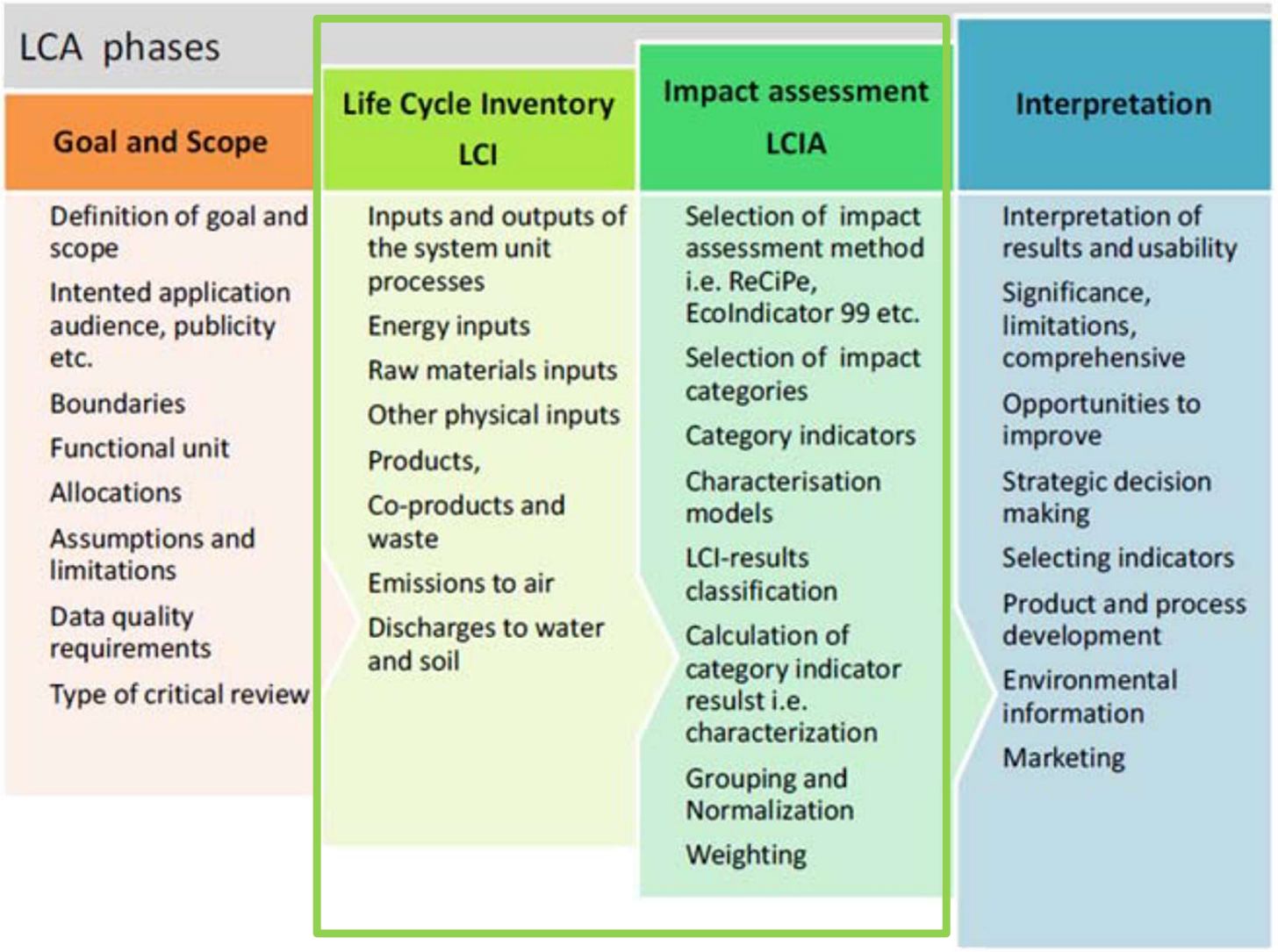
Avaliação do Ciclo de Vida
Aula 4 – Elementos da ACV
2 Dezembro 2022

INSTITUTO SUPERIOR DE AGRONOMIA
Universidade de Lisboa

mestrado em engenharia do ambiente
U.C. de Avaliação de Impacte Ambiental
módulo II
ano letivo 2022/2023

Componentes de uma ACV



Componente 2: Software

- Permite a integração dos dados de inventário: dados recolhidos (foreground) e bases de dados (background)
- Permite a modelação dos impactes e a sua avaliação

- Software comercial: Simapro, GaBi, Umberto, ...
- Software gratuito: OpenLCA

Componente 2: Software - inputs

C:\Users\Public\Documents\SimaPro\Database\FullUpdate930; Cork_test - [View material process 'Cork slab {SOUSA SA}| market for cork slab | Cut-off, U']

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Documentation | **Input/output** | Parameters | System description

Products

Outputs to technosphere: Products and co-products	Amount	Unit	Quantity	Allocation	Waste type	Category	Comment
Cork slab {SOUSA SA}| market for cork slab | Cut-off, U	1000	kg	Mass	100 %	Compost	Constructio...\Market	Production Volume Amount: 1.3223694562911987

Outputs to technosphere. Avoided products	Amount	Unit	Distribution	SD2 or 2SD	Min	Max	Comment

Inputs

Inputs from nature	Subcompartment	Amount	Unit	Distribution	SD2 or 2SD	Min	Max	Comment

Inputs from technosphere: materials/fuels	Amount	Unit	Distribution	SD2 or 2SD	Min	Max	Comment
Cork slab {RER}| production | Cut-off, U	1010	kg	Undefined				Production Volume Amount: 1.3223694562911987
Transport, freight, lorry, unspecified {RoW}| market for transport, freight, lorry, unspecified | Cut-off, U	301,3	tkm	Undefined				
Transport, barge ship, container, 2000t, 50%LF, empty return/GLO Mass	65,1409031418564	tkm	Lognormal	1,9993			(3,5,2,1,4,na) Transport distance based on eurostat transport statistics for railway transport of goods. The transport data was extracted from the database leaf 'Railway transport - goods transported, by group of goods - from 2008 onwards based on NST 2007 (1 000 t, million tkm) (rail_go_grpgood)' (http://ec.europa.eu/eurostat/data/database) on the 2018-06-01. The transport distance was calculated based on the total mass of goods transported and total payload-distance for the NST 2007 category 'GT06 - Wood and products of wood and cork (except furniture); articles of straw and plaiting materials; pulp, paper and paper products; printed matter and recorded media' in the year 2016 for all countries for which data was available. The average distance of railway transport for goods in this category in 2016 was 328 km. The fraction of goods transported by rail (in terms of mass) relative to the total mass of goods transported by road, rail and inland waterways was 7.7% in 2016. Therefore, the average distance that goods travelled by rail in 2016 was 25 km. This value is assumed to be representative for Europe.
Transport, freight, lorry, unspecified {RER}| market for transport, freight, lorry, unspecified | Cut-off, U	0,18661856	tkm	Lognormal	1,9993			(3,5,2,1,4,na) Transport distance based on eurostat transport statistics for road freight transport. The transport data was extracted from the database leaf 'Annual road freight transport, by type of goods and type of transport (1 000 t, Mio Tkm), from 2008 onwards (road_go_ta_tg)' (http://ec.europa.eu/eurostat/data/database) on the 2018-06-01. The transport distance was calculated based on the total mass of goods transported and total payload-distance for the NST 2007 category 'GT06 - Wood and products of wood and cork (except furniture); articles of straw and plaiting materials; pulp, paper and paper products; printed matter and recorded media' in the year 2016 for all countries for which data was available. The average distance of road transport for goods in this category in 2016 was 203 km.

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Componente 2: Software - Inventário

C:\Users\Public\Documents\SimaPro\Database\FullUpdate930; Cork_test - [Analyse Cork slab {M.SOUSA SA}| market for cork slab | Cut-off, U (excluding infrastruc]

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Network | Tree | Impact assessment | **Inventory** | Process contribution | Setup | Checks (912) | Product overview

Compartment: All compartments — Indicator: Amount — Cut-off: 0% — Default units

☑ Per sub-compartment — Category — ◉ Standard — ☐ Exclude long-term emissions

☐ Skip unused — ○ Group — ☐ Per impact category

No	Substance	Compartr	Subcompartn	Unit	Total	Cork slab {M.SOUSA SA}|	Cork slab {RER}|	Transport, freight, lorry,	Transport, barge ship,	Transport, freight, lorry,
847	Formic acid	Water	river	µg	3,5249238	x	3,5242814	0,00059974204	x	4,2651777E-5
848	Fungicides, unspecified	Water	ocean	µg	19,89837	x	19,056643	0,73916012	x	0,10256701
849	Fungicides, unspecified	Soil	agricultural	ng	38,923482	x	38,283207	0,55569468	x	0,084580744
850	Furan	Air		pg	647,88839	x	647,46418	0,41921962	x	0,0049952566
851	Furan	Air	low. pop.	mg	449,33242	x	449,27464	0,055267958	x	0,002505234
852	Gadolinium	Raw	in ground	µg	833,12121	x	738,28342	86,476246	x	8,3615449
853	Gallium	Raw	in ground	mg	6,2963488	x	6,1165673	0,16121823	x	0,018563284
854	Gangue	Raw	in ground	kg	3,7938266	x	3,6934752	0,094119566	x	0,0062317912
855	Gangue, bauxite	Raw	in ground	g	215,44168	x	209,29011	5,5163917	x	0,63517843
856	Gas, mine, off-gas, process, coal mining/m3	Raw	in ground	m3	1,5488337	x	1,548101	0,00066353026	x	6,9256307E-5
857	Gas, natural/m3	Raw	in ground	m3	230,50938	x	230,08387	0,36920239	x	0,056302711
858	Glufosinate	Soil	agricultural	µg	1,4192684	x	1,399129	0,0178734	x	0,0022660262
859	Glutaraldehyde	Water	ocean	ng	[illegible]	x	[illegible]	[illegible]	x	[illegible]
860	Glyphosate	Air	low. pop.	mg	41,121319	x	41,121164	0,00012891487	x	2,6078504E-5
861	Glyphosate	Water		ng	37,553202	x	37,513875	0,03606176	x	0,003264964
862	Glyphosate	Water	groundwater	µg	13,659973	x	13,659867	8,9895897E-5	x	1,5804482E-5
863	Glyphosate	Water	river	ng	89,114194	x	89,113594	0,00050864305	x	9,1260729E-5
864	Glyphosate	Soil	agricultural	mg	207,85048	x	207,81264	0,036051984	x	0,0017904103
865	Glyphosate	Soil	industrial	ng	271,37604	x	220,86163	43,739045	x	6,7753653
866	Gold	Raw	in ground	µg	149,43934	x	144,61734	4,2438878	x	0,57811278
867	Granite	Raw	in ground	g	12,736017	x	12,616814	0,10360044	x	0,015602614
868	Gravel	Raw	in ground	kg	28,396914	x	28,394564	0,0020323517	x	0,00031800172
869	Gypsum	Raw		mg	27,374505	x	x	x	27,374505	x
870	Gypsum	Raw	in ground	g	5,8564808	x	5,813784	0,039011631	x	0,003685144
871	Hafnium	Raw	in ground	mg	59,115246	x	54,069246	5,0216131	x	0,024387104
872	Halosulfuron-methyl	Soil	agricultural	ng	4,2867716	x	4,2519472	0,030146574	x	0,0046778362
873	Haloxyfop- (R) Methylester	Soil	agricultural	µg	453,01971	x	452,85357	0,15983645	x	0,0063058255
874	Heat, waste	Air		MJ	26,196713	x	19,711706	4,8179944	0,91908176	0,74793135
875	Heat, waste	Air	high. pop.	MJ	4,2932093	x	4,2830453	0,008510359	x	0,0016536238
876	Heat, waste	Air	low. pop.	kJ	16,727144	x	16,722103	0,0045767404	x	0,00046443903
877	Heat, waste	Air	low. pop., lon	J	13,448195	x	11,966432	1,350495	x	0,13126748
878	Heat, waste	Water		MJ	5,3983414	x	4,1639286	1,061799	x	0,17261384
879	Heat, waste	Water	groundwater,	MJ	1,241652	x	1,2305362	0,010017346	x	0,0010984523
880	Heat, waste	Water	river	MJ	1,0860085	x	1,0437883	0,0021809349	0,039615356	0,00042388375
881	Heat, waste	Soil	industrial	kJ	144,97755	x	143,54048	1,2970981	x	0,13997084
882	Helium	Air		mg	9,4587906	x	9,4511404	0,0052889715	0,001658394	0,00070278446
883	Helium	Air	low. pop.	mg	116,27046	x	100,29951	13,755075	x	2,2158737
884	Heptane	Air		mg	35,979325	x	22,178411	10,312882	1,69991	1,7881215
885	Heptane	Air	high. pop.	mg	20,57358	x	20,004711	0,036252745	x	0,53261642
886	Herbicides, unspecified	Soil	agricultural	µg	41,013049	x	41,012684	0,0003112027	x	5,3737313E-5

Analysing 1000 kg 'Cork slab {M.SOUSA SA}| market for cork slab | Cut-off, U'; Method: ReCiPe 2016 Endpoint (H) V1.06 / World (2010) H/A / Excluding infrastructure processes

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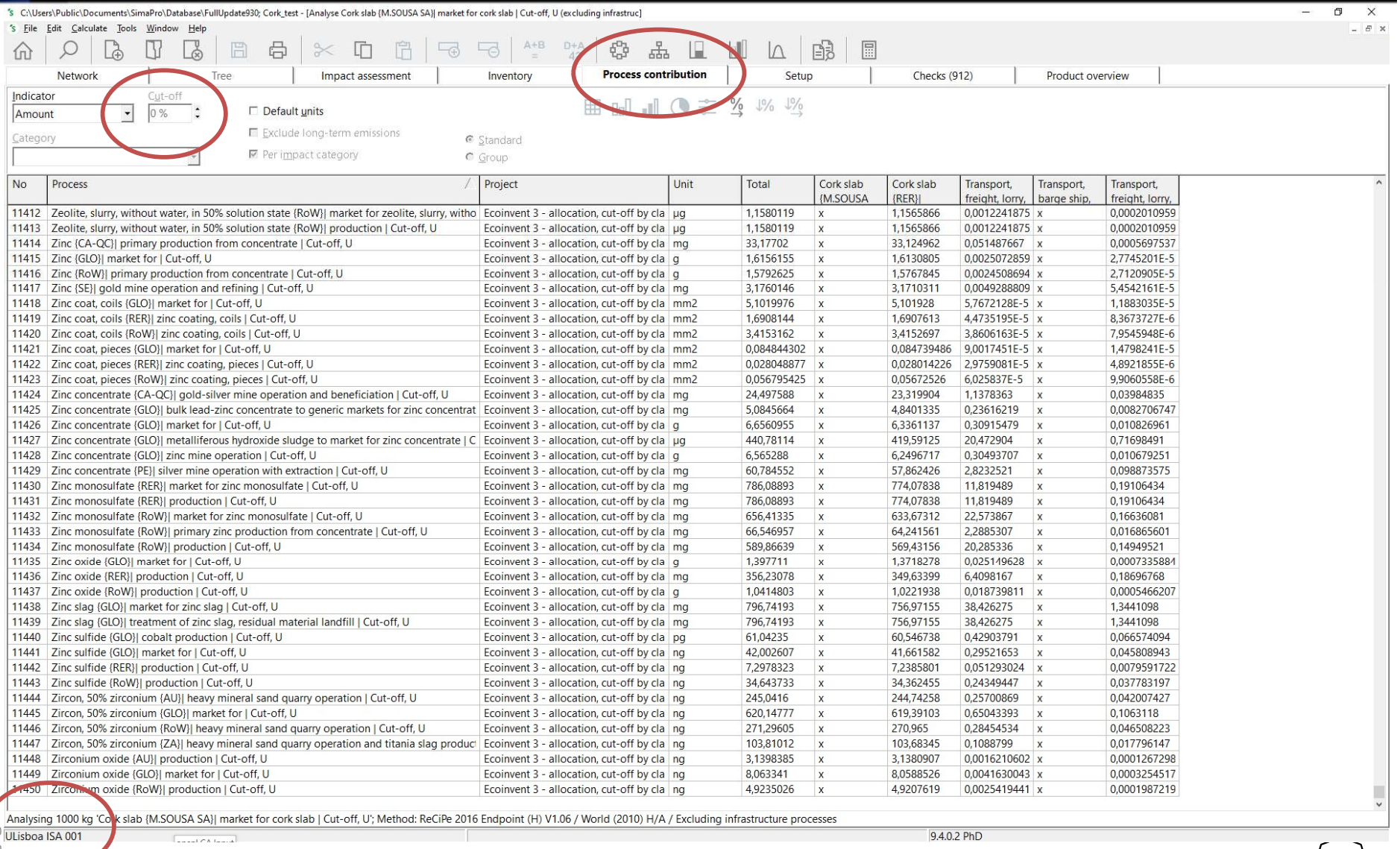
Componente 2: Software - processos



No	Process	Project	Unit	Total	Cork slab {M.SOUSA	Cork slab {RER}|	Transport, freight, lorry,	Transport, barge ship,	Transport, freight, lorry,
11412	Zeolite, slurry, without water, in 50% solution state {RoW}| market for zeolite, slurry, witho	Ecoinvent 3 - allocation, cut-off by cla	µg	1,1580119	x	1,1565866	0,0012241875	x	0,0002010959
11413	Zeolite, slurry, without water, in 50% solution state {RoW}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	µg	1,1580119	x	1,1565866	0,0012241875	x	0,0002010959
11414	Zinc {CA-QC}| primary production from concentrate | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	33,17702	x	33,124962	0,051487667	x	0,0005697537
11415	Zinc {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	1,6156155	x	1,6130805	0,0025072859	x	2,7745201E-5
11416	Zinc {RoW}| primary production from concentrate | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	1,5792625	x	1,5767845	0,0024508694	x	2,7120905E-5
11417	Zinc {SE}| gold mine operation and refining | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	3,1760146	x	3,1710311	0,0049288809	x	5,4542161E-5
11418	Zinc coat, coils {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	5,1019976	x	5,101928	5,7672128E-5	x	1,1883035E-5
11419	Zinc coat, coils {RER}| zinc coating, coils | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	1,6908144	x	1,6907613	4,4735195E-5	x	8,3673727E-6
11420	Zinc coat, coils {RoW}| zinc coating, coils | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	3,4153162	x	3,4152697	3,8606163E-5	x	7,9545948E-6
11421	Zinc coat, pieces {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	0,084844302	x	0,084739486	9,0017451E-5	x	1,4798241E-5
11422	Zinc coat, pieces {RER}| zinc coating, pieces | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	0,028048877	x	0,028014226	2,9759081E-5	x	4,8921855E-6
11423	Zinc coat, pieces {RoW}| zinc coating, pieces | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mm2	0,056795425	x	0,05672526	6,025837E-5	x	9,9060558E-6
11424	Zinc concentrate {CA-QC}| gold-silver mine operation and beneficiation | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	24,497588	x	23,319904	1,1378363	x	0,03984835
11425	Zinc concentrate {GLO}| bulk lead-zinc concentrate to generic markets for zinc concentrat	Ecoinvent 3 - allocation, cut-off by cla	mg	5,0845664	x	4,8401335	0,23616219	x	0,0082706747
11426	Zinc concentrate {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	6,6560955	x	6,3361137	0,30915479	x	0,010826961
11427	Zinc concentrate {GLO}| metalliferous hydroxide sludge to market for zinc concentrate | C	Ecoinvent 3 - allocation, cut-off by cla	µg	440,78114	x	419,59125	20,472904	x	0,71698491
11428	Zinc concentrate {GLO}| zinc mine operation | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	6,565288	x	6,2496717	0,30493707	x	0,010679251
11429	Zinc concentrate {PE}| silver mine operation with extraction | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	60,784552	x	57,862426	2,8232521	x	0,098873575
11430	Zinc monosulfate {RER}| market for zinc monosulfate | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	786,08893	x	774,07838	11,819489	x	0,19106434
11431	Zinc monosulfate {RER}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	786,08893	x	774,07838	11,819489	x	0,19106434
11432	Zinc monosulfate {RoW}| market for zinc monosulfate | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	656,41335	x	633,67312	22,573867	x	0,16636081
11433	Zinc monosulfate {RoW}| primary zinc production from concentrate | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	66,546957	x	64,241561	2,2885307	x	0,016865601
11434	Zinc monosulfate {RoW}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	589,86639	x	569,43156	20,285336	x	0,14949521
11435	Zinc oxide {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	1,397711	x	1,3718278	0,025149628	x	0,0007335884
11436	Zinc oxide {RER}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	356,23078	x	349,63399	6,4098167	x	0,18696768
11437	Zinc oxide {RoW}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	g	1,0414803	x	1,0221938	0,018739811	x	0,0005466207
11438	Zinc slag {GLO}| market for zinc slag | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	796,74193	x	756,97155	38,426275	x	1,3441098
11439	Zinc slag {GLO}| treatment of zinc slag, residual material landfill | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	mg	796,74193	x	756,97155	38,426275	x	1,3441098
11440	Zinc sulfide {GLO}| cobalt production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	pg	61,04235	x	60,546738	0,42903791	x	0,066574094
11441	Zinc sulfide {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	42,002607	x	41,661582	0,29521653	x	0,045808943
11442	Zinc sulfide {RER}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	7,2978323	x	7,2385801	0,051293024	x	0,0079591722
11443	Zinc sulfide {RoW}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	34,643733	x	34,362455	0,24349447	x	0,037783197
11444	Zircon, 50% zirconium {AU}| heavy mineral sand quarry operation | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	245,0416	x	244,74258	0,25700869	x	0,042007427
11445	Zircon, 50% zirconium {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	620,14777	x	619,39103	0,65043393	x	0,1063118
11446	Zircon, 50% zirconium {RoW}| heavy mineral sand quarry operation | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	271,29605	x	270,965	0,28454534	x	0,046508223
11447	Zircon, 50% zirconium {ZA}| heavy mineral sand quarry operation and titania slag produc	Ecoinvent 3 - allocation, cut-off by cla	ng	103,81012	x	103,68345	0,1088799	x	0,017796147
11448	Zirconium oxide {AU}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	3,1398385	x	3,1380907	0,0016210602	x	0,0001267298
11449	Zirconium oxide {GLO}| market for | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	8,063341	x	8,0588526	0,0041630043	x	0,0003254517
11450	Zirconium oxide {RoW}| production | Cut-off, U	Ecoinvent 3 - allocation, cut-off by cla	ng	4,9235026	x	4,9207619	0,0025419441	x	0,0001987219

Componente 3: Avaliação de impactes (AICV)

C:\Users\Public\Documents\SimaPro\Database\FullUpdate930; Cork_test - [Analyse Cork slab {M.SOUSA SA}| market for cork slab | Cut-off, U (excluding infrastruc]

File Edit Calculate Tools Window Help

Network | Tree | **Impact assessment** | Inventory | Process contribution | Setup

Characterisation | Damage Assessment | Normalisation | Weighting | Single score

Skip categories: Never

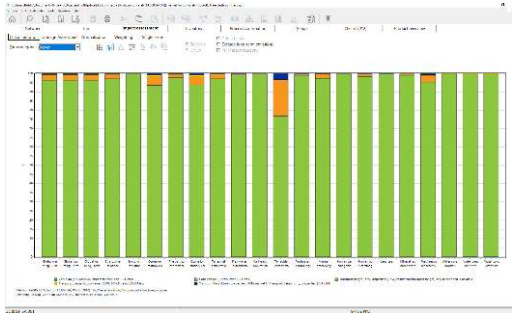
Standard / Group; Default units; Exclude long-term emissions; Per impact category

Se	Impact category	Unit	Total	Cork slab {M.SOUSA SA}|	Cork slab {RER}|	Transport, freight, lorry,	Transport, barge ship,	Transport, freight, lorry,
☑	Global warming, Human health	DALY	0,0009174597	x	0,00088559554	2,552578E-5	2,3850702E-6	3,9533137E-6
☑	Global warming, Terrestrial eco	species.yr	2,7687154E-6	x	2,6725726E-6	7,7018612E-8	7,1959238E-9	1,1928281E-8
☑	Global warming, Freshwater ec	species.yr	7,562065E-11	x	7,2993996E-11	2,1041679E-12	1,966007E-13	3,2588469E-13
☑	Stratospheric ozone depletion	DALY	2,901582E-7	x	2,8202956E-7	6,9840856E-9	1,371839E-10	1,007377E-9
☑	Ionizing radiation	DALY	1,9660855E-6	x	1,9639503E-6	1,7980307E-9	2,6171675E-11	3,1103584E-10
☑	Ozone formation, Human healt	DALY	2,8689474E-6	x	2,6896917E-6	1,2849415E-7	2,9540506E-8	2,1221016E-8
☑	Fine particulate matter formati	DALY	0,0012377083	x	0,0012112038	2,0702373E-5	2,498972E-6	3,3031707E-6
☑	Ozone formation, Terrestrial ec	species.yr	4,2592552E-7	x	4,0030669E-7	1,8377326E-8	4,2069909E-9	3,0345144E-9
☑	Terrestrial acidification	species.yr	7,9761011E-7	x	7,7521527E-7	1,6970895E-8	2,7264367E-9	2,6975106E-9
☑	Freshwater eutrophication	species.yr	3,8783447E-7	x	3,8490432E-7	2,5616722E-9	1,7853756E-12	3,6669651E-10
☑	Marine eutrophication	species.yr	7,735056E-11	x	7,7252198E-11	7,9894319E-14	1,270173E-14	5,7657971E-15
☑	Terrestrial ecotoxicity	species.yr	3,5484155E-8	x	2,7256709E-8	7,0929001E-9	2,9771452E-12	1,1315687E-9
☑	Freshwater ecotoxicity	species.yr	1,0472355E-8	x	1,0378981E-8	8,204038E-11	6,1856626E-14	1,1272044E-11
☑	Marine ecotoxicity	species.yr	2,3278715E-9	x	2,2700912E-9	4,9954323E-11	2,3163596E-13	7,5942946E-12
☑	Human carcinogenic toxicity	DALY	0,00014304095	x	0,0001427416	2,5737538E-7	2,2187209E-8	1,9785179E-8
☑	Human non-carcinogenic toxici	DALY	0,00018605939	x	0,00018335788	2,3081659E-6	4,9253519E-8	3,4409056E-7
☑	Land use	species.yr	4,6601756E-5	x	4,6601618E-5	1,2618701E-10	x	1,1731126E-11
☑	Mineral resource scarcity	USD2013	0,11128869	x	0,11030621	0,00089375011	1,8833921E-5	6,9887063E-5
☑	Fossil resource scarcity	USD2013	109,17416	x	104,19855	3,9910785	0,35013412	0,63440223
☑	Water consumption, Human he	DALY	3,7061957E-5	x	3,7063912E-5	-1,8492032E-9	5,0389652E-10	-6,0974331E-10
☑	Water consumption, Terrestrial	species.yr	2,2173979E-7	x	2,2170235E-7	3,7712096E-11	3,0642356E-12	-3,3380714E-12
☑	Water consumption, Aquatic ec	species.yr	2,4705053E-11	x	2,4689226E-11	1,5770965E-14	1,3709617E-16	-8,0263262E-17

Método de LCIA

ReCiPe

AICV – quantificação dos impactes ambientais potenciais causados pelas intervenções entre a tecnosfera e a ecosfera abarcadas pela ACV (e.g. emissões, extração de recursos, uso do solo)



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Componente 3: Avaliação de impactes (AICV)

Métodos de AICV | LCIA methods

- Europeus: methods that are focused on the European context and, therefore, mostly useful when doing LCA studies in Europe.
- Globais: methods with a global scope, i.e. ideal to apply in studies with a global value chain.
- Norte Americanos: methods developed for the North American region.
- Indicador único | single issue: methods which focus on one single metric or environmental impact area, except for those focused on water.
- Pegada da água (Water footprint): which include methods to assess only water related impacts.
- Superseded (em desuso): methods that are outdated.

Componente 3: Avaliação de impactes (AICV)

Globais:
- IMPACT World+ Endpoint
- IMPACT World+ Midpoint
- LC-IMPACT (8 variations)
- ReCiPe 2016 Endpoint (3 perspectives)
- ReCiPe 2016 Midpoint (3 perspectives)

Europeus:
- CML-IA baseline
- CML-IA non-baseline
- Ecological Scarcity 2021
- EF 3.0 Method (adapted)
- EN 15804 + A2
- Environmental Prices
- EPD (2018)
- EPS 2015d
- EPS 2015dx

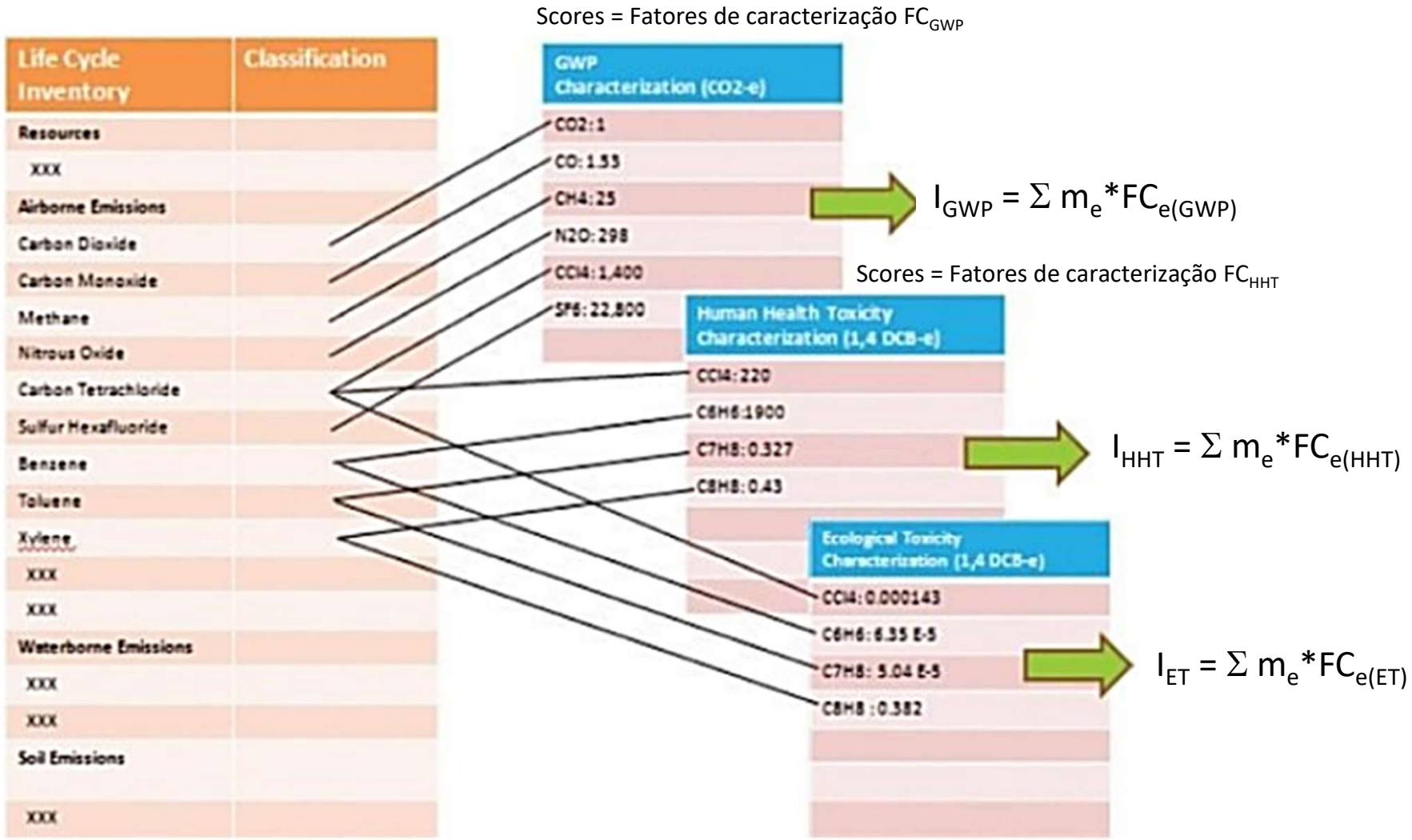
Ver também https://ecoinvent.org/the-ecoinvent-database/impact-assessment/#1661431165511-34b04bce-bdc4

Norte Americanos
- BEES+
- TRACI 2.1

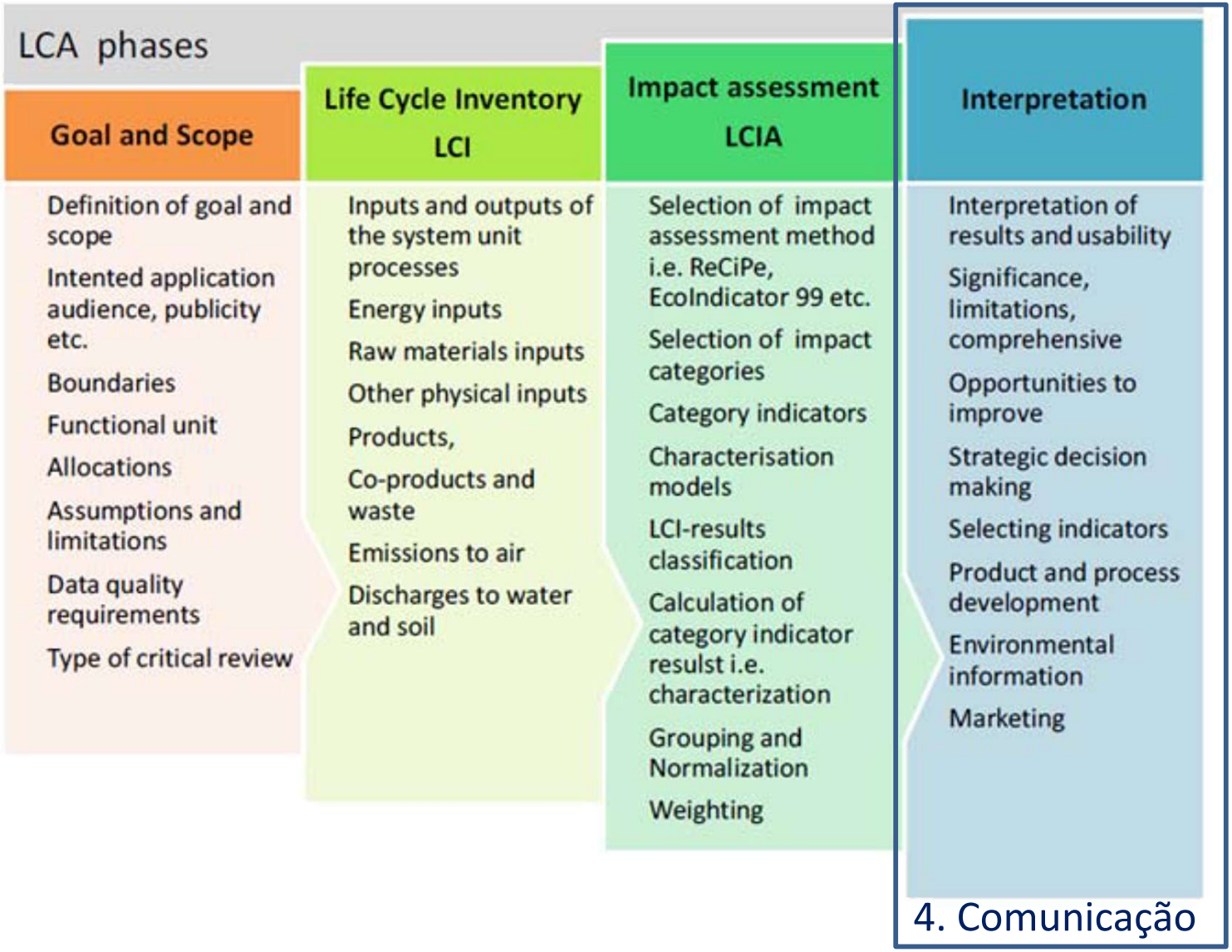
Indicador único
- Cumulative Energy Demand
- Cumulative Energy Demand (LHV)
- Cumulative Exergy Demand
- Freshwater eutrophication (Payen et al., 2021)
- IPCC 2021 (8 variations)
- Land use biodiversity (Chaudhary et al., 2015)
- Selected LCI results
- Selected LCI results, additional
- USEtox 2 (recommended + interim)
- USEtox 2 (recommended only)

Pegada da água
- AWARE
- Berger et al 2014 (Water Scarcity)
- Boulay et al 2011 (Water Scarcity)
- Hoekstra et al 2012 (Water Scarcity)

Componente 3: Avaliação de impactes (AICV)



Componentes de uma ACV



Componentes 4a: "Hotspot analysis"

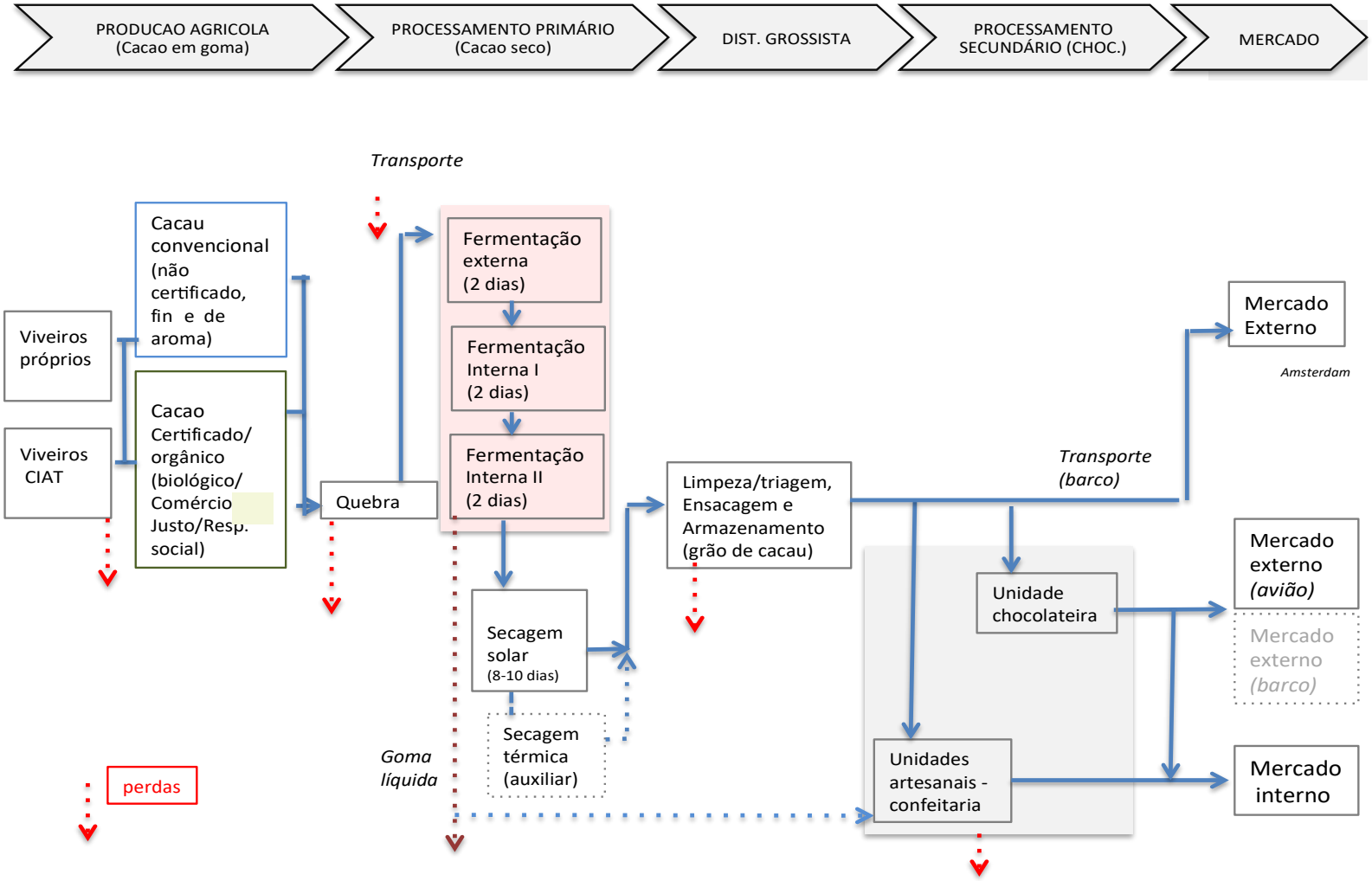
Cadeia de valor do cacau: resultados para as categorias de impacte da produção de cacau convencional

	Produção de Cacau Convencional ST		Transporte Porto	Limpeza, calibração e armazenamento	Secagem Solar	Transporte Secador	Fermentação	Transporte Fermentador	Fase Produção	Fase Estabelecimento	Viveiro
Global warming, Human health	1,315E-05	DALY	12,535%	0,386%	1,132%	0,003%	0,136%	84,214%	0,760%	0,725%	0,108%
Global warming, Terrestrial ecosystems	3,969E-08	species.yr	12,535%	0,386%	1,133%	0,003%	0,136%	84,214%	0,760%	0,726%	0,109%
Global warming, Freshwater ecosystems	1,084E-12	species.yr	12,535%	0,385%	1,132%	0,003%	0,136%	84,214%	0,760%	0,725%	0,108%
Stratospheric ozone depletion	4,237E-09	DALY	6,598%	1,309%	1,054%	0,003%	0,203%	89,407%	0,778%	0,626%	0,023%
Ionizing radiation	1,848E-09	DALY	9,880%	0,999%	27,578%	0,002%	5,609%	53,219%	2,105%	0,182%	0,427%
Ozone formation, Human health	1,346E-07	DALY	7,934%	0,107%	0,463%	0,003%	0,078%	90,556%	0,230%	0,598%	0,032%
Fine particulate matter formation	1,458E-05	DALY	4,479%	1,454%	0,557%	0,003%	0,066%	91,461%	1,217%	0,709%	0,054%
Ozone formation, Terrestrial ecosystems	1,927E-08	species.yr	7,929%	0,107%	0,527%	0,003%	0,091%	90,481%	0,231%	0,598%	0,033%
Terrestrial acidification	1,526E-08	species.yr	8,435%	0,459%	0,641%	0,003%	0,079%	88,279%	1,328%	0,709%	0,067%
Freshwater eutrophication	2,431E-10	species.yr	5,053%	7,337%	5,677%	0,001%	0,731%	24,517%	50,072%	6,188%	0,425%
Terrestrial ecotoxicity	4,541E-10	species.yr	52,970%	0,171%	1,376%	0,001%	0,282%	33,375%	10,754%	1,054%	0,015%
Freshwater ecotoxicity	1,461E-10	species.yr	1,699%	0,372%	0,585%	0,000%	0,069%	5,199%	87,836%	4,114%	0,126%
Marine ecotoxicity	2,040E-11	species.yr	6,390%	0,549%	0,958%	0,000%	0,121%	9,761%	78,331%	3,701%	0,189%
Human carcinogenic toxicity	7,175E-08	DALY	15,043%	6,470%	11,496%	0,001%	1,368%	31,384%	30,558%	2,101%	1,578%
Human non-carcinogenic toxicity	1,414E-05	DALY	0,377%	0,032%	0,056%	0,003%	0,007%	96,347%	2,943%	0,226%	0,009%
Land use	5,181E-07	species.yr	0,003%	0,026%	3,027%	0,000%	0,658%	0,010%	92,123%	4,151%	0,001%
Mineral resource scarcity	6,797E-04	USD2013	0,922%	0,267%	5,901%	0,000%	1,166%	3,718%	80,873%	6,959%	0,195%
Fossil resource scarcity	2,121E+00	USD2013	12,493%	0,091%	1,538%	0,003%	0,123%	84,684%	0,334%	0,558%	0,177%
Water consumption, Human health	1,872E-06	DALY	0,371%	0,200%	0,293%	0,000%	0,033%	2,436%	74,084%	15,517%	7,066%
Water consumption, Terrestrial ecosystem	1,138E-08	species.yr	0,371%	0,200%	0,293%	0,000%	0,033%	2,436%	74,084%	15,517%	7,066%
Water consumption, Aquatic ecosystems	5,092E-13	species.yr	0,371%	0,200%	0,293%	0,000%	0,033%	2,436%	74,084%	15,517%	7,066%

Os impactes absolutos são expressos por unidade funcional, 1 kg de cacau convencional, em grão seco, à porta ponto de exportação. As contribuições relativas para os impactes globais são também apresentadas *(legenda: vermelho para uma contribuição relativa superior a 50%, lilás entre 50-20%, laranja 20-5% e verde se inferior a 5% e branco se não aplicável)*

Componentes 4: Interpretação | Comunicação

Interpretação|Comunicação dos resultados da ACV da cadeia de valor da produção de cacau em STP



Componentes 4a: Comparação entre ACVs

Cadeia de valor do cacau: comparação dos impactes ambientais entre a fileira do cacau convencional e a do cacau certificado (orgânico)

Pontos finais (ReCiPe 2016 Endpoint (H)).	Produção de Cacau Convencional ST	Produção de Cacau Certificado ST		Diferença Percentual
Human health	4,396E-05	3,746E-05	DALY	14,8%
Ecosystems	6,045E-07	5,710E-07	species.yr	5,5%
Resources	2,122E+00	1,793E+00	USD2013	15,5%

Pontos médios (ReCiPe 2016 Endpoint (H))	Produção de Cacau Convencional ST	Produção de Cacau Certificado ST		Diferença Percentual
Global warming, Human health	1,315E-05	1,106E-05	DALY	15,9%
Global warming, Terrestrial ecosystems	3,969E-08	3,336E-08	species.yr	15,9%
Global warming, Freshwater ecosystems	1,084E-12	9,115E-13	species.yr	15,9%
Stratospheric ozone depletion	4,237E-09	3,627E-09	DALY	14,4%
Ionizing radiation	1,848E-09	1,650E-09	DALY	10,7%
Ozone formation, Human health	1,346E-07	1,149E-07	DALY	14,7%
Fine particulate matter formation	1,458E-05	1,254E-05	DALY	14,0%
Ozone formation, Terrestrial ecosystems	1,927E-08	1,644E-08	species.yr	14,7%
Terrestrial acidification	1,526E-08	1,297E-08	species.yr	15,0%
Freshwater eutrophication	2,431E-10	1,819E-10	species.yr	25,2%
Terrestrial ecotoxicity	4,541E-10	3,471E-10	species.yr	23,6%
Freshwater ecotoxicity	1,461E-10	1,384E-10	species.yr	5,3%
Marine ecotoxicity	2,040E-11	1,898E-11	species.yr	6,9%
Human carcinogenic toxicity	7,175E-08	6,244E-08	DALY	13,0%
Human non-carcinogenic toxicity	1,414E-05	1,230E-05	DALY	13,0%
Land use	5,181E-07	4,992E-07	species.yr	3,6%
Mineral resource scarcity	6,797E-04	5,482E-04	USD2013	19,3%
Fossil resource scarcity	2,121E+00	1,792E+00	USD2013	15,5%
Water consumption, Human health	1,872E-06	1,383E-06	DALY	26,1%
Water consumption, Terrestrial ecosystem	1,138E-08	8,412E-09	species.yr	26,1%
Water consumption, Aquatic ecosystems	5,092E-13	3,764E-13	species.yr	26,1%

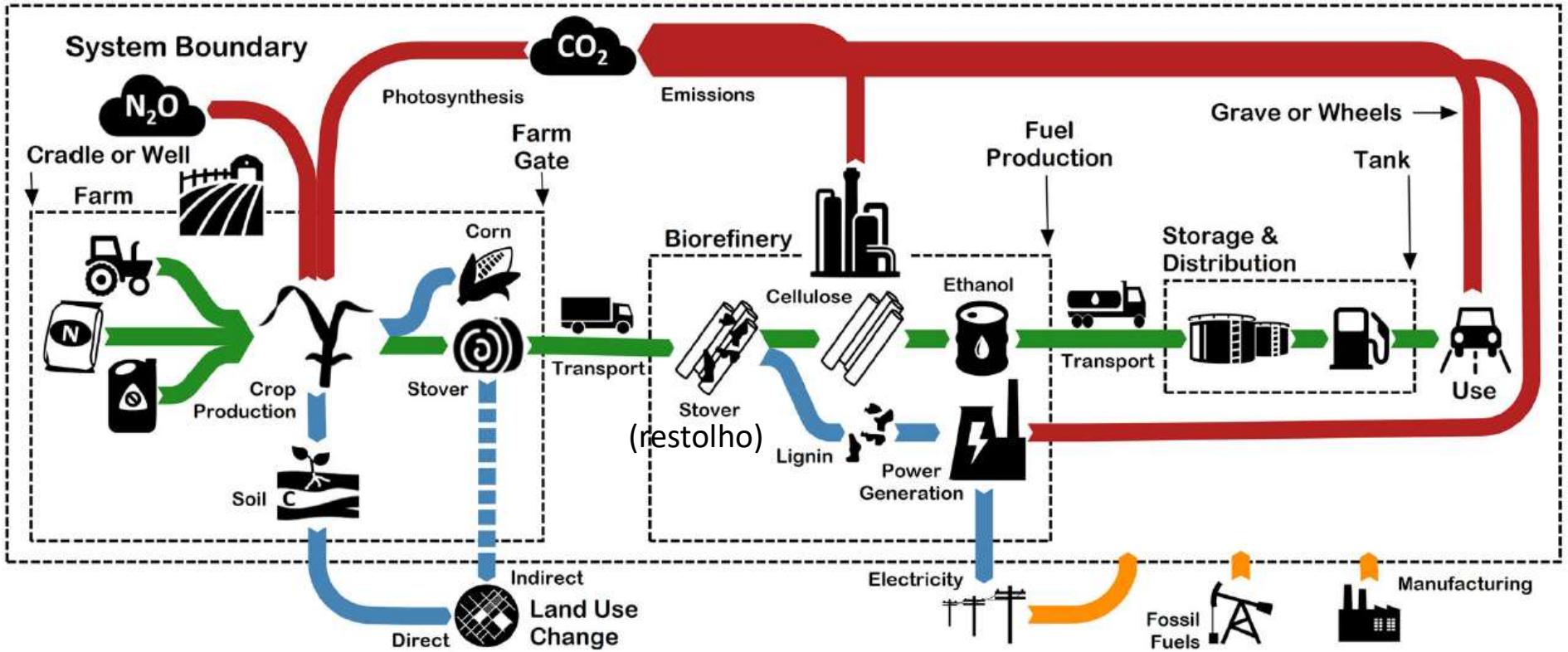
Componentes 4b: Comunicar resultados

Como comunicar os resultados de um modelo complexo que processa uma enorme quantidade de informação, fazendo-o de forma clara, simples e eficaz?

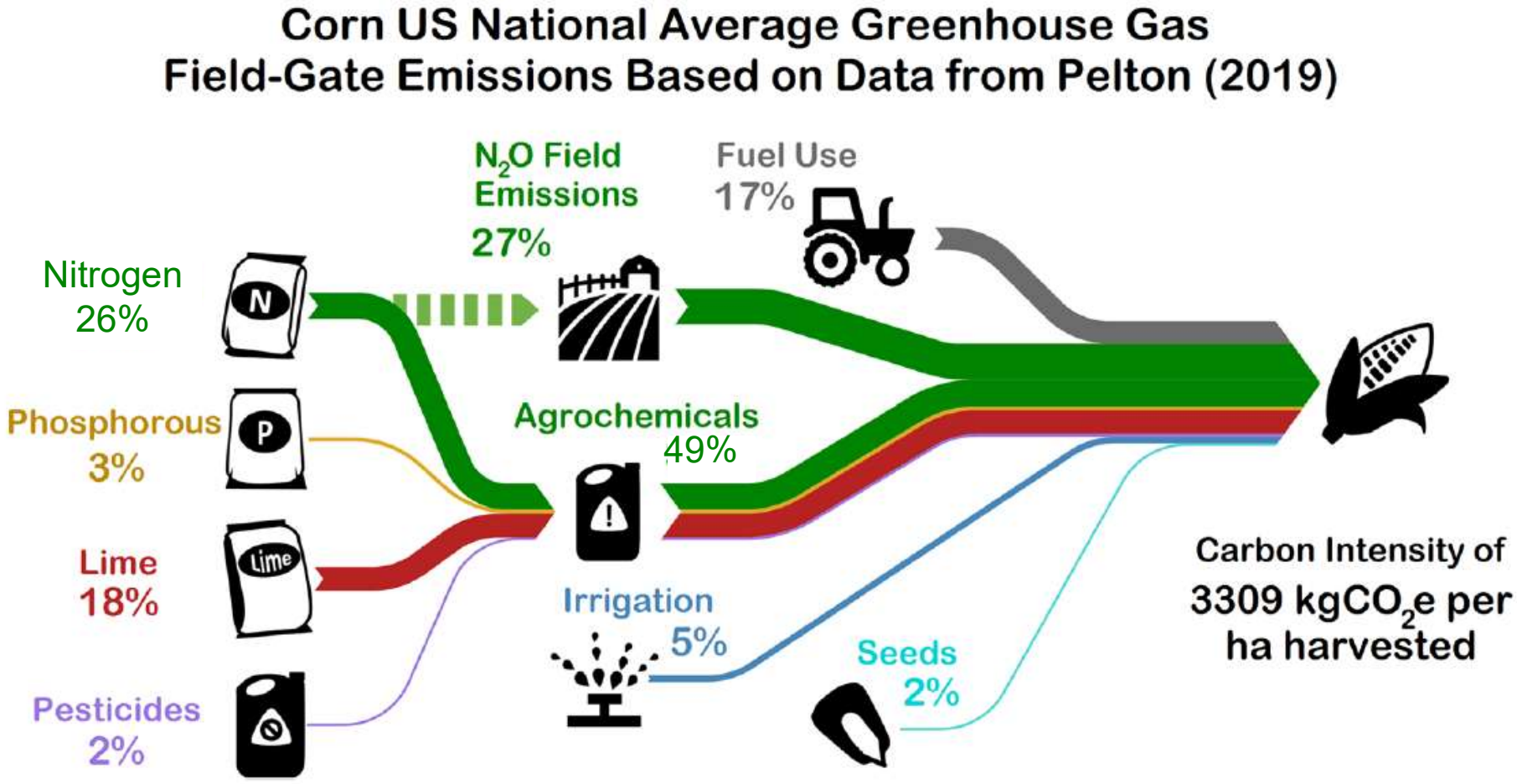
Impacte (midpoint)	Uso do solo	Ecotoxidade	Toxicidade (Não) Carcinogénica (metais pesados)	Consumo de Água (irrigação)	Aquecimento global e Partículas finas
Área de Impacte (endpoint)	Ecossistemas	Ecossistemas	Saúde Humana	Saúde Humana Ecossistemas	Saúde Humana
Nível de impacte	Elevado	Moderado	Moderado	Moderado	Elevado
Ponto da Cadeia de Valor	Produção Agrícola	Produção Agrícola	Produção Agrícola	Produção Agrícola	Transportes
Causa da disfunção ambiental	Alteração do uso do solo	Controlo fitossanitáro - sulfato de cobre	Controlo fitossanitáro - sulfato de cobre	Escassez de água em áreas/meses desfavoráveis	Emissões derivadas do consumo de combustiveis
Recomendação	Aumento da produtividade/ Concentração da produção ("land sparing")	Promoção da certificação orgânica/ procura de alternativas ao sulfato de cobre/ melhoramento genético das variedades locais	Promoção da certificação orgânica/ procura de alternativas ao sulfato de cobre/ melhoramento genético das variedades locais	Instalação de sistemas de irrigação/ melhoramento genético das variedades locais	Inspecção de veículos/ modernização da frota

Componentes 4b: Comunicar resultados

Interpretação|Comunicação dos resultados da ACV de um sistema de produção celulósica de bio-etanol



Componentes 4b: Comunicar resultados



Field gate U.S. national average emissions for corn production of approximately 0.35 kg CO2-eq. kg−1 of corn grain shown as a Sankey diagram. Pelton (2019) found that corn production impacts ranged from 0.20 to 0.70 kg CO2-eq. kg−1 of corn grain across the United States. Nitrogen fertilizer manufacturing and N2O emissions associated with use contribute significantly to U.S. corn production GHG emissions.

Componentes 4b: Comunicar resultados

Método de LCIA

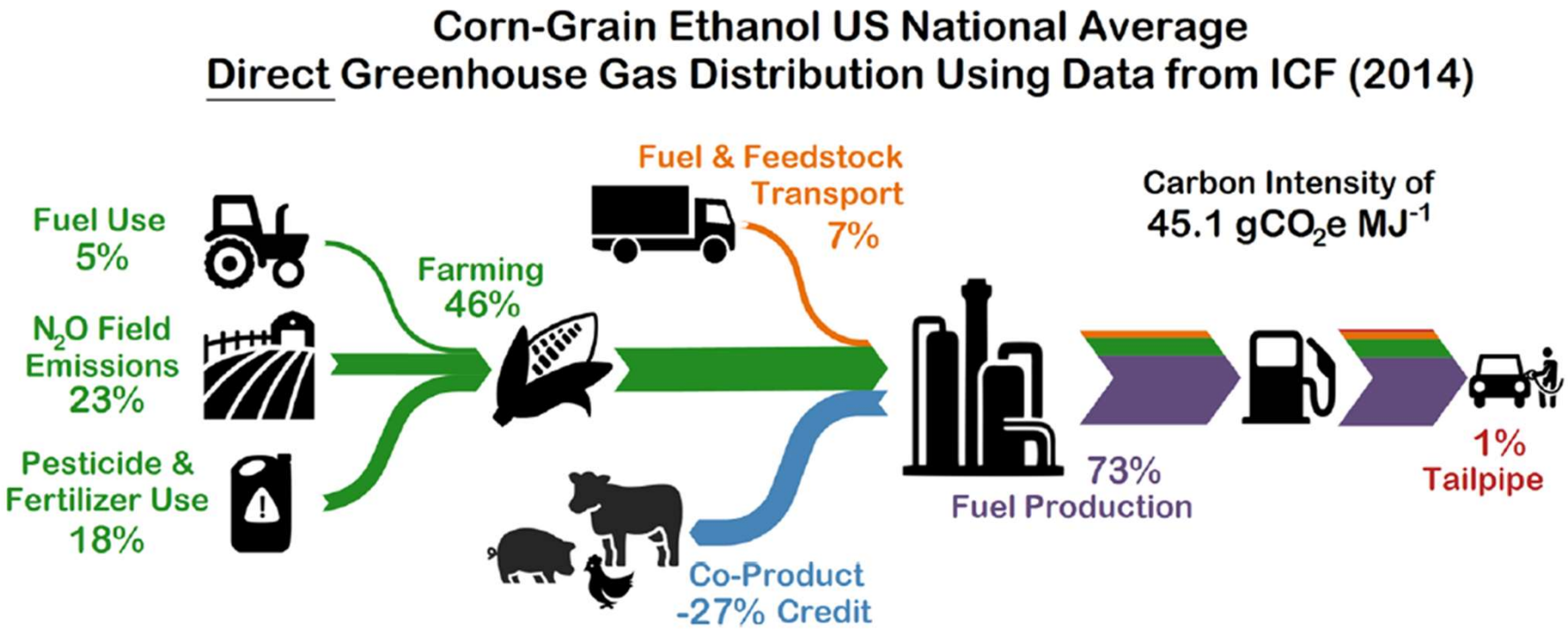
Pontos médios (ReCiPe 2016 Endpoint (H))
Global warming, Human health
Global warming, Terrestrial ecosystems
Global warming, Freshwater ecosystems
Stratospheric ozone depletion
Ionizing radiation
Ozone formation, Human health
Fine particulate matter formation
Ozone formation, Terrestrial ecosystems
Terrestrial acidification
Freshwater eutrophication
Terrestrial ecotoxicity
Freshwater ecotoxicity
Marine ecotoxicity
Human carcinogenic toxicity
Human non-carcinogenic toxicity
Land use
Mineral resource scarcity
Fossil resource scarcity
Water consumption, Human health
Water consumption, Terrestrial ecosystem
Water consumption, Aquatic ecosystems

GWP100

kg CO_2-equiv

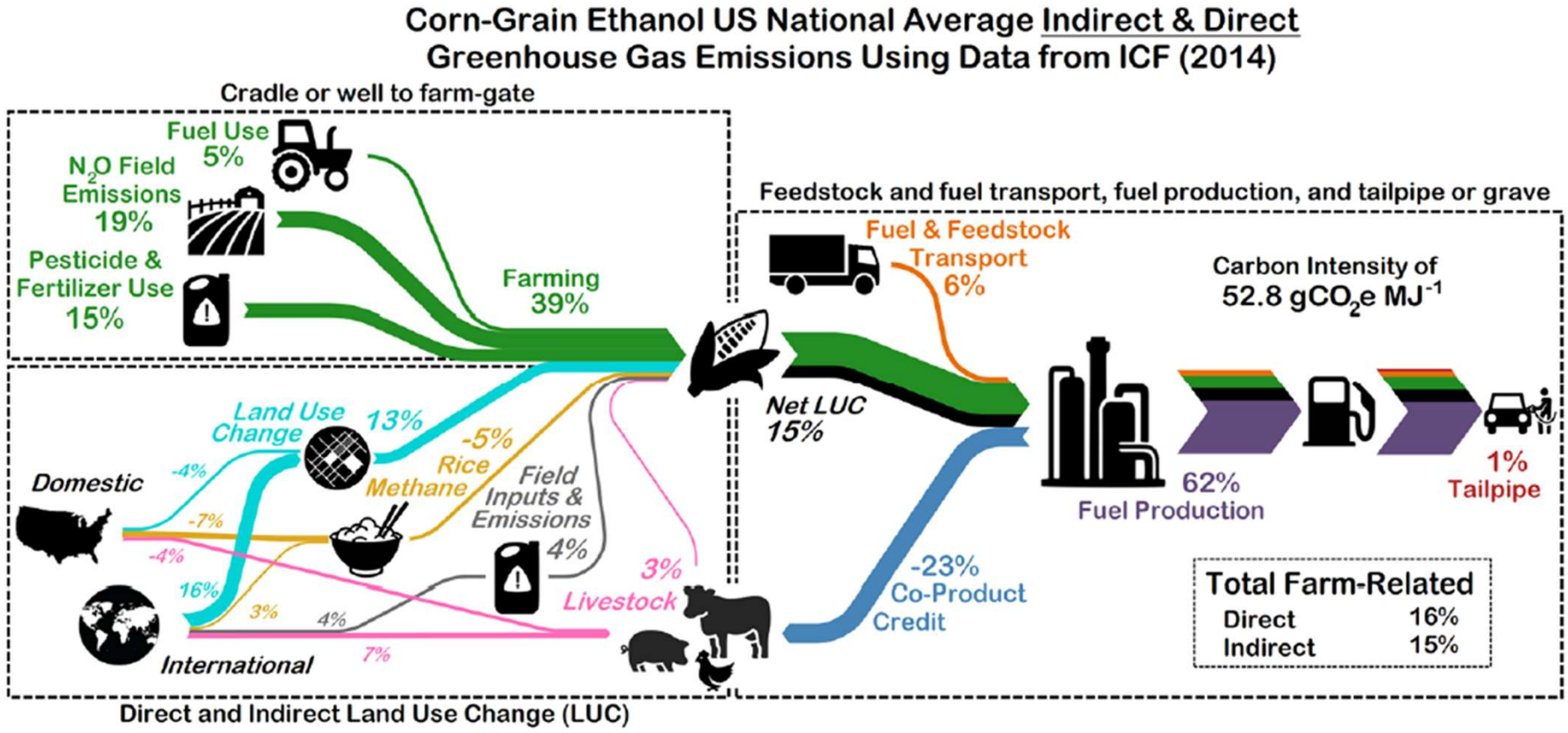
"Global warming potential" a 100 anos

Componentes 4b: Comunicar resultados



US average corn-grain ethanol direct GHG contributions (without land use change or indirect effects) based on data from ICF International, Inc. 2014 survey (Flugge et al., 2017).

Componentes 4b: Comunicar resultados



Sankey diagram of US average corn-grain ethanol GHG contributions with indirect effects based on ICF International, Inc. 2014 survey and consequential LCA scenario results (Flugge et al., 2017). In this visualization, livestock feed co-product credits are applied to farm-related emissions to represent net farm-related impacts and domestic and international livestock, rice methane, and land use change indirect impacts were assumed to be additive

ACV na prática : aspetos críticos

Equipa

Peritos responsáveis pela ACV (experiência, "know-how", independência | ética)

ATCr

Adequação (ex. "berço à cova, todas as categorias de impactes)
Transparência
Consistência (âmbito, inventário metodologia, conclusões, terminolog.)
Revisão

Comunicação

Com os clientes, técnicos, decisores políticos e público em geral. Pode oferecer grandes desafios

Informação

Recolha e gestão do grande volume de informação gerado no processo de contrução do inventário:.
dados recolhidos; dados bibliográficos; bases de dados internacionais
(ex. Ecoinvent, Agrybalise)

Avaliação do Ciclo de Vida
Aula 4 – Elementos da ACV
2 Dezembro 2022

INSTITUTO SUPERIOR DE AGRONOMIA
Universidade de Lisboa

mestrado em engenharia do ambiente
U.C. de Avaliação de Impacte Ambiental
módulo II
ano letivo 2022/2023