. TEAM 4.0

EDF, Corus-Steel, Arcelor, some construction products manufacturers, FAT (Research project), Unilever...etc.

6.4. RangeLCA 2.1

RangeLCA is used by RDC-Environment engineers.LCA of air compressors, LCA study on Raychem & competitive telephone splice closures, Comparative LCA of different elimination options of sewage sludge, LCA of consumable goods (Passenger car, white goods, Household detergent and packaging) and development of a formula for calculating the environmental performance of these products are LCA projects performed by RDC-Environment.

7. Reference tool

The question: *"Is your software widely accepted as a reference tool?"*

7.1. Gabi 4

As you can see in the reference list above, many leaders of different branches use Gabi as their standard LCA tool.

7.2. SimaPro 7

They have hundreds of users in more than 45 countries, making SimaPro the most widely used LCA software.

7.3. TEAM 4.0

Not communicated

7.4. RangeLCA 2.1

RangeLCA has been used to perform some studies for several Belgian and international companies.

8. The main assets of the software compared with the other softwares found on the market (TEAM, Gabi 4, SimaPro 5 and RangeLCA 2.1)?

8.1. Gabi 4

Gabi is a comprehensive tool. Due to the easy to understand structure and intuitive user interface, very complex and individual modelling is possible. One more time the comparison with the car you can quickly and easily learn how to drive a car, but understanding the complex structure and the background needs some time.
Parameters:
Compared to other available LCA tools one of the unique selling points is the possibility to use parameters for your calculation. Parameterised process models allow the definition of non-linear equations (e.g. non-

linear input-output relations) which are the basis for parameter variation and scenario balances. Therefore the set-up of one parameterized process can simulate thousands of different process characteristics (e.g. different operation modes etc.) The Gabi 4 Analyst facilitates this. Other new analysis features implemented in Gabi 4 are the Sensitivity Analysis and the user-friendly and Monte-Carlo Analysis.
Gabi 4 is the only software available on the market that can handle parameters.

Handling:
Gabi supports you with a lot of useful tools e.g. the consistency check helps to minimize systematic error possibilities.
Within the weak point analysis you can highlight or hide values that differ an entered percentage.

Presentation of results:
Several new easy-to-use balance-exploring functions and flexible filters for categories like "country" or the weak-point analysis helps you to analyze your results without the need of entering complicated settings.
In Gabi you can create different types of diagrams (bar, column, pie, scatter point or line charts) from each balance view. The charts relate to the current representation in the input or the output table, which is, by means of an appropriate switch of the balance view you can create diagrams of inventories, normalised balances or evaluated balances. The diagrams are created separately from the input and the output table.
The diagrams can be transposed and stacked. The user has a lot of possibilities to customise the diagram. Furthermore the diagram can be copied into several Microsoft applications like Word and PowerPoint.
Like in Excel it is possible to mark an area in the balance and create a diagram out of it.

Database:
A further unique selling point is the high quality LCI database delivered with the software. The standard database delivered with the Gabi 4 software is the professional database. This database contains 638 processes out of different branches and is an optimal basis to apply LCA.
Furthermore twelve extension databases are available for the Gabi 4 software. The wide range of the Gabi 4 data sets cover many industrial branches including metals (steel, aluminium and non-ferrous metals), organic and inorganic intermediate products, plastics, mineral materials, energy supply (steam, thermal energy, power grid mixes), end-of-life, coatings, manufacturing and electronics.

We are an official re-seller of the Swiss ecoinvent database which contains more than 2500 processes from different sectors including energy supply, building materials and building processes, chemicals, detergent ingredients, graphic papers, transport, disposal, agricultural products and processes. Purchasing the ecoinvent database includes a license of ecoinvent allowing full access to the ecoinvent download website.

8.2. SimaPro 7

-LCI model in SimaPro
In SimaPro, creating a model is easy compared to many competitors, due to the intuitive user interface. Linking a process with another process or a substance can be done with a few clicks, whereas in other software tools you need to follow a rather complex procedure. As a result, new users very quickly learn how to work in SimaPro. To further improve the learning curve, we offer extensive documentation including a User Manual and Tutorial (you can find these via Help in the menu of your SimaPro demo).
We also support advanced modelling for the assembly and disposal of complex products, via the product stages. This allows you to assign different product parts (assemblies) of product to different waste streams (disposal scenarios), with semi-automatic modelling of the waste treatments of the individual materials used in your product model. This will save you the time assigning each material to an individual waste treatment.
Furthermore we offer LCA wizards to help you start building your model in SimaPro, in the demo these can be found in the automatic Guided Tour script.
Indeed SimaPro does not support variables. Apart from practical and technical reasons, we feel that one needs to analyze the differences between different products, and analyzing a product one by one with different variables does not give you the desired comparison in one convenient overview. In SimaPro you can compare two or more products and immediately analyse the differences.

To make sure you can quickly adjust your model, we implemented various copy options for individual processes and partial or full models.

-Analysis of models in SimaPro
Generic model analysis is easily done in SimaPro using the process tree or network. Here you have the option to show various material or substance flows, use a cut-off to hide less important processes. Various navigation, find, and analysis options are given.

In the new SimaPro we will implement Monte-Carlo analysis. This works optimally in combination with the new ecoinvent database (www.pre.nl/ecoinvent) where uncertainty data are available in the Unit processes. We will support both analysis of a single model or a comparison of 2 models (with process coupling to make sure that processes that are used in both models are varied in the same way) and detailed graphs and tables will be available. Scenario analysis is not supported.

-Impact assessment in SimaPro
SimaPro is well known for its sophisticated impact assessment and analysis options. All results are presented in one convenient window. Impact assessment is possible on any part of your model, on any process or product stage, at any stage in your modelling.
Comparisons are possible on 2 or more processes (basically unlimited but 20 or more processes will not produce useful graphs). In the new SimaPro we will have further improved calculation times, in order to cope with the increasing complexity of models, such as those used in the ecoinvent database.
We are the only tool to support real-time analysis of impact assessment results, either via graphs, tables or the process tree via double click or right mouse button. This way it is possible to trace the origins of any result down to individual substances or processes. We offer an extensive range of filtering options both on impact assessment results, inventory results, process contribution as well as the process tree/network.
SimaPro is the only tool yet to support damage categories in impact assessment methods, such as with the Eco-indicator 99 method. To my knowledge SimaPro is also the only tool that shows process contributions, and shows you which substances in a model are not included in the selected impact assessment method.
Creating your own methods in SimaPro can be done easily. Furthermore for each method you can create new normalisation and weighting sets. Copying a method to adjust it to your own needs is very simple.

-Data collection
All software vendors offer data collection services, including PRé Consultants. With hundreds of users worldwide we can always try to bring you in contact with users that work in the same area.
With SimaPro you also get a free membership of the SimaPro e-mail user group where you can ask questions about data availability (similar to the open Eco-indicator user group). Further we offer our exclusive LCA search tool, see www.pre.nl/lcasearch.

-Maintenance
SimaPro comes with a free first year service contract included. This will give you both software and database updates, including new versions like SimaPro 6.0. Pricing of the service contract is competitive; please see our overview on www.pre.nl/simapro/simapro_prices.htm. Our in-house development team and experienced consultants make sure your problems or questions are solved quickly.

8.3. TEAM 4.0

The main advantage is the implementation of global and local variables in the model so that it is possible to easily make sensitivity analysis using a control panel that runs as many simulations in batch as you wish. One example is the FILMM syndicate (mineral wool), using the model and a control panel, the environmental manager can produce the Environmental Product Datasheet of any product in a short time. We can also develop a specific web interface also (for example the Unilever tool)/

8.4. RangeLCA 2.1

The RangeLCA software, developed by RDC-Environment, has innovating characteristics and much assets, compared to other LCA softwares, allowing to improve the reliability (and the credibility) of the outcomes. The basic concept is that the outcomes must show the diversity of the individual cases (instead of summarizing the average of possible cases and some alternative scenarios) and to integrate automatically the sensitivity analysis of the parameters. From a mathematical point of view, this concept results in the use of random variables (with probability distributions) instead of fixed values by producing a range of different values for which several iterations of calculation are carried out in order to produce statistical results. For the parameters with strongly variable data, we have taken all the values between two known extreme values by giving a probability of occurrence to each value. The produced results integrate a set of possible combinations for the variability of the various parameters and data in order to take into account possible synergy and compensation effects (simultaneous variation of all the variables). The classification of the results according to the parameter's value allows identifying the sensitivity of the result to this parameter. In the practice, it is possible to determine to which parameters the results are most sensitive. Thus, the software makes it possible to determine the sensitivity of the different results to each variable parameter of the model and all the other variable parameters remaining variable (and not, classically, all the other parameters being fixed). For the data inventory, this software also makes it possible to automatically calculate the contribution of each elementary flow (emissions in the air, water, soil...) and/or of each process to the total impacts. This allows focusing on key data searching.

9. The main drawbacks/problems encountered using the other softwares on the market

9.1. Gabi 4

One feature some users may miss is the multi-user capability of Gabi. The reasons for this are as follows:
PE Europe and IKP took the strategic decision during the development of Gabi4, not to make a multi-user version of the Gabi software, as the disadvantages of a multi-user database could be compensated to a high degree and the advantages can be fully applied.

Several reasons for this decision exist:
- The high performance of Gabi4 is based on the non-multi-user function. This performance will decrease, if more than one user is working with the database at the same time.
- The complexity of the Gabi4 database does not allow an easy multi- user functionality.
- Basically the database of Gabi4 can be used by two or more users at the same time. But if two users would work on the same process, this will cause inconsistencies in the modelling.

The advantages out of the non-multi-user capability of Gabi 4 are as follows:
- The Gabi database needs less effort for maintenance and has an easier handling than a multi-user database.
- The ultimate ambition of the Gabi LCA database is to provide a database with the highest quality. Checking the quality of the database entries is easier in a single user database.
- The exchange of data between two databases is quite easy in Gabi4.
- The first possibility is to exchange the data via drag-and-drop from one database to another database. Gabi notes all exchanged flows, processes and plans in a log file for an easy check-up, which files have other contents and different saving dates.
The second possibility is to export the data to Excel and import them again into another Gabi database.

9.2. SimaPro 7
Not communicated: They did the same remarks as with the main assets.

9.3. TEAM 4.0

Not communicated

9.4. RangeLCA 2.1

Not communicated.

10. Estimation for an academic license and multi-user of the software and various packs (database, training, service hotline, upcoming version upgrade...)

10.1. Gabi 4

   a)   Basically we sell two versions of Gabi professional:
•   Gabi 4 professional is intended for consulting and research facilities and commercial projects with the industry. Gabi 4 professional includes our professional database with BUWAL, APME and large IKP/PE-Data. The price for a Gabi 4 professional license is 7500€. The price for an additional license is 1500€.

•   The Gabi 4 lean provides a basic database which contains APME, BUWAL and selected IKP/PE data. The price of a Gabi 4 lean license is 2900€. The price of the second and any further licenses is 1500€.

   b)   Gabi academy versions:
•   Gabi 4 professional academy is intended for use in thesis, seminar paper, and dissertation and is provided with a 50 % discount. The functionality and the data are the same as in the regular professional version. The price for Gabi4 professional academy license is 3750€. The price for a second license is 750€.
•   The Gabi 4 lean academy provides a basic database which contains APME, BUWAL and selected IKP/PE data. The price of a Gabi 4 lean license is 1450€. The price of the second and any further licenses is 750€.

By purchasing the Gabi 4 software no additional fees for software updates or for the support by phone and mail from PE Europe have to be paid. All Gabi licenses are valid indefinitely. There is no time limit for the use of any Gabi product.

10.2. SimaPro 7

Note that academic licenses cannot be used for commercial activities, including consultancy type of work or research projects with industry.
SimaPro Multi-user educational (indefinite license): 2400€.
Ecoinvent license for Multi-user educational: 1200€.
Franklin US LCI database: 500€.

Free first year service contract
One year service contract renewal after one year: 600€.
Two years service contract renewal after one year: 1140€. (-5%)
Three years service contract renewal after one year: 1620€. (-10%)
Service contracts are optional. If you order SimaPro together with SimaPro training we can offer 10% discount on the training.

10.3. TEAM 4.0

License "pro" (for consultant): 10 000 Euro per year, included a contract maintenance (8 hours).

10.4. RangeLCA 2.1

License for 4 years contract including service costs 10000€. The purchase of the Ecoinvent database is highly recommended and costs 1200€.