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2nd International ecoinvent Meeting
Lausanne, March 14, 2008

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ecoinvent data v2.0
electronics data

Roland Hischier, Martin Lehmann
Empa / Technology & Society Lab

Presentation: R. Hischier/M. Lehmann

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Acknowledgement

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Content

- Introduction

- General overview

- Content

- How to use these new data ??
  - Case study no.1 – "use of Electronics"
  - Case study no.2 – "Printed Wiring Boards of a ICT device"

- Conclusion & Outlook

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Introduction
ecoinvent v1.x & electronics

Processes found

Your search brought the following results:

4 processes were found.

no.	category / subcategory	datasetname	location	unit	infra.	synonyms
1	construction processes / buildings	electronics for control units	RER	kg	No	-
2	waste management / building demolition	disposal, electronics for control units	RER	kg	No	-
3	waste management / municipal incineration	disposal, plastic, consumer electronics, 15.3% water, to municipal incineration	CH	kg	No	larger plastic parts in brown goods
4	waste management / municipal incineration	disposal, plastic, industr. electronics, 15.3% water, to municipal incineration	CH	kg	No	larger plastic parts in industrial electronics

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Introduction
ecoinvent v1.x & electronics

Process information	electronics for control units, RER, [kg]
Reference function	electronics for control units, RER, [kg]
name	electronics for control units
localName	Elektronik für technische Anlagen
infrastructureProcess	no
unit	kg
category	construction processes
subCategory	buildings
localCategory	Bauprozesse
localSubCategory	Gebäude
amount	1
includedProcesses	This module includes the composition of the average electronics for control units in the industry. Included are the materials of the different components (housing, cables, printed wiring board incl. its different compounds), as well as the final mounting of the PWB with the different components. Not included are other production efforts (for housing, etc.).
generalComment	The control unit has a composition of 46% steel (housing), 32% plastics, 14% printed wiring boards and 8% cables.
infrastructureIncluded	yes
datasetRelatesToProduct	yes
Geography	electronics for control units, RER, [kg]
location	RER
text	Data used has no specific geographical origin (literature values).
Technology	electronics for control units, RER, [kg]
text	estimated composition of the electronics for control units in the industry, based on literature (% of the different parts) and on the composition of a television (composition of the PWB)
Time period	electronics for control units, RER, [kg]

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Introduction
ecoinvent v1.x & electronics

Introduction
Data coverage in ecoinent v1.x

Applicability of Public LCI Databases for IPP in Electronics Industry

Case study „ecoinvent"

Roland Hischier / Martin Lehmann

Presentation @ EGG conference, Berlin (DE), 2004

Introduction
e.g. data coverage "Devices"

example 4 - mobile phone

Data availability in ecoinvent:
- good
- sufficient
- no coverage

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9

Introduction
e.g. data coverage "Components/Modules"

example "Printed Wiring Board (PWB)"

ii. Composition of an "average" PWB

Data availability in ecoinvent:
- good
- sufficient
- no coverage

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10

Introduction
conclusion data coverage in ecoinvent v1.x

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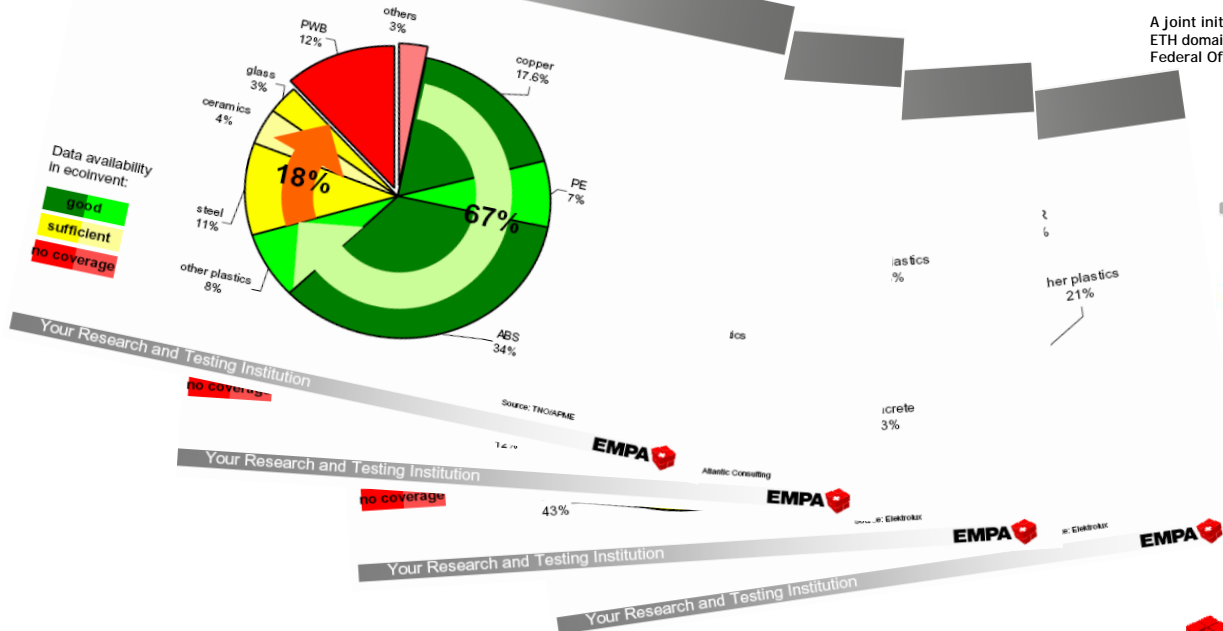A joint initiative of the
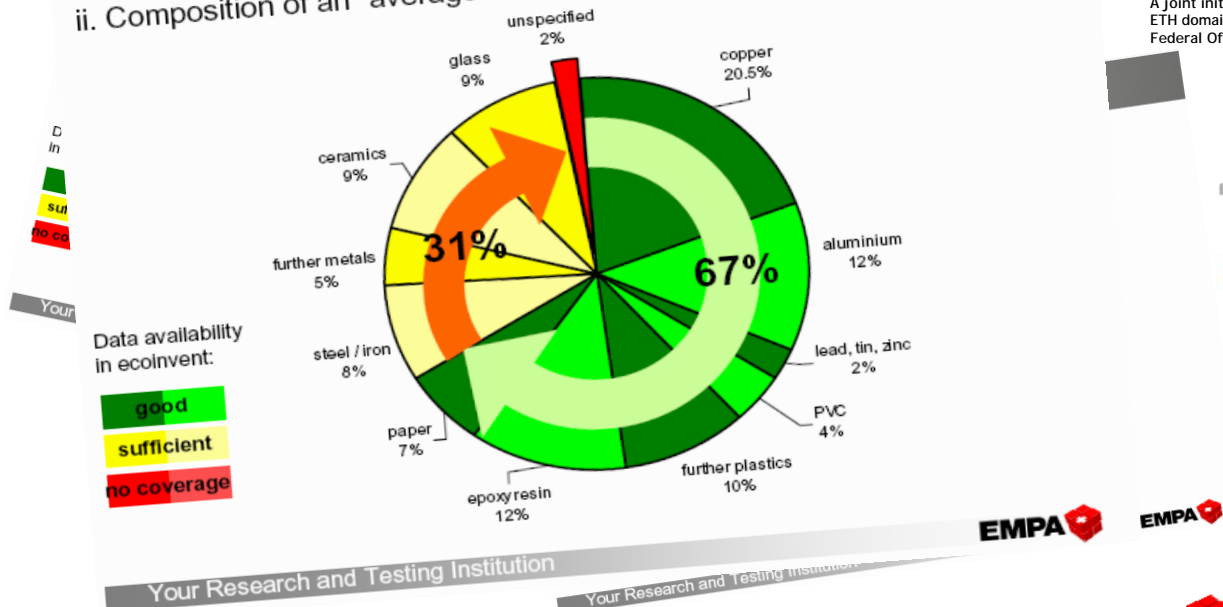ETH domain and Swiss
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ecoinvent LCI database can **cover** already a **major part of the materials** used by the EEE industry

there is still a **part of raw materials** with a relevant environmental influence **missing**:

- Metals: alloyed steels, precious metals, …
- Chemicals: ICT specific chemicals, high purity grade chemicals, …

specific processes for the production of **electronic components and modules** are **missing** (e.g. printed wiring board, capacitors, …)

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General Overview
Objective "electronics @ ecoinvent"

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To establish **average datasets** – valuable for a use (at least !) in Switzerland and Western Europe – of **production, use and disposal of electronics devices and its components** (including all subsequent datasets for the necessary basic materials etc.).
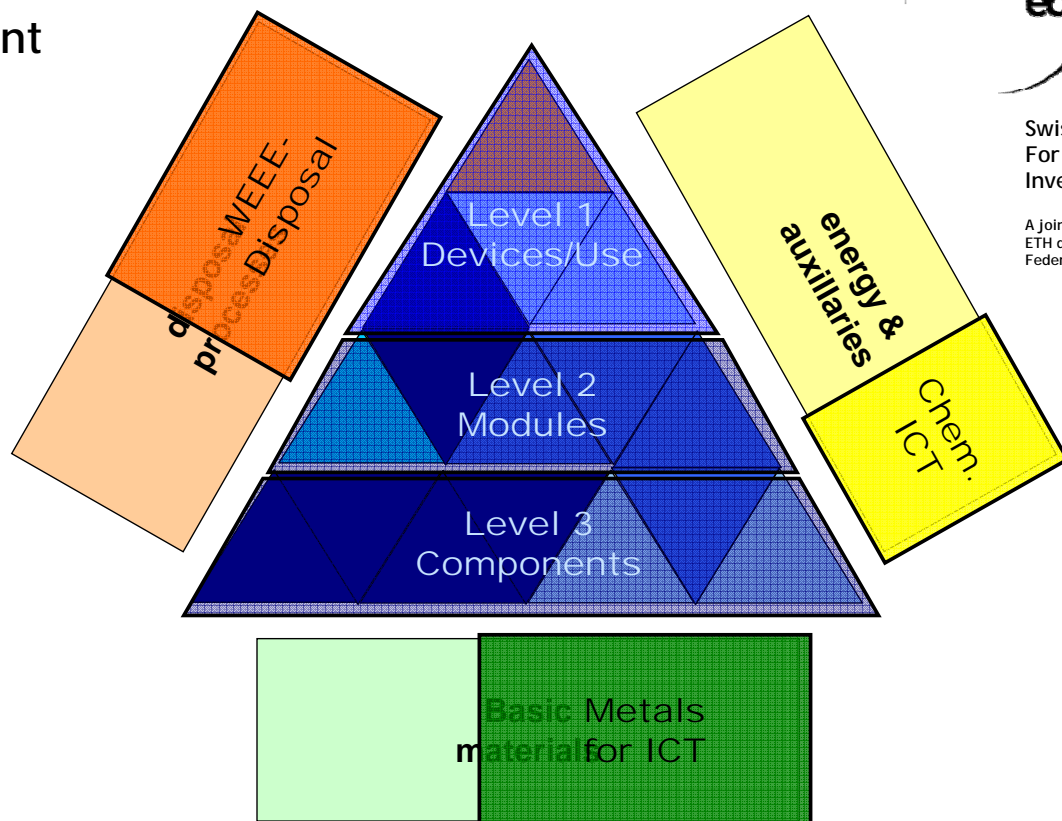
ecoinvent data v2.0

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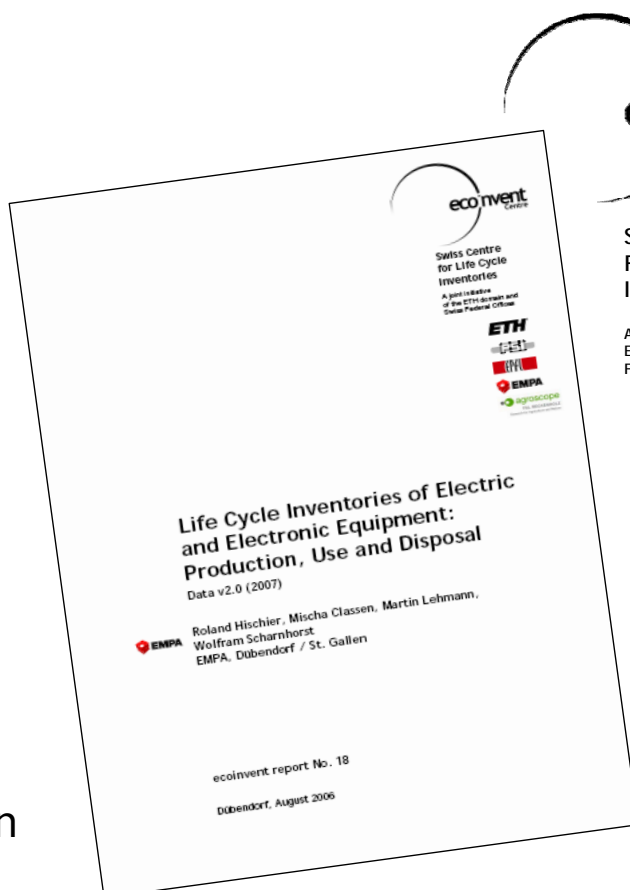
General Overview
Content

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General Overview
Data sources used …

- Company data (CER, Questionnaires, …)
- Own measurements / own analysis

- Scientific publications
- LCA database(s)

- Statistics
- Further literature

- Personal communication

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Content
Level "Electronic Devices"

Limited number of devices –
covering ICT sector

- Desktop **Computer**
- Keyboard
- Mouse
- CRT **Screen**
- LCD Screen
- Laptop Computer
- b/w Laser **Printer**
- Color Laser Printer

→ ecoinvent datasets		
desktop computer, without screen, at plant	GLO	unit
CRT screen, 17 inches, at plant	GLO	unit
LCD flat screen, 17 inches, at plant	GLO	unit
laptop computer, at plant	GLO	unit
printer, laser jet, b/w, at plant	GLO	unit
printer, laser jet, colour, at plant	GLO	unit
keyboard, standard version, at plant	GLO	unit
mouse device, optical, with cable, at plant	GLO	unit

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Content
Level "Electronic Modules"

Mounted PWB

Battery

DVD drive

HD drive

= f(devices covered)

CRT tube

LCD module

Toner module

etc. …

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Content
Level "Electronic Components"

unmounted PWB

microchip

capacitor

resistor

= f(devices covered)

CRT frit

LCD glass

connector, type x

etc. ...

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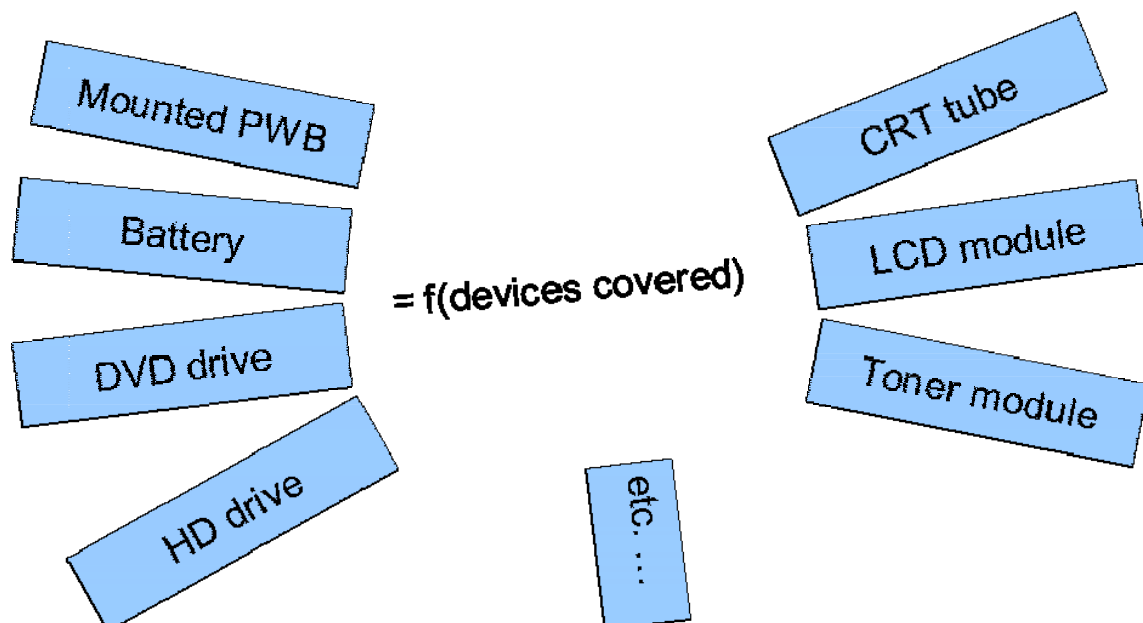
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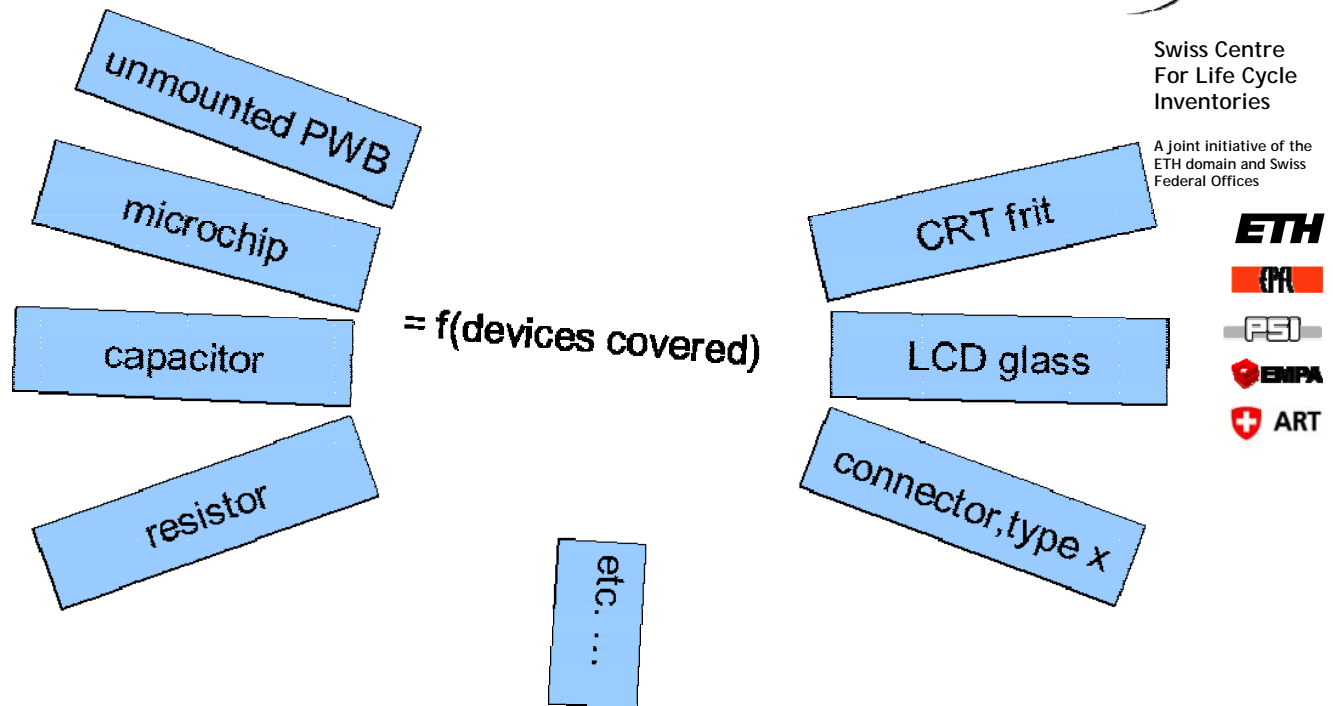
Content
Level "Electronic Modules & Components"

"Capacitors"

capacitor, film, through-hole mounting, at plant	GLO	kg
capacitor, SMD type, surface-mounting, at plant	GLO	kg
capacitor, electrolyte type, < 2cm height, at plant	GLO	kg
capacitor, electrolyte type, > 2cm height, at plant	GLO	kg
capacitor, Tantalum-, through-hole mounting, at pla	GLO	kg
capacitor, unspecified, at plant	GLO	kg

- Specific & unspecific data available

- Datasets on a "kg" basis – but typical average weights (per specific type) in Meta Information documented
  - Dataset can be used also when "number of capacitors" known (instead of "weight of capacitors" …)

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Content
Level "Electronic Modules & Components"

"PWB"

- Two clearly distinguished levels (mounted / unmounted)

- several types of mounted boards –
  plus all information in order to establish additional own, specific
  types of mounted PWB datasets

unmounted

printed wiring board, through-hole, at plant	GLO		m2
printed wiring board, surface mount, at plant	GLO		m2

mounted

SnPb solder		SnAgCu solder		Mix	
through-hole soldering		surface mount soldering		Mix	
Desktop	Laptop	PSU	SM, unspec.	TH, unspec.	unspec.

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Content
Level "Disposal of Electronics (e-Waste)"

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Content
Level "Disposal of Electronics (e-Waste)"
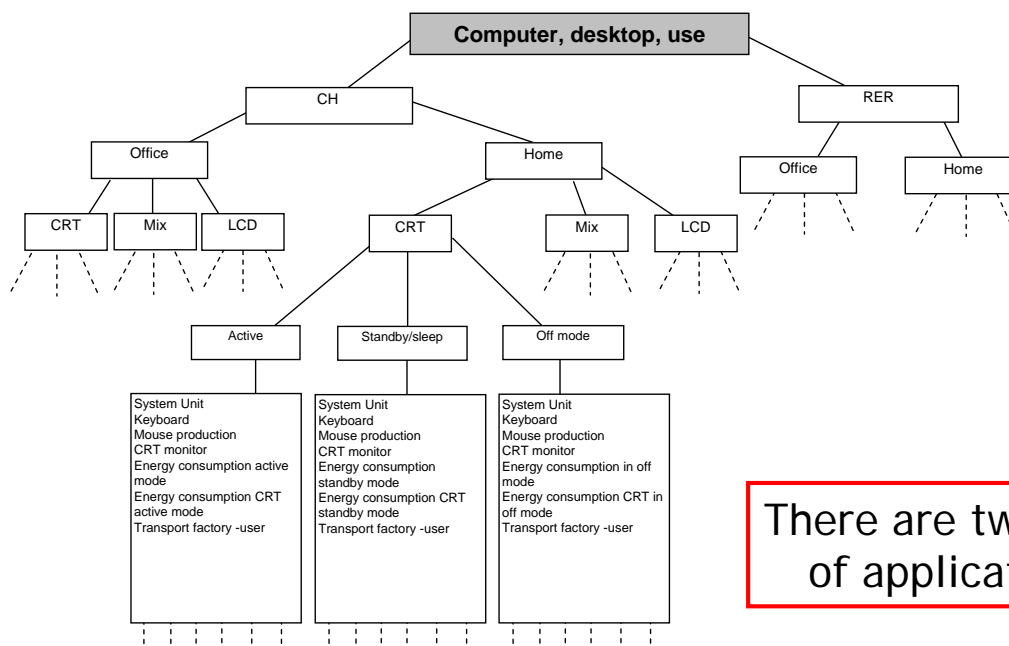
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ecoinvent 2.0: "Use of Electronics"

There are two levels of application →

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ecoinvent 2.0: "Use of Electronics"

- First level of application (1):

  - General datasets to describe the <u>average</u> operation expressed for home or office conditions as part of whole equipment life-time (in hrs of use)
    - Parameters:
      - Activation mode (time per day and year operating at different modes, based on literature and assumptions)

Desktop computer			Laptop computer			Printer	
Mode	Office	Home	Mode	Office	Home	Mode	More for office use
Active	5.5 h	3.1 h	Active	5.5 h	3.1 h	Active	2 h
Standby/sleep	2 h	2.7 h	Standby/sleep	2 h	2.7 h	Standby/sleep	7 h
Off	16.5 h	18.2 h	Off	16.5 h	18.2 h	Off	15 h

- Power consumption at different activation modes (based on literature survey → see ecoinvent report 18, IV)
- (First) life-time of the equipment (4 years for desktop computers, laptops and printers, 6 years for CRT and LCD monitors)

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Case study to demonstrate the first level of application (ecoinvent 2.0)
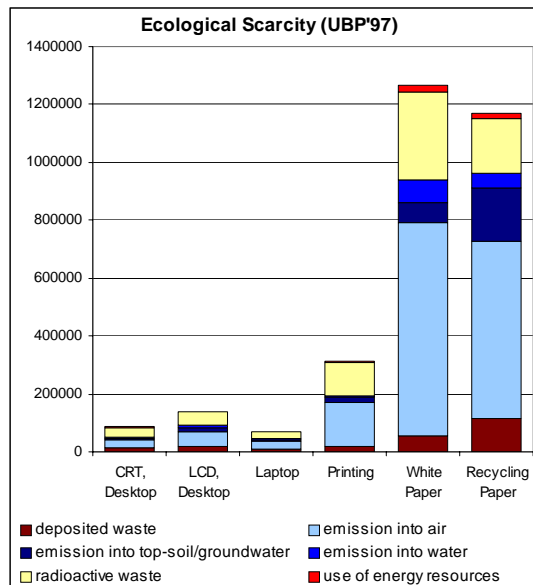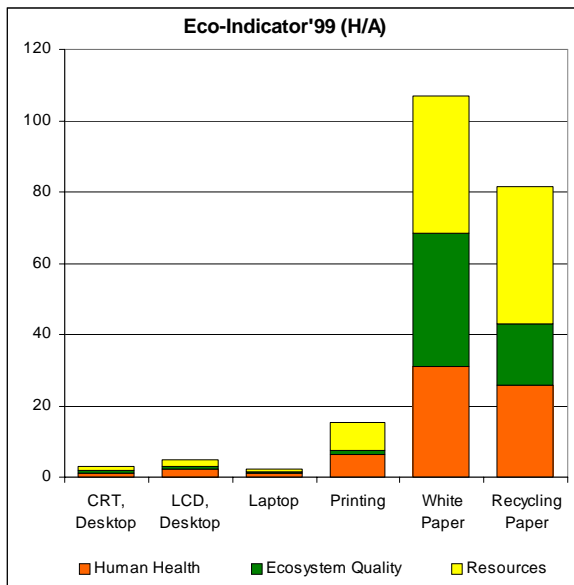
- Assumption:
  - Swiss Company with 5 office workers
    - 3 use desktop computers (2x LCD, 1x CRT), plus 2 use laptop computers
    - Each worker works an average 240 days per year, 8 hours a day
    - The company consumes 300 kg of paper per capita and year; 50% recycling paper and 50% bleached paper [US consumption 2005: 301 kg/capita & year]
  - The boss wants to know what environmental impact his company causes due to the office work . . . to publish it in the Environmental Report!

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Case study to demonstrate the first level of application

Eco-Indicator'99 (H/A)

Legend: Human Health, Ecosystem Quality, Resources

Ecological Scarcity (UBP'97)

Legend: deposited waste, emission into air, emission into top-soil/groundwater, emission into water, radioactive waste, use of energy resources

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ecoinvent 2.0: "Use of Electronics"

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- Second level of application (2):

  - Specific underlying datasets for the use of desktop and laptop computer
  - → active, standby/sleep, off; based on literature and assumptions
    - Parameters:
      - Power consumption of activation mode in question (per h)
      - Share of laptop/desktop production (including keyboard and mouse); again per h
      - Transport of desktop/laptop computer by rail and road from factory to user; again per h

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Scenario(s) illustrating the application of the ecoinvent "use of electronics" datasets

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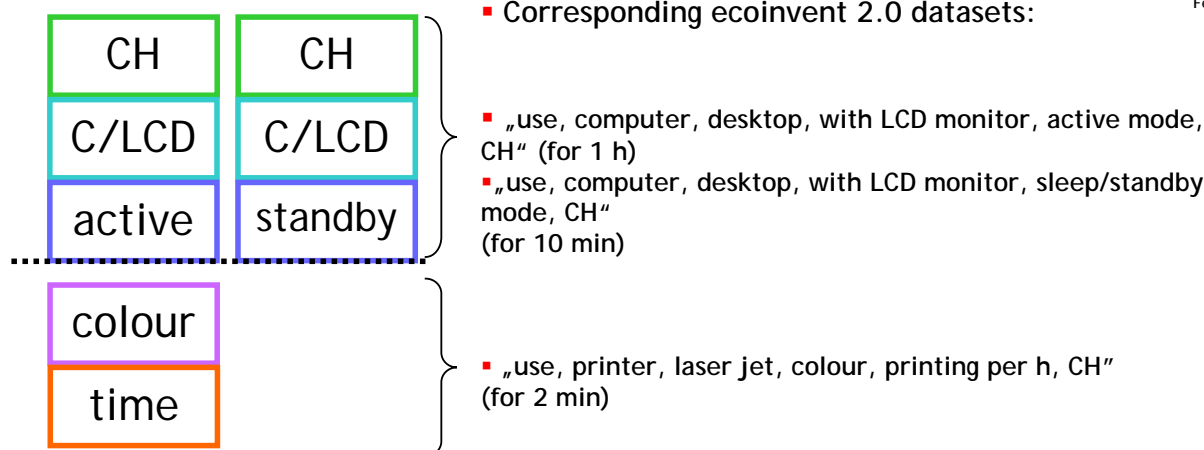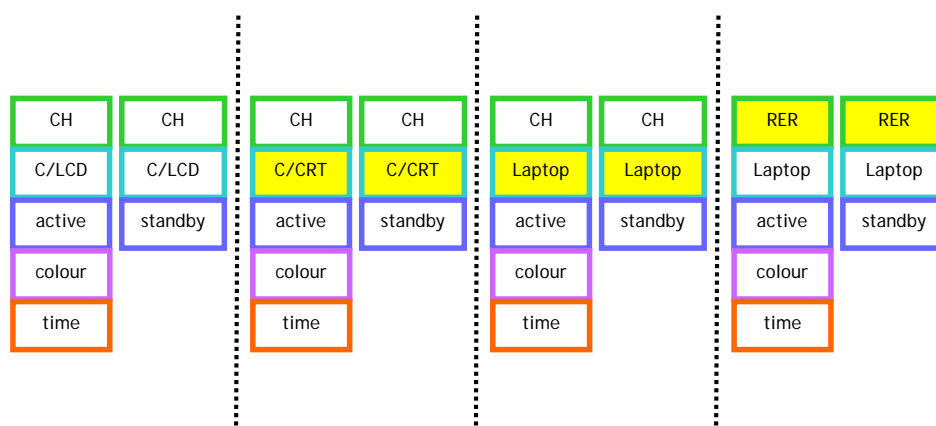ETH domain and Swiss
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- Calculation and modelling of assumed specific use pattern:

  - Intensive use of desktop computer for 1 hour to produce e.g. a PowerPoint presentation (active mode)

  - b/w Print-out of presentation; takes 2 minutes; printer is switched off right after

  - Computer is switched off after another 8 min (a total of 10 minutes in standby mode).

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Scenario(s) illustrating the application of the ecoinvent "use of electronics" datasets

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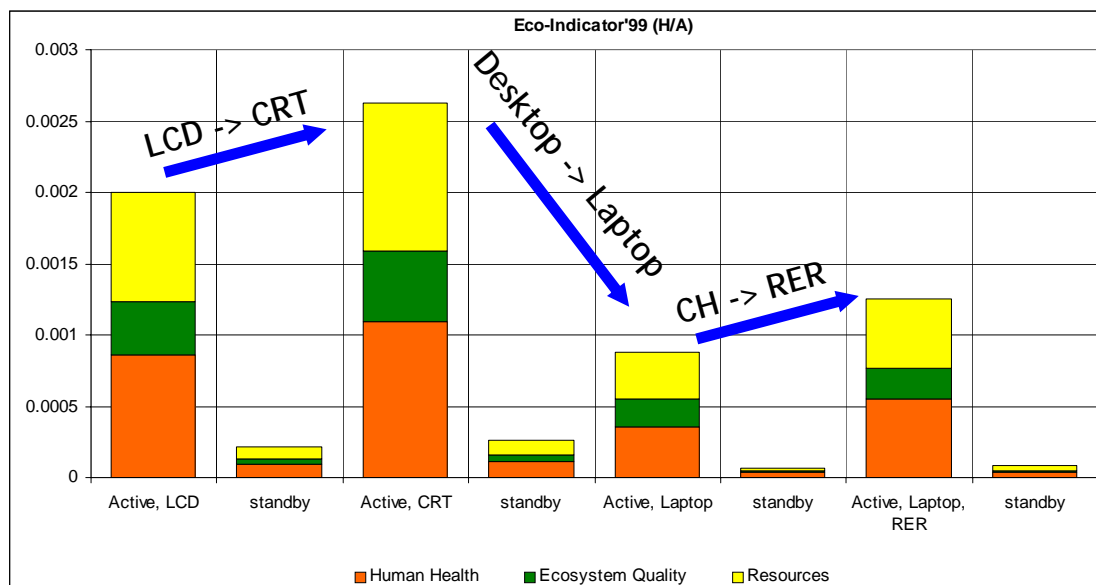ETH domain and Swiss
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- ecoinvent 2.0: different ways how to describe my "case"

Region	CH		RER
Equipment	Comp/CRT	Comp/LCD	laptop
Activation mode	active	standby	off
Printer	b/w		colour
Functional unit (Printer)	quantity		time

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Scenario(s) illustrating the application of the ecoinvent "use of electronics" datasets

- Modelling: Application of suitable datasets

CH	CH
C/LCD	C/LCD
active	standby

colour
time

- Corresponding ecoinvent 2.0 datasets:

- „use, computer, desktop, with LCD monitor, active mode, CH" (for 1 h)
- „use, computer, desktop, with LCD monitor, sleep/standby mode, CH" (for 10 min)

- „use, printer, laser jet, colour, printing per h, CH" (for 2 min)

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Scenario(s) illustrating the application of the ecoinvent "use of electronics" datasets

- Modelling and calculation in any of the leading LCA software programmes with implemented ecoinvent 2.0 datasets (variations high-lighted in yellow)

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CH	CH		CH	CH		CH	CH		RER	RER
C/LCD	C/LCD		C/CRT	C/CRT		Laptop	Laptop		Laptop	Laptop
active	standby		active	standby		active	standby		active	standby
colour			colour			colour			colour	
time			time			time			time	

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Scenario(s) illustrating the application of the ecoinvent "use of electronics" datasets

Eco-Indicator'99 (H/A)

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Final comments on the application of ecoinvent "use of electronics" datasets

- **Situation 1**

- <u>Don't know</u> specific use pattern (e.g no idea what computer monitor)

    - → apply average dataset like "use, computer, desktop, mix office use, CH/RER"

    - Attention: time-frame of your study is a must, datasets are calculated <u>per hour!!</u>

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Final comments on the application of ecoinvent "use of electronics" datasets

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- **Situation 2**

- <u>Do know</u> the specific use pattern and the equipment (e.g. 1 hour standby mode; desktop computer with CRT monitor)

  - → apply specific dataset like "use, desktop computer with CRT monitor, standby/sleep mode, CH/RER"

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Final comments on the application of ecoinvent "use of electronics" datasets

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- **Office vs. home**

- This differentiation only makes sense when you do not know the specific use pattern of your study.

- The provided office and home datasets illustrate an average use pattern retrieved on the basis of literature reviews and expert opinions

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Case Study No.2
Printed Wiring Boards of a ICT Device

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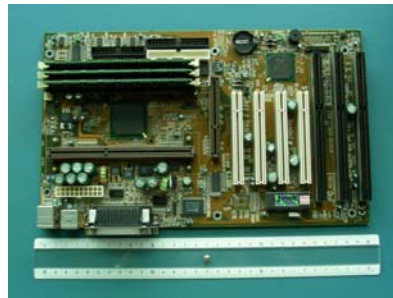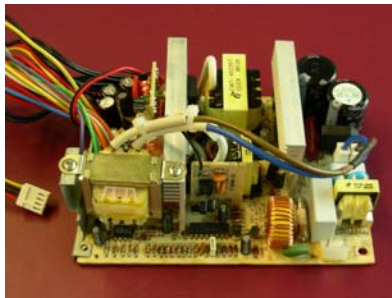
Case Study No.2
(i) Standard PWB data in ecoinvent data v2.0

Modular approach for mounted printed wiring boards

SnPb solder	SnAgCu solder	Mix		
through-hole soldering	surface mount soldering	Mix		
Desktop	Laptop	PSU	SM, unspec.	TH, unspec.	unspec.

example 1 – different types of PWB

example 2 – different mounting technologies
& different solder materials

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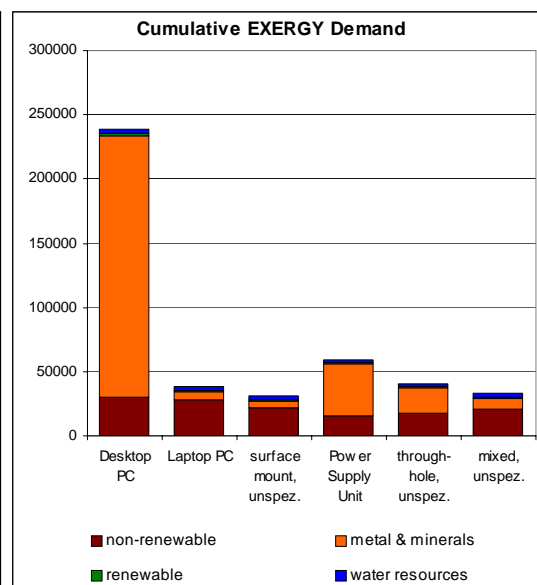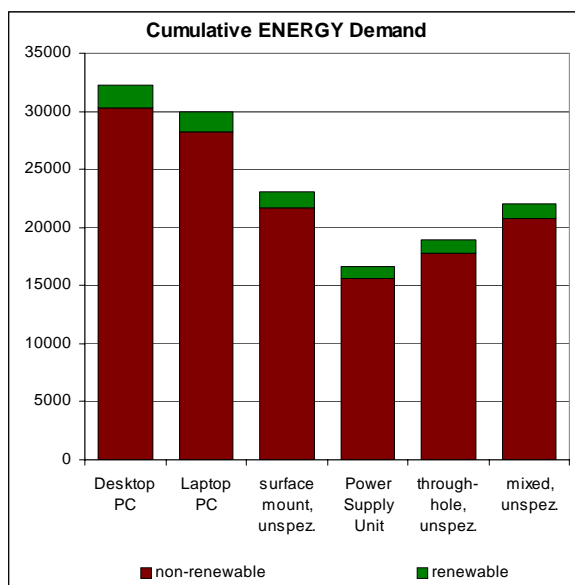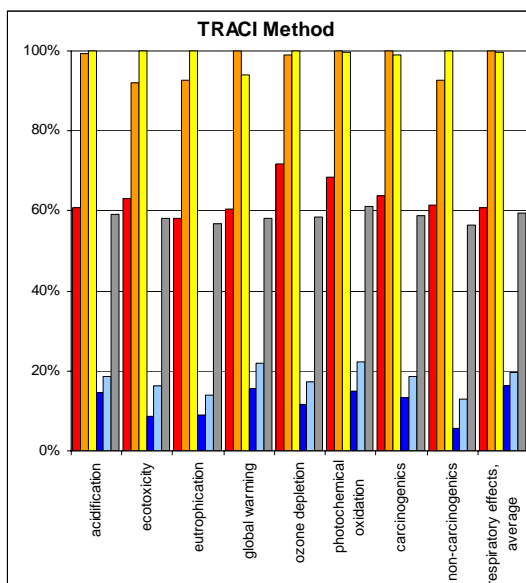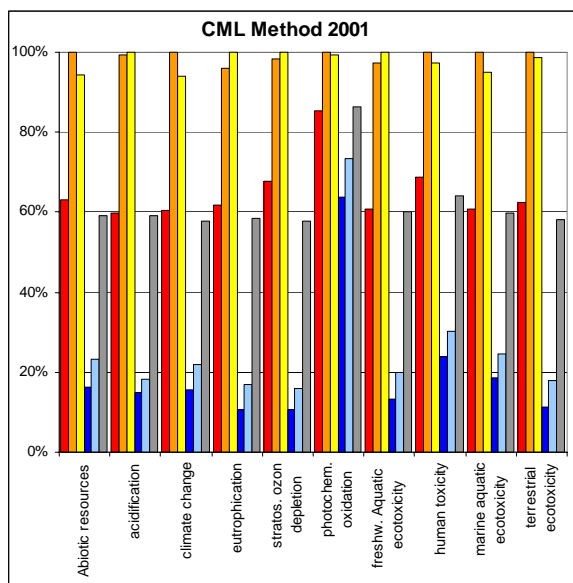
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Case Study No.2
(i) Standard PWB data in ecoinvent data v2.0

example 1 - different types of PWB (per **kg** PWB)

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Case Study No.2
(i) Standard PWB data in ecoinvent data v2.0

example 1 - different types of PWB (per **m^2** PWB)

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Case Study No.2
(i) Standard PWB data in ecoinvent data v2.0

example 1 – different types of PWB (per **kg** PWB)

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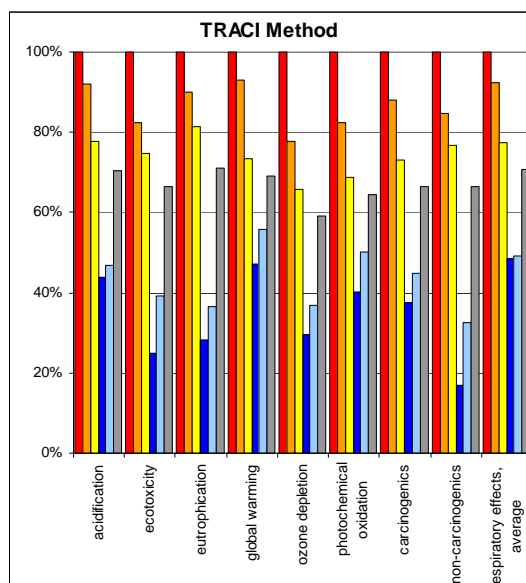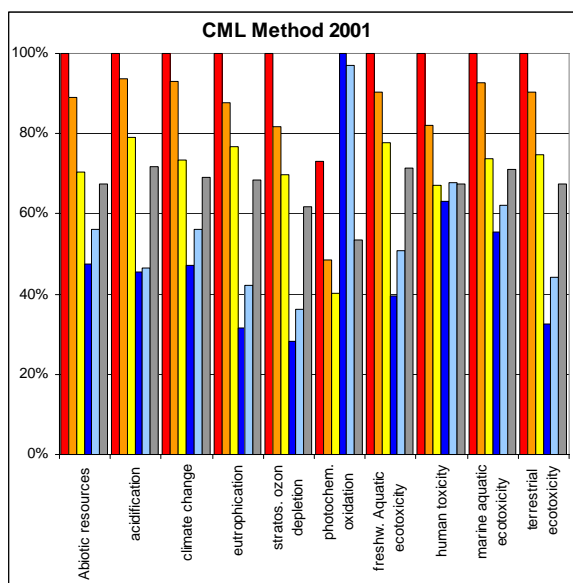ETH domain and Swiss
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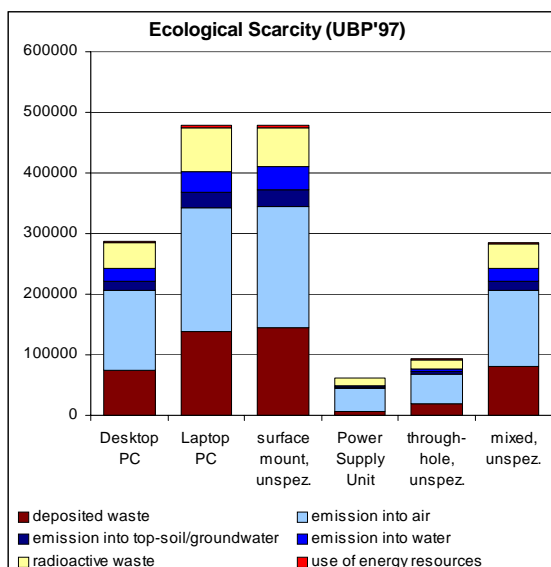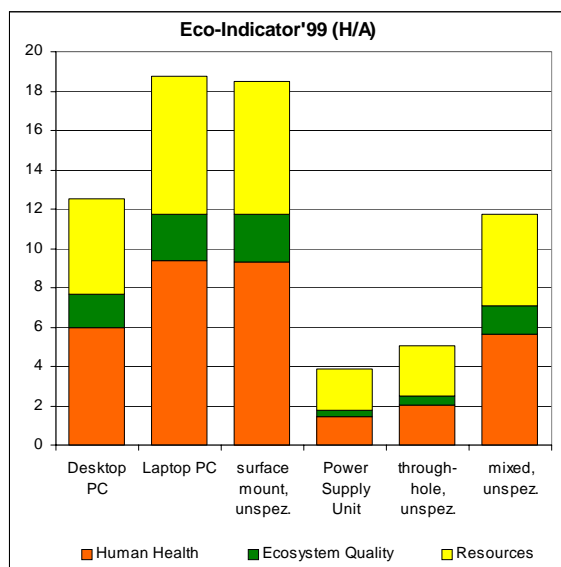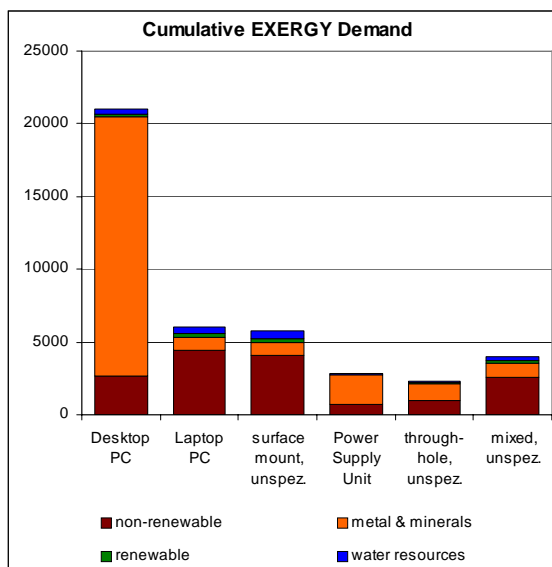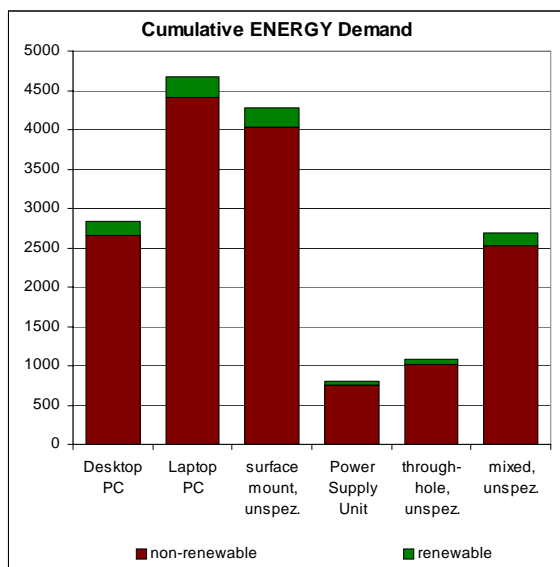
Case Study No.2
(i) Standard PWB data in ecoinvent data v2.0

example 1 – different types of PWB (per **m²** PWB)

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(i) Standard PWB data in ecoinvent data v2.0

example 1 – different types of PWB (per **kg** PWB)

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example 1 – different types of PWB (per **m²** PWB)

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(i) Standard PWB data in ecoinvent data v2.0

example 2 – different mounting technologies / solder materials

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Case Study No.2
(ii) How detailed are your information ?

example „Plasma Display Panel (PDP) Television Device"

(1) kg of each PWB

(2) (simplified) BoM

etc.

etc.
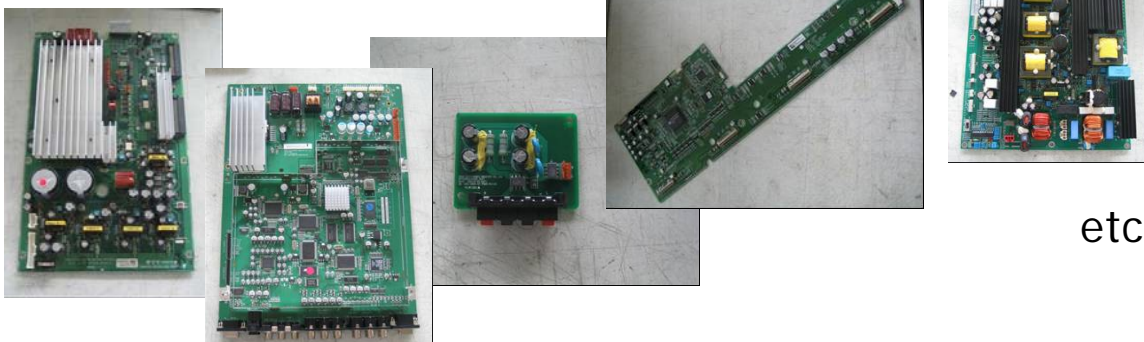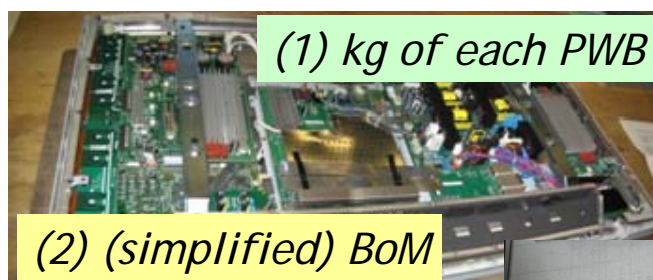
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Case Study No.2
(iii) PWB for a PDP Television Device

(iii.1) Through-hole PWB (Eco-Indicator'99)
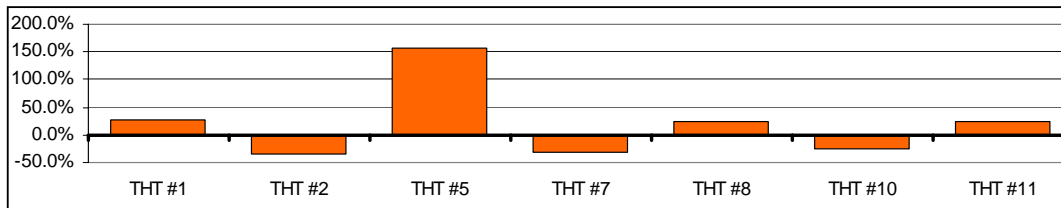
(iii.2) Surface-Mounted PWB (Eco-Indicator'99)
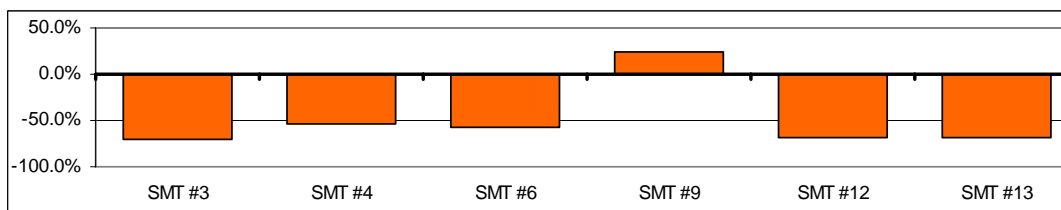
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Case Study No.2
(iii) PWB for a PDP Television Device

Carcinogenics

Resp. Inorganics

Climate Change

Ecotoxicity

Acid./Eutroph.

Minerals

Fossil Resources

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Case Study No.2
(iii) PWB for a PDP Television Device

Presentation: R. Hischier/M. Lehmann

Case Study No.2
(iii) PWB for a PDP Television Device

Presentation: R. Hischier/M. Lehmann
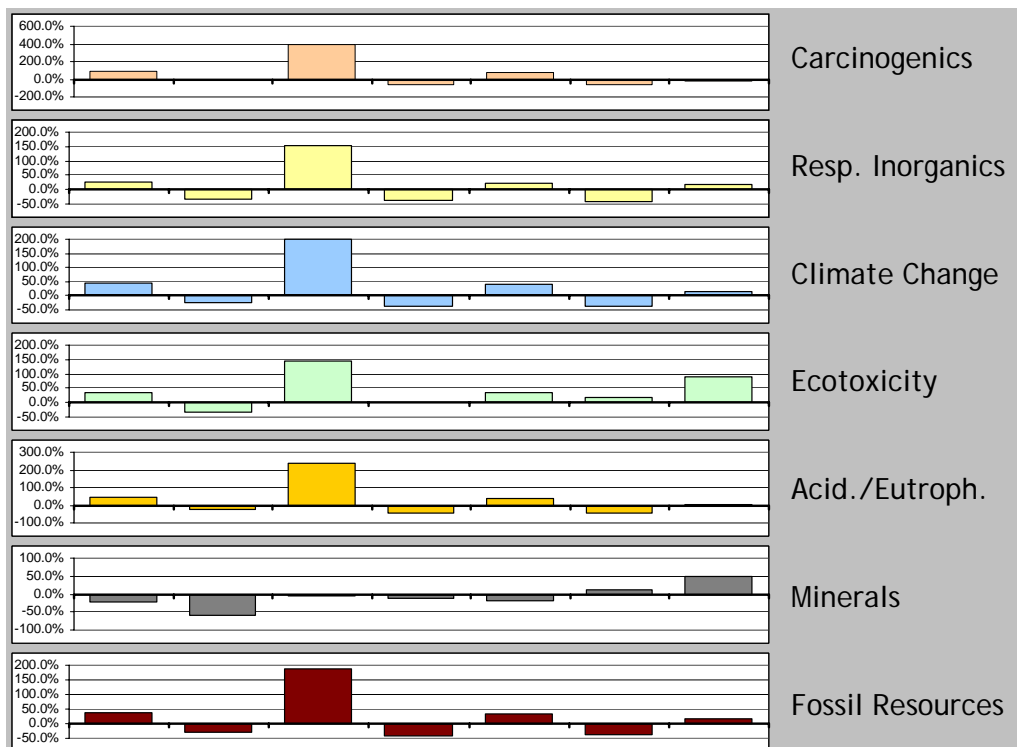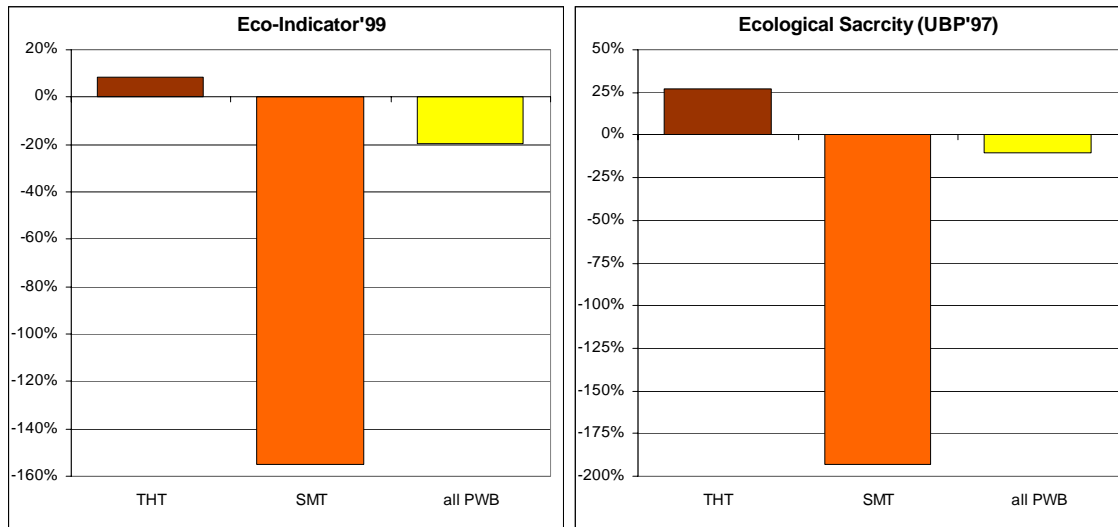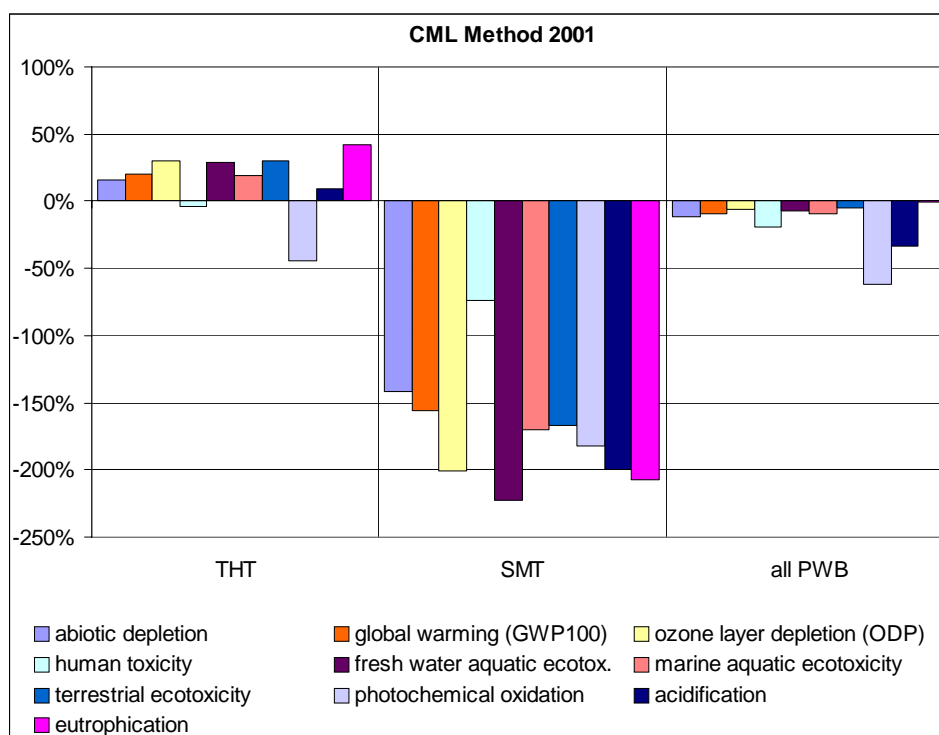
… thank you for your attention !

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