Product Environmental Footprint – Can't we do better in LCA

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1 Environmental Footprint (EF) – the start

The Environmental Footprint, in short EF, has already a longer history, which has been presented numerous times. Knowing its history probably helps to frame and better understand the idea of EF, and therefore it will be shortly summarised here. More information is available at the sources mentioned above; especially the European webpage on EF provides further details and links to further readings[1].

One important starting point for EF was certainly the conclusions drawn from the "Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan"[2].

In this plan, the European Council encouraged the European Commission

> *"[…] to start working as soon as possible on common voluntary methodologies facilitating the future establishment of carbon audits for organisations and the calculation of the carbon footprint of products."*[3]

An EC-commissioned study from 2010 listed about "30 important methodologies" for GHG reporting alone and recommended[4]

> *"To allocate the required level of budgets and resources (which may be significant […]) and develop a detailed programme of work to address these areas, recognising that harmonisation of GHG reporting standards is likely to be a complex and iterative process involving a wide range of stakeholders over a period of several years."*

The scope was further extended to include also other environmental impacts than Climate Change; the communication on the Single Market Act from 2010 contains e.g., in a section on consumer empowerment, the statement[5]

> *"In order to ensure that consumers receive reliable information on the environmental performance of products, the Commission will propose – in connection with the Action Plan on Sustainable Consumption and Production – an initiative on the ecological footprint of products."*

The idea and suggestion were broadly discussed also in public consultations[6]. Finally, the EF project started with a first phase with public involvement in 2013.

2 EF – the project

2.1 The 2013-2016 pilot phase

As with many major projects, there is probably more than one starting point for EF; definitely important was the call and assignment for so called pilots. The EC website calls the first phase of the EF project the "*2013-2016 Environmental Footprint (EF) pilot phase*"[7]. A pilot is

[1] http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm

[2] http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2016914%202008%20INIT

[3] Cited from http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm

[4] http://ec.europa.eu/environment/pubs/pdf/ERM_GHG_Reporting_final.pdf, p 216

[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0206, section 2.4

[6] E.g. http://ec.europa.eu/environment/consultations/sustainable.htm.

[7] http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm

focussing on one specific product group or type, and aim of the pilot phase (and thus the pilots) was to "*test*[8]

- *a process for the development of Product Environmental Footprint Category Rules (PEFCR) and Organisation Environmental Footprint Sector Rules (OEFSR). These are product group and sector-specific rules for calculating Product Environmental Footprints and Organisation Environmental Footprints;*
- *the development of a "product benchmark" for a given product group or a an "organisation benchmark" for a given sector;*
- *the application of PEFCRs and OEFSRs to concrete cases;*
- *different compliance and verification systems, in order to set up such systems in an proportionate, effective and efficient way;*
- *how to communicate life cycle environmental performance information to various target audiences (e.g. PEF information through business-to-business and business-to-consumer communication tools; OEF information in sustainability reporting) in collaboration with stakeholders."*

The pilots were selected based on this public call for pilots. Funding was not available for the pilots from the commission[9]. Altogether, about 30 pilots initially were selected, for many different products, and it was often emphasised that also organisations from outside of Europe engaged[10]. Each pilot was working on one, or several related, products of a dedicated group, called representative product, RP for PEF, and representative organisation, or RO, for the OEF.

A pilot was typically "run" by an experienced LCA consulting company (thinkstep, Quantis, Blonk, for example) and paid for by an industry association or group of companies for the respective product group of each pilot, and in part, one can assume, the pilots were also paid for in kind by the LCA consultants, with the idea to be part of, and leading, a market certainly assumed to be important in future, for services and LCA software[11].

Overall, an elaborate procedure for developing rules and finding agreement on rules was developed, and a correspondingly elaborate organisational structure. Figure 1 shows the steps foreseen for, and mostly, with exception of the red boxes, accomplished by, the pilots. In the annex 1.3, one example for a PEFCR is provided, for leather.

This broad involvement of various industry and LCA stakeholders, including LCA consultants and LCA software providers, certainly helped to broaden the basis for EF.

The drawback was though that each pilot was modelling in a somewhat independent mode, at least from one LCA consultant to another, using different LCA software tools, different background databases (ecoinvent and GaBi, mostly), and different modelling principles, which made the models inhomogeneous, and conclusions drawn from the models most likely as well.

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[8] From the call for pilot volunteers, still available e.g. here: https://www.cebre.cz/dokums_raw/call_volunteers_final_2_.pdf

[9] „Funding will not be available to cover the costs of the participation of organisations for the EF pilot phase.", https://www.cebre.cz/dokums_raw/call_volunteers_final_2_.pdf

[10] http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm#pef lists the pilots, including those discontinued.

[11] See e.g. https://quantis-intl.com/pef-a-gold-standard-in-the-making/

There was no common, agreed way to model basic goods used in probably any LCA model, such as transport, energy, construction[12].

There was no common, free software used for the modelling, which made an exchange of models difficult to impossible, and the rules were described in text documents, often with only manually created changelogs.

[12] There was no common modelling approach for electricity, transport or construction, but there was, somewhat really surprisingly, a working group established to agree on the modelling of a cow, since cows are part of the life cycle for dairy products, beef, and leather, but this working group was not able to reach conclusions for all involved it seems.

Analysis of existing PCRs and/or sectoral guidance	Whenever possible, the rules in Product Environmental Footprint Category Rules (PEFCRs) and draft Organisation Environmental Footprint Sector Rules (OEFSRs) are based on existing work.
Consultation on scope and representative product/ organisation	• the precise definition of the product group or sector (product portfolio); • the results of the analysis of existing Product Category Rules and/ or sectoral guidance to check potential compliance with the requirements of the Environmental Footprint methods; • the "representative product" or "representative organisation", which describes the features of a typical average product sold on the market or an organisation typical to the sector.
Approval by the Steering Committee	
Screening	This is a simplified Environmental Footprint for the representative product/ organisation. It is performed to understand which are the most relevant life cycle stages, processes and environmental impacts. This document is checked by the European Commission (screening review).
Consultation 1st draft PEFCR/ OEFSR	The draft PEFCRs and draft OEFSRs are prepared based on the results of the screenings. They are the "recipe" for calculating the environmental footprint for the product or sector. **This is a virtual consultation.** Comments can be uploaded through the Environmental Footprint Wiki (instructions for signing up). Pilots produce the 2nd draft of the PEFCR / OEFSR based on the consultation.
Approval of the 2nd draft PEFCR/OEFSR by the SC	This draft should also include a preliminary indication of 3-4 communication vehicles that the pilot judges to be appropriate for the product / sector.
Supporting studies	The Environmental Footprint profile is calculated for at least 3 products or companies based on the 2nd draft PEFCR/ OEFSR. The results of this exercise are going to be the basis for the communication phase and for the testing of verification approaches.
Testing communication vehicles	The testing of communication vehicles will be carried out based on the Background Document for the Testing of Communication Vehicles in the Environmental Footprint Pilot Phase 2013-2016.
Consultation final PEFCR/ OEFSR	The final PEFCR/ OEFSR is based on the experiences with the supporting studies and communication phase. A **four-week consultation** will take place.
Review by the review panel	Each pilot appoints a 3-member review panel. The panel's remarks will be taken into consideration for the final version of the documents.
Approval of the final PEFCR/ OEFSR by the SC	The final documents will be discussed at the December 2017 and January 2018 meetings of the Steering Committee and Technical Advisory Board.

Figure 1: Steps to carry out for the pilots, from http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm

2.2 Early critique

The EF idea is very similar to Environmental Product Declarations, EPD, and even borrows elements such as the category rules. Despite its attempt to "enroot" itself into LCA stakeholders, EF faced harsh critique, for several reasons, which can probably be summarised in three[13]:

- Non-compliance with ISO 14040, for example since weighting in product comparisons is permitted[14]
- No mature, good, or different than usual, LCIA category set[15]
- Specific, "fix" modelling rules, e.g. regarding the functional unit, which were not acceptable for some, and led some pilots to discontinue

The dedicated LCA practitioner-driven, and therefore necessarily scattered, approach, leading to different models and results for practically the same things in each life cycle model, for e.g. electricity, transport, and construction, was to it seems not really criticized at the time[16].

2.3 The tendered datasets called EF compliant

After the pilots have started, several calls were released by the EC for "*Provision of […] product environmental footprint-compliant life cycle inventory datasets*", each for a specific content and topic of datasets, the first being energy and transport, end of 2015. The datasets needed to pass a review and quality assessment system each, which was part of the assessment and payment procedure: in case the tenderer failed to supply a minimum number of dataset above a certain "quality", the payment would be reduced by a specified percentage.

Overall, the following topics have been covered (Figure 2)[17]:

[13] Since these critiques are not the main part of this paper, they are treated really shortly here only, longer explanations can be found in the references e.g.

[14] „*It has been a long-established global consensus (formulated in ISO 14044), that subjective weighting is not to be used for comparative assertions to be disclosed to the public*", Finkbeiner, M.: Product environmental footprint — breakthrough or breakdown for policy implementation of life cycle assessment? Int J Life Cycle Assess (2014) 19:266–271

[15] E.g. Finkbeiner, M., a.a.O.: „*Acidification and eutrophication impacts are assessed in almost every LCA today, based on tested methods. The PEF proposes the accumulated exceedance method (Seppälä et al. 2006 ; Posch et al. 2008) which was basically never used and tested*."

[16] An exception is my (Andreas Ciroth) comment in the PEF Food conference in Berlin 2014, https://issuu.com/thema1/docs/pef_food_conference_prelim_pro_2014, which exactly addressed why PEF does not start from basic building blocks of an LCA instead of complicated and interesting products

[17] http://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml

Energy and transport	Thinkstep	http://lcdn.thinkstep.com/Node/
Packaging	Thinkstep	http://lcdn.thinkstep.com/Node/
Agrofood	Quantis	https://lcdn.quantis-software.com/PEF/
Metals	Thinkstep	http://lcdn.thinkstep.com/Node/
Chemicals for Paint	CEPE ecoinvent	http://lcdn-cepe.org
Others	Quantis	https://lcdn.quantis-software.com/PEF/
Chemicals	Ecoinvent	http://ecoinvent.lca-data.com/
End of Life	Thinkstep	http://lcdn.thinkstep.com/Node/
Feed	Fefac	http://lcdn.blonkconsultants.nl/Node/
Incineration	Thinkstep	http://lcdn.thinkstep.com/Node/
Plastics	Thinkstep	http://lcdn.thinkstep.com/Node/
Textiles	Cycleco	https://node.cycleco.eu/node/
Electronics	Thinkstep	http://lcdn.thinkstep.com/Node/
Cooling and freezing transport	Thinkstep	http://lcdn.thinkstep.com/Node/
Glass recycling	RDC	http://soda.rdc.yp5.be/login.xhtml?stock=FEVE_EF_comp

Figure 2: Life Cycle Data Nodes with tendered, so-called *product environmental footprint-compliant life cycle inventory datasets*

In each of the topics, the number of datasets can be large, overall, there are almost ten thousand datasets, albeit many differing only by a parameter value. The second column in Figure 2 contains the main performing consultant or institution for the topic. Datasets have been tendered in batches, but all have been tendered in 2016, which means that the development of the datasets was performed in parallel, by the different institutions.

The datasets are released as fully aggregated datasets and as a special form of a disaggregated dataset which was differing from one of the batches to another. For example, for the ecoinvent Chemicals datasets, the disaggregated datasets follow the structure shown in Figure 3[18]. For this tender, only the energy and transport datasets were available, and are thus separated. On the other side, this means that that a similar disaggregation was not possible for the very first packages where energy and transport datasets were still not released, and, vice versa, the energy and transport datasets cannot include the chemicals datasets created since these were created and released after the energy and transport datasets; they instead included other datasets for the same products:

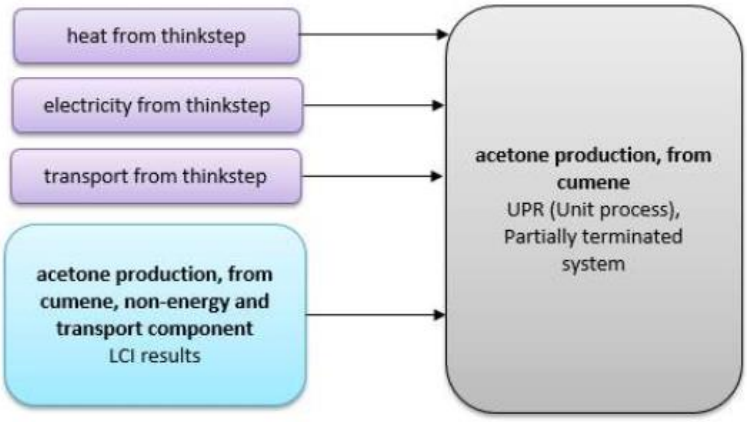


Figure 3: Disaggregated dataset for the Chemicals datasets: energy and transport are disaggregated, other products are aggregated, screenshot from ecoinvent report

For quality assurance and review, rules changed from one batch to another as well.

[18] https://www.ecoinvent.org/files/ecoinvent_pef_production_of_chemicals_sectorial_report_20170713.pdf

This in turn means that, strictly speaking, the datasets cannot be, and thus are not, consistent across the different nodes and topics.

In addition, the dataset projects were awarded for sometimes really low budgets. For example, the transport and energy dataset batch, for requested 1444 datasets, was won by thinkstep, who offered for exactly 0.01 € (see Energy and transport data tender result in the annex).

The changing review rules and the parallel creation aside, and not scrutinising the created datasets content, there is one other point worth being mentioned. The EF compliant datasets are to use the EF reference data, i.e. the reference elementary flows, flow properties, and unit groups. During the creation of the different "EF-compliant" data and afterwards, there were *many* changes in the reference data. As an effect, datasets use, in the version 2.0 that can be downloaded from the various nodes, elementary flows not in the version 2.0 reference elementary flow package (Table 1).

Table 1: Elementary flows used in tendered datasets not part of the elementary flow package of EF, version 2.0 for each (EF..: elementary flow UUID used in the processes, fname: flow name)

EF_In_PROC20.REF_ID	FNAME	CATNAME	UNAME
4c8a27a2-bc80-42e1-88ee-7070958a2508	methane (fossil)	Emissions to urban air close to ground	kg
53458008-e79e-4314-ad9b-57fc191533f5	Inert gases	Emissions to air, unspecified	kBq
a886b0b7-0404-4cf5-bf45-f406a6f981d5	Radioactive emissions (general)	Emissions to air, unspecified	kBq
bc24aa23-dfed-4abe-b5c4-5547141bb51e	Radioactive isotopes (unspecific)	Emissions to fresh water	kBq
cc821f5b-ce74-4f6f-b90a-d747e6bdcd60	HFC (unspec.)	Emissions to air, unspecified	kg
d6ffd442-2ac4-42e4-9c6d-a1b86b8c3d72	Water (river water from technosphere, turbined)	Emissions to fresh water	kg

Some of the flows may be somewhat exotic, and these are certainly not many, but the first one for example is frequently used (Figure 4).

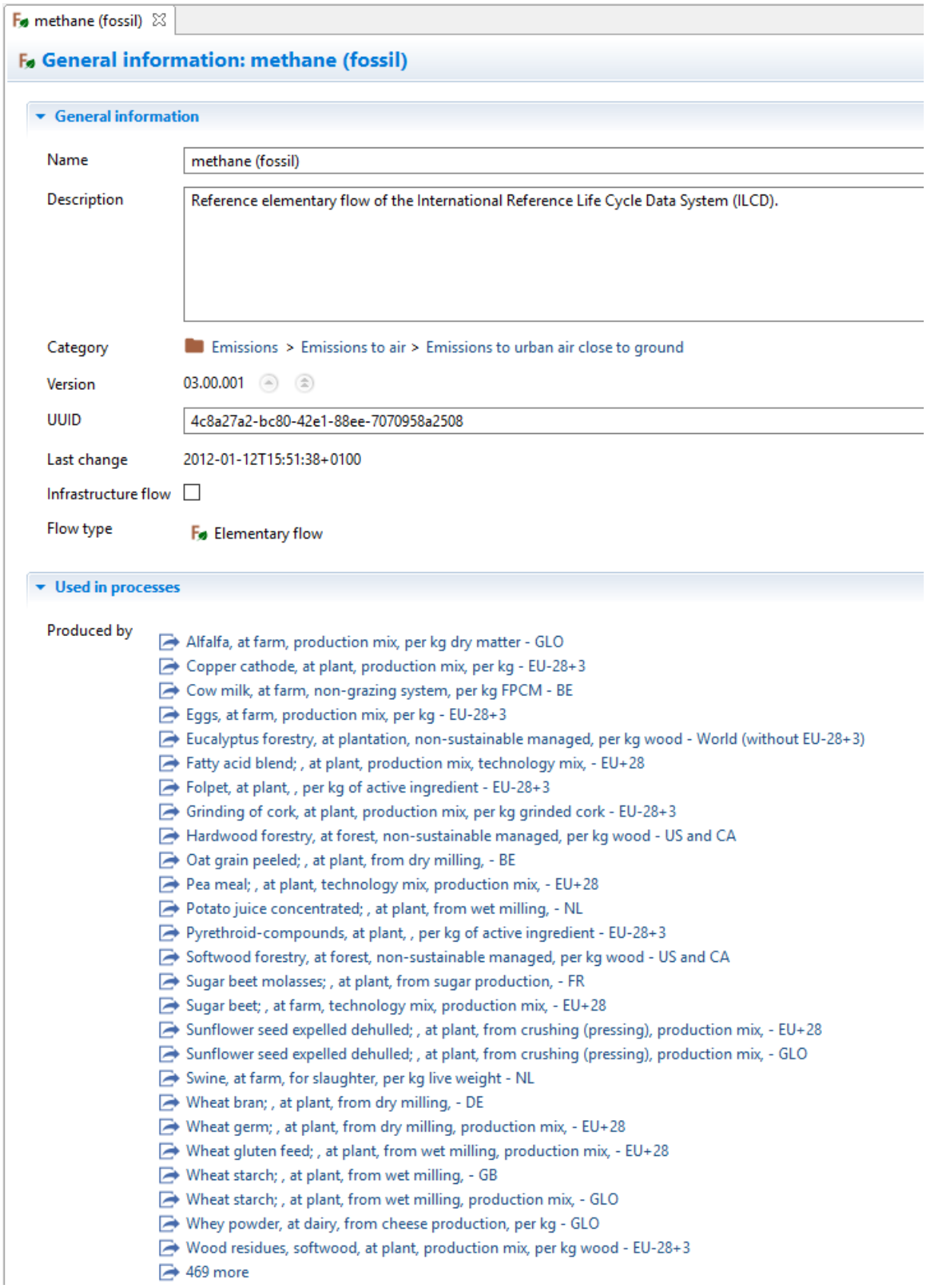


Figure 4: Usage of the non-compliant elementary flow methane (fossile), UUID 4c8a27a2-bc80-42e1-88ee-7070958a2508, in about 500 of the tendered datasets; screenshot from openLCA

Even though these might be somewhat exotic flows, this is still somewhat worrisome, for two reasons:

a) This shows that there is a structural flaw in the data sets and their release, or maybe also in the release of the reference elementary flows: I will try with an analogy: if in an airport, someone manages to bypass security, this is alarming, even though there may have been thousands of passengers who *have* passed security. These flows will not be characterised in the reference impact assessment methods. Finding these flows is possible with one query that takes about one minute to create.

b) Strictly speaking, this makes these datasets, where these flows are used, incompliant to EF (!).

2.4 The remodelling project

With the aim to better align the different pilots, to harmonise category rules and the background datasets used in them, and to enable exchange of the created pilots in different LCA software systems, a remodelling project was launched, which was won by a very large consortium comprising all major LCA software developers and altogether nine partners[19].

The project produced or is about to produce many outcomes, including remodelled pilot models, now with updated reference flows and tendered datasets for background data, and updated regarding the category rules, in both an extended, newly developed ILCD format, and in an excel template. The extended ILCD format is to be implemented in different LCA software systems.

The project is still ongoing; without mentioning details outside of the project, some apparent aspects are worth being listed:

- The project took much longer than initially planned, with lot of effort for all involved
- Multiple versions of reference elementary flows, with no real changelog, multiple versions of LCIA methods, with no real change log, as well, flaws in the reference elementary flows and also in the tendered datasets as well, increased the effort for them , somewhat depending on the specific pilot and the specific LCA software
- No real infrastructure for versioning of files and datasets, or for file sharing, sometimes, manually created excel sheets to document changes, or declared "main" or "relevant" changes, in e.g. reference data, further made handling of changing reference data more complicated

The project is not about changing the tendered background datasets, although some additional datasets have been developed linked to the remodelling project, nor about the elementary flows or LCIA methods. Results of course build on the quality of both tendered datasets and flow lists.

3 Status now, key terms of EF, August 2018

So, where are we now? Instead of attempting a full analysis of the different aspects and deliverables foreseen, a look at key terms used in EF might be useful.

3.1 The Life Cycle Data Network and the tendered datasets

"*The Life Cycle Data Network is a web-based infrastructure giving access to quality assured data for Life Cycle Assessment (LCA) provided by different actors, such as industry, national LCA projects, research groups and consultants. It supports Policy development […]*"[20]

[19] Including GreenDelta; for GreenDelta, it was the first time to enter into a EF project consortium.

[20] https://ec.europa.eu/jrc/en/network-bureau/life-cycle-data-network

The Life Cycle Data Network is used in EF to distribute the tendered datasets, via the data nodes shown in Figure 2.

However, so far, the nodes are not connected. To download datasets, it is necessary to register in most nodes separately; for one of the nodes, initially it took more than two weeks to get access, and when trying to download, the node was not operational (gateway timeout). Further, it seems the nodes are not centrally managed, which means each node operator can upload and remove datasets to the own node.

This seems inappropriate for a system to host reference data.

3.2 Representative, relevant, compliant

One of the immediately remarkable aspects in EF are the qualifying, "self-declarative" names for things in EF. There are

- Representative products and representative organisations
- EF compliant datasets
- "Relevant" is a further, key, term, used throughout many EF key documents

3.2.1 Representative products and organisations

The whole starting point for Product Environmental Footprint Category Rules, *"PEFCR is considered to be representative of a specific product category when all the following conditions are met:*

1) The Technical Secretariat in charge of a specific product category has invited to contribute to the PEFCR development process all the major competitors, or their representatives (i.e. via industry associations) covering for at least 75% of the EU market (in terms of yearly turnover or production). All companies contributing to more than 10% to the EU market (in terms of yearly turnover or production) have been invited.

2) The industry stakeholders (producers/importers, either as single companies and/or as business associations) participating to the whole process cover at least 51% of the EU market (in terms of yearly turnover or production). The participation of stakeholders will be judged on the basis of their inputs to the process and/or participation to meetings. The 51% target has to be achieved by the end of the pilot phase. This means that it is not a requirement for the Technical Secretariats themselves to fulfil.

3) The Technical secretariat has invited and involved in the PEFCR development process a wide range of stakeholders, with particular reference to SMEs, consumers' and environmental associations. In cases where all these conditions are not met by the time a final draft PEFCR is ready, the document will not be put forward to the final approval of the Steering Committee"[21]

This is evidently a thorough procedure to try to engage important producers and other stakeholders. The product defined in these category is called the representative product, RP.

That said, the product defined in this procedure is not necessarily representative for the European market from a scientific standpoint.

Simply speaking, a representative product is obtained by random sampling, i.e. a sampling where all products on the market, called "population" in statistics, have a known chance of

[21] http://ec.europa.eu/environment/eussd/smgp/pdf/Guidance_products.pdf, pp 23

being drawn (e.g.,[22] Vol I p 9). This is clearly not met in the procedure proposed above; it is admittedly rather uncommon in LCA so far, and also not easy, but would be implied by the name used in EF.

3.2.2 Relevant

Relevant is truly a key term in EF. One screenshot may serve to illustrate this point (Figure 5).

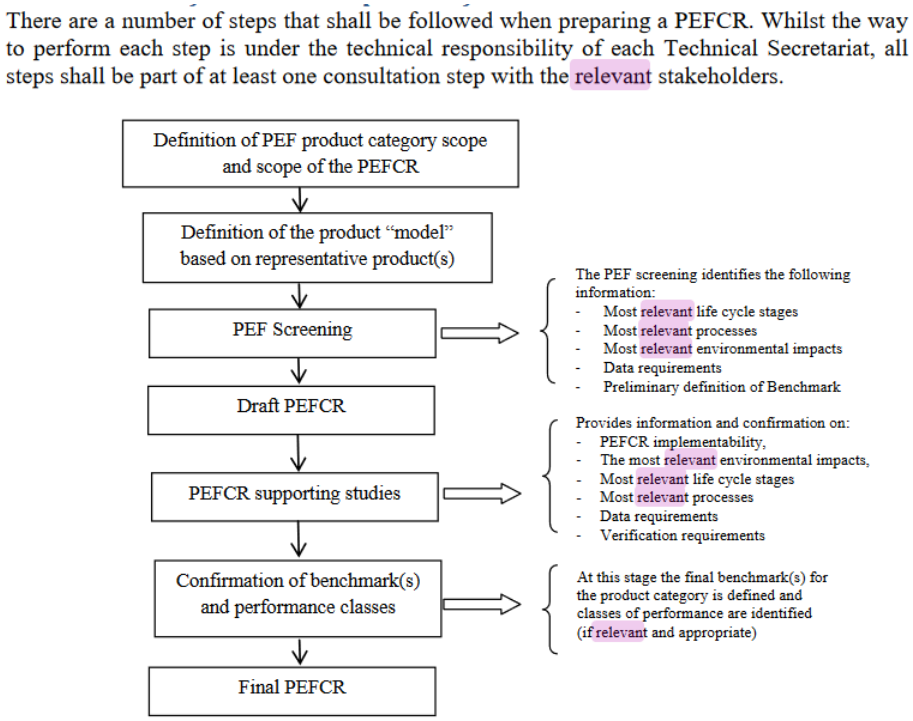


Figure 5: Screenshot from the PEF implementation guidance[23], p 25; the term "relevant" is highlighted

This makes sense as in any LCA model, and especially in an evolving data / model / stakeholder system, where many things change, to be able to draw conclusions and to isolate what matters from the rest.

However, it needs to be applied correctly. If elementary flows that are not part of the reference flows are occurring in process datasets (2.3), and are thereby making these datasets non-compliant, this is "structurally relevant" even if the specific contribution of the new flows to LCIA results might not be high, and even if these flows barely used (similar to one single passenger bypassing airport security).

Further, often, but not always, is guidance provided as to when something should be assessed as relevant, which makes the "relevant" an entry door for subjective expert judgement.

[22] Hansen, M.H., Hurwitz, W.N., and Madow, W.G., Sample Survey Methods and Theory, Volumes I and II, John Wiley & Sons, New York, 1953 - who continue: "When the determination of the [items] included in a sample involves personal judgement, one cannot have an objective measure of the reliability of the sample results, because the various [items] may have differing and unknown chances of being drawn."

[23] http://ec.europa.eu/environment/eussd/smgp/pdf/Guidance_products.pdf

3.2.3 Compliant

Compliant is another key term in EF; the tendered datasets are called compliant (2.3), and the remodeled pilot models as well. As already elaborated above, quite some of these datasets are not compliant currently, even though they are already called compliant.

This "incompliance" obviously propagates to life cycle models who are using these incompliant tendered datasets.

3.3 The reference elementary flows

When looking into the PEF reference database, several things immediately catch attention, especially when using a tool like openLCA that keeps categories as they are and does not enforce own categories or rules:

- A somewhat crowded and seemingly disorganised flow system, with several almost identical categories with flows in each (the particles, Figure 6); with a product flow "porocalce", and with waste flows appearing in several subfolders spread over various sections (deposited goods, end of life treatment, wastes), Figure 7.

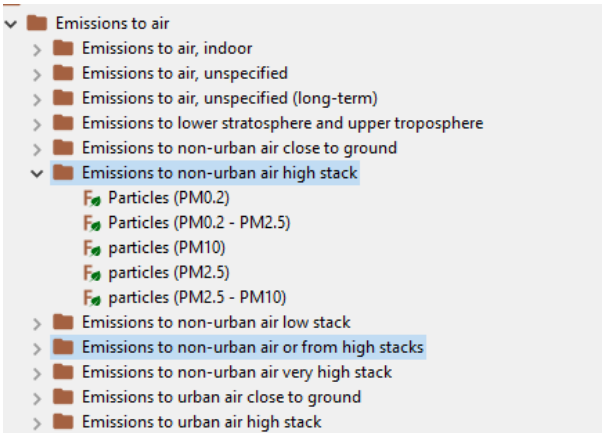


Figure 6: PEF 189 oct reference data, emissions to air (excerpt)

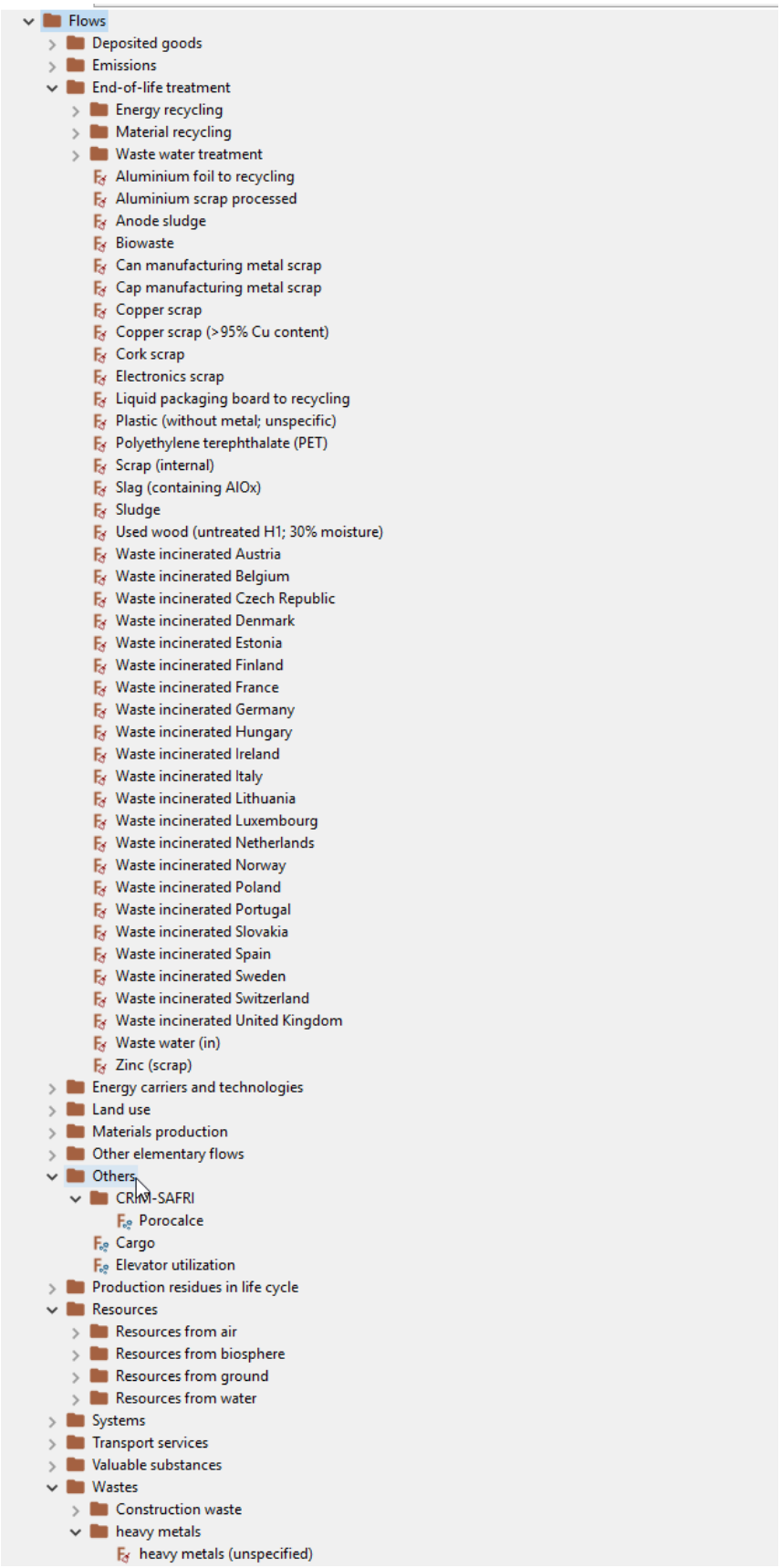


Figure 7: PEF 189 oct reference data, flows (excerpt)

For the technical unit groups, there are "Masseeinheiten", and "unit of kgkm" in parallel to "Units of mass*length" (Figure 8). For the "other unit groups", there are "ecoinvent unit cubic

meter years" and "unit of abiotic resource consumption (EI99)", obviously referring to the ecoindicator 99 LCIA method (Figure 9).

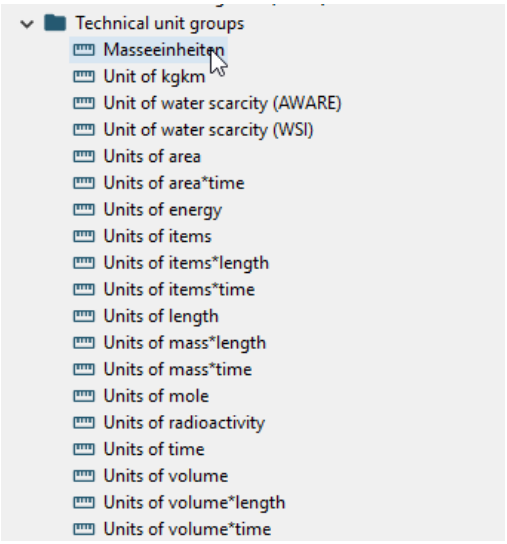


Figure 8: PEF 189 oct reference data, technical unit groups, excerpt

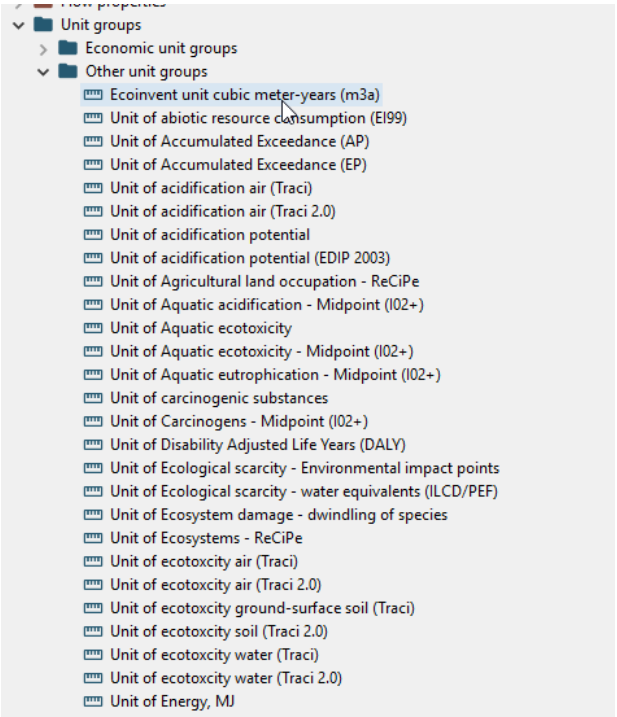


Figure 9: PEF 189 oct reference data, other unit groups, excerpt

Further, many units occur several times in the reference data (Figure 10), often linked to different unit groups.

ID	REF_ID	NAME	DESCRIPTION	VERSION	LAST_CHANG	CONVERSION	SYNONYMS	F_UNIT_GRO
2444	64aa765c-3253-47f2-862e-e9090c8fc4f3	$	NULL	0	0	1	NULL	2443
2673	c91d4c1e-7fc8-4fb2-b567-e739020915e6	$	NULL	0	0	1	NULL	2672
2834	5405a099-6401-4a1e-849f-3726042ce6d2	$	NULL	0	0	1.15730373	NULL	2832
2787	8131fa67-fb9d-428b-964b-b63362bb90a9	(cmol*m2)/kg	NULL	0	0	1	NULL	2786
2574	d1108aa2-8958-49dd-83f7-1a2c30dcdf39	(cmol*m2*a)/kg	NULL	0	0	1	NULL	2573
2580	2521692b-6bc6-4600-ad67-80a3a90c152a	(mm*m2)/a	NULL	0	0	1	NULL	2579
2517	a9669b82-1531-4165-a2f9-a55110d5a7a6	A	NULL	0	0	1.00E-10	NULL	2515
2537	e23e98e9-e1bf-4b76-92af-9806ded2ab15	a	org.apache.c	0	0	365	NULL	2533
2624	1edbda64-4cd6-43b9-98c5-f2d78358a94a	a	org.apache.c	0	0	100	NULL	2616
2622	365fe93f-2616-45ef-8cd4-2b843d4247e6	ac	org.apache.c	0	0	4046.856	NULL	2616
2518	b7ebb37e-f7bb-4963-89bb-9191a3ebbdca	AE	NULL	0	0	1.50E+11	NULL	2515
2722	d450d0fa-4868-459d-9d3e-a85fe8fc9909	Annual crop eq.·y	NULL	0	0	1	NULL	2721
2450	a6010231-8890-49ad-b0f8-012301605b3d	AUD	org.apache.c	0	0	0.63	NULL	2446
2490	2554fb10-88d3-4ca5-af5c-650761e342ac	bbl	NULL	0	0	0.1589873	NULL	2481
2649	4d6da1fc-9ecc-412f-b86e-58789ac5aae2	bbl	org.apache.c	0	0	0.15898729	NULL	2632

Figure 10: Units in the reference data, 189 oct package, excerpt

Overall, these units in table 1 occur more than once in the reference data. While some may certainly be somewhat exotic and hardly be used, the list contains also kg, MJ, t, and m².

Table 1: Units in the reference data ,189 oct package, where the name occurs multiple times, with different UUID

NAME	NumberOfREF_ID
CTUeco	6
kg	4
Cases	4
MJ	4
m2a	3
kg DCB eq.	3
$	3
kg 1,4-DB eq.	3
m2	3
kg SO2 eq.	3
m3	3
CTUcancer	3
A	3
t	3
mg	3
GJ	2
bbl	2
kBq	2
J	2
in	2
EUR	2
h	2
g	2
ft	2
Bq	2
Btu	2
cm	2
ha	2
l	2
u	2
TOE	2
s	2
Nm	2

NAME	NumberOfREF_ID
MWh	2
mm	2
min	2
mi	2
kg NOx eq.	2
m	2
kg C2H3Cl eq. to air	2
kWh	2
km	2
kg/a	2
kg Toluene eq.	2
kg SO2 eq. to air	2
yd	2
kg PM10 eq.	2
kg CO2 eq.	2
m2 UES	2

4 Can't we do better in LCA

So, from the current status,

- there are datasets and also life cycle models that are called compliant but are not compliant (3.2.3)
- the tendered datasets are not consistent, which can hardly be corrected (2.3)
- products and organisations called "representative" while they are not, from a scientific standpoint (3.2.1)
- there is an infrastructure called life cycle data network meant to distribute the tendered datasets and the pilot models, which is not a network yet since nodes are not connected (3.1)
- and reference elementary flows that seem to have quite some issues still (3.3).

Given all the effort, by literally hundreds of experienced experts in industry, policy, consultancy and academia, over more than five years, this is somewhat depressive[24].

Some of the points mentioned above in bullets can be overcome, with more effort (the network can become a real network, the non-compliant elementary flows can be removed making the datasets compliant, asf.). It is however not the main point that there are initial flaws in a large, new system.

From the outside, it seems the starting ideas for EF were mainly to create something that "sounds good", with many, diverse products, with broad stakeholder involvement, from

[24] And reminds of this question from https://www.quora.com/Why-was-East-Germany-called-a-Democratic-Republic-when-it-was-actually-Communist: "*Why was East Germany called a "Democratic Republic" when it was actually Communist?"* With this highest-voted answer: "*Many countries that are authoritarian in nature use, and have used, "Democratic", or "Democratic Republic of", even when they're anything but that. Some notable examples are the DPRK(Democratic peoples Republic of Korea) and the DRC(Democratic Republic of Congo). In my opinion, countries that utilise this in their name are just trying to sound good; it doesn't actually mean that the country in question is more democratic, and it's actually a pretty useful indicator as to which countries are oppressive."*

many, independent or not well-connected sides. And many results are indeed presentable, especially the coordinated category rules seem really a major step forward[25]. For a framework and system to provide "*reliable information on the environmental performance of products*", and to assess compliance and consistency, this approach falls short however. The introduction of the tendered data sets afterwards, and the setup of the remodelling project, are then steps to "curate" issues created by the diverse, good-sounding start.

Stepping a bit back from the current situation, it seems that the overall EF was started upside down, with end results and "good looking" procedures and outputs, and less attention was paid to building blocks and coordination for such a broad, overarching system, meant to provide reliable information. And all the effort put into it to-date serves to publish soon about not more than 70 different product life cycle models, with flaws introduced by linked background data, where the European market has literally thousands of different product groups, which also change. Seeing this, the system so far does not appear as to address and solve the starting question for EF, *"[…] to ensure that consumers receive reliable information on the environmental performance of products"*[26]

This is, again, a bit depressive, since EF is one chance for LCA to move "*from the cellar to the stage*"[27].

So, let us ask, how should such a system be built, considering what has been done; and of course, can't we do better in LCA?

A bit more time is needed to elaborate this, but some key aspects are apparent:

- The approach should be indeed science based
- It should be based on facts
- A life cycle model should be seen as a model, and thus as an approximation of reality
- Model casts can be used to provide hard answers if needed; they should be provided with a summary of the assumptions and modelling decisions leading to the model result
- In some parts, it may be needed to think outside of the LCA box, and extend to include other models as well, to address the environmental performance of products properly (such as risk assessment, and possibly environmental impact assessment)
- Sufficient technical infrastructure should be provided to manage data updates and sharing of data and models
- Sufficient funds should be provided, to prevent projects are won mainly for lobbying reasons or with other hidden agenda points in mind
- For the initial creation, focus should be on establishing initial building blocks, which can be extended to become more detailed and specific afterwards
- Selling and claiming should be executed with caution, and be fact-based[28].

[25] See e.g. https://www.feednavigator.com/Article/2018/07/24/Do-PEF-category-rules-allow-sound-analysis-of-the-ecological-impacts-of-feed-Yes-says-FEFAC (although FEFAC was leading the feed EF pilot, thus this is not a fully neutral statement probably).

[26] See also footnote 2

[27] See also "Making the life cycle metrics department more relevant in large organizations : from the Cellar to the Stage", session, LCM 2015, http://lcm-conferences.org/lcm-2015/program/theme/

These points should be refined further.

Really positive for EF is that industry indeed came together and put effort into creating a common model for the respective pilots, but it is now, and since some time already, probably the time to put this effort to good use for a solid, sound sustainability assessment of products in Europe.

[28] See e.g., somewhat old but still valid: https://www.cbsnews.com/news/dont-make-brand-promises-you-cant-keep/

1 Annex

1.1 *Energy and transport data tender result*

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate A – Green Economy
Director

Brussels,
DG ENV.SRD.2/ 29/02/2016

BY REGISTERED MAIL

GreenDelta
Mr Andreas Ciroth
CEO Gren Delta
Mullerstrasse 135
13349 Berlin
Germany

Subject: "Provision of energy and transport product environmental footprint-compliant life cycle inventory datasets"

Ref: ENV.A.1/SER/2015/0049vl of 02/12/2015

Dear Mr Ciroth,

Thank you for having submitted a tender in response to the above call.

The competent services in the Commission have studied your offer very carefully, however, despite our interest in your proposal it has not been selected. Even though your offer passed the selection and exclusion criteria, it has not been retained, as your organization failed to represent the best case of value for money in accordance with the award criteria set out in the above mentioned call for tender.

Your offer was given on overall score of **95,88/100** and was ranked in 2nd place.

The contract was awarded to **Thinkstep** for a total amount of **0,01 €** and a score of **87,32/100.**

If you believe that there was maladministration, you may lodge a complaint to the European Ombudsman within two years of the date when you became aware of the facts on which the complaint is based (see http://www.ombudsman.europa.eu).

Any request you may make and any reply from us, or any complaint for maladministration, will have neither the purpose nor the effect of suspending the time-limit for lodging an action for annulment of the present decision, which must be done within two months of notification of this letter. The court responsible for hearing annulment procedures is the General Court of the European Union:

General Court
Rue du Fort Niedergrünewald
L-2925 Luxembourg
tel.: (+352) 4303 1 fax: (+352) 4303 2100
e-mail: GeneralCourt.Registry@curia.europa.eu
URL: http://curia.europa.eu

Thank you for your interest in the work of the European Commission. We trust that it will be renewed in future procurement procedures.

Yours sincerely,

Kestutis Sadauskas

Director

BU 9 – 04/47, B-1049 Brussels - Belgium – Telephone : switchboard +32 2 299.11.11

1.2 All Product Environmental Footprint pilots

All Product Environmental Footprint pilots are listed in the European pilot page[29].

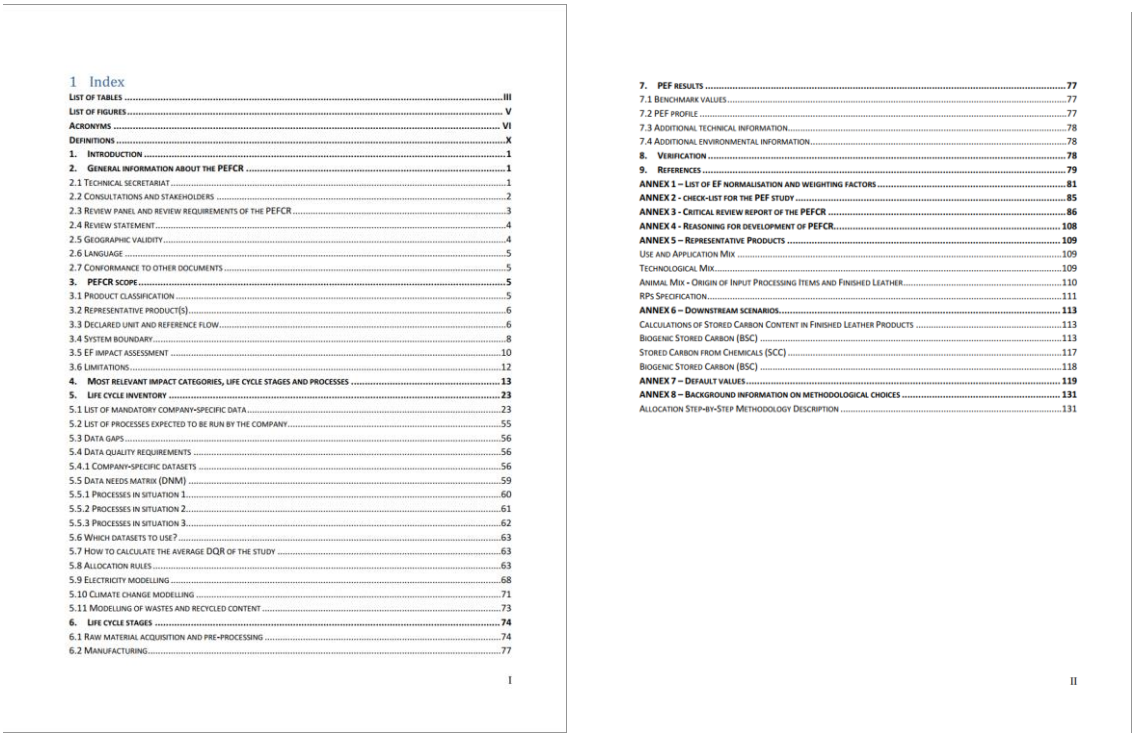
Pilot (wikis & factsheets)	Date of 1st consultation meeting	Consultation on the draft final PEFCR
Batteries and accumulators	25/2/2014	16/9/2016
Decorative paints	6/3/2014	11/11/2016
Hot and cold water supply pipes	20/3/2014	26/9/2016
Household detergents	24/3/2014	1/7/2016
Intermediate paper product (JRC)	17/3/2014	27/6/2016
IT equipment	6/3/2014	24/10/2016
Leather	22/1/2015	15/9/2016
Metal sheets	7/3/2014	16/7/2016
Footwear	13/3/2014	9/9/2016
Photovoltaic electricity generation	9/4/2014	27/9/2016
Stationery (discontinued)	30/4/2014	
Thermal insulation	15/10/2014	10/10/2016
T-shirts	14/3/2014	12/9/2016
Uninterruptible Power Supply	26/2/2014	27/10/2016
Beer	26/9/2014	15/9/2016
Coffee (discontinued)	16/10/2014	
Dairy	31/10/2014	9/9/2016
Feed for food-producing animals	28/10/2014	9/9/2016
Marine fish (discontinued)	20/11/2014	
Meat (bovine, pigs, sheep) (discontinued)	19/12/2014	16/9/2016
Olive oil	30/10/2014	25/10/2016
Packed water	8/10/2014	8/9/2016
Pasta	14/11/2014	30/8/2016
Pet food (cats & dogs)	24/10/2014	5/9/2016
Wine	25/11/2014	9/9/2016

[29] http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm

1.3 PEFCR for leather

As an example for PEFCRs, the one for leather is provided here[30], w.l.o.g..

Figure 11 Shows the table of content to get an idea about the content, Figure 12 shows one example for rules, for allocation.



1 Index

I

II

Figure 11: Table of Content for the PEFCR on leather, April 2018

[30] Taken from http://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_leather.pdf

528 **Table 19 Allocation rules**

Process	Allocation rule	Modelling instructions
Bovine farming	Biophysical	Subdivision shall be used for processes that can be directly attributed to certain outputs (e.g. energy use and emissions related to milking processes). When the processes cannot be subdivided due to the lack of separate data or because technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values shall be used by PEF studies unless company-specific data are collected. The change of allocation factors is allowed only when company-specific data are collected and used for the farm module. In case generic data are used for the farm module, no change of allocation factors is allowed and the ones listed below shall be used: • Milk: 88,0% • Live animal to slaughter: 12,0%
Caprine and ovine farming	Biophysical	Subdivision shall be used for processes that can be directly attributed to certain outputs (e.g. energy use and emissions related to milking processes). When the processes cannot be subdivided due to the lack of separate data or because technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values shall be used by PEF studies unless company-specific data are collected. The change of allocation factors is allowed only when company-specific data are collected and used for the farm module. In case generic data are used for the farm module, no change of allocation factors is allowed and the ones listed below shall be used: • Milk: 73,85% • Wool: 23,64% • Live animal to slaughter: 2,51%

Figure 12: Excerpt for rules in the PEFCR for leather; here only for two processes, the table continues