



**ECO-innovation**  
WHEN BUSINESS MEETS THE ENVIRONMENT

**CIP Eco-innovation  
Pilot and market replication projects  
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# **Deliverable D3.1 Tools Analysis**

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## INTRODUCTION

The information included in this report is the result of the work done under the LiMaS project. It does not intent to be an exhaustive analysis of all the tools available in the market, neither a detailed analysis of them.

The report reflects the opinion of the authors based on the public information available from the different software tools. Therefore it should not be considered as "actual user" point of view. In all cases, the authors suggest to visit the referred links for more information about the tools.

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## 1 GENERAL SOFTWARE TOOLS EVALUATION

### 1.1 Environmental Assessment Tools

There are numerous Life Cycle Assessment tools available, typically licensed for in-house use in companies and most of the large brandname manufacturers of energy-using products make use of these tools, but among small and medium sized companies this software is rarely used by the SMEs directly, rather as a consulting tool of external experts. But even this software supported LCA use with guidance from external consultants is done by only very few SMEs at all: The leading LCA software tools on the market currently are **GaBi** from PE International and **SimaPro** from PRÉ. Other major players in the market are **Umberto** from ifeu and specifically for the French market **EIME** of CODDE, now being part of Bureau Veritas. Historically CODDE originated from the French electrical and electronics association and consequently EIME covers this sector specifically. PE claims that more than 500 companies and institutions make use of their (consulting services) and software tools<sup>1</sup>. As this covers all kinds of branches and mainly large companies the dissemination level among SMEs of the Energy-using Products sector can be assumed to be very minor. Throughout the 2005 EcoDesign Awareness Raising Campaign for Electrical and Electronics SMEs a couple of eco-design case studies have been identified, some of them using LCA software tools, but mostly in funded pilot projects. This leads to the estimate, that there are rarely more than a few 100s SMEs in the Energy-using Products sector with LCA experience, rather less than 100 – compared to more than 170.000 SMEs in the electrical and electronics sector in the EU. The number of SMEs applying (even streamlined or abridged) Life Cycle Assessments regularly for eco-design, supplier selection or compilation of environmental product declarations is presumably less than 20 EU wide in the Energy-using Products sector. Actually, we are not aware of any single SME applying LCA regularly. The existing LCA tools usually also

<sup>1</sup> Note, this might comprise also consultants using the software tools to provide services for more companies than only these 500. It can be assumed however, that a regular implementation of LCA based product design is done only in companies with an own licensed software version.

provide additional features for cost calculations, but actually – furnished by a statement of one leading software supplier – such parallel cost accounting is not done by the companies, even not the large ones. Cost accounting is done in the standard enterprise resource planning (ERP) systems, but the added value of linking directly this cost data with the LCA data is either not recognised by the companies or data exchange between the LCA software and ERP systems is not sufficiently supported by suitable interfaces and limited compatibility.

The widespread use of LCA tools among SMEs is also hampered by data availability barriers: First of all many databases are only available on a commercial, partly very costly basis (including for the electronics sector ecoinvent 2.0 and the generic datasets of the GaBi, SimaPro and EIME software tools) and public data is very limited and rarely appropriate for product specific declarations and eco-design activities: The most comprehensive public and free LCA data for energy-using products still is the **EuP EcoReport** excel tool developed by VHK in 2005 for the European Commission as a standard tool for the EuP Preparatory Studies. This software tool, comprising generic datasets for the most relevant materials and electronics components (although without much distinction of component types and printed circuit board types), can be used as a “quick & dirty” assessment tool and can be assumed to be used by some SMEs for internal purposes, but is not meant for publishable product LCAs and can provide only very rough guidance for any eco-design activity. Whereas the EuP EcoReport is an excel-spreadsheet, which makes it easy to use and to understand for any user familiar with excel. There are also webbased LCA tools. Probably the most sophisticated is the **Greenfly** tool from Australia, which works with a very straight-forward user interface, displaying the results of the LCA as data entries are made. Greenfly does not target at a specific branch, and thus contains only very few electronics specific databases and in no way this tool is suitable for very electronics dominated products (such as computers). Nevertheless, regarding userfriendliness, free data access, and visualisation of results this tool might be the most promising approach for a webbased LCA tool (Figure 1). Even more, this tool provides some additional explanations on environmental impacts of the various materials and components and allows to compile directly an environmental product declaration with the major environmental characteristics of a product. Since 2008 a test version (alpha version) is available and it is not clear yet, whether Greenfly will actually be launched.

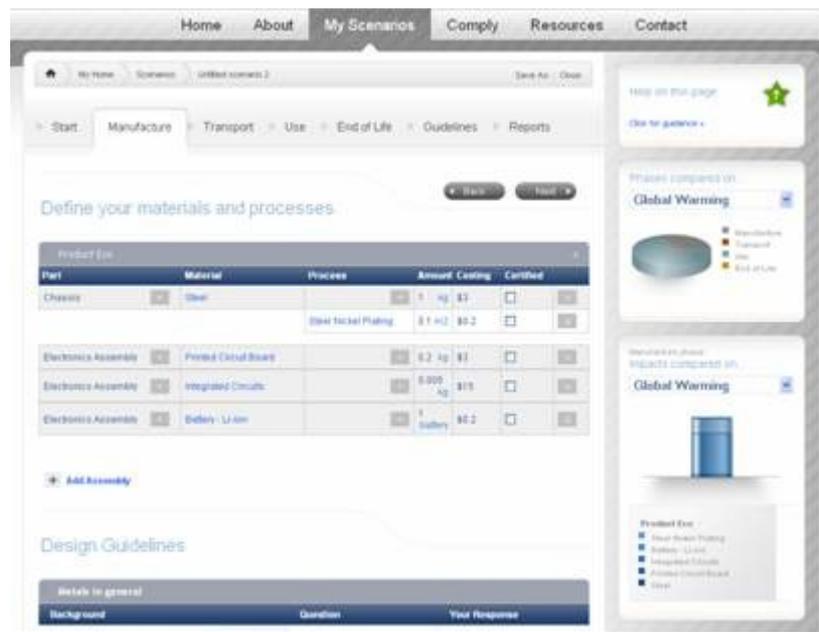


Figure 1: Screenshot Greenfly

The **eVerDEE** tool is a webbased tool to support explicitly SMEs to compile a simplified LCA. Also eVerDEE has no specific branch focus. **LCALight** is a screening tool for the electrical and electronics sector intended to be used not only by environmental experts, but is not maintained for a couple of years now, meaning the generic datasets for electronics specifically can be considered outdated in the meantime.

Other public databases, such as the **ELCD** and the German **ProBas** database are scheduled to provide more datasets in the future, ProBas explicitly also for electronics, but as of today these databases just do not provide sufficient data for the electrical and electronics sector, neither specific resources, nor production processes for the key sub-components.

Throughout recent years it was noticed frequently that there is a need to provide interfaces between LCA tools and product planning, accounting and engineering software tools used in SMEs, to make use of Bills-of-Materials used in the companies anyhow or CAD (Computer Aided Design) systems. However, the typical BOM does not fit standard nomenclature of datasets in LCA databases making major adaptations necessary, which are typically not undertaken.

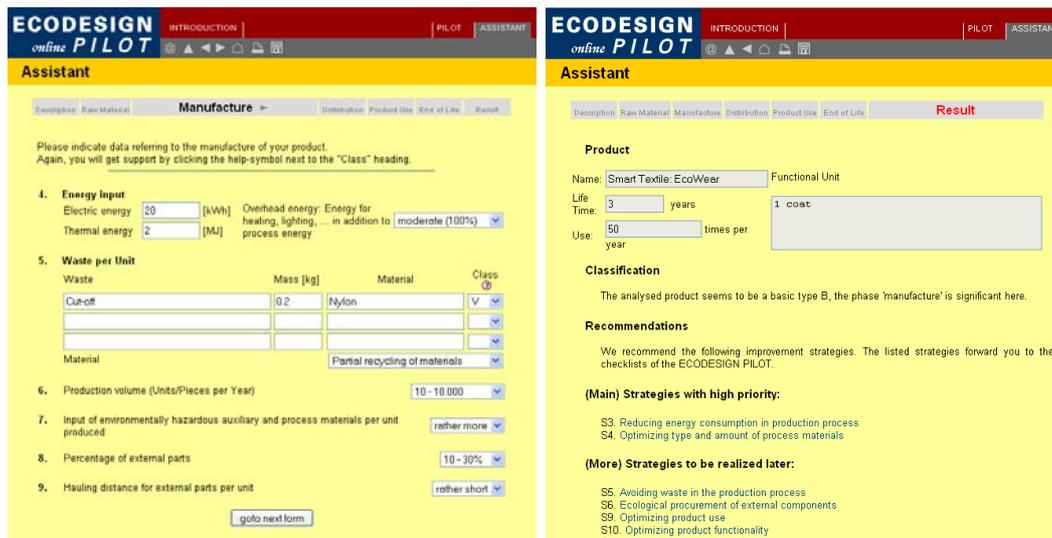
Concluding, the current status of using LCA software tools in SMEs in the Energy-using Products sector can be summarised as follows:

Availability of software tools:	Numerous commercial tools available, some free tools and databases
Use in SMEs of the Energy-using Products sector:	Few "pilot applications", close to no use for day-to-day business
Use of other company internal data:	BOM, CAD data transfer hampered by incompatibilities

## 1.2 Eco-design Tools

LCA software might serve various purposes, among them product related eco-design, or "Design for Environment". However, there are some tools dedicatedly for eco-design, which incorporate some LCA know-how to guide the user directly to the most relevant

environmental aspects. Maybe the most user-friendly and targeted tool is the **EcoDesign Pilot** by TU Vienna: This webbased tool guides the user based on some key entries to most appropriate eco-design strategies. Consequently this tool does not require to compile a full LCA. As additional features information on e.g. RoHS and WEEE requirements are provided with this software, although not on a level that allows a direct tracking of legal compliance nor a regular update regarding changes of the relevant legislation. The EcoDesign Pilot explicitly addresses the electrical and electronics sector. In general, the EcoDesign Pilot can be considered an educative tool to be used by product managers and developers and not solely environmental experts (see Figure 2). The tool pragmatically provides guidance, but is not suitable for compiling public information nor does it provide an interface to any other software system, consequently has to be used "stand alone".



The screenshot shows two side-by-side views of the EcoDesign Pilot web interface. The left view is the 'Manufacture' entry screen, and the right view is the 'Results' screen.

**Manufacture Entry Screen (Left):**

- Navigation:** Description, Raw Material, **Manufacture**, Distribution, Product Use, End of Life, Result.
- Instructions:** Please indicate data referring to the manufacture of your product. Again, you will get support by clicking the help-symbol next to the "Class" heading.
- 4. Energy Input:**
  - Electric energy: 20 [kWh]
  - Thermal energy: 2 [MJ]
  - Overhead energy: Energy for heating, lighting, ... in addition to process energy: moderate (100%)
- 5. Waste per Unit:**

Waste	Mass [kg]	Material	Class
Out-off	0.2	Nylon	V

Material: Partial recycling of materials
- 6. Production volume (Units/Pieces per Year):** 10 - 10.000
- 7. Input of environmentally hazardous auxiliary and process materials per unit produced:** rather more
- 8. Percentage of external parts:** 10 - 30%
- 9. Hauling distance for external parts per unit:** rather short
- Buttons:** goto next form

**Results Screen (Right):**

- Navigation:** Description, Raw Material, Manufacture, Distribution, Product Use, End of Life, **Result**.
- Product:**
  - Name: Smart Textile: EcoWeer
  - Functional Unit: 1 coat
  - Life Time: 3 years
  - Use: 50 times per year
- Classification:** The analysed product seems to be a basic type B, the phase 'manufacture' is significant here.
- Recommendations:** We recommend the following improvement strategies. The listed strategies forward you to the checklists of the ECODESIGN PILOT.
  - (Main) Strategies with high priority:**
    - S3 Reducing energy consumption in production process
    - S4 Optimizing type and amount of process materials
  - (More) Strategies to be realized later:**
    - S5 Avoiding waste in the production process
    - S6 Ecological procurement of external components
    - S9 Optimizing product use
    - S10 Optimizing product functionality
    - S11 Increase product durability

Figure 2: Screenshot Ecodesign Pilot – Manufacture entries and Results

Similarly **TESPI** (Tool for Environmentally Sound Product Innovation) provides guidance, which environmental strategies to consider for product development, but also this one is a "stand alone" solution.

The Ecodis project (Ecodesign Interactive Systems), funded under FP6, developed a comprehensive set of ecodesign tools (**ECODESIGN X-Pro, X-Change, X-Mat, X-Rec, Roadmap**), aiming specifically at SMEs. Target sectors are automotive and parts, electronic / electric / consumer electronics, mechanical, aeronautic / aeronautic equipment, materials. These tools provide some features, which allow an efficient integration in the business environment, such as interface with usual CAD, PDM, ERP systems, direct import of parts/suppliers data, traceability (part number, suppliers contact etc.). Compliance management for RoHS and REACH are implemented.

A similar approach to Greenfly of instantly displaying the impact results, but in this case even directly for design decisions is implemented in **SolidWorks SustainabilityXpress** (Figure 3). As SolidWorks is a market leader in 3D mechanical CAD software tools this provides a working environment product designers are already familiar with, which can be considered an important aspect to implement ecodesign in companies.

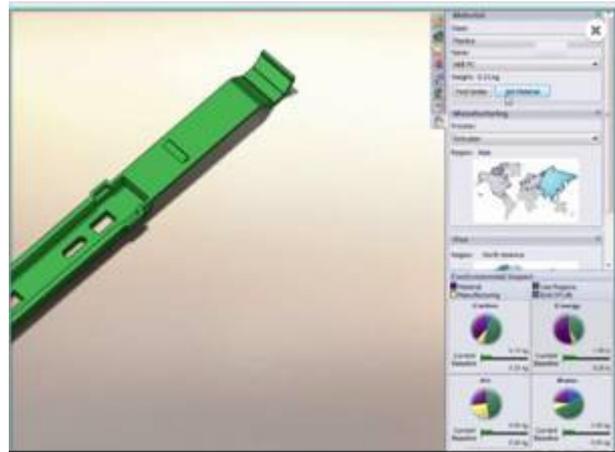


Figure 3: Screenshot SolidWorks SustainabilityXpress

Other eco-design tools are “paper based”, i.e. rather a compilation of general environmental strategies regarding products, or methodological approaches, such as the **Eco-Efficiency Analysis**, which is offered by BASF as a consultancy service, but not as a software tool meant for the end-user.

Concluding, the current status of using eco-design software tools in SMEs in the Energy-using Products sector can be summarised as follows:

Availability of software tools:	Inhomogeneous software landscape, very limited number of commercial tools known, but CAD tool approach is promising; some free tools and databases
Use in SMEs of the Energy-using Products sector:	Few “pilot applications”, close to no use for day-to-day business, serves rather an educational purpose
Use of other company internal data:	Conventional CAD tools extended with eco-design support features

### 1.3 Compliance Management Tools

Maybe the most important driver for eco-innovations in SMEs is legislation, as this sets “must do” requirements regarding the product design. Keeping track of legislative requirements is essential also for SMEs and a couple of software providers offer solutions to track globally the development of the legislation and to allow a regular webbased update. Among the most prominent solutions for the electrical and electronics sector are **C2P Navigator** and **C2P Enterprise** and **EIATRack**. Given the continuous evolvement of new or revised legal requirements a frequent update regarding latest developments is essential for an efficient compliance management, although even very comprehensive information will not be sufficient to answer all practical questions arising from a company’s specific situation. C2P Enterprise allows a webbased access and management of relevant documents, providing access to more than 4.000 global regulations and supporting documents in an intelligent structure. Figure 4 depicts a screenshot of the legal information section of C2P, comprising news, comments from experts, and features to customize the related knowledge management. EIATRack is targeting at the electrical and electronics sector specifically, tackling product and material requirements. Tools such as C2P and EIATRack can be considered the most efficient way to comply with the essential requirement for environmental management systems to keep track of all relevant legislation. Whereas large companies have implemented these or other tools to track legal requirements the situation might be different in SMEs. Use of such a tool typically is the responsibility of an environmental manager.



Figure 4: Screenshot C2P

TechniData’s **Environmental Performance Solutions** are presumably the most comprehensive toolset for environmental management supporting any kind of standard business processes ranging from plant permits to calculation and documentation of emissions, compliance management etc. TechniData traditionally is the EHS solution provider for SAP systems, which consequently means, that mainly the needs of the chemical industry and similar branches are served, although with the IMDS and related documentation needs also the suppliers for the automotive sector are among the users of TechniData’s software tools. SAP traditionally is for large enterprises and so are TechniData’s solutions. However, given this close link to the leading Enterprise Resource Planning system TechniData’s software presumably is the one, which has been developed with a maximum integration into an existing software landscape in mind. Dissemination level among electrical and electronics SMEs can be assumed to be low.

The **Compliance Agent** by iPoint Systems addresses some of the relevant legislation for the electronics sector, but not all. For each product display of the current compliance

status is displayed and a tracking of supplier data and customer requirements is supported. A main feature is an LCA module with database and an interface with CAD tools.

E2open's **Eco-Compliance Solution** includes the ability to gather evidence of compliance with a fully documented audit trail and manage the analysis, tracking and reporting of part, product and supplier compliance levels, providing a comprehensive RoHS compliance risk management solution.

The **ARAS Innovator** as a webbased tool is an integrated supply chain management tool. The webbased solution manages each part's RoHS status and supplier Material Compliance Declaration documents online. See Figure 5 for the implemented RoHS dashboard, which visually displays the current compliance status for the different legal requirements globally. Features include part tracking & status, supplier part compliance, data exchange with formats including IPC-1752, material declarations, compliance history & audits, manage regulatory exemptions and configure processes to handle exceptions, run reports on a part-by-part, bill of materials, and supplier basis.



The screenshot shows a web browser window titled 'Report: Compliance Report - Microsoft Internet Explorer'. The main heading is 'Compliance Report'. Below the heading, there is a form with the following details:

- Part Number: IDSP-PCB-009
- Part Name: Digital Signal Processor RoHS Daughter Board
- Description: description

Below the form is a table with the following data:

BP#	Supplier Part	Name	Vendor	RoHS for China	RoHS for Japan Green	RoHS for CA Prop 28/50	RoHS for EU
IPS-03993	MVP5060311	12v supply module	All Electronics Corp.	Fail	OK	OK	OK
IDSP-IC-1944	CL98111	DSP Module	LG Electronics	Fail	OK	Fail	Fail
	DSP-0111-A06	DSP Packaged Unit	Kustson Code Limited	OK	OK	OK	OK
ICAP-0333	240897-MEC	Capacitor SM795 330PF	Matsushita Electrical Components	No Data	No Data	No Data	No Data

Figure 5: Screenshot ARAS Innovator

Concluding, the current status of using compliance management software tools in SMEs in the Energy-using Products sector can be summarised as follows:

Availability of software tools:	Several commercial tools in the market, including conventional ERP tools with compliance features and links to databases
Use in SMEs of the Energy-using Products sector:	Assumed widespread use plus "home grown" solutions
Use of other company internal data:	Supply chain data (components, suppliers)

## 1.4 Summary

Software tools recommended for a detailed assessment:

Tool	Specifics of core interest to LiMaS approach:	Further information
GreenFly	Easy to use, webbased, well designed tool for abridged LCAs	demonstration video and free log-in to trial version: <a href="http://www.greenflyonline.org/index.php">http://www.greenflyonline.org/index.php</a>
SolidWorks SustainabilityXpress	Standard 3D CAD tool with implemented LCA feature, perfect integration in conventional software based mechanical design process	demonstration video at: <a href="http://www.solidworkslaunch.com/en/Default.aspx">http://www.solidworkslaunch.com/en/Default.aspx</a> ; tutorial and product information at <a href="http://www.solidworks.com/sw/education/7375_ENU_HTML.htm">http://www.solidworks.com/sw/education/7375_ENU_HTML.htm</a>
ECODESIGN X-Pro, X-Change, X-Mat, X-Rec, Roadmap	Comprehensive set of tools for ecodesign and materials management, simplified LCAs, developed for target group SMEs	Description of features at: <a href="http://www.ecomundo.eu">http://www.ecomundo.eu</a> ; product brochure: <a href="http://www.ecodis.org/downloads/Ecodesign-Solutions-2008.pdf">http://www.ecodis.org/downloads/Ecodesign-Solutions-2008.pdf</a> ; no direct access to (trial) software; further information requested, reply from ecomundo is pending
C2P Enterprise	Tracking of legal compliance including related document management	Brochures and information available at: <a href="http://www.complianceandrisk.com/products09.html">http://www.complianceandrisk.com/products09.html</a>
ARAS Innovator	Comprehensive, webbased RoHS compliance / supply chain management; approach might be suitable also for other legal requirements, such as REACH	Information, screenshots and download at <a href="http://www.aras.com/solutions/RoHS-WEEE.aspx">http://www.aras.com/solutions/RoHS-WEEE.aspx</a>

It is assumed, that "traditional" LCA tools (GaBi, SimaPro, Umberto) are all well known to the project partners and do not need further investigation, but consideration to identify the market gap for any LiMaS solution.

We are not aware of any environmental tool providing an interface with the relevant electrical circuitry design tools, whereas some claim to support CAD tools. In fact there is a major gap between the electrical design process and "eco-design" or eco-innovation. Furthermore, there are some tools with general guidelines on eco-design, but none with dedicated up-to-date information on best-available technologies for specific product categories.

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
<b>Environmental management system assistance</b>							
EMAS Toolkit for small organisations <a href="http://www.inem.org/new_toolkit/">http://www.inem.org/new_toolkit/</a>	environmental management guide	no branch focus	EMS relevant aspects	no	moderate	yes	focus on implementing an environmental management system (eco-design to be seen as a sub-aspect)
Ecomapping <a href="http://www.inem.org/default.asp?menu=93&amp;ShowNews=ON&amp;Artikel=34">http://www.inem.org/default.asp?menu=93&amp;ShowNews=ON&amp;Artikel=34</a>	screening of environmental performance of an organisation	no branch focus	EMS relevant aspects	no	moderate	yes (registration required)	focus on implementing an environmental management system (eco-design to be seen as a sub-aspect)
EMAS easy <a href="http://www.emas-easy.eu/">http://www.emas-easy.eu/</a>	environmental management guide	no branch focus	EMS relevant aspects	no	low	yes (registration required)	
<b>Screening / Management methodologies and tools</b>							
EcoScan	Screening LCA tool	no branch focus	Full life cycle	Eco-indicator 99	low	yes	download website is not online anymore
Fraunhofer IZM / EE Toolbox <a href="http://www.pb.izm.fhg.de/ee/070_services/75_toolbox/index.html">http://www.pb.izm.fhg.de/ee/070_services/75_toolbox/index.html</a>	screening tools	electrical / electronics	various life cycle aspects	no	moderate	yes (toxicity assessment)	
KEPI – Key Environmental Performance Indicators <a href="http://europa.eu.int/comm/environment/ipp/pdf/nokia_mobile_05_04.pdf">http://europa.eu.int/comm/environment/ipp/pdf/nokia_mobile_05_04.pdf</a>	design indicators	mobile phones	various life cycle aspects	development of indicator based on weighting	low	published	serves as a good example what are the decisive design parameters (not directly transferable to other product groups)
TESPI – Tool for Environmentally Sound Product Innovation <a href="http://www.ecosmes.net/tespi/login2">http://www.ecosmes.net/tespi/login2</a>	benchmarking tool	no branch focus	various life cycle aspects	no	moderate	yes (registration required)	sets environmental aspects in context to product features / customer satisfaction, recommended to set priorities for redesign options
Smart ecoDesign™ (Electronics) strategy wheel <a href="http://www.cfsd.org.uk/etmuel/tools.htm#stratwheel">http://www.cfsd.org.uk/etmuel/tools.htm#stratwheel</a>	screening tool	electronics	various life cycle aspects	no	low	yes	
QWERTY / EE concept <a href="http://ieeexplore.ieee.org/xpl/freeabs_al.jsp?tp=&amp;arnumber=1331571&amp;isnumber=29408">http://ieeexplore.ieee.org/xpl/freeabs_al.jsp?tp=&amp;arnumber=1331571&amp;isnumber=29408</a>	eco-efficiency assessment tool	electrical / electronics	recycling	partly based on eco-indicator 99	detailed	published	rather a "policy" tool than a design tool
Eco-Efficiency Analysis (BASF) <a href="http://corporate.basf.com/en/sustainability/oekoeffizienz/?id=V00-Ipa6V7eHlbcp0Lt">http://corporate.basf.com/en/sustainability/oekoeffizienz/?id=V00-Ipa6V7eHlbcp0Lt</a>	eco-efficiency assessment tool	chemical industry background, but also applicable for other branches	full life cycle	yes	detailed	no, but methodology principles published	
ECODESIGN X-Pro© <a href="http://www.ecodis.org/index.html%3Fpage_name=process.html">http://www.ecodis.org/index.html%3Fpage_name=process.html</a>	Assessment tool	Industrial processes	Processes units (Input/Output)	no		no	Industrial processes input/output analysis and conversion to LCI data
<b>Life cycle assessment methodologies and databases</b>							
Eco-Indicator 99 <a href="http://www.pre.nl/eco-indicator99/default.htm">http://www.pre.nl/eco-indicator99/default.htm</a>	impact assessment methodology	no branch focus	yes	yes	detailed	methodology report published	state-of-the-art in one-indicator LCAs
ProBas <a href="http://www.probas.umweltbundesamt.de/php/">http://www.probas.umweltbundesamt.de/php/</a>	life cycle data (database)	no branch focus	yes	no	-	yes	in German only, limited data for electrical / electronics sector
EcoInvent <a href="http://www.ecoinvent.ch/">http://www.ecoinvent.ch/</a>	life cycle data (database)	no branch focus	yes	no	-	no	extended data for electrical / electronics sector in version 2.0, implemented in several commercial LCA tools

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
APME/Boustead data <a href="http://www.plasticseurope.org/Content/Default.asp">http://www.plasticseurope.org/Content/Default.asp</a>	life cycle data	plastics industry	yes	no	-	yes	data on some basic / bulk materials
Boustead Model 5.0 <a href="http://www.boustead-consulting.co.uk/">http://www.boustead-consulting.co.uk/</a>	life cycle data	No branch focus	yes	no	detailed	no	13.000 datasets, but most of them on energy and transportation in the various countries; very limited data with relevancy for electronics
ELCD database v 1.0.1 <a href="http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm">http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm</a>	life cycle data (database)	no branch focus	yes	no	detailed	yes	European Life Cycle Database, 115 datasets, but none electronics specific
<b>Life cycle assessment tools – screening and full-scale</b>							
EIME - Environmental Information and Management Explorer <a href="http://www.codde.fr/eng/EIMEOutilEcocognition.html">http://www.codde.fr/eng/EIMEOutilEcocognition.html</a>	LCA tool	electrical / electronics	full life cycle	no	detailed	no	
eVerdEE <a href="http://www.ecosmes.net/cm/navContent.s?l=EN&amp;navID=info&amp;subNavID=1&amp;pagID=6">http://www.ecosmes.net/cm/navContent.s?l=EN&amp;navID=info&amp;subNavID=1&amp;pagID=6</a>	LCA tool	no branch focus	yes	yes	detailed	yes (registration required)	specifically for SMEs
EUP EcoReport <a href="http://ec.europa.eu/energy/efficiency/ecodesign/doc/studies/eup_ecoreport_v5.xls">http://ec.europa.eu/energy/efficiency/ecodesign/doc/studies/eup_ecoreport_v5.xls</a>	assessment tool	electrical / electronics	full life cycle	no	moderate	yes	developed for basic product group studies, not as an operative eco-design tool
GaBi <a href="http://www.gabi-software.com/">http://www.gabi-software.com/</a>	LCA tool	no branch focus	full life cycle	optional	detailed	no	LCC feature
GaBi DFX <a href="http://www.gabi-software.com">www.gabi-software.com</a>	LCA tool	industrial (automotive and electronic) and commercial application	yes	yes	detailed	no	
SimaPro <a href="http://www.pre.nl/simapro/">http://www.pre.nl/simapro/</a>	LCA tool	no branch focus	full life cycle	optional	detailed	no	more than 5,000 data sets, LCC feature
GEMIS 4.5 <a href="http://www.oeko.de/service/gemis/">http://www.oeko.de/service/gemis/</a>	LCA tool	no branch focus	full life cycle		detailed	free of charge	6,100 datasets
Green-e <a href="http://www.green-e.ch/">http://www.green-e.ch/</a>	Calculation of companies' environmental footprint	no branch focus	full life cycle	yes	detailed	no	Comes with ecoinvent database, covers also cost accounting
Umberto <a href="http://www.umberto.de/en/">http://www.umberto.de/en/</a>	LCA tool	no branch focus	full life cycle	optional	detailed	no	
IDEMAT <a href="http://www.idemat.nl/">http://www.idemat.nl/</a>	life cycle and materials data (database)	no branch focus	full life cycle	optional	detailed	no	
LCA-E <a href="http://extra.ivf.se/lcae/">http://extra.ivf.se/lcae/</a>	screening LCA tool	printed circuit boards / electronic assemblies	full life cycle	optional	moderate	yes	in Swedish only

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
LCALight <a href="http://project.imi.chalmers.se/LCALight/Codenew/GUI-LCALight-Frame.asp?selected_project_id=Anonymous10310514157661">http://project.imi.chalmers.se/LCALight/Codenew/GUI-LCALight-Frame.asp?selected_project_id=Anonymous10310514157661</a> <a href="http://www.dantes.info/Tools&amp;Methods/Software/webbasedtools_LCALight.html">http://www.dantes.info/Tools&amp;Methods/Software/webbasedtools_LCALight.html</a>	screening LCA tool	electrical / electronics	full life cycle	no	moderate	yes	useful to train LCA principles
World Wide LCA Workshop <a href="http://workshop.imi.chalmers.se/workshop/">http://workshop.imi.chalmers.se/workshop/</a>	project management & LCA tool	no branch focus	yes	yes	moderate	yes	
EuPmanager <a href="http://www.simpple.com/index.php?option=com_content&amp;view=article&amp;id=73&amp;Itemid=72">http://www.simpple.com/index.php?option=com_content&amp;view=article&amp;id=73&amp;Itemid=72</a>	LCA tool	EuP products	yes	no	moderate	no	Transposition of the EuP EcoReport (see above) into a user-friendly software tool
CMLCA <a href="http://www.cml.leiden.edu/software_cmlca.jsp">http://www.cml.leiden.edu/software_cmlca.jsp</a>	LCA tool	no branch focus	yes	yes	moderate	yes (non-commercial use only)	supports technical aspects of LCA procedure, not the procedural aspects (it assumes the user is aware of the basic principles of LCA)
EIO-LCA <a href="http://www.eiolca.net/">http://www.eiolca.net/</a>	LCA tool regarding economic activities	no branch focus	full upstream modelling	no		yes	Based on economic parameters
Greenfly <a href="http://www.greenflyonline.org/index.php">http://www.greenflyonline.org/index.php</a>	designing tool using LCA and EcoDesign	no branch focus	yes	no	Moderate (entries for electronics only IC, PCB, 3 batteries)	yes (alpha version)	intended to designers, engineers, manufactures and management, bulk materials only, not suitable for electronics circuit design; entries directly linked to useful ecodesign strategies
ECO-it <a href="http://www.pre.nl/eco-it/default.htm">http://www.pre.nl/eco-it/default.htm</a>	Screening LCA tool to identify life cycle impacts rapidly	no branch focus	yes	Eco-indicator 99	moderate	no, but low-cost	200 Eco-indicator 99 scores for commonly used materials as well as production, transport, energy and waste treatment processes
ECO-it 1.4 <a href="http://www.pre.nl">http://www.pre.nl</a> & <a href="http://www.ihobe.net">www.ihobe.net</a>	Screening LCA tool to identify life cycle impacts rapidly	no branch focus	yes	RECIPE	moderate	free for Basque Country enterprises via IHOBE	RECIPE and CO <sub>2</sub> -eq Indicators for commonly used materials as well as production, transport, energy and waste treatment processes
REGIS 2.3 <a href="http://www.sinum.com/htdocs/d_software_regis.shtml">www.sinum.com/htdocs/d_software_regis.shtml</a>	Input-output analysis of a company	no branch focus	Cradle-to-gate			no	comes with ecoinvent database, intended to support environmental management systems, claims to be one of the most frequently sold company LCA tools
TEAM 4.0 <a href="http://www.ecobilan.com/uk_lcatool.php">http://www.ecobilan.com/uk_lcatool.php</a>	Screening LCA tool	no branch focus	yes	yes	moderate	no	Approx. 300 data modules
ECODESIGN X-Change© <a href="http://www.ecodis.org/index.html%3Fpage_name=lifecycle.html">http://www.ecodis.org/index.html%3Fpage_name=lifecycle.html</a>	LCA tool	no branch focus		no	low	no	Not available yet
OpenLCA <a href="http://www.openlca.org/index.html">http://www.openlca.org/index.html</a>	LCA tool	no branch focus	yes	no	moderate	yes	Ongoing project started in 2007 to develop a freely available software for Life Cycle Analysis with new application fields, in education, training and peer-review, openLCA beta 1.1 released in November 200
OpenLCAconverter <a href="http://www.openlca.org/Overview_37_0.html">http://www.openlca.org/Overview_37_0.html</a>	Exchange between some of the most important LCA data	no branch focus	yes	no	moderate	yes	Database exchange between different formats (EcoSpold, ISO@Spine and ELCD)

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
	formats						
AIST-LCA <a href="http://www.aist-riss.jp/main/modules/product/software/nire.html">http://www.aist-riss.jp/main/modules/product/software/nire.html</a>	LCA tool	no branch focus	Yes	Eco-indicator 95 Ecopoint and EPS	detailed	no	Japanese LCA software, principal method is the Japanese developed LIME (Life -cycle Impact assessment Method based on Endpoint modeling), since Version 5 also in English and follows ISO 14040 series <a href="http://www.aist-riss.jp/LCA ver5">http://www.aist-riss.jp/LCA ver5</a>
ATHENA Eco Calculator <a href="http://www.athenasmi.org/tools/ecoCalculator/index.html">http://www.athenasmi.org/tools/ecoCalculator/index.html</a>	designing tool	construction sector	yes	no	low	yes (generic version )	designed for architects, engineers in construction sector only, instant comparison of different building design
BEES 4.0 <a href="http://www.bfrl.nist.gov/oea/software/bees/">http://www.bfrl.nist.gov/oea/software/bees/</a>	LCA tool	construction sector	yes	yes	detailed	yes	aimed at designers, builders, and product manufacturers in construction sector, adapted for application to biobased products
E3DATABASE <a href="http://www.e3database.com/">http://www.e3database.com/</a>	LCA based energy modelling tool	no branch focus	Yes only energy analyse		Detailed only for energy	no	a tool in the framework of LCA for the modelling of energy chains by experts, only GHG and Air pollutant emissions are considered
E!SANKEY <a href="http://www.e-sankey.com/de/">http://www.e-sankey.com/de/</a>	Tool for Sankey diagrams	no branch focus	n.a.	no	no analyse	no (only 30 days trial version)	a tool for visualizing of material flows, energy or costs
ECO-BAT 3.0 <a href="http://www.eco-bat.ch/">http://www.eco-bat.ch/</a>	LCA tool	construction sector	yes		moderate	no (only 10 days trial version)	rapidly assess the environmental impacts of a building, including Design for environment (DfE, DfR) approaches
ECO-QUANTUM	Impacts assessment tool	construction sector	yes	n.a.		No	policy instrument to determine environmental targets for housing programmes /include implications and risks of nanotechnology
JEMAI-LCA 2.0 <a href="http://www.jemai.or.jp/CACHE/lca_details_lcaobj198.cfm">http://www.jemai.or.jp/CACHE/lca_details_lcaobj198.cfm</a>	LCA tool	no branch focus	yes	Eco-indicator 95 Ecopoint and EPS	detailed	No	using electricity data and import model of 200 countries/regions
KCL-ECO 4.0 <a href="http://www.kcl.fi/page.php?page_id=166">http://www.kcl.fi/page.php?page_id=166</a>	LCA tool	no branch focus	yes	EcoIndicator 99 and DAIA 98		no	sustainability indicators and data base related for the forest industry's value chain
LCA EVALUATOR 2.0 <a href="http://greendeltac.com/index.php?id=112">http://greendeltac.com/index.php?id=112</a>	LCA valuation tool	no branch focus	yes			no	implements different evaluation methods (T-diagram, Hasse diagram)
LTE OGIP 5.0 <a href="http://www.the-software.de/ogip/einfuehrung.html">http://www.the-software.de/ogip/einfuehrung.html</a>	LCA based mass flow analysis	construction sector	yes	EcoIndicator 99 Swiss Eco Points	moderate	no	open data types and own data sets can be added
STAN 1.1.3. <a href="http://www.iwa.tuwien.ac.at/iwa226_english/stan.html">http://www.iwa.tuwien.ac.at/iwa226_english/stan.html</a>	material flow analysis	No branch focus	n.a.	n.a.	moderate	for free, not webbased	to perform material flow analysis according to the Austrian standard ÖNorm S 2096, graphical model as first step to define all system components
<b>Material Declarations and Hazardous Substance Management</b>							
International Material Data System (IMDS) <a href="http://www.mdssystem.com/">http://www.mdssystem.com/</a>	Supply chain material declaration tool for 100% material composition	Automotive sector	n.a.	n.a.	Detailed, but regarding electronics on UmbrellaSpec and generic PCB assembly level	database accessible only for actors in the supply chain	IMDS was meant to support compliance of the automotive manufacturers with the ELV requirements, e.g. the recycling quotas, but focuses solely on the material declaration; no RoHS compliance check possible as the "homogenous material" level is not addressed

	<b>Tool / methodology type</b>	<b>Branch focus</b>	<b>Life cycle focus</b>	<b>weighting of life cycle aspects</b>	<b>level of analysis</b>	<b>for free (webbased)</b>	<b>Comments</b>
TechniData Product Safety & Stewardship Solutions / SAP EHS Management application <a href="http://www.technidata.com">http://www.technidata.com</a>	Product compliance (RoHS, Automotive ELV, EuP Directive and industry standards such as GADSL, IMDS and the Joint Industry Guide)	electrical / electronics	n.a.	n.a.	According to legal requirements	no	background in enterprise resource planning systems, close cooperation with SAP to cover their EHS related ERP aspects. Consequently, TechniData first focused mainly on EHS in large companies with stringent environmental requirements, such as the chemicals industry, but – just as the general SAP strategy – tries to tackle SME needs as well for some years; TechniData claims to have provided 1.600 customers with their solutions
E2open Eco-Compliance Solution <a href="http://www.e2open.com">http://www.e2open.com</a>	Supply chain management (RoHS compliance)	no branch focus	n.a.	n.a.	n.a.	no	Supports IPC-1752; the RoHS compliance feature is only a minor part of the broader E2open package for general management of supply networks
RoHS manager <a href="http://www.greenoaksolutions.com/Products/RoHSManager.aspx">http://www.greenoaksolutions.com/Products/RoHSManager.aspx</a>	Document management, material declaration forms	electrical / electronics	n.a.	n.a.	n.a.	no	
Green-ES 'Software as a Service' <a href="http://www.green-ecosystems.com/reach-software-as-a-service.html">http://www.green-ecosystems.com/reach-software-as-a-service.html</a>	collect, manage, and report REACH and RoHS related data	Suitable for electrical / electronics, but otherwise no branch focus	n.a.	n.a.	n.a.	no	Supports IPC-1752
Aras Innovator <a href="http://www.aras.com">http://www.aras.com</a>	RoHS management		n.a.	n.a.	n.a.	no, web-based	Part tracking, supplier part compliance, data exchange, material declarations etc.
ECODESIGN X-Mat© <a href="http://www.ecodis.org/index.html%3Fpage_name=substances.html">http://www.ecodis.org/index.html%3Fpage_name=substances.html</a>	Product compliance (REACH, RoHS, 67/548/EC, 1999/45/EC, ELV directives)	no branch focus	n.a.	n.a.	n.a.	no	Trial version
IUCLID 5 <a href="http://iuclid.echa.europa.eu/">http://iuclid.echa.europa.eu/</a>	Data collection related activities	no branch focus	n.a.	n.a.	n.a.	yes	ECHA tool for exchange data on chemical substances stored according the format of the OECD
TESS <a href="http://www.reach-serv.com/index.php?option=com_frontpage&amp;Itemid=1">http://www.reach-serv.com/index.php?option=com_frontpage&amp;Itemid=1</a>	Toolbox to Support Environmental and Sustainable Systems to comply with REACH legislation	no branch focus	n.a.	n.a.	n.a.	yes	
EUSES 2.1 <a href="http://ecb.jrc.ec.europa.eu/euses/">http://ecb.jrc.ec.europa.eu/euses/</a>	Decision-support instrument to carry out rapid and efficient assessments of the general risks	no branch focus	n.a.	n.a.	n.a.	yes	Based on the EU Technical Guidance Documents (TGD) on Risk Assessment for New Notified Substances, Existing Substances and Biocides
EU TGB <a href="http://www.envsci.science.ru.nl/cem-nl/products.html">http://www.envsci.science.ru.nl/cem-nl/products.html</a>	Risk assessment of a broad range of substances	no branch focus	n.a.	n.a.	n.a.	yes	Based on the EU Technical Guidance Documents (TGD)
<b>Product Declarations</b>							
The EPD@system <a href="http://www.environdec.com/pageId.asp?id=200">http://www.environdec.com/pageId.asp?id=200</a>	Document management, material declaration forms	no branch focus	n.a.	n.a.	n.a.	yes	Available models for different types of products

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
<b>Legal Compliance Management</b>							
C2P Navigator, C2P Enterprise <a href="http://www.complianceandrisk.com/">http://www.complianceandrisk.com/</a>	Tracking global environmental regulations	all	n.a.	n.a.	n.a.	no	Access to regulations database, including experts' comments, flexibility in organising and accessing compliance information
EIAtrack <a href="http://www.eiatrack.org">http://www.eiatrack.org</a>	online tool for navigating environmental regulations and legislation globally	electrical / electronics	n.a.	n.a.	n.a.	no	Topics included: RoHS & REACH, WEEE, EuP & Design for Environment, Energy Efficiency, Batteries, Packaging
TechniData Environmental Performance Solutions <a href="http://www.technidata.com">http://www.technidata.com</a>	business compliance management that covers all regulatory requirements in the environmental domain relating to air, water and waste	typically applied in utilities, oil & gas and chemicals	n.a.	n.a.	n.a.	no	typical standard processes supported: Plant permits - Management of operating permits and requirements, EU pollutant registers and reports- (e.g. EPRT), Exception monitoring and management (e.g. deviations), Carbon footprint (greenhouse gas emissions), Emissions trading according to EU schemes, Environmental incident tracking, Environmental monitoring network (ENVINET), Environmental Performance Management (EPM)
Compliance Agent <a href="http://www.ipoint-systems.de">http://www.ipoint-systems.de</a>	Modules include: ELV/IMDS, REACH, RoHS, RRR (Reusability, Recyclability, Recoverability), LCA	automotive	yes			no	LCA module comes with database, RRR module allows to calculate recycling quotas according to ISO 22628, interface to CAD tools
EMARS™ Environmental Compliance Software <a href="http://www.synapsistech.com/solutions/compliance/emars.html">http://www.synapsistech.com/solutions/compliance/emars.html</a>	management of environmental compliance and material content information	electronics	n.a.	n.a.		no	Used by large companies (see Motorola case study)
ECODESIGN X-Rec© <a href="http://www.ecodis.org/index.html%3Fpage_name=recycling.html">http://www.ecodis.org/index.html%3Fpage_name=recycling.html</a>	Define scenario to comply with WEEE and ELV directive.	automotive electronics	End of life	n.a.		no	Trial version
<b>Guidelines / Checklists / Handbooks</b>							
ECMA 341 - Environmental design considerations for ICT & CE products <a href="http://www.ecma-international.org/publications/files/ECMA-ST/ECma-341.pdf">http://www.ecma-international.org/publications/files/ECMA-ST/ECma-341.pdf</a>	guideline / checklist / standard	ICT and CE	full life cycle	no	moderate	yes	
Electrical and Electronic – Practical EcoDesign Guide (Rodrigo, J., Castells, F.: <i>Electrical and Electronic Practical Ecodesign Guide</i> , University Rovira I Virgili, 2002, ISBN: 84-8424-010-X)	teaching material / guideline	electrical / electronics	full life cycle	no	detailed	no	very comprehensive, starting from the basics
ECODESIGN PILOT <a href="http://www.ecodesign.at/pilot/ONLINE/ENGLISH/INDEX.HTM">http://www.ecodesign.at/pilot/ONLINE/ENGLISH/INDEX.HTM</a>	guidance for identifying design options	electrical / electronics	full life cycle	ranking	moderate	yes	recommended for a first product assessment and to set eco-design priorities

	Tool / methodology type	Branch focus	Life cycle focus	weighting of life cycle aspects	level of analysis	for free (webbased)	Comments
A Designer's Guide to Eco-Conscious Design of Electrical & Electronic Equipment <a href="http://www.ecodesignguide.dk/">http://www.ecodesignguide.dk/</a>	teaching material / guide / screening tool	electrical / electronics	full life cycle	no	moderate	yes	modular approach with 3 downloadable spreadsheets
Smart ecoDesign™ checklists <a href="http://www.cfsd.org.uk/seeba/">http://www.cfsd.org.uk/seeba/</a>	checklist	electrical / electronics	full life cycle	no	detailed	yes	
Eco-design Health Check <a href="http://www.inem.org/Default.asp?Menuue=190">http://www.inem.org/Default.asp?Menuue=190</a>	checklist	electrical / electronics	various life cycle aspects	no	very rough	yes	gives a first, very rough overview (management check)
Guide: Sustainable design of electrical and electronic products to control costs and comply with legislation <a href="http://www.envirowise.gov.uk/">http://www.envirowise.gov.uk/</a>	teaching material / guide	electrical / electronics	full life cycle	no	moderate	yes	
Navigator <a href="http://guidance.echa.europa.eu/navigator_en.htm">http://guidance.echa.europa.eu/navigator_en.htm</a>	Obligations under REACH	substances	n.a.	n.a.	n.a.	yes	Some questions to detect REACH obligations of a substance
Guidance for Downstream Users <a href="http://guidance.echa.europa.eu/docs/guidance_document/du_en.htm?time=1254828437">http://guidance.echa.europa.eu/docs/guidance_document/du_en.htm?time=1254828437</a>	Guide under REACH						
Guidance on requirements for substances in articles <a href="http://guidance.echa.europa.eu/docs/guidance_document/articles_en.htm?time=1254828552">http://guidance.echa.europa.eu/docs/guidance_document/articles_en.htm?time=1254828552</a>	Guide under REACH						
<b>Standards Design Tools (Product Lifecycle Management tools)</b>							
CATIA <a href="http://www.3ds.com/products/catia/welcome/">http://www.3ds.com/products/catia/welcome/</a>	Conventional 3D design tool	Multiple industries	recently considering the integration of a carbon footprint calculator	Carbon footprint only	n.a.	no	"several thousand" installations, not specific for electronics design / circuitry layout; SME version available
SolidWorks SustainabilityXpress <a href="http://www.solidworks.com/sw/education/7375_ENU_HTML.htm">http://www.solidworks.com/sw/education/7375_ENU_HTML.htm</a>	Module to a standard CAD tool	Mechanical design in general	full life cycle	Impact categories: Carbon footprint, air acidification, water eutrophication, total energy consumed	moderate	Sustainability Xpress module is for free, but requires a commercial standard SolidWorks version	SolidWorks is among the market leaders for CAD tools, more than one million users claimed, SustainabilityXpress allows instant assessment, comparison with a baseline design and automatic compilation of the results in a report

## 2 SPECIFIC SOFTWARE TOOLS EVALUATION

### 2.1 GREENFLY

#### 2.1.1 General Information

Project Partners:

- The Centre for Design at RMIT University
- WSP Environmental
- Design Institute of Australia

Project Sponsor:

- Sustainability Victoria

Web-site: <http://www.greenflyonline.org>

Analysed Version: Beta version

Additional Information: web-site, brochure and QUICK START GUIDE Release 1.0

#### 2.1.2 Main Characteristics

##### Functionality

Greenfly incorporates life-cycle modelling and EcoDesign strategies with easy to use, cutting-edge web technology. Greenfly shows the environmental impacts of the design choices through strong graphical representation and helps user improve and communicate product sustainability decisions.

##### Platform

Greenfly is a Web based application, and therefore can be accessed from any computer connected to the Internet using a web browser. Greenfly is accessed from the URL <http://www.greenflyonline.org/>. It is written in PHP, a widely used scripting language designed for web development. The web application makes extensive use of Ajax (Asynchronous JavaScript and XML), a technology that is the basis of so-called Web 2.0 applications and that enables to create faster and more responsive web applications that mimic to some extent desktop applications. Dynamic graphs shown in the application are created with Fusion Charts, software to create animated and interactive charts for web and desktop applications with Adobe Flash.

It is required to sign-up in order to use Greenfly, and currently Greenfly is available for free demo (alpha version). The sign-up form asks for some information: first name, last name, position, company, sector and email address. A captcha (powered by <http://recaptcha.net/>) is also required, to prevent the automated creation of accounts. Once this information is submitted, a password is automatically created and sent to the provided email address. Sign-up page is shown in Figure 6.

The email address acts as Login ID, and together with the password are used for login.



Figure 6. Sign-up page.

Greenfly (alpha versions) is not secured with https to provide encryption and secure identification of the server. Https provides a method to create a secure channel over an insecure network, and to verify the identity of the web site.

### Data Input

Two different data input mechanisms are provided: interactive forms and modal dialogs. To input data on interactive forms (as shown in Figure 7), the user clicks on the text of the field he wants to edit. The text is a hyperlink, and after being clicked it is transformed into an editable form field. Once the user has finished editing the field, the editable field recovers the text hyperlink format after clicking anywhere in the page. Interactive forms as the one used are easier to read and look nicer than traditional forms, but they may be difficult to fill in by some users that are used to traditional web forms.

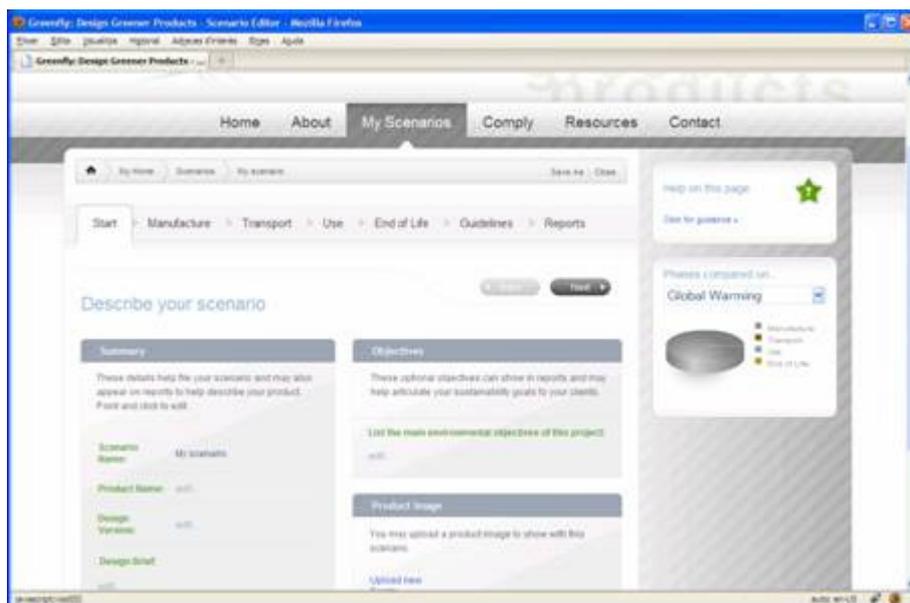


Figure 7. Scenario description. Page showing an interactive form.

Modal dialogs (created using Javascript and DHTML) are used to enter details on the different scenario steps. An example is shown in Figure 8. Modal dialogs are used to draw user attention to vital information or required input, and they are being increasingly used in web applications. In Greenfly, when a modal dialog appears, the part of the web page not hidden by the new window is covered by a transparent black layer. This type of modal dialog is very effective for getting user attention, since it is the only window the user can interact with.

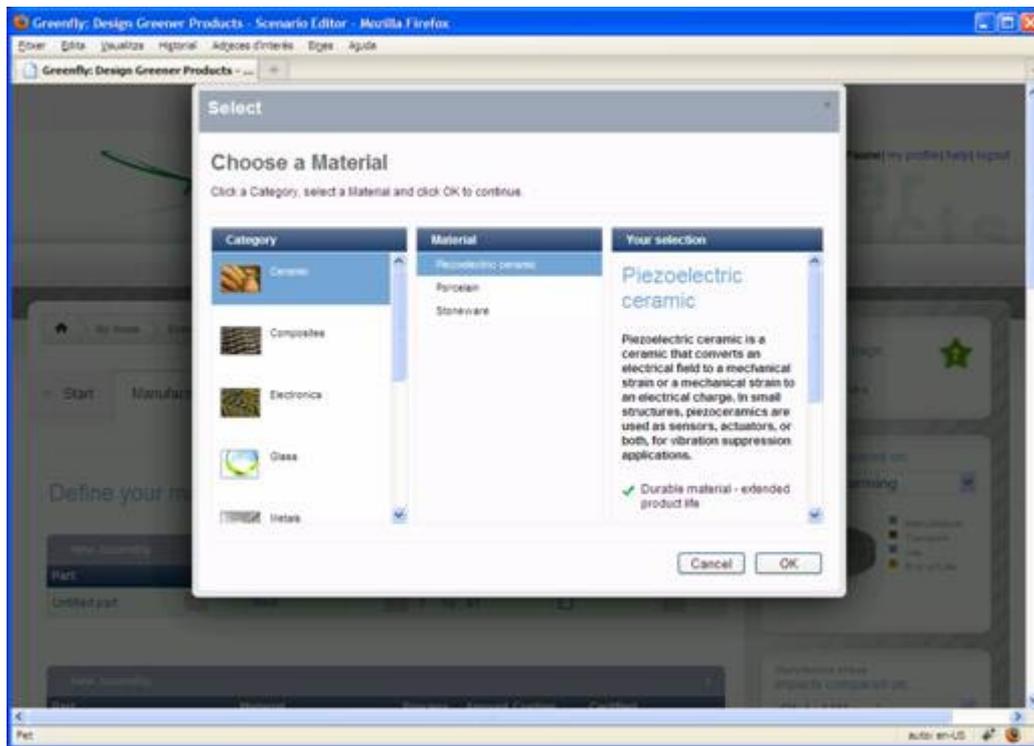


Figure 8. Material selection dialog

The user should introduce the needed information in the following sequence:

- Entering into user page ("My Home Page") after the "Login" page
- Here the user is able to access a number of different functions of the tool. This includes 'construct a new product', 'view resources' and 'certification program' (currently unavailable)
- "Construct a new scenario"
  - Scenario general description: Summary, product image, objectives, etc.
  - Entering Manufacturing Data: Selection of materials and processes applicable to the product (using parts or assemblies description). The materials are ordered within a number of different categories including paper, ceramic, composites, glass, metals, plastics, wood, textiles and electronics. When the user click on the desired material a list of the environmental pros and cons of the material are displayed in the right hand column of the window.

After that, it should be entered the weight (kg) of the part, costing and whether the material was sourced from an environmentally certified supplier.

The user can also assign a manufacturing process to the material selected. The processes are within a number of different categories

including energy consumption, water consumption, cardboard converting process, glass converting process, ferrous metal converting process, non-ferrous metal converting process, plastic converting process, timber converting process, recycling, composting, remanufacture/reuse and landfill.

- Reviewing and Editing the Design Guidelines: As the user select materials, design guidelines appears for the category and specific material selected. A series of questions are presented to read and answer. The design considerations and user responses will then appear in the final report.
- Definition of Transport steps: The user should enter the transport types and distances associated with the analysed product. Needed to define the type of transport in the description section and the transport mode (a pop up window allows user to select from a list). Then the user should enter the estimated distance.
- Definition of product use: First selection if product will consume electricity and decide its life expectancy. Then the user should add consumables during product use.
- Definition of product end of its life: In the end of life (EoL) stage all the data that user input in the materials and manufacturing section will be automatically loaded. User will then be asked to assign an end of life destination for each part of product assemblies. Clicking on 'select destitution' a pop up window allows user to select from a variety of EoL options. The categories for selection include: recycling, composting, remanufacture and landfill

With these steps, the scenario is already defined.

- Review and Select a Design Strategy: On this page there are a variety of design strategies presented with an introduction and a list of questions for user to answer. The answers will appear in the report with user chosen guidelines.

## Data Output

The graphs on the right-hand side of the page will change as the user makes his selections (see Figure 9). It is possible to compare materials and processes here by selecting them in new parts and assemblies and seeing the changes in the graphs.

The graphics shows the contribution of each component/material to the following Environmental Impact Indicators, considering the different life cycle steps:

- Global Warming
- Water use
- Energy
- Solid Waste



Figure 9. Graphics showing the results of the manufacturing step

The final output of the application consists in a global report. This Report is provided as any other web page in the application, and it can not be exported in any document format such as Microsoft Word (.doc), Rich Text Format (.rtf) or Portable Document Format (.pdf). To use the report results in a different document, the only option is to copy and paste the report contents from the web page to the destination document. Report graphs are plain images, but the web application does not provide any link to download the graphs as images. However, they can be saved using the usual options built-in in web browsers.

The report includes the following information:

- Project Details
- Graphics of percent contribution of the different life cycle steps to the different Environmental Impact indicators
- Table with the absolute values for each Environmental Impact Indicator and life cycle step
- Key Environmental Issues to Consider (defined by the user)
- Project Objectives (defined by the user)
- Product Life Cycle Overview (data entered to simulate the scenario, such as materials, etc.)
- Additional End of Life Items
- Transport Steps
- Consumables in use phase
- Guidelines, function of the selected materials. Questions and user answers.

### **Data interchange**

Greenfly does not have any mechanism to import bulk data into the web application, all data has to be entered interactively. It is not possible to export data introduced by the user: all data introduced by the user is effectively locked in the application.

### **Internal Database**

The materials are ordered within a number of different categories including paper, ceramic, composites, glass, metals, plastics, wood, textiles and electronics. Inside each category there are specific materials.

The processes are within a number of different categories including energy consumption, water consumption, cardboard converting process, glass converting process, ferrous metal converting process, non-ferrous metal converting process, plastic converting process, timber converting process, recycling, composting, remanufacture/reuse and landfill. Similar to above, each category includes specific processes.

The Environmental Impact Indicators used by the software are:

- Global Warming (kg CO<sub>2</sub> eq)
- Water use (kL)
- Energy (MJ LHV)
- Solid Waste (kg)

### **Others**

Upcoming versions of Greenfly versions will evaluate designs based on a range of regulatory and compliance protocols, including Green Building Council of Australia's Green Star rating.

Moving Graphs: On pie chart that demonstrates the overall environmental impact of the product. The user can move the different sections to see their percentage by clicking on the part.

Tips of the day: These are tailored for each life cycle stage and are different each time user refresh the page.

## 2.2 SOLIDWORKS SUSTAINABILITY

### 2.2.1 General Information

Owner:

- Dassault Systemes SolidWorks Corp. (USA)

Powered by:

- GaBi Software

Web-site: [www.solidworks.com](http://www.solidworks.com)

Information Source: Demo Videos and "Product description" document

Price: For Free (designed to work with SolidWorks 2009)

### 2.2.2 Main Characteristics

#### Functionality

SolidWorks Sustainability works integrated into the SolidWorks 2009 software, which is market leader in 3D mechanical CAD software tools. It allows the user to analyse the environmental impact of the proposed design (or parts of it) in the same 3D design screen that designers use in their day-to-day work (see Figure 3).

The LCA results could be seen in real time and it is possible to make comparisons with new design variations (e.g. new materials or processes).

#### Platform

Because the SolidWorks Sustainability product lives right in the SolidWorks 2009 Task Pane, it effortlessly becomes a natural part of the workflow. Sustainability data is even stored in the model file as standard engineering information for the design — so when the model is shared with others, the Life Cycle Assessment data is available to them as well. Individual model assessments are then compiled into one report when assembly begins.

#### Data Input

Once a part of the proposed design is selected, the designer could go to the task pane tab, and select the Sustainability button. Then, the user has to define:

- Material name (from a proposed list) and weight (see Figure 10)
- Manufacturing process and region
- Where the product will be used



## Data interchange

SolidWorks Sustainability generates customized reports showing sustainability data, complete with user contact information and company branding. With one click, it is generated a professional presentation to demonstrate steps taken to design the product, and product variations comparison from a LCA perspective.

## Internal Database

Internal Environmental data base of materials, processes, etc.

Impact Indicators:

- Carbon Footprint: Greenhouse gases, such as the carbon dioxide, carbon monoxide, and methane that can contribute to global warming.
- Air Acidification: Air acidification refers to the burning of fossil fuels that can result in acid rain.
- Water Eutrophication: Water eutrophication occurs when fertilizers reach coastal waters and cause algae blooms that can result in the death of local sealife.
- Total Energy Consumed: Total energy consumed refers to all forms of energy the design consumes and releases over its life cycle.

## Others

The user could also use the "Find similar" button, which allows the user to find a similar material, fixing the most relevant material properties that the new material has to fulfil (see Figure 12). The software shows a list of possible substitutes and their environmental impacts. Once a choice is selected, the software makes the environmental comparison with the base case.



Figure 12. Screenshot of demo video ("Find Similar" application)

## 2.3 ECODESIGN X

### 2.3.1 General Information

Owner:

- EcoMundo (France)

Web-site: <http://www.ecomundo.eu>

Based on the Project ECODIS (Ecodesign Interactie Systems)

Sixth Framework Programme

[www.ecodis.org](http://www.ecodis.org)

Information Source: web-site information and brochures

Price: ??

### 2.3.2 Main Characteristics

#### Functionality

Consisting in four different modules to support eco-design within a firm:

- Ecodesign X-Mat.- Is a material and hazardous substance management system which helps companies to get compliant with regulations REACH (1907/2006), ROHS (2002/95/EC), 67/548/EC, 1999/45/EC, ELV (2000/53/EC) Directive, as well as to reduce the time and costs spent on the hazardous substances management and reporting process.
- Ecodesign X-Pro.- Is an industrial process management system which helps companies to evaluate the environmental impacts of various manufacturing steps, from material to product. It supports the ISO 14001 environmental management activities and eco-design activities for example by getting prepared to Directive EuP 2005/32/EC.
- Ecodesign X-Rec.- Is a decision aid tool which helps companies to define the most appropriate End of life scenario for their products and get compliant with WEEE (2002/96/EC) and ELV (2000/53/EC) directive.
- Ecodesign X-Change.- Is a product management system designed to ensure the product environmental compliance and impacts' traceability along the supply-chain. It helps companies to get appropriate reports used for internal management or external communication

#### Platform

- No local installation
- Internet access: accessible with usual web browsers (Internet Explorer, Mozilla Firefox, ...)
- Import/export interface for data down-/upload (XML, xls,...)
- Customizable with easy parameters set-up
- Confidentiality protection (Secured data transfer protocol)
- Data storage and maintenance

## Data Input

The Data Input is different for each tool depending on the aspect to be covered. For example:

Ecodesign X-Mat (see Figure 13):

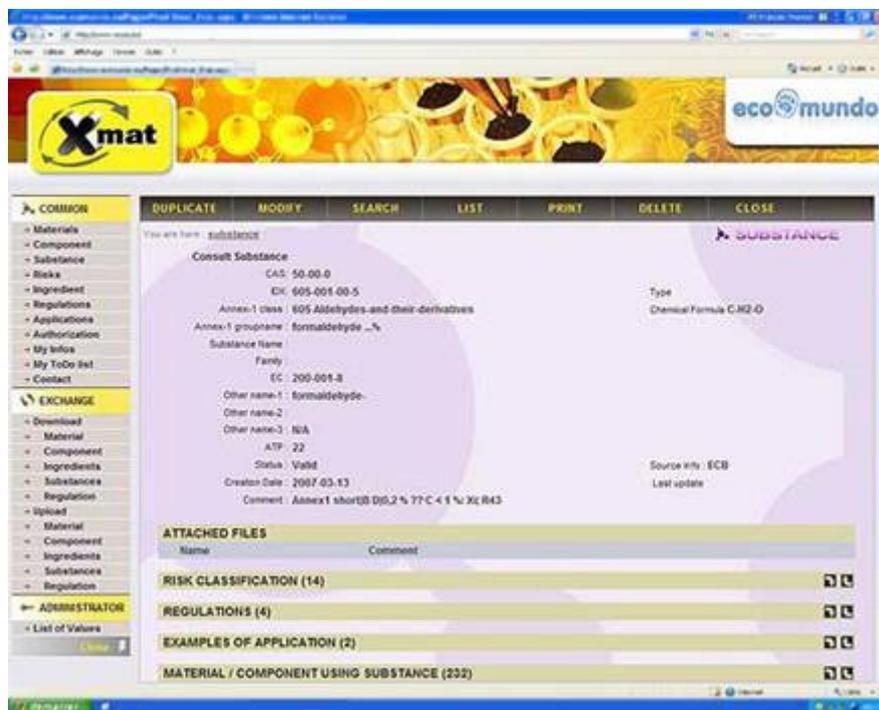


Figure 13. Substance Description screen shot

- Possible to make the own inventory and build easily the own material database
- Powerful navigator : Search by material type, supplier, trade reference, by codification, by hazardous substance, by risk...

Ecodesign X-Pro (see Figure 14):

Possible to model the own processes easily and checking the most common impacts (global warming, acidification, ozone layer depletion, eutrophication...) thanks to a reliable LCA (Life-Cycle Assessment) calculation.

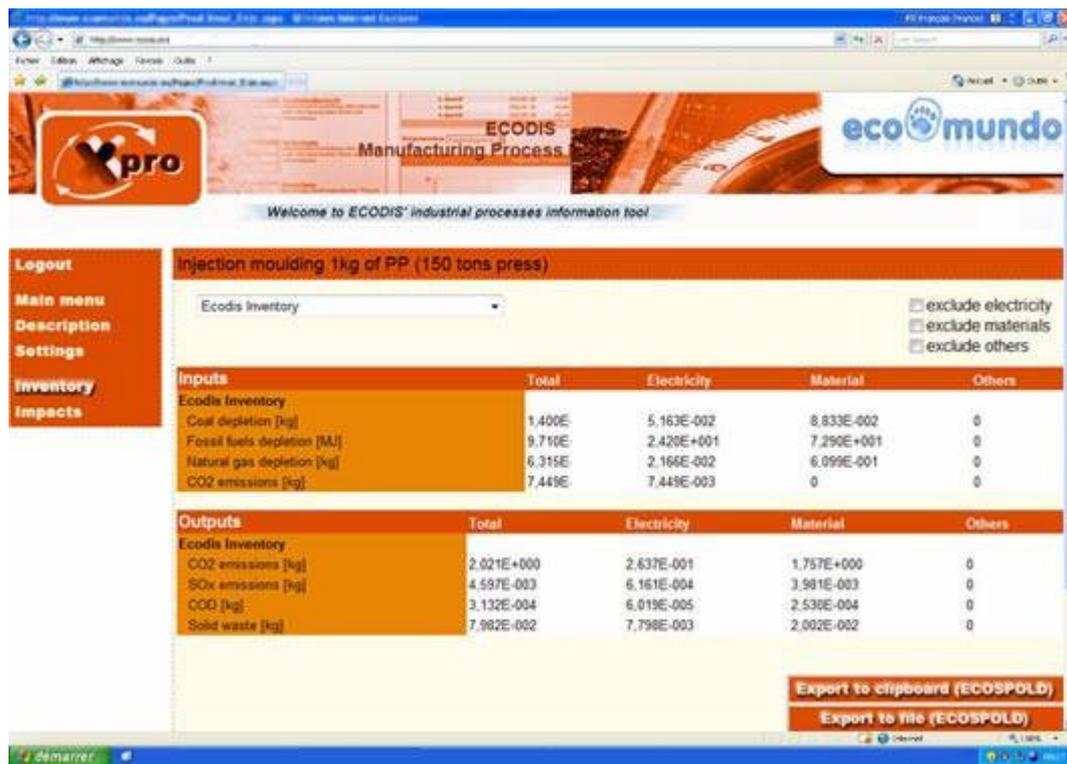


Figure 14. Industrial Process Information screen shot

## Data Output

The Data Output is different for each tool. For example:

### Ecodesign X-Mat:

- Detailed and complete inventory of chemical substances used and manufactured.
- Automate production of documentation (REACH-IT format).
- Track of compliance level to REACH.
- Benchmark data on main preparations and components.

### Ecodesign X-Pro:

- Evaluation of the carbon footprint of products or processes
- Identification of hot-spots in energy consumption and related CO2/greenhouse gas emissions.
- Modelling of the own processes with a reliable life cycle assessment and verifying the most commonly found impacts such as global warming, acidification, ozone layer depletion and eutrophication.
- Identifying the contribution of each step in the product life-cycle.

### Ecodesign X-Change:

- Identify, quantify and localize the material and potentially hazardous substances contained in products.
- Edit certificate or compliance for RoHs, ELV and other common standards.
- Model easily the products with its sub-parts, processes, material and sum-up its global impact.

- Create standardized Environmental Product Declaration for Marketing communication.
- Provide customers with BOM/BOS (Bill of Material/Bill of Substances) data in the requested format.

### Data interchange

Import/export interface for data down-/upload (XML, xls,...). For example:

#### Ecodesign X-Pro:

- Interface for data download (XML Ecospond) and use in other LCA software (GaBi, SimaPro, Umberto, EIME, Team, ...)

#### Ecodesign X-Change

- Several interfaces (.xls, XML etc.) which connect flawlessly with computer-aided design systems (e.g. CATIA V5), Product Data Management (e.g. Matrix one) and ERP (e.g. SAP).

### Internal Database

Different internal databases for each tool. For example:

#### Ecodesign X-Mat:

- Hazardous substance library with risk, danger and safety labelling (C1, R32 etc...). Reference data about the hazardous composition of various materials (plastics, metals, etc ...) and components
- Market restrictions lists: GADSL, GIFAS BT, JIG

#### Ecodesign X-Pro:

- Reference data on the environmental impact of common industrial processes and materials, for example:
  - Machining
  - Plastics processing
  - Electronic appliance manufacturing
  - Transport and logistics
  - Surface treatments
- Materials from the European Reference Life Cycle Data System (ELCD) v 1.0.1. from the European Commission DG Environment and supported by the European Commission Joint Research Centre.
- Various European Energy models.
- Data on various energy sources such as wind or nuclear.
- Normalised LCA evaluation method (CML 2001).

#### Ecodesign X-Rec

- An up-to-date library of more than 70 dedicated treatment, recycling or recovery processes with technical constraints to be taken into account for product design.

### Others

EcoMundo full assistance to get the system going. Data administration and software maintenance is performed by EcoMundo. Also it offers training programmes.

## 2.4 C2P ENTERPRISE

### 2.4.1 General Information

Owner:

- Compliance & Risks Ltd (Republic of Ireland)

Web-site: <http://www.complianceandrisks.com>

Information Source: Web-site information and brochures

Price: ??

### 2.4.2 Main Characteristics

#### Functionality

Compliance-To-Product (C2P) is a web-based application that integrates compliance software and global regulations. It is a sophisticated new model for managing the impact of regulations on products and business activities.

C2P replaces spreadsheets and email paper trails. It integrates a structured regulations database with the features of a knowledge management system and the functionality that is needed to manage compliance issues.

#### Platform

Web based application. The main characteristics are described hereafter:

- HARDWARE.- Any platform that can run Tomcat 5.5 application server. Supports most modern Windows, Unix and Mac OS X operating systems.
- SOFTWARE.- Open Source JDK 5.0+ (Java Development Kit from Sun) and Tomcat 5.5. Other application servers supporting JDK 5.0 and J2EE (Java 2 Enterprise Edition) 1.4 specification.
- DATABASES:- Tested extensively with Oracle 9i and MySQL 5.0. Other relational databases can be easily supported due to the database-independence layer in C2P that is based on Hibernate 3.1, the open source object-relational mapping framework.
- BROWSERS.- Tested extensively with Internet Explorer 6, Safari and Firefox on both PC and Macintosh.
- SECURITY.- User passwords are encrypted. The entire application can be encrypted using the standard secure socket layer (SSL) protocol. C2P uses Acegi security system, which is an enterprise-level security module for the open-source Spring framework. The installation process is streamlined using the standard web application archive (WAR) distribution.

#### Data Input

C2P's customizable dashboard, flexible interface, and comprehensive search engine allow users to manage regulations, issues, and tasks with unparalleled speed and precision (see Figure 4).

#### Data Output

The main features and benefits are described hereafter:

GLOBAL REGULATIONS:

- Regulations database: Saves data entry, tracking and monitoring.

- Terms and definitions: Facilitates analysis and interpretation of legal and business terms.
- Smart links: Shows the relationship between regulations and requirements and their impact on a product or activity.
- Structured data: Streamlines all compliance processes.
  - requirements
  - organizations
  - geographical areas
  - exceptions/exemptions
  - impacts
- Frequent data updates: Client does not have to track and monitor new regulations.
- Advisor commentary: Faster, more informed decision making. Input from legal and business experts adds intelligence to compliance data.

#### COMPLIANCE:

- Issue management: Users can collaboratively evaluate, escalate and address compliance issues.
- Risk ratings: Shows the history of risk and opportunity for each issue.
- Impact: Users can see the impact of regulations on products and business activities.
- Assignments: Managers can quickly delegate and monitor issues and responsibilities.
- Action plans: Users can create milestones and manage tasks for each issue.
- Reminders: Users can set reminders and track assigned areas of responsibility.
- Personal dashboard: Users see their own compliance issues, searches, bookmarks, reminders and alerts.
- Custom reports: Users can compile reports according to their issues and products.
- Multiple views: Users can move easily between summary views and detailed data.

#### KNOWLEDGE MANAGEMENT:

- Knowledge database: Captures information from all sources in one place.
- Comments: Captures the discussion thread between users.
- Context: Users can create contexts for classifying and reporting the evolving impact of issues.
- History links: Audit view of the history of all changes and updates.
- Watches: E-mail notification when changes are made to areas of critical interest.
- Alerts: Changes to a user's area of responsibility triggers an alert.
- Attachments: Easy document storage and retrieval.
- Search: Users can run queries and produce reports based on specific parameters.

## Data interchange

N/A

## Internal Database

The relational database and application server tiers of C2P can be hosted inside a company firewall or by C&R. Hosting by C&R includes the following benefits according the distributor:

- Installation of the application on fast servers with advanced redundancy and fail-over features.
- Setup of daily updates from C&R's global regulations database.
- Major functionality upgrades every 3–4 months.
- Frequent application of bug fixes and security patches.
- Daily backups.
- Automated continuous monitoring of the health of the system.
- Quick response to problems 24/7.
- Security and protection by a state-of-the-art data center....

More than 4,000 global regulations and supporting documents in an intelligent structure. C2P's data repository currently includes more than 2,500 global environmental regulations that are updated daily. Key regulations include REACH, EU RoHS, China RoHS, WEEE, Energy Star, EPEAT, Eco Design, and EMC. Updates include draft and new regulations so that compliance teams can prepare as requirements develop and when they come into force. For example, in the case of REACH:

- 180-plus Regulations and supporting documents in C2P's structured format
- 160-plus dates
- 270-plus key sections
- 300-plus expert comments
- 380-plus impacts to named business activities
- 430-plus direct-scope impacts to named substances
- Key definition

## Others

C&R continues to build a network of top environmental consultants around the world who contribute commentary to the regulatory database. These experts know the local laws, how they are being implemented, and which challenges are being faced by the companies doing business in their areas.

The company's growing team of domain experts includes lawyers in Ireland, the United Kingdom, Europe, the United States, and Asia.

## 2.5 ARAS INNOVATOR

### 2.5.1 General Information

Owner:

- Aras® Corporation (USA).- Microsoft enterprise open source software provider for companies

Web-site: <http://www.aras.com>

Information Source: Web-site information and brochures

Price: For Free (Open Source)

### 2.5.2 Main Characteristics

#### Functionality

Aras Innovator® enterprise RoHS software provides companies with powerful, easy-to-use capabilities to achieve and maintain RoHS environmental compliance. The highly flexible Web-based solution manages each part's RoHS status and supplier Material Compliance Declaration documents online.

It is a solution suite to the global Aras Innovator® Product Engineering enterprise software solution and it can be downloaded at no charge on the project site.

#### Platform

Open Source format.

Aras Innovator takes advantage of the Microsoft Windows Server System, .NET, SQL Server and standard Internet protocols including HTTP/HTTPS, XML and SOAP [Simple Object Access Protocol] Web services.

#### Data Input

The main input data is the Bill of Material of the analysed product and suppliers' information. Some key features are described hereafter:

- Part Tracking & Status.- Define material content at the substance and homogeneous material level
- Supplier Part Compliance.- Manage thousands of multi-sourced components and parts in complex product structures through the global supply chain
- Exemptions & Exceptions.- Manage regulatory exemptions and configure processes to handle exceptions
- Process Flexibility.- Quickly add new substance requirements and regulatory regions over time
- Internet Based.- Web-based access enables global communication and coordination

#### Data Output

Some key features of the application are described hereafter:

- Compliance Validation.- Ensure compliance across regulations including EU RoHS, China RoHS, Taiwan, Japan Green, South Korea, and US states such as Cal Prop 20/50

- Product Challenges.- Quickly access Material Composition Declaration proof to successfully prove compliance and avoid stop ships
- Compliance History & Audits.- Track parts, products, and suppliers with status over time and records for compliance
- Customer Inquiries.- Respond quickly to customer requests for compliance information & status
- Reports.- Run reports on a part-by-part, bill of materials, and supplier basis
- Dashboard Visibility.- Red-Yellow-Green status indicators deliver RoHS compliance tracking visibility roll-ups. See an example in the Figure 5.

### **Data interchange**

Some key features of the application are described hereafter:

- Data Exchange.- Supports data exchange standards with formats including IPC-1752-1, IPC-1752-2, and RosettaNet 2A10, 2A13 & 2A15 PIPs and other methods such as Excel spreadsheets
- Material Declarations.- Import & export MCDs and attach files to part and product records

### **Internal Database**

N/A

### **Others**

Aras offers an extensive portfolio of corporate service options to complement different deployment scenarios of the advanced Aras software solutions across the enterprise application life-cycle.

### 3 SMES NEEDS AND ASPECTS COVERED BY THESE TOOLS

Although multitude of tools has emerged aiming at providing SMEs with the means to consider the environmental aspects in their product development and design activities, companies still identify different needs so as to find the most convenient tool for their business. In this sense, it appears really worthy to link the main needs obtained as results in the prior Work Package 2 SMEs analysis, with the tools that have been deeply analysed along the current Work Package 3 Tools Analysis.

A major finding from the SME survey is, that all aspects asked for are similarly relevant and of interest to responding SMEs. There is no specific field for a “killer application” to be served by LiMaS with high priority, but vice versa there is also no single aspect which is of no interest to SMEs, so no aspect to be ruled out from further methodology development per sé.

The table below contains the result obtained when crossing the review of the tool aspects identified as the most important from the SMEs point of view with the software tools’ analysis:

SMEs needs on software tools	Aspects covered by the software tools	
<b>Clear results</b>	e.g ARAS Innovator	This software tool ends up with clear and easily understandable results. In fact, its results are based on red-yellow-green status indicators.
<b>Easy to use</b>	e.g. EuP EcoReport; EcoDesign Pilot; Greenfly; EuP Manager; ARAS Innovator	These software tools are user friendly, have an easy navigation and are easy to follow by non-experts.
<b>Sector specific</b>	e.g. LCALight; Fraunhofer IZM/EE Toolbox; EIME; EuP Manager; EuP EcoReport; GaBi DfX; EIAtrack	Companies are willing to get a software tool adapted to their real needs and which is, obviously targeted on their specific sector. Most of the software tools launched to the market are generic, this means that are tools conceived for use in a wide range of sectors. Anyhow, there are fortunately tools focused directly into the EuP/electric and electronic sector.
<b>Affordable</b>	e.g. EuP EcoReport; ARAS innovator; Solidworks Sustainability	The price is a critical aspect when achieving a software tool. This is the reason why the market offers various free-cost tools.
<b>Web-based</b>	e.g. Greenfly; eVerdEE; EcoDesign Pilot; C2P Enterprise; ARAS Innovator;	The vast majority of the companies has internet access and uses it as a habit within their daily business activity. This may be the reason why most of the companies appear proactive to use software tools via web rather than desktop.

SMEs needs on software tools	Aspects covered by the software tools	
<b>Benchmark data</b>	e.g. Ecodesign X;	Information on benchmarks with competitors' products is highly important for the companies. The Ecodesign X-Mat, for example, includes benchmark data on main preparations and components.
<b>Life Cycle Assessment</b>	e.g. Solidworks Sustainability; Ecodesign X	SMEs have shown their interested in Environmental Impact Assessments considering the complete life cycle. There are numerous commercial tools available so as to perform LCA. Some tools give the chance to compile a simplified LCA while others get into detailed full LCAs.
<b>Legislative requirements compliance monitoring</b>	e.g. EIME; C2P Enterprise; EIAtrack; Compliance Agent; Eco-Compliance Solution; ARAS Innovator; Ecodesign X	Legislative compliance is essential for the companies. These software tools may help SMEs to get compliant with different regulations, such as: REACH, RoHS, etc.
<b>Environmental legislation update</b>	e.g. C2P Enterprise	Being updated about environmental legislation is crucial for SMEs. Companies use more than one method (internal monitoring, information from suppliers, external subcontracted services, etc.) for this update. C2P Enterprise, for instance, includes frequent legislative data updates.
<b>Results communication</b>	e.g. Greenfly; Solidworks Sustainability; Ecodesign X	The communication of the environmental results is considered to be a competitive advantage by SMEs. These software tools, for instance, help the user improve and communicate product sustainability decisions as they include strong graphical representations, reports generation, etc.
<b>Information on the product's CO<sub>2</sub> footprint</b>	e.g. Solidworks Sustainability; Ecodesign X	Even though CO <sub>2</sub> footprint was not the main aspect for SMEs it was considered relevant. Some of the software tools calculate the carbon footprint.
<b>Exportable results</b>	e.g. Ecodesign X; EuP Manager; EuP EcoReport	These software tools allow exporting the results obtained in the different assessments as XML, xls, etc. formats.

## 4 ASPECTS TO BE CONSIDERED IN LIMAS

Despite software tools covering some of the aspects of relevancy for SMEs, there are still some aspects which are not covered by any of the tools in the market. In fact, as shown in the tool analysis there is not yet a **common approach**, i.e. there are stand-alone tools for performing environmental assessments, tools for developing eco-design, tools for legal compliance, etc. but not an integrated one. Indeed, integration across environmental topics could reduce user workload which may be really helpful for SMEs. Furthermore, SMEs still have to face information gaps within the wide variety of tools that have been analysed. While most of the companies are willing to get information on innovative technologies, no tool offers dedicated up-to-date **information on best available technologies** for specific product categories. The same happens with other kinds of information, such as: information on possible sources of external funding, research groups in the different sectors, etc.

In summary, from the tools analysis matched with the SME needs survey the following features are key for the LiMaS tool and methodology:

- ✿ Intuitive use: Tools which are used only occasionally should be particularly user-friendly.
- ✿ Webbased tools are acceptable for SMEs and become a general trend. As this also facilitates a software update (regarding both, software engineering and content update), a state-of-the-art webbased concept (using AJAX) is recommended.
- ✿ Focus on target sector: EuP – to keep it manageable and attractive for the target SMEs.
- ✿ There is no need for another comprehensive stand-alone LCA tool, as this is covered pretty well already by numerous commercial tools.
- ✿ Although the RoHS legislation was enforced already in 2006, there are still companies, which are interested to get the business processes managed correctly. Consequently, RoHS guidance and compliance is still an issue for LiMaS.
- ✿ Making better use of data synergies (interfaces to business environment, harmonisation of terminology) is a key issue, linking product data and production data. This approach is likely to make eco-innovation much more efficient, thus feasible for SMEs.
- ✿ Assessment is important, but needs to be complemented by guidance. There is a clear gap to link to targeted technical solutions, including Best Available Technologies.

Details of the LiMaS tool and methodology, based on these findings, will be explored further in WP4.