Using online scientific notebooks for LCA calculations

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This is a annotated set of slides which has been slightly modified from the presentation to make it more understandable as a handout.

Some basic propositions

- LCA is a tool for decision support
- LCA decisions help decide conflicts over resources
- LCA goods are not captured in market prices
- LCA is therefore a political activity

Controversial pipe LCA claims concrete is better than PVC

ENDS Report 262, November 1996
1 November 1996

Concrete sewer pipes have a markedly better environmental performance than PVC pipes across a range of impacts, according to a life cycle assessment (LCA) published by the Dutch association of concrete pipe manufacturers, VPB.1 Its case has been weakened by a refusal to publish key raw data, but the study adds to the PVC industry's problems in portraying its product as environmentally benign.

New Life Cycle Assessment Study Shows Replacing Wood Utility Poles With Steel Significantly Lowers Key Environmental Impacts

SOURCE Steel Market Development Institute

LCA claims are put forward by many parties, including parties which could be considered as less than neutral. This is promising for LCA – it means that it matters in policy decision-making – but means that LCA claims must be understandable and transparent.

RESEARCH AND ANALYSIS

Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles

Troy R. Hawkins, Bhawna Singh, Guillaume Majeau-Bettez, and Anders Hammer Strømman

Keywords:

batteries
electricity mix
global warming
industrial ecology
life cycle inventory (LCI)
transportation

Supporting information is available on the *JIE* Web site

Summary

Electric vehicles (EVs) coupled with low-carbon electricity sources offer the potential for reducing greenhouse gas emissions and exposure to tailpipe emissions from personal transportation. In considering these benefits, it is important to address concerns of problem-shifting. In addition, while many studies have focused on the use phase in comparing transportation options, vehicle production is also significant when comparing conventional and EVs. We develop and provide a transparent life cycle inventory of conventional and electric vehicles and apply our inventory to assess conventional and EVs over a range of impact categories. We find that EVs powered by the present European electricity mix offer a 10% to 24% decrease in global warming potential (GWP) relative to conventional diesel or gasoline vehicles assuming lifetimes of 150,000 km. However, EVs exhibit the potential for significant increases in human toxicity, freshwater eco-toxicity, freshwater eutrophication, and metal depletion impacts, largely emanating from the vehicle supply chain. Results are sensitive to assumptions regarding electricity source, use phase energy consumption, vehicle lifetime, and battery replacement schedules. Because production impacts are more significant for EVs than conventional vehicles, assuming a vehicle lifetime of 200,000 km exaggerates the GWP benefits of EVs to 27% to 29% relative to gasoline vehicles or 17% to 20% relative to diesel. An assumption of 100,000 km decreases the benefit of EVs to 9% to 14% with respect to gasoline vehicles and results in impacts indistinguishable from those

A great example of open and transparent LCA is this study of electric vehicles (http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2012.00532.x/abstract).

It has an incredible amount of supporting information, allowing interested parties (e.g. electric car manufacturers) to examine the input data and suggest updates. Industry-provided data led to [an update](http://onlinelibrary.wiley.com/doi/10.1111/jiec.12011/abstract) (http://onlinelibrary.wiley.com/doi/10.1111/jiec.12011/abstract). However, printed tables still require significant work to reproduce manuscript results.

Bjorn Lomborg: Green Cars Have a Dirty Little Secret

Producing and charging electric cars means heavy carbon-dioxide emissions.

By Bjorn Lomborg

Electric cars are promoted as the chic harbinger of an environmentally benign future. Ads assure us of "zero emissions," and President Obama has promised a million on the road by 2015. With sales for 2012 coming in at about 50,000, that million-car figure is a pipe dream. Consumers remain wary of the cars' limited range, higher price and the logistics of battery-charging. But for those who do own an electric car, at least there is the consolation that it's truly green, right? Not really.

For proponents such as the actor and activist Leonardo DiCaprio, the main argument is that their electric cars—whether it's a $100,000 Fisker Karma (Mr. DiCaprio's ride) or a $28,000 Nissan Leaf—don't contribute to global warming. And, sure, electric cars don't emit carbon-dioxide on the road. But the energy used for their manufacture and continual battery charges certainly does—far more than most people realize.

A 2012 comprehensive life-cycle analysis in Journal of Industrial Ecology shows that almost half the lifetime carbon-dioxide emissions from an electric car come from the energy used to produce the car, especially the battery. The mining of lithium, for instance, is a less than green activity. By contrast, the manufacture of a gas-powered car accounts for 17% of its lifetime carbon-dioxide emissions. When an electric car rolls off the production line, it has already been responsible for

Of course, being open also allows those more interested in political points than scientific claims to selectively pull results. This is an inevitable part of democratic discussion.

Resource conflicts

5. ???

4. provide metadata

3. export LCI files

2. … plus give SI tables

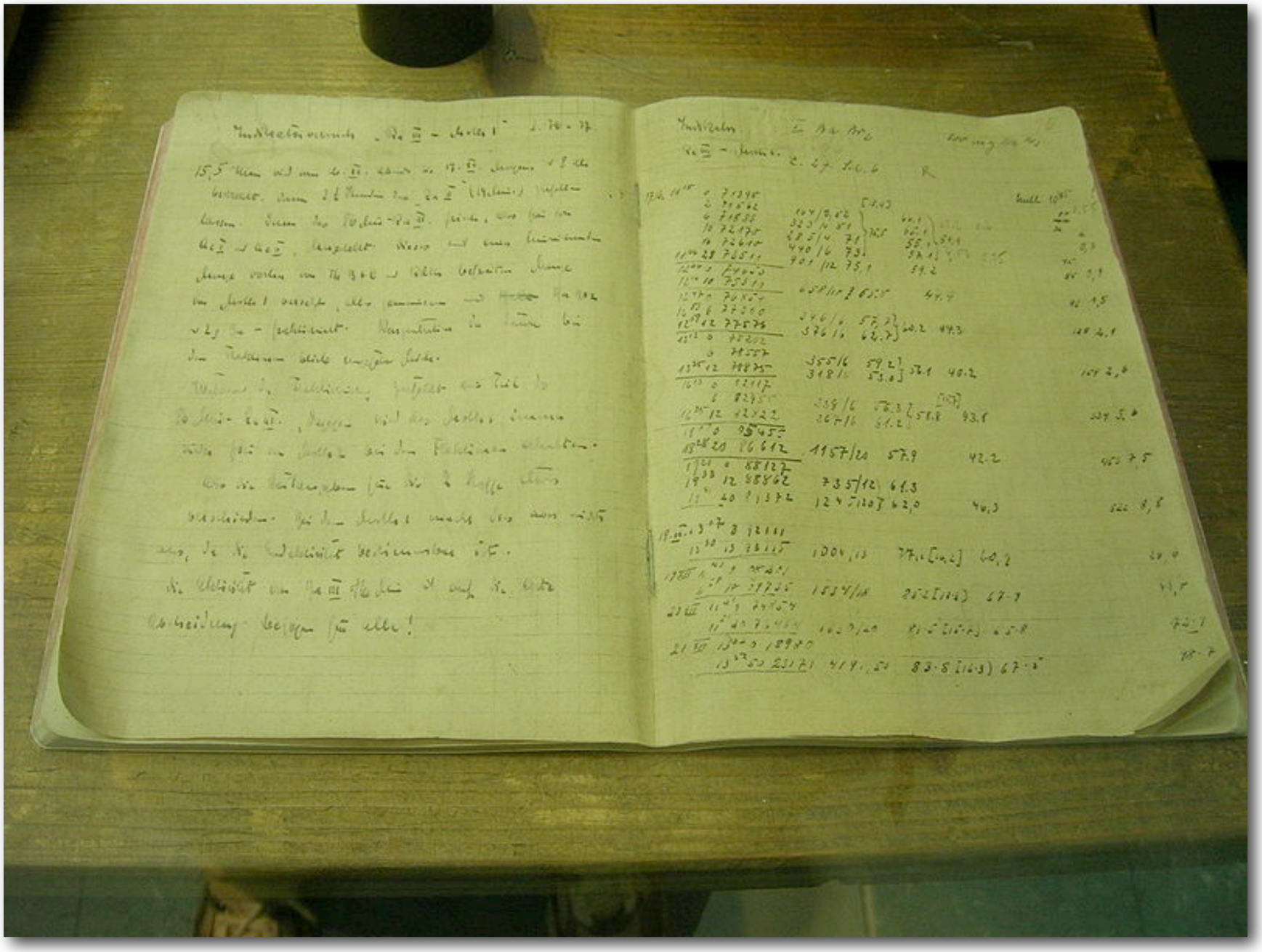
1. Plug some numbers
into some software

Trust

Energy

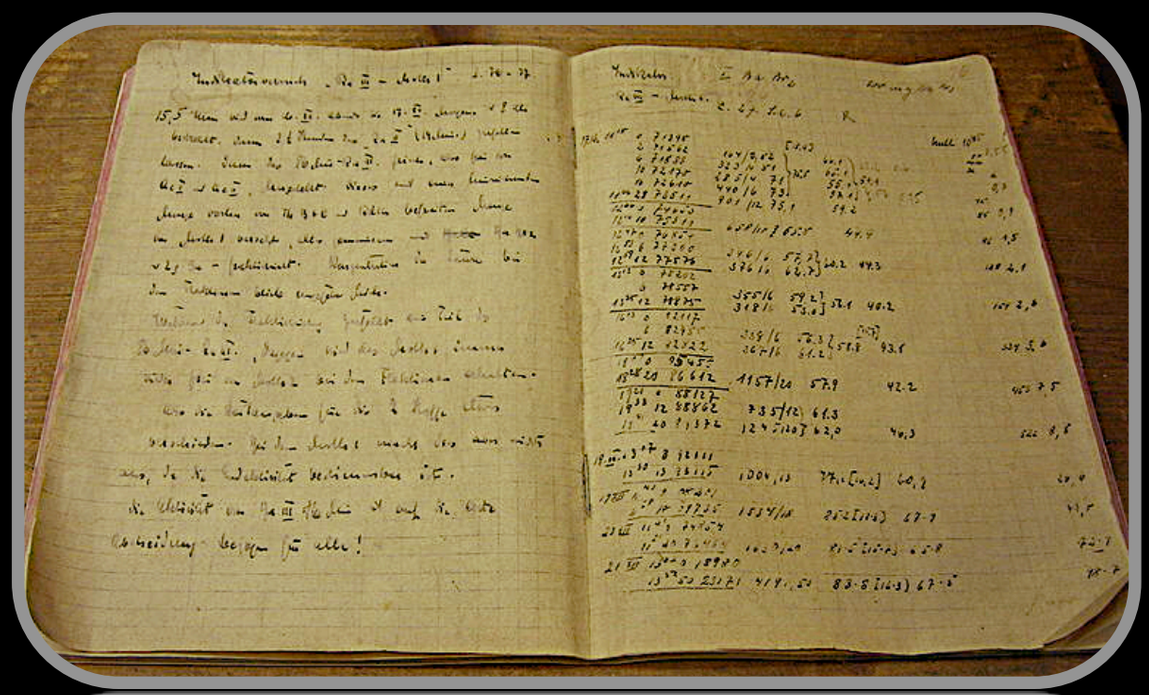
There are various ways of providing data to make reproducible or open LCA science. Is there a “batcat” option, which is more reproducible, or has higher trust, but requires less work?

Lab notebook



The classic way to record your work is a scientific lab notebook.

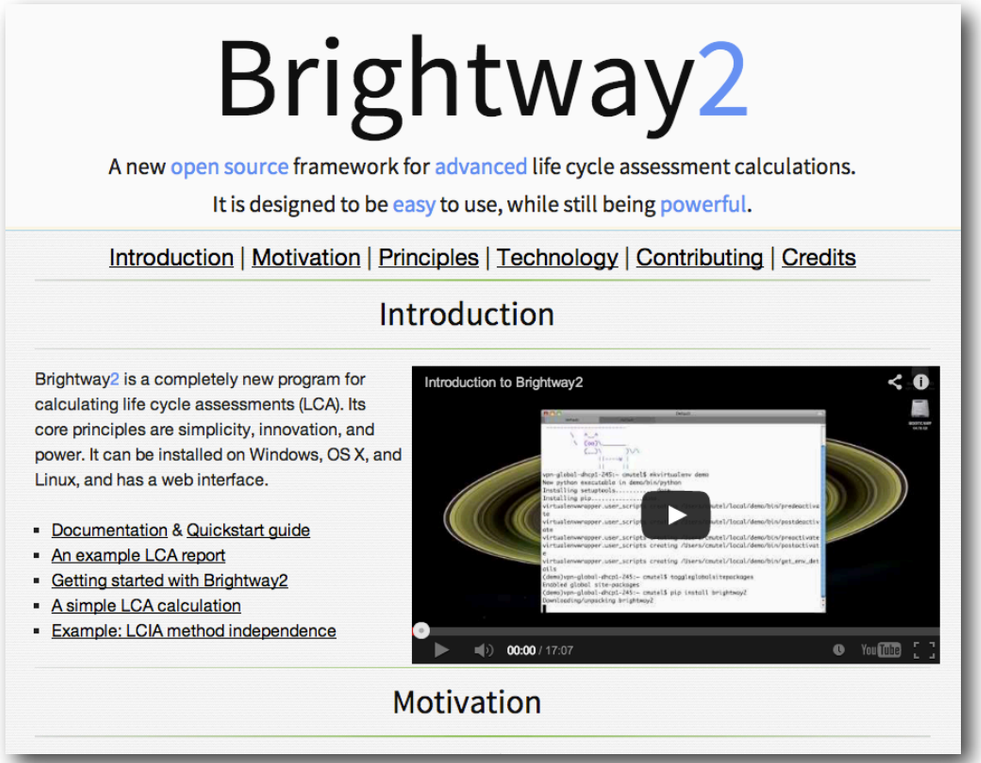
iLab notebook 2.0

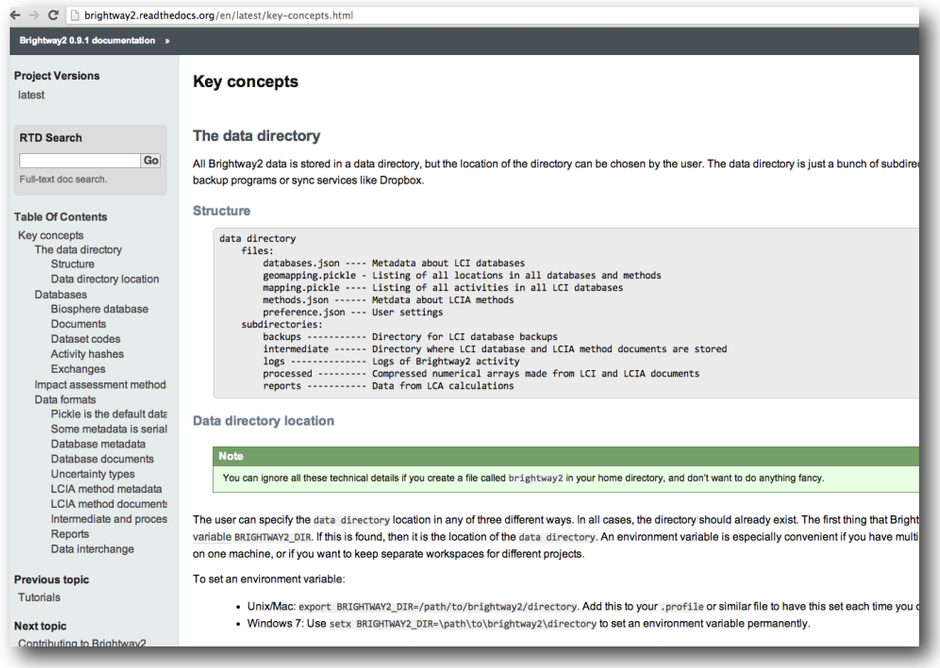


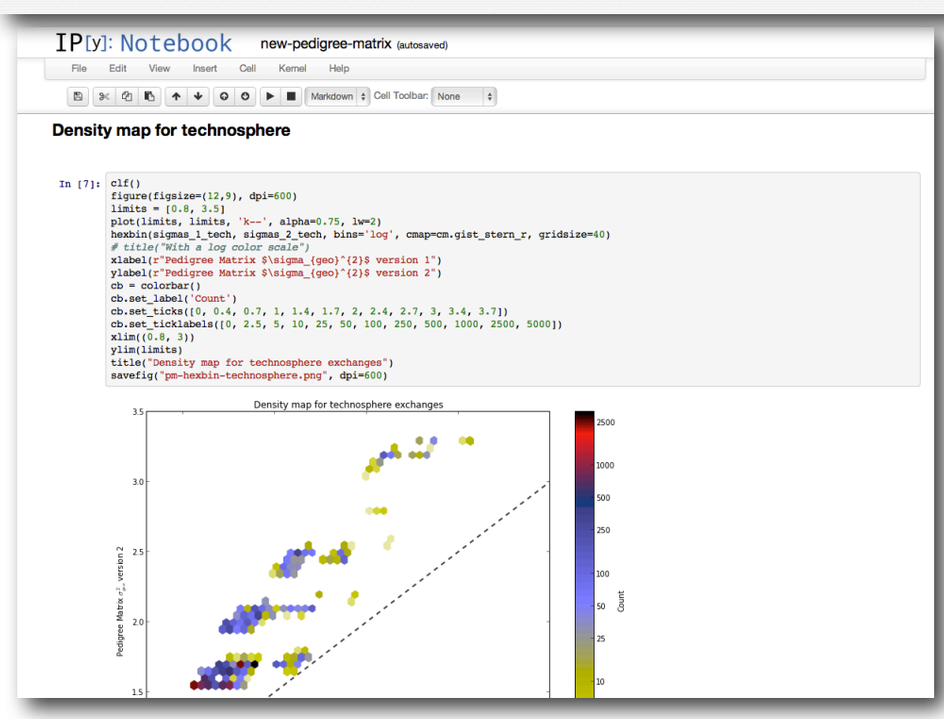
- Combine notes and work
- Copy and paste links, pictures, video
- Copy and modify work, & redo calculations
- Access by teams (web)

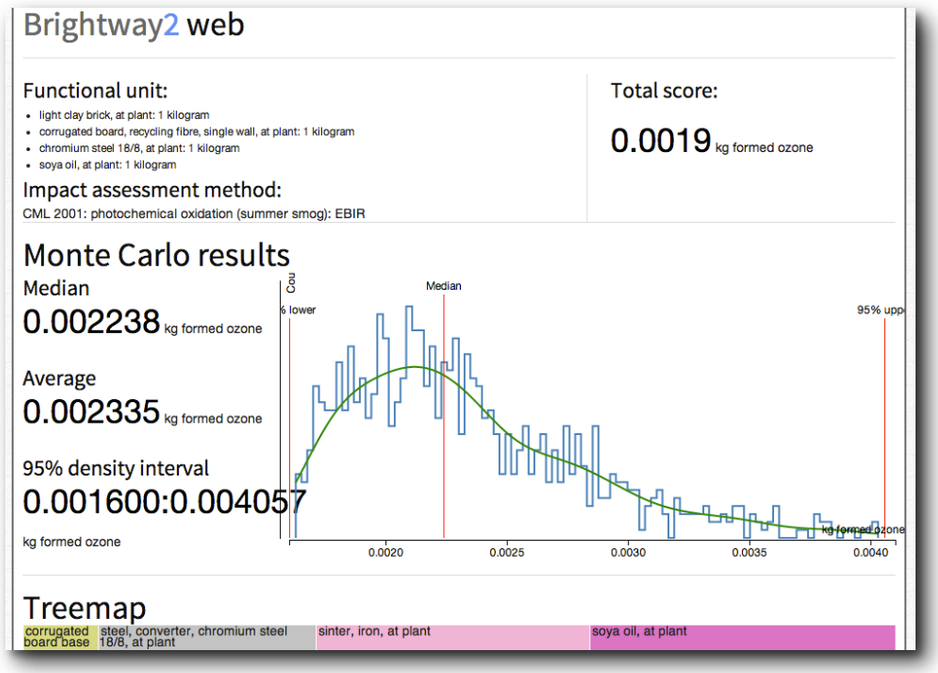
An updated scientific lab notebook would include a record of work, but add significant value with additional features.

Brightway2









Brightway2 (http://brightwaylca.org/) is one possible LCA software which can be used interactively, and is therefore well suited for use in online scientific notebooks.

Demonstration

http://brightwaylca.org/examples/demo-notebook-lca-orlando.html

The demo online notebook is static, not interactive, but can show the general idea of what an online lab notebook can look like.

Conclusions

- Notebooks not specific to IPython
  - e.g. Sage, Rstudio
- Notebooks are a journey, not a destination
  - Still need to do & document your work
- Reproducibility and openness good for LCA used in democratic decision making