# Sustainable Purchasing Using Life Cycle Assessment and the PIE (Purchasing Impact Estimator)

***El Paso, Texas***

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# Our Mission

- Life Cycle Assessment
  - What is it?
  - How does it work?
  - What can it do for me?
  - What's happening these days that I might care about?
- The Purchasing Impact Estimator (PIE)
  - What is it?
  - How does it work?
  - What can it do for me?
  - What's happening these days that I might care about?
- Your additional requirements for this workshop to be worthwhile for ***you:***

# Additional Requirements for a Worthwhile Workshop

- (Your ideas, questions, requirements, needs here)

# Life Cycle Assessment

- What is it?
- How does it work?
- What can it do for me?
- What's happening these days that I might care about?

# What is Life Cycle Assessment?

- Sustainability “Footprinting” (climate and much more)

| | | | |
|---|---|---|---|
| Emissions of GHGs from other suppliers | Emiss. of GHGs from your energy suppliers | Emissions of GHG's from your organiz. | Emission impacts after you discard |
| “Scope 3” | “Scope 2” | “Scope 1” | “Scope 3” |

| | | |
|---|---|---|
| Global Warming emissions from the *entire* supply chains of *all* inputs to your org. | Emissions of GHG's from your org. | Emission impacts after you discard |
| “”Cradle to gate” | “*Use* phase” | “End of Life” |

| Global Warming emissions from the *entire* supply chains of *all* inputs to your org. | Emissions of GHG's from your org. | Emission impacts after you discard |
| --- | --- | --- |
| Impacts on human health | | |
| Impacts on ecosystems | | |
| Impacts related to resource depletion | | |
| “”Cradle to gate” | “*Use* phase” | “End of Life” |

# Grandma's Home-Made Organic


... is dioxin-free, right?



... sorry Grandma.

"Show me the data."

"How many grams, and how does that compare with our other impacts, like climate change?"

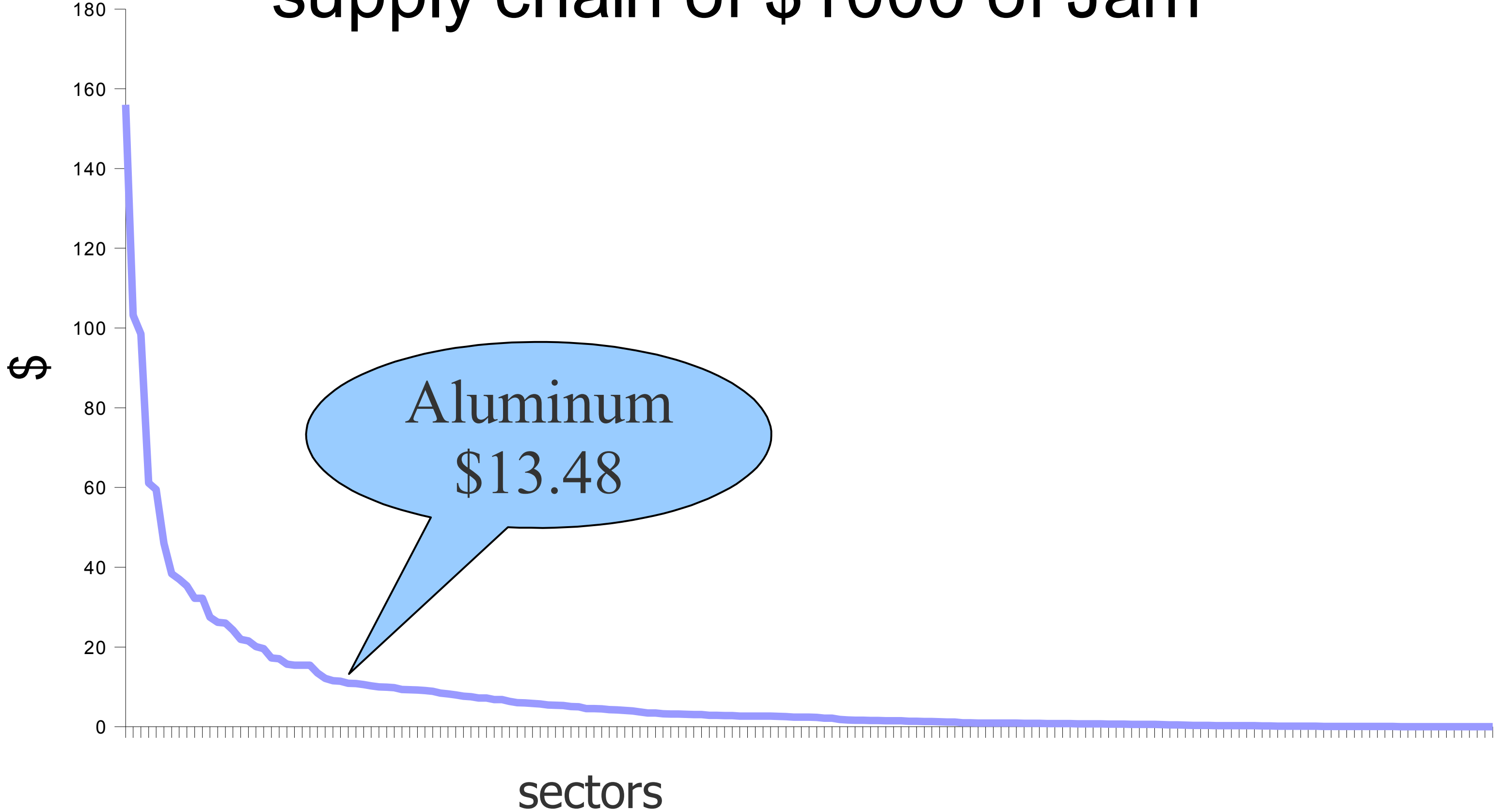
"And I've been wondering about all the jar-washing by our customers..."

"And what can we *do* about these issues ??"

# Canned fruits, vegetables, preserves, jams and jellies: What do the data say?

- The sector “Canned Fruits, vegetables, preserves, jams and jellies” purchases from 224 other sectors
- Sectors purchase inputs from a median number of 150 other sectors
- Your suppliers each purchases from their suppliers...

# Output from every sector, $, induced in supply chain of $1000 of Jam



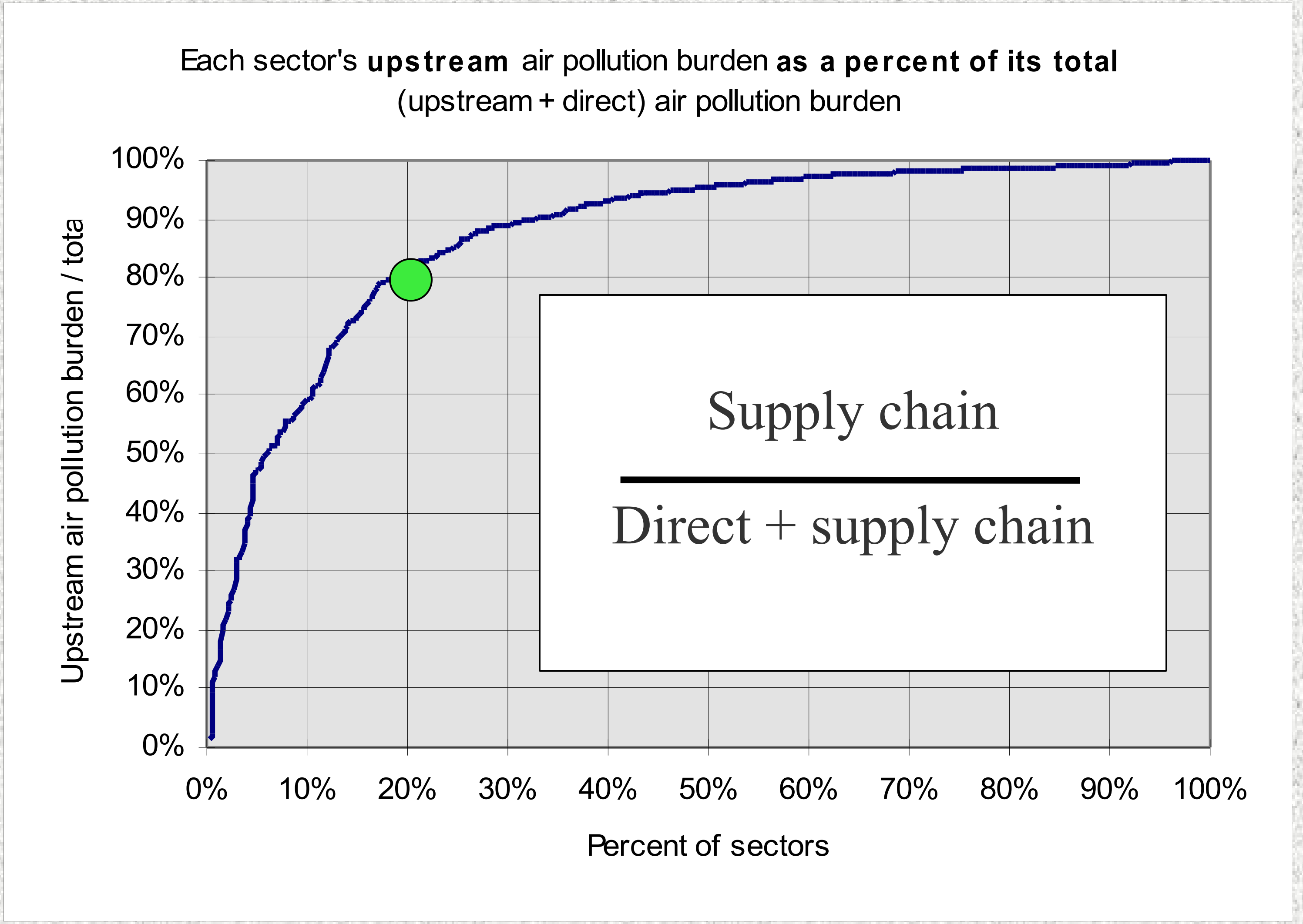
# Take-away messages?...

We are radically connected.

(Every sector is in the supply chain of every sector.)

We can't get green/sustainable alone.

# Buyer power, and the 80-80 Rule



# Life Cycle Assessment: Perspective

- Think broadly: Life cycle, cradle-to-next-life
- Think deeply: Impacts, endpoints
- Think quantitatively: data; how much of x?
- Think comparatively: what if we change y?
- Assess and document systematically: standards, transparency

International Organization for Standardization

# Historical context

- When?
- 1968. Where?
- USA. Who?
- Coca-Cola Topic?
- Packaging
- Developed the method to answer the question: "What are the energy and solid waste implications of the beginning shift to 1-way (plastic) bottles?"

# Findings, 1968

- Surprise: Plastic not as bad as employees feared
  - Weight of glass bottles
    - Transportation energy
    - Material use / processing in manufacturing
  - Declining “trippage rates”
  - Lightweighting of 1-way packaging

# 1970 – 75

- UK and Belgium: beverage packaging applications
- Ron Teaseley left Coke, went to EPA OSW
- Series of studies of consumer products
  - Plan: Regulate if disposables found problematic

# Parallel Evolution: USA and Europe

- USA: Consulting firm with database: Franklin Assoc.
- Industry in-house, low-profile, proactive expertise (P&G)
- Emphasis on Inventory, de-emphasize impact assess.

- Europe: Quasi-academics
- Government development of databases began in early 1980's
- Included development / use of impact assessments

# Late 1980's

- Re-emergence of environmental issues
- Planet Earth was "man of the year"
- New York "Garbage barge"
- "The Diaper Debate"
  - P & G was ready
  - Knew what impacts / assumptions mattered
  - Refined/informed ***functional unit*** with market research
- Final result of studies: "It depends"

# 1990's

- Surge in LCA interest, new actors
- SETAC “Code of Practice”
- ISO 14040 standards

- Application beyond consumer disposables
  - Automobiles
  - Electronics
  - Buildings
  - Integrated solid waste management

# 2000-2005

- LCA goes global
  - Data, participation
  - Impacts
  - UNEP / SETAC Life Cycle Initiative
- North America: academia gets involved
  - Students start graduating
- Journals: Int Jou LCA, and Jou Industrial Ecology
- Buildings, Auto, Govt:
  ***US LCI Database***

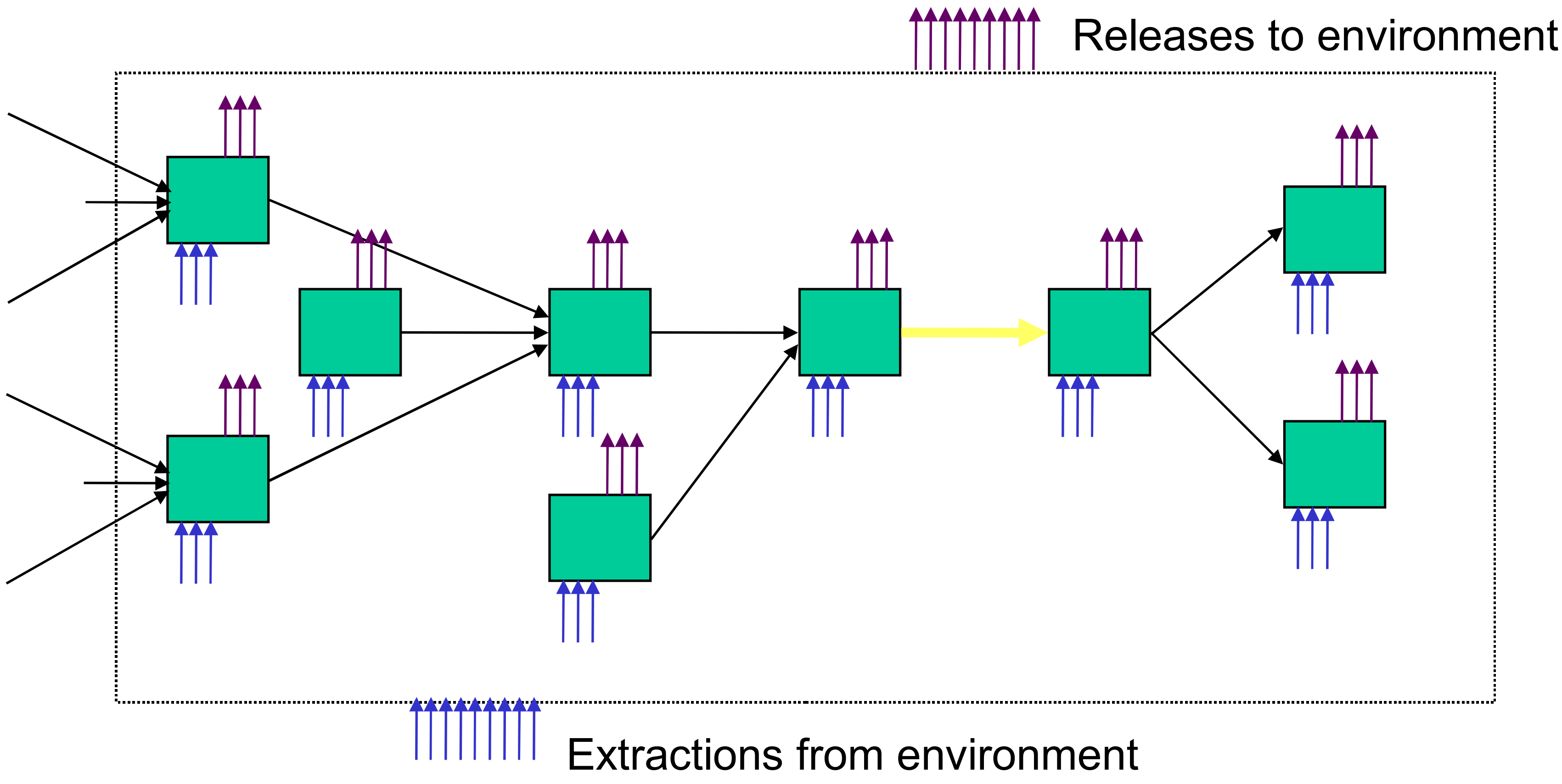
## 2005-2008

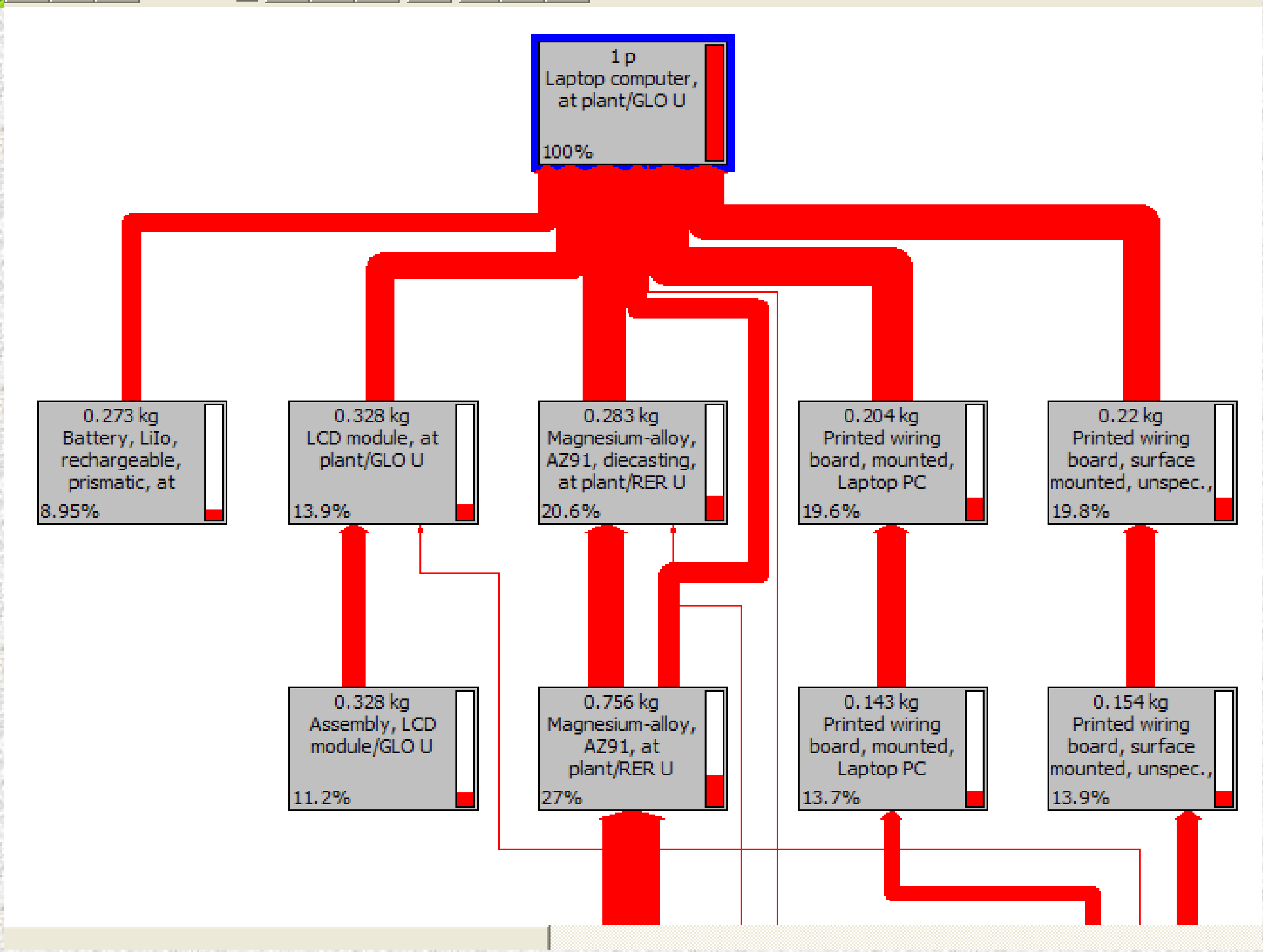
- Climate
- Wal-Mart

## 2008-2010

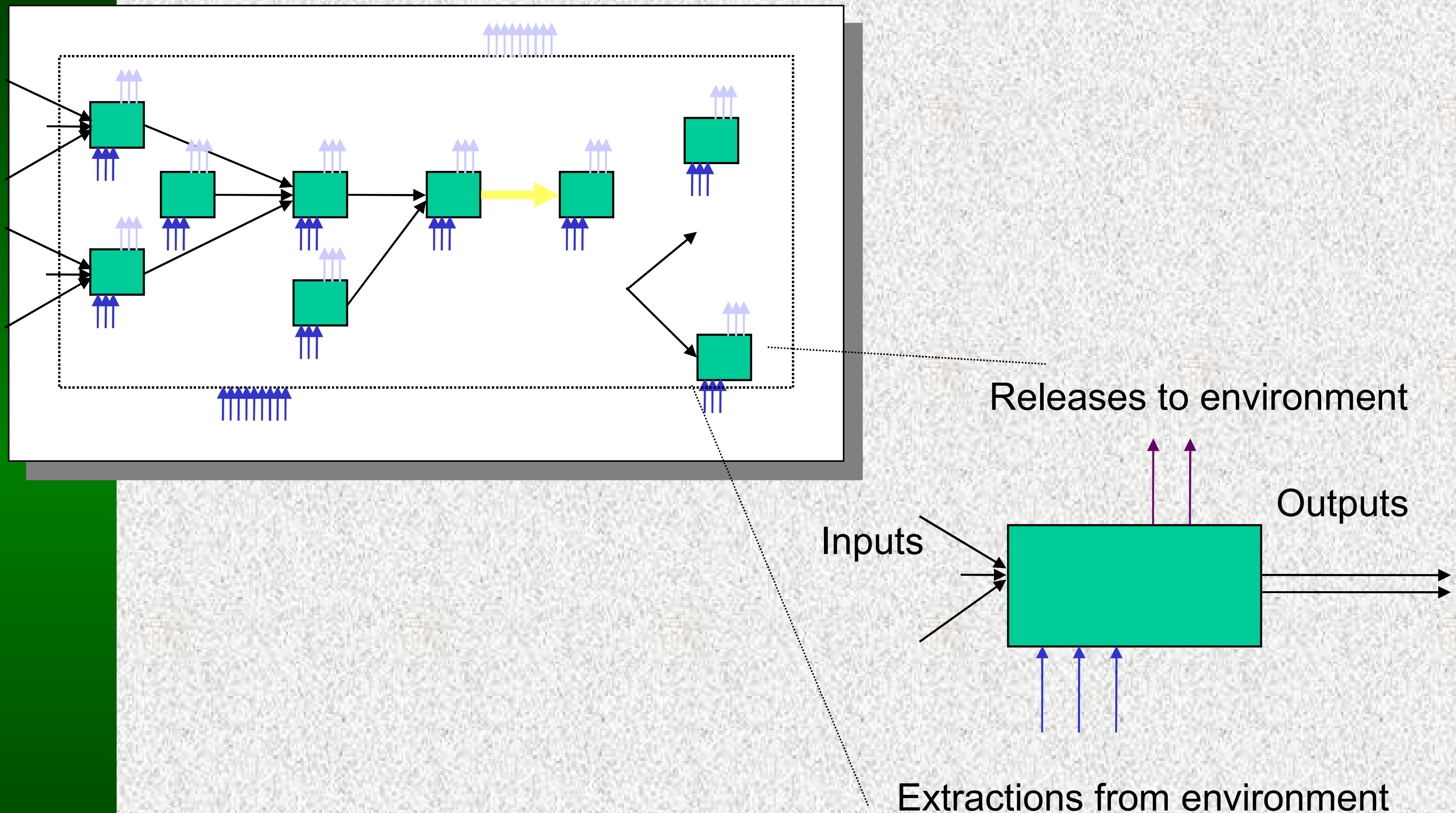
- Climate
- Wal-Mart
- Web 2.0, Social Computing, Open Source Paradigm

# Life Cycle Inventory Analysis




1 p
Laptop computer, at plant/GLO U
100%
0.273 kg
Battery, LiIo, rechargeable, prismatic, at
8.95%
0.328 kg
LCD module, at plant/GLO U
13.9%
0.283 kg
Magnesium-alloy, AZ91, diecasting, at plant/RER U
20.6%
0.204 kg
Printed wiring board, mounted, Laptop PC
19.6%
0.22 kg
Printed wiring board, surface mounted, unspec.,
19.8%
0.328 kg
Assembly, LCD module/GLO U
11.2%
0.756 kg
Magnesium-alloy, AZ91, at plant/RER U
27%
0.143 kg
Printed wiring board, mounted, Laptop PC
13.7%
0.154 kg
Printed wiring board, surface mounted, unspec.,
13.9%

# Life Cycle Inventory Analysis

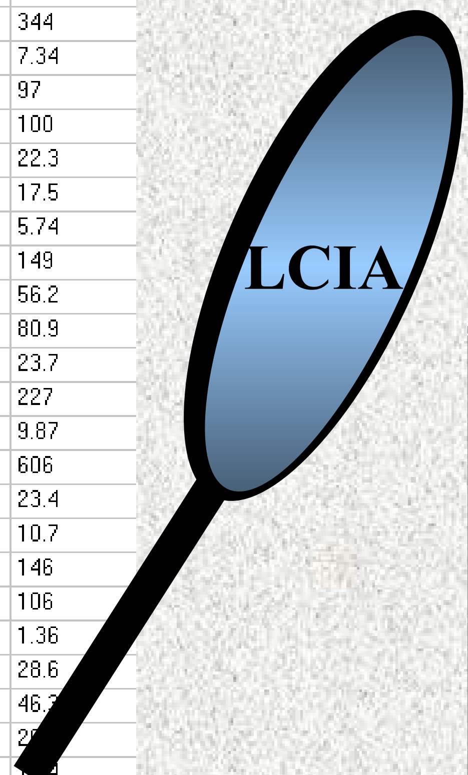


| Substance | Compa | Unit | Total | Laptop computer, | Aluminium production | Battery, LiIo, | Battery, NiMH, | Cable, network | CD-ROM/D drive, | Chromium steel | Copper, at | Corrugate board, | Electricity, medium | Extrusion, plastic | HDD, laptop | LCD module, | M A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminium, 24% in bauxite, 11% in crude ore, in ground | Raw | g | 319 | x | 134 | 36.3 | 3.5 | 0.0251 | 3.45 | 8.49 | 0.0517 | 0.233 | 0.00619 | 0.00133 | 75 | 9.65 | 6. |
| Anhydrite, in ground | Raw | mg | 12 | x | 0.000507 | 0.385 | 0.0364 | 0.00221 | 1.8 | 0.00207 | 0.000621 | 0.0034 | 0.000176 | 0.00819 | 0.115 | 2.28 | 0. |
| Barite, 15% in crude ore, in ground | Raw | g | 25.6 | x | 0.0303 | 0.151 | 0.0508 | 0.00266 | 0.582 | 0.00143 | 0.000289 | 0.00654 | 0.000307 | 0.000119 | 0.242 | 7.46 | 0. |
| Basalt, in ground | Raw | mg | 22.1 | x | 6.67 | 1.89 | 3.84 | 0.00519 | 0.298 | 0.00986 | 0.00809 | 0.00263 | 0.00495 | 0.000763 | 3.85 | 0.505 | 0. |
| Borax, in ground | Raw | mg | 21.5 | x | 0.002 | 0.0414 | 0.000992 | 0.000101 | 0.119 | 0.00393 | 3.44E-5 | 0.000485 | 0.00344 | 0.000452 | 0.0489 | 18.2 | 0. |
| Cadmium, 0.30% in sulfide, Cd 0.18%, Pb, Zn, Ag, In, in grc | Raw | mg | -1.01 | x | 0.000813 | -0.00954 | 0.00383 | 0.00434 | -0.333 | -4.32E-5 | 5.48E-6 | 0.000157 | -1.12E-6 | -2.1E-5 | -0.128 | 0.339 | 0. |
| Calcite, in ground | Raw | kg | 27.6 | x | 0.0256 | 0.0535 | 0.0664 | 0.00326 | 0.771 | 0.203 | 0.00316 | 0.00389 | 0.00802 | 0.00124 | 0.304 | 1.45 | 0. |
| Carbon dioxide, in air | Raw | kg | 5.93 | x | 0.00642 | 0.0407 | 0.00515 | 0.000737 | 0.0946 | 0.0287 | 0.000345 | 0.477 | 0.0236 | 0.0242 | 0.0572 | 0.124 | 1. |
| Carbon, in organic matter, in soil | Raw | mg | 84.1 | x | 0.924 | 5.33 | 8.73 | 0.00739 | 1.29 | 0.0681 | 0.0107 | 31.5 | 0.00434 | 0.00209 | 0.835 | 11.4 | 0. |
| Cerium, 24% in bastnasite, 2.4% in crude ore, in ground | Raw | g | 3.16 | x | -1.25E-20 | -1.24E-19 | 3.12 | -6.15E-21 | -6.88E-19 | -1.26E-20 | -8.71E-21 | -2.56E-20 | -7.77E-21 | -1.67E-21 | -3.39E-19 | 0.0422 | -1 |
| Chromium, 25.5% in chromite, 11.6% in crude ore, in grounc | Raw | g | 209 | x | 0.00664 | 0.0483 | 0.0202 | 0.0272 | 3.15 | 135 | 0.123 | 0.00126 | 0.00458 | 0.00613 | 0.94 | 10.7 | 0. |
| Chrysotile, in ground | Raw | mg | 52 | x | 0.334 | 1.58 | 0.424 | 0.0287 | 1.36 | 0.0151 | 0.00244 | 0.0718 | 0.00282 | 0.00123 | 0.721 | 2.75 | 0. |
| Cinnabar, in ground | Raw | mg | 5.77 | x | 0.0307 | 0.179 | 0.0403 | 0.00308 | 0.131 | 0.00139 | 0.000227 | 0.00662 | 0.000261 | 0.000115 | 0.0683 | 0.988 | 0. |
| Clay, bentonite, in ground | Raw | g | 13.4 | x | 0.0416 | 0.185 | 0.0229 | 0.00244 | 1.79 | 3.41 | 0.00364 | 0.00941 | 0.0548 | 0.0132 | 0.322 | 0.679 | 0. |
| Clay, unspecified, in ground | Raw | kg | 9.05 | x | 0.00269 | 0.00773 | 0.00439 | 0.000796 | 0.252 | 0.00413 | 8.04E-6 | 6.14E-5 | 1.45E-5 | 1.02E-5 | 0.098 | 0.49 | 0. |
| Coal, brown, in ground | Raw | kg | 27.9 | x | 0.136 | 0.19 | 0.0344 | 0.00871 | 1.1 | 0.36 | 0.00306 | 0.0684 | 0.318 | 0.0418 | 0.701 | 1.31 | 0. |
| Coal, hard, unspecified, in ground | Raw | kg | 25 | x | 0.228 | 4.2 | 0.0866 | 0.00962 | 0.758 | 0.808 | 0.00323 | 0.0417 | 0.174 | 0.0233 | 0.497 | 2.95 | 0. |
| Cobalt, in ground | Raw | mg | 114 | x | 0.00144 | 0.00441 | 114 | 7.3E-5 | 0.0139 | 0.000625 | 9.58E-6 | 0.000648 | 2.81E-5 | 2.5E-5 | 0.00687 | 0.0166 | 0. |
| Colemanite, in ground | Raw | g | 52.9 | x | 4.98E-5 | 0.000254 | 0.000121 | 2.86E-6 | 1.95 | 0.000112 | 1.12E-6 | 1.22E-5 | 9.87E-5 | 1.3E-5 | 0.75 | 2.88 | 0. |
| Copper, 0.52% in sulfide, Cu 0.27% and Mo 8.2E-3% in cruc | Raw | mg | 9.58 | x | x | 9.55 | 0.0385 | x | x | x | x | x | x | x | x | x | x |
| Copper, 0.99% in sulfide, Cu 0.36% and Mo 8.2E-3% in cruc | Raw | g | 36.2 | x | 0.0186 | 0.0834 | 0.00143 | 0.134 | 1.29 | 1.73E-5 | 0.612 | 1.43E-6 | 2.6E-6 | 1.68E-6 | 0.239 | 1.84 | 0. |
| Copper, 1.18% in sulfide, Cu 0.39% and Mo 8.2E-3% in cruc | Raw | g | 104 | x | 0.103 | 0.459 | 0.00765 | 0.744 | 5.86 | 7.38E-5 | 3.39 | 5.94E-6 | 1.31E-5 | 3.05E-6 | 0.827 | 2.47 | 0. |
| Copper, 1.42% in sulfide, Cu 0.81% and Mo 8.2E-3% in cruc | Raw | g | 27.7 | x | 0.0273 | 0.122 | 0.00203 | 0.197 | 1.55 | 1.96E-5 | 0.9 | 1.58E-6 | 3.47E-6 | 8.08E-7 | 0.219 | 0.655 | 0. |
| Copper, 2.19% in sulfide, Cu 1.83% and Mo 8.2E-3% in cruc | Raw | g | 152 | x | 0.135 | 0.604 | 0.0102 | 0.978 | 9.77 | 9.72E-5 | 4.46 | 7.87E-6 | 1.73E-5 | 4.03E-6 | 1.88 | 4.61 | 0. |
| Diatomite, in ground | Raw | µg | 1.97 | x | 0.0023 | 0.0129 | 0.0776 | 0.000125 | 0.0554 | 0.00494 | 4.52E-5 | 0.000545 | 0.00435 | 0.000572 | 0.0254 | 0.109 | 0. |
| Dolomite, in ground | Raw | g | 4.40 | x | 0.0016 | 0.00813 | 0.00438 | 0.000253 | 0.407 | 1.04 | 0.000052 | 0.00447 | 3.77E-5 | 0.00122 | 0.0715 | 0.773 | 0. |

ng 1 p 'Laptop computer, at plant/GLO U'; Method: IMPACT 2002+ V2.04 / IMPACT 2002+

# Inventory results (LCI)

| Substance | Compartment | Unit | Total |
|---|---|---|---|
| Aluminum | Air | mg | 27 |
| Ammonia | Air | mg | 776 |
| Ammonium carbonate | Air | ng | 441 |
| Antimony | Air | µg | 9.52 |
| Antimony-124 | Air | nBq | 33 |
| Antimony-125 | Air | nBq | 344 |
| Argon-41 | Air | Bq | 7.34 |
| Arsenic | Air | µg | 97 |
| Barium | Air | µg | 100 |
| Barium-140 | Air | µBq | 22.3 |
| Benzaldehyde | Air | ng | 17.5 |
| Benzene | Air | mg | 5.74 |
| Benzene, ethyl- | Air | µg | 149 |
| Benzene, hexachloro- | Air | ng | 56.2 |
| Benzene, pentachloro- | Air | ng | 80.9 |
| Benzo(a)pyrene | Air | µg | 23.7 |
| Beryllium | Air | ng | 227 |
| Boron | Air | mg | 9.87 |
| Bromine | Air | µg | 606 |
| Butadiene | Air | pg | 23.4 |
| Butane | Air | mg | 10.7 |
| Butene | Air | µg | 146 |
| Cadmium | Air | µg | 106 |
| Calcium | Air | mg | 1.36 |
| Carbon-14 | Air | Bq | 28.6 |
| Carbon dioxide, biogenic | Air | g | 46.[illegible] |
| Carbon dioxide, fossil | Air | kg | 2[illegible] |
| Carbon disulfide | Air | mg | [illegible]4 |
| Carbon monoxide, biogenic | Air | mg | 24.4 |
| Carbon monoxide, fossil | Air | g | 26.4 |



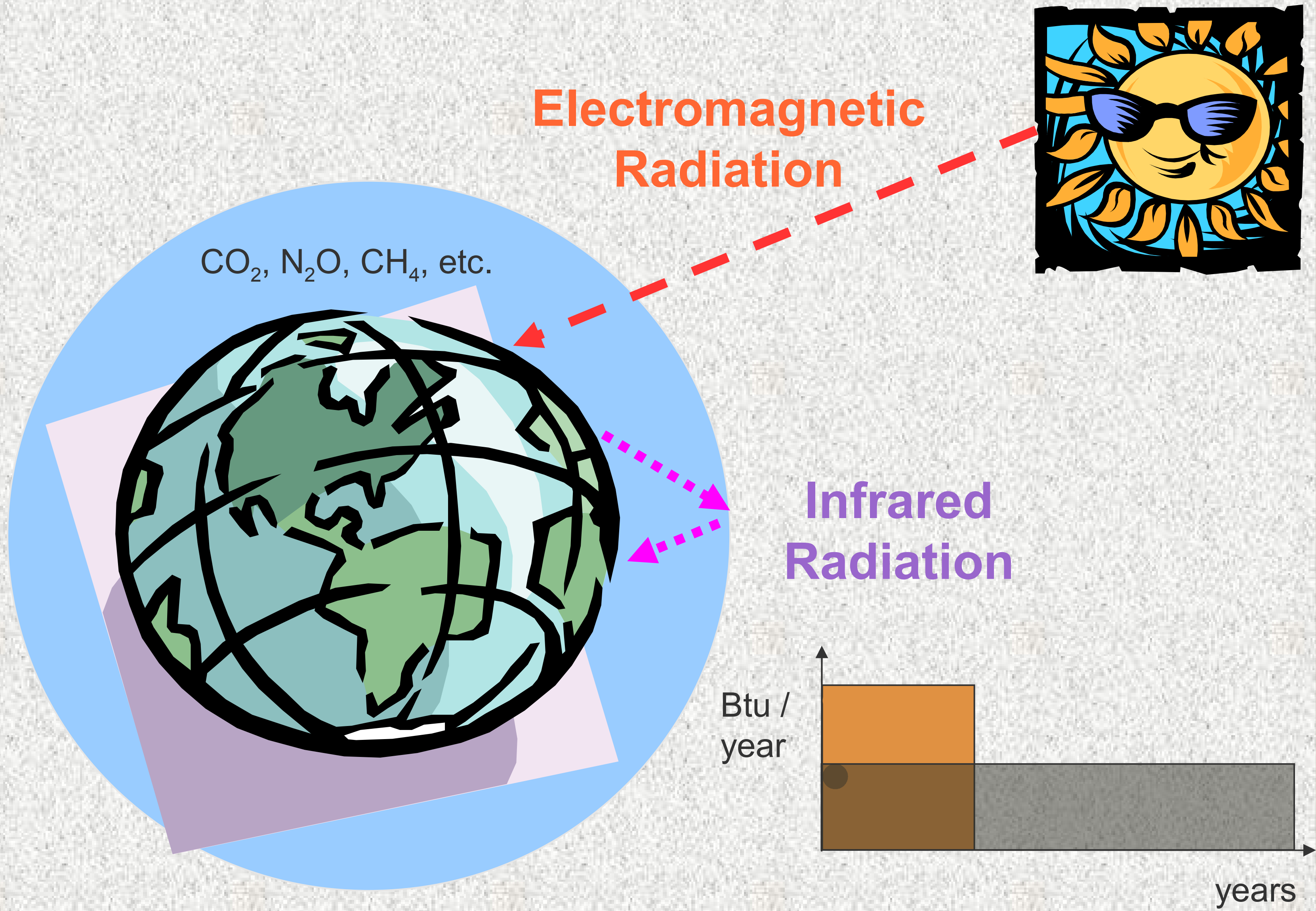

# Impact Assessment results

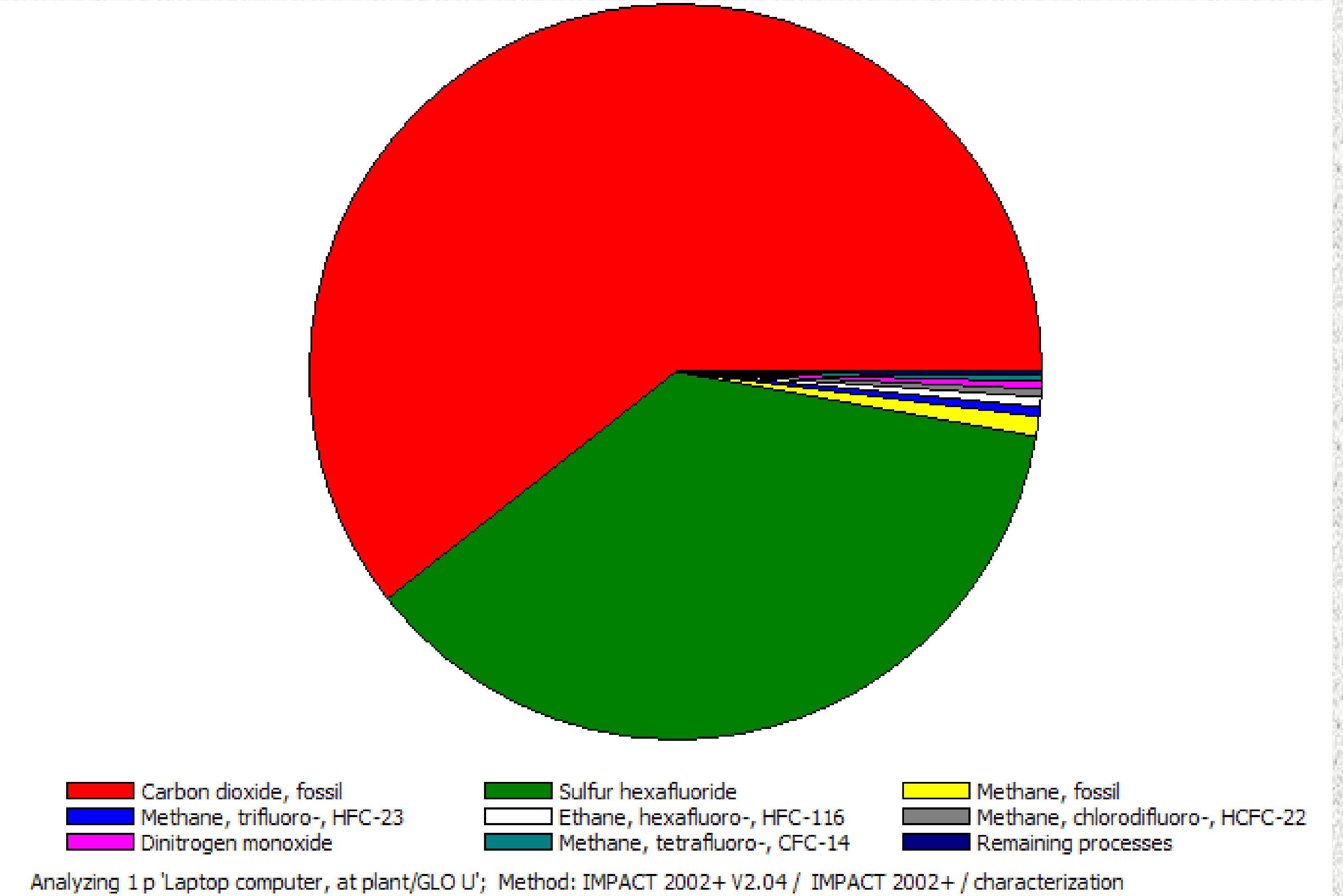
| Impact category | Total |
|---|---|
| Carcinogens | 2.35E-5 |
| Resp. organics | 3.03E-6 |
| Resp. inorganics | 0.0011 |
| Climate change | 0.000432 |
| Radiation | 1.21E-6 |
| Ozone layer | 5.16E-9 |
| Ecotoxicity | 1.15E-5 |
| Acidification/ Eutrophication | 0.000128 |
| Land use | 1.85E-6 |
| Minerals | 1.3E-6 |
| Fossil fuels | 0.00624 |

# Life Cycle Impact Assessment

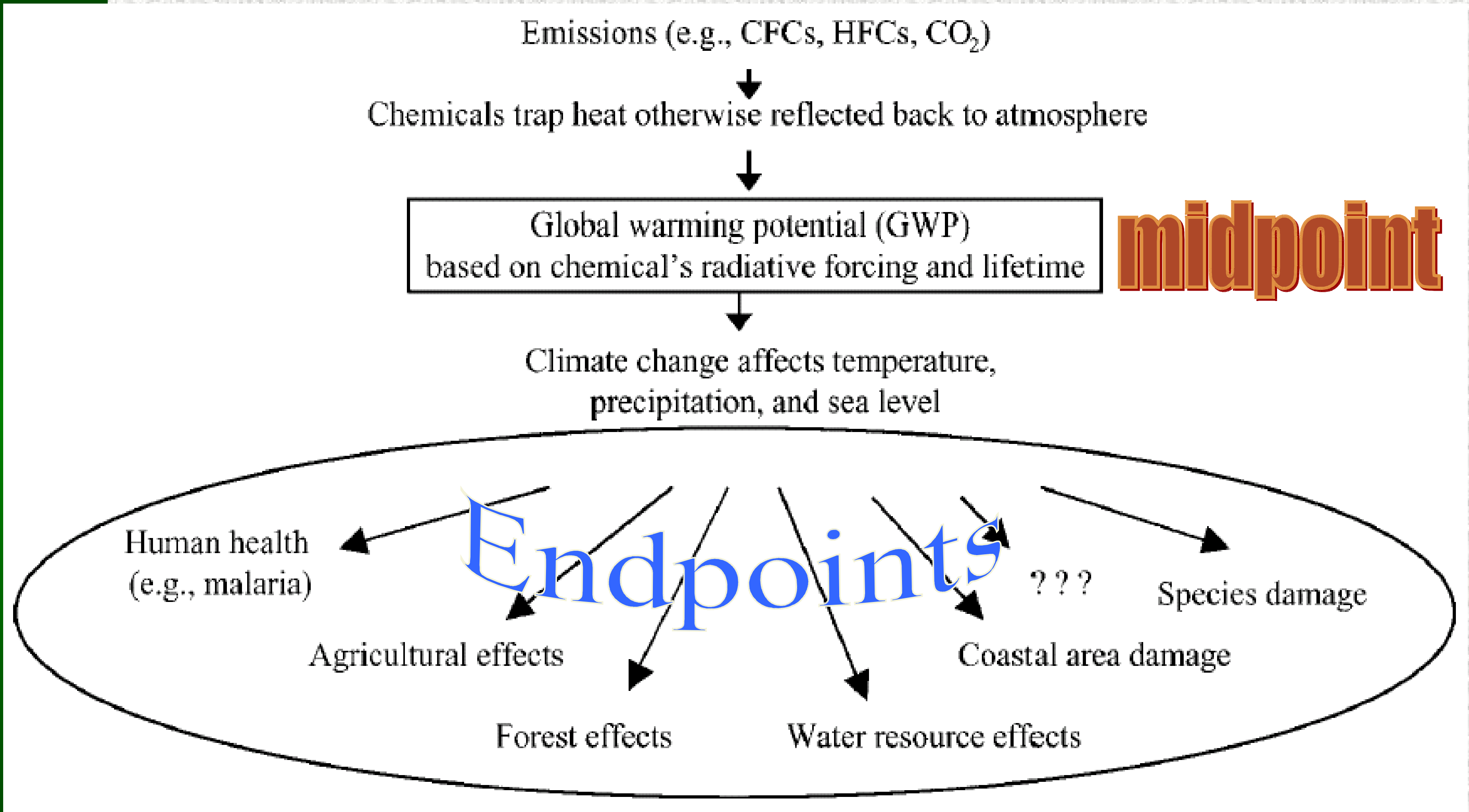
- Origins
  - Global warming potentials (GWPs)
  - Ozone depletion potentials (ODPs)
    - Origin outside LCA
    - Reasonable international acceptance
    - Indicators, equivalency measures, not damage calculations
    - Permit summation within impact category

# The greenhouse mechanism




Carbon dioxide, fossil
Sulfur hexafluoride
Methane, fossil
Methane, trifluoro-, HFC-23
Ethane, hexafluoro-, HFC-116
Methane, chlorodifluoro-, HCFC-22
Dinitrogen monoxide
Methane, tetrafluoro-, CFC-14
Remaining processes
Analyzing 1 p 'Laptop computer, at plant/GLO U'; Method: IMPACT 2002+ V2.04 / IMPACT 2002+ / characterization

# Climate Change



# Thanks, but what does this mean to ME??

- Life Cycle Assessment is an internationally standardized method for environmental (and social) "footprinting" of products
- Life Cycle Assessment is being done by others, and the results are used in the PIE tool
  - Average product categories in the US (and abroad)
  - Individual companies, specific products
- You can use the results, in PIE, to:
  - Prioritize your purchasing categories
  - Compare the impacts of prior and current purchasing
  - Identify environmentally preferable products
  - Compute and report the benefits of your choices