

GreenDelta

sustainability consulting + software



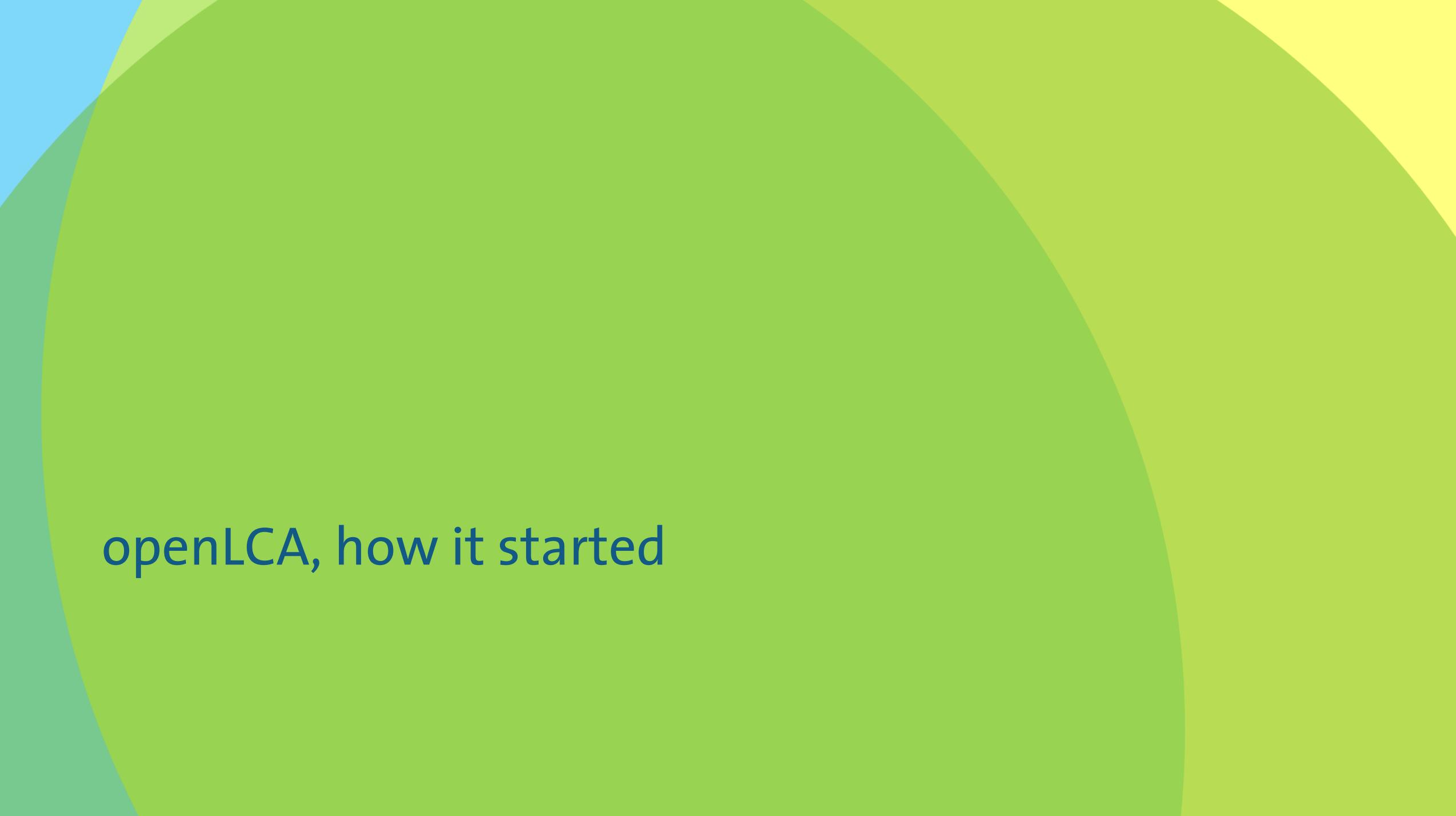
openLCA past, present, future

1st openLCA conference, April 15 2024

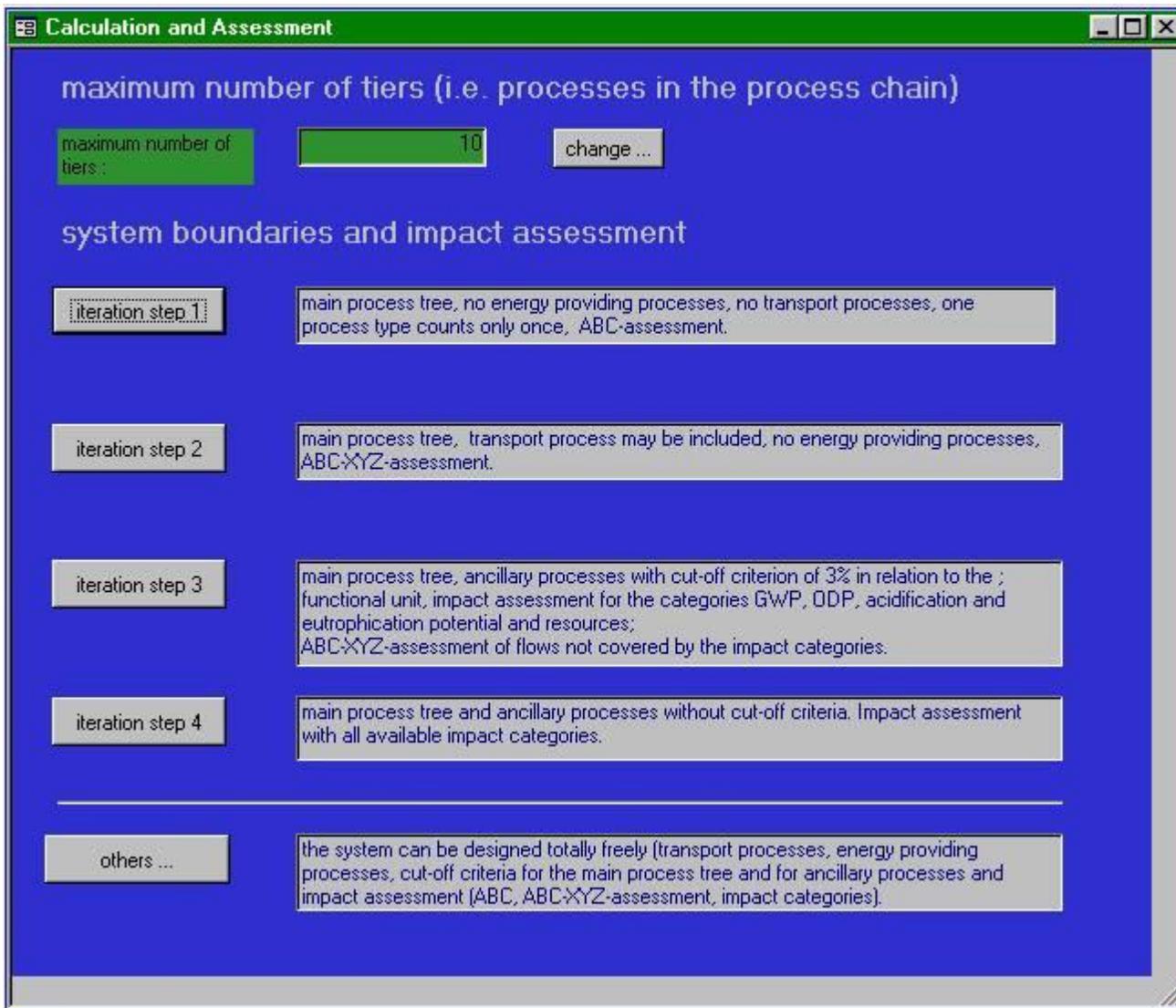
Dr. Andreas Ciroth
GreenDelta GmbH

Topics

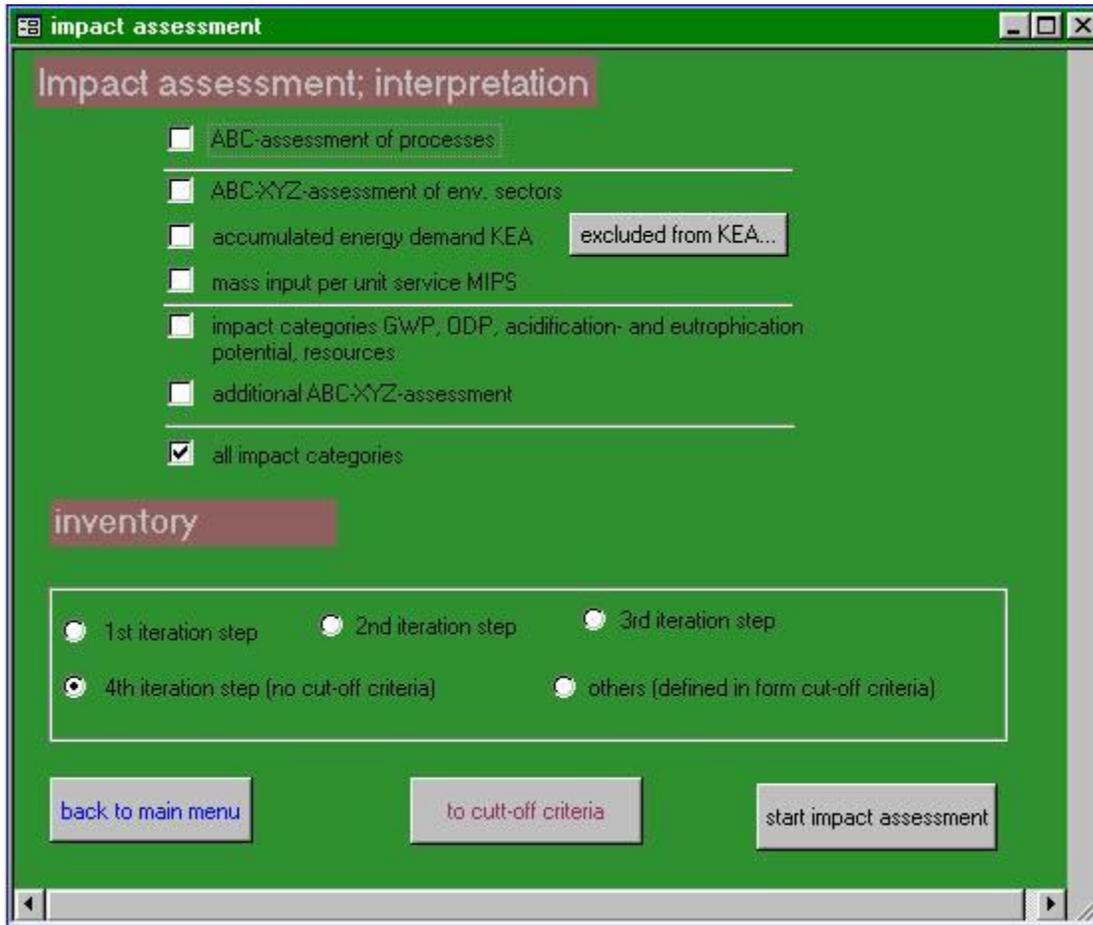
- **openLCA, how it started**
- **Developments over time**
- **Where we are now**
- **And what's upcoming**



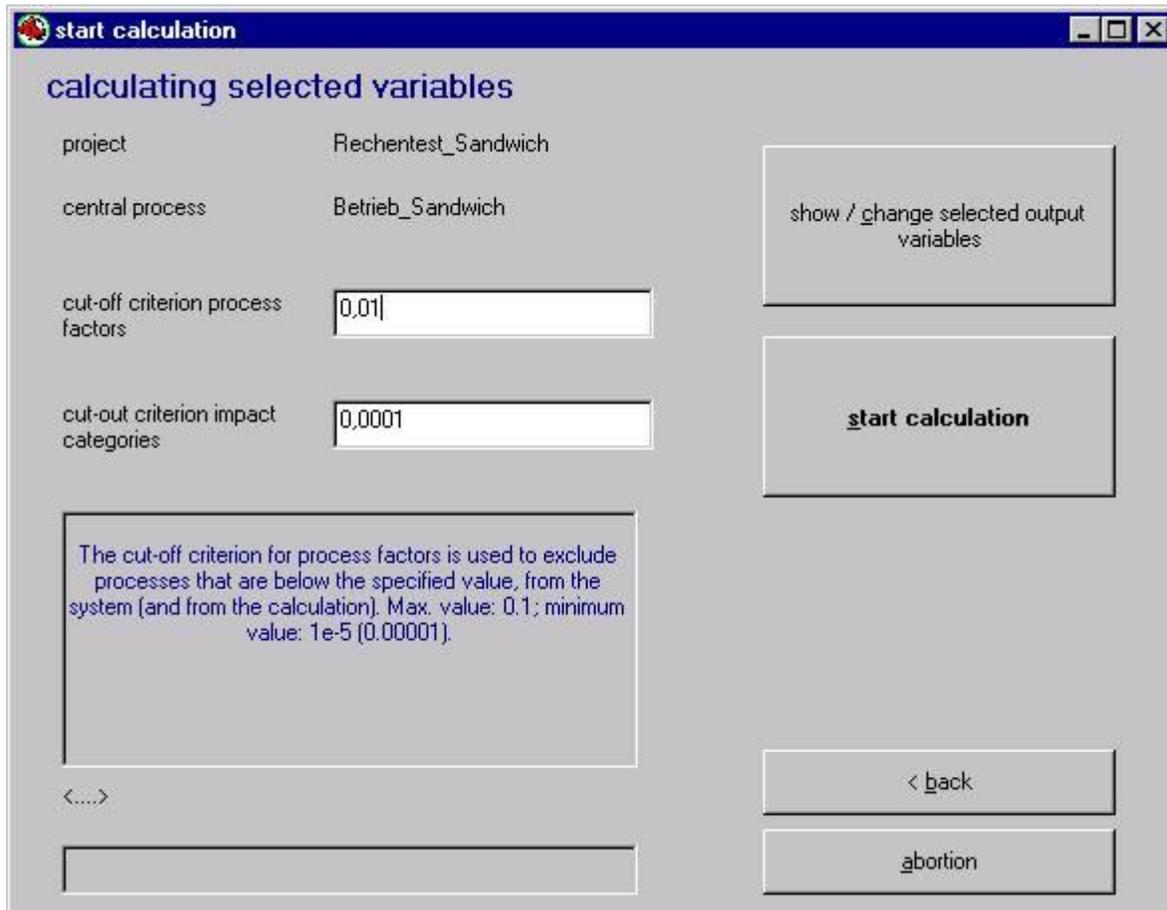
openLCA, how it started



Software, iterative LCA,
master thesis Andreas Ciroth,
TU Berlin, 1998



Software, iterative LCA,
master thesis Andreas Ciroth,
TU Berlin, 1998



“trainEE” Software,
economic & environmental
life cycle calculation of trains over time,
Andreas Citroth, 2000

GreenDelta

Founded by Dr. Andreas Citroth in 2004

Initially GreenDeltaTC, tools and consulting

GreenDelta

Michael Srocka joined as first employee, 2004



Towards openLCA

- **We need a software for LCA**
 - **Why not make an own one**
 - **The market is already full (SimaPro, GaBi, etc.)**
 - **LCA software is expensive – this limits the application of LCA**
 - **Selling LCA software licenses is demanding**
- **Why not make an open source LCA software**

Towards openLCA

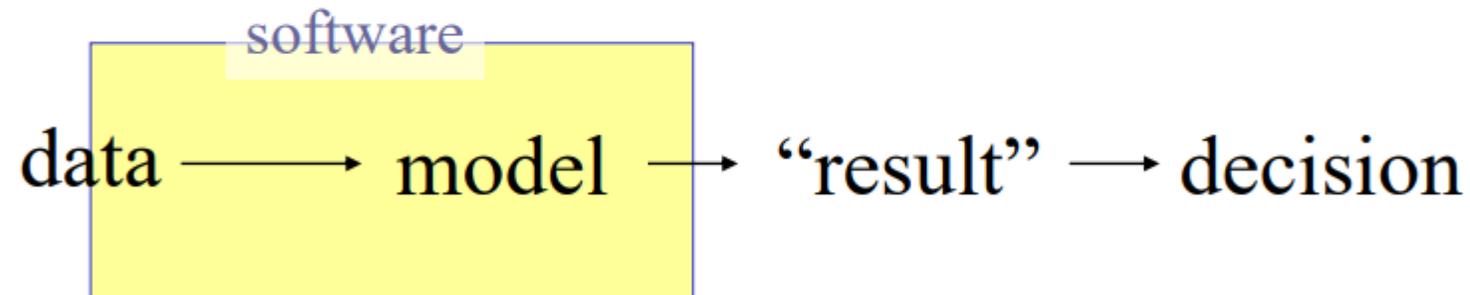
- **Presentation at the ecobalance conference in Tsukuba**



Towards openLCA

- **Presentation at the ecobalance conference in Tsukuba**

The role of software in sust. assessment



Towards openLCA

- **Presentation at the ecobalance conference in Tsukuba**

Conclusions

- Aim of Open Source Project (2006-2008):
Develop high-performance, modular
framework for sustainability assessment
& life cycle modelling
- Using Open Source, standard components
for language, components, database
- Two modules, uncertainty assessment and
format converter, will be implemented in
project course

Towards openLCA

- **Presentation at the ecobalance conference in Tsukuba**
 - **PRé, ecoinvent, UNEP, and later also PE international (GaBi) volunteered to support the project**

openLCA alpha version, 2008

openLCA Framework

File Edit Window Help

Navigation

Categories

- Metals and semimetals
- Organic chemicals
- Other materials
- Other mineralic materi.
- Paper and cardboards
- Plastics
- Raw materials
- Water
- Wood
- Other Services
- Systems

Objects

Aluminium sheet

Inputs and outputs

Exchange

Input

Flow

Flow property

Unit

Amount

Description

Exchanges

Inputs				Outputs			
Flow / Flow components	Flow property	Unit	Amc	Flow / Flow components	Flow property	Unit	Amc
<input type="checkbox"/> Air	Mass	kg	5.28	<input type="checkbox"/> Acenaphthene	Mass	kg	1.78
<input type="checkbox"/> Air	Mass	kg	5.28	<input type="checkbox"/> Acenaphthene	Mass	kg	6.14
<input type="checkbox"/> <input type="checkbox"/> Remove exchange		kg	16.8	<input type="checkbox"/> Acenaphthylene	Mass	kg	6.80
<input type="checkbox"/> Basalt	Mass	kg	0.01	<input type="checkbox"/> Acenaphthylene	Mass	kg	2.48
<input type="checkbox"/> Bauxite	Mass	kg	0.94	<input type="checkbox"/> Acetaldehyde	Mass	kg	1.23
<input type="checkbox"/> Bentonite	Mass	kg	0.00	<input type="checkbox"/> Acetic acid	Mass	kg	9.76
<input type="checkbox"/> Blast furnace dust	Mass	kg	1.25	<input type="checkbox"/> Acetic acid	Mass	kg	4.31
<input type="checkbox"/> Calcium chloride	Mass	kg	1.26	<input type="checkbox"/> Acetic acid	Mass	kg	5.87
<input type="checkbox"/> Carbon dioxide	Mass	kg	0.03	<input type="checkbox"/> Acetone	Mass	kg	1.21
<input type="checkbox"/> Chromium (ore)	Mass	kg	3.29	<input type="checkbox"/> Acid (calculated as	Mass	kg	2.15
<input type="checkbox"/> Circuit material (Fe	Mass	kg	2.78	<input type="checkbox"/> Acrolein	Mass	kg	1.56
<input type="checkbox"/> Clay	Mass	kn	4.94	<input type="checkbox"/> Acrylonitrile	Mass	kg	7.94
				<input type="checkbox"/> Aldehydes	Mass	kn	1.09

Information | Inputs and outputs | Modelling and validation | Administrative information | Parameters

openLCA website, 2010



The openLCA project

- Idea & need
- How it is organised
- License concept
- Schedule
- Project outcomes
- Participation



User login

Enter your username and password here in order to log in on the website:

Username:
Password:

Welcome to the project website of openLCA!

The openLCA project will create, in the coming 1.5 years, a modular software for life cycle analysis and sustainability assessments. The software will be available as open source, and will be available for free.

Initially, a basic framework for life cycle assessment (LCA) calculation and two plugins will be implemented, a format converter and an uncertainty module. The format converter serves to convert relevant LCA data formats from one to the other, in a loss-less manner. The uncertainty module will help to specify, calculate, visualise and interpret uncertainty in LCA product systems.

This site provides you an overview of the project; you are invited to browse through background information and to say your opinion; you might be interested to join, as a tester, contributor, or funder - and we are keen to explain why you should! You will also find download resources, and some words about us. We expect the site to grow with project schedule - you are invited to join the project newsletter to stay informed.

Open-IO database for use with openLCA

January 7 2010: Two notes;

First, our friends from the Open-IO project (www.open-io.org) have made a **US Input-Output database** available specifically for openLCA (note the different writings of open.) - thanks! . As the current release of openLCA has no money currency, but the IO database contains money flows, you will need to create a unit and flow property before the import, then everything runs smoothly. We have written a short documentation about the import should you need help.

Database download:

Website: <http://www.open-io.org/>

Download link: http://www.open-io.org/OIO_UnitNonHybrid.zip

Documentation download [here](#).

Second, you may have noticed that openLCA does not directly support Windows 7 (reason: we need to state each operation system explicitly for the embedded MySQL server). We will fix this in the next couple of days with a new release.

Beta 1.1.1 released

December 17 2009: We released today a new version of openLCA with only two



Project supported by PRé Consultants, since January 2007, as member of the [Funding Consortium](#).

Project supported by PE International GmbH, since March 2007, as new member of the [Funding Consortium](#). Welcome!

The [Green Standard](#) has funded integration of data in [Earthster](#) and [openLCA](#), in order to enable manufacturers who are doing LCA to publish, share, and use life cycle results with suppliers and customers, and purchasers to have access to better information that helps them to purchase more sustainably.



Format converter project supported by the SETAC/UNEP [Life Cycle](#)





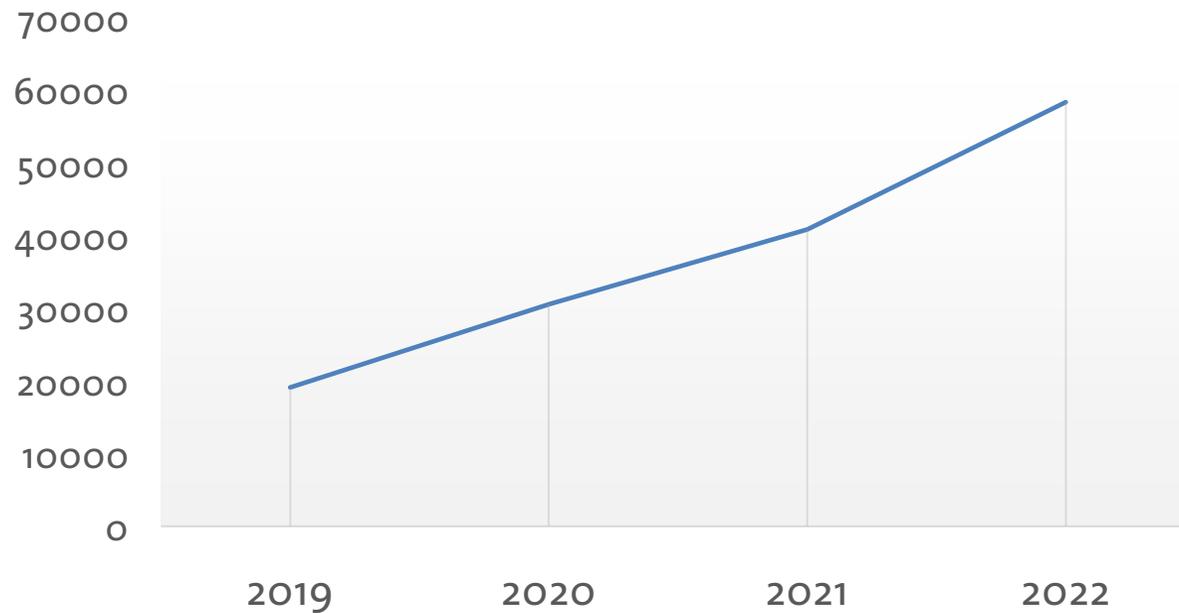
openLCA, developments over time

openLCA, developments over time

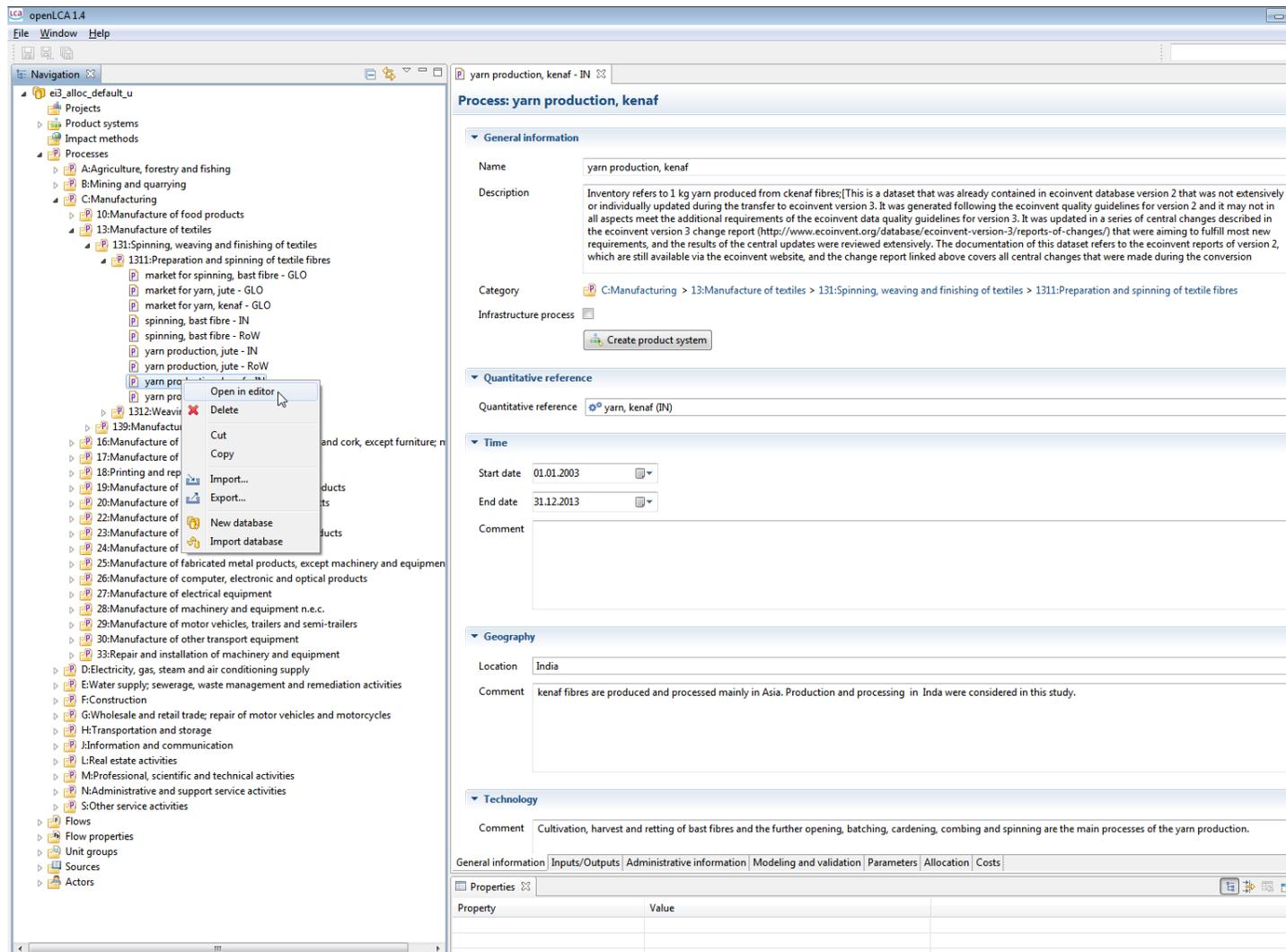
- **Support from US EPA, from 2010 onwards**
- **..and later USDA and other agencies**
- **openLCA Nexus as “webshop” for data for openLCA, started 2014, nexus.openLCA.org**
- **Many technical and UI revisions over time, additional features, and usability improvements**

openLCA - growing interest each year

Unique downloads for openLCA



openLCA, UI developments over time



- openLCA 1.4 beta, 2013

openLCA, UI developments over time

The screenshot displays the openLCA 1.4 beta user interface. On the left, a navigation tree shows a hierarchy of processes under 'C:Manufacturing' > '13:Manufacture of textiles' > '131:Spinning, weaving and finishing of textiles' > '1311:Preparation and spinning of textile fibres'. A context menu is open over the 'yarn production, kenaf - IN' process, with 'Open in editor' selected. The main panel shows the 'Process: yarn production, kenaf' editor. It includes a 'General information' section with fields for Name, Description, and Category. The 'Quantitative reference' section shows 'yarn, kenaf (IN)'. The 'Time' section has 'Start date' set to 01.01.2003 and 'End date' set to 31.12.2013. A 'Comment' field is also present.

• openLCA 1.4 beta, 2013

openLCA, UI developments over time

- **New icons with version 1.5**

P *Production of wood_example ✕

Allocation

Default method

▼ **Physical & economic allocation**

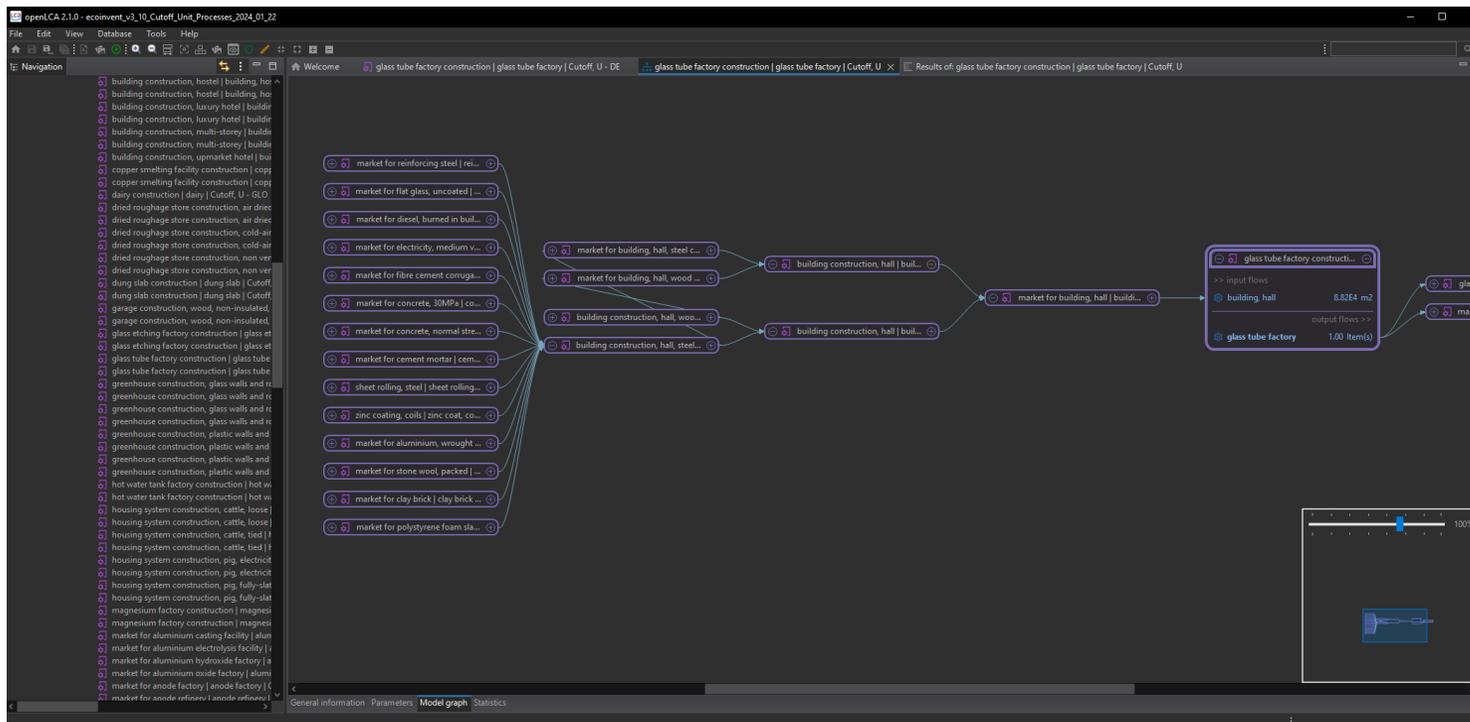
Product	Physical	Economic
 bark (0.30 kg)	0.23076923076923075	0.10714285714285712
 Wood (1.00 kg)	0.7692307692307692	0.8928571428571428

▼ **Causal allocation**

Flow	Direction	Category	Amount	bark	Wood
 sawlog and veneer log, hardw...	Input	022:Logging/0220...	1.00000 m3	0.4	0.6

openLCA, UI developments over time

- Dark mode and again new icons with version 2.0



openLCA, technical changes over time

- **E.g.**
 - **Switch to matrix calculation version 1.0**
 - **Replace mysql as database (startup often blocked by security guidelines), with 1.5**
 - **Many changes and advancements on the calculation, for some time calculation libraries needed to be downloaded separately due to license restrictions, since 2.0.4 Intel Math Kernel (MKL), integrated**
 - **API, since version 1.10, heavily extended since then**

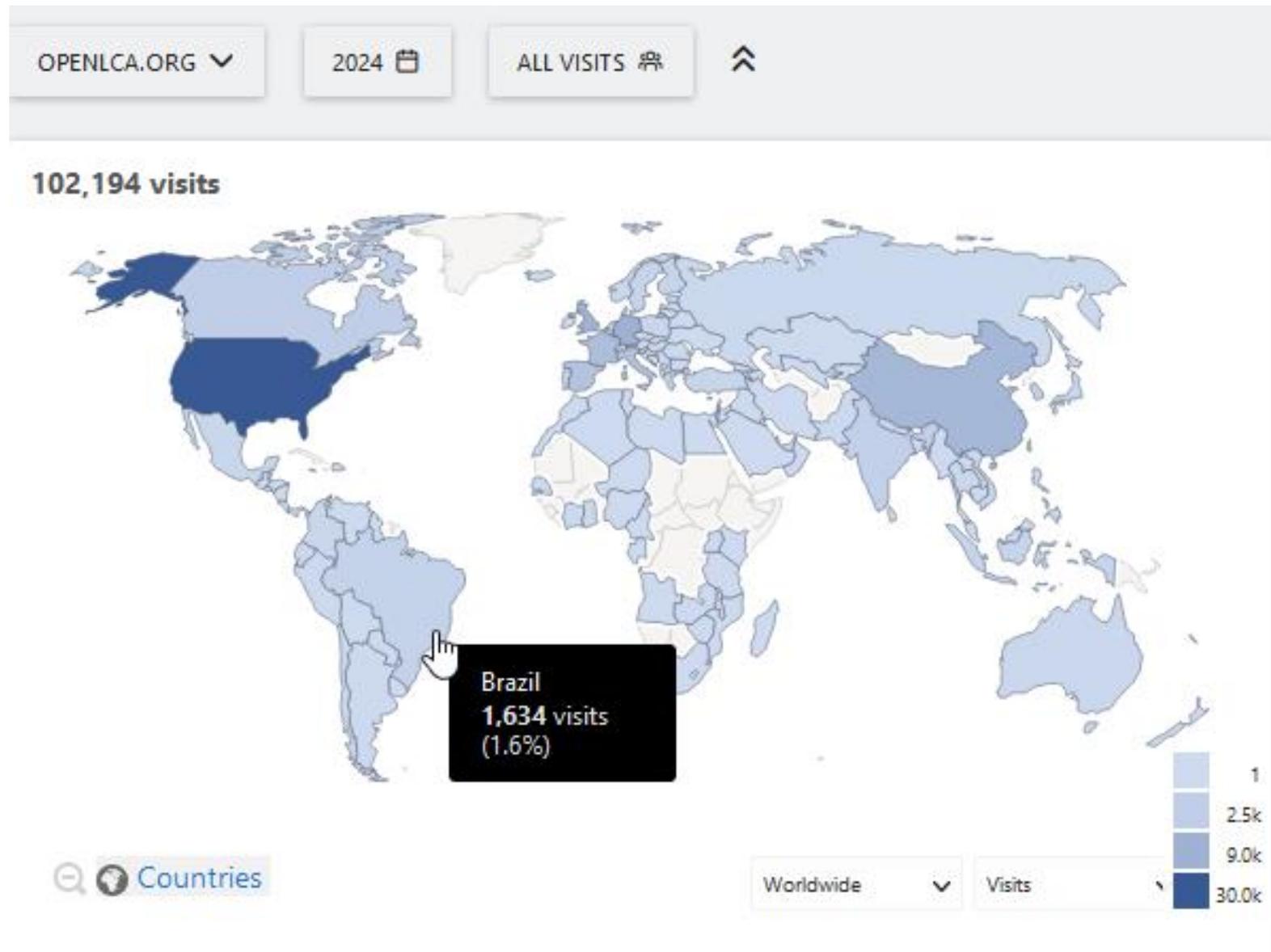
openLCA, organisational over time

- **Funding consortium 2007-2009 (with PRé and PE international etc.)**
- **Afterwards no further organisational “complications”:
GreenDelta develops and hosts openLCA, so far:**
 - **Organic growth**
 - **No venture capital**
 - **Full independence**
- **Partners in several countries, (IT, US, ..), some also here present**

openLCA, now

openLCA, now

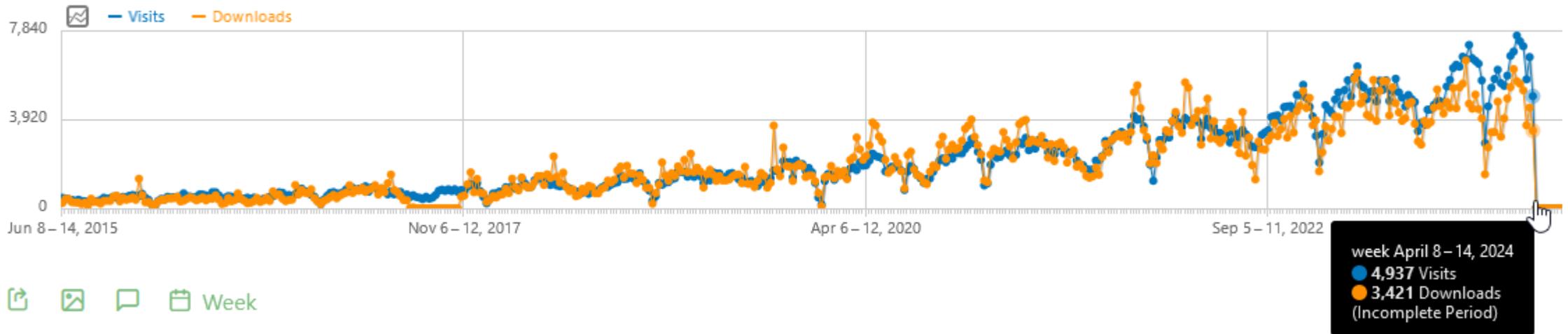
- We think the most widely used LCA and sustainability software worldwide



openLCA, now: openLCA Nexus

- > 110,000 Nexus users
- ~ 500 downloads per day

Visits Over Time



openLCA, now

- **A full, mature LCA and sustainability assessment software**
- **Still open source and free**
- **Features:**
 - **Fast calculation also of large systems**
 - **Broad import and export capabilities**
 - **Environmental, social, and economic calculations**
 - **Natural modelling of life cycles in a model graph**
 - **Flexible reference system & nomenclature, broadest support for LCA databases...**

openLCA, now

- **Features, 2:**
 - **Powerful API allows integration in web applications**
 - **In-App Scripting -> inspect your database, modify it, mass-import or export, via SQL or Python**
 - **Dedicated Social LCA calculation**

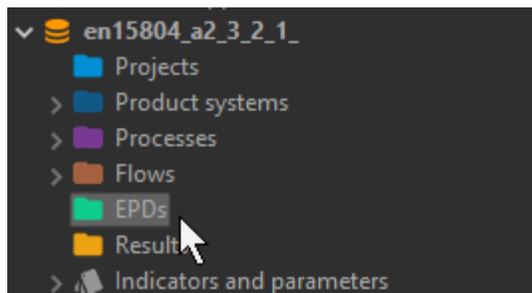
Indicator results

	Activity value	Raw value	HO	MO	LO	NOP	NOR	VLR	LR	MR	HR	VHR	ND	NA
> Local Community			0%	0%	0%	0%	6%	18%	11%	18%	19%	9%	19%	0%
✓ Society			0%	1%	5%	0%	0%	16%	4%	22%	40%	14%	0%	0%
> Contribution to economic dev			0%	2%	9%	0%	0%	12%	3%	17%	31%	27%	0%	0%
> Health and Safety			0%	0%	0%	0%	0%	20%	5%	26%	49%	0%	0%	0%
✓ Value Chain Actors			0%	0%	0%	0%	0%	1%	5%	27%	12%	41%	14%	0%
✓ Corruption			0%	0%	0%	0%	0%	0%	5%	2%	12%	42%	38%	0%
> Active involvement of enter	314.73037	2.57385 [%]	0%	0%	0%	0%	0%	0%	10%	5%	6%	3%	76%	0%
✓ Public sector corruption	314.73037	59.15187 [Inde	0%	0%	0%	0%	0%	0%	0%	0%	19%	81%	0%	0%
✗ hard coal mine operation	118.51449	60.00000	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
✗ market for hard coal, run	118.51449	60.00000	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
✗ industrial furnace product	8.98497	58.54545	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
✗ market for industrial furn	6.49665	58.54545	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
✗ building construction, ha	5.38133	55.48227	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
✗ fish canning plant constru	4.79410	62.59091	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
✗ hard coal mine operation	2.91603	57.00000	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
✗ hard coal mine operation	2.74047	57.00000	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%
✗ market for industrial furn	2.59762	56.83486	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
✗ market for building hall	2.43220	55.48227	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%

openLCA, now

- **Features, 2:**

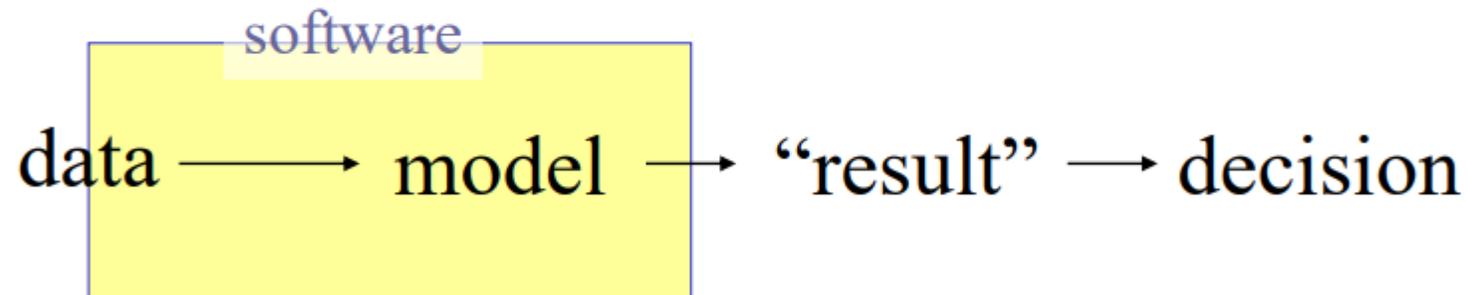
- **Powerful API allows integration in web applications**
- **In-App Scripting -> inspect your database, modify it, mass-import or export, via SQL or Python**
- **Dedicated Social LCA calculation**
- **Dedicated regionalised calculation, improved**
- **Dedicated EPDs (Environmental Product Declarations) - > as data input but also to create EPDs**



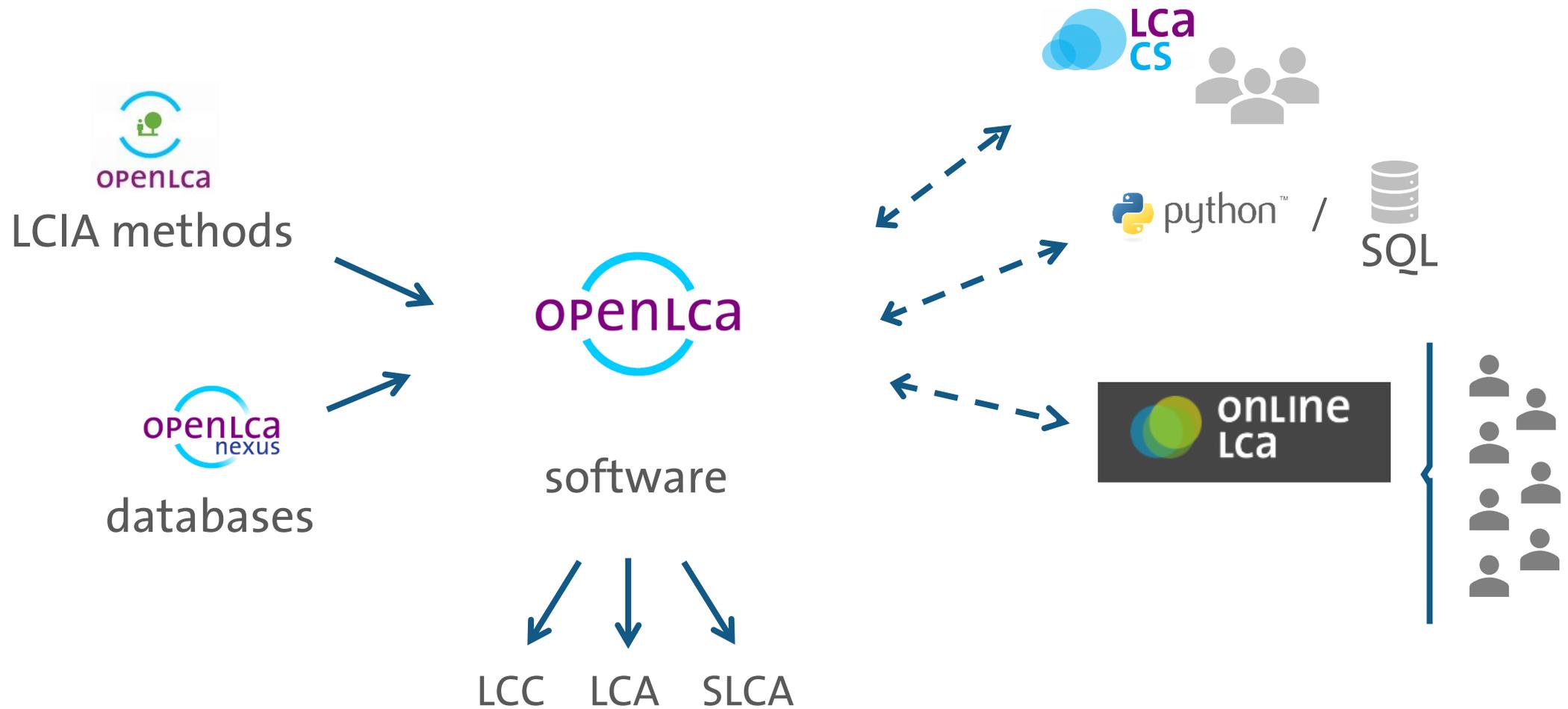
openLCA, now

- **Features:**

The role of software in sust. assessment

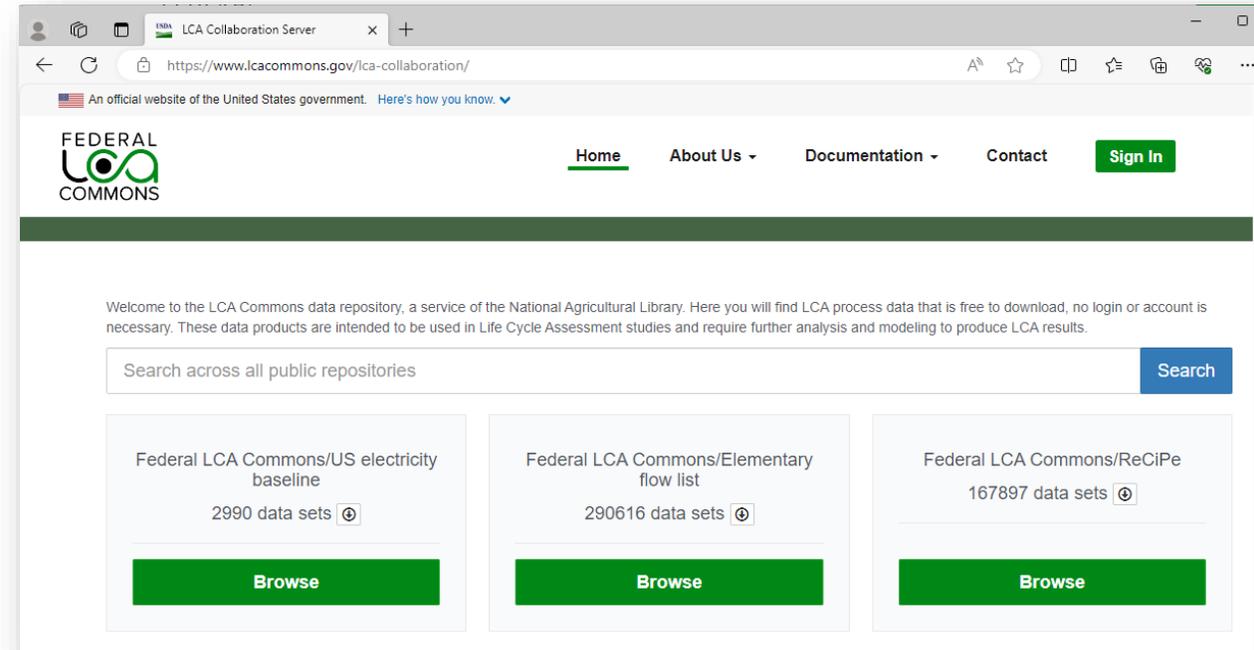


openLCA, now: a growing ecosystem



Collaboration

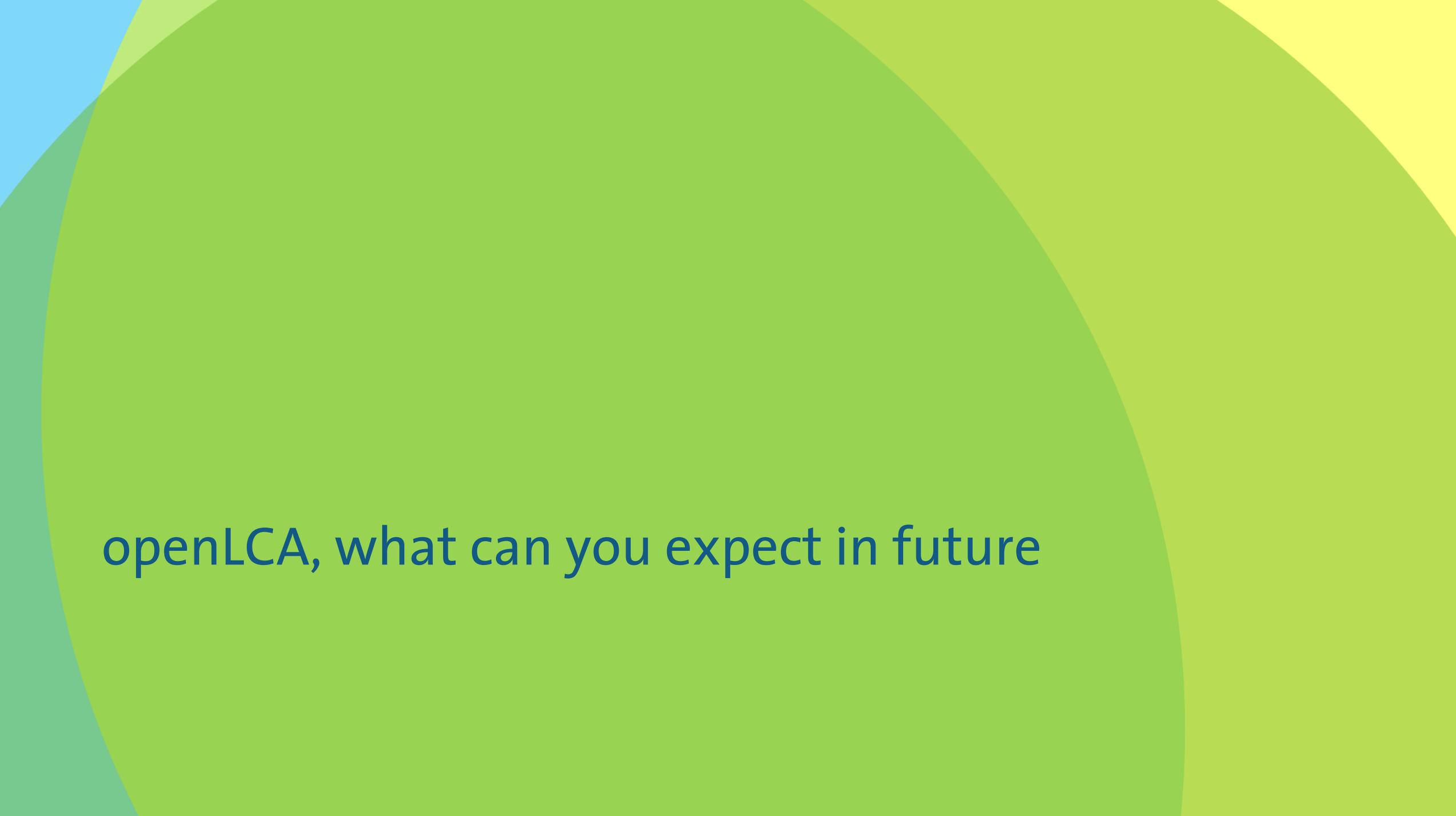
- The LCA Collaboration Server (for openLCA)
- Share, synchronize, review, safely store and publish LCA datasets, life cycle models, impact assessment methods. Similar to modern software code repositories.
- Developed by GreenDelta for the USDA, free software since 2017, first release 2019.
- Public use cases e.g. [lcacommons.gov](https://www.lcacommons.gov)



Solution for Enterprises



- **Specifically configured solution for sustainability, at company level**
- **openLCA, the LCA Collaboration Server, and a new openLCA webtool that talks to openLCA in a Docker container**
- **-> Mass-creation of LCAs, in corporate and large organisations, maintaining model validity**



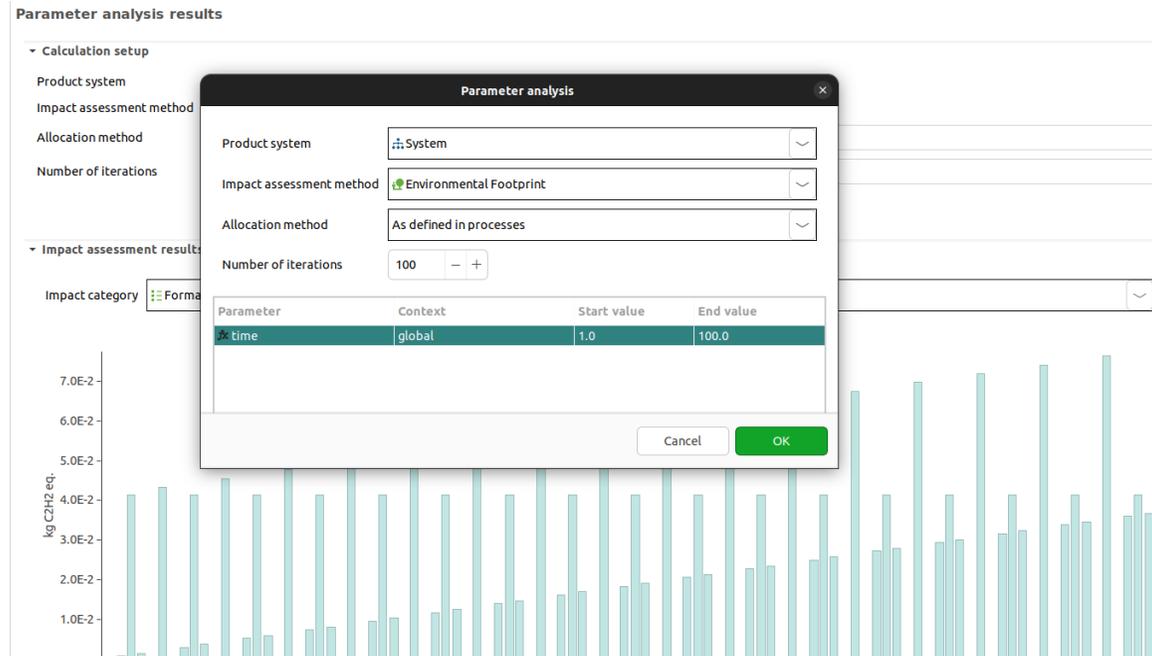
openLCA, what can you expect in future

openLCA, future

- **No plans to change openLCA being open source**
- **We want to enable and support more contact with openLCA users and more connections across openLCA users (hence this 1st conference)**
- **We do not have one overall master plan (and never had), it was good to listen to users and their feedback and ideas for projects, and we wish to main this -> input welcome!**

openLCA, future, technical pathways

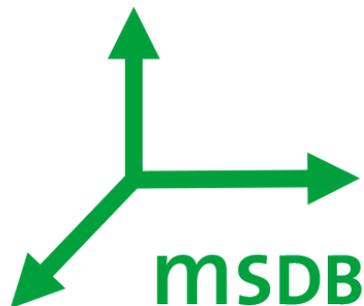
- **Modeling time, more interaction with system dynamics models (-> much more powerful and elegant than LCA alone for sustainability modeling)**



Iteration steps and time dependency calculated for parameters in the SH2E tool based on openLCA, developed by GreenDelta in the SH2E Eu project, 2024, <https://github.com/GreenDelta/shze-tool>

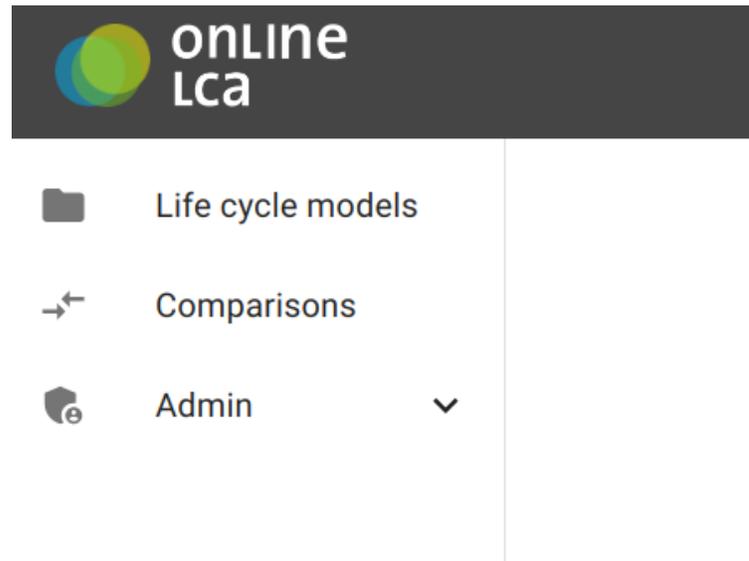
openLCA, future, technical pathways

- **Data for LCA and sustainability: so far we have typically used other existing databases and adapted them to openLCA (e.g. ecoinvent) or developed additions to existing databases – openLCA has a more flexible architecture nicely suited for database development -> massive sustainability database, presentation tomorrow**



openLCA, future, technical pathways

- **Continue development of a web-based LCA tool based on openLCA: onlineLCA**



GreenDelta

sustainability consulting + software



Thank you!

Dr. Andreas Ciroth, ciroth@greendelta.com

GreenDelta GmbH

Alt-Moabit 130, 10557 Berlin

www.greendelta.com