The most important process(es) in ecoinvent 2.2

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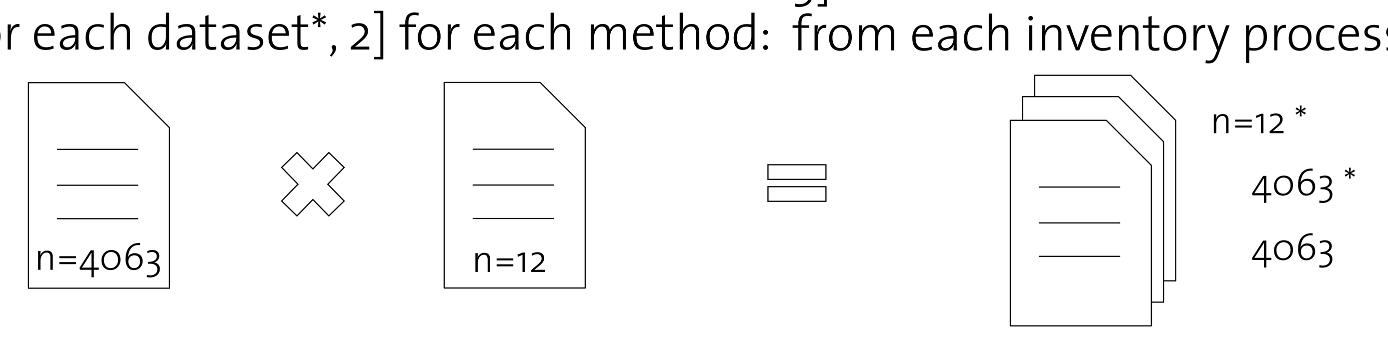
Introduction

- Over time, inventory databases should increase in quality as well as quantity. This requires prioritizing some datasets for increased data quality.
- Ecoinvent 2.2 has over 4000 inventory datasets, but most of them do not substantially effect LCA scores.

Methodology

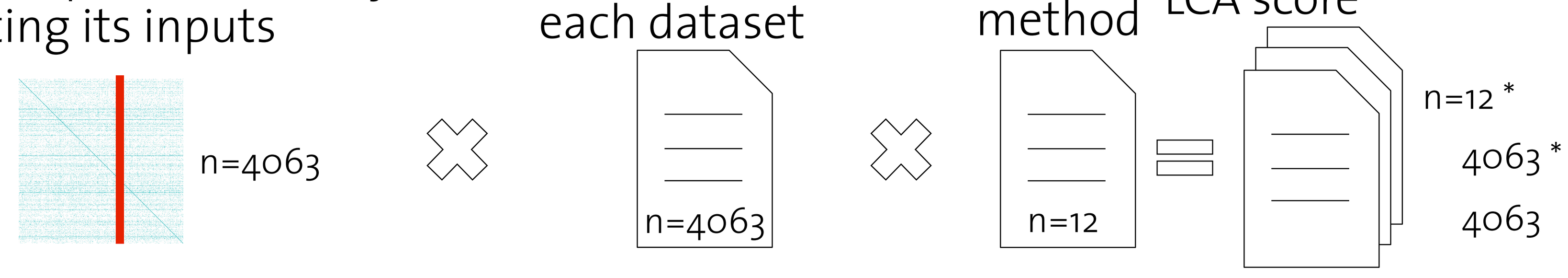
Direct contributions

1] for each dataset*, 2] for each method: 3] sum the total characterized emissions from each inventory process



Indirect contributions

1] for each dataset, modify the technosphere matrix by deleting its inputs 2] with the modified technosphere, for each dataset 3] and each method 4] calculate the relative change in LCA score



- CML 2001, resources, depletion of abiotic resources
- IPCC 2007 GWP, 100 year timeframe
- ReCiPe Midpoint, freshwater eutrophication
- ReCiPe Midpoint, ionising radiation
- ReCiPe Midpoint, marine eutrophication
- ReCiPe Midpoint, ozone depletion
- ReCiPe Midpoint, photochemical oxidant formation
- ReCiPe Midpoint, agricultural land occupation
- ReCiPe Midpoint, terrestrial acidification
- USEtox, ecotoxicity
- USEtox, human toxicity, carcinogenic
- USEtox, human toxicity, non-carcinogenic

We chose 12 LCIA methods based on EU JRC recommendations and statistical independence of LCA results. Not all results are can be shown here.

* So-called "system" datasets (confidential datasets where only aggregated results are given) were removed from the results

Direct contributions

Name	Geo	Median	Mean
lignite, burned in power plant	DE	0.016	0.032
hard coal, burned in power plant	DE	0.013	0.026
natural gas, burned in industrial furnace >100kW	RER	0.009	0.038
hard coal, burned in power plant	PL	0.007	0.015
pig iron, at plant	GLO	0.006	0.022

CML 2001, resources, depletion of abiotic resources

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IPCC 2007 GWP, 100 year timeframe

Name	Geo	Median	Mean
disposal, spoil from lignite min., in surface landfill	GLO	0.423	0.426
disposal, spoil from coal mining, in surface landfill	GLO	0.148	0.205
disposal, sulfidic tailings, off-site	GLO	0.083	0.181
disposal, basic oxygen furn. w., 0% water, landfill	CH	0.006	0.022
disposal, lignite ash, 0% water, to opencast refill	DE	0.001	0.001

ReCiPe Midpoint, freshwater eutrophication

crude oil, at production onshore	RME	0.150	0.162
transport, natural gas, pipeline, long distance	RU	0.138	0.177
crude oil, at production onshore	RAF	0.114	0.139
crude oil, at production onshore	RU	0.092	0.100
crude oil, at production	NG	0.051	0.073

ReCiPe Midpoint, ozone depletion

hardwood, standing, under bark, in forest	RER	0.368	0.393
softwood, standing, under bark, in forest	RER	0.357	0.391
softwood, Scandinavian, standing, u. bark, in forest	NORD.	0.011	0.051
hardwood, Scandinavian, standing, u. bark, in for.	NORD.	0.001	0.013
green manure IP, until march	CH	0.001	0.007

ReCiPe Midpoint, agricultural land occupation

natural gas, sour, burned in production flare	GLO	0.020	0.036
operation, transoceanic freight ship	OCE	0.014	0.031
hard coal, burned in power plant	ES	0.010	0.024
diesel, burned in building machine	GLO	0.010	0.047
blasting	RER	0.010	0.034

ReCiPe Midpoint, terrestrial acidification

disposal, slag, unall. electr. steel, 0% water, landfill	CH	0.085	0.161
disposal, spoil from lignite min., in surface landfill	GLO	0.037	0.097
disposal, basic oxygen furn. w., 0% water, landfill	CH	0.023	0.044
disposal, spoil from coal mining, in surface landfill	GLO	0.020	0.051
disposal, sludge fr. steel rolling, 20% water, landfill	CH	0.015	0.031

USEtox, ecotoxicity

disposal, slag, unall. electr. steel, 0% water, landfill	CH	0.206	0.253
disposal, spoil from lignite min., in surface landfill	GLO	0.083	0.154
disposal, basic oxygen furn. w., 0% water, landfill	CH	0.051	0.074
disposal, spoil from coal mining, in surface landfill	GLO	0.041	0.077
disposal, sludge fr. steel rolling, 20% water, landfill	CH	0.035	0.049

USEtox, human toxicity, carcinogenic

steel, electric, un- and low-alloyed, at plant	RER	0.078	0.145
copper, primary, at refinery	RLA	0.031	0.072
ferronickel, 25% Ni, at plant	GLO	0.015	0.033
zinc, primary, at regional storage	RER	0.010	0.060
sinter, iron, at plant	GLO	0.009	0.019

USEtox, human toxicity, non-carcinogenic

disposal
fossil fuels

Median and mean contribution of individual datasets to total LCA score

- Against expectations, there are few datasets which contribute the vast majority of LCIA impacts
- Disposal processes have high relative impacts and high uncertainties, making them good candidates for focused data quality efforts

Indirect contributions

Name	Geo	Median	Mean
electricity, production mix UCTE	UCTE	0.115	0.201
electricity, high voltage, production UCTE, at grid	UCTE	0.083	0.175
electricity, medium voltage, at grid	UCTE	0.070	0.162
natural gas, at long-distance pipeline	RER	0.058	0.120
natural gas, high pressure, at consumer	RER	0.058	0.118

CML 2001, resources, depletion of abiotic resources

Name	Geo	Median	Mean
electricity, production mix UCTE	UCTE	0.094	0.185
electricity, high voltage, production UCTE, at grid	UCTE	0.071	0.165
electricity, medium voltage, at grid	UCTE	0.057	0.154
electricity, production mix DE	DE	0.029	0.059
electricity, lignite, at power plant	DE	0.017	0.032

IPCC 2007 GWP, 100 year timeframe

Name	Geo	Median	Mean
lignite, at mine	RER	0.424	0.426
electricity, production mix UCTE	UCTE	0.388	0.419
electricity, high voltage, production UCTE, at grid	UCTE	0.309	0.369
electricity, medium voltage, at grid	UCTE	0.268	0.345
lignite, burned in power plant	DE	0.166	0.166

ReCiPe Midpoint, freshwater eutrophication

natural gas, production RU, at long-dist. pipeline	RER	0.138	0.177
crude oil, production RME, at long dist. transport	RER	0.129	0.140
crude oil, production RU, at long distance transport	RER	0.095	0.104
natural gas, high pressure, at consumer	RER	0.071	0.153
diesel, at refinery	RER	0.071	0.146

ReCiPe Midpoint, ozone depletion

round wood, softwood, u. bark, u=70% at for. road	RER	0.339	0.376
round wood, softwood, debark., u=70% at for. road	RER	0.338	0.375
round wood, hardwood, u. bark, u=70%, at for. road	RER	0.332	0.369
sawn timber, hardwd, raw, pl.-debark., u=70%, at pl.	RER	0.256	0.303
sawn timber, hardwd, raw, air dried, u=20%, at pl.	RER	0.255	0.302

ReCiPe Midpoint, agricultural land occupation

electricity, production mix UCTE	UCTE	0.067	0.164
electricity, high voltage, production UCTE, at grid	UCTE	0.054	0.145
electricity, medium voltage, at grid	UCTE	0.046	0.136
crude oil, production RU, at long distance transport	RER	0.022	0.041
crude oil, at production onshore	RU	0.021	0.041

ReCiPe Midpoint, terrestrial acidification

steel, electric, un- and low-alloyed, at plant	RER	0.071	0.141
reinforcing steel, at plant	RER	0.054	0.140
electricity, production mix UCTE	UCTE	0.047	0.117
electricity, high voltage, production UCTE, at grid	UCTE	0.038	0.104
lignite, at mine	RER	0.037	0.099

USEtox, ecotoxicity

steel, electric, un- and low-alloyed, at plant	RER	0.159	0.217
reinforcing steel, at plant	RER	0.107	0.211
electricity, production mix UCTE	UCTE	0.087	0.169
lignite, at mine	RER	0.083	0.155
electricity, high voltage, production UCTE, at grid	UCTE	0.058	0.150

USEtox, human toxicity, carcinogenic

copper, at regional storage	RER	0.049	0.113
reinforcing steel, at plant	RER	0.048	0.115
electricity, production mix UCTE	UCTE	0.037	0.083
electricity, high voltage, production UCTE, at grid	UCTE	0.029	0.074
electricity, medium voltage, at grid	UCTE	0.026	0.071

USEtox, human toxicity, non-carcinogenic

electricity
fossil fuels

Median and mean change in LCA score, normalized relative to LCA score with no technosphere modification. A value of zero means no change; a value of one means the LCA score with the modified technosphere is now zero.

- Energy datasets datasets are consistently important, and have strong network effects
- There is little overlap between direct and indirect contributions to total LCA scores

Conclusions

- The often-used energy supply and mixing processes could be split into more specific datasets
- Database meta-analysis is a useful tool for prioritization and exploration