Open Life Cycle Tools for Measuring and Communicating Sustainability Information

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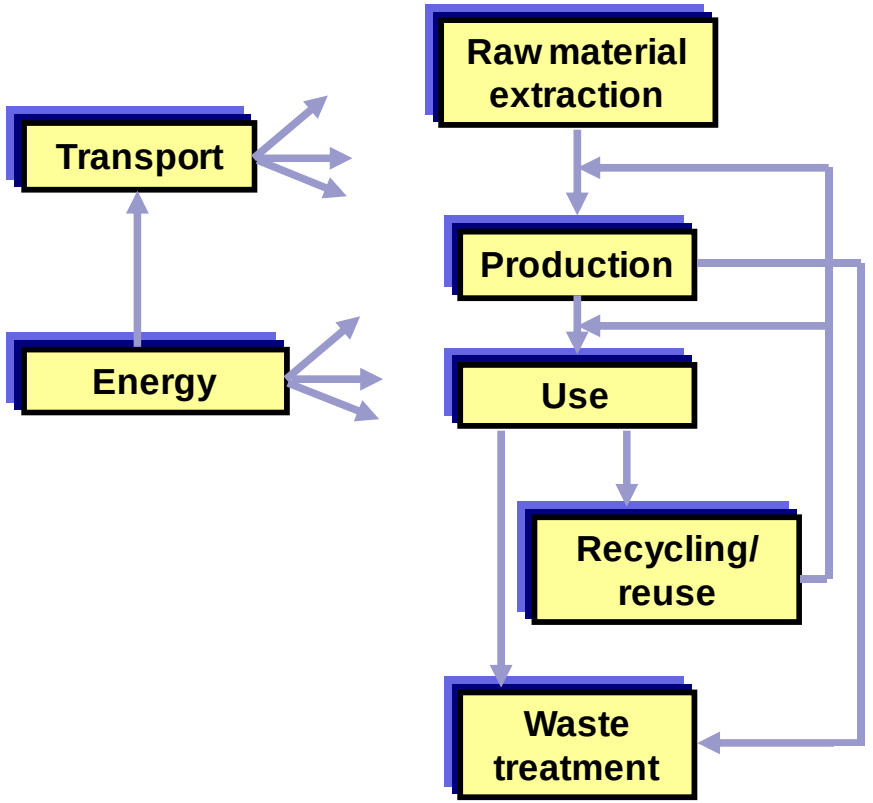
Three main points

- 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

ISO International Organization for Standardization

14040: Principles and Framework

14044: Requirements and Guidelines

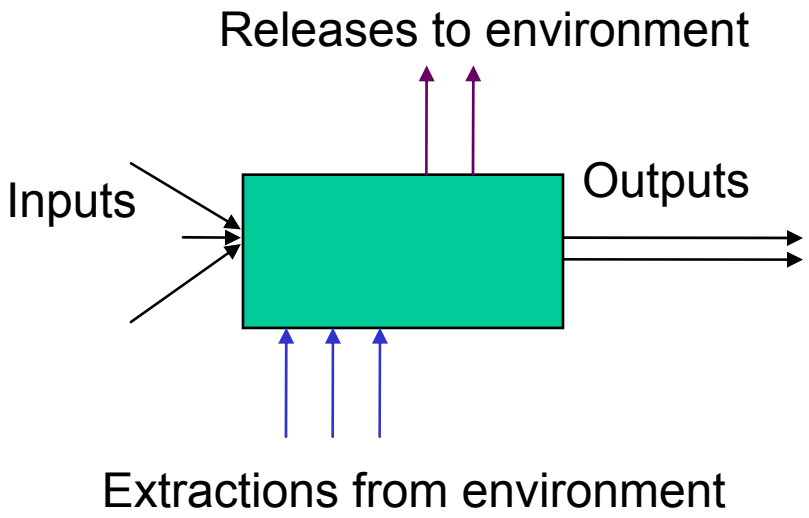
Back-of-envelope example

- 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

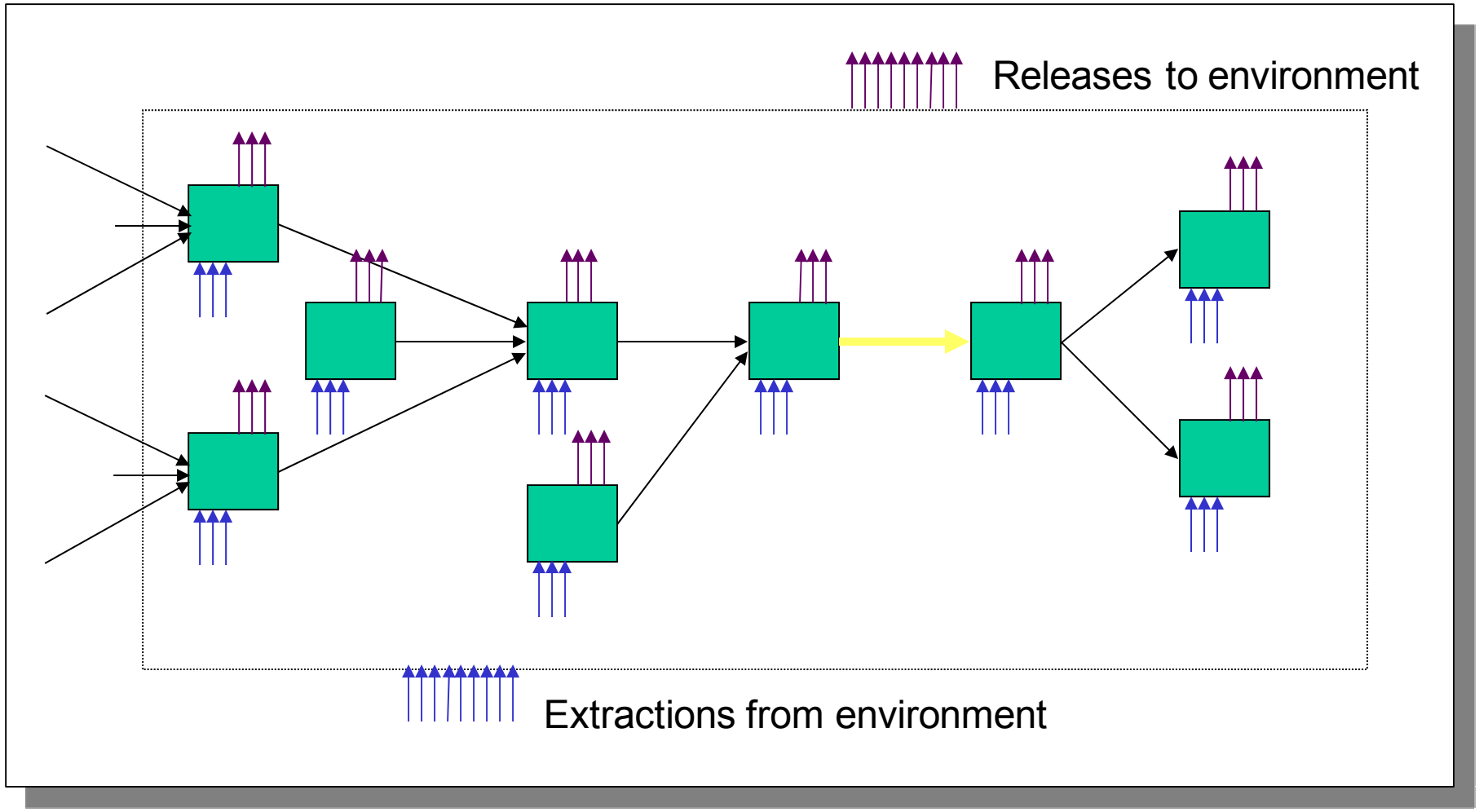
Name	Sub-compartment	Amount	Unit
Heat, waste	high. pop.	16	MJ
Carbon dioxide, biogenic	high. pop.	0.458	kg
Carbon dioxide, fossil	high. pop.	0.0489	kg
Nitrogen oxides	high. pop.	0.00055	kg

2 inputs from nature

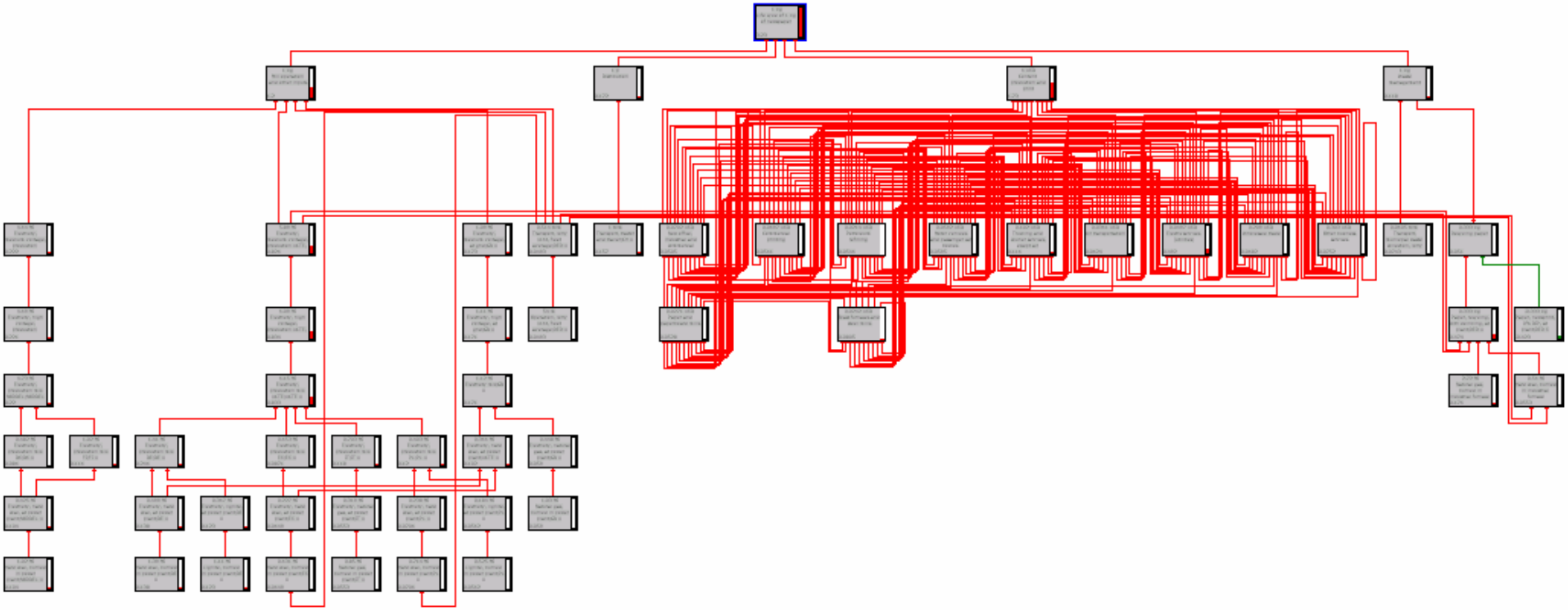
Known inputs from nature (resources)

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!

Life Cycle Inventory Analysis

Substance	Comp	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	Unit	Total
Cadmium	Air	kg	4.32E-8
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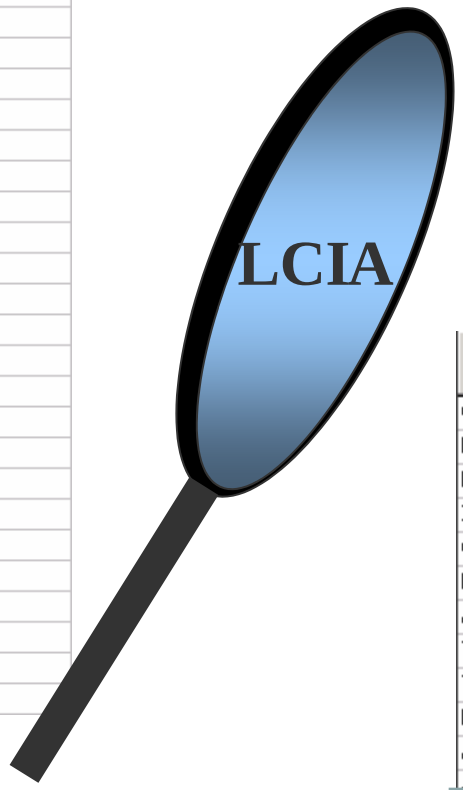
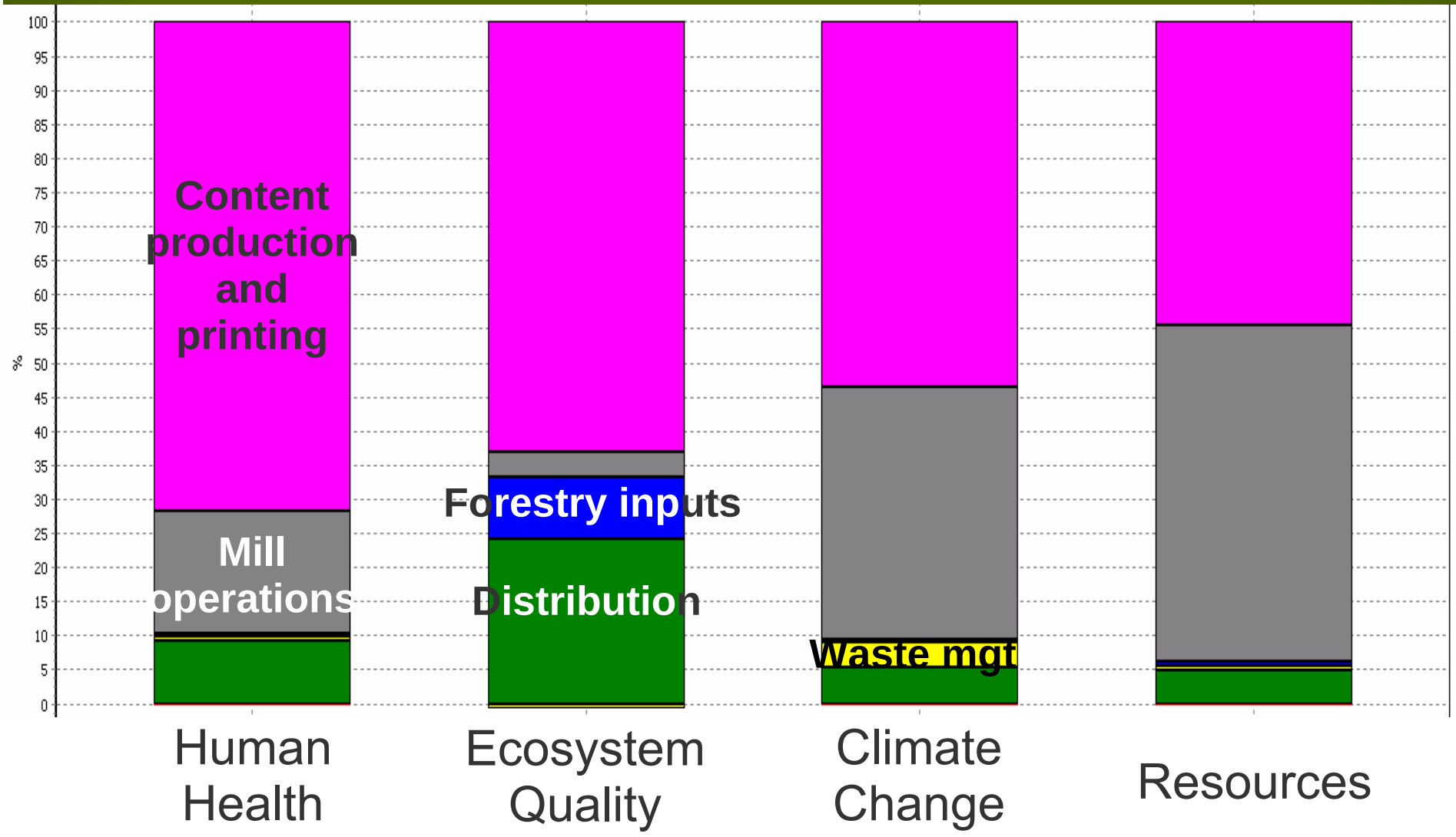
LC Inventory



LC Impact Assessment Results

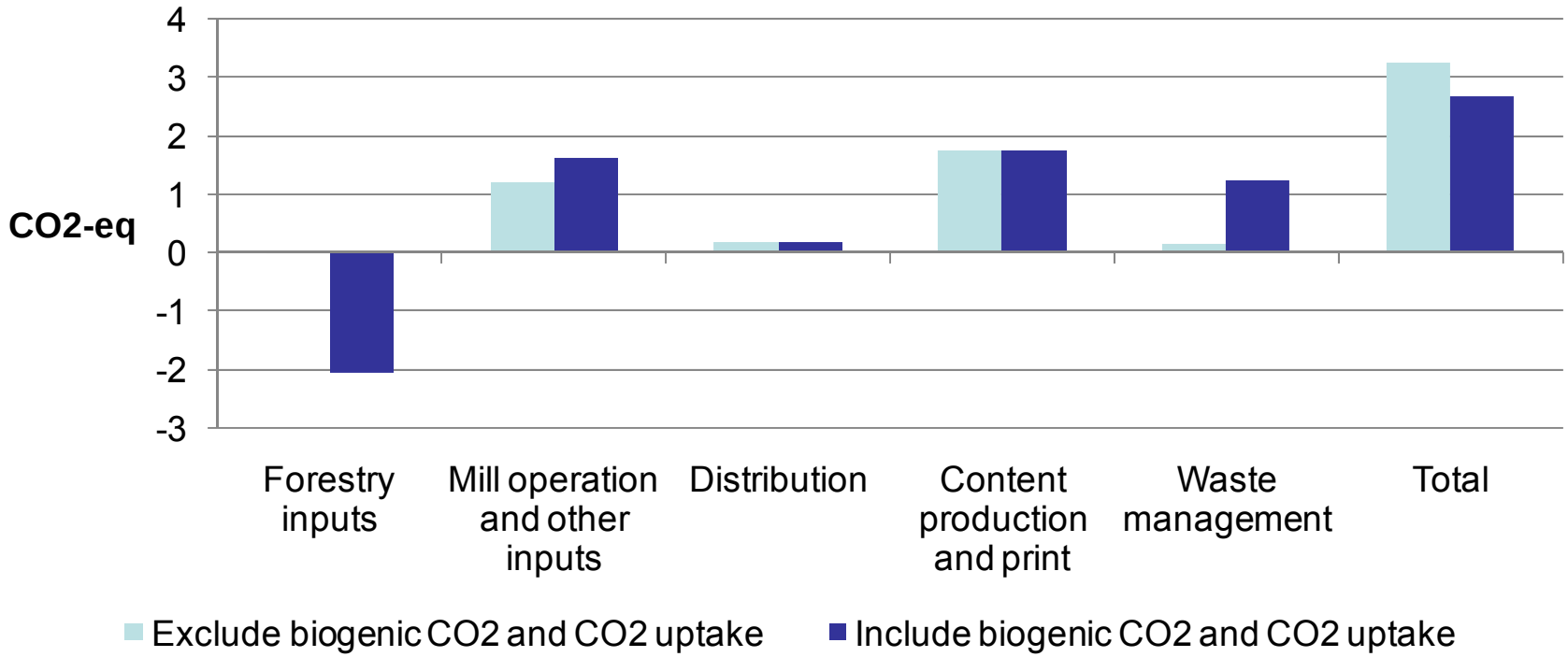
Impact category	Unit	Total
Carcinogens	kg C2H3Cl eq	0.109
Non-carcinogens	kg C2H3Cl eq	0.983
Respiratory inorganics	kg PM2.5 eq	0.00368
Ionizing radiation	Bq C-14 eq	82
Ozone layer depletion	kg CFC-11 eq	3.15E-6
Respiratory organics	kg C2H4 eq	0.00332
Aquatic ecotoxicity	kg TEG water	877
Terrestrial 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
Global warming	kg CO2 eq	3.23
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

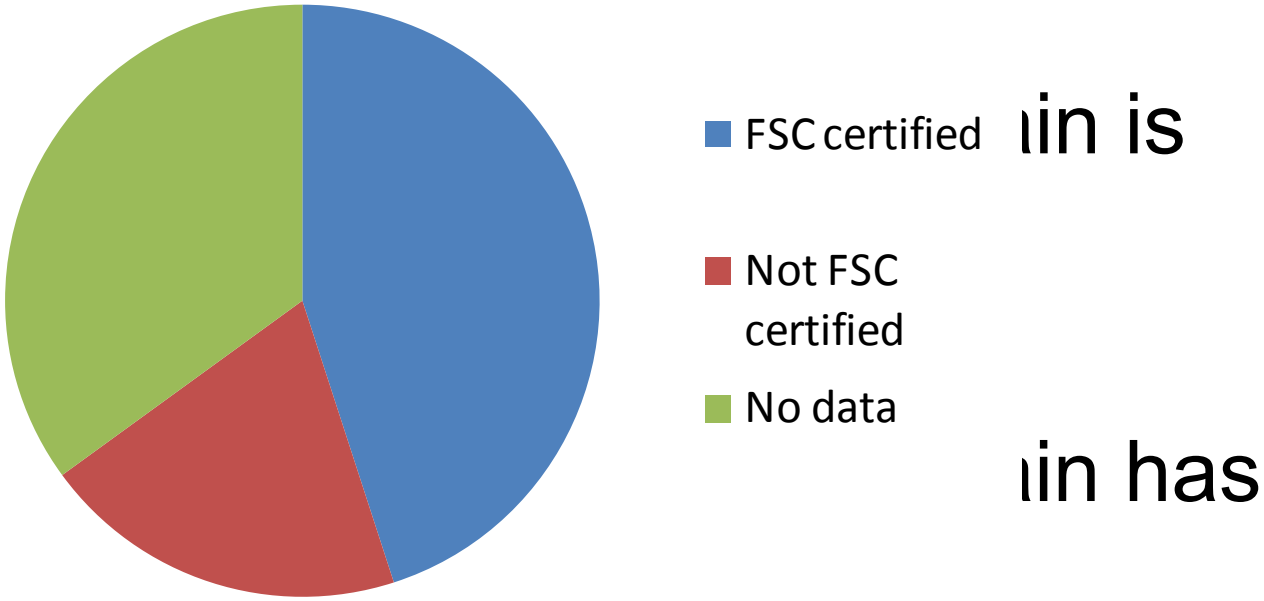
- LCA has some difficulty evaluating the environmental benefits of sustainable forestry

- Solution:

  Life cycle *attribute* assessment

Life Cycle Attribute Assessment

- What percentage of my forestry-related supply chain is FSC certified?
- What swea ıin is
- What *xyz a* ıin has



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

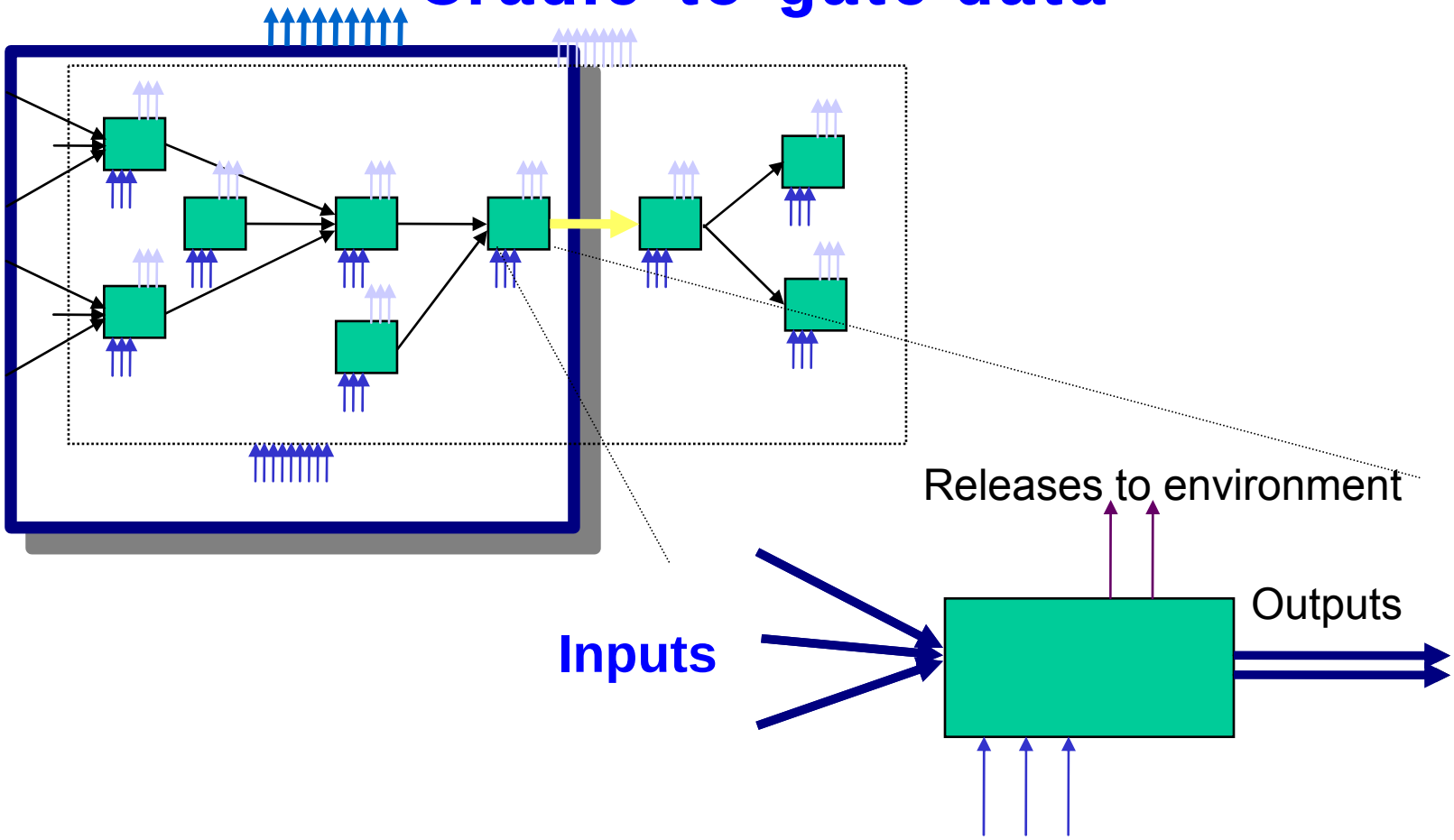
1. Data on your process(es)
   - (Emissions per unit output; inputs per unit output)

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

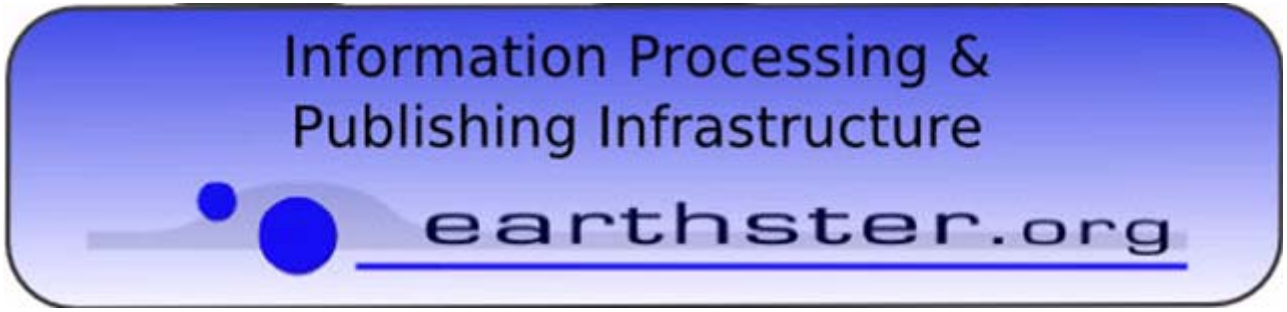
Traditional solution 2:

- 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

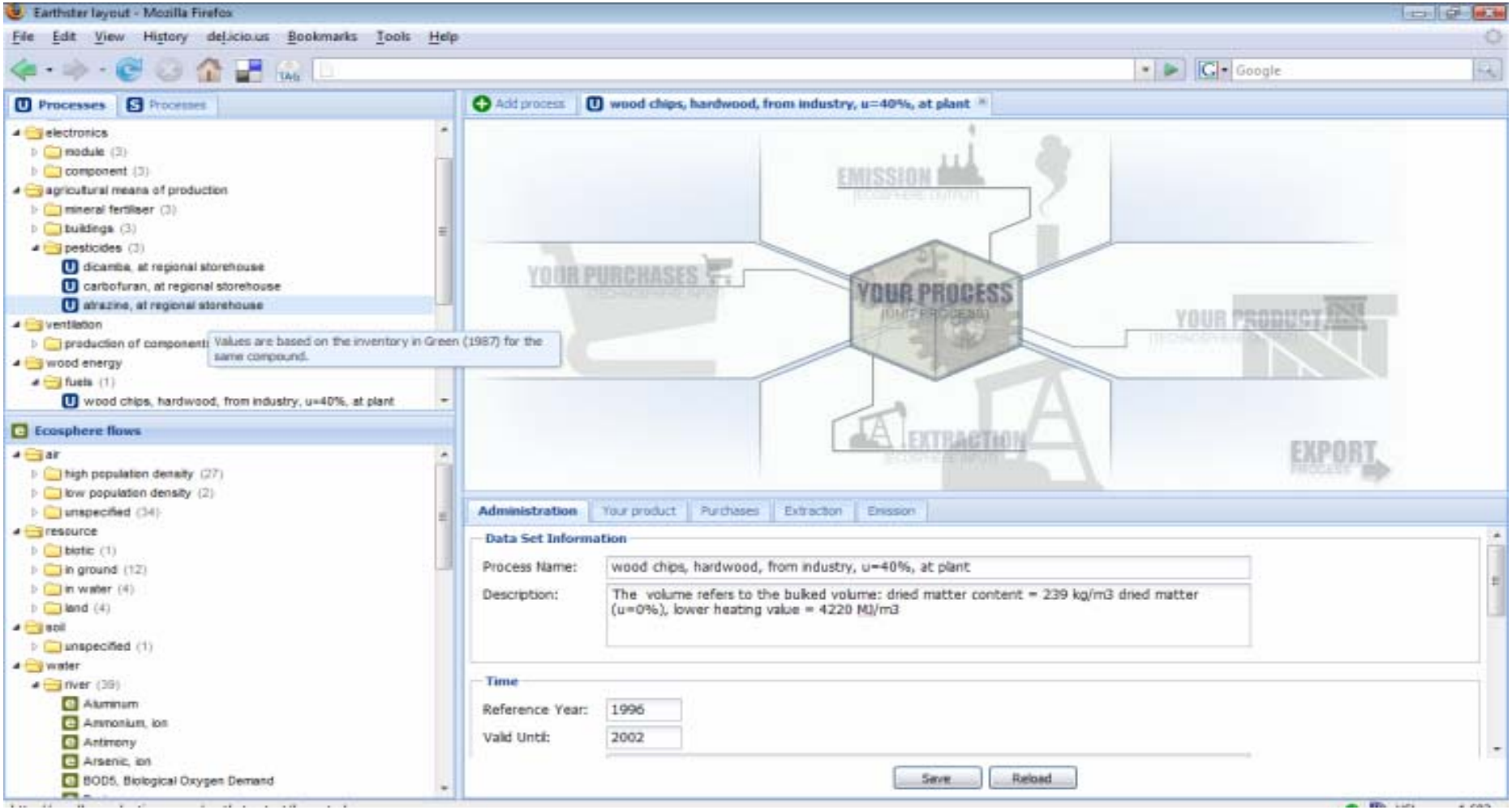
- Aim for manufacturers
  - Share life cycle information on their product
  - Improve their products through supplier selection

- 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.org



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 nutritionis
Margarine contains trans-fatty acids implicated in heart disease.

LCA Data

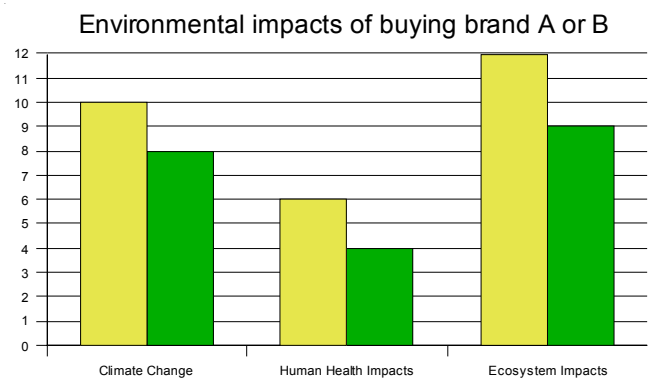
Cradle to Gate: Air Emissions (kg)

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.

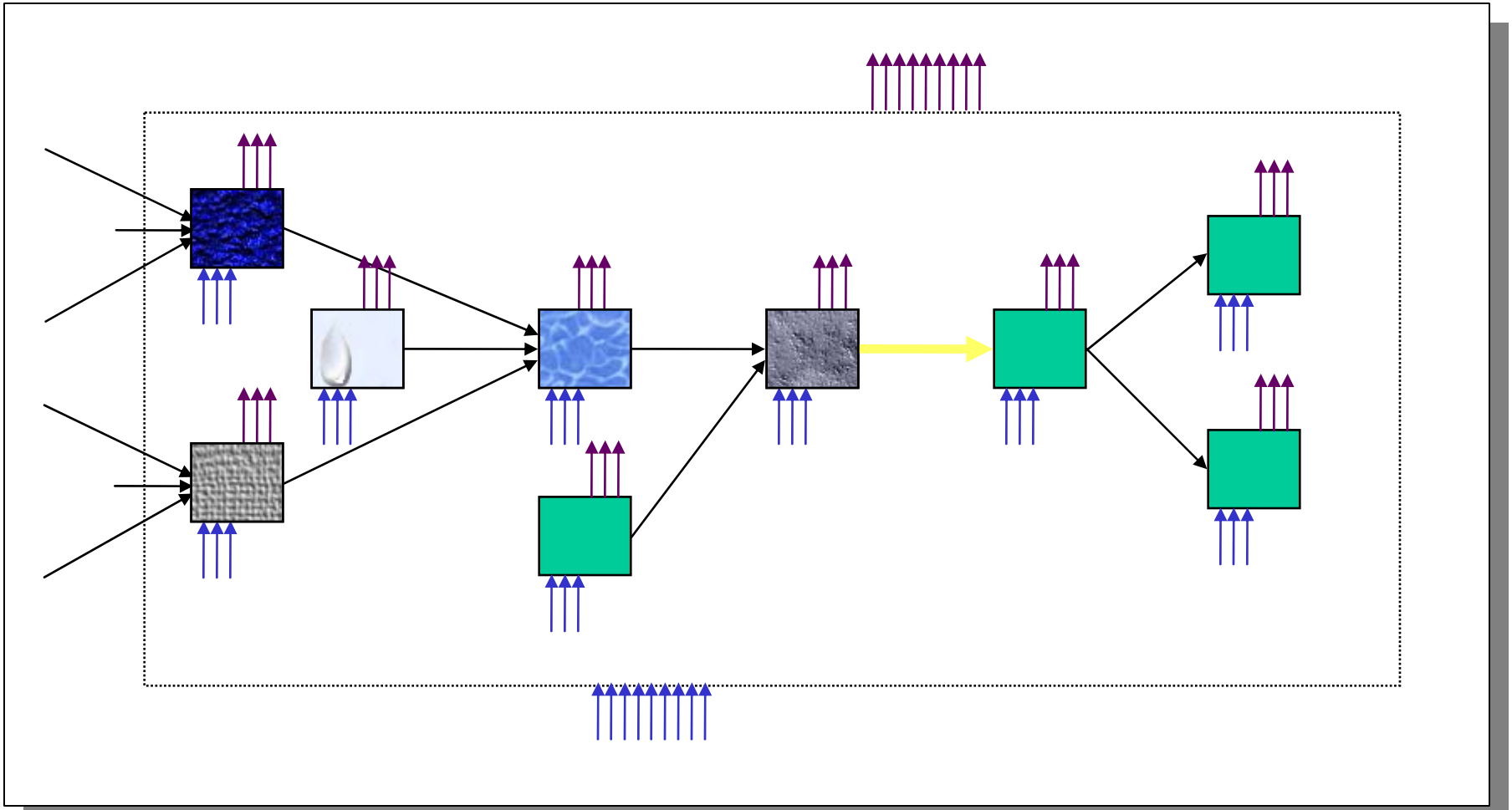


Using Earthster, as a manufacturer

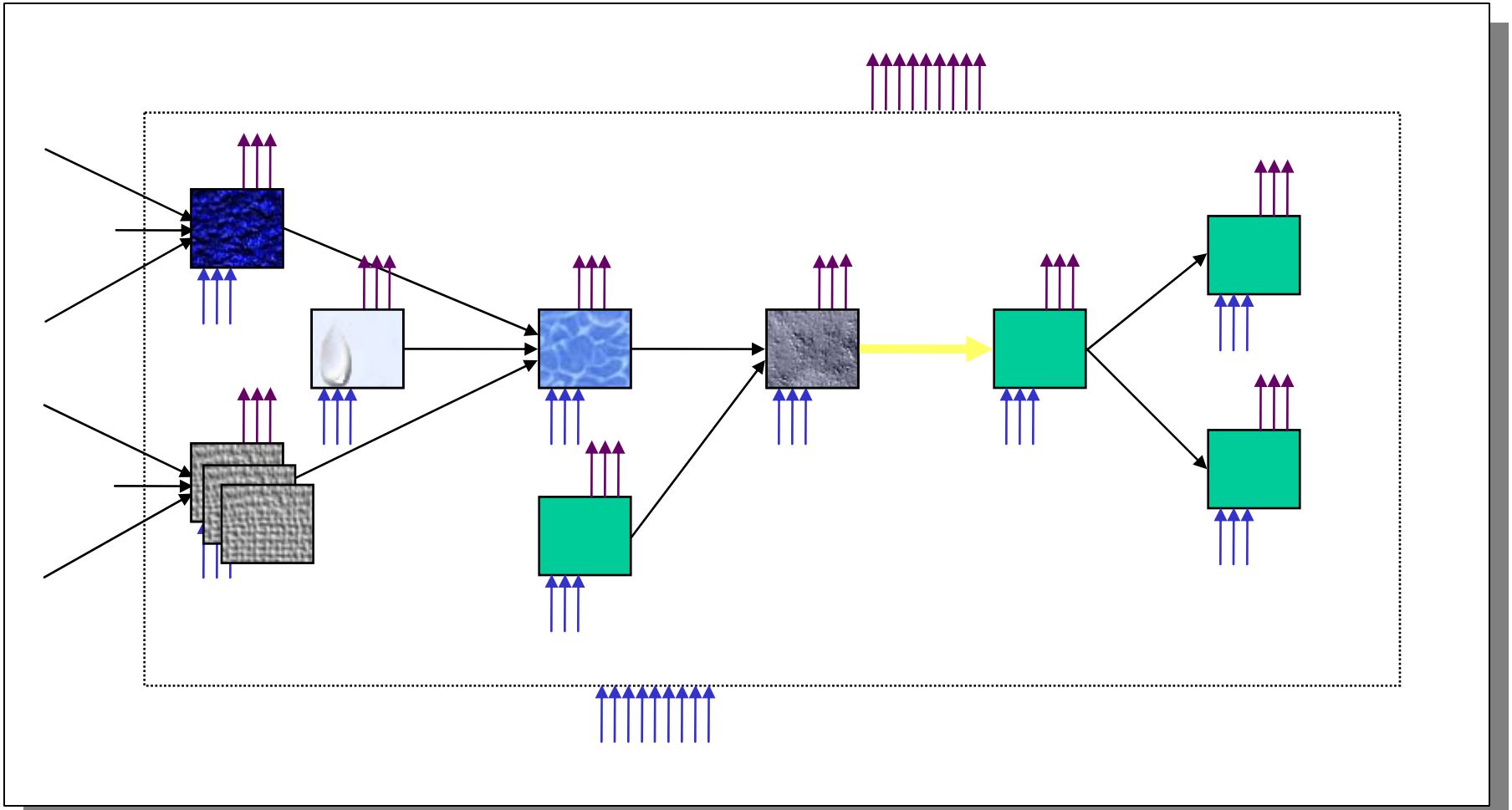
- Next step, make results accessible to clients (or potential clients)
  - Have your data validated by a third party
  - Clients can then use results to green their own profile

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?

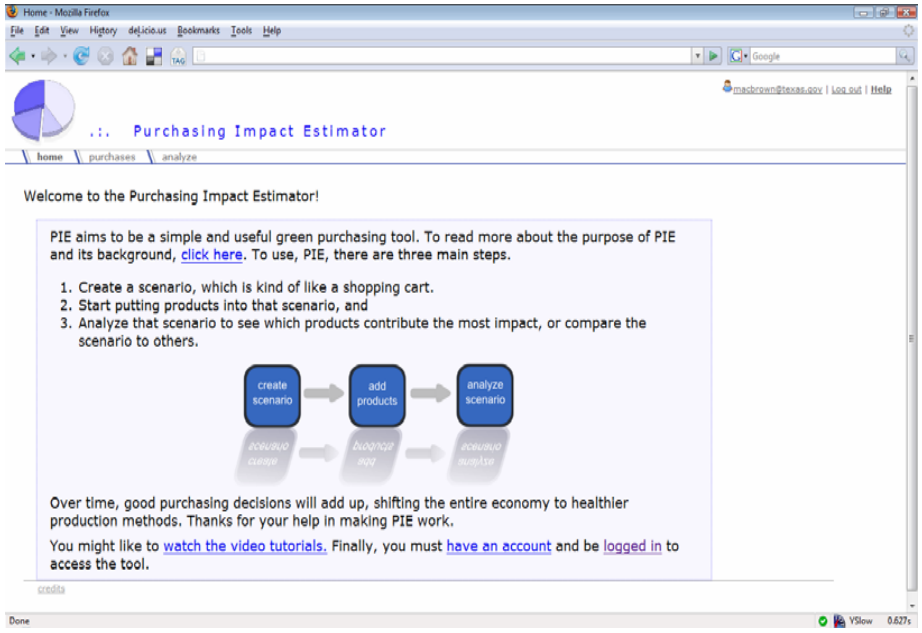
– Find out why, using Earthster or, more in-depth, OpenLCA

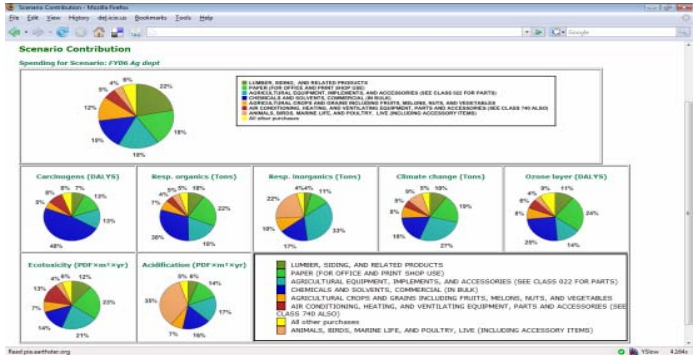
earthster.org

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

Using Earthster as a purchaser

– Find greener/more socially responsible suppliers





- 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)

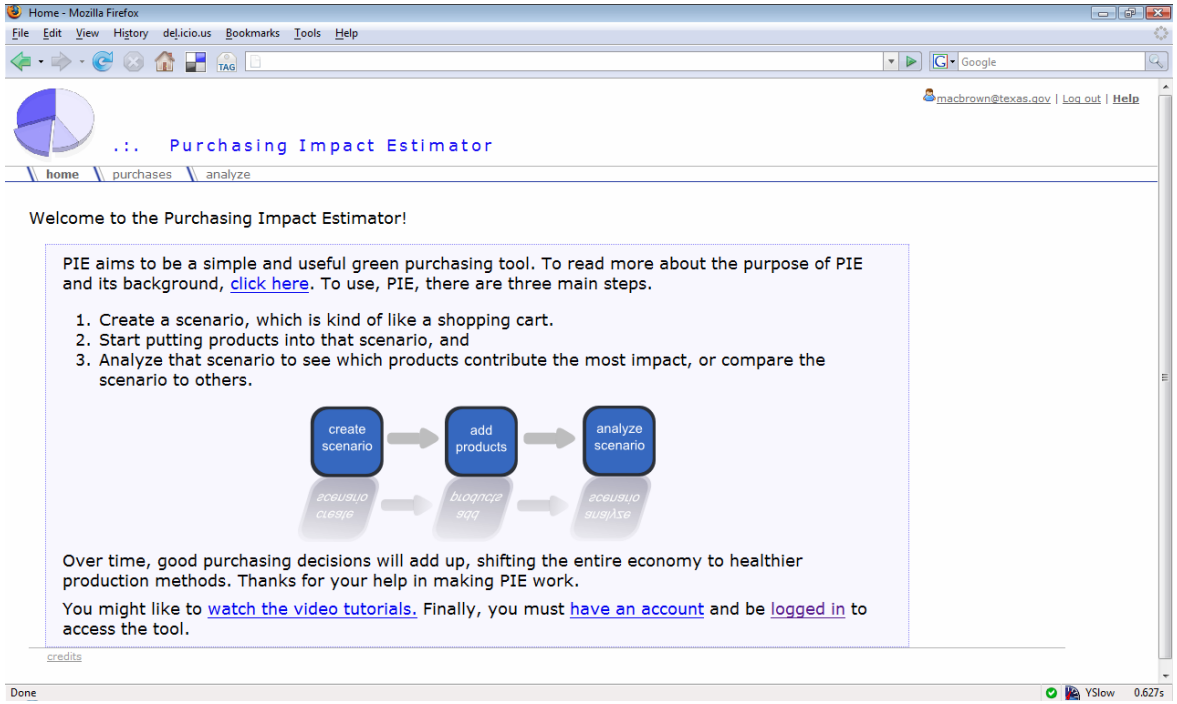
Name/Purchases	1	2	3	4	5	Totals	% of Total	Cumulative %
Phosphorus	27.3	0.00	0.0275	0.0410	0.0362	27.405 kg	90.8%	90.8%
Nitrate compounds	1.79	0.00	0.157	0.527	0.130	2.598 kg	8.6%	99.4%
Ammonia	0.113	0.00	0.00282	0.0145	0.00333	0.134 kg	0.4%	99.9%
Manganese compounds	0.0156	0.00	0.00205	0.00228	0.00214	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



1st user:

TCEQ

- 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