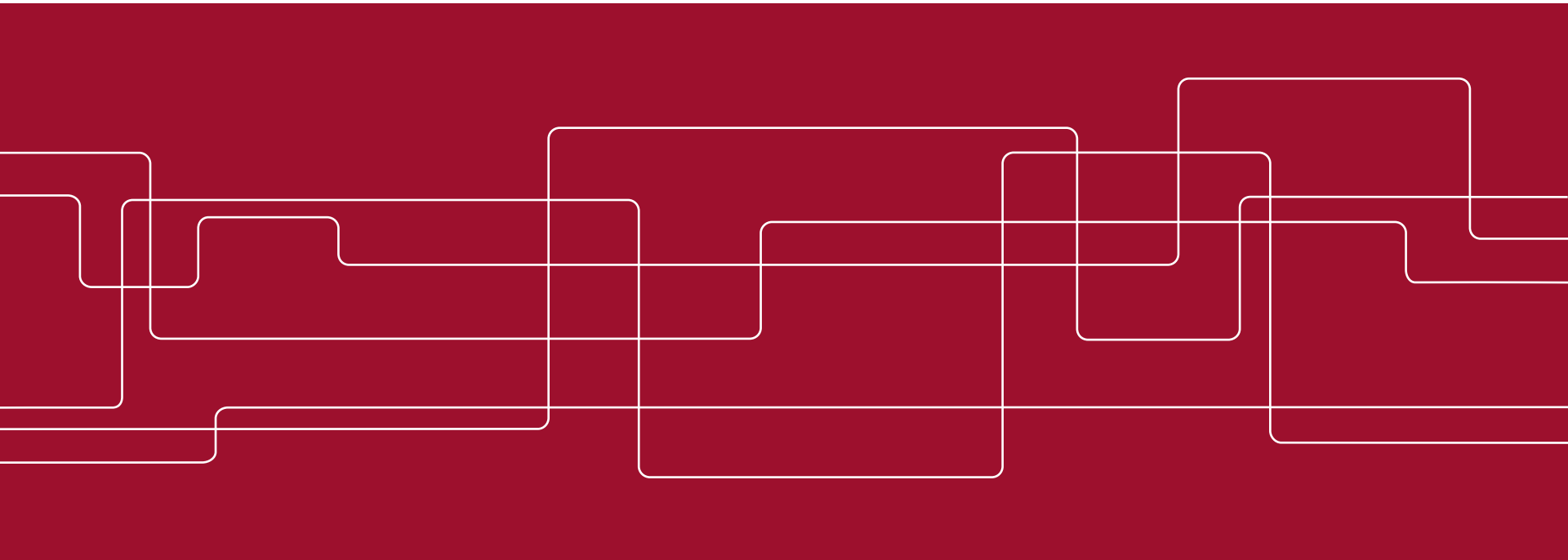
Introducing *lcopt*

An interactive tool for creating fully parameterised Life Cycle Assessment (LCA) foreground models

James Joyce

15/11/2017



What is Lcopt?

The Journal of Open Source Software

Submit Papers About **P. James Joyce** · Sign out

Lcopt - An interactive tool for creating fully parameterised Life Cycle Assessment (LCA) foreground models

Authors
P James Joyce

Repository:
Repository link »

Paper:
PDF link »

Review:
View review issue »

DOI:
https://doi.org/10.21105/joss.00339

Status badge:
JOSS 10.21105/joss.00339

Citation:
Joyce, (2017). Lcopt - An interactive tool for creating fully parameterised Life Cycle Assessment (LCA) foreground models. *Journal of Open Source Software*, 2(16), 339, doi:10.21105/joss.00339

Summary

Lcopt is an open source Python package for creating fully parameterised Life Cycle Assessment (LCA) foreground models. Lcopt includes an intuitive Flask (Ronacher 2017) based user interface to greatly simplify the modelling process for LCA practitioners and researchers. Background Life Cycle Inventory (LCI) data from the ecoinvent 3.3 database (Ecoinvent Centre 2016), or the FORWAST I/O database (Forwast 2007) can be linked to the foreground models. Models are created by drawing flow sheets. Each link in the flow sheet is assigned a parameter which can either be set directly or calculted using user defined functions. Any number of parameter sets representing variations of the model can be created in order to undertake scenario analysis and options appraisal. Once created, the models can be analysed directly from within the Flask interface, utilising Brightway (Mutel 2017) to generate the LCA results. This includes hotspot identification, process contribution and scenario comparison. If required, the models can also be exported to commonly used LCA softwares (Brightway (Mutel 2017) and SimaPro (Pre Sustainability 2014)) for further, more comprehensive analysis. The source code repository is hosted on github (Joyce 2017b) and full online documentation is available (Joyce 2017a).

Overview

- LCA software
- Lcopt modelling approach
- Demonstration

LCA Software

	Foreground modelling	LCI/LCIA calculation	Background modelling
Commercial		SimaPro GaBi Product Sustainability Performance	ecoinvent
Freeware		openLCA	
Open source		Brightway2	Ocelot

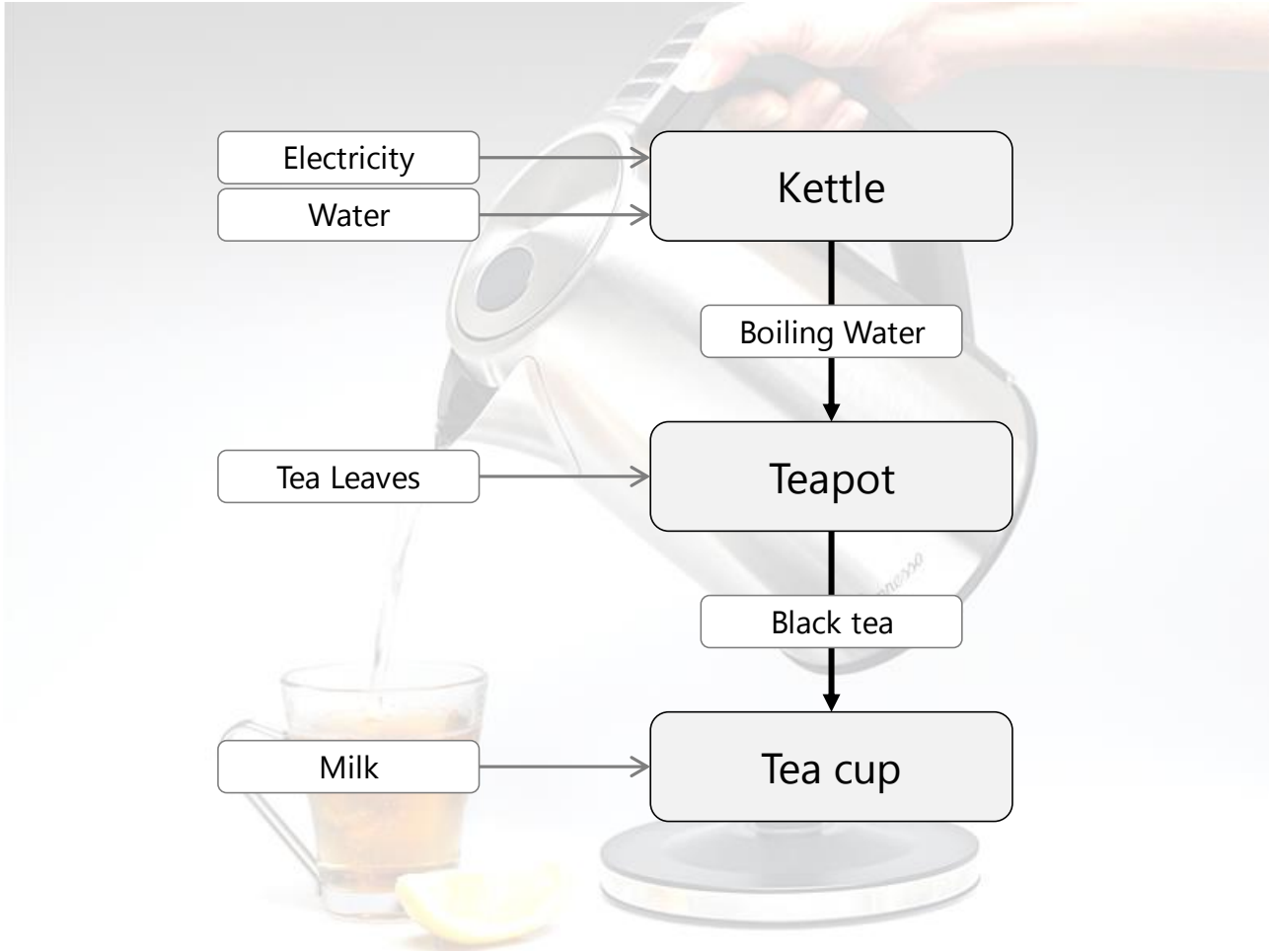
LCA Software

	Foreground modelling	LCI/LCIA calculation	Background modelling
Commercial		SimaPro GaBi Product Sustainability Performance	ecoinvent
Freeware		openLCA	
Open source	LCOPTINTERACT	Brightway2	Ocelot

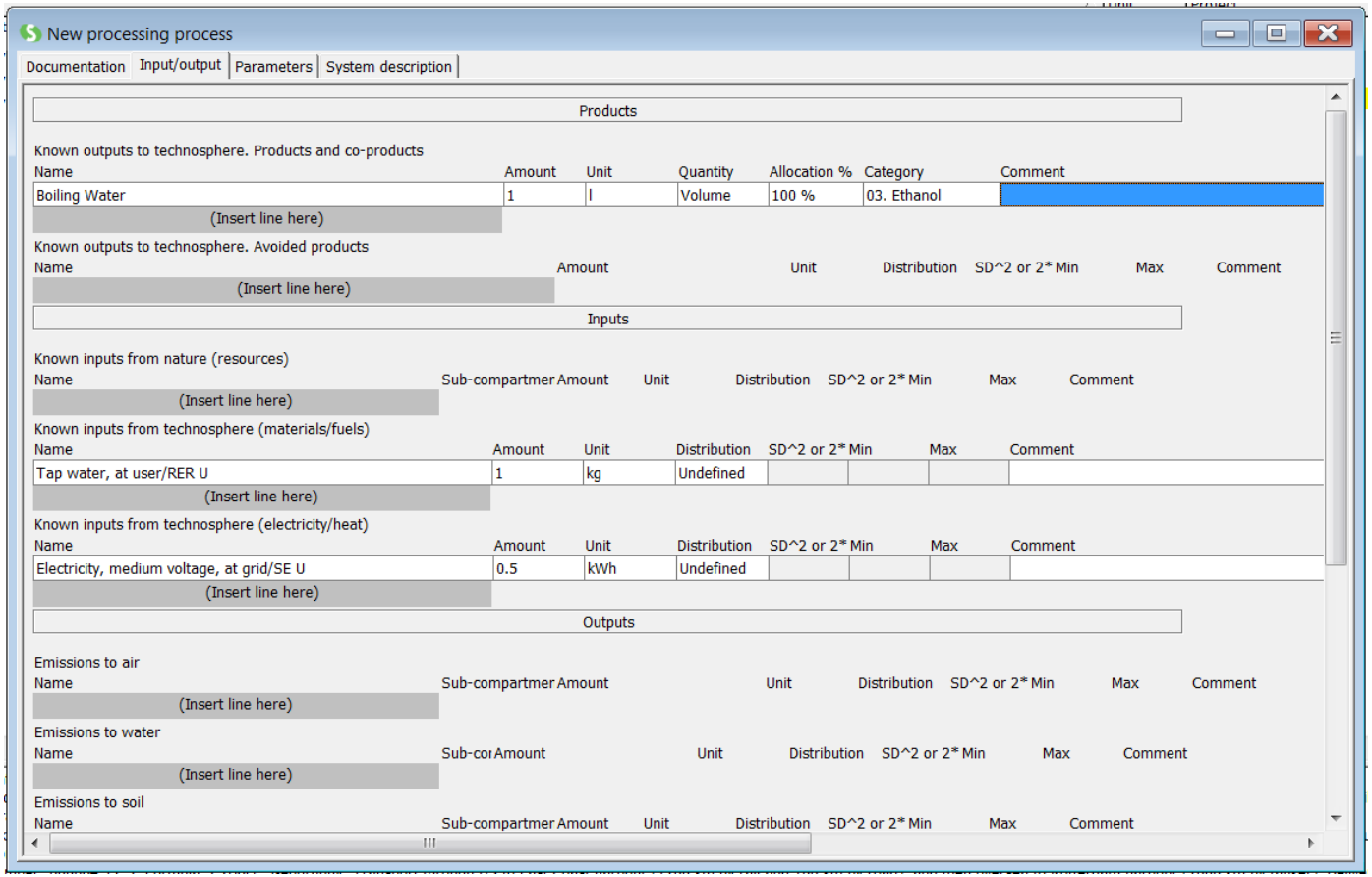
Lcopt modelling approach

Making a cup of tea

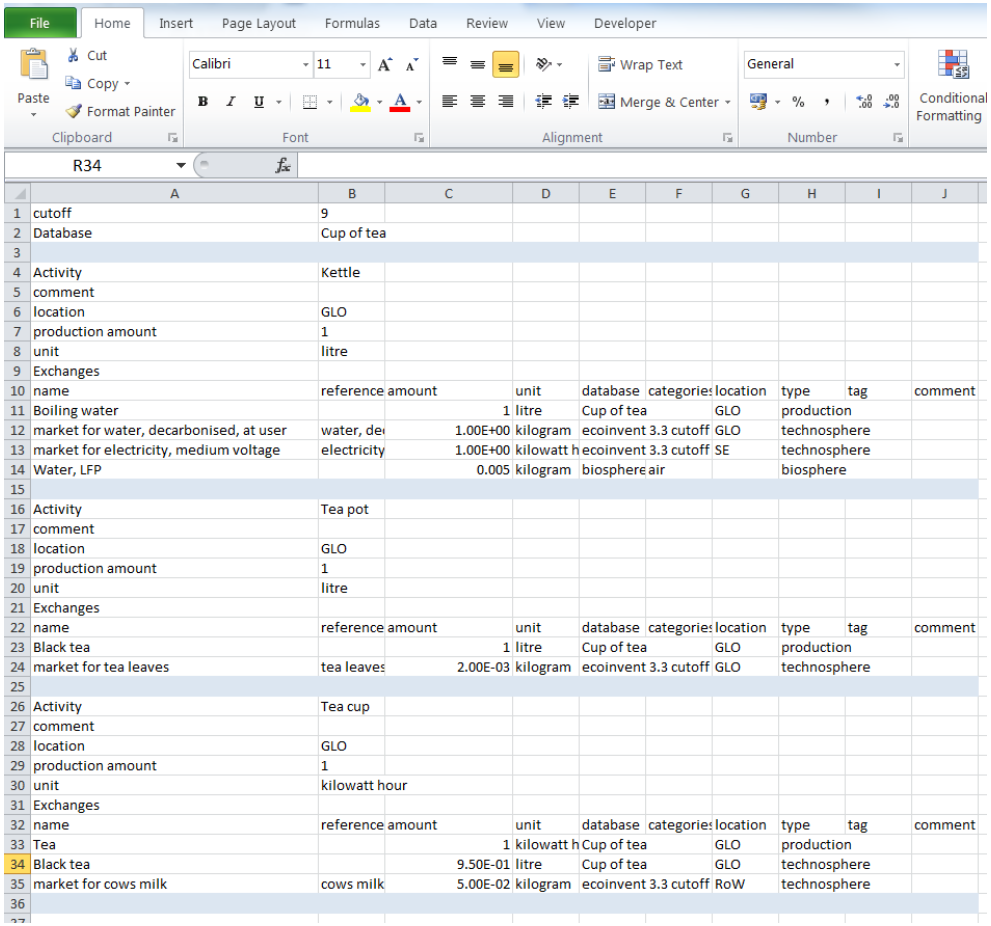
Making a cup of tea



SimaPro


New processing process
Documentation
Input/output
Parameters
System description
Products
Known outputs to technosphere. Products and co-products
Name Amount Unit Quantity Allocation % Category Comment
Boiling Water 1 l Volume 100 % 03. Ethanol
(Insert line here)
Known outputs to technosphere. Avoided products
Name Amount Unit Distribution SD^2 or 2* Min Max Comment
(Insert line here)
Inputs
Known inputs from nature (resources)
Name Sub-compartmer Amount Unit Distribution SD^2 or 2* Min Max Comment
(Insert line here)
Known inputs from technosphere (materials/fuels)
Name Amount Unit Distribution SD^2 or 2* Min Max Comment
Tap water, at user/RER U 1 kg Undefined
(Insert line here)
Known inputs from technosphere (electricity/heat)
Name Amount Unit Distribution SD^2 or 2* Min Max Comment
Electricity, medium voltage, at grid/SE U 0.5 kWh Undefined
(Insert line here)
Outputs
Emissions to air
Name Sub-compartmer Amount Unit Distribution SD^2 or 2* Min Max Comment
(Insert line here)
Emissions to water
Name Sub-cor Amount Unit Distribution SD^2 or 2* Min Max Comment
(Insert line here)
Emissions to soil
Name Sub-compartmer Amount Unit Distribution SD^2 or 2* Min Max Comment

Excel and Brightway



	A	B	C	D	E	F	G	H	I	J
1	cutoff	9								
2	Database	Cup of tea								
3										
4	Activity	Kettle								
5	comment									
6	location	GLO								
7	production amount	1								
8	unit	litre								
9	Exchanges									
10	name	reference	amount	unit	database	categories	location	type	tag	comment
11	Boiling water		1	litre	Cup of tea		GLO	production		
12	market for water, decarbonised, at user	water, de	1.00E+00	kilogram	ecoinvent 3.3	cutoff	GLO	technosphere		
13	market for electricity, medium voltage	electricity	1.00E+00	kilowatt h	ecoinvent 3.3	cutoff	SE	technosphere		
14	Water, LFP		0.005	kilogram	biosphere	air		biosphere		
15										
16	Activity	Tea pot								
17	comment									
18	location	GLO								
19	production amount	1								
20	unit	litre								
21	Exchanges									
22	name	reference	amount	unit	database	categories	location	type	tag	comment
23	Black tea		1	litre	Cup of tea		GLO	production		
24	market for tea leaves	tea leaves	2.00E-03	kilogram	ecoinvent 3.3	cutoff	GLO	technosphere		
25										
26	Activity	Tea cup								
27	comment									
28	location	GLO								
29	production amount	1								
30	unit	kilowatt hour								
31	Exchanges									
32	name	reference	amount	unit	database	categories	location	type	tag	comment
33	Tea		1	kilowatt h	Cup of tea		GLO	production		
34	Black tea		9.50E-01	litre	Cup of tea		GLO	technosphere		
35	market for cows milk	cows milk	5.00E-02	kilogram	ecoinvent 3.3	cutoff	RoW	technosphere		
36										

Excel and Brightway

In [1]:
```
from brightway2 import *
from lcopt import *
```

In [ ]:
```
# setup project
projects.set_current("An_Example")
bw2setup()
```

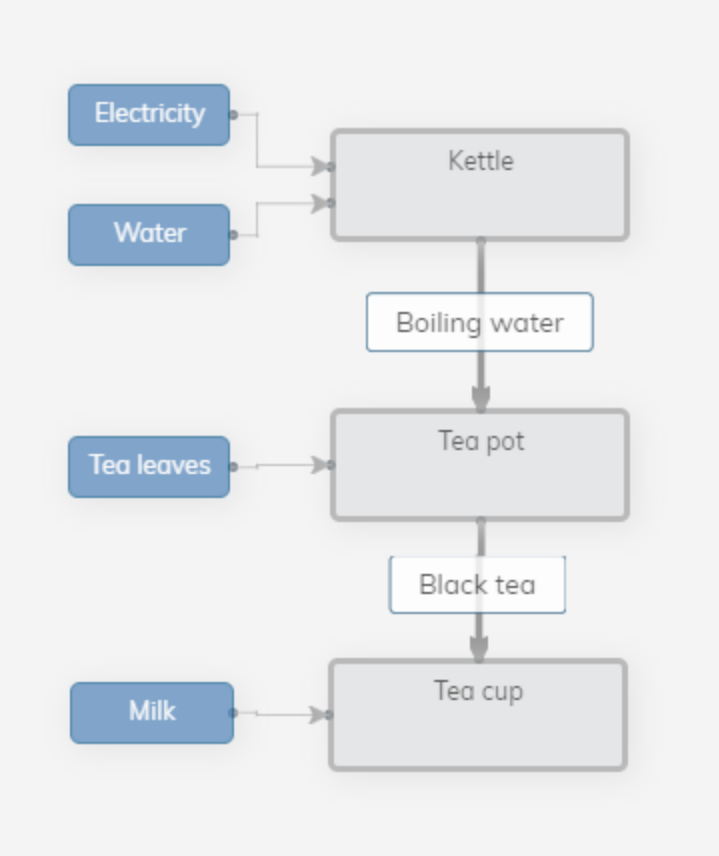
In [ ]:
```
import bw2io
```

In [ ]:
```
# import ecoinvent 3.3 cutoff
if 'ecoinvent 3.3 cutoff' not in databases:
    ei33cutofflink=r"C:\Users\pjjoyce\Documents\08_ecoinvent_3_3_Cutoff\ecoinvent 3.3_cutoff_ecoSpold02\datasets"
    ei33cutoff=SingleOutputEcospold2Importer(ei33cutofflink, 'ecoinvent 3.3 cutoff')
    ei33cutoff.apply_strategies()
    ei33cutoff.statistics()
    ei33cutoff.write_database()
```

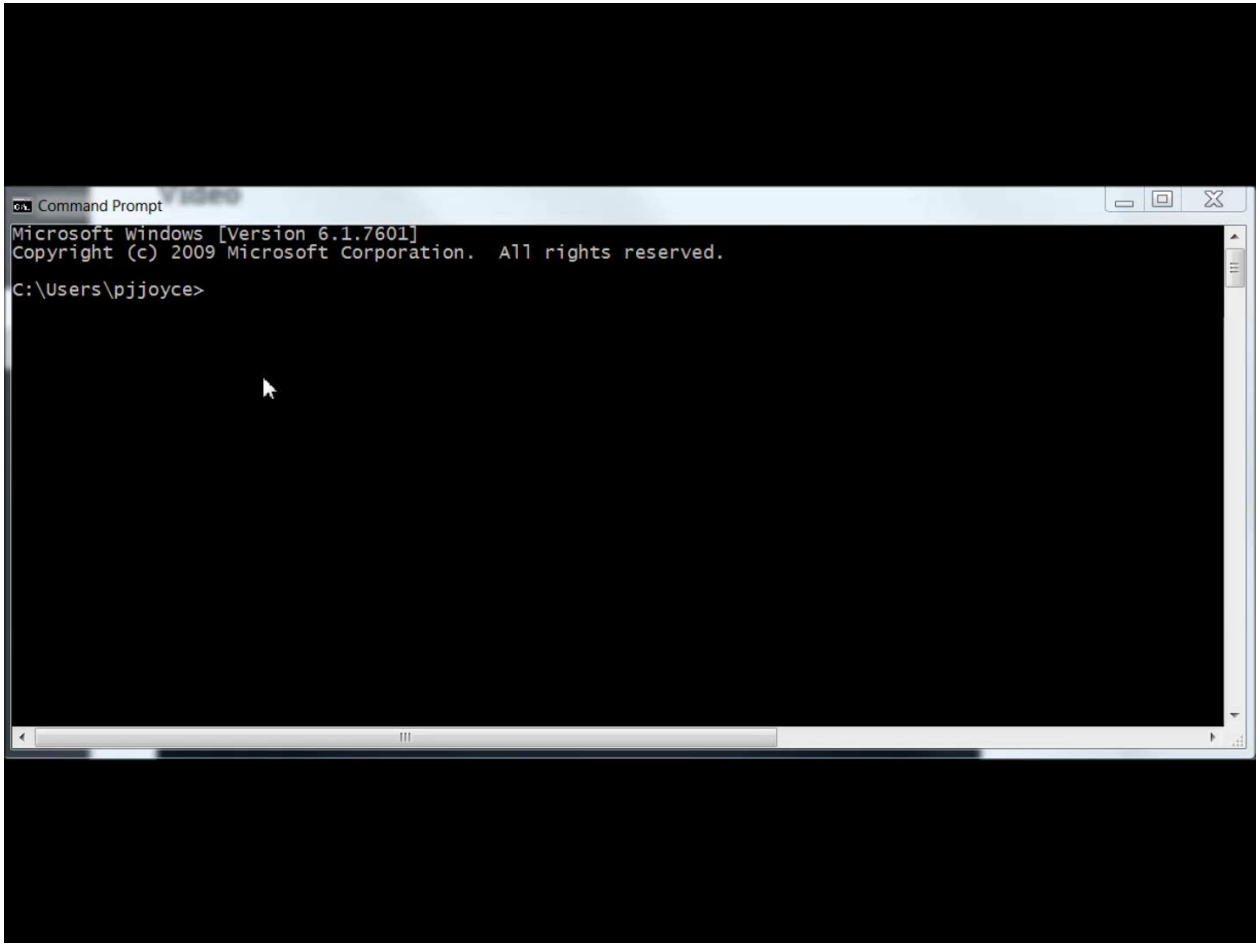
In [ ]:
```
# import foreground inventory in excel, and link it with background database
tea = ExcelImporter(r"C:\Users\pjjoyce\Dropbox\02. James' files\39. lcopt_new_features\excel_import\example\Example_170925.xlsx")
tea.apply_strategies()
tea.match_database("ecoinvent 3.3 cutoff", fields=('name', 'unit', 'location','reference product'))
```

In [ ]:
```
# save foreground database
lfp.write_database()
```

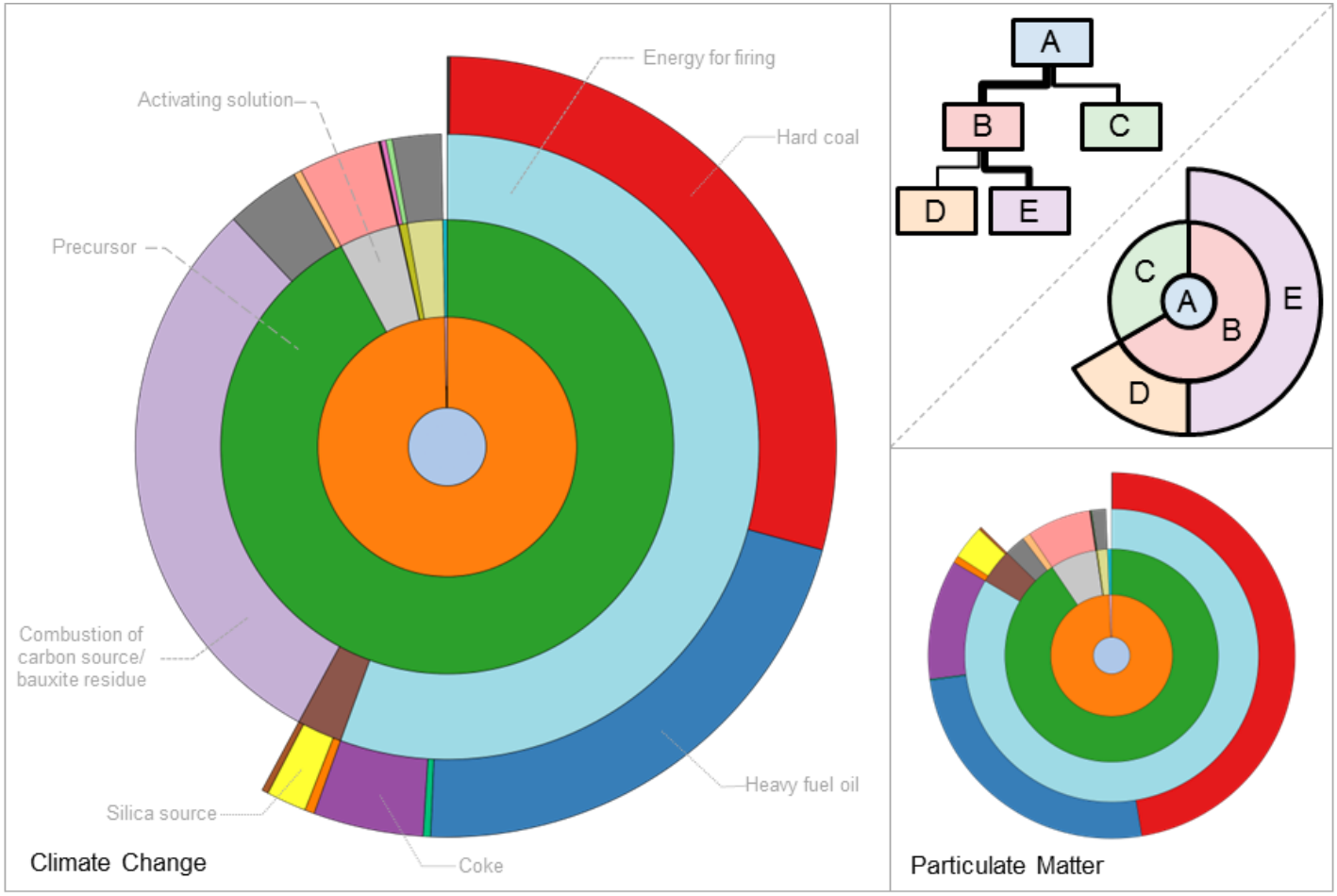
Lcopt


Electricity
Water
Kettle
Boiling water
Tea leaves
Tea pot
Black tea
Milk
Tea cup

Demonstration



‘Real world’ example



Summary

- Simple, intuitive way to create LCA models
- Accessible for novice practitioners
- New visualisations
- Flexible and open source
- Aim to build a community
- Interact with the growing open source movement in LCA