

SUOMEN YMPÄRISTÖKESKUS

**315**

Sirkka Koskela and Marja-Riitta Hiltunen

# A guide to the utilization of LCI/LCA databases for Estonian enterprises



**315**

Sirkka Koskela and Marja-Riitta Hiltunen

A guide to the utilization of LCI/LCA databases  
for Estonian enterprises



Helsinki 2004  
FINNISH ENVIRONMENT INSTITUTE

Partners of the OSELCA project:

**Finnish Environment Institute**

**SYKE**

Mechelininkatu 34a

P.O.Box. 140, FIN-00251

Helsinki, Finland

[www.environment.fi/syke](http://www.environment.fi/syke)

**CyclePlan Ltd.**

Akadeemia tee 33-427

12618 Tallinn

Estonia

[www.cycleplan.com](http://www.cycleplan.com)

**Eesti Energia Ltd.**

Laki 24,

12915 Tallinn

Estonia

[www.energia.ee](http://www.energia.ee)

The publication is available only in the internet

[www.environment.fi/SYKE](http://www.environment.fi/SYKE)

> Publications > Mimeograph series

ISBN 952-11-1907-1 (PDF)

ISSN 1455-0792

Printing place: Edita Prima Ltd

Helsinki 2004

## **Preface**

Dissemination and promotion of life cycle thinking and the IPP (Integrated Product Policy) approach are central aims in an EU Life-Environment project called *'Introduction and Implementation of Life Cycle Assessment Methodology in Estonia: Effects of Oil Shale Electricity on the Environmental Performance of Products'* (OSELCA, [www.energia.ee/OSELCA](http://www.energia.ee/OSELCA)). The project was launched in September 2003 by the Estonian state-owned energy company (Eesti Energia AS), Estonian consultancy CyclePlan Ltd. and the Finnish Environment Institute SYKE. Duration of the project is 27 months and it will be finalised by the end of 2005.

The project comprises eight tasks altogether. Present guide is a final result of Task 3 *'Analysis of available LCA databases to apply them in Estonia'*. It has been composed by Sirkka Koskela and Marja-Riitta Hiltunen from the Finnish Environment Institute. Evelin Põld and Siret Talve (Cycleplan Ltd.) contributed in the selection process of the key industrial products for Estonia.

In Helsinki, October 31<sup>st</sup>, 2004

Sirkka Koskela and Marja-Riitta Hiltunen  
([sirkka.koskela@ymparisto.fi](mailto:sirkka.koskela@ymparisto.fi))

## Summary

Life Cycle Assessment (LCA) is a standardised environmental management tool to analyse the overall environmental burden of the product, process or activity throughout the all stages of their life cycle - from extraction of raw materials to the disposal of the product. According to the ISO standard 14040 LCA consists of four phases: 1) goal and scope definition; 2) inventory analysis (LCI); 3) impact assessment (LCIA); and 4) interpretation of the results. The LCA methodology for assessment of the performance of product systems is practically unknown in Estonia until now. Recently, interest has been growing to carry out LCA-studies for Estonian products as well.

The focus in this guide is on the data collection for LCIs, and the aim is to encourage Estonian enterprises to conduct LCAs for their own products by

- providing information on the data collection phase of LCI,
- developing guidelines on important issues to be taken account in the data collection and
- providing information on some databases from the viewpoint of Estonian key products.

The importance of the data collection phase cannot be overemphasised. In conducting LCIs it plays a very conclusive role because the reliability of the final LCA results are based on the quality of the collected data. Generally, LCIs include two different types of data. The primary data are used for specific processes of the product system (accurate data). The secondary data origin from databases and are used for background processes which are not specific for the defined product system (average data).

From the point of view of Estonian LCA practitioners, in prospective the most serious problems are not going to occur with site-specific data. Such data can be gathered by practitioners themselves. Additionally, country-specific energy production data will soon be available as an output of the OSELCA project. Yet the practitioners are left with the problem of how to find the best available data for raw and auxiliary materials manufactured abroad. To facilitate prospective LCA practitioners to start their own LCAs we have developed seven guidelines on the issues, which need to be taken into consideration in the data collection phase. The guidelines deal with the modeling of the product systems, the use of primary and secondary data, the importance of the country-specific electricity production profiles, and the validation and documentation of the collected LCI data.

Several LCA software tools have been developed to facilitate the data collection and also the calculation of the inventory results. For an LCA-beginner the plentitude of databases and software tools itself may become confusing and orientation may seem too complicated. Nowadays, there are more than 30 LCA or LCA-type software tools available on the global market. The exact number of different databases is not known but most of the LCA-softwares include initially one or several databases from external sources. They tend, however, to use the same databases with a slight variation. In addition to the secondary data for LCIs, some of the databases also contain impact assessment methods and LCA results for LCIAAs. The available generic databases are usually provided and managed either by industry, government, consultants or research institutes.

Basically there are available two types of databases - extensive general databases which include data on various industrial sectors and smaller databases with data on some specific field. Within the small sample of European databases, based on our selection criteria, half of the databases happened to be general, and the other half specific. The main selection criterion was that there had to be easily accessible information in English about a database on the Internet. Seven LCI databases were selected for more detailed introduction in the current guide. They were the Swiss Ecoinvent, the Finnish KCL Ecodata, the Belgian APME, the Swedish SPINE@CPM, the Belgian IISI, the Dutch

IVAM LCA Data 4, and additionally a Canadian database Athena. Ecoinvent, SPINE@CPM, and IVAM LCA Data 4 are broad databases which include data on hundreds of processes. KCL Ecodata is focused on forestry products and practices, APME on plastics and IISI on steel products. Athena is specialised on construction materials.

The applicability of the selected generic databases for future LCIs of the Estonian products was also considered. At first, the industrial production of Estonia was analysed in order to select those ten key products, regarding to which the applicability was investigated (oil shale mining and energy production were excluded). The selection of the products was based mainly on their share of the total industrial production sector (according to the 2001 Statistical Yearbook of Estonia). Their main raw materials and as well countries of origin were identified. Primarily, generic databases are used for the raw materials produced abroad, therefore this study concentrates on the main raw materials instead of the key products themselves.

There exists no country-specific LCI data for Estonia in generic databases. Therefore we cannot recommend a particular database to be used for inventories of Estonian products. Even the seven examined databases include extensive amount of data to choose from. These databases contain data for almost all Estonian key products and their main raw materials, but the applicability of specific process data must be verified separately in each case. An important issue to investigate while selecting the best available data for the inventory is the technology of a process, since the environmental interventions of different processes may vary significantly, thus having a major influence on the final results of LCI. The validity and reliability of LCI results may improve considerably, if the technological level is taken properly into the consideration.

All examined databases are applicable for Estonian industry in similar way as in any other country, because the generic databases are typically used for raw materials manufactured elsewhere. In the future, when the willingness to gather domestic site-specific data has raised and country-specific energy production data have been completed, Estonia will find itself in the same situation regarding to conduction of LCIs as other LCA-methodology using countries.

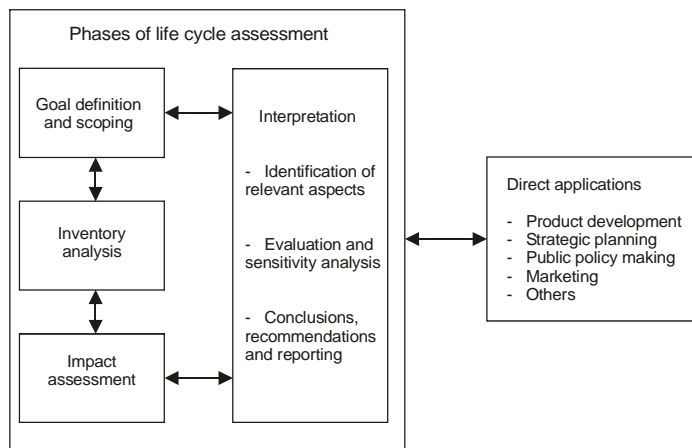
# Contents

<b>PREFACE .....</b>	<b>3</b>
<b>1 INTRODUCTION .....</b>	<b>7</b>
<b>2 LIFE CYCLE INVENTORY (LCI).....</b>	<b>8</b>
<b>3 DATABASES AND SOFTWARE TOOLS.....</b>	<b>9</b>
3.1 LCI / LCA DATABASES .....	9
3.2 LCA SOFTWARE TOOLS.....	10
3.3 DATA DOCUMENTATION AND EXCHANGE FORMATS.....	11
3.4 INTRODUCTION TO SOME LCA/LCI DATABASES .....	12
<b>4 APPLICABILITY OF STUDIED DATABASES FOR THE ESTONIAN KEY PRODUCTS .....</b>	<b>18</b>
4.1 SELECTION OF THE KEY PRODUCTS .....	18
4.2 AVAILABLE LCI DATA FOR THE RAW MATERIALS .....	19
4.3 CONCLUSIONS .....	21
<b>5 GUIDELINES FOR THE LCI DATA COLLECTION.....</b>	<b>21</b>
<b>REFERENCES .....</b>	<b>26</b>
<b>APPENDIX .....</b>	<b>28</b>
<b>DOCUMENTATION PAGES.....</b>	<b>32</b>



# 1 Introduction

**Life Cycle Assessment (LCA)** is a standardised environmental management tool for the analysis of the environmental burden of the product, process or activity through stages of their life cycle - from raw material extraction, processing, transportation, manufacturing, distribution, use, re-use, maintenance, recycling to waste disposal. (Consoli et al. 1993, Guinée et al. 2002). LCA can be used for generating information to improve the environmental performance, to compare possible alternatives or to establish recommendations for action, product procurement, purchase and disposal (Neitzel 1996). According to ISO 14040 standard LCA consists of four phases: goal and scope definition, inventory analysis (LCI), impact assessment (LCIA) and interpretation of the results (ISO 14040, 1997, Figure 1).



**Figure 1.** Life cycle assessment framework (ISO 14040, 1997)

First LCA studies were conducted in the 1960s and 1970s but it did not become popular until in the early nineties when standardisation of modeling and reporting procedures increased the conformity of LCA studies (Heiskanen 2002). Recently, interest has been growing to conduct LCA-studies for Estonian products as well. Dissemination and promotion of life cycle thinking and the IPP (Integrated Product Policy) approach are central aims in an EU Life-Environment project 'Introduction and Implementation of Life Cycle Assessment Methodology in Estonia: Effects of Oil Shale Electricity on the Environmental Performance of Products' (OSELCA). The project was launched in 2003 by the Estonian Energy Company Ltd (*Eesti Energia*), CyclePlan Ltd and the Finnish Environment Institute.

The OSELCA project includes eight tasks or sub-projects altogether. This guide is a result of the task named 'Analysis of available LCA databases to apply them in Estonia'. The main aim of this task is to encourage Estonian enterprises to conduct LCAs for their own products by

- providing information on the data collection phase of LCI,
- composing guidelines on important issues to be taken account in the data collection and
- providing information on some databases from the viewpoint of Estonian key products.

The data collection always plays a very conclusive role in LCAs because the final results are based on the quality of the collected data. In the future, from the point of view of Estonian LCA practitioners, probably the most serious problem is not going to be **primary** (site-specific) **data**, which they are able to gather by themselves (Table 1). Additionally, country-specific energy production data will soon be available as one of outputs of the OSELCA project. Yet the practitioners are left with the problem of how to find the best available data for raw and auxiliary

materials manufactured abroad. Thus, the practitioners need information about **secondary data**, which currently are only available in generic databases or LCI/LCA-studies.

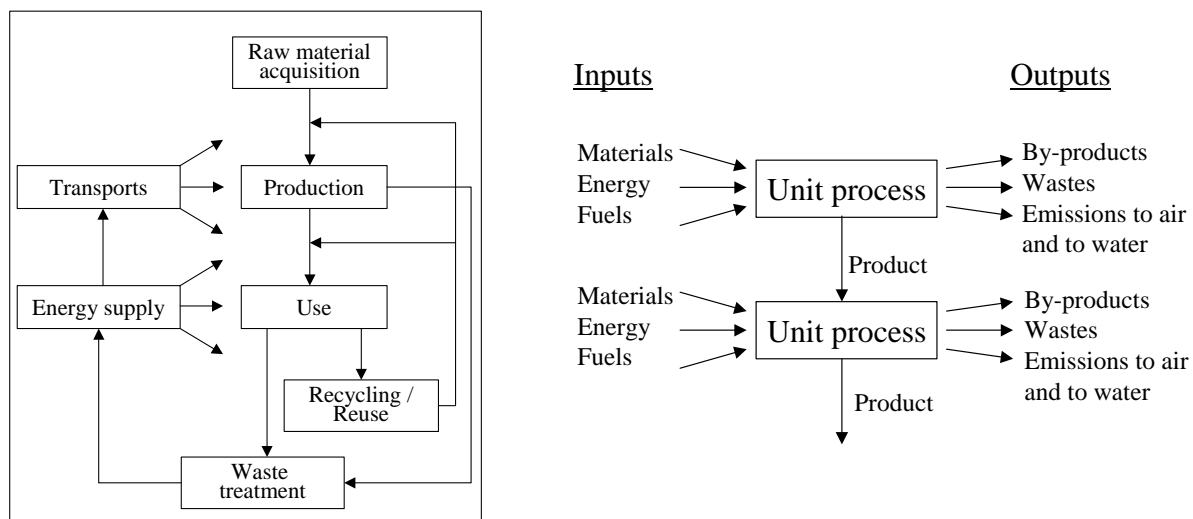
**Table 1.** Differences between primary and secondary data.

	<b>Primary data</b>	<b>Secondary data</b>
<b>Processes</b>	Manufacturing of a product on specific site	Production of raw and auxiliary materials, fuels, energy, transportation
<b>Source of data</b>	Producing companies	Databases, LCI/LCA studies

Present guide includes at first a brief introduction of the Life Cycle Inventory analysis (LCI) and the presentation of some available databases. In following discussion the applicability of databases in conducting an LCI for Estonian products is observed through the list of key products, manufactured in Estonia. In the end there are compiled some general guidelines of important issues to be taken account in the data collection phase of LCI. It is important to notice that the focus of this guide is not the entire LCI but only the data collection phase. In order to obtain more information about conducting of the LCIs we advise other available guides - such as: *Handbook on Life Cycle Assessment* (Guinée et al. 2002), *Guidelines for Life-Cycle Assessment: A 'Code of Practice'* (SETAC, 1993), *Nordic Guidelines on Life-Cycle Assessment* (1995), *Life-Cycle Assessment: Inventory Guidelines and Principles* (Vigon et al. 1994) and *ISO Standard 14041* (ISO 14041, 1998).

## 2 Life Cycle Inventory (LCI)

According to the standard ISO 14041 (1998) **data collection** for each unit process (smallest portion of a product system for which data are collected, ISO 14040) (Figure 2) and **calculation of the inventory results** are main activities in the inventory analysis. The aim is to prepare an inventory, first qualitative then quantitative, of all the processes involved in the life cycle of the product system(s) under study, detailing all the relevant interactions with the environment. (Guinée et al. 2002)



**Figure 2.** Examples of a product system for LCI analysis (ISO 14041, 1998), relating inputs and outputs to a unit process and interconnecting unit processes.

The main result of the inventory analysis is a table listing the quantified inputs from and outputs to the environment associated with **the functional unit** (quantified performance of a product system for use as a reference unit in a LCA study, ISO 14040 - in other words a final product or service). Inputs and outputs may be expressed for example in kg-s of carbon dioxide, kg-s of iron ore or cubic metres of natural gas per one functional unit. (Guinée et al. 2002)

The inventory analysis phase (LCI) can be broken down into the following simplified main issues, based on ISO 14041 standard (1998).

- **Data collection:** Collection and treatment of data of material consumption, waste and emissions for all the unit processes and for all the phases in the life cycle (data collection phase is more thoroughly discussed in Chapter 5.)
- **Validation of data:** Shall be conducted during the process of the data collection. May involve establishing, for example, mass or energy balances.
- **Relating data to unit processes:** Quantitative input and output data of the unit process shall be calculated in relation to a reference flow (for instance per 1 kg of material).
- **Allocation:** Most industrial processes yield more than one product, therefore the material and energy flows as well as associated environmental releases shall be allocated to the different products following appropriate procedures.
- **Data aggregation:** Unit processes are interconnected to allow calculations throughout the complete system. This is accomplished by normalising the flows of all unit processes in the system to the functional unit (the final product of the product system).
- **Refining the system boundaries:** The system boundaries are defined as a part of the scope definition procedure in the beginning of LCA study. The system boundaries can be refined e.g. by exclusion of material flows or inclusion of new unit processes shown to be significant.

Usually, the inventory analysis is the most time and resource consuming phase of an LCA. Especially the data collection of an LCI is an utterly important phase because the final results are directly based on the collected data. Consequently the validity and reliability of the LCA results largely depend on the quality of data. Different LCA/LCI databases have been developed to facilitate the data collection phase and several LCA software tools have been developed for gathering and calculating the inventory data.

### 3 Databases and software tools

#### 3.1 LCI / LCA databases

There are several LCA/LCI databases available on the market. Since there is no comprehensive listing of all existing databases available, a work to compile the registry of available LCA databases worldwide is being undertaken by Task Force 1 of the **UNEP/SETAC Life Cycle Initiative's Inventory Programme**. This database registry will provide a comprehensive survey of the LCI data resources, highlights data gaps and provides useful resource for LCI data users worldwide. The database registry work should be concluded by the end of year 2004. Results of the survey will be published on a regularly updated web-portal. The summary document of the project will be available in January 2005. For some more background information on the database registry work please visit at: [www.unep/ie.org/sustain/lcinitiative/](http://www.unep/ie.org/sustain/lcinitiative/) (UNEP/SETAC 2004).

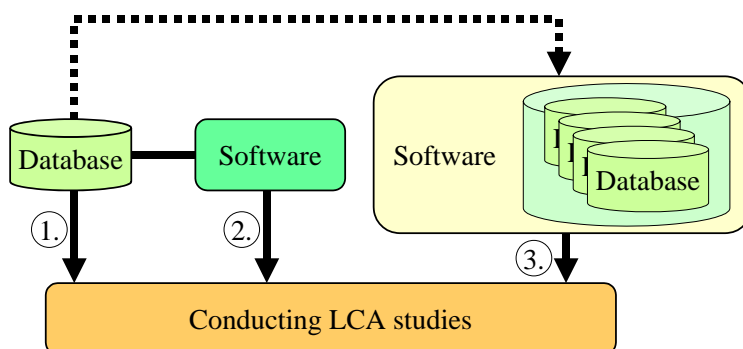
The available databases are provided and managed either by industry, government, consultants or research institutes (Norris and Notten 2002). Inventories produced and published under the auspices of a particular industry organisation tend to be comprehensive and the datasets are compiled by

conducting a survey of the region's facilities. Usually the data reflect industry's average information but sometimes the industry provided data are site-specific i.e. the data are provided from one site or company (Young et al. 2002). The database projects managed by government typically involve collaboration between several organisations and the goal is to produce nationally representative and accessible databases. Consultants and research institutes also produce LCI data, which they make publicly available in their own databases or with an LCA software tool usually for a fee (Norris and Notten 2002). These national, consultancy and research institute based databases contain data from several sources and from different branches of industry.

Databases on the market are either stand-alone databases, from which the whole database or a single dataset can be purchased, or the data are available within an LCA software tool. In this study, the focus is on the stand-alone databases. Databases include information on various processes and services. The content of the databases varies - some offer unit process raw data or LCI results but in some databases as well the LCA results and methods are included. Depending on the database the processes are presented as different process types: unit process (gate-to-gate or cradle-to-gate), multi-process system or multi-output process. Generally the processes are documented with the help of **meta information** (process information, modeling and validation, administrative information) and **flow data** (inputs and outputs of unit processes). Usually the meta information is accessible without charge but the access to the flow data is restricted and can only be viewed for a fee. The structure of the data format in the databases usually takes pattern from the SPOLD or SPINE data exchange formats, which have been, adapted to the ISO technical specification ISO/TS 14048 data documentation format (see Chapter 3.3).

### 3.2 LCA software tools

For an LCA-beginner the plentitude of databases and software tools as such can be confusing and the interconnections between them may seem sophisticated. Nowadays there are more than 30 LCA or LCA-type software tools available on the global market around the world for conducting LCA studies (Young et al. 2002). Most of the softwares include one or several databases from external sources. Some organisations have created their own database from their own data sources and these databases are usually concentrated on data from a specific field of industry. From the plentitude of databases the software tools tend to use the same databases with a slight variation. For more information on available software tools and their applicability for different purposes see LCA Software Survey (Jönbrink et al. 2000).



**Figure 3.** Three ways to conduct LCA studies using databases and software tools.

The use of different databases and softwares is outlined from the perspective of conducting an LCA study in Figure 3. Regardless of the usefulness of LCA databases and software tools a simple LCA study can be conducted without them. It is also possible to exploit databases but to calculate LCI results without a software tool (1). On the other hand, database data can also be saved and used by

the software tools (2). Nowadays, on the market there are also tools, which already include several databases (3). The use of LCA tools is not bound only to databases. There is always a possibility to save your own data, for example site-specific data from a producing plant, into every software tool.

### **3.3 Data documentation and exchange formats**

For the comparison of the different LCI data, it would be important that the data in different databases were documented similarly, and that the exchange of data between databases and LCA softwares would be possible. In 1990's a number of different data formats for LCA have been developed around the world. Some of them, such as SPOLD and SPINE, have been implemented in database software, while others are available as a printed form only (Guinée et al. 2002). Regardless of the development work the problem of incompatible data documentation and exchange formats has not yet been fully solved. Nowadays the focus is on harmonisation of formats for data documentation and exchange, as well as on the nomenclature between European LCI databases (Hischier and Kumlin 2003).

#### **SPOLD format**

The SPOLD - an electronic data format for exchange of LCI data - was developed in the years 1995 to 1997 as a joint effort by SPOLD (*Society for Promotion of Life-cycle Assessment Development*) and different database and software developers. Some other LCA-softwares have been designed in compliance with SPOLD (i.e. able to import and export data in SPOLD format) - for example *SimaPro 5* and *KCL-ECO 3.0*. In the case of not having the SPOLD compatible software, the SPOLD Data Exchange Software can be used to create, edit, view, import and export LCI data in the SPOLD'99 format. It is a freeware and can be downloaded from the website [www.lca-net.com/spold/](http://www.lca-net.com/spold/) (SPOLD 2004). SPOLD as an association terminated its activities in 2001 but the SPOLD data documentation and exchange format is still in use. A new format called EcoSpold has been developed on behalf of EcoInvent project and it is based on the SPOLD '99 data documentation and exchange format (SPOLD 2004, [www.ecoinvent.ch](http://www.ecoinvent.ch)).

#### **SPINE format**

The SPINE (*Sustainable Product Information Network for the Environment*) format was developed in Sweden by the national competence centre at Chalmers University of Technology (CPM). It was generated to handle, structure and store information and to enable communication between different software tools. The data documentation requirements were composed as well. The format has been used in practical exchange of well-documented life cycle inventory datasets between LCA practitioners since 1996. SPINE data communication file is called XFR (SPINE transfer format). Currently the XFR file is used in three softwares: SPINE@CPM Data Tool, EcoLab and LCAiT 4.0. ([www.globalspine.com](http://www.globalspine.com)). A compatible documentation format, Sirii SPINE, has been created also, it is based on interpretation of SPINE (Carlsson and Erlandsson 2002).

#### **ISO/TS 14048**

Both SPOLD and SPINE formats are nearly compatible with the ISO/TS 14048, which was developed in 2002 to provide a framework and requirements for the unambiguous documentation of LCI data. The specification "*provides the requirements and a structure for a data documentation format, to be used for transparent and unambiguous documentation and exchange of LCA and LCI data, thus permitting consistent documentation of data, reporting of data collection, data calculation and data quality, by specifying and structuring relevant information*" (ISO/TS 14048, 2002). The ISO/TS 14048 requires the data documentation structure to include meta information and flow data of the processes.

### 3.4 Introduction to some LCA/LCI databases

As mentioned above, there are several LCA or LCI databases available around the world. In the frames of the current guide it was not possible to investigate all of them, thus seven different LCI databases were selected for the more detailed introduction. Shortlist includes: the Swiss **Ecoinvent**, the Finnish **KCL Ecodata**, the Belgian **APME**, the Swedish **SPINE@CPM**, the Belgian **IISI**, the Dutch **IVAM LCA Data 4** and the Canadian **Athena**.

The three staple criteria of the selection were following:

1. There had to be easily accessible information in English about a database on the Internet. All users can freely review some of them, but unfortunately most of the databases are subject to charge and therefore they could not be studied in detail. In many cases, lists of processes and meta (background) data are available on websites free of charge after the registration.
2. A database had to be a European database. Only one non-European database was accepted onto the list, namely the Canadian *Athene*, which is specialised in construction products.
3. Databases which could be acquired only in aggregation with some LCA software tool (such as *SimaPro* or *Gabi*) were left aside. It is difficult to get sufficient information about such databases without purchasing the whole tool. Only *IVAM LCA Data 4* was included into our study as an exception to this criterion. *IVAM LCA Data 4* is compatible with *SimaPro* software tool.

In following the selected databases are presented briefly. The information has been gathered from the Internet. A summary table, listing the key features of the examined databases (Table 2), is presented on page 16. The information was gathered from June to September 2004, accordingly it reflects the situation of that period. The current and updated information on the databases can be found on their websites.

#### **Ecoinvent 2000**

In the 1990s several public LCA databases were developed in Switzerland by different institutes and organisations, partly covering the same and partly different economic sectors. In the multitude of different databases an idea of a harmonised and comprehensive LCA-database arose. Under the leadership of *Swiss Federal Laboratories for Material Testing and Research (EMPA)* different LCA-institutes in the *Swiss Federal Institutes of Technology (ETH)* domain and *Swiss Federal Offices* founded the *Swiss Centre for Life Cycle Inventories*. The project, called **Ecoinvent 2000**, was launched with the objective of a harmonised, revised and updated Swiss national LCI database. In the project The Swiss Centre for Life Cycle Inventories combined and extended different LCI databases with the goal of establishing a unified and generic set of LCI data of high quality.

The core product of the project is the *ecoinvent data v1.1* which provides more than 2 500 datasets for products, services and processes often used in LCA case studies. The database includes LCI data on energy, transport, waste disposal, building materials, chemicals, detergents, pulp and paper and agricultural products and processes, and the data are valid mainly for Swiss and Western European conditions. Collection and producing the data for different tasks are distributed according to the expert knowledge of the partners within the Ecoinvent project. Existing databases such as *Buwal 250* and *ETH-ESU* were used in building up the Ecoinvent database.

Ecoinvent data includes three kinds of information:

- **Process data:** Each dataset describes a life cycle inventory on a unit process level. The process data are documented with the help of meta information and flow data (inputs and outputs of a unit process).

- **Elementary flow data:** In elementary flow section there are detailed information on flows of pollutants and resources between technosphere and nature.
- **Life Cycle Impact Assessment (LCIA) methods:** In LCIA section characterisation and weighting factors of various impact assessment methods are presented.

The ecoinvent database supports the calculation of results with or without the infrastructure of the production process. At the moment only the results including infrastructure are published. Before the storage of the datasets in the database all reports have been reviewed and validated by a person from another ecoinvent institute and a validation comment has been added to the dataset.

The ecoinvent data v 1.1 are accessible via the Internet either as a guest or registered member user. Guests have a free but limited access to ecoinvent database. Guests are able to carry out simple and advanced searches on the database and have a free access to meta information. The access to quantitative information about the inputs and outputs and dataset downloading opportunities are enabled only for registered members for a fee. Registration is open (either as a guest or a member user) on Ecoinvent website. Registered member access to the flow data is cleared after the payment and all the data will be available on Ecoinvent website and in an Ecoinvent CD-ROM, which will be sent by mail. Ecoinvent database is a stand-alone database but it can be connected with many LCA software tools such as SimaPro, Gabi and Umberto.

*Data sources: [www.ecoinvent.ch](http://www.ecoinvent.ch) , Frischknecht et al. 2004.*

### **KCL EcoData**

KCL is a Finnish pulp and paper research company which core activities are research, pilot trials and laboratory services in the field of forestry. The limited company was founded in 1916 and it is owned by the Finnish pulp, paper and board industries. To support their core activities the company has developed KCL EcoData LCI module database for life cycle inventory calculations related to forest products. Experts from different branches of industry have been used in the data collection and data review processes. Also questionnaires and publications have been exploited in collection of data for KCL EcoData database.

KCL EcoData contains nearly 300 data modules, covering various sectors related to pulp and paper industry. The sectors covered are: energy production, manufacturing pulp and paper chemicals, wood growth and harvesting operation, pulp, paper and board mills, de-inking processes, printing, waste management options, plastics and transportation of both raw materials and products. The data in the modules are mainly from the late 1990's varying from 1989 to 2001. All data have been revised later to guarantee that it is still valid.

In most cases the geographical area for which the KCL EcoData is valid is Finland. However, some transportation modules are country-specific and some are valid for Scandinavia or Europe. Pulp, paper and board processes and energy generation represent high-level Scandinavian technology. KCL EcoData database can be obtained either by purchasing the entire database or by buying a single module or a set of modules. The price of a set of modules varies depending on the accuracy and amount of data.

*Data source: [www.kcl.fi](http://www.kcl.fi)*

### **APME - The Association of Plastics Manufacturers in Europe**

APME represents the European plastics manufacturing industries. APME has around 50 members, covering altogether 90 per cents of Western Europe's polymer production capability. In 1990, on behalf of the member companies, APME set up a task force to generate information describing the

production of polymers in Europe. The aims were to 1) gather detailed information on the processes operated by its member companies and 2) make this information publicly available without fee.

Instead of comprehensive LCI data, APME has gathered series of smaller process datasets, which are called Eco-profiles. These Eco-profiles do not cover the whole life cycles but are cradle-to-gate analyses. The first APME eco-profile reports were published during the period 1993 to 1995 and at the moment there are altogether sixteen eco-profile reports including process data on polymers, plastics and basic chemicals. The data for eco-profile studies are collected from the participating companies and it has been further processed to produce industry average data instead of company specific data. These Eco-profiles are updated regularly and they are available for free on APME website after registration.

Data source: [www.apme.org](http://www.apme.org)

## **SPINE@CPM**

A *Competence Centre for Environmental Assessment of Product and Material Systems* (CPM) was established at *Chalmers University of Technology in Gothenburg*, Sweden in 1996. Its aims were to develop a comprehensive knowledge base to support the industry needs in the field of environmental assessment. The product developed is called SPINE (Sustainable Product Information Network for the Environment), which is a database structure for storing and maintaining environmental data. CPM has developed the data documentation freeware SPINE@CPM Data Tool for data entry, search and exchange, World Wide LCA workshop (WWLCAW), which is a utility for managing LCA projects on the web, and the SPINE@CPM database.

The commercial SPINE@CPM database was established in order to give everyone access to the data. The aim was also to establish an infrastructure (trade structure) in which many parties have financial incentives to contribute towards the development of the system and enhance the quality of LCI data. Trade structures consist of a network of people and organisations who wish to buy, sell or exchange data in orderly manner, for example the access to the database is free for CPM members if they submit a certain amount of data per year.

There are more than 500 datasets in SPINE@CPM database containing detailed information on all types of goods transportation, electricity, heat, and fuel production, raw material production for example polymers, metals, chemicals, fertilizers, building materials, electronic components as well as some manufacturing processes such as metal processing and waste management alternatives. The system type is different in different data sets varying from cradle-to-gate or grave or from gate-to-gate or grave and in some cases only unit operation is included in the data set. The geographical area, for which the data is valid, differs in the datasets. A large share of the data are valid for Swedish conditions, some data cover the whole of Europe and some are valid for a specific plant or area. The data are from the late 1990s or from the beginning of 2000 depending on the dataset. The data is compiled from different sources such as studies, reports, statistics and CPM member organisations.

The database is located at global SPINE website. After registration anyone is able to enter the database to study the information describing the datasets free of charge. The flow data including quantitative information are subjected to a fee. The level of documentation of the data varies and therefore the data in the database has been classified into three price categories depending on the degree of documentation; sufficient, acceptable and unsatisfying. The employees at CPM-member companies have an access to all datasets free of charge, if five SPINE-formatted and documented dataset are submitted to the database per company per year. When ordering data it is possible to



choose from four delivery options; CD ROM containing the LCI information in different forms (either MS Access database, xfr-files or html-files) or paper transcripts.

*Data sources: [www.globalspine.com](http://www.globalspine.com), Carlson et al. 2000*

#### **IVAM LCA Data 4**

IVAM is an environmental research, training and consultancy firm of the University of Amsterdam. In 1993 IVAM originated from the Department of Environmental Science. For many years building materials have been of special interest to IVAM researchers. Besides the building materials IVAM has performed LCA studies on agriculture products, electronics, chemicals waste treatment etc.

IVAM LCA Data 4 database is a generic (data are average, not site-specific) database which consists of nearly 1 500 processes, leading to more than 350 materials. It includes data on construction materials, chemicals, plastics, metals, transports, electricity, agriculture (e.g. milk, fish, chicken, fertilizers and pesticides), electrical industries and waste treatment (23 waste types with about six processing alternatives each). The data in the database are either cradle-to-gate or cradle-to-grave data because many waste treatment processes are present in IVAM LCA Data. In the most cases infrastructure is included but there is also a possibility to calculate the results without it. Quantitative approximation of land use impacts as well as normalisation data, methods for characterisation and for weighting are included in the database. The geographical coverage of the data in most cases is the Netherlands but the data are often representative for Western Europe.

The major data sources for IVAM database are the previous LCA studies conducted by IVAM. However, in the latest update the emphasis has shifted towards the integration of various data sources (e.g. ETH/BUWAL and PRé data) into a more consistent set of data. The new data sources included complement the actual data and add to the completeness and value of the IVAM database.

The IVAM LCA Data 4 is sold as an additional database in SimaPro LCA Software ([www.pre.nl](http://www.pre.nl)) format. However, it is possible to deliver the IVAM data in CSV-format (to be opened for example with Excel) but it is not recommended, because many links between processes are lost this way.

*Data source: [www.ivam.nl](http://www.ivam.nl)*

#### **IISI, International Iron and Steel Institute**

International Iron and Steel Institute (IISI) was founded in 1967. It is a non-profit research organisation with headquarters in Brussels, Belgium. IISI is one of the largest and most dynamic industry associations and serves as a world forum for the international steel industry. IISI currently has a membership of more than 115 steel producing companies and over 60 national and regional steel federations and steel research organisations. The members come from more than 50 countries around the world. The countries in which IISI member companies are located account for over three-quarters of total world steel production. Nearly all the world's major steel producers are members of the Institute. Both publicly and privately owned enterprises are members of IISI.

In 1996 IISI launched a comprehensive data collection project, known as the IISI Worldwide Life Cycle Inventory (LCI) Study for Steel Products - in order to gather the data necessary for initiating or participating in LCA's - and this exercise has subsequently been updated for 1999/2000 data for steelmaking operations. An integral part of the project was the development of a common worldwide methodology for collating and evaluating steel product LCI data.

**Table 2.** A summary of the LCI/LCA databases examined in this study.

Database	Provider	Special features	Data source	Included processes	Geographical coverage	Data format	Updated	Price (August 2004)	Contact information
<b>Ecoinvent</b>	The Swiss Centre for Life Cycle Inventories (Switzerland)	Wide database. Data include infrastructure. (Data will be available without infrastructure in the future)	ETHZ (ETH-ESU database) PSI, EMPA (Buwal database), FAL, DOKA	Over 2500 processes: Energy supply, building materials and processes, chemicals, detergents, graphic papers, transport services, waste treatment services, agricultural products and processes	Mainly for Swiss and Western Europe conditions	EcoSpold ISO/TS 14048	Regularly	1200 EUR (+ VAT)	www.ecoinvent.ch
<b>KCL EcoData</b>	KCL (A pulp and paper research company) (Finland)	Concentrated on processes related to pulp and paper industry.	Experts, questionnaires, publications	Nearly 300 data modules: energy production, manufacturing pulp and paper chemicals, wood growth and harvesting operation, pulp, paper and board mills, de-inking processes, printing, waste management options, plastics and transportation	Mostly Finland, also some Scandinavia or Europe data.	SPOLD	Regularly	5400 EUR (entire database) 110 EUR (one module separately)	www.kcl.fi
<b>APME</b>	The Association of Plastics Manufacturers in Europe (Belgium)	Concentrated on plastics.	The participating companies.	16 eco-profile reports including over 60 datasets: process data on polymers, plastics and basic chemicals	Western European countries depending on the eco-profile.	Eco-profiles	Regularly	Free of charge after registration	www.apme.org
<b>SPINE@CPM</b>	CPM, A competence Centre for Environmental Assessment of Product and Material Systems (Sweden)	Wide database. Degree of documentation is clearly reported in each dataset.	Studies, reports, statistics, CPM member organisations and APME.	More than 500 datasets: Energy production, polymers, metals, chemicals, fertilizers, building materials, electronic, components, waste management alternatives and goods transportation	Mainly for Swedish conditions, some processes for the entire Europe.	SPINE ISO 14041		Prices vary from decree of documentation: 250-1000 SEK + tax (one separate dataset) + mandatory administrative fee of SEK 200 Delivery options: 10-600 SEK	www.globalspine.com
<b>IISI</b>	The International Iron and Steel Institute (Belgium)	Concentrated on steel product data.	Steel producing companies.	The exact amount of LCI data is not known. Some twenty thousand items of data from steel companies have been gathered: e.g. different kind of coils, tin free steel, organic coated flat, plate, tubes, and rebar/wire rod	Worldwide and regional averages (Western Europe, Far East Asia and Rest of the World)	ISO 14040 series	Updated regularly at least once in five years.	Free of charge.	www.worldsteel.org
<b>IVAM LCA Data 4</b>	IVAM, An environmental research, training and consultancy firm of the University of Amsterdam (Netherlands)	Wide database. Includes data on animal production.	Mainly LCA research of IVAM Environmental Research.	Nearly 1500 processes leading to more than 350 materials: Agriculture products, electronics, materials, chemicals, transport, electricity and waste treatments	Mostly the Netherlands, often being representative for Western Europe.	SPOLD-compatible SimaPro Format	Regularly	1575 EUR + VAT (SimaPro format)	www.ivam.nl
<b>Athena</b>	The Athena Sustainable Materials Institute (Canada)	Concentrated on construction products.	LCIs conducted by Industry experts.	More than 90 processes: e.g. wood, steel and concrete structural products, roofing, windows and glazed curtain walls	North America		Regularly as the funding allows.	Database reports CD 325 USD, Software 390 USD.	www.athenasmi.ca

DOKA Doka Life Cycle Assessment  
 EMPA Swiss Federal Laboratories for Materials testing and Research  
 ETHZ Swiss Federal Institute of Technology Zurich  
 FAL Swiss Federal Research Station for Agro-ecology and Agriculture  
 PSI Paul Scherrer Institute

The IISI LCI Study is a cradle-to-gate LCI - an inventory of fourteen products, quantifying inputs and emissions related to the production of a range of steel products - from the extraction of raw materials in the ground thorough to the steel factory gate. These products are among others: various kinds of coils, tin free steel, organic coated flat, plate, tubes, rebar/wire rod. In total, 50 sites (28 in Europe, 12 in Far East Asia and 10 in North America, Eastern Europe and Africa) operated by 28 companies participated in the IISI LCI study representing different operations (34 blast furnace, 13 electric arc furnace and 3 direct reduction operations).

The LCI study has resulted in the creation of a database that contains the inventory results (resource use, emissions into air and water, by-products and wastes) in accordance with the ISO standards on LCA (ISO 14040 series). As the study was a cradle-to-gate analysis the database includes upstream data (i.e., iron ore mining, electricity production, etc.) and it also includes information on whether data were measured, calculated or estimated. The quality of data is considered as excellent since it is recent and from reliable sources. The IISI LCI data are freely available by completing a brief questionnaire on the Internet in order that the appropriate dataset and support can be supplied.

*Data source:* [www.worldsteel.org](http://www.worldsteel.org)

### **Athena**

The Athena Sustainable Materials Institute is a not-for-profit organisation with the aim of finding answers to critical questions about the environmental impact of buildings and building products. The Institute is a world-leading source of data, expertise and tools for designing buildings with the environment in mind. The Institute is supported by members whose fees help fund the core research program. Memberships are offered to individuals, companies, governments and other organisations.

The Athena Institute commissions inventory studies by people or organisations expert in the specific industry or product group of interest, and have industry associations and their members participate by providing information and by reviewing and commenting on reports at a draft stage. Athena's research teams follow common building materials from cradle-to-grave and calculate the environmental effects at each stage in the product's life cycle. These data have formed Athena Life Cycle Inventory Product Databases, which cover more than 90 structural, and envelope materials. These materials are wood, steel and concrete structural products, cladding products, gypsum wallboard, finishing materials, insulation and vapour barriers, residential and commercial roofing, windows and glazed curtain walls, glazing systems, window frame materials and paints. The data in the databases take into consideration manufacturing technology, transportation and electricity grid differences in various regions in Northern America.

The material databases are sold as an LCI Database reports CD. These reports present the basic inventory data by material or material grouping, but it is the Estimator software established by the Athena Institute with which the actual LCIs can be calculated. The individual LCI reports are not stand-alone documents because for example, an LCI report may specify the amount of electricity used in production processes without taking account of environmental interventions, or it may include estimates of transportation requirements in mode and distance terms without including the energy use and emissions associated with the transportation. The Estimator includes the common fuel and electricity generation databases as well as the indirect emission data associated with the transportation and manufacturing of materials.

*Data source:* [www.athenasmi.ca](http://www.athenasmi.ca)

## 4 Applicability of studied databases for the Estonian key products

The purpose of this chapter is to investigate LCI databases introduced in the preceding chapter from the viewpoint of the Estonian key products. While starting to conduct LCIs site-specific for the manufacturing processes of the products, attempt may be made to obtain LCI data from the producers. If, however, data are not available it is possible to utilise generic databases. Primarily, generic databases are used for the raw materials produced abroad, transportation, energy production etc. This study concentrates on the main raw materials instead of the Estonian key products themselves, and excludes also other background information of LCIs.

### 4.1 Selection of the key products

In order to select the **ten key products**, the industrial production of Estonia was analysed on the basis of their share in the total industrial production according to a statistical database on economic activity in 2001 (Statistical Yearbook of Estonia 2004). An analysis of this data led to the selection of the products, listed in Table 3. Simultaneously their main raw materials and the countries of origin of the raw materials were identified. The information on the raw materials were obtained either from websites of manufacturing companies or by contacting the companies directly.

A product called '*furniture*' originally belonged to the set of the ten key products. However, furniture was so diverse product group to analyse from the raw material perspective, hence *lime* was chosen to be the tenth product examined in this study. Oil shale mining and energy production were also excluded because simultaneously a detailed LCA of oil shale based electricity is underway in the frames of Task 1 of the same project.

**Table 3.** The key products of Estonia (excluding oil shale mining and energy production), their main raw or auxiliary materials, the countries of origin and the source of information.

Product	Main raw or auxiliary materials	Countries of origin	Source of information
Beer	malt, hops, yeast, water	Estonia, Denmark, Germany, Finland	Saku Brewery ( <a href="http://www.saku.ee/">http://www.saku.ee/</a> )
Building bricks	lightweight aggregate, cement	Estonia	AS Optiroc ( <a href="http://www.optiroc.ee/">http://www.optiroc.ee/</a> )
Cement	limestone, clay, oil shale ash, gypsum, ground sand	Estonia, Spain	AS Kunda Nordic Cement ( <a href="http://www.knc.ee/">http://www.knc.ee/</a> )
Cotton fabrics	Cotton	USA, Uzbekistan	Estonian Clothing and Textile Association
Fertilizers	natural gas	Russia	AS Nitrofert ( <a href="http://www.nitrofert.ee/">http://www.nitrofert.ee/</a> )
Fibreboard	wood, wood chips, chemicals (e.g. formaldehyde, paraffin, sulphuric acid)	Estonia, EU countries, Russia	AS Repo Vabrikud ( <a href="http://www.repo.ee/">http://www.repo.ee/</a> ); Statistical Office of Estonia ( <a href="http://www.stat.ee/">http://www.stat.ee/</a> )
Lime	Limestone	Estonia	Nordkalk ( <a href="http://www.nordkalk.com/">http://www.nordkalk.com/</a> )
Metal constructions	steel, zinc, sand, paints	Finland, Russia, Sweden, Italy, Germany	Websites of the producers of metal constructions; Statistical Office of Estonia ( <a href="http://www.stat.ee/">http://www.stat.ee/</a> )
Milk powder	Milk	Estonia	Estonian dairy association
Sawn timber	redwood, spruce, aspen, birch, alder, ash-tree, oak	Estonia, Russia	Estonian Forest Industries Association; Websites of the producers of sawn timber

## 4.2 Available LCI data for the raw materials

The raw materials of the Estonian key products were rearranged under the categories of **agriculture, chemicals, metals, construction materials and timber**. The appropriate data for the raw materials of these categories from the selected databases are discussed below. (See also more detailed information on the databases in Table 2 and Appendix.) Even though LCI databases include large amount of data, there still are many processes for which there are no life cycle inventory data available. In our case, we could not find LCI data on malt, hops, yeast, lightweight aggregate and cotton. However, other databases or LCI studies may provide information also on some of these products. A summary of the databases that provide LCI data for the main raw materials of the Estonian key products is presented in Table 4 on page 20.

### Agriculture

Agricultural products consumed in Estonia are mainly produced domestically, and there are no country-specific data available, yet. Ecoinvent includes data for different means of agriculture production such as machinery, buildings, and work processes as well as data for fertilizers, pesticides, and plant production. This agricultural data in Ecoinvent are valid for Swiss conditions, and the means of agriculture production are valid either for Switzerland or for the entire Europe. IVAM LCA Data 4 includes several datasets for crops, feed, fertilizers, pesticides, and additionally data on animal production i.e. dairy, meat and fish production. The milk data of IVAM are valid for Western Europe and all the other data either for the Netherlands or Western Europe. The other databases (SPINE@CPM, KCL EcoData, APME) also provide LCI data on fertilizers, but they have no data on plant or animal production. The APME data covers geographically France, Germany or UK.

The Russian origin natural gas is used for fertilizer production in Estonia. Ecoinvent provides data on natural gas production onshore in Russia together with the natural gas transportation. However, all the natural gas data in the Ecoinvent dataset are not based on Russian data but on standard data. APME and IVAM provide natural gas production data for Western European conditions.

### Chemicals

Most of the chemicals used in the Estonian industry are imported. For instance chemicals in the production of fibreboard are imported mainly either from the EU countries or Russia. The chemicals data are well represented in various LCI databases, but the range of chemicals is not yet extensive enough. Ecoinvent has more than 150, KCL EcoData more than 30 and IVAM LCA Data 4 more than 100 different processes for organic and inorganic chemicals. In SPINE@CPM and in APME there are also several datasets for chemicals. Data for formaldehyde and paraffin manufacturing in Europe can be acquired from Ecoinvent or from IVAM LCA Data 4. KCL EcoData, Ecoinvent, and IVAM LCA Data 4 include data on European sulphuric acid production.

A geographical coverage for which chemical data are valid differs only slightly between different databases. However, especially with chemicals, the technology of manufacturing processes may vary between datasets, hence it is recommended to examine the process technology within these potential datasets to find the most appropriate data for one's own purposes.

### Metals

In Estonia there are no metal refineries, but metals, mainly steel and zinc, for making metal constructions are imported either from some EU countries (Finland, Sweden, Italy, Germany) or Russia. Ecoinvent includes about 140 datasets on metal extraction and processing, but some of them

are describing the same processes in different locations. SPINE@CPM has dozens of datasets for different metals and IVAM LCA Data 4 includes more than 50 processes on metals. IISI has concentrated only on steel products and its LCI data are worldwide or regional averages. The North American Athena database includes datasets of 17 steel products available in various lengths and thicknesses.

## Construction materials

In this study, the construction materials under investigation were limestone, clay, gypsum, sand and also paints were added to this category. As the gypsum, used in cement production in Estonia, is imported from Spain, there are no exact gypsum data available. This is also the case in domestic limestone, clay and sand production. However, LCI data for mining and producing the above mentioned materials in Western Europe are available in Ecoinvent and in IVAM LCA Data 4. The SPINE@CPM provides information only on extraction of lime.

In Estonia the paints are used for example in metal constructions, and they are imported from Finland, Russia, Sweden, Italy or Germany. Ecoinvent includes more than ten datasets on different types of paints - such as acrylic and alkyd paints. IVAM provides data on approximately ten processes related to acryl, alkyd and natural paints. In SPINE there are two datasets describing the production of paints for different purposes. Ecoinvent and IVAM provide the European data and SPINE@CPM the Swedish data.

**Table 4.** The main raw materials, used in manufacturing the Estonian key products, and the databases in which LCI data for the raw materials are available.

Product category	Raw material	Databases (X = data available)							
		Ecoinvent	SPINE @CPM	IVAM Data 4	LCA	KCL EcoData	APME	IISI	Athena
<b>Agriculture</b>	milk			X					
	fertilizers	X	X	X		X	X		
	natural gas	X		X			X		
<b>Chemicals</b>	formaldehyde	X		X					
	paraffin	X		X					
	sulphuric acid	X		X		X			
<b>Metals</b>	steel	X	X	X				X	X
	zinc	X		X					
<b>Construction materials</b>	limestone	X	X	X					
	clay	X		X					
	gypsum	X		X					
	sand	X		X					
	paints	X	X	X					
<b>Timber</b>	<b>softwood</b>	redwood (pine)	X	X			X		
		spruce	X	X			X		
	<b>hardwood</b>	birch	X				X		
		aspen	X						
		alder	X						
		ash tree	X						
		oak	X						
		chips	X						

**No data found:** malt, hops, yeast, lightweight aggregate, cotton, soapstone, and lignosulphonate

## Timber

There are only a couple of LCI databases that provide data on wood-based products and forestry processes. The most specific LCI database for forestry operations is KCL EcoData but also Ecoinvent and SPINE@CPM include forest data. KCL EcoData includes altogether about 80

datasets concerning wood growth, thinning and regeneration fellings for fibre wood and logs of different wood species (pine, spruce, birch). This KCL database also includes many pulp, paper and board processes. Ecoinvent has more than 100 datasets for wooden materials including such processes as thinning, planning and sawing for both hard- and softwood, and also processes for sawn timber and boards. In SPINE@CPM there is a dataset for silviculture of softwood, which includes silviculture operations from tree plant nursing to final felling and forwarding of harvested wood.

The sawn timber (redwood, spruce, birch, aspen, alder, ash tree and oak) used by Estonian enterprises is either domestic or it has been imported from Russia. In the examined databases there is no data on sawn timber that has grown in Estonia or in Russia. In KCL EcoData the forest growth and felling data on pine, spruce and birch represents the Finnish conditions, and in Ecoinvent the wooden material data are valid for the whole of Europe except for some datasets that are valid for Scandinavia. The utilisation of these databases in Estonia for acquiring LCI data of sawn timber is possible. However, the existing differences in the technology level between Estonia and Scandinavia must be taken into account.

### **4.3 Conclusions**

As we expected there is no country-specific LCI data in generic databases for Estonia, therefore we can recommend no particular database to be used for inventories of Estonian products. Around the world there are several LCA/LCI databases available but even the seven databases we examined include extensive amount of data to choose from. In these databases there are data available for almost all Estonian key products and their main raw materials but the applicability of a certain process data must be verified in every case separately. An important issue to be found out while selecting the best available data for inventory is the technology of a process, hence environmental interventions of processes may vary significantly and thus may have a great influence on the final results of LCI. Taking a technological level into consideration the validity and reliability of LCI results may improve notably.

On the market there are basically two main types of databases - wide general databases including data on various industrial sectors and smaller databases with data on some specific field. In the small sample of European databases based on our selection criteria a half of them happened to be general and the other half specific databases. Most of them provide cradle-to-gate data but Ecoinvent differs from other databases since its LCI data includes infrastructure.

All examined databases are applicable for Estonian industries similarly as in any other country because generic databases are typically used for raw materials manufactured elsewhere. In the future when willingness to gather domestic site-specific data has increased and country-specific energy production data have completed, Estonia is in the same situation with other LCA methodology using countries regarding the conducting of LCIs.

## **5 Guidelines for the LCI data collection**

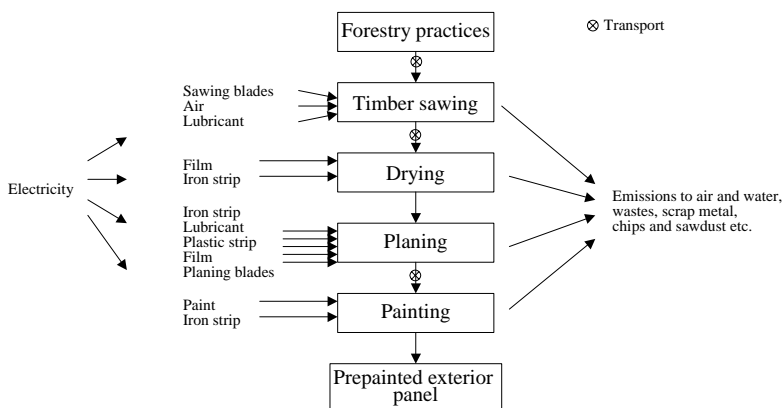
One of the findings of this Task was that it is impossible to point out any specific database to be used for a specific raw material or product. A need for some general guidelines still remains. We developed seven guidelines for LCI data collectors pertaining the most important issues to be taken into consideration during the data collection. The aim of these guidelines is to make sure that the collected data will be appropriate for the purpose of an LCI. In context of each of the seven guidelines the main point of the guideline is condensed after the background information. In the end of this chapter the guidelines are still summarised in the table 5.

## Guideline 1

Before collecting data, boundaries have to be set up for a studied product system. The system may consist of two or several of the following life cycle stages: raw material acquisition, production, waste treatment, use, recycling/reuse and waste disposal. In every case it also includes transports between unit processes and energy supply. However, the product systems of life cycle inventories especially conducted by the industry sector are often simplified cradle-to-gate analysis. It means that the examined system ends at the gate of the factory i.e. the use, recycling/reuse and the waste disposal stages have been excluded from the studied system.

The boundaries separate the studied product system – its unit processes and their interrelationships - from the surrounding environment. Generally, LCIs are quite large aggregated systems including many small details e.g. minor material inputs, therefore it is essential to clarify thoroughly what is important to investigate for the totality and for the final results of the study. In the beginning, it is also good to consider how detailed the unit processes should be studied, and what actually was the scope of study.

**A flow chart** drawn from the system can be helpful in the data collection process because it, together with the system boundaries, reveals at the same time the unit processes for which the actual data will be gathered, and helps to discern the whole product system. The system should be described in sufficient detail and clarity to allow another practitioner to duplicate the inventory analysis (ISO 14041, 1998) when it is needed. The documentation of the product system can be performed by using the data documentation format by ISO (ISO/TS 14048, 2002) or some other transparent way. As an example, a simplified flow chart (cradle-to-gate) of the pre-painted exterior panel is presented in Figure 4. This flow chart includes only the main unit processes and the main inputs and outputs of the product system. In the reality, the flow charts are more complicated and detailed. The connection between two unit processes can be carried out so that the output of the previous unit process is the input to the next unit process.



**Figure 4.** A flow chart of the pre-painted exterior panel including the main unit processes and the main inputs and outputs.

The modeling of the flow chart as well as the calculation of the LCI results can be carried out with the help of an LCA software tool (see Chapter 3.2). These software tools enable managing of the sophisticated calculations, and they are very practical as well in the phase of interpretation the final results of an LCI or LCA. The LCI calculations can be carried out by using an electronic spreadsheet program, such as MS-Excel, but these programs are useful only in the case of a simple LCA study.

---

**GUIDELINE 1. Model a product system to find out unit processes for which data are needed.**

---



## Guideline 2

It is important to distinguish two different types of data, primary (site-specific) and secondary (average) data. The primary data is used for foreground systems, which are specific processes of the product system, and the secondary data for background processes, which are not specific for the defined product system. Primary data should be acquired directly from producing companies. Secondary data is more generic, such as data on materials, energy and transport, and it can be acquired from databases or literature. (Guinée et al. 2002, Goedkoop and Oele 2004)

Thus available data sources are:

- **Producing companies:** Producing companies provides the most specific data for a process. This site-specific data can be acquired either by personal communication or by questionnaires. Sometimes also company's environmental reports can be helpful in getting the data. Site-specific data is the best available data and it should be used as often as possible.
- **Databases:** LCI databases contain life cycle data on a large amount of different processes related to material manufacturing, energy supply and transports.
- **General technical literature and reports from LCAs and similar projects:** Data may also be acquired from other general sources, which are not specifically developed for LCA database purposes such as LCA reports. LCA reports describe the whole product systems and due to this there might be a lack of documentation of subsystems. Also, the documentation vary between different LCA studies, hence the interpretation of the reports may be difficult. These sources should be used with caution, likewise databases, because the system boundaries of the completed studies are usually not equivalent with the goal and scope of the current study.

---

**GUIDELINE 2. Always use primary (site-specific) data if it is possible.**

---

## Guideline 3

If site-specific data are not available, data have to be acquired from different databases or from literature. Most of the LCA databases have their own websites providing lists of available datasets in the databases. In some cases, you can even investigate the content of the data more closely but usually the actual flow data in the datasets are subject to charge. To facilitate the search for an appropriate data source, a tool called **Global LCI Directory** has been developed by U.S. Environmental Protection Agency. This directory, located at [www.epa.gov](http://www.epa.gov) (EPA 2004), is a tool to identify LCIs and other sources of LCI data that can be used to complete an LCI for a specific product, process, or activity. For more information on some available databases see Chapter 3 of this guide.

Additionally, the summary document of the database registry compiled by Task Force 1 of the **UNEP/SETAC** Life Cycle Initiative's Inventory Programme will be available in January 2005 (see Chapter 3.1).

---

**GUIDELINE 3. If primary data are not available, use secondary data from databases or literature.**

---

## Guideline 4

Before selecting the best secondary data source for a unit process, some considerations should be given to the system boundaries, the specificity and the quality of data.

- **System boundaries:** Do the selected data describe the same unit process that you are going to investigate or are there any differences?
- **Specificity:** How specific should the data be? For example, how many emissions should be reported?
- **Data quality:** There are three data quality aspects that should be taken into consideration.
  - *age of the data:* When conducting an LCA of a present situation, the data have to be as new as possible, thus the technology changes will be taken into account.
  - *geographical coverage:* If possible, the data have to represent the geographical area in which the unit process takes place (e.g. the same continent or the same country). This is not always possible, because the data may not cover all the geographical areas. In these cases, it is best to use data of which geographical coverage is as close as possible to the area where the investigated process occurs.
  - *technological coverage:* The technology level of the unit process described in the data has to be consistent with the technology of the process under study. If this is not the case the results will not be accurate. For instance, the emissions to the environment can vary greatly between the best available technology and the technology, which is already out-of-date. If there are no data in the databases for a certain technology then data on the closest technology could be used but the differences have to be reported.

---

**GUIDELINE 4. Always use the most recent secondary data possible. Check that the technological and geographical coverage apply for your purposes.**

---

## Guideline 5

In the case of a total lack of either site-specific or database data you have to resort to **expert estimations** or to **substitute** the original process for a similar one. However, before estimating data for missing processes it is reasonable to analyse how important this missing data is for the overall LCA. According to ISO 14041 (1998) "resources need not be expended on the quantification of such inputs and outputs that will not significantly change the overall conclusions of the study". There are several criteria used among LCA practitioners for the selection of inputs that should be studied. They are usually based on mass, energy or environmental relevance. The relevance of inputs should be determined in each LCI separately. If the mass relevance is used in an inventory, it can be defined for instance so that all the raw materials that have the weight of over 0.1% of the total weight of the materials used in the process should be investigated and included in the calculations of LCI.

---

**GUIDELINE 5. If some data are not available at all, you can use an estimate or a substitute. If the relevance of data is not significant for the whole product system, you can omit it.**

---

## Guideline 6

Energy is an integral part of every life cycle stages of every product. The environmental burden arisen from electricity production differs from one country to another due to different production profiles (energy sources). For example, in Estonia approximately 96% of produced electricity is generated from oil shale, and in Norway almost the same amount is produced by hydropower. A difference in the emissions is significant, and it will be shown especially in an LCI of a very

energy-intensive product. Thus, it is important to use the **electricity production profile** of the country where the product actually has been manufactured. In several databases data on country-specific electricity production profiles can be found.

---

**Guideline 6. If emissions of electricity production are not included in the data, use a country-specific profile and emissions for electricity production.**

---

## **Guideline 7**

**Data validation and documentation** are important issues, which should be considered already during the process of data collection. The data validation has to be conducted in order to improve the overall data quality. It may point out areas where data quality is inadequate and therefore has to be improved. LCA works have to be documented thoroughly in order to achieve transparency and reproducibility. These criteria will be fulfilled, if the collected LCI data, the treatment of missing data, the differences between the needed and the available data, and the aims set up in the goal and scope definition phase are documented systematically. To avoid double counting or gaps, a description of each unit process shall be made. Also all the calculation procedures and allocation (i.e. partitioning the input or output flows of a unit process to the product system under study) methods should be validated and documented. Additionally, the source of the data has to be referenced.

---

**Guideline 7. Check validity during the process of the data collection. Document all the collected data thoroughly.**

---

**Table 5.** A summary of the guidelines for the data collection.

---

<b>GUIDELINES</b>	
<b>1</b>	Model a product system to find out unit processes for which data are needed.
<b>2</b>	Always use primary (site-specific) data if it is possible.
<b>3</b>	If primary data are not available, use secondary data from databases or literature.
<b>4</b>	Always use the most recent secondary data possible. Check that the technological and geographical coverage apply for your purposes.
<b>5</b>	If some data are not available at all, you can use an estimate or a substitute. If the relevance of data is not significant for the whole product system, you can omit it.
<b>6</b>	If emissions of electricity production are not included in the data, use a country-specific profile and emissions for electricity production.
<b>7</b>	Check data validity during the process of data collection. Document all the collected data thoroughly.

---

## References

Carlson, R., Erixon, M. and Pålsson, A-C. 2000. Establishment of trade structures for LCI data. A report describing CPM's strategy for the development of LCI data trade.

Carlsson, A-S. and Erlandsson, M. 2002. Users manual to Sirii ED Application. Sirii – Swedish Industrial Research Institute's Initiative. July 2002.

Consoli, F., Allen, D., Boustead, I., Fava, J., Franklin, W., Jensen. A.A., de Oude, N., Parrish, R., Perriman, R., Postlethwaite, D., Quay, B., Séguin, J. and Vigon, B (eds.) 1993. Guidelines for life-cycle assessment: A 'Code of Practice'. Society of Environmental Toxicology and Chemistry (SETAC), Brussels. 69p.

EPA 2004. [www.epa.gov/ORD/NRMRL/lcaccess/dataportal.htm](http://www.epa.gov/ORD/NRMRL/lcaccess/dataportal.htm)

Frischknecht, R., Jungbluth, N. (eds.), Althaus, H-J., Koka, G., Dones, R., Hellweg, S., Hirschier, R., Nemecek, T., Rebitzer, G. and Spielmann, M. 2004. Overview and Methodology. Data v1.1. Ecoinvent report No.1.

Goedkoop, M. and Oele, M. 2004. Introduction to LCA with SimaPro 6. Pré Consultants.

Guinée J.B. (final editor), Gorrae, M., Heijungs, R., Huppes, G., Kleijn, R., de Koning, A., van Oers, L., Wegener Sleeswijk A., Suh, S., de Haes, U., de Bruijn, H., van Duin, R. and Huijbregts, M.A.J. 2002. Handbook on Life Cycle Assessment. Operational Guide to the ISO Standards. Eco-efficiency in industry and science, volume 7. Kluwer Academic Publishers, Dordrecht.

Heiskanen, E. 2002. The institutional logic of life cycle thinking. *Journal of Cleaner Production* 10 (2002):427-437.

Hirschier, R., and Kumlin, A-S. 2003. How compatible are the Swiss EcoSpold and the Swedish Sirii-SPINE format for data documentation and exchange. In: Proceedings of the International Workshop on Quality of LCI Data, October 20<sup>th</sup> to 21<sup>st</sup>, 2003. Karlsruhe, Germany.

ISO 14040, 1997. Environmental management. Life Cycle Assessment; Principles and framework. International Organization for Standardization.

ISO 14041, 1998. Environmental management. Life cycle assessment. Goal and scope definition and inventory analysis.

ISO/TS 14048, 2002. Environmental management – Life cycle assessment – Data documentation format. Technical specification. International Organization for Standardization.

Jönbrink, A.K., Wolf-Wats, C., Erixon, M., Olsson, P. and Wallén, E. 2000. LCA Software Survey. IVL report No B 1390. IVL Swedish Environmental Research Institute Ltd. Stockholm.

Neitzel, H. 1996. Principles of product-related life cycle assessment – "Conceptual framework"/"Memorandum of understanding", State October 1993". *The International Journal of Life Cycle Assessment*, vol. 1, no. 1, p. 49-54.

Nordic Guidelines on Life-Cycle assessment. 1995. Nordic Council of Ministers. Nord 1995:20.

Norris, G.A. & Notten, P. 2002. Current Availability of LCI Databases in the World. Working Draft 2a. May 2002.

SETAC 1993. Guidelines for Life-Cycle Assessment: A 'Code of Practice'. Edition 1. From the SETAC Workshop held at Sesimbra, Portugal 31 March – 3 April. Society of Environmental Toxicology and Chemistry.

SPOLD 2004. [www.lca-net.com/spold](http://www.lca-net.com/spold)

Statistical Office of Estonia. 2004. [www.stat.ee](http://www.stat.ee)

UNEP/SETAC 2004. [www.uneptie.org/sustain/lcinitiative/](http://www.uneptie.org/sustain/lcinitiative/)

Vigon, B.W., Tolle, D.A., Cornaby, B.W., Latham, H.C., Harrison, C.L., Boguski, T.L., Hunt, R.G. and Sellers, J.D. 1994. Life Cycle Assessment: Inventory Guidelines and Principles.

Young, S.B., Turnbull, S. & Russel, A. 2002. What LCA Can Tell Us About the Cement Industry. Toward a Sustainable Cement Industry, Substudy 6. Five Winds International. An Independent Study Commissioned by World Business Council for Sustainable Development.

## Appendix

### Raw materials of the Estonian key products and some relevant databases for them.

Raw materials	Database	Dataset (module) names and some examples of processes
Limestone	EcoInvent	<p><i>Mine, at mine, crushed for mill, crushed and washed, milled and loose, milled and packed.</i></p> <p><i>At mine:</i> Includes blasting, all transports within the mine (for mining and recultivation), a part of the heating energy for "administration" buildings and the infrastructure. Data are only from one company in Switzerland which works on a technically high level.</p> <p><i>Geographical boundary:</i> mining CH, blasting RER, diesel GLO, heating CH</p>
	SPINE@CPM	<p><i>Extraction of lime, production of powered limestone</i></p> <p>Quality of data is unsatisfying.</p>
	IVAM LCA Data 4	<i>Limestone</i>
Clay	EcoInvent	<p><i>Mine, at mine, clay plaster</i></p> <p><i>At mine:</i> Includes clay excavation by digger, transportation to first grinding machine, the land-use of the mining and the recultivation area. Typical technology for Swiss clay mining. Electricity not used hence not included.</p> <p><i>Geographical boundary:</i> diesel GLO, mining CH</p>
	IVAM LCA Data 4	<i>Clay</i>
Gypsum	EcoInvent	<p><i>Mineral at mine, fibre board, plaster board</i></p> <p><i>Mineral at mine:</i> Includes mining and crushing of gypsum and anhydrite. Since the electricity consumption has a relevant share on the total energy consumption, the choice of the energy mix is important. For gypsum mined in countries with high fossil share in the electricity mix this module has to be adopted accordingly.</p> <p><i>Geographical boundary:</i> electricity CH, mining CH, others RER or GLO</p>
	IVAM LCA Data 4	<i>Gypsum: natural and ore</i>
Sand / gravel	EcoInvent	<p><i>Mine, mining</i></p> <p><i>Mining:</i> Includes the whole manufacturing process for gravel round and sand, internal processes (transport, etc.) and infrastructure for the operation (machinery). Typical technology for Swiss production.</p> <p><i>Geographical boundary:</i> electricity CH, others CH, RER, GLO</p>
	IVAM LCA Data 4	<i>Sand and gravel</i>
Steel	EcoInvent	<p><i>Converter and chromium steel, converter and low-alloyed steel, converter and unalloyed steel, electric and chromium steel, electric and un- and low-alloyed steel, low-alloyed steel</i></p> <p><i>Steels, converter:</i> Include transports of hot metal and other input materials to converter, steelmaking process and casting. Produces primary steel.</p> <p><i>Geographical boundary:</i> EU technology mix, electricity UCTE, others RER, CH, GLO or OCE</p> <p><i>Steels, electric:</i> Include transports of scrap metal and other input materials to electric arc furnace, steelmaking process and casting. Produces secondary steel.</p> <p><i>Geographical boundary:</i> EU technology mix, electricity UCTE, others RER, CH, DE, UCTE</p>
	SPINE@CPM	<p><i>Virgin steel production, scrap-based steel production, ore-based steel production, steel jointing production, steel rail production</i></p> <p><i>Virgin steel production:</i> Includes iron ore pellet production, steel production with mainly virgin raw material and the production of explosives. Quality of data is sufficient.</p> <p><i>Geographical boundary:</i> Most of the processes takes place in Sweden, except for the production of microballoons which takes place in France. The chalice is mined in Chile, the aluminium powder is imported from Germany, Italy or Switzerland and the ammonia from Ukraine.</p> <p><i>Scrap-based steel production:</i> Scrap refining; production of slag formers; coal mining. Quality of data is acceptable</p> <p><i>Geographical boundary:</i> Sweden, except for the coal mining which is done in Australia and USA.</p> <p><i>Ore-based steel production:</i> Includes olivine and bentonite mining, iron-ore mining, dressing, concentrating and palletising, lime production, coal mining, scrap refining, steel production (from pellets to slabs), coking plant (with coal storage), blast furnaces, steel plant (with lime kiln and continuous casting), oxygen plant, rolling mill. Quality of data is sufficient</p> <p><i>Geographical boundary:</i> Sweden, except for bentonite which is imported from Greece, coal which is mined in USA and Australia and steel scrap which comes from Germany</p>

		(25%) and from Poland (25%).
	IISI	<i>Hot rolled coil; pickled hot rolled coil; cold rolled coil; finished cold rolled coil; tinplated coil; tin free steel; hot-dipped galvanised; electrogalvanised; organic coated flat; plate; tubes; rebar/wire rod; engineering steel and sections</i> Data includes electricity production and the quality of data is good. <i>Geographical boundary: Western Europe, Far East Asia or Rest of the World</i>
	IVAM LCA Data 4	<i>Steel: galvanised, powdercoated, precoated, cold rolled, hot rolled, stainless</i>
	Athena	17 products available in various length, thickness and load carrying designations produced in virgin (integrated), electric-arc (mini-mill) and in combination integrated and mini-mills. <i>Galvanised C-studs and tracks, galvanised C-joists, wire mesh, ladder wire, fasteners (screws, nails, nuts and bolts), open web joists, rebar and rod, light sections, hollow structural steel, tubing and bracing, hot rolled sheet, cold rolled sheet, galvanised sheet, galvanised decking, heavy trusses.</i>
<b>Zinc</b>	EcoInvent	<i>Zinc coating coils, zinc coating pieces, zinc for coating, zinc concentrate</i> <i>Zinc coating coils:</i> Includes the process steps surface cleaning (by means of chemical and/or thermal treatment), heat treatment, immersion in a bath of molten zinc and finishing treatment. Also includes zinc input and transportation to coiling plant. <i>Geographical boundary: Average technique for EU. Electricity UCTE, others RER or CH</i> <i>Zinc coating pieces:</i> Includes the process steps degreasing, pickling, fluxing, galvanising (melt zinc coating) and finishing. Does not include the fabricates being coated. <i>Geographical boundary: Average technique for EU. Electricity UCTE, others RER, CH or GLO</i> <i>Zinc for coating:</i> The module describes the production of primary SHG zinc used for galvanising in Europe. <i>Geographical boundary: Electricity UCTE, others RER, GLO, OCE, CH</i>
	IVAM LCA Data 4	<i>Primary and secondary zinc</i>
<b>Paints</b>	Ecoinvent	<i>Alkyd paints, wood preservatives, printing colours</i> <i>Alkyd paint white:</i> Either water reducible or in solvent. Includes transport of raw materials and production of paint. Packaging is neglected. This dataset stands for one specific long oil alkyd as used in architectural paints of white colour and should not be used for other alkyds. <i>Geographical boundary: Electricity UCTE, others RER</i>
	SPINE@CPM	<i>Production of paint and anti corrosion agents (data quality acceptable), production of paint, thinner and enamel mainly for surface treatment of steel (data quality unsatisfying)</i> <i>Geographical boundaries: Sweden</i>
	IVAM LCA Data 4	<i>Paints: acryl, acrylic wallpaint, alkyd, alkyd varnish, high solid, natural, natural wallpaint</i>
<b>Natural gas</b>	EcoInvent	Several modules for natural gas production, heating systems, cogeneration, fuels and power plants in different areas are available. <i>Production onshore in Russia:</i> Includes exploration and production of gas onshore. Data doesn't include combusted fuels for turbines, motors etc. It includes well testing (fuel requirements and emissions). Data for RU is mostly based on standard data, as only few information on the Russian production is available. <i>Natural gas production RU at long distance pipeline:</i> Russian natural gas production together with transportation is also available. An average distance of 6000 km is estimated for the export distance. These data are valid for RER. <i>Long distance transport of natural gas in pipeline:</i> This dataset describes the energy consumption and the emissions linked to the transport of 1 tkm Russian natural gas in an onshore pipeline. The data for emissions and for energy requirements is based on German data.
	APME	Includes natural gas extraction and transportation <i>Geographical boundary: Western Europe</i>
	IVAM LCA Data 4	<i>Natural gas</i>
<b>Milk</b>	IVAM LCA Data 4	<i>Raw milk</i>
<b>Redwood</b>	KCL EcoData	<i>Wood growth for pine;</i> <i>Harvesting pine:</i> Separate modules for 1 <sup>st</sup> and 2 <sup>nd</sup> thinnings and regeneration felling for fibrewood and logs (includes fuel use by forest machinery, construction of forest roads, forestry operations). Finnish average technology <i>Geographical boundary: Finland</i>
	SPINE@CPM	<i>Silviculture of softwood:</i> The system describes the cultivation cycle for softwood delivered at road side. The following subsystems are included: tree plant nursing, soil preparation, planting softwood plants, clearing of young forest, fertilising in silviculture, thinning of forest area, final felling and forwarding of harvested wood. All subsystems are also available as separate datasets. Quality of data is acceptable.

		<i>Geographical boundary: Sweden</i>
	Ecoinvent	Several modules on sawn timber, standing, round wood, thinning / final cutting for softwood. Also modules for industrial residue wood, residual wood and for many processes such as planing and sawing. <i>Softwood, standing:</i> Includes the CO <sub>2</sub> absorption from air and the land use for the trees to grow. RER <i>Softwood, thinning / final cutting:</i> Includes motormanual processes for thinning and final cutting as well as transport of the products to the nearest forest road. RER <i>Industrial wood, Scandinavian softwood:</i> Includes material and energy amounts for stand establishment, tending, site development, thinnings and final cutting of scandinavian industrial softwood, its transport to the nearest forest road as well as the land and materials use for the forest roads. NORDEL
<b>Spruce</b>	KCL EcoData	<i>Wood growth;</i> <i>Harvesting:</i> Separate modules for 1 <sup>st</sup> and 2 <sup>nd</sup> thinnings and regeneration felling for fibrewood and logs (includes fuel use by forest machinery, construction of forest roads, forestry operations). Finnish average technology <i>Geographical boundary: Finland</i>
	SPINE@CPM	<i>Silviculture of softwood:</i> The system describes the cultivation cycle for softwood delivered at road side. The following subsystems are included: tree plant nursing, soil preparation, planting softwood plants, clearing of young forest, fertilising in silviculture, thinning of forest area, final felling and forwarding of harvested wood. All subsystems are also available as separate datasets. Quality of data is acceptable. <i>Geographical boundary: Sweden</i>
	Ecoinvent	Several modules on sawn timber, standing, round wood, thinning / final cutting for softwood. Also modules for industrial residue wood, residual wood and for many processes such as planing and sawing. <i>Softwood, standing:</i> Includes the CO <sub>2</sub> absorption from air and the land use for the trees to grow. RER <i>Softwood, thinning / final cutting:</i> Includes motormanual processes for thinning and final cutting as well as transport of the products to the nearest forest road. RER  <i>Industrial wood, Scandinavian softwood:</i> Includes material and energy amounts for stand establishment, tending, site development, thinnings and final cutting of scandinavian industrial softwood, its transport to the nearest forest road as well as the land and materials use for the forest roads. NORDEL
<b>Birch</b>	KCL EcoData	<i>Wood growth;</i> <i>Harvesting:</i> Separate modules for 1 <sup>st</sup> and 2 <sup>nd</sup> thinnings and regeneration felling for fibrewood and logs (includes fuel use by forest machinery, construction of forest roads, forestry operations). Finnish average technology <i>Geographical boundary: Finland</i>
	Ecoinvent	Several modules on sawn timber, standing, round wood, thinning / final cutting for hardwood. Also modules for industrial residue wood, residual wood and for many processes such as planing and sawing. <i>Hardwood, standing:</i> Includes the CO <sub>2</sub> absorption from air and the land use for the trees to grow. RER <i>Hardwood, thinning / final cutting:</i> Includes motormanual processes for thinning and final cutting as well as transport of the products to the nearest forest road. RER <i>Industrial wood, Scandinavian hardwood:</i> Includes material and energy amounts for stand establishment, tending, site development, thinnings and final cutting of scandinavian industrial softwood, its transport to the nearest forest road as well as the land and materials use for the forest roads. NORDEL
<b>Alder</b>	Ecoinvent	<i>see Birch</i>
<b>Aspen</b>	Ecoinvent	<i>see Birch</i>
<b>Ash tree</b>	Ecoinvent	<i>see Birch</i>
<b>Oak</b>	Ecoinvent	<i>see Birch</i>
<b>Wood</b>	Ecoinvent	<i>see Birch</i>
<b>Chips</b>	Ecoinvent	<i>Hardwood, softwood and mixed chips, Scandinavian chips, bark chips</i> <i>Wood chips at plant:</i> Includes the chopping of residual hardwood or softwood or both with a stationary chopper in the sawmill. No transports for the inputs are assumed. RER <i>Wood chips at forest:</i> Includes the chopping of residual hardwood or softwood or both with a mobile chopper in the forest. Also includes the driving of the mobile chopper to and within the forest, RER
<b>Chemicals:</b>		
<b>- formaldehyde (CH<sub>2</sub>O)</b>	Ecoinvent	<i>Formaldehyde at plant:</i> Cradle-to-gate analysis including all precursors, ancillary materials and transports. The processes that are used to produce formaldehyde from methanol are described in the dataset. Data represents a current cross-section of actual plants in Europe, RER. electricity



		UCTE.
	IVAM LCA Data 4	<i>Formaldehyde</i>
<b>- paraffin</b>	Ecoinvent	<i>Paraffin at plant:</i> Includes material and energy input, production of waste and emissions for the production of n-paraffins out of crude oil. Water consumption and infrastructure have been estimated. Average technology, typical for European production conditions in the mid 90s. RER
	IVAM LCA Data 4	<i>N-paraffin</i>
<b>- sulphuric acid (H<sub>2</sub>SO<sub>4</sub>)</b>	KCL EcoData	<i>Manufacturing H<sub>2</sub>SO<sub>4</sub> from sulphur:</i> Transport and energy data not included, European average.
	Ecoinvent	<i>Sulphuric acid at plant:</i> Includes the obtention of SO <sub>2</sub> -containing gas. It includes also the conversion of SO <sub>2</sub> to SO <sub>3</sub> and the absorption of SO <sub>3</sub> into solution to yield Sulphuric acid. Manufacturing process starting with sulphur-containing raw materials (elemental sulphur, pyrites, ores and spent acids) is considered, plus consumption of auxiliaries, energy, infrastructure and land use, as well as transportation of raw materials, auxiliaries and wastes. The generation of solid wastes and emissions into air and water and wastes. Transport and storage of the final product sulphuric acid are not included. <i>Geographical boundary:</i> Electricity UCTE, others RER
	IVAM LCA Data 4	<i>H<sub>2</sub>SO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub> from zinc production</i>
<b>Fertilizers</b>	KCL EcoData	<i>N:</i> Weighed mean data for N fertilizers. Consist of production of N fertilizer including ammonia synthesis from fossil energy carriers, saltpeter acid production and urea production. Emissions from use of energy carriers in the processes, both as fuel and feedstock are included. Energy for transports are not included. <i>Geographical boundary:</i> Finland; European average technology. <i>P:</i> Weighed mean data for different P fertilizers. Includes production of P-fertilizer from commercial phosphate ore and phosphoric acid. Energy for transports not included. <i>Geographical boundaries:</i> Finland; European average technology..
	Ecoinvent	<i>Ammonium nitrate phosphate, calcium ammonium nitrate, calcium nitrate, diammonium phosphate, monoammonium phosphate, potassium nitrate, potassium sulphate, potassium chloride</i> <i>Ammonium nitrate phosphate:</i> The unit process inventory takes into account the production of ammonium nitrate phosphate from ammonia and rock phosphate. Transports of raw materials and intermediate products to the fertiliser plant as well as the transport of the fertiliser product from the factory to the regional department store were included. Production and waste treatment of catalysts, coating and packaging of the final fertiliser products were not included. <i>Geographical boundary:</i> RER
	SPINE@CPM	<i>Production of ammonia, ammonium nitrate, CAN fertilizer, nitric acid, NP fertilizer, NPK fertilizer, phosphorus acid, TSP fertilizer, N-fertilizer</i> <i>N-fertilizer:</i> Data are weighted averages for different N-fertilizers and are accumulated including ammonia synthesis from fossil fuels, salpete acid production and urea production. Energy for transports is not included. gate to gate. Quality of data is unsatisfying. <i>Geographical boundary:</i> Germany <i>Production of ammonia:</i> The dataset is applicable for production of ammonia from natural gas or from other light hydrocarbons. gate to gate. Quality of data is acceptable. <i>Geographical boundary:</i> Central and Eastern Europe
	APME	<i>Production of ammonia: includes fuel production and fuel use, transports and the actual process data.</i> <i>Geographical boundary:</i> France, Germany, UK
	IVAM LCA Data 4	<i>Fertilizers: K, NKP, TSP, N, P, NH<sub>3</sub> etc.</i>

**Area codes in Ecoinvent:**

CH = Switzerland, RU = Russia, DE = Germany, RER = Europe, GLO = Global, OCE = Oceanic, UCTE = Union for the Co-ordination of Transmission of Electricity, NORDEL = Nordic countries power association

## Documentation page

Publisher	Finnish Environment Institute (SYKE)	Date	November 2004
Author(s)	Sirikka Koskela and Marja-Riitta Hiltunen		
Title of publication	A guide to the utilization of LCI/LCA databases for Estonian enterprises		
Parts of publication/ other project publications	Publication is available on the Internet <a href="http://www.environment.fi/SYKE">www.environment.fi/SYKE</a> > Publications > Mimeograph series.		
Abstract	<p>The LCA methodology for assessment of the performance of product systems is practically unknown in Estonia until now. Recently, interest has been growing to carry out LCA-studies for Estonian products as well. The aim of this guide is to encourage Estonian enterprises to conduct LCAs for their own products by providing information on the data collection phase of LCI and information on some databases from the viewpoint of Estonian key products.</p> <p>The applicability of the seven selected generic databases for future LCIs of the Estonian key products was considered. Also their main raw materials and countries of origin were identified. Additionally, guidelines on important issues to be taken account in the data collection were also developed. The guidelines deal with the modeling of the product systems, the use of primary and secondary data, the importance of the country-specific electricity production profiles, and the validation and documentation of the collected LCI data.</p> <p>The main conclusions were that there exists no country-specific LCI data for Estonia in generic databases. These databases contain data for almost all Estonian key products and their main raw materials, but the applicability of specific process data must be verified separately in each case. All examined databases are applicable for Estonian industry in similar way as in any other country, because the generic databases are typically used for raw materials manufactured elsewhere.</p>		
Keywords	life-cycle assessment, life-cycle inventory analysis, databases, data collection, industry, Estonia		
Publication series and number	Mimeograph series of Finnish Environment Institute 315		
Theme of publication			
Project name and number, if any	OSELCA project (LIFE03 ENV/EE/000194)		
Financier/ commissioner	EU LIFE-Environment Programme, Eesti Energia Ltd., Finnish Environment Institute, CyclePlan Ltd.		
Project organization	Finnish Environment Institute, CyclePlan Ltd, Eesti Energia Ltd		
	ISSN 1455-0792	ISBN 952-11-1907-1 (PDF)	
	No. of pages 34	Language English	
	Restrictions Public	Price	
For sale at/ distributor			
Financier of publication	Finnish Environment Institute, P.O. Box 140, FIN-00251 Helsinki, Finland		
Printing place and year			
Other information			

## Kuvailulehti

Julkaisija	Suomen ympäristökeskus (SYKE)	Julkaisu-aika Marraskuu 2004
Tekijä(t)	Sirkka Koskela ja Marja-Riitta Hiltunen	
Julkaisun nimi	LCI/LCA tietokantojen hyödyntäminen - opas Viron yrityksille	
Julkaisun osat/ muut saman projektin tuottamat julkaisut	Julkaisu on saatavana internetistä <a href="http://www.environment.fi/SYKE">www.environment.fi/SYKE</a> > Publications > Mimeograph series.	
Tiivistelmä	<p>Elinkaariarviointi (LCA), jota käytetään erilaisten tuotejärjestelmien ympäristövaikutusten arvioimiseen, on tähän asti ollut lähes tuntematon menetelmä Virossa. Viimeaikoina kiinnostus elinkaariarviointitarkasteluiden tekemiseen on kuitenkin lisääntynyt. Tämän oppaan tarkoituksena on rohkaista virolaisia yrityksiä aloittamaan omien tuotteidensa elinkaariarviointien tekeminen. Opas tarjoaa tietoa sekä elinkaari-inventaarioissa (LCI) tarvittavan tiedon keräämisestä että yleisten LCI-tietokantojen käytöstä virolaisten tuotteiden näkökulmasta.</p> <p>Tässä työssä tarkasteltiin seitsemän LCI-tietokannan soveltuvuutta tulevaisuudessa tehtävien virolaisten avaintuotteiden inventaarioihin. Avaintuotteiden valinnan yhteydessä selvitettiin niiden pääraaka-aineet ja valmistusmaat. Lisäksi kehitettiin yleiset ohjeet LCI-tiedonkeruussa huomioon otettavista seikoista. Ohjeet sisältävät suosituksia tuotejärjestelmän mallintamisesta, ensisijaisen ja toissijaisen tiedon käyttämisestä, maakohtaisen sähköntuotantomallin tärkeydestä sekä kerätyn inventaariotiedon vahvistamisesta ja dokumentoinnista.</p> <p>Työssä saavutetut tulokset osoittivat, että yleisistä tietokannoista ei ole saatavilla maakohtaista LCI-tietoa Virossa valmistettaville tuotteille. Sen sijaan tutkitut tietokannat sisälsivät LCI-tietoa lähes kaikista avaintuotteista ja niiden raaka-aineista, mutta tämän keskimääräisen tiedon käyttökelpoisuus virolaisissa inventaarioissa tulee selvittää jokaisessa tapauksessa erikseen. Yleisesti ottaen kaikki tutkitut tietokannat soveltuvat yhtä hyvin niin Viron kuin muidenkin maiden teollisuuden käyttöön, koska tietokantoja käytetään yleisimmin ulkomailla valmistettujen raaka-aineiden tietojen keräämisessä.</p>	
Asiasanat	elinkaariarviointi, elinkaarianalyysi, inventaarioanalyysi, tietokannat, tiedonhankinta, teollisuus, Viro	
Julkaisusarjan nimi ja numero	Suomen ympäristökeskuksen moniste 315	
Julkaisun teema		
Projektin nimen nimi ja projektinumero	OSELCA-hanke (LIFE03 ENV/EE/000194)	
Rahoittaja/ toimeksiantaja	EY:n Life-Environment-ohjelma, Eesti Energia, Suomen ympäristökeskus, CyclePlan Ltd.	
Projektiryhmään kuuluvat organisaatiot	Suomen ympäristökeskus, CyclePlan, Eesti Energia	
	ISSN 1455-0792	ISBN 952-11-1907-1 (PDF)
	Sivuja 34	Kieli Englanti
	Luottamuksellisuus Julkinen	Hinta
Julkaisun myynti/ jakaja		
Julkaisun kustantaja	Suomen ympäristökeskus, PL 140, 00251 Helsinki	
Painopaikka ja -aika		
Muut tiedot		

## Presentationsblad

Utgivare	Finlands miljöcentral	Datum	November 2004
Författare	Sirkka Koskela och Marja-Riitta Hiltunen		
Publikationens titel	Hur LCI/LCA databaserna kan utnyttjas – handledning för Estlands företag		
Publikationens delar/ andra publikationer inom samma projekt	Publicationen finns tillgänglig på internet <a href="http://www.environment.fi/SYKE">www.environment.fi/SYKE</a> > Publications > Mimeograph series.		
Sammandrag	<p>Livscykelanalys (LCA), som används för bedömning av olika produktsystems miljökonsekvenser, har hittills varit en nästan okänd metod i Estland. På sista tiden har intresset för livscykelanalyser dock ökat. Avsikten med denna handledning är att uppmuntra estniska företag att sätta igång med livscykelanalyser på sina egna produkter. Guiden ger råd om hur man samlar data för att göra livs-cykelinventarier (LCI) och om hur man använder LCI-databaser för estniska produkter.</p> <p>I detta projekt genomgicks sju LCI-databaser och deras lämplighet för att inventera estniska nyck-elprodukter i framtiden. När nyckelprodukterna valdes utreddes deras huvudsakliga råvaror och framställningsland. Därtill utvecklade vi allmänna råd för faktorer som man ska ta i beaktande när man samlar LCI-information. Anvisningarna innehåller rekommendationer om att skapa modeller för produktsystemet, om att utnyttja primär och sekundär information, om betydelsen hos den landsspecifika elproduktionsmodellen samt om att granska och dokumentera den insamlade inventarieinformationen.</p> <p>Våra resultat visade, att det i de allmänna databaserna inte finns någon landsspecifik LCI-information för de estniska produkterna. Däremot innehöll de undersökta databaserna LCI-information om nästan alla nyckelprodukter och deras råvaror, men huruvida denna genomsnittliga information är användbar i de estniska inventarierna bör utredas i varje enskilt fall. Allmänt taget lämpar sig alla de undersökta databaserna lika bra såväl för Estlands som andra länders industri, emedan databaserna används mest för att samla produktionsdata för utländska råvaror.</p>		
Nyckelord	livscykelanalys, inventarieanalys, databaser, informationsanskaffning, industri, Estland		
Publikationsserie och nummer	Finlands miljöcentrals duplikat 315		
Publikationens tema			
Projektets namn och nummer	OSELCA-projektet (LIFE03 ENV/EE/000194)		
Finansiär/ uppgångsgivare	EG:s Life-Environment-program, Eesti Energia, Finlands miljöcentral, CyclePlan		
Organisationer i projektgruppen	Finlands miljöcentral, Eesti Energia, CyclePlan		
	ISSN 1455-0792	ISBN 952-11-1907-1 (PDF)	
	Sidantal 34	Språk Engelska	
	Offentlighet Offentlig	Pris	
Beställningar/ distribution			
Förläggare	Finlands miljöcentral, PB 140, FIN-00251 Helsingfors, Finland		
Tryckeri/ tryckningsort och -år			
Övriga uppgifter			

ISBN 952-11-1907-1 (PDF)  
ISSN 1455-0792

