LCA methodology challenges and opportunities for ICT products

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- Next steps: SimaPro Application Programming Interface and Blockchain
- Many topics are relevant for improvement of state-of-the art LCA. The LCA theory development – to which I also contribute - is crucial. However - for LCA - companies usually focus on the practical business side of things...

Some Quick LCA methods – non-exhaustive list

- 1) Original Huawei Quick LCA (HQLCA) method from 2012 based on material contents
- 2) HQLCA based on masses of Parts and components
- 3) Eco-rating type LCA (ERLCA) from 2017
- 4) Advanced ERLCA from 2018 based on ”strict SimaPro” and HQLCA
- 5) Remaining Value (RV) input–output (IO) correction LCA method
- 6) Carbon Disclosure Project (CDP) normalization method (CDPLCA)

Characteristics of some Quick LCA methods - I

	Speed	Likely Precision compared to ”perfect” PEF method	More than categories than GWP100	Primary data used	Secondary data used	1st tier and Assembly electricity separated
HQLCA (original)	Medium	Medium	Yes	Amount of each material content in MCD and components/parts	Literature AND material contents.	Yes
HQLCA (part masses)	High	Medium	Yes	Mass used for all parts	Literature for all except Amounts.	Yes
ERLCA	Very high	Low	No	Amount for each metric, e.g. Screen area, total die area, MP	EcoRating.	No
Advanced ERLCA	High	High	Yes	Amounts for some material contents and components	Literature.	Yes
RV IO LCA	Medium	Low	No	Amounts for some materials.	Value of priority parts and EIOLCA to account for remaining CO2. Predefined Embodied CO2 of materials account for upstream before distribution.	No
CDPLCA	High	Medium	No	Purchase Price of parts, CDP (annual CO2e/annual sales revenue) for Parts	CO2e/purchase price for similar Parts	Yes

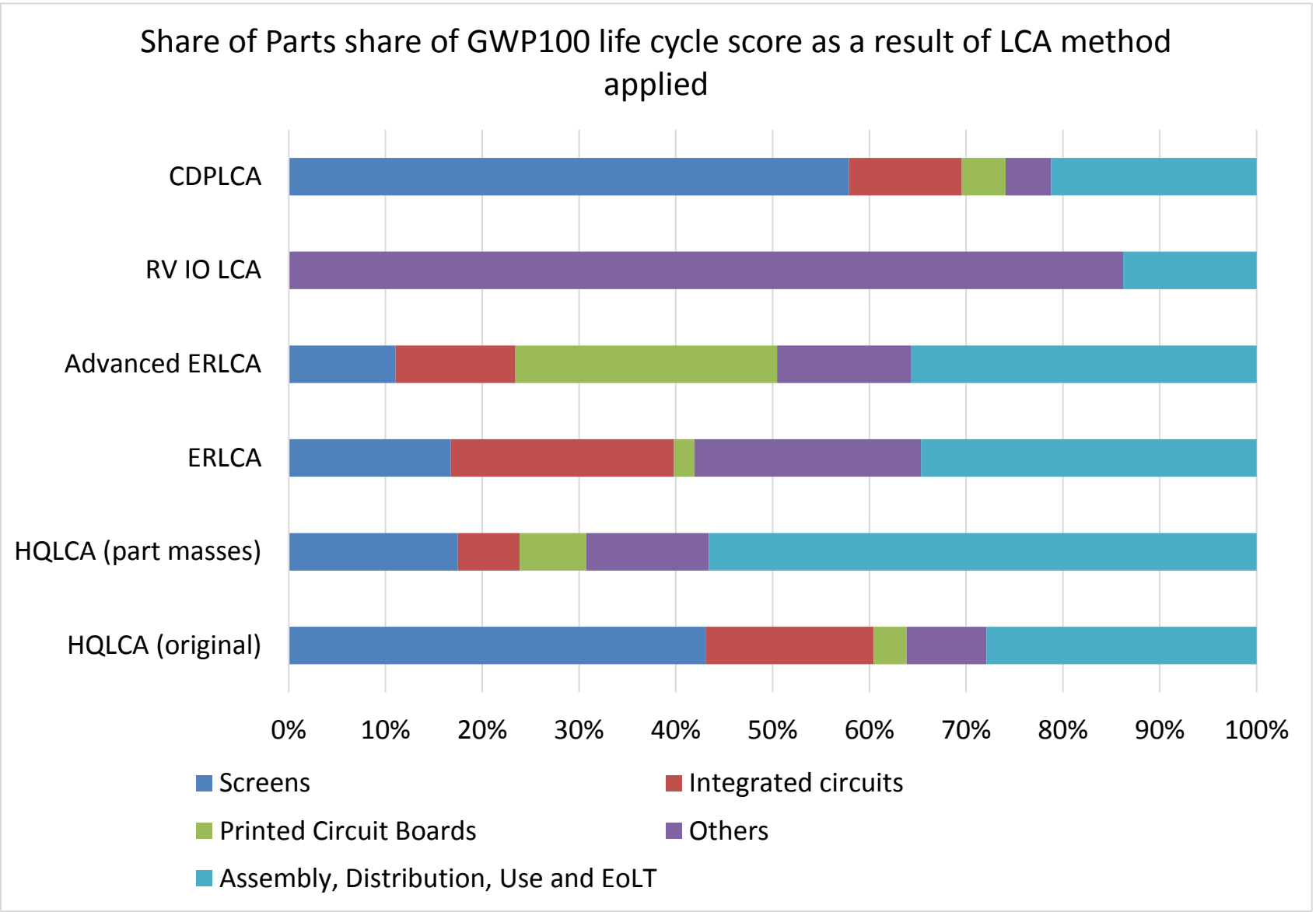
Metrics to be used in methods 1)-6) for ICT goods where applicable

	Amount (g)		Amount (g)		Amount (g)
Al	g, purchase price/piece	Tin		USB cable	
Cu		Zn			
Epoxy		Cameras			
Fiber Glass		Capacitors SMD			
Glass		Battery			
Gold		Capacitors Tantal			
Iron		Charger			
Lead		Diode SMD			
Mn		Connectors			
Ni		Inductors			
Nylon		ICs	g, cm2, purchase price/piece		
PVC		Displays	g, cm2, purchase price/piece		
PBT		PCBs	cm2, purchase price/piece		
Silver		Resistors			
Steel		Switches			

Characteristics of Quick LCA methods applied to a smartphone - II

	Relative LCA GWP score to RV IO LCA	Share of Upstream, Assembly Distribution, Use, EoLT	Main drivers Upstream as % of total LCA score	Comments
HQLCA (original)	0.49	0.72	Screens 43, ICs 17, PCBs 3, Others 8	Screens overestimated
HQLCA (part masses)	0.24	0.43	Screens 17, ICs 17, PCBs 7, Others 8	ICs underestimated
ERLCA	0.23	0.65	Screens 17, ICs 23, PCBs 2, Others 8	PCBs underestimated
Advanced ERLCA	0.39	0.64	Screens 11, ICs 12, PCBs 27, Others 8	PCBs need more confirmation.
RV IO LCA	1.00	0.86	The contribution of processes that are not included in either process-sum analysis or additive IO	The process related CO2 is captured by CO2/GDP.
CDPLCA	0.65	0.79	Screens 58, ICs 12, PCBs 4, Others 5	Supplier specific

Characteristics of Quick LCA methods applied to smartphone - III



CDPLCA: Specific primary data. Will ”every supplier” report?

RV IO LCA: Show the possible magnitude of hidden flows

Advanced ERLCA: More details than HQLCA and ERLCA – losses PCB, re-use of sub-parts, use stage

RV IO LCA: Embodied CO2eq for materials is not enough for consumer ICT

Table 1. Embodied CO_2eq in materials.

Material	Amount per Converter (kg)	CO_2eq Intensity (kg CO_2eq/kg)	CO_2eq per Converter (ton)
Aluminum	32.78	8.24	0.270114
Arsenic	0.04	4	0.000145
Brass	0.03	4.39	0.000153
Cadmium	0.00	5.8	0.000002
Carbon	0.10	6.5	0.000648
Ceramic	0.15	5.5	0.000841
Copper	8.63	3.5	0.032747
Epoxy	0.70	9	0.006321
Fiber glass	0.0002	8.1	0.000002
Glass	0.002	0.85	0.000001
Gold	0.02	3000	0.048786
Iron	0.19	1.91	0.000368
Lead	0.00	20	0.000026
Manganese	0.10	2.6	0.000289
Nickel	0.19	12.4	0.002323
Nylon	0.06	6.5	0.000420
Phosphor	0.02	3.39	0.000081
PVC	0.08	2.2	0.000343
PBT	0.08	7.9	0.000647
Silicon	0.29	10	0.002880
Silver	0.20	754	0.150227
Steel	13.85	5.9	0.081720
Tantalum	1.21	260	0.313812
Tin	0.28	13.7	0.003888
Zinc	0.07	9	0.000596
Total	59.07	-	0.917350

Table 1 to the left → 0.58 kg CO2 per smartphone.

1. Value per priority part *i* (Ai)
2. Fraction accounted of Each priority part *i* in process-LCA (Bi)
3. Value of electronic chemicals (C)
4. Fraction accounted (D)
5. Cost of parts 2018 (E)
6. Cost of parts 2002 (F = 1268/1775×E)
7. CO2 GDP intensity (CO2GDPI)
8. Remaining value, RV = F - ∑(Ai×Bi)+C×D
9. RV IO CO2 {Total RV per ICT good} = CO2GDPI × RV, ≈ 50-100 kg for a smartphone

Most upstream CO2 emissions are derived by CO2 Emissions (kg per 2010 US$ of GDP) Data. Unit GDP impact intensity is not new…

Source Table 1 and method: Energies 2019, 12, 3347; doi:10.3390/en12173347, https://www.mdpi.com/1996-1073/12/17/3347. 1268/1775 is USD adjustment from Table 3. https://data.worldbank.org/indicator/EN.ATM.CO2E.KD.GD gives CO2GDPI

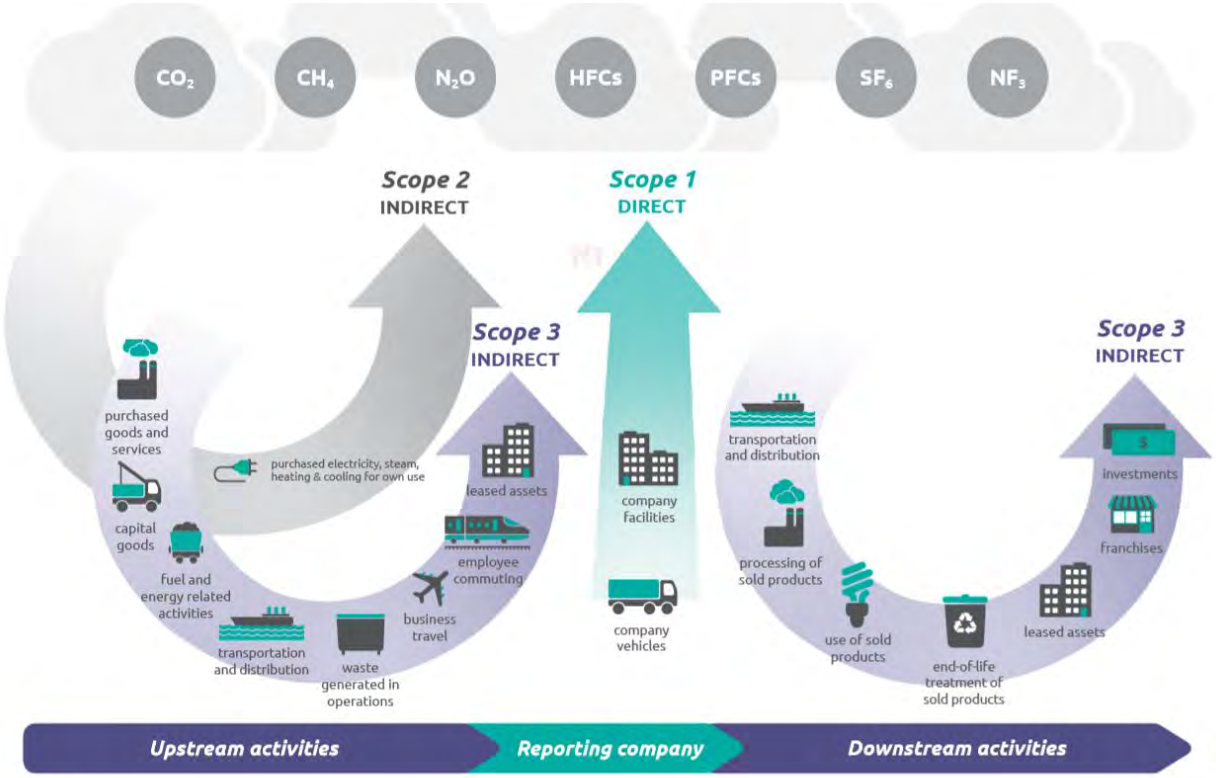
CDPLCA: GHS Scope 1,2,3 explanation (not rigorous definition)

- **The GHG Protocol Corporate Standard classifies a company's GHG emissions into three 'scopes'.**

  Scope 1 emissions are direct emissions from owned or controlled sources.

  Scope 2 emissions are indirect emissions from the generation of purchased energy.

  Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.



Source: Figure 1.1 of *Scope 3 Standard.*

CDPLCA: Scope 3 Upstream - Product LCA or Scope 1&2?

- Customers of OEM need Scope 3 Upstream Data to reach reduction targets in the supply chain.
- Product LCA (HQLCA, PAIA etc) is often used to estimate the Upstream (and Downstream) Scope 3 CO2e emissions – Categories, 1,4,9,11,12.
- However, some companies outright reject the idea of Scope 3 estimations due to B2B allocation problems
- Some use partial estimation of their Scope 3 Upstream
- Product LCA is essential until ”all” companies globally have reported to CDP?
- CO2e/revenue sales ($,€,£,¥) intensities for parts and product categories

CDPLCA: Preliminary carbon intensities

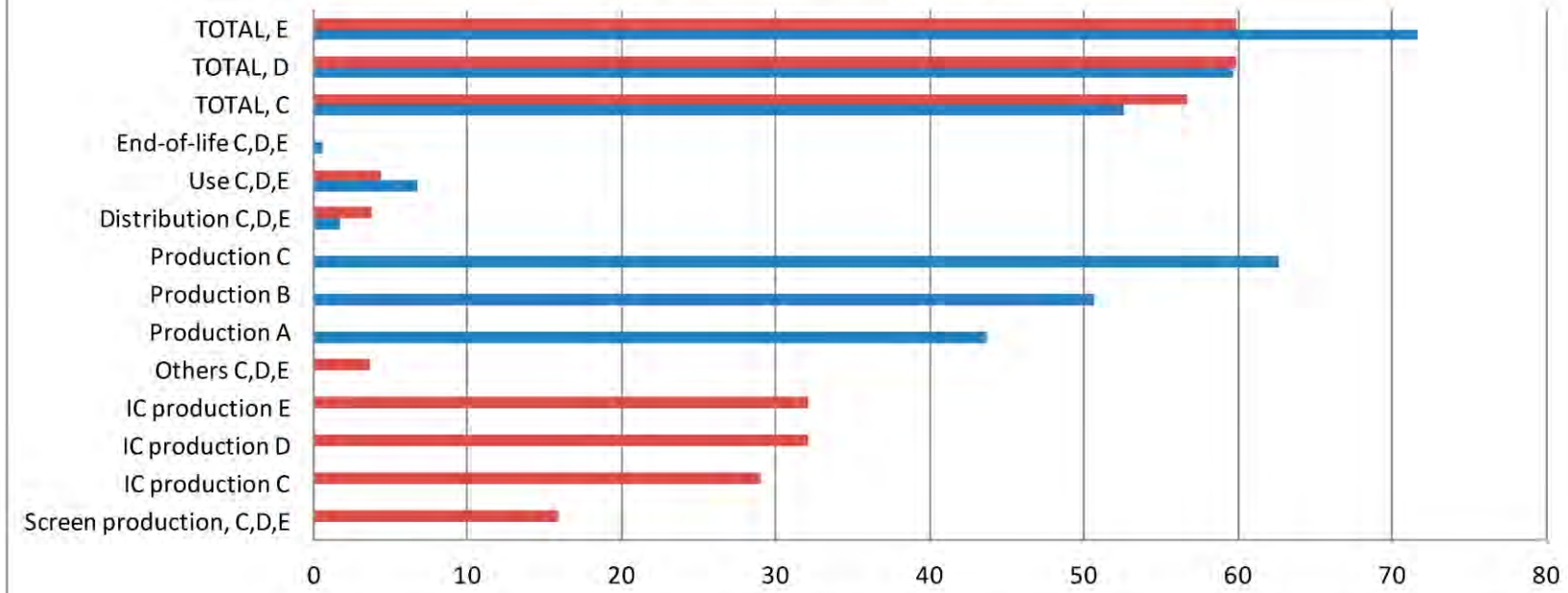
Carbon intensity, kg/€ , by HQLCA (using € sales price/piece)	**Carbon intensity, kg/€ , by CDPLCA (using € annual revenue sales/company)**	**Product or Part category**
0.2	0.16	Base station
0.07	0.12	Smartphone
0.1	0.24	Server
0.06	0.4	Screen
0.05	0.07	Integrated circuit
0.67	0.13	Printed Circuit Board

Sales prices, revenue sales and company carbon accounts (Scope 1,2,3) might have a higher availability – and consistency - in the short-term than PLCAs. CDPLCA can be used as a sensitivity check of existing product LCAs etc.

Eco-rating LCA vs. Full LCA - smarphones

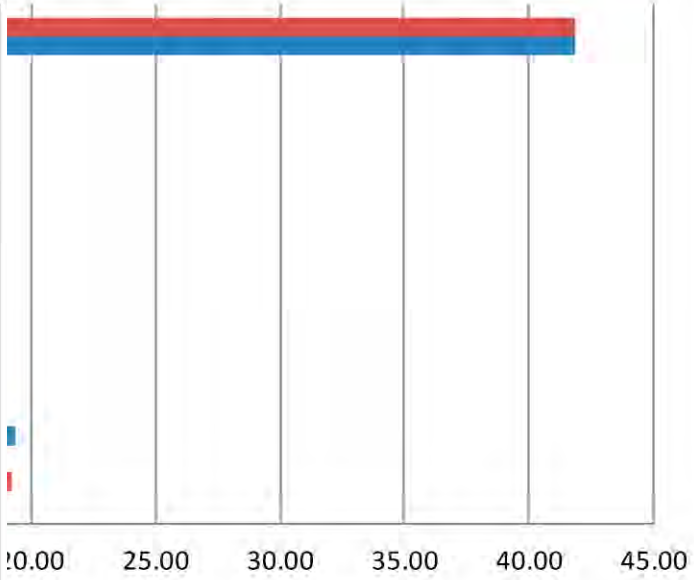
Repartition of GWPI score of FLCA and [$kgCO_2$—eq./2 years]

Repartition of GWPI score of FLCA and OLCA, Phones C to E [$kgCO_2$—eq./2 years]



	Screen production, C,D,E	IC production C	IC production D	IC production E	Others C,D,E	Production A	Production B	Production C	Distribution C,D,E	Use C,D,E	End-of-life C,D,E	TOTAL, C	TOTAL, D	TOTAL, E
OLCA Phones C,D,E	15.87	28.96	32.12	32.12	3.68	0			3.76	4.33	0.08	56.68	59.84	59.84
FLCA Phones C,D,E	0	0	0	0	0	43.68	50.68	62.68	1.68	6.72	0.56	52.64	59.64	71.64

Repartition of GWPI score of FLCA and OLCA, Phone B [$kgCO_2$—eq./2 years]



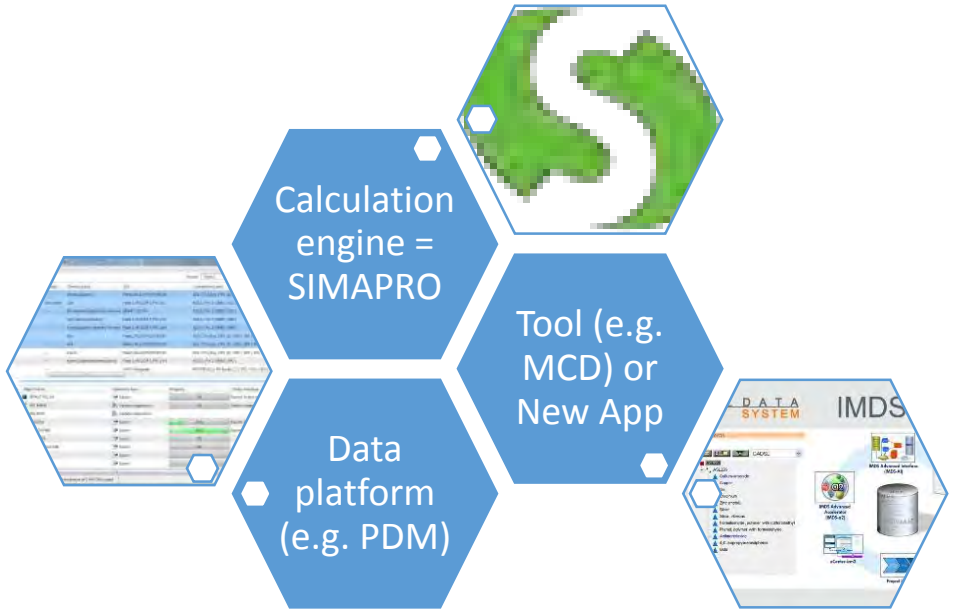
on	Use	End-of-life	Others	TOTAL
	5.35	0.12	5.41	41.82
	3.99	-1.11	9.15	41.86

https://www.mdpi.com/2078-1547/8/2/21

Eco-rating LCA → Fast PEF based LCA

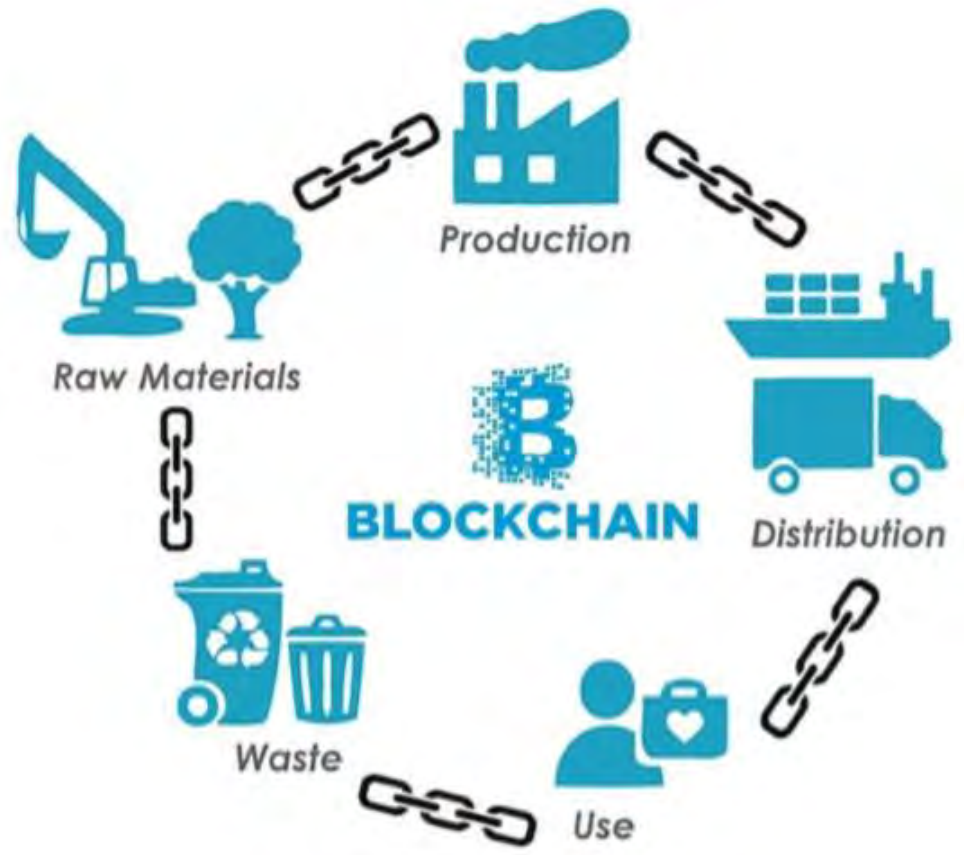
- The LCA section of ERLCA will be transformed into PEF LCA
- However, conclusions from ETSI TR 103 679 May 2019:
  - Something more than what the ETSI LCA standard ETSI ES 203 299 prescribes is probably useful.
  - However, it is doubtful if a full adherence to the PEFCR Guidance is necessary for smartphones.

SimaPro API interface – ALCA made perfect?



As SimaPro API helps connect existing or new tools to the LCA calculation engine, we know that suppliers could insert LCI data directly as well as material Content from e.g. IMDS. CDP answers and finan-Cial reports too.

Can Blockchain bridge the gaps of current LCA shortcomings?



BC could help verify information in all steps of the value chain

"Blockchain traceability for recycled cobalt to power electric vehicles"

Source: E-Waste World Conference & Expo, Frankfurt, Nov. 14, 2019

No difference compared to life cycle inventory data in LCA?

Summary

- The uncertainty range is likely less than one order of magnitude for leading companies PCFs
- New IT tools will bring down the uncertainty range of PCFs
- Clear requirements are necessary, otherwise few incentives for developing state-of-the art LCA
- CDPLCA might be an interesting practical approach
- It can be determined which sub-parts drive CO2 emissions – i.e. more than order of magnitude estimations for life cycle stages are possible – the unknowns are known!
- Toxicity categories and others need a new look soon.

Danke schön!