Brightway2: A new open-source framework for advanced LCA

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Introduction

Brightway2 is a new **open source** framework for LCA calculations

It is programmed in **Python**, with visualizations in **Javascript**

It is installable on Linux, OS X, and Windows

It is a framework for **research**, **innovation**, and **advanced calculation**, not a replacement for OpenLCA or SimaPro

1] Import all the data!

`Ecospold1Importer`	Ecoinvent < 3, US LCI
`Ecospold2Importer`	Ecoinvent 3
`SimaProImporter`	SimaPro 7.1 (CSV)

Automatic data importers

Because the data model is very simple, you can also manually import data from **virtually any** source – text files, spreadsheets, even geodata.

You can also **programmatically** create data.

import ecoinvent 2.2 in 40 seconds!

data is processed to a fast binary format for calculations

2] There is no database

Data is stored as document files in a single directory:

- Easy to backup
- Easy to share
- Even possible to use e.g. dropbox

```
'categories': ['oil', 'production'],
'exchanges': [
    {'comment': '(3,na,na,3,1,5); Extrapolation for sum parameter',
     'input': ['biosphere', 4712],
     'amount': 2.4, 'loc': 0.54, 'scale': 0.22, 'uncertainty type': 2,
     'type': 'biosphere'}
],
'location': 'NG',
'name': 'combined gas and oil production',
'type': 'process',
'unit': 'year'
```

uncertainty parameters work with the fast and well-tested `stats_arrays` library

units are automatically normalized

Example dataset document

Flexible dataset documents can be easily added to and adapted. There are no limitations to the data you can store and use in your calculations.

3] Go speed racer, go!

`LCA`	Static LCA
`MonteCarloLCA`	Simple Monte Carlo
`IterativeMonteCarlo`	Use iterative solvers instead of LU decomposition
`OATSensitivity`	One-at-a-time sensitivity
`SobolSensitivity`	Sobol sensitivity factors
`GraphTraversal`	AKA structural path analysis

Some of the available calculation engines

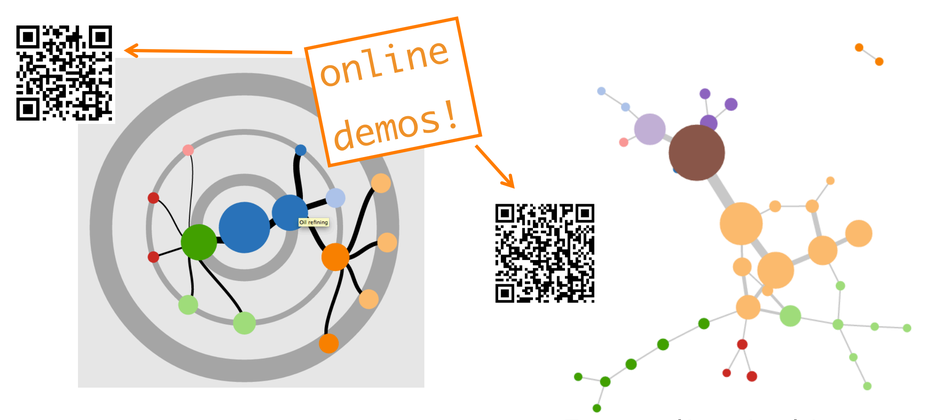
100 Monte Carlo iterations **per second** on a laptop, **500** per second on a dedicated server.

Ecoinvent 3 calculations in **2.5** seconds.

A **new class** of meta-analysis is possible.

more than 35,000,000,000 (!) Monte Carlo iterations already served

4] Interpret & visualize



Supply chain circles

Force-directed impacts

Visualization in javascript with **D3** allows new interactive visualizations buildable by anyone, dramatically improving result communication and interpretation.

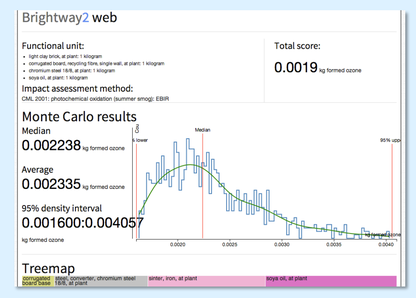
What's next?

brightwaylca.org
Brightway2 homepage
bitbucket.org/cmutel/brightway2
Source code repository
brightway2.rtfd.org
Online documentation
chris.mutel.org
Development blog

Features

Every change to data is saved, and it is easy to revert changes

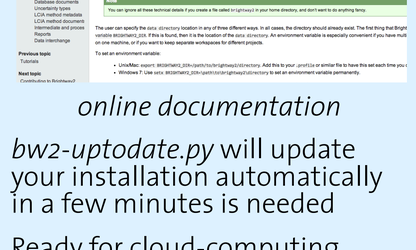
Interact through the web interface, command line, or in an interactive web notebook



web interface

LCI and LCIA uncertainty (even weighting and normalization)

Real open source: easy to learn languages, open development, new features and releases every few weeks

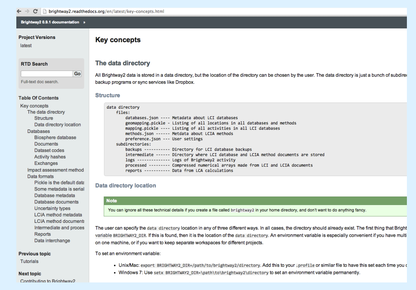


notebook interface

Notebooks are collaborative: they can be used by teams

Notebooks preserve work processes, leading to reproducible science and easy fixing of mistakes

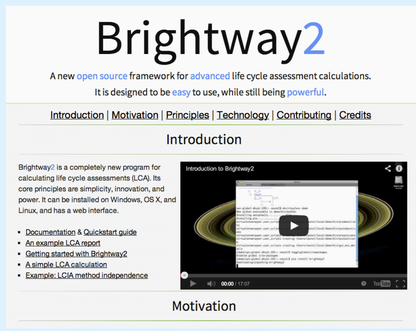
New analysis tools (econometrics, page rank, etc.)



online documentation

bw2-uptodate.py will update your installation automatically in a few minutes is needed

Ready for cloud-computing (remote LCA calculation and data storage)



Brightway2 homepage

Plays nicely with other programs and web services

Report server makes it easy to share LCA calculation reports

See also

- Talk on scientific notebooks: Thursday, Ligurian 1, 10:30
- Talk on LCIA uncertainty: Thursday, Tuscan 2, 1:30
- Posters on new pedigree matrix and contribution analysis, both calculated using Brightway2

Conclusions

- Brightway2 is not a replacement for existing LCA software, but works **in addition** to make new ideas possible
- Brightway2 is under **continual development**, and frequently adds new features
- Brightway2 is great for **LCA research** and **open LCA science**