

Open Life Cycle Tools for Measuring and Communicating Sustainability Information

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Sylvatica



GAA Environmental Workshop – June 17-19, 2008

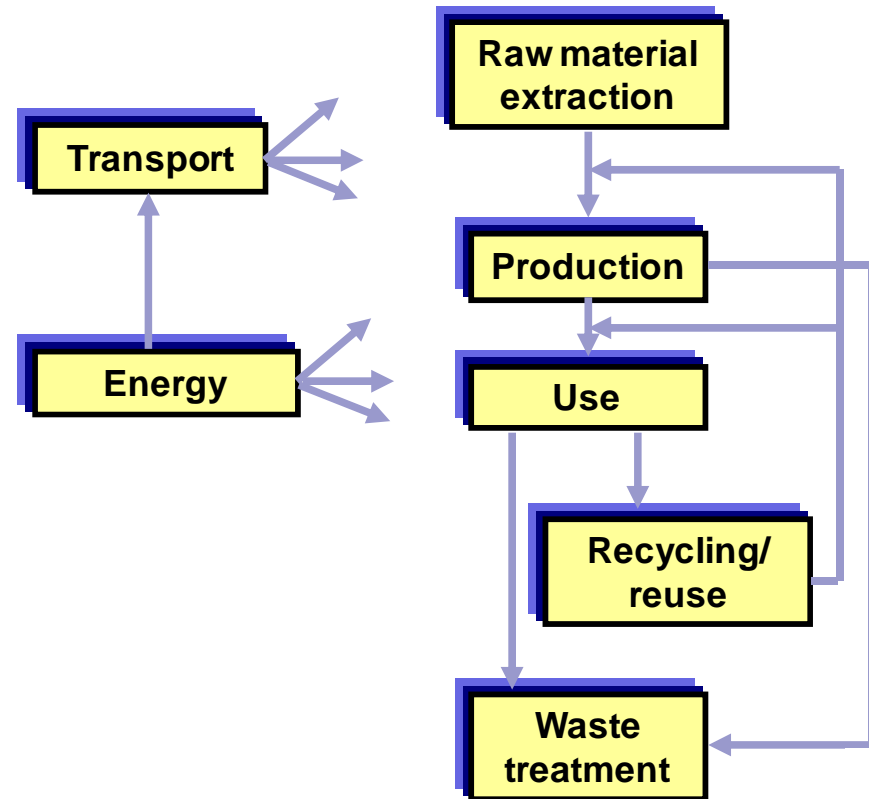
Three main points

- The life cycle assessment (LCA) world has been doing carbon accounting for years...
 - and has looked at many other environmental issues too
- There are some challenges left...
 - some of which are especially relevant for paper products
- Recent developments can help you measure and communicate life cycle information



What is Life Cycle Assessment

- Life cycle of a product
- Life cycle *assessment* of a product: evaluation of the potential environmental impacts of a product throughout its life cycle



Origin of LCA

When?

Question they wanted answered:
“What are the energy and solid waste implications of the beginning shift to 1-way (plastic) bottles?”



Origin of LCA

- **The question became general**
 - “What are the energy and solid waste implications of the beginning shift to 1-way (plastic) bottles?”

Became

- **What are the health, environmental, & resource consequences of products over their life cycles?”**



The standardization of LCA



14040: Principles and Framework

14044: Requirements and Guidelines



Back-of-envelope example

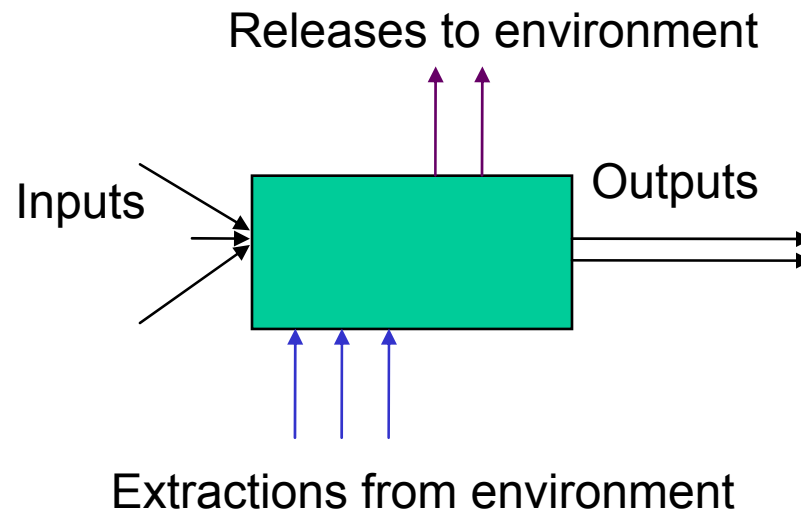
- LCA of a newspaper
- Includes
 - Forestry
 - Newsprint production
 - Content production
 - Printing
 - Distribution
 - End-of-life management

You cannot
take these
numbers to the
bank!



Building blocks of LCA

- Four types of data are needed for each process in the product life cycle



Data can be specific or average



Example of data for one process

1 “sold” output: Newsprint

30 “bought” inputs

Known inputs from technosphere (materials/fuels)		
Name	Amount	Unit
Industrial wood, softwood, under bark, u=140%, at forest road/RER U	0.000722	m3
Industrial wood, Scandinavian softwood, under bark, u=140%, at forest road/NOR	0.0006	m3
Industrial residue wood, softwood, forest-debarked, u=70%, at plant/RER U	0.000749	m3
Chips, Scandinavian softwood (plant-debarked), u=70%, at plant/NORDEL U	0.000622	m3
Sulphate pulp, average, at regional storage/RER U	0.0257	kg
Kaolin, at plant/RER U	0.0563	kg
Aluminium sulphate, powder, at plant/RER U	0.0092	kg

98 emissions to air, 8 emissions to water

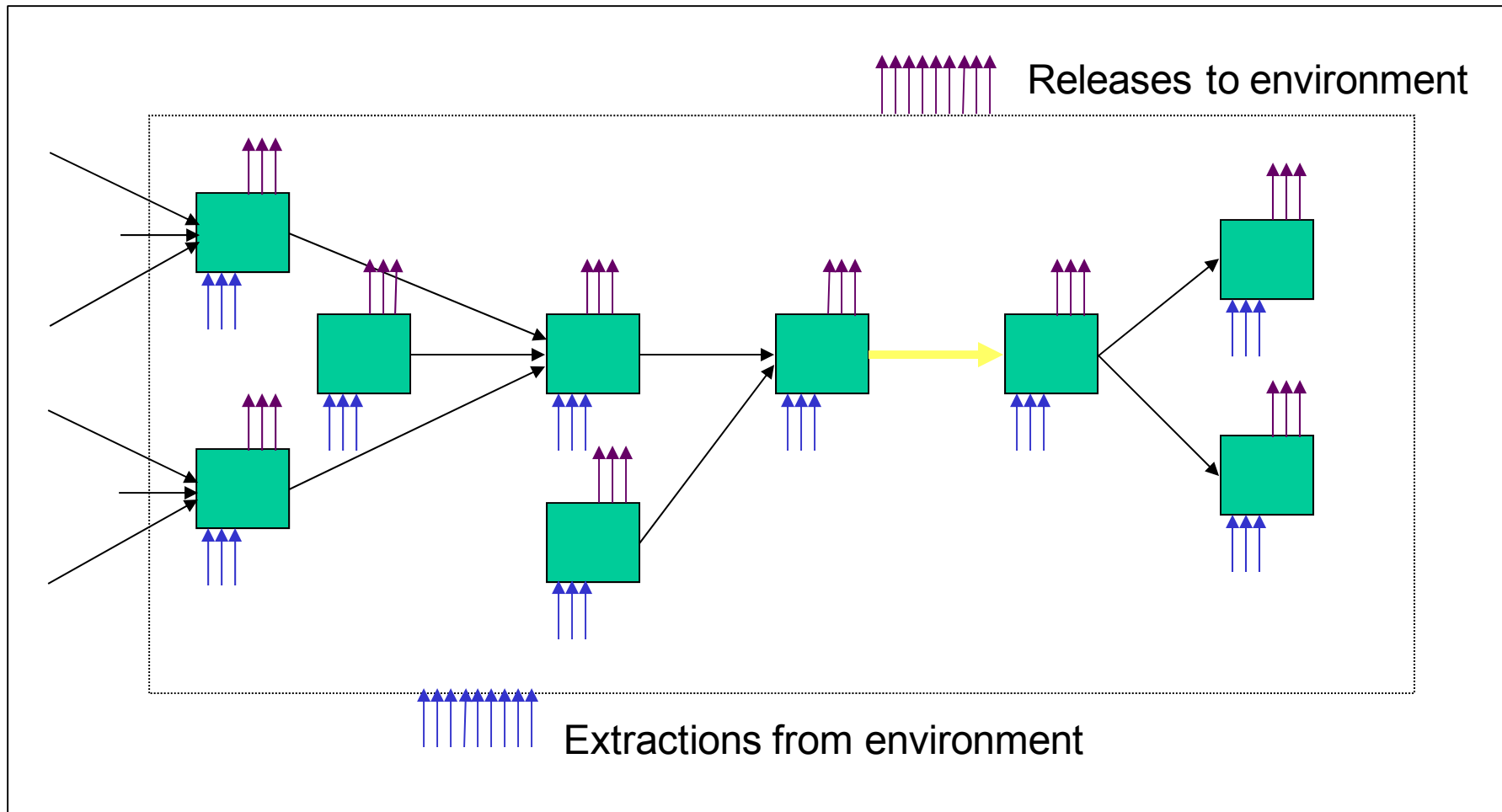
Emissions to air			
Name	Sub-compartment	Amount	Unit
Heat, waste	high. pop.	16	MJ
Carbon dioxide, biogenic	high. pop.	0.458	kg
Carbon dioxide, fossil	high. pop.	0.0489	kg
Nitrogen oxides	high. pop.	0.00055	kg

2 inputs from nature

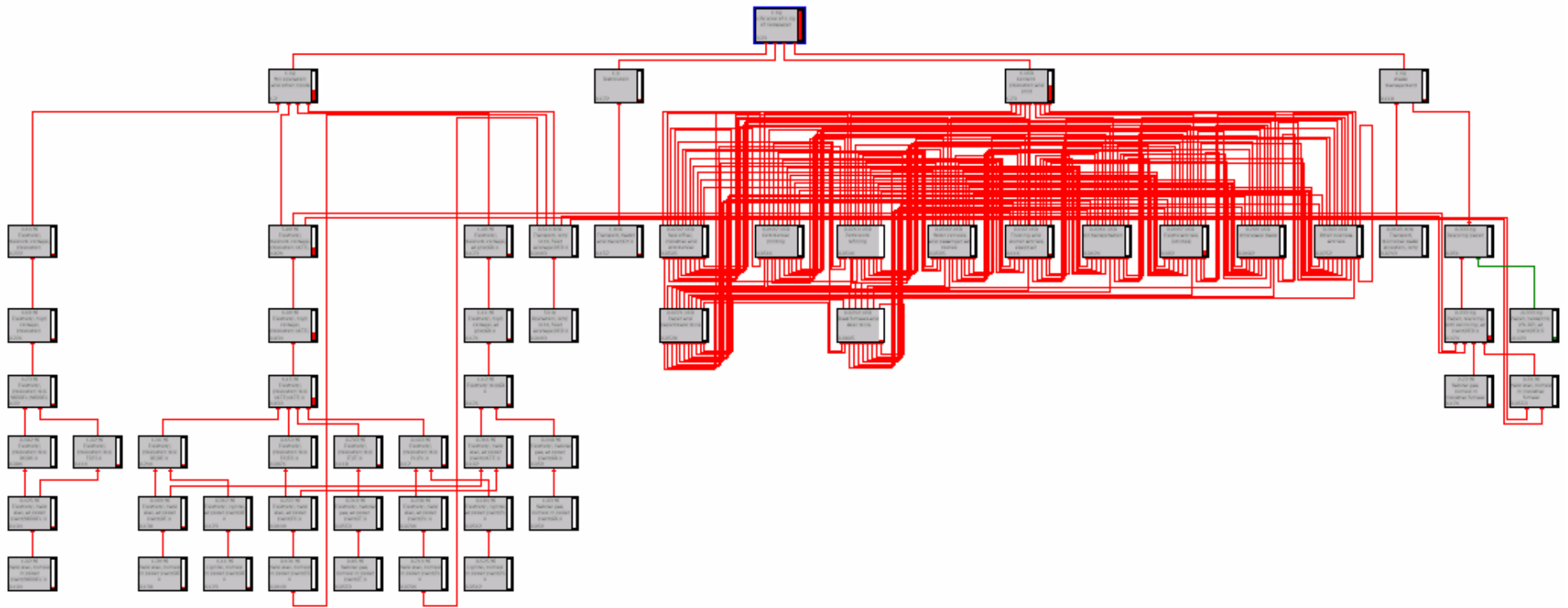
Known inputs from nature (resources)			
Name	Sub-compartment	Amount	Unit
Water, cooling, unspecified natural origin/m3	in water	0.0523	m3
Water, unspecified natural origin/m3	in water	0.013	m3



Life Cycle Inventory Analysis



Life Cycle Inventory Analysis



Showing 57 nodes out of 1930!



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Life Cycle Inventory Analysis

Substance	Comp Δ	Unit	Total
Cadmium	Air	kg	4.32E-8
Cadmium compounds	Air	kg	3.33E-8
Calcium	Air	kg	2.68E-5
Calcium cyanamide	Air	kg	2.87E-10
Captan	Air	kg	2.38E-10
Carbamic acid, butyl-, 3-iodo-2-propynyl ester	Air	kg	4.87E-11
Carbamic acid, ethyl ester	Air	kg	1.36E-7
Carbaryl	Air	kg	1.62E-7
Carbofuran	Air	kg	1.15E-5
Carbon-14	Air	Bq	24.9
Carbon dioxide	Air	kg	1.64
Carbon dioxide, biogenic	Air	kg	1.01
Carbon dioxide, fossil	Air	kg	1.46
Carbon dioxide, land transformation	Air	kg	0.00364
Carbon disulfide	Air	kg	5.12E-6
Carbon monoxide	Air	kg	0.0256
Carbon monoxide, biogenic	Air	kg	0.000249
Carbon monoxide, fossil	Air	kg	0.00129
Carbonyl sulfide	Air	kg	3.38E-6
Carboxin	Air	kg	2.82E-9
Catechol	Air	kg	6.15E-9
Cerium-141	Air	Bq	2.9E-6
Cesium-134	Air	Bq	1.39E-7
Cesium-137	Air	Bq	2.46E-6
Chlordane	Air	kg	3.71E-7

203 types of inputs from nature
 938 types of emissions to air
 726 types of emissions to water
 522 types of emissions to soil

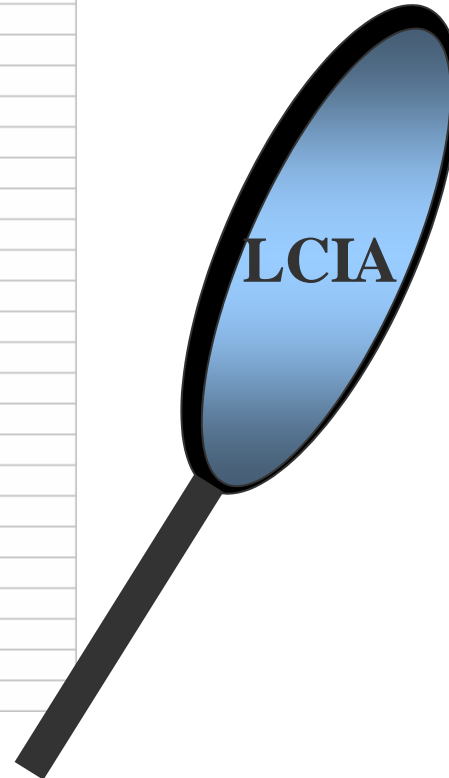
Way too much information to be useful!



Life Cycle Impact Assessment

Substance	Comp Δ	Unit	Total
Cadmium	Air	kg	4.32E-8
Cadmium compounds	Air	kg	3.33E-8
Calcium	Air	kg	2.68E-5
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LC Inventory

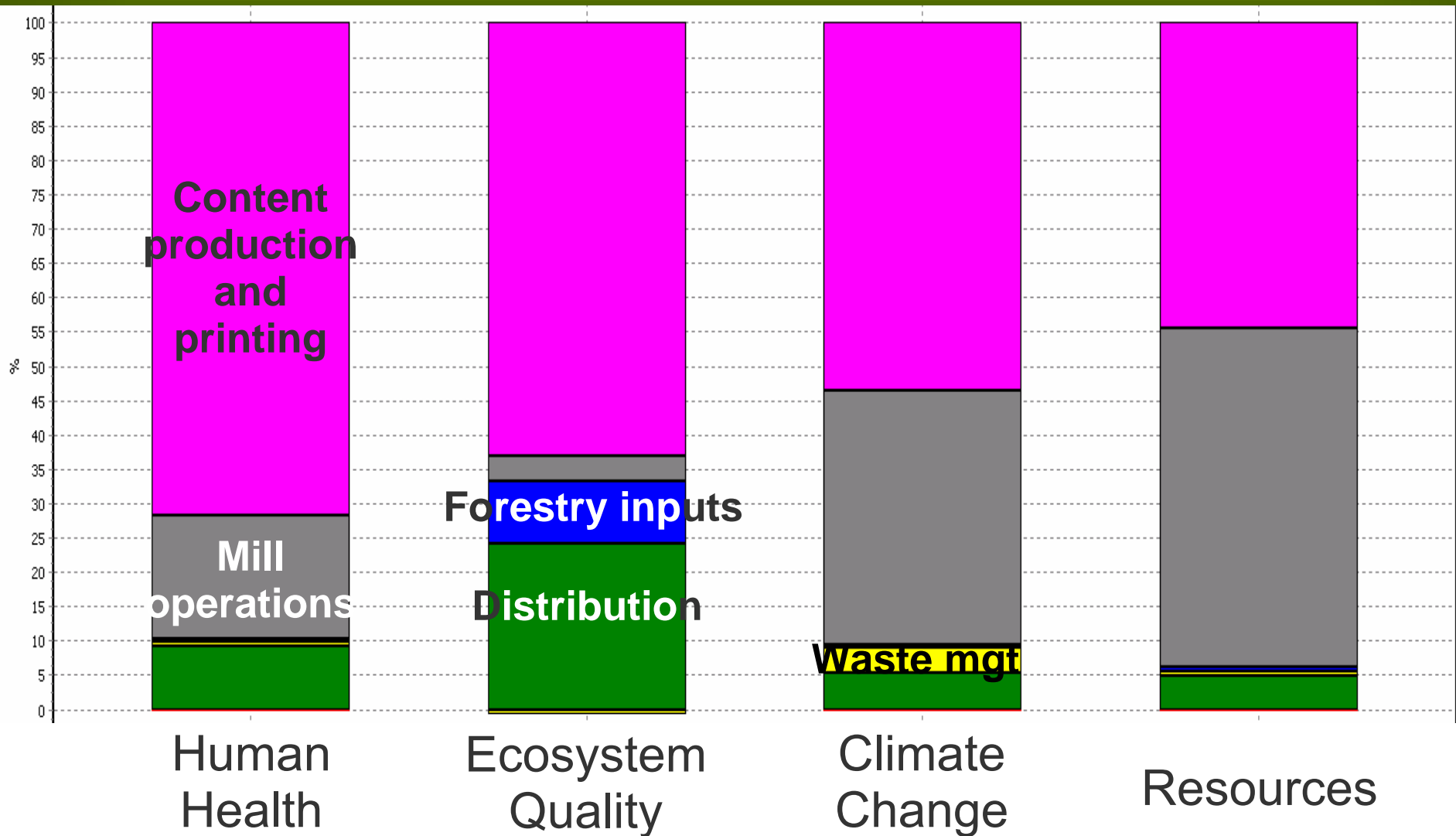


LC Impact Assessment Results

Impact category	Δ Unit	Total
Carcinogens	kg C2H3Cl eq	0.109
Non-carcinogens	kg C2H3Cl eq	0.983
Respiratory inorganics	kg PM2.5 eq	0.00368
Ionizing radiation	Bq C-14 eq	82
Ozone layer depletion	kg CFC-11 eq	3.15E-6
Respiratory organics	kg C2H4 eq	0.00332
Aquatic ecotoxicity	kg TEG water	877
Terrestrial ecotoxicity	kg TEG soil	449
Terrestrial acid/nutri	kg SO2 eq	0.0739
Land occupation	m2org.arable	0.394
Aquatic acidification	kg SO2 eq	0.0167
Aquatic eutrophication	kg PO4 P-lim	0.000248
Global warming	kg CO2 eq	3.23
Non-renewable energy	MJ primary	51.9
Mineral extraction	MJ surplus	0.000557

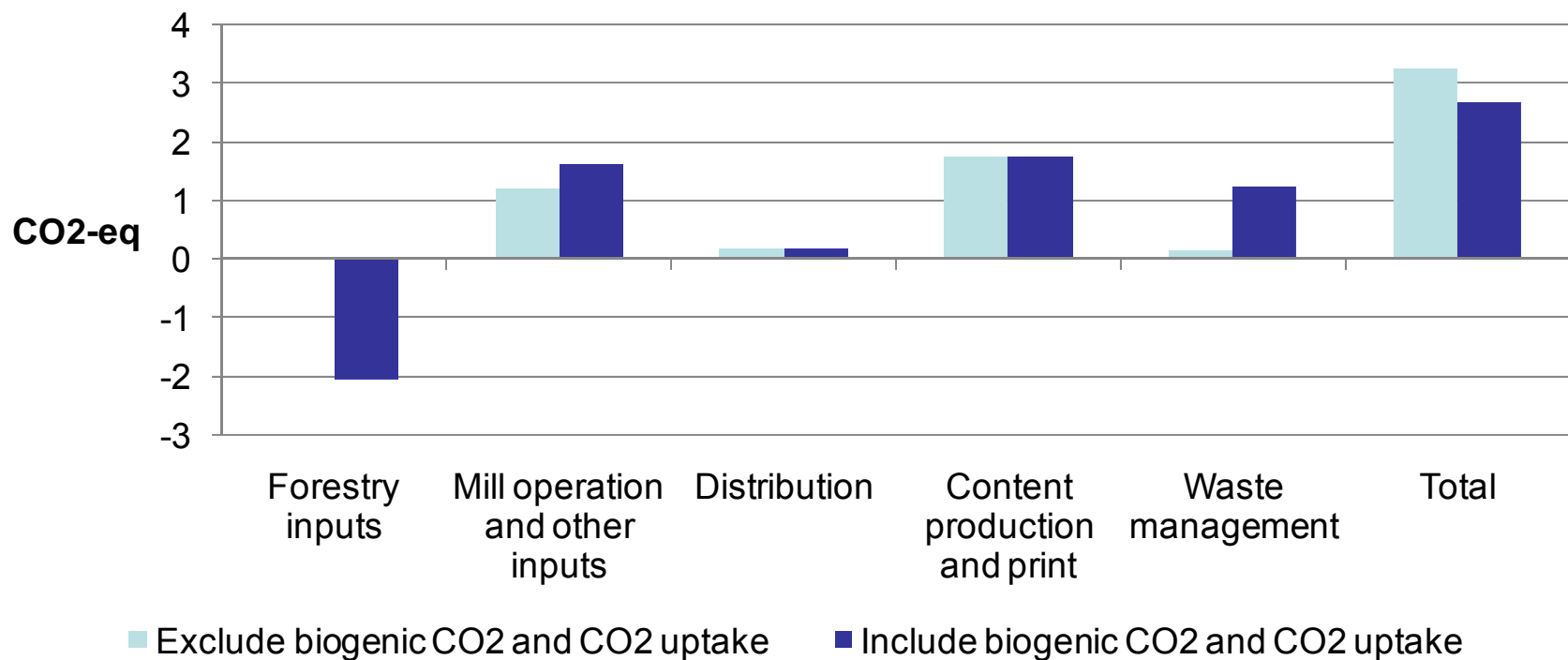


Life Cycle Impact Assessment



LCA and carbon accounting

- Different assumptions can lead to different results



LCA and carbon accounting

- LCA community paying much attention to carbon accounting initiatives
 - NCASI
 - WRI/WBCSD Greenhouse Gas protocol
 - British “Publicly available specification” (PAS)
 - USDA 1605(b)” guidelines for reporting GHGs
 - ...



LCA and sustainable forestry

- LCA has some difficulty evaluating the environmental benefits of sustainable forestry

- Solution:

Life cycle *attribute* assessment

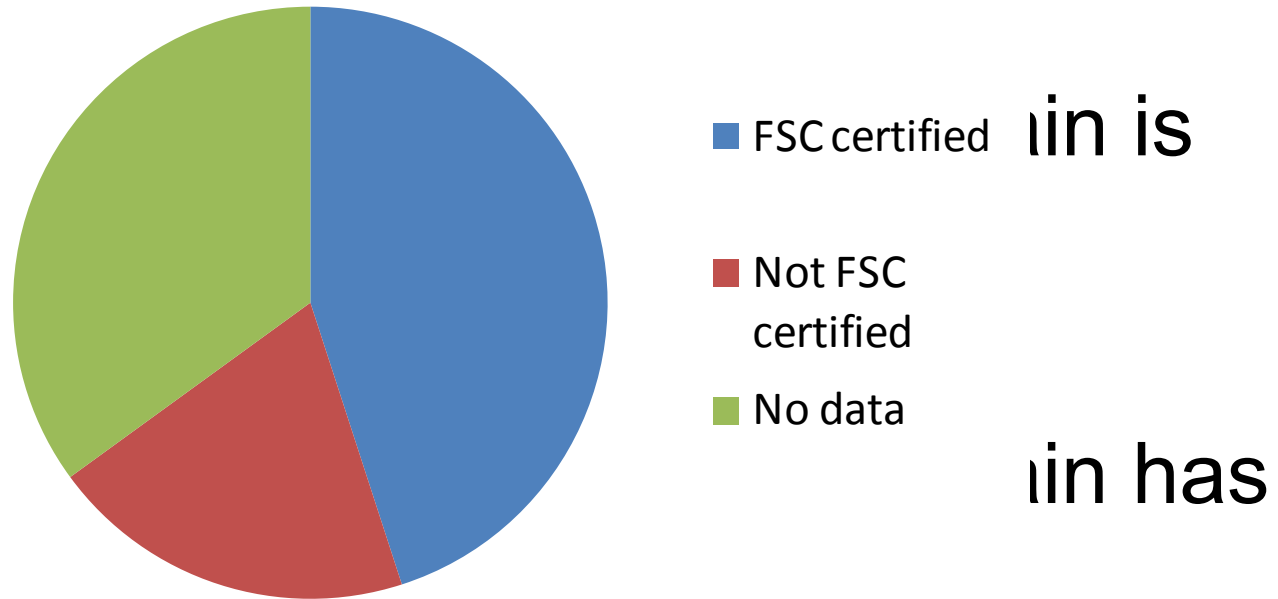


Life Cycle Attribute Assessment

- What percentage of my forestry-related supply chain is FSC certified?

- What
swea

- What
xyz a



How-to

- How could you calculate the CO2 footprint (and other impacts/attributes) of your product or company using LCA data and methods?

You only need two things



How-to

1. Data on your process(es)
 - (Emissions per unit output; inputs per unit output)

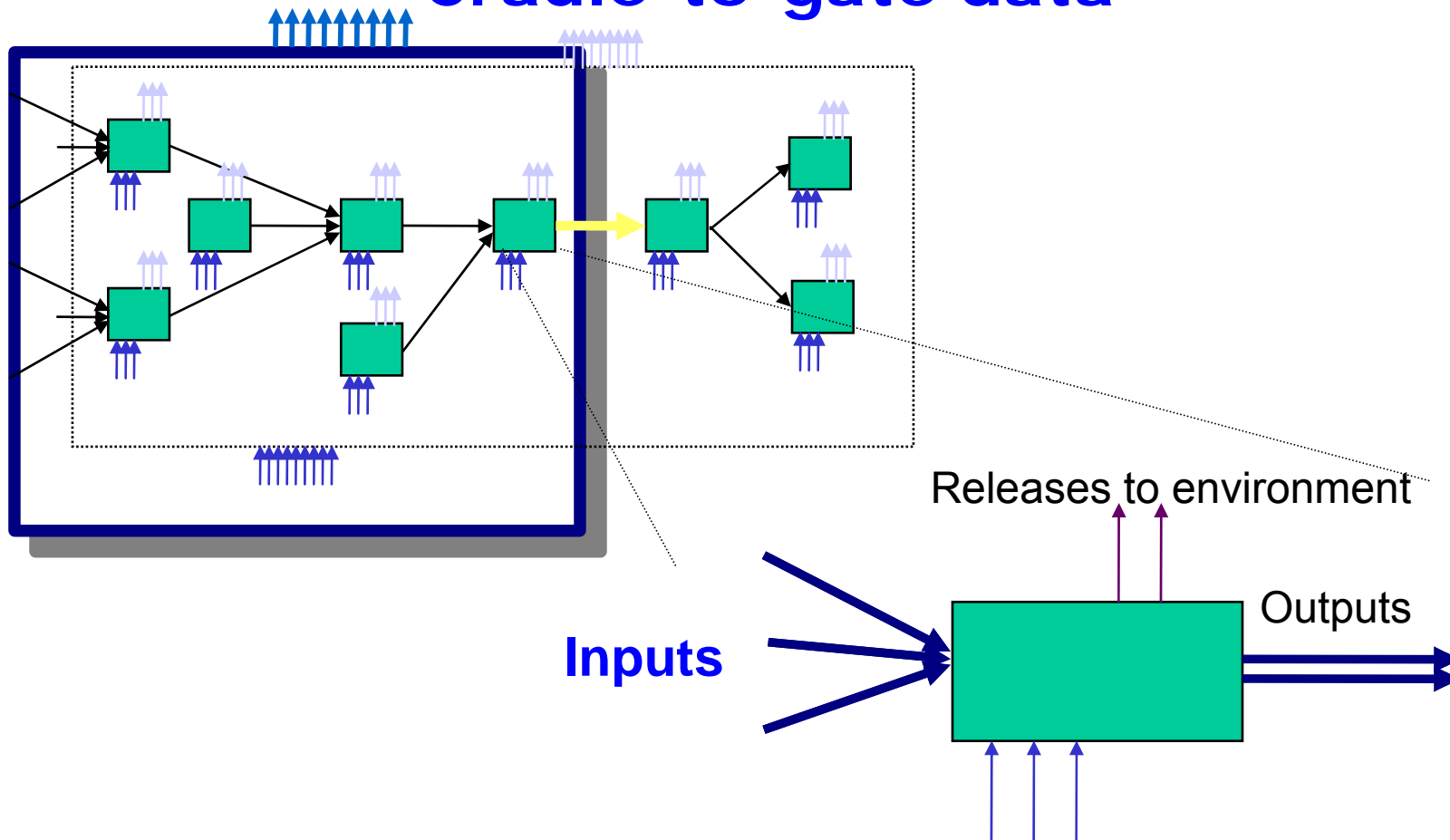
Confidential/proprietary

2. Data on the entire supply chain for every important input

IMPOSSIBLE, right?



Cradle-to-gate data



Gate-to-gate data



Calculating cradle-to-gate inventory

- Calculating your cradle-to-gate inventory:

Mission Impossible?

NO!



Calculating cradle-to-gate inventory

Traditional solution 1:

- Consultants use your gate-to-gate data with their proprietary database.
- Your data may help them grow their database.



Calculating cradle-to-gate inventory

Traditional solution 2:

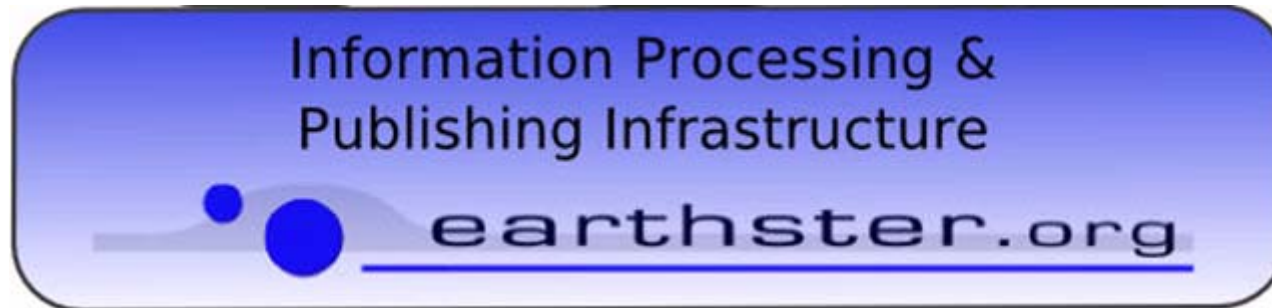
- You buy software, and use proprietary or non-proprietary databases:

Do-It-Yourself.



Calculating cradle-to-gate inventory

- New approach, taking advantage of information technology



Before diving into specificities...

Think LCA software meets Facebook

Open source, free



- Aim for manufacturers
 - Share life cycle information on their product
 - Improve their products through supplier selection
- Aim for purchasers
 - Access green/socially responsible markets
 - Drive transformation



Using Earthster, as a manufacturer

- First, calculate cradle-to-gate environmental (and social) profile
 - Access a simple and free LCA/LCAA software to generate confidential results for benchmarking and improvement



Earthster layout - Mozilla Firefox

File Edit View History delicious Bookmarks Tools Help

Google

Processes Processes

- electronics
 - module (3)
 - component (3)
- agricultural means of production
 - mineral fertilizer (3)
 - buildings (3)
 - pesticides (3)
 - dicamba, at regional storehouse
 - carbofuran, at regional storehouse
 - atrazine, at regional storehouse
 - ventilation
 - production of component: Values are based on the inventory in Green (1987) for the same compound.
 - wood energy
 - fuels (1)
 - wood chips, hardwood, from industry, u=40%, at plant

Ecosphere flows

- air
 - high population density (27)
 - low population density (2)
 - unspecified (34)
- resource
 - biotic (1)
 - in ground (12)
 - in water (4)
 - land (4)
- soil
 - unspecified (1)
- water
 - river (39)
 - Aluminum
 - Ammonium, ion
 - Antimony
 - Arsenic, ion
 - BOD5, Biological Oxygen Demand

Add process: wood chips, hardwood, from industry, u=40%, at plant

YOUR PURCHASES (PURCHASES) → YOUR PROCESS (UNIT PROCESS) → YOUR PRODUCT (TECHNOLOGY)

EMISSION (PROCESS EMISSION) → EXTRACTION (EXTRACTION) → EXPORT (EXPORT)

Administration Your product Purchases Extraction Emission

Data Set Information

Process Name: wood chips, hardwood, from industry, u=40%, at plant

Description: The volume refers to the bulked volume: dried matter content = 239 kg/m3 dried matter (u=0%), lower heating value = 4220 MJ/m3

Time

Reference Year: 1996

Valid Until: 2002

Save Reload



Using Earthster, as a manufacturer

- Same four questions, with a twist

- What do you produce
- What do you buy, and FROM WHOM
- What do you emit
- What do you extract



The greener
your supplier,
the greener
your own
profile

- One extra set of question

- How do you fare on attributes xyz



Using Earthster, as a manufacturer

- Next step, if better than average (optional)
 - Click-to-report cradle-to-gate LCI on the web.

NOTE:

Not reporting purchasing or emission data





Category: 71: Creamery butter

How does Organic Valley make "Salted Butter"

Organic Valley's Organic Salted Butter is made by churning pasteurized organic sweet cream to create a perfect butter consistency and lightly salting it during the process.

Why is it salted?

Salt enhances flavor, helping to bring out the subtle flavors of our butter. Salt also extends the butter's freshness.

Does Organic Valley Butter add nutritional value to the diet?

Organic milk from our grass-fed cows increases the nutritional value of Organic Valley Butter and lends it a rich flavor. Our butter provides Vitamin A and calcium. It also contains higher levels of conjugated linoleic acid (CLA), one of nature's beneficial fatty acids. Studies show that CLA can improve the way the body uses and stores energy by regulating the accumulation of body fat and improving muscle tone. CLA has also been shown to prevent thickening of the arteries and to help regulate the immune system. Many doctors and nutritionists believe that Margarine contains trans-fatty acids implicated in heart disease.

LCA Data

Cradle to Gate: Air Emissions (kg)

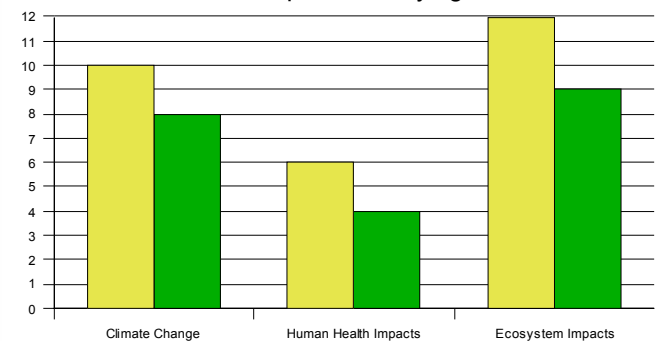
Name	Amount
Carbon dioxide	132.298 kg
Carbon monoxide	2.268 kg
Ammonia	0.987 kg
Methane	2.122 kg
Particulates, < 10 um	0.904 kg
VOC, volatile organic compounds	0.268 kg
Nitrogen dioxide	0.380 kg
Sulfur dioxide	0.285 kg

Cradle to Gate: Water Pollution (kg)

Name	Amount
Phosphorus	0.119 kg
Nitrate compounds	0.011 kg
Ammonia	0.001 kg

Editor: Use EarthAssistant to edit LCA data for this product.

Environmental impacts of buying brand A or B



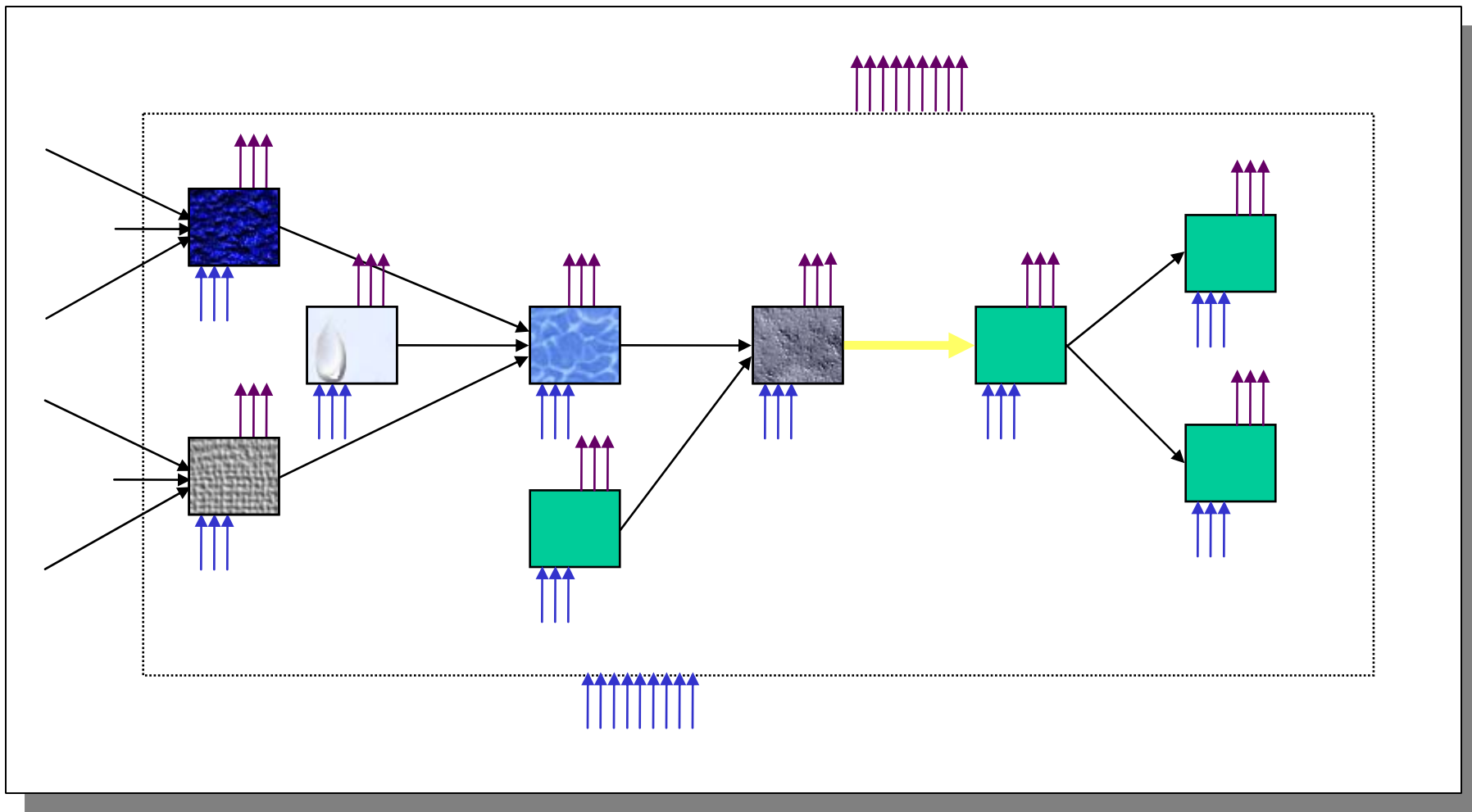
Using Earthster, as a manufacturer

- Next step, make results accessible to clients (or potential clients)
 - Have your data validated by a third party
 - Clients can then use results to green their own profile

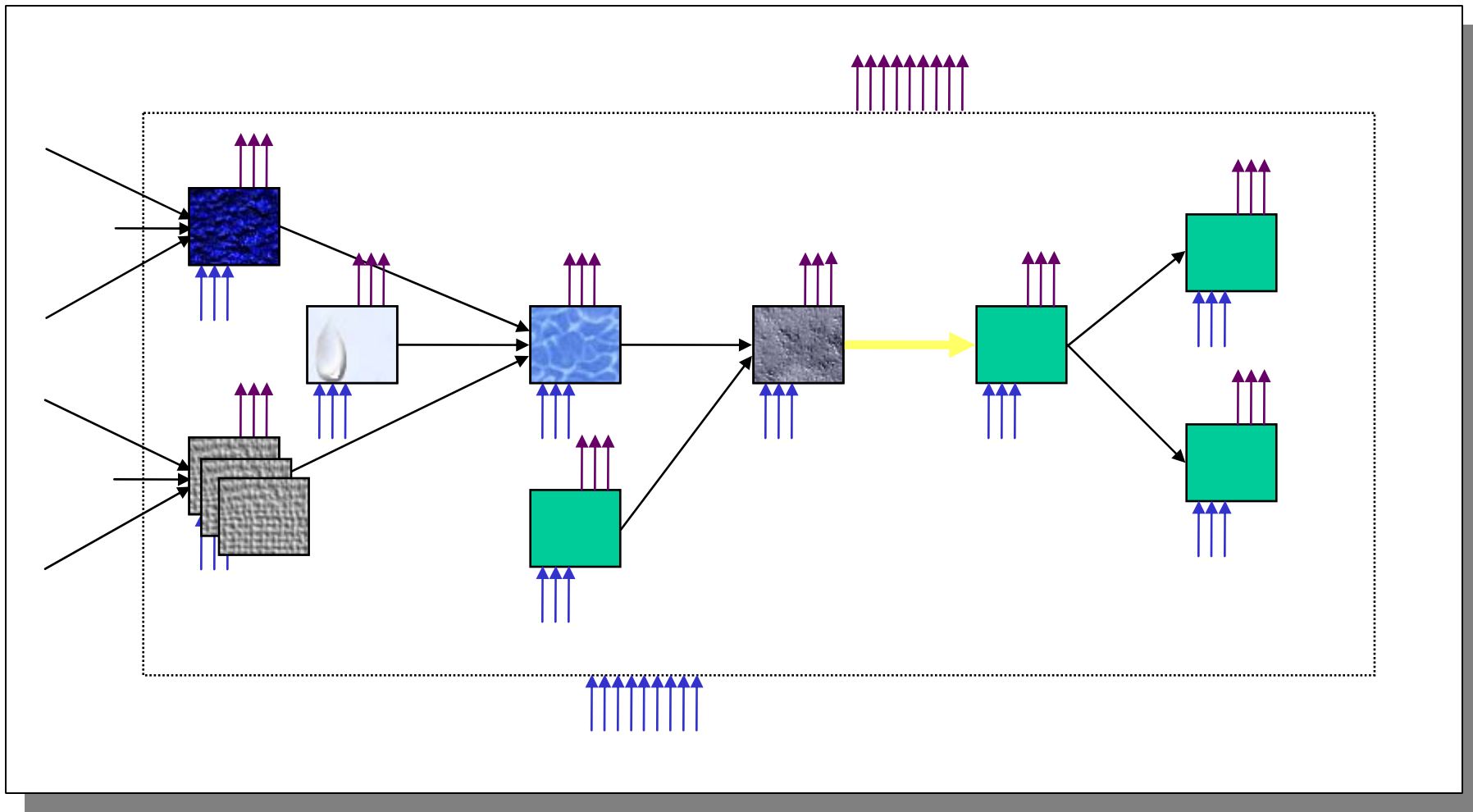
Creation of a market for green (or responsible) products



Company/product-specific data evolution



Growth of average data in non-proprietary databases



What if profile is not better than average?

- Find out why, using Earthster or, more in-depth, OpenLCA

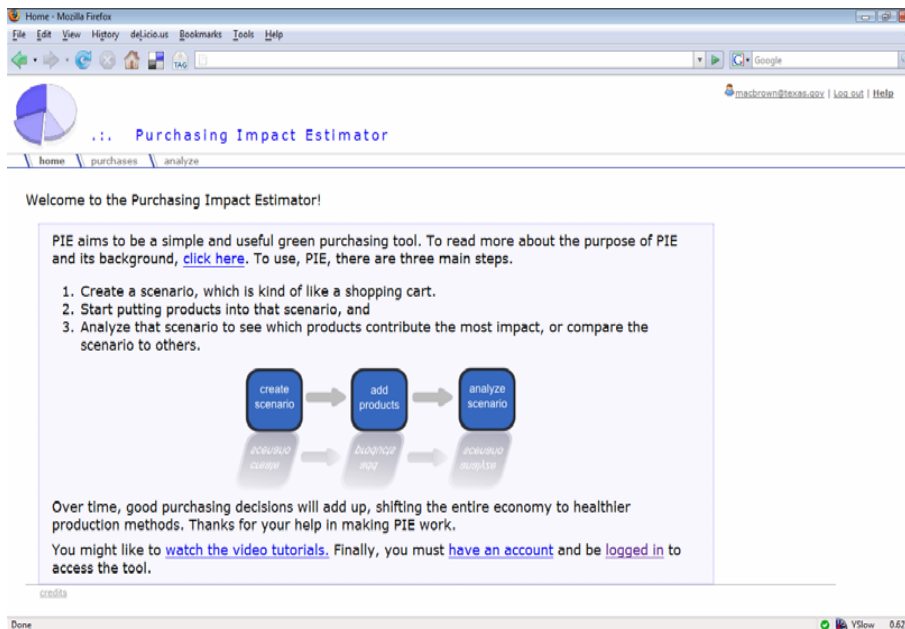


- Analysis can lead to appropriate action
 - Investment in eco-efficiency
 - Product re-design
 - Material selection
 - Supplier selection
 - ...
- One can then publish improvements
 - Life cycle *progress* assessments



Using Earthster as a purchaser


- Find greener/more socially responsible suppliers



Welcome to the Purchasing Impact Estimator!

PIE aims to be a simple and useful green purchasing tool. To read more about the purpose of PIE and its background, [click here](#). To use, PIE, there are three main steps.

1. Create a scenario, which is kind of like a shopping cart.
2. Start putting products into that scenario, and
3. Analyze that scenario to see which products contribute the most impact, or compare the scenario to others.

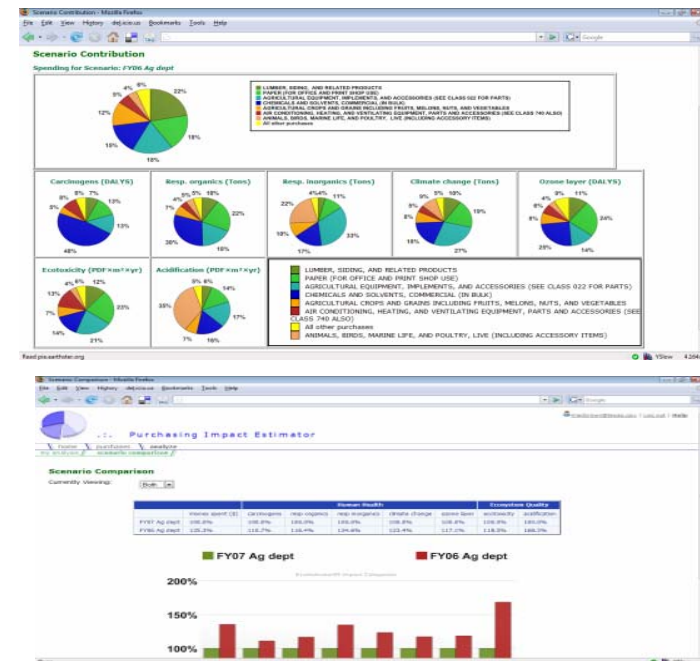


```

graph LR
    A[create scenario] --> B[add products]
    B --> C[analyze scenario]
    
```

Over time, good purchasing decisions will add up, shifting the entire economy to healthier production methods. Thanks for your help in making PIE work.

You might like to [watch the video tutorials](#). Finally, you must [have an account](#) and be [logged in](#) to access the tool.



- Consortium of co-sponsors:
 - Sponsor refinement / scale-up of prototype
 - Pilot-test in-house
 - Input to design, and validation protocol
 - Advanced implementation
 - Perpetual credit as co-funders that launched it



- Status
 - Proof-of-concept version tested

Project > Edit Product > Calculate LCA

[1. Edit Product](#) | [2. Calculate LCA](#) | [3. Publish](#)

Cradle to Gate: Air Emissions (kg)

Name/Purchases	1	2	3	4	5	Totals	% of Total	Cumulative %
Carbon dioxide	2.35e+4	3.33e+4	2.15e+3	5.11e+3	6.07e+3	70142.075 kg	93.5%	93.5%
Carbon monoxide	611	700	26.4	33.2	213	1583.034 kg	2.1%	95.6%
Ammonia	540	516	0.00	0.00	0.00	1056.050 kg	1.4%	97.0%
Methane	477	494	131	143	35.4	1280.887 kg	1.7%	98.7%
Particulates, < 10 um	396	387	0.00	0.00	0.00	783.700 kg	1.0%	99.7%
VOC, volatile organic compounds	0.00	0.00	47.1	0.00	36.6	83.750 kg	0.1%	99.9%
Nitrogen dioxide	0.00	0.00	26.1	26.3	38.3	90.686 kg	0.1%	100.0%
Sulfur dioxide	0.00	0.00	0.00	19.8	0.00	19.758 kg	0.0%	100.0%

Cradle to Gate: Water Pollution (kg)

Name/Purchases	1	2	3	4	5	Totals	% of Total	Cumulative %
Phosphorus	27.3	0.00	0.0275	0.0410	0.0362	27.405 kg	90.8%	90.8%
Nitrate compounds	1.79	0.00	0.157	0.527	0.130	2.598 kg	8.6%	99.4%
Ammonia	0.113	0.00	0.00282	0.0145	0.00333	0.134 kg	0.4%	99.9%
Manganese compounds	0.0156	0.00	0.00205	0.00228	0.00214	0.022 kg	0.1%	100.0%
Methanol	0.00944	0.00	0.00	0.00	0.00119	0.011 kg	0.0%	100.0%
Sodium nitrite	0.00	0.00	0.00126	0.00	0.00	0.001 kg	0.0%	100.0%
t-Butyl methyl ether	0.00	0.00	0.00	0.00264	0.00	0.003 kg	0.0%	100.0%

Purchases Key

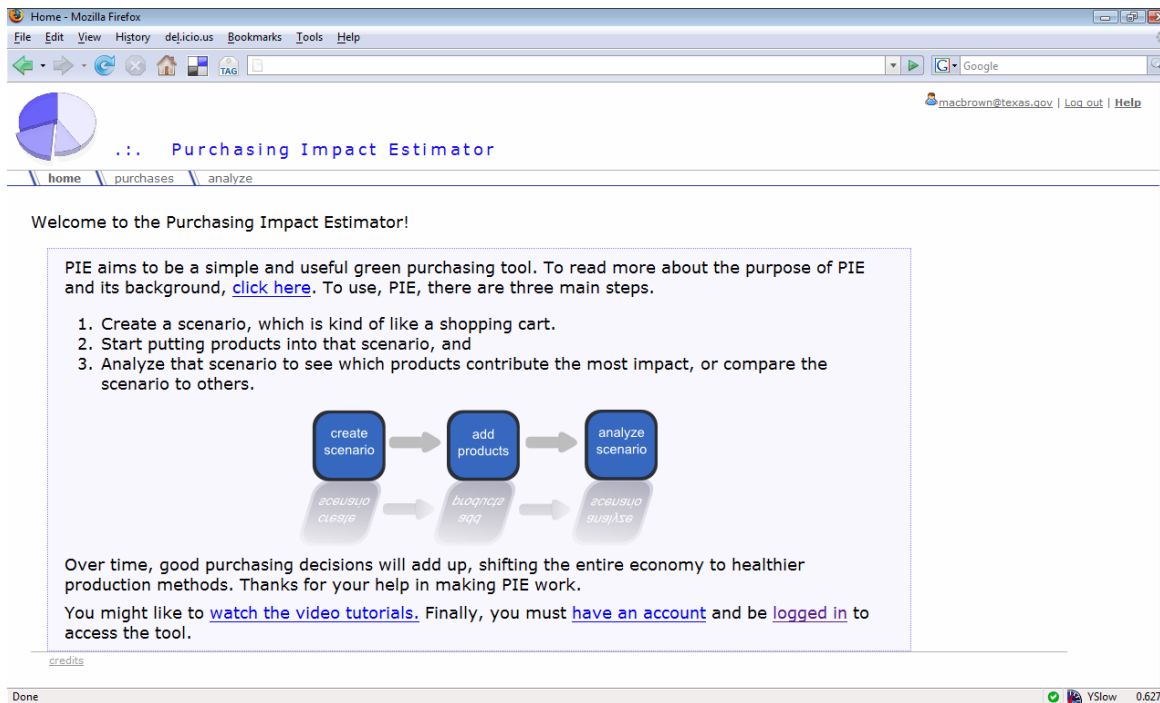
#	Name	Classification
1	Fat	220: Dairy farm products
2	Milk	115: Fluid milk
3	Natural gas	272: Natural gas distribution
4	Fuel oil	317: Petroleum refining
5	Distribution	434: Trucking and courier services, except air

2007



- Status

- Proof-of-concept version tested
- New version for purchasers finished

A screenshot of a Mozilla Firefox browser window displaying the Purchasing Impact Estimator (PIE) website. The browser's address bar shows "deJicio.us". The website header includes a pie chart icon and the text "... Purchasing Impact Estimator". Below the header, there are navigation links for "home", "purchases", and "analyze". The main content area begins with a welcome message: "Welcome to the Purchasing Impact Estimator!". This is followed by a text box explaining the tool's purpose and providing three main steps: 1. Create a scenario, 2. Start putting products into that scenario, and 3. Analyze that scenario. A flowchart below the steps shows three blue boxes labeled "create scenario", "add products", and "analyze scenario" connected by arrows. Below each box is a faint, mirrored image of the box. The text box concludes with a note about the tool's long-term impact and a link to video tutorials. The browser's status bar at the bottom shows "Done" and a loading time of "0.627s".

1st user:



- **Status**

- Proof-of-concept version tested
- New version for purchasers finished
- New version for manufacturers advancing quickly



- **Status**

- Proof-of-concept version tested
- New version for purchasers finished
- New version for manufacturers advancing quickly
- Will be beginning new round of pilot tests early fall
 - Gather CO2 data within supply chain
 - Track progress
 - Integrate with spend management systems



Thank you for your attention

