MATERIALS WEEK EUROPE

The next speaker is...

Jan Boomsma
Managing Director
Sondel Engineering

sondel engineering

Lifecycle Analysis Tools for Advanced Material Choices

Scan below for Conference Agenda

Circular Rubber Platform™

The online community on rubber circularity

Lifecycle analysis tools for advanced material choices

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CRP-LCA

CRP-LCA – The new easy to use app for Life Cycle Analysis of all your rubber products!

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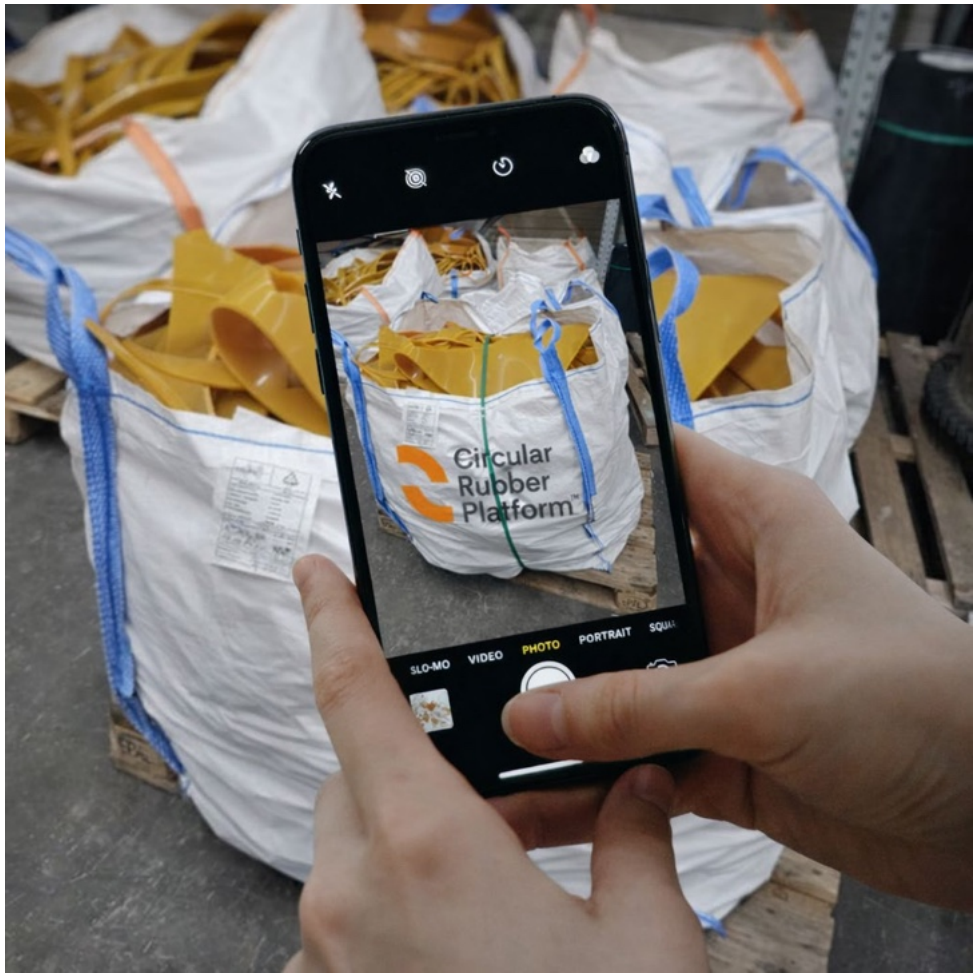
CRP-LCA



How it works:

- Take a picture of your product
- Let the app do the calculation
- Get your Carbon Footprint score!

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Time to wake up!

This is **NOT** how it works with LCA

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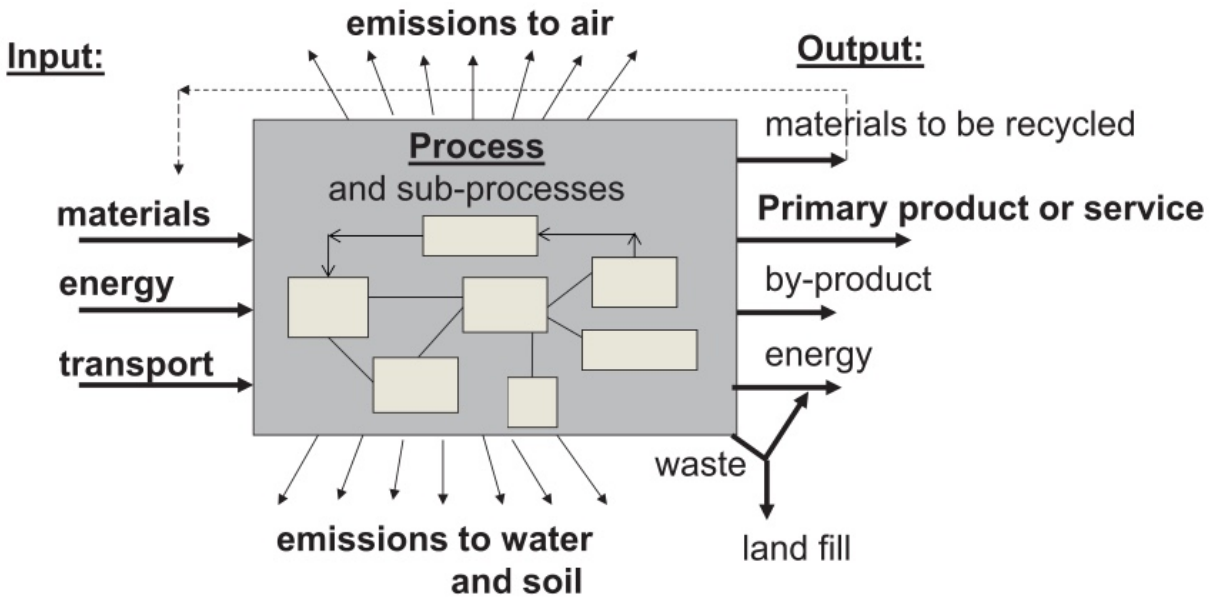
Purpose and Principles of Life Cycle Assessment



Overview of Life Cycle Assessment

LCA quantifies environmental impacts throughout all stages of a product's life from raw materials to disposal.

Holistic Systems Thinking

LCA assesses direct and upstream environmental impacts to avoid burden-shifting between lifecycle stages.

Environmental Trade-offs Visibility

LCA reveals trade-offs such as biobased materials reducing fossil use but increasing land or water consumption.

Supporting Sustainable Innovation

LCA guides material choices and supports regulatory compliance for sustainability certifications and market demands.

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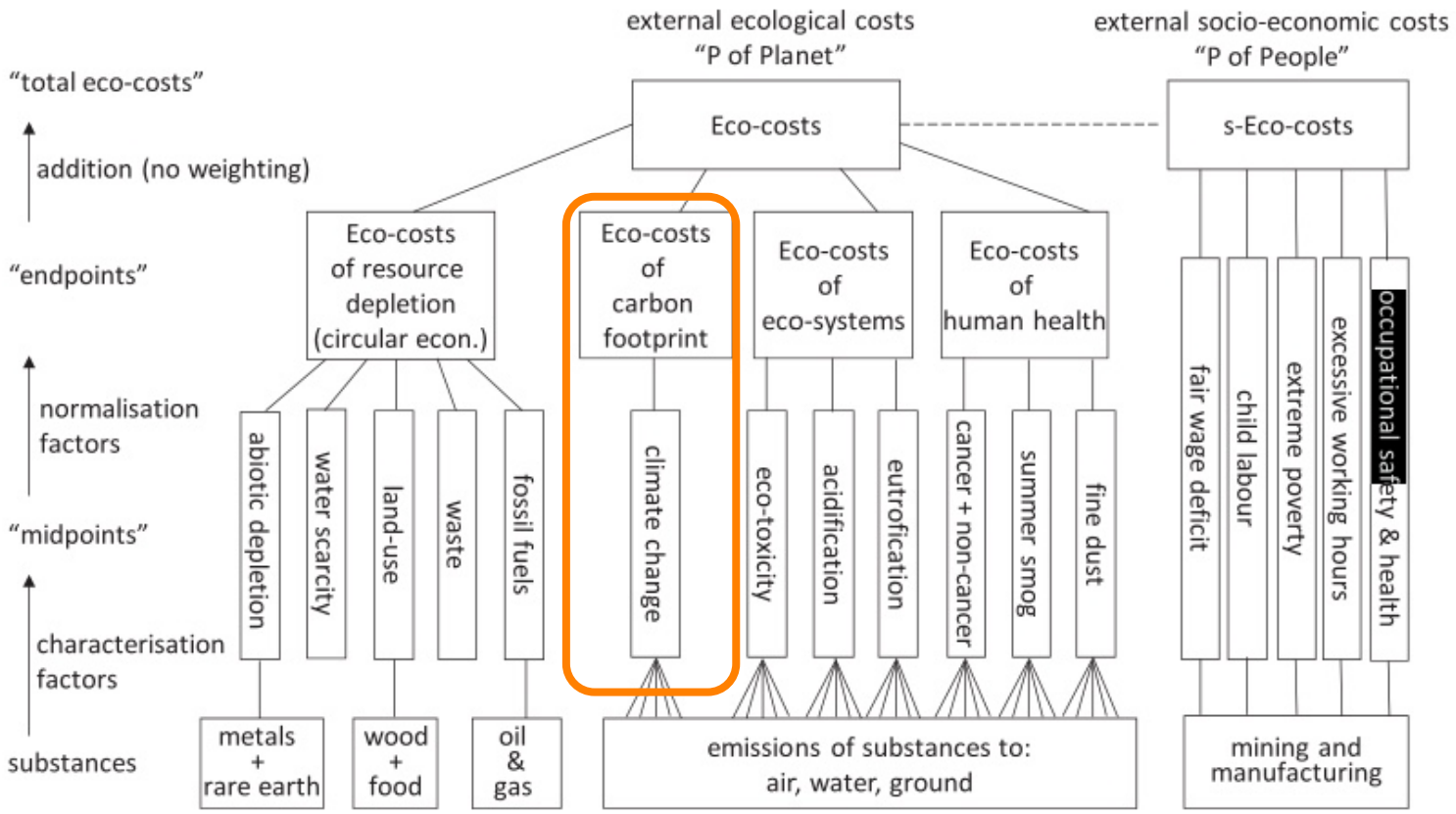
What you get with your LCA



Example of EPDM extruded profile from Ecoinvent

Midpoint	Value	Unit
Acidification	0.011167716	mol H+ -Eq
Climate change	2.760087529	kg CO2 Eq
Ecotoxicity, freshwater	17.77242673	CTUe
Resource depletion, fossils	79.02920248	MJ, net calorific value
Eutrophication, freshwater	0.000791368	kg P - Eq
Eutrophication, marine	0.001927182	Kg N -Eq
Eutrophication, terrestrial	0.019947258	mol N-Eq
Human toxicity, cancer	7.6816E-10	CTUh
Human toxicity, non-cancer	2.51621E-08	CTUh
Ionising radiation	0.345243003	-
Land use	11.66731169	
Resource depletion, minerals and metals	4.34567E-05	kg Sb-Eq
Ozone depletion	9.47703E-08	kg CFC-11-Eq
EF-particulate matter	1.75964E-07	disease incidence
Photochemical ozone formation	0.016019705	kg NMVOC-Eq
Water use	1.770271334	m3 world Eq deprived

Key Stages Required to Build an LCA

Goal and Scope Definition

Defines study purpose, functional unit, and system boundaries, often using cradle-to-gate for material LCAs.

Life Cycle Inventory (LCI)

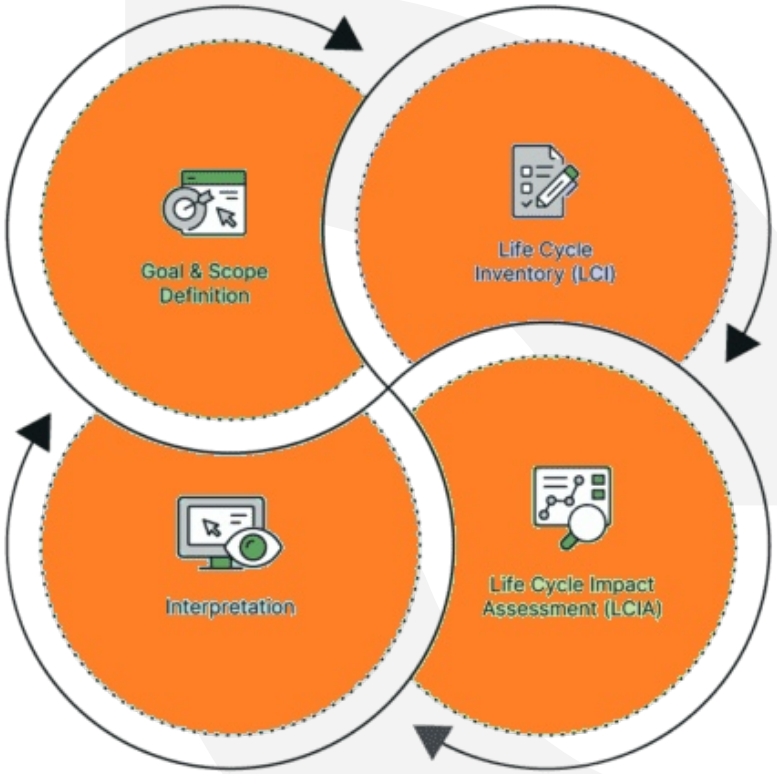
Quantifies inputs and outputs like raw materials, energy, emissions, and waste using databases or custom models.

Life Cycle Impact Assessment (LCIA)

Converts inventory data into environmental impacts such as climate change and resource depletion indicators.

Interpretation and Decision Making

Analyzes results, identifies hotspots, addresses uncertainties, and guides formulation improvements.



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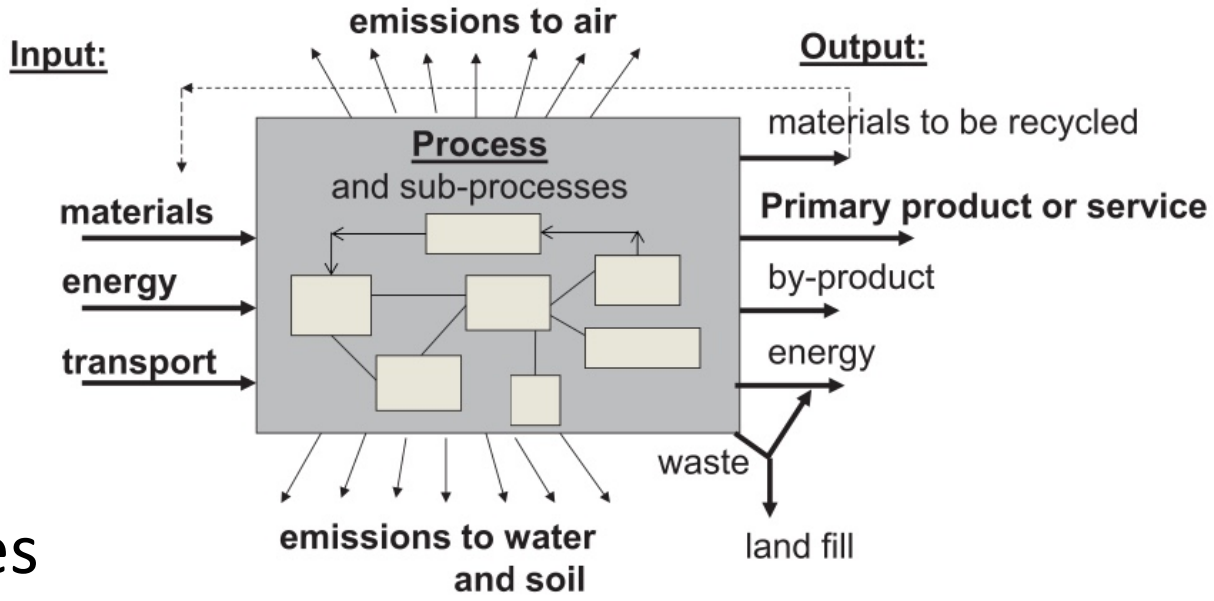
Life Cycle Inventory (LCI)

- Map your system
  - collect data: How much do we need of which raw material, energy input, or waste stream, to create our product or service
- LCI databases are collections of LCI–datasets
- Primary data – measured directly
- Data from literature
- Add up the LCI data of all sub-processes



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Idemat Fast track LCA

Streamlined LCA Method

Fast-track LCA uses predefined inventory blocks from databases to quickly estimate product environmental impacts.

Ideal Use Cases

Best suited for early-stage design, standard materials, and approximate sustainability reporting needs.

Limitations of Fast-Track LCA

Relies on generalized data, missing detailed supplier-specific or process-specific variations.

Purpose and Application

Serves as a directional tool for quick screening, benchmarking, and high-level sustainability evaluations.

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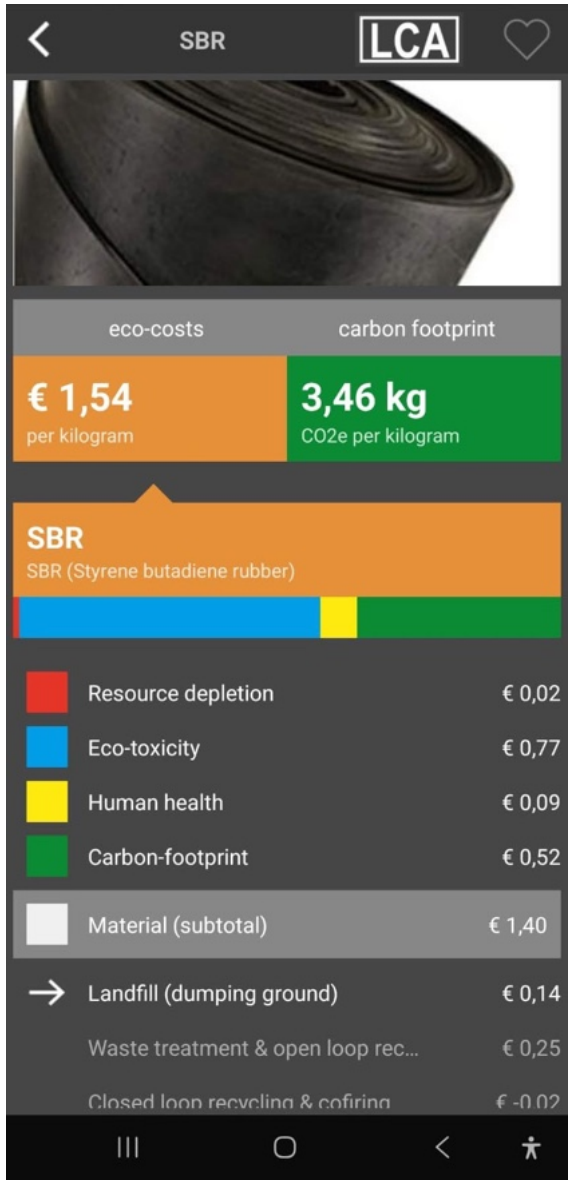
Fast track LCA



Lack of Granularity

Fast-track LCA cannot model ingredient-level variations or custom chemistries critical for material innovation.

Inadequate Dataset Coverage

Missing or emerging substances lack database entries, forcing inaccurate proxy approximations in fast-track LCA.

Process-Specific Transformations

Fast-track LCA cannot replicate energy use, emissions, and waste from custom mixing and curing processes.

Need for Advanced Modeling

Accurate scenario forecasting requires advanced tools.

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LCI databases

There is an ever-growing amount of LCI databases:

GaBi, Estimol, Agri-footprint, **ecoinvent**, EU and Danish Input Output, Industry data 2.0, US Life Cycle Inventory database, AGRIBALYSE, Agri-footprint, Environmental Footprint database, EXIOBASE 3, WEEE LCI database, Carbon Minds cm.chemicals database, DATASMART LCI package, ESU world food LCA database, IDEA Japanese Inventory database, Social hotspots database, PEF, NMD, ….

Choose the database that match the goal and scope of case studies done with the database

Create different scenarios to compare

Scenario	Change	Purpose
Baseline	Virgin rubber, conventional electricity mix	Reference scenario
Scenario A	30% recycled rubber	Reduce virgin material use
Scenario B	Renewable electricity (green energy)	Lower energy-related impacts
Scenario C	Mechanical recycling instead of thermal recycling	Improve end-of-life performance
Scenario D	Increased product lifetime (+20%)	Reduce impact per functional unit

Life Cycle Impact Assessment (LCIA)

LCA software to calculate the impact of each scenario

Software	Typical Use Case
SimaPro	Detailed, research-grade LCA across all industries; used by consultants, researchers, manufacturers
GaBi / Sphera LCA for Experts	Industrial LCA, chemicals, manufacturing, corporate sustainability
oneClickLCA	Construction LCAs, EPD generation, buildings & materials
openLCA	Open-source LCA for research, academia, government, SMEs
Ecochain (Mobius & Helix)	Manufacturing, product carbon footprints, factory footprints

Altermaker, Askor, bAwear-score, Brightway, CarbonBright, Carboncloud, Carbonfact, Carbongraph, CarbonSync, Cerclos, Dayrize, dCycle, Eandox, Earthshift, Earthster, Emvide, Goodlab, Greenly, Greenstory, iPoint (Umberto), LCA Calculator, Makersite, Peftrust, Pickler, Pilario, PIQET, ROOT, Solidworks Sustainability (Xpress), Sustainable Minds, Terrascope, Trazable, Umberto (iPoint), Yook.

Activity Browser

Open-Source and Python Based

Activity Browser is a Python-based open-source interface designed for advanced LCA research and Brightway2 integration.

Full Transparency and Customization

The tool exposes complete modeling logic, allowing users to inspect, modify, and extend datasets at a granular level.

Supports Advanced Scientific Workflows

It supports parameterized models, Monte-Carlo analysis, scenario testing, and sensitivity studies for robust research.

Flexible Automation and Integration

Based on Python, users can automate tasks and integrate external data like lab analytics or supplier inventories.

Required Expertise for Using Activity Browser

```
------------------------------------------------------------
InvalidExchange                           Traceback (most rec
Cell In[21], line 9
      6 imp.write_excel() #(only_unlinked=True)
      7 list(imp.unlinked)
----> 9 imp.write_database()

File /opt/homebrew/Caskroom/miniconda/base/envs/env_bw2/lib/p
    282 """Same as base ``write_database`` method, but ``acti
    283 kwargs["activate_parameters"] = kwargs.get("activate_
--> 284 super(ExcelImporter, self).write_database(**kwargs)

File /opt/homebrew/Caskroom/miniconda/base/envs/env_bw2/lib/p
    270 self.write_database_parameters(activate_parameters, d
    272 existing.update(data)
--> 273 db.write(existing)
    275 if activate_parameters:
    276     self._write_activity_parameters(activity_paramete

File /opt/homebrew/Caskroom/miniconda/base/envs/env_bw2/lib/p
    356 if projects.read_only:
    357     raise ReadOnlyProject(READ_ONLY_PROJECT)
--> 358 return wrapped(*args, **kwargs)

File /opt/homebrew/Caskroom/miniconda/base/envs/env_bw2/lib/p
    258 if data:
    259     try:
--> 260         self._efficient_write_many_data(data)
    261     except:
    262         # Purge all data from database, then reraise
    263         self.delete(warn=False)
```

Programming and Software Skills

Users require intermediate to advanced Python skills and familiarity with Brightway2 for scripting and dataset management.

LCA Principles and Modeling

A solid understanding of LCA conventions, including technosphere flows and system boundaries, is essential to avoid errors.

Manual Process Design

Users must manually design subprocesses by entering mass balances, energy use, emissions, and waste pathways.

Data Science and Analysis

Basic data science skills like spreadsheet handling and stoichiometric calculations improve modeling accuracy.

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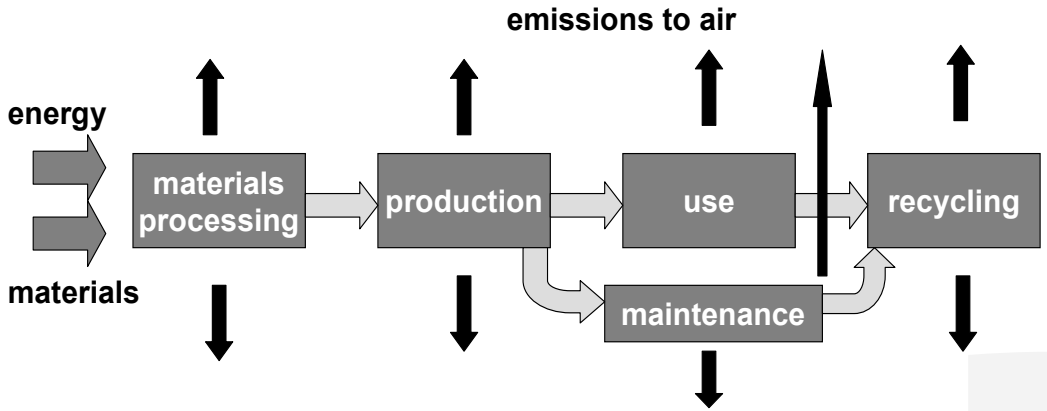
LCA estimates



LCA estimates can be made with (free) databases, production info and Excel

Functional unit:

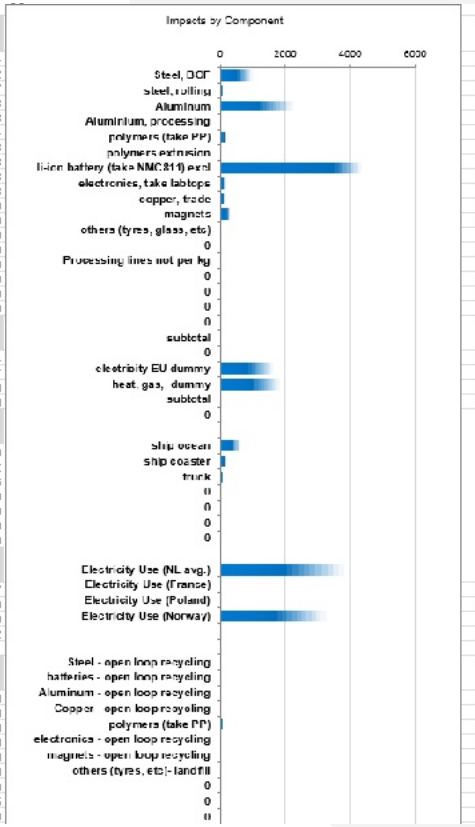
Manufacturing								
	item	unit	database name	Eco-intensity (impacts per kg)	Mass per item (kg)	Items per functional unit (#)	Uncertainty %	Notes
	Steel, BOF	kg	Steel virgin	15% scrap BOF for beams & sh	0,88	1000	1,3	30% afactor 1.3 to cope with the pro
	steel, rolling	kg	Rolling steel		0,03	1000	1	30% includes mfg process for rolling
	Aluminium	kg	Aluminium (primary) European production, b		7,9	700	1,3	30% afactor 1.3 to cope with the pro
	Aluminium, processing	kg	Machining aluminium		0,07	700	1	30% data in CEMAT, but many polic
	polymers (take PP)	kg	PP (Polypropylene)		1,15	100	1	30% type of polymer not known, but
	polymers extrusion	kg	extrusion, production site		0,05	100	1	10% assumption
	li-ion battery (take NMC811 excl electronic	kg	Lithium NMC811 (21.5 Wh per sq cm) cell packag		13,64	375	1	10% exact data in IDEMAT, but som
	electronics, take labtops	p	Computer laptop, 14 inch display		38,57	2	1	30% assumption
	copper, trade	kg	Copper wire, plate, tube, trade mix (68%		3,86	20	1	30% for wires this is the Idemat LCI d
	magnets	kg	Neodymium magnet (NdFeB) across production		105,13	2	1	30% weight is estimate per kW elect
	others (tyres, glass, etc)							
	Processing lines not per kg							
	subtotal			weight check:	2159			6983

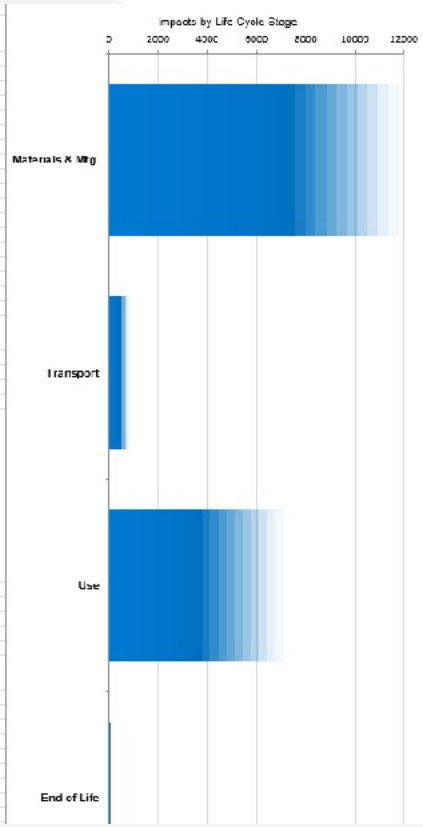
Manufacturing							
	unit	database name	Eco-intensity (impacts per MJ)	Energy per activity (MJ)	Items per functional unit (#)	Uncertainty %	Notes
electricity EU dummy	MJ	Electricity EU-27 production	0,1	4,11111	1	10%	to match carbon footprint data
heat, gas, dummy	MJ	Heat from natural gas for chemical processe	0,1	4,11111	1	10%	to match carbon footprint data
subtotal							7685
total manufacturing							14669

Transport								
	unit	database name	Eco-intensity (impacts/ton-km)	Mass per item (ton)	Distance per item (km)	Uncertainty %	Notes	Calculated impact
ship ocean	km	Container ship (min weight/volume ratio 0.41	0,02	2	20000	30%	parts from china to sweden	476,16349
ship coaster	km	Coaster Class A (coast LS and North and Ba	0,06	2	3000	30%	from manufacturing gate to cle	56,282352
truck	tkm	Truck+container 28 tonne net EF (min weigh	0,62	2	1000	30%	from manufacturing gate to cle	24,943056
total transport								599

Use							
	unit	database name	Eco-intensity (impacts/MJ or other)	Amount per item (MJ or other)	Items per functional unit (#)	Uncertainty %	Notes
Electricity Use (NL avg.)	MJ	Electricity Netherlands production	0,080	144 000	1	30%	Assumed Dutch electricity mix.
Electricity Use (France)	MJ	Electricity France production	0,016	111 000	0	30%	Assumed Polish electricity mi
Electricity Use (Poland)	MJ	Electricity Poland production	0,016	111 000	0	30%	Assumed Swedish electricity m
Electricity Use (Norway)	MJ	Electricity Norway production	0,007	111 000	1	30%	Assumed Norwegian electricity

End of Life							
	unit	database name	Eco-intensity (impacts/kg)	Mass per item (kg)	Items per functional unit (#)	Uncertainty %	Notes
Steel - open loop recycling		open cut recycling	1,111	1,111	1	10%	open loop recycling gas pore
batteries - open loop recycling		no recycling, let of batteries	1,111	13,64	1	10%	open loop recycling gas pore
Aluminium - open loop recycling		open cut recycling	1,111	7,11	1	10%	open loop recycling gas pore
Copper - open loop recycling		open cut recycling	1,111	3,11	1	10%	open loop recycling gas pore
polymers (take PP)	kg	PP (Polypropylene) waste incineration with	1,75	1,11	1	10%	waste incineration with heat re
electronics - open loop recycling		no recycling	1,111	5	1	10%	open loop recycling gas pore
magnets - open loop recycling		no recycling, let of magnets	0,000	2	1	30%	open loop recycling gas pore
others (tyres, etc)- landfill	kg	landfill inert waste	0,14	50	1	30%	landfill





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Conclusion on tools and databases

- There is no short-cut, no simple way to make an official LCA for a new material
- LCA estimates can be made with (free) databases, production info and Excel
- LCI databases are numerous and differ per goal or scope
- There are many LCA software packages available to calculate the final impact for different scenarios.

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Missions

Increase rubber recycling

Increase biobased content

Creating circular ecosystems

Community: 120 organizations and over 500 professionals

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Circular Rubber Economy

A circular economy uses less resources by prevention of waste, renewable materials and recirculation of materials at high value levels.

Eliminate material waste by design and during use

Use sustainably sourced regenerative materials

Reduce, reuse, repair, remanufacture, recycle

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Circular Rubber Economy

A circular economy uses less resources by prevention of waste, renewable materials and recirculation of materials at high value levels.

These questions are the same for
every sustainable rubber engineer globally.

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We have a database with circular rubber solutions

Solutions Stage.

Ready to use circular solutions for the rubber industry, supplied by the members of the platform.

Submit a solution

Search 49 solutions...

Category

- All
- Material
- Service
- Machinery
- Software
- Product

CATEGORY	NAME	SUPPLIER
Devulcanized rubber	Masterbatch NR100-01	ReRun Rubber Products B.V.
TPE Granulate	WAB N1	KUORI
Rubber compound	HEXGREEN 30 Sponge	HEXPOL Compounding
Functionalized powder	Actifine ST80	ARP
Mineral oils	Rerefined base oils RECOR-T and RECOR-M	H&R Group
Rubber powder	Vulcanized rubber powder	Nora Systems GmbH
Silicone compound	Silicrumb	Adpol

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So, want to join us and make rubber circularity the norm?

Become a member!

Link to website

Direct contact!

Whatsapp Jan Boomsma

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Join us and become part of the change!

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