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DSM Nutritional Products							
2	38-41			Ge	Shouldn't we have each species as heading number 4 (meaning indented) to better reflect the structure for the paragraphs on baseline evaluation	6.13.5.1 Large ruminants 6.13.5.2 Small ruminants 6.13.5.3 Pigs 6.13.5.4 Poultry	Corrected as suggested
3	2-5			Ge	Shouldn't we have each species as heading number 4 (meaning indented) to better reflect the structure for the paragraphs on feed efficiency	6.13.11.1 Large ruminants 6.13.11.2 Small ruminants 6.13.11.3 Pigs 6.13.11.4 Poultry	Corrected as suggested
7	31	Glossary		Te	The definition provided appears not appropriate: "Co-product is the output from a production activity that generates more than one output. The term does not include services that may also be provided" Actually, co-product is an additional output associated to a (financial) value. Otherwise it must be treated as by-product or waste.	Suggested corrected definition Co-product is the output from a production activity that generates more than one output of financial value.	Definition from ISO14044 or ISO13065 is adopted: co-product any of two or more products coming from the same unit process or product system
8	5	Glossary		Te	Considering that the variations considered are dealt as ratio, designating the change as a factor rather than as a spread, the expression as Δ should be replaced by a F for factor or r for ratio	Replace Δ by F for Factor or r for ratio	We changed the □ by □ (to keep the Greek variation and be more visible), as we use the □ as a ratio. F is already used in other parts for e.g. emission factors in some of the equation.
9		Glossary		ge	SF6	SF_6	Corrected as suggested
10	22	Glossary		Ge	Typo: Is an n enzyme	Delete the n. Is an enzyme	Corrected as suggested
16	26	2.1		Te	Don't we miss land use in addition to climate change, fossil energy use,	Introduce the consideration of land occupation	Land occupation is relevant for feed production, which is mentioned under 2.1

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					acidification and eutrophication. Several additives enable an improvement on the feed efficiency, known to impact the land use Cf: MOTTET, A., DE HAAN, C., FALCUCCI, A., TEMPIO, G., OPIO, C. and GERBER, P., 2017. Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. Global Food Security, 14, pp. 1-8. "[...] gains […] can be achieved through precision livestock farming and the development of feed additives"		Environmental impact It is very unlikely that a livestock system is investigated without considering the production of feed.
17	21	2.2	Figure 1	Ge	The legend should be better distinguished from the diagram, some arrows do not connect with blocks	Reposition the legend in the diagram	Done as suggested
17	20			Te	Traceability for the equations The doc would value tracing the origin (other LEAP guidelines) of the equations proposed in the section 6.13 onwards This would also ease the update exercise upon tuning/aligning/cleaning the equations during the road testing	Consider introducing a table which trace the origin of the equations proposed in the section 6.13 onwards.	The equation naming has been completely revised so hopefully traceability has improved.
20	13			Te	Consider adding WBCSD 2016 as non-normative references	WBCSD. Life Cycle Metrics for Chemical Products. A guideline by the chemical sector to assess and report on the environmental footprint of products, based on life cycle assessment. 2016	Corrected as suggested
25	10		Table 1	Ge	Ecoinvent data base indeed only covers a limited number of feed raw materials but it is the database of choice for chemically manufactured products, which happen to be the case of numerous feed additives	Database of choice for chemically manufactured products, contains only few feed raw materials	Appropriate; no further action

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					Consider rewording the salient feature for this data base as in the next column		
26	5-9			Te	Consider wording the sentence in a more concise manner Initial sentence: "As described in chapter 2.3 on the functional unit for the manufacturing process, in some cases the environmental impact of the manufacturing process of the active substance has to be extended, when feed additives are placed on the market in the form of a commercial product (i.e. the active substance sprayed on a carrier or a pre-mixture of different active substances"	Replace by "All environmental impacts arising over the full production chain have to be included, from the raw material up to the final product in its commercialized form, which may be a preparation or just the pure substance."	We feed that the original text is more appropriate.
27	9			Ge	A minor rewording is proposed to clarify that the additive manufacturer sometime proceeds to the further formulation of the ingredients in addition to the primary obtention. Initial sentence For this reason, feed additive manufacturer are manufacturing preparations of feed additive, consisting of the active substance and other ingredients (e.: flowability agent, antioxidants, carriers).	Replace by For this reason, in addition to the production of the pure substance/ingredient additives manufacturers can formulate the substance/ingredient in the form of a preparation, by implementing additional ingredients and processes (eg.: flowability agent, antioxidants, carriers). This ultimate step is sometimes named "formulation".	We have added 'formulation' in the sentence.
27	14			Ge	A minor rewording is proposed Initial sentence When a feed additive is used within the feed chain and/or within the livestock production system in the form of a preparation, the environmental impact of	Replace by When a feed additive is used within the feed chain and/or within the livestock production system in the form of a preparation, the environmental impact of the feed additive manufacturing shall comprise the environmental impact of	Appropriate. This is a simpler description of the original so we have replaced it.

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					the feed additive manufacturing shall encompass the environmental impact of the preparation manufacturing processes.	both steps: the production of the substance/ingredient and its formulation.	
27	11	4.1.2		Ge	Granulated should be replaced by “granulation” to align with the wording with “coating” and “mixing”	Granulated should be replaced by granulation	Appropriate
27		Figure 3	Ge	Spelling	Energy: 1 “e” too much		Corrected
27	24			Te	Is it really so that more detailed data give better modelling? Energy and raw material consumption figures from financial accounting are often more reliable than more detailed other sources. Just a side comment!		Thank you.
28	8			Ge	Typo	Man-made	
29			Figure 4	Ge		O_2-emission is not modelled. Can be omitted in the graphic. Level 1 and Level 2 are not shown in the box. Propose to put the emission arrows further to the right in the box (outside the dotted line).	Figure 4 revised
29			Figure 4	Te	The set for these figures is debatable. For example, steam ore heat is missing here and the box Chemical/Solvent and physical extraction is a hybrid between inputs and processes. Furthermore, in de detailed elaboration the inputs and outputs (which are the most important part) are missing.	Consider clarifying input/output/processes	Figure 4 revised.
30	11	4.1.2.2		Te	To match the concept of preparation of	These products can be in dry or liquid	Appropriate

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					additives, it would be advisable to mention “preparation” in this §	form and can be further reacted or coated to produce ~~additional products~~ preparations of additives.	
30	7			Te		The specification on petrochemicals does not help. Specify later: In the case of fossil raw materials, CO2-emissions from end-of-life scenarios have to be taken into account.	We have not considered end-of-life of raw materials in this guideline
30	8			Ge		Delete “small”	Appropriate and deleted
30	10-11			Te		Delete “These products can be in dry or liquid form and can be further reacted or coated to produce additional products.” And replace by “The active products are usually formulated to ensure required physico-chemical behavior (e.g. stability, solubitlity, flowability). “	We feed that coating is not always a form of formulation.
31			Figure 6	Te		“Educt” is not an English word. Replace by “raw materials”, replace “broth” by “crude product” or reaction mixture. In Level 2: Delete “chromatography”, which is not used often in manufacturing. Add “Distillation”.	Broth is not always crude product e.g. a fermentation broth can contain biomass and several further crude products which can be isolated. Educt is an English word used in chemistry; broth is a common understandable term; chromatography takes many forms and commonly used to purify chemicals and separate complex mixtures
31	11			Te		Add “fatty acids”, these can also serve as raw material for fermentation.	Added
31	20	4.1.2.4		Te	Not all probiotics are lyophilized, Most of them are not, esp the ones that sporulates spontaneously like B. Subtilis for ex	‘For probiotics, the microorganism is removed from the majority of the substrates and lyophilized for further packaging.’	Appropriate; and changed

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						To be replaced by: 'For probiotics, the microorganism is separated from the fermentation broth and further processed (coated or placed on carrier or lyophilized) before packaging.'	
33			Figure 8	Ge	Why is one box in black and the others in blue?	Homogenize the style of the illustrations	Figure 8 revised
33-34			Figure 8, 9, 10	Ge	The size of diagrams is much bigger than the earlier presented production diagrams	Homogenize the style of the illustrations	Figure 8,9,10 revised
33	6	4.1.3		Ge	Typo. Treatment slike	Delete the s	changed to such as
33	6			Te		Coating is a formulation operation, the word "coating" can be deleted.	Same comment as above
36	4			Te		Delete terms in brackets and replace by "macronutrients such as Protein, carbohydrates, fat, micronutrients such as vitamins, minerals",	Changed as suggested
36	11	4.2.1		Te	Feed is formulated shooting for advanced nutritional criteria. In monogastric feed formulation, level of crude protein and total phosphorus are replaced by digestible amino acids and digestible phosphorus	The nutritional constraint on the feed, e.g. level of crude protein, digestible amino acids, digestible ~~total~~ phosphorus, are defined based on animal performance objectives, while each feed ingredient is characterized by nutrient concentration to achieve the nutritional constraints of the feed.	Changed as suggested
36	32	4.2.1 Feed composition		Ge	Spelling of the ref. Wideman or Wiedemann?	See ref page 107	Changed as suggested
36	8			Ge		In most instead of "in the most".	Changed as suggested
37	9 and	4.2.2. Feed		Te	The wording "*Animal sourced product quality*" brings confusion. "Marketability of	Marketability of animal products	Changed as suggested

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	19	Efficiency			animal products" using the same wording as in line 9, same page, would possibly be clearer		
37	3			Te		Add (kg feed)/(kg animal derived product) after "animals".	Changed as suggested
38	10	4.2.2. Feed Efficiency	Animal health and welfare maintenance	Te	Several types of additives contribute to the stabilization of the physiology of animals, and thus on their welfare. This is the case for probiotics, prebiotics, some enzymes, some organic acids and phytochemicals which help support the gut function and therefore contributes to the overall resilience of animals to diseases. In Europe, the Reguation (EU) 2019/962 of 12 June 2019 is formally introducing the new functional group: *physiological condition stabilisers - substances or, when applicable microorganisms, which, when fed to animals in good health, favourably affect their physiological condition, including their resilience to stress factors*. Cf LCA on the role of Specialty Feed Ingredients in livestock production's environmental sustainability – Part 2: Non-Starch-Polysaccaride-degrading enzymes, Protease, Probiotics, Phytogenics, Organic Acids (draft) 2019. The sole example provided in the current draft (coccidiostats) is a product targeting pathogens (a drug in several jurisdiction) while other products with indirect impact on health are worth a featuring, in	Animal health and welfare maintenance. ~~Diseases provoke disruption of physiological balance and can influence nutrient utilization. For example, Eimeria are unicellular parasites causing coccidiosis in cattle, poultry, sheep and goats. Coccidiostats are used as a prophylactic to prevent coccidiosis in poultry and other animals.~~ Animal health and welfare maintenance. Several types of additives contribute to the stabilization of the physiological conditions of the animals, especially by supporting the gut function. This is the case for examples for probiotics, prebiotics, some enzymes, organic acids and phytochemicals. Coccidiostats acting against parasites also contribute to animal health and welfare maintenance. Healthier animals spare the burden to restore metabolic functions and can develop and/or produce more efficiently. The benefits of such additives translate into enhanced production parameters and often in enhanced feed efficiency.	Changed as suggested

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					consideration of their extended use. It matters also there to highlight how this can be modeled, pointing to the effect on performance and feed efficiency later developed in 6.14.10 page 76.		
38	30	4.2.3		Ge	Suggest replacing “It” by “access to silage”	~~It~~ *Access to silage* enables the provision of feed during period of the year when the animals are not able to graze outside	Corrected as suggested
39	1 to 8	4.2.3		Te	Why some comments on different performances of the microorganisms used as silage additives? One can understand that in these sections, an inventory of the possibly contribution is provided, with generalities on how additives work, without discriminating one against and other.	~~Adding silage additives/inoculants to freshly harvested forage can greatly increase the likelihood of achieving good quality silage. Silage inoculants containing homolactic bacteria, such as Lactobacillus plantarum accelerate the decline in silage pH by preventing the growth of bacteria that increase dry matter losses. In addition, such bacteria conserve sugars in silage by reducing heterofermentation. Whereas, heterolactic silage inoculants such as Lactobacillus buchneri are more effective at improving aerobic stability by degrading lactic acid into acetic acid, which inhibits growth of yeasts and molds, and improves silage stability at feed-out (Reich and Kung, 2010). A recent meta-analysis has shown the feeding silage inoculated with homlolactic and facultative heterofermentative bacteria results in improved performance of the dairy cows (Oliveira et al., 2017).~~	Corrected as suggested
39	6 to 8	4.2.3		Te	Furthermore, it appears inappropriate to speak of an improvement of dairy cow performances for a silage additive, in this		Section is now deleted

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					section. Silage additive are meant to improve the performance of the ensiling technique (for ex kinetic of pH reduction, reduction of dry matte loss, reduction of yeast and moulds) NOT animal performance.		
39	12			Te		Add methane in "gaseous emissions from manure storage"	It is provided in parenthesis
39	22					"present study" doe not make sense, as the document is not a study but guidelines. Delete or replace by "several studies suggest"	Corrected as suggested
41			Part 2	Te	GENERAL COMMENT For the assessment of additive production, it could be worth considering the following **<u>subsidiarity principle</u>** to leverage, without redundancy, the competences already build per sector. In case there are undisputed applicable sectorial guidelines available, then these sectorial guidelines should be considered. In the contrary, the assessment and the report of the environmental footprint of products should be done considering the principle laid down in the present LEAP guidelines. It appears for example that for the entire chemical sector the WBCSD guidelines (2016) prevails as the reference to elaborate an LCA. WBCSD. Life Cycle Metrics for Chemical Products. A guideline by the chemical sector to assess and report on the environmental footprint of products,	When this comment is taken up then it should feature somewhere below the Part 2 title and before the title 5. A proposal could read as follows: *The key feature of the LEAP guidance is to go beyond the well-accepted standards for some specific topics related to animal nutrition and livestock supply chains.* *When considering the manufacturing of additives, in case there are undisputed applicable sectorial guidelines available, then these guidelines should be considered. In the contrary, the assessment and the report of the environmental footprint of products should be done considering the principle laid down in the present LEAP guidelines which are grounded on the same ISO principles.* *For example, in the case of fermentation and/or chemical process the WBCSD guidelines (2016) appear as the reference*	Comment is valid; and has been incorporated.

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					based on life cycle assessment. 2016 NB: these Guidelines are authored by key stakeholders of the additives sector (affiliations of authors: AkzoNobel, Evonik, Solvay, DSM, SABIC, Cefic, SCG Chemicals, BASF, Mitsubishi Chemical Holdings) and should then make consensus. Secondly the Chemical product footprint studies shall in any case be based on the ISO 14040:2006 and 14044:2006 requirements as much as feasible. And all deviations shall be explained and documented in the product footprint report. Best practice standards for product environmental footprint assessment most notably the International Organization for Standardization's ISO 14040:2006 – "Environmental management – Life cycle assessment – Principles and framework" and ISO 14044:2006– "Environmental management - Life cycle assessment - Re-quirements and guidelines" should be considered. Other international guidance, such as the GHG Protocol standards developed by the World Resources Institute (WRI)/WBCSD, the European Commission's Product Environmental Footprint (PEF) guide and other existing sector guidance, could also be referred to.	*to assess and report on the environmental footprint of products, based on life cycle assessment.* *The LEAP guidelines are complementary to international standards on life cycle assessment and environmental footprint and does not intend to replace them. Thus, relevant recommendations or standards, such as ISO 14044:2006 and/or the PEF Guide, shall be followed to claim alignment with them and with the present LEAP guideline.*	
52	10, 32	6.5		Ge	Shouldn't we have each sub paragraph of section 6,5 as heading number 3 (meaning indented) to better reflect the	6.6.1 Intermediate transport and trade 6.6.2 Relevant inputs, resource use and	Corrected as suggested

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					structure	emissions during transport and trade	
55	1		Equation 1	Ge	Why the featuring of “(formula 3)” in equation 1		Removed
57			Figure 13	Ge	Typo in the bottom box: 1 ton of animal liveyweight, milk, eggs	1 ton of animal live weight, milk, eggs	Corrected
57	2,3			Te	Why the legend: LPG = Liquid petroleum gas		Because it is not apparent what LPG in the figure refers to
57	11			Ge	Point missing at the end of the sentence		Corrected as suggested
58	7			Ge	Sukling cow, should read suckling cow Not sure if the wording is appropriate Suckling piglets with sows Suckling veals with breeding cows		Corrected as suggested
58	11-12			Te	To be limited only to cases where it makes sense. Restrictions should be made for example for dairy cows that only receive an additive during the lactation period.		Agreed
58	17			Ge	Shouldn’t we have each animal type in section 6,13.3 as heading number 4 (meaning indented) to better reflect the structure	6.13.3.1 Large ruminants 6.13.3.2 small ruminants 6.13.3.3 pigs 6.13.3.4 poultry	Done as suggested
58	18			Ge	ERROR a reference to the equations in Table 3 is expected and not to equations in Table 2	The equations in Table 3 for the baseline were used for cattle, buffaloes and camels used for	Corrected
59			Table 2	Te	ERROR Methane density = 0.656 kg/m3. Not 0.662	Methane density = 0.656 kg/m3	Corrected but it depends on the temperature of the gas: 15°C, 0.678 kg/m3 20°C, 0.667 kg/m3

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							25°C, 0.656 kg/m3
59			Table 2	Te	A definition for FCR, exploited in the appendices is missing	Add below definition feed efficiency (total feed intake given, kg / final body weight, kg) a feed efficiency may apply to a given time period or to the total life span of the animal	Added
59			Table 2	Te	ERROR 6.25 is not the concentration of nitrogen in protein in feed and in the animal tissues as laid down in Table 2, but 6.25 is the factor for the conversion of nitrogen content to protein content (CP = N x 6.25) in feed and in the animal tissues	Replace the definition given for 6.25 by 6.25 is the factor for the conversion of nitrogen content to protein content (CP = N x 6.25) in feed and in the animal tissues	Replaced
59			Table 2	Te	ERROR 6.38 is not the concentration of nitrogen in protein in milk as laid down in Table 2, but 6.38 is the factor for the conversion of nitrogen content to protein content (CP = N x 6.38) in milk.	Replace the definition given for 6.38 by 6.38 is the factor for the conversion of nitrogen content to protein content (CP = N x 6.38) in milk	Replaced
59			Table 2	Te	%Cu, %Ptotal, %Zn Weird wordy definition “Weighed average concentration of copper in the diet, considering the copper concentration in each kg of feed and their individual intake”. We understand that it is the average concentration of the element in the diet across the various phases of the feeding program which should be considered	Replace “Weighed average concentration of copper in the diet, considering the copper concentration in each kg of feed and their individual intake”. By average concentration of the element in the diet across the various phases of the feeding program (using the feeding intake in each phase to weigh the average	Replaced

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						concentration)	
59	1		Table 2	Te	CP% It should be specified that the protein should be expressed on a dry matter basis together with the intake on a dry matter basis to align the approach in monogastric with the one for the ruminants	Clarify the expression for the total protein content	Clarification added
60	1		Table 2	Te	Many units are missing in Table 2		The missing units are dimensionless
60			Table 2	Te	Bo and MCF would deserve an indication of average expected value to enable a CH4 calculations for non-specialists or of reference publications where to read these parameters Without a clue on these parameters no calculations can be rolled out on methane	Consider proposing an indicative value for Bo and MCF or pointing at reference publications.	Default values are found in IPCC (2019) and we have added this information.
60			Table 2	Te	Bo could deserve a renaming towards $P_{CH4,h,max}$ with a mention of the units	Consider renaming Bo and add the units to the definition	Bo is standard in manure emission literature and IPCC so we like to keep it that way for consistency
60			Table 2	Te		CO_2e is not a unit, it must say “kg CO_2-e”	replaced
61			Table 2	Te	VS definition VS is declared as “per day” but the unit in the table does not reflect the daily dimension. As well in the equations p 66 or 67 the equation does not consider any daily dimension From the equation it appears that VS is simply the excreted organic matter. The definition could be expanded/simplified	Correct the unit or delete the reference to a time dimension Consider amending the definition for this compartment	Unit adjusted to reflect it is a dairy value
62			Table 3	Ge	Equation 1: DM is not contained in table	DM should be listed in table 2	Added

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					2.		
62			Table 3, eq. 2	Te	Theunit for MEintakeother should be stipulated as well	DMIother=MEintakeother (MJ)/ (ME/kg DM (MJ/kg))	Added
62-99			Equations	Te	Excessive mention of units, unit convention could be specified in table 2 once for all. This would simplify the equations by sparing redundnacies.	Consider specifying all the unit convention in table 2 and not in the equations	Where it makes sense and given in Table 2, we have removed the units from the equations
62-99			Equations	Te	GENERAL COMMENT The writings of the equation would benefit from leaner and more functional convention as exemplified in the case below. How about simplifying the equations towards I = F * f (1) In words intake is feed times fraction of the nutrient. Add indices for species and nutrient if you want. For nitrogen fN = fCP * fN.CP (1A). In which the latter is the fraction of N in crude protein And likewise R = P * f (2) In words retention is (net) production times fraction of the nutrient in the product (s) (with appropriate indexes) And E= I-R (3) In words excretion = Intake minus retention		We have completely changed the structure of the equations based on several comments we received. Hopefully the revisions will make it easy to read.

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					All of these for P, Cu, Zn and N and for all species. In case of exception, highlight the exception in approach		
61			Table 2	Te	WF: Fraction of feed that is not consumed, in kg a fraction can't have a dimension The definition deserves a rewording	*WF. Quantity* of feed that is not consumed, in kg	In the guidelines for pig production WF is a fraction, we deleted 'in kg' in the sentence.
61			Table 2	Te	R_{MMS} is given as "Fraction of nitrogen degraded in an animal manure management system". Nitrogen is not degraded but gasified I believe.	Replace R_{MMS} = Fraction of nitrogen degraded in an animal manure management system". By: "Fraction of nitrogen which disappeared from the manure in an animal manure management system". Or Fraction of nitrogen lost as gas in an animal manure management system". Or Fraction of nitrogen gasified from animal manure	Corrected (option 2)
66			Table 7 Eq 11 vs Table 8 Eq 8	Te	What justifies a different approach for pigs and poultry with a standard retention coefficient for the nitrogen in broilers and a variable N content in animal tissues for the pigs	Consider aligning the N retention approach in pig and poultry	The TAG agreed to keep the equations from the animal guidelines as this document is intended to work with the appropriate guideline.
67			Equation 8	Te	Is it so that the N retention is chicken is systematically 60.2% of the N intake? Probably not. The nitrogen retention depends on the nutritional balance of the feed	Consider replacing 0.602 by a coefficient Consider taking the same approach for pigs and poultry	The TAG agreed to keep the equations from the animal guidelines as this document is intended to work with the appropriate guideline.

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Page no.	**Line no.**	**Chapter no./ annex/ spreadsheets name (e.g. 3.1)**	**Paragraph/ figure/table/note (e.g. table 1)**	**Type of comment ***	**Comment (justification for change of technical aspects must be supported by either scientific literature or technical documents)**	**Proposed change (please provide alternative text)**	**TAG reply**
66			Equation 9	Te	VS (kg) would deserve the mention "excreted" to help identifying the compartment	$VS_{excreted}$ (kg)	VS has been defined in Table 2
67			Table 8	Te	The line on N intake is missing	The equation showing N intake should be added	The approach taken by the poultry guidelines defers from the other guidelines, as the N excreted is directly calculated. So the TAG decided to follow the equations already given in the other guidelines for baseline.
67			Equation 13	Te	What justifies the difference in approach in pigs and in poultry (with consideration of RMMS for pigs) – to be possibly reviewed in the road testing. Pig: $NitrousOxide_{housing}$ (kg) = $N_{excreted}$ (kg) x (1 - R_{MMS}) x EF_{MMS} (%) x 44 / 28 Poultry: $NitrousOxide_{housing}$ (kg) = $N_{excreted}$ (kg) x EF_{MMS} (%) x 44/28		The difference in approach in the feed additive guidelines is linked to a difference of approach between the pig and the poultry guidelines
63-70				Te	The designation of enteric methane differs from monogastrics to ruminants Enteric methane or Methane $_{enteric}$	Methane $_{enteric}$ across the board	OK done as suggested
63-70				Te	The designation of methane produced from manure differs from monogastrics to ruminants Manure methane or Methane $_{housing}$	Methane $_{manure}$ across the board	Done as suggested
63-70				Te	The designation of Nitrous Oxide produced from manure differs from monogastrics to ruminants Manure Nitrous Oxide or Nitrous Oxide $_{housing}$	Nitrous Oxide $_{manure}$ across the board	Done as suggested
66			Equation 15b	Te	ERROR The coefficient "5.665e" probably	Add the exponent 7 to the coefficient "5.665e".	Done as suggested

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					deserves the exponent 7		
66			Equation 10	Te	WF Why is the wasted feed only considered for the appraisal of methane (via virtual solid) and not for the other parameters (N, P) No such WF for the other species?	In the road testing consider spreading the consideration of WF to other species, other parameters, unless proven impacting highly and specifically the CH4 from housing	This will be considered in road testing
66			Equation 10	Te	ERROR? In table 2 VS is mentioned to be expressed on a dry matter basis, while nothing in equation 10 allow setting the parameter on a dry matter basis	Alter the definition for VS in Table 2 or the equation	Table 2 states VS expressed in kg dry matter.
70				Ge	Shouldn't we have additive effect in section 6,13.8 as heading number 4 (meaning indented) to better reflect the structure	6.13.8.1 Modification of feed composition 6.13.8.2 Feed efficiency 6.13.8.3 Emission factor	Corrected as suggested
71		6		Te	Considering that the variations considered are dealt as %, designating the change as a factor rather than as a spread, the expression as Δ could be replaced by a F for factor	Replace Δ by F	We changed □ to □ as proposed above (to make it more visible and avoid confusion with F used for other emission factors.
71		6		Te	The subscript "nc" standing for nutritional contribution could be replaced by "nl" nutrient level. Indeed the "*nutritional"* contribution goes beyond the nutrient level. The overall physico-chemistry of the feed is impacting the nutritional contribution. In this section we follow a given atomic element (N or P) and it could by Zn or Cu as well, which happen to be nutrients.	Replace "nc" by "nl"	Corrected as suggested
71		14 and		Te	The example provided is in the magnitude	Replace 0.95 by 0.90 for Δ_{nc} or actually	True but it does not change the example.

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		17			of 5%, how about taking a more striking example and take an example of at least 10%. This is the minimum magnitude of the gain obtain with amino acid on nitrogen.	F_{nl}	
71		16		Ge	Principle for numbering of the equations is not straight forward. Does it restart per page? Not the case everywhere. A unique identifier per equation would bring clarity, like for tables or figures.	A unique identifier for each equation	Numbering of the equations has been completely overhauled and hopefully improves readability
67		6	Equation 12	Te	The unit for the last factor is missing $Methane_{housing}$ (kg) = VS (kg) x Bo (m3/kg) x MCF (%) x 0.662 (kg/m3)	Add (kg/m3) next to the last term of the equation	The factor has been defined with units in Table 2
68		3	Equation 12	Te	The unit for the last factor is missing $Methane_{housing}$ (kg) = VS (kg) x Bo (m3/kg) x MCF (%) x 0.662 (kg/m3)	Add (kg/m3) next to the last term of the equation	Same as above
71 to 75			Table 12 to 20	Te	The principle for populating the tables differs per species while the mathematical approach is the same across species • Either the intake is kept as such in the calculated impacts because it already includes the modification linked to the additive (the case in tab 12, 13, 14, 15, 16) • Or the intake is redeveloped systematically to show the variation induced by the additive (the case in tab 17, 18, 19 20) The most elegant way is probably to keep the modification at the "basis for	Table 12 delete equations 9 and 10 Table 13 delete equations 9 and 10 Table 14 delete equations 11 and 12 Table 15 delete equations 11 and 12 Table 16 delete equations 11 o 17 Table 17 delete equations 5 to 13 Table 18 delete equations 7 to 13 Table 19 delete equations 7 to 13 Table 20 delete equations 7 to 13	All equations have been reorganized.

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					calculation" level and not to repeat the equations for the impact		
74			Table 17, table 18	Te	The line on Nitrogen is missing for the tables on broilers and turkeys for the "basis for calculation"	Add a line/equation similar to the for pigs: Nintake (kg) = FI (kg) x % CP x Δ_{nc} / 6.25 Or actually Nintake (kg) = FI (kg) x % CP x F_{nl} / 6.25	This was not done because it is not the approach taken in the guidelines for poultry. So we kept it for consistency with other guidelines
75			Table 19, table 20	Te	The line on Nitrogen is missing for the tables on layers and breeders for the "basis for calculation""	Add a line/equation similar to the for pigs: Nintake (kg) = FI (kg) x % CP x Δ_{nc} / 6.25 Or actually Nintake (kg) = FI (kg) x % CP x F_{nl} / 6.25	This was not done because it is not the approach taken in the guidelines for poultry.
76	13			Ge	The delta already captures a modification, no need to add "change" in the subscript	Replace $_{pc}$ by $_{p}$ as a subscript	Changed as requested
76	13			Te	Considering that the variations considered are dealt as %, designating the change as a factor rather than as a spread, the expression as Δ could be replaced by a F for factor or r for ration	Replace Δ by F or r	We changed □ to □ as proposed above (to make it more visible and avoid confusion with F used for other emission factors.
89 to 97			Table 19, table 20	Te	The line on Nitrogen is missing for the "basis for calculation""	Add a line/equation showing the N retention as affected by the modification factor	This is due to the difference in calculation of the Nitrogen excretion equation in the guidelines for poultry, compared to the pig guidelines.
86 to 92			Tables 22 to 46	Te	It probably suffices to develop the equation pertaining to the *basis for calculation* and to not develop the ones calculating the impact which are redundant with the ones earlier displayed in 6.13.3	Delete the equations designated as "calculated impacts"	All the set up of the equations have been overhauled
79 and 81			Tables 23, 25	Te	ERROR The 2 tables show the equations modeling a modification of the milk	Add the ECM equations in the "Basis for calculations" And delete the calculated impacts	Changed as suggested

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					production or quality. The equation showing the basis for calculation should include a revision of the ECM calculation [Milk x (0.1226 x % fat + 0.0776 x % true protein + 0.2534)] The corrected ECM proposed in the intensity calculation for the impacts is wrong.		
79 and 81			Tables 23, 24, 29, 30, 34, 40, 41, 42, 43	Te	All these tables show the equations to be considered for modeling the impact of performance or health and welfare conditions at present only the titles of table 34, 40 and 41 carry this wording (others only speak “performance”)	Get a a similar wording for the table mentioned Adaptation of emissions equation, when feed additives modify performance or health and welfare conditions of …	Tables containing equations have been revised according to the comments received
89 to 97			Tables 36 to 46	Te	The line on Nitrogen is missing in the “basis for calculation”	Add the equation showing the nitrogen calculations	This is due to the difference in calculation of the Nitrogen excretion equation in the guidelines for poultry, compared to the pig guidelines.
97	8		Emmisison factor	Te	Shouldn’t we have the effect on the emission factor as a highlighted heading, same levels as feed composition or feed efficiency	6.13.8.1 Modification of feed composition 6.13.8.2 Feed efficiency 6.13.8.3 Emission factor	Changed as recommended
99		6.14.15		Te	One could propose a rewording of the paragraph to boot on the modification factor rather than on the intra study methodology	To be considered suitable for LCA consideration the effects of the additive on the nutrient level in feed, on the feed efficiency or on the emission factors should be documented by robust state of the art studies. One study is considered as a limited level of substantiation, while minimum three studies could be considered as a suitable level of substantiation.	OK. Changed as recommended

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						Peer reviewed publication in reputable journals is favoured. However, if reports are not published, they should be made available, including raw data for scientific evaluation by qualified independent reviewers, such as regulatory bodies, academia, third parties, or certification bodies. In case extrapolation rules are applied from one type of animals to another (species, genotype…), or from one farm management to another (geography, climatic conditions, feed type) they should be explicitly documented. In the evaluation of the results, the dosage of the additive should be considered and LCA should be done on this basis	
90	1			Ge	The terminology broiler turkeys could be simplified towards turkeys	Replace “broiler turkeys” by “turkeys”	There is breeder and egg layer production systems that meets the market for poults for the broiler market and a turkey egg market in Asia so it is left unchanged
102			Table 51	Ge	Table 51 is not referred to in the text	Remove or explain	Reference added into section 7.1
102			Table 51	Te	The discrimination of just two classes of robustness (high vs low) is not adequate	Label center two case robustness as intermediate or something like that	OK Done as suggested
109			Appendix 1 and 2	Te	Examples provided in these appendices are sometimes redundant, motley and are not necessarily in line with the equations and approaches proposed few pages before. This part of the document is particularly weak and un-structured vs the rest of the document. The case studies should assist the reader	Keep only one appendix along the current appendix 2 as follows • Case 1 – Change of feed composition and minor modification of feed efficiency in broilers and pigs. Run the N, P, on Kebreab et al. 2016 show the delta on those A2 and A3 vs A1	Case studies were intended to show how to use the equations and the guideline

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					in getting the systems considered in the guidelines and illustrate the possible role of additives in controlling the environmental footprint of livestock. In the current version: Appendix 1 • A1-P1 part 1 is Kebreab et al. 2016 (poultry and pig), exemplifying possible feed formulas but, in the LEAP doc, does NOT show any calculated impacts on N, P or CH4 production nor GWP nor LUC. This is critically missing • A1-P2 part 2 is unclear, not comprehensive, lists additives to be possibly considered (proteases, amylases, phytogenic substances, probiotics, ionophores, methane inhibitors) or correction factors to be expected (on feed efficiency, on emission rates). Not structured. Can be read as redundant vs § 4.2 of the core doc • change on feed composition for layers (redundant with A1, P1)	(pig and broiler) => -40% N and P excretions thanks to additives [see xls attached and table appended] • Case 3 – possibly a case with an additive enhancing the productivity via enhanced health support. - Proposal: a meta-analysis on probiotics led by Argentinean organisations: ZIMMERMANN, J.A., FUSARI, M.L., ROSSLER, E., BLAJMAN, J.E., ROMERO-SCHARPEN, A., ASTESANA, D.M., OLIVERO, C.R., BERISVIL, A.P., SIGNORINI, M.L., ZBRUN, M.V., FRIZZO, L.S. and SOTO, L.P., 2016. Effects of probiotics in swines growth performance: A meta-analysis of randomised controlled trials. Animal Feed Science and Technology, 219, pp. 280-293. • Case 2 – Change on emission factor. Run a CH4 calculation based on a peer reviewed study show the delta on CH4 emission (dairy or cattle) - Proposal (several trials compiled in): DIJKSTRA, J., BANNINK, A., FRANCE, J., KEBREAB, E. and VAN GASTELEN, S., 2018. Short communication: Antimethanogenic effects of 3-nitrooxypropanol depend on supplementation dose, dietary fiber content, and cattle type.	

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						Journal of dairy science, 101(10), pp. 9041-9047. • Conclusions on the appendix, providing a very concise outlook on additives documented to act on the key coefficient listed (feed composition, FCR, emission factor) with possible development prospects - Proposal 1: use the SFIs reports (Part 1 (final) and Part 2 (draft)) to come up with a 1st generic list of products susceptible to influence notably feed environmental foodprint (amino acids, phytase, fiber degrading enzymes, protease, probiotics, phytogenics, organic acids). - Proposal 2: refer to the FAO paper under construction (den Hartog as 1st author) which is also listing micro ingredients supporting animal health. Provided it is accepted for publication.	
109			Appendix 1 and 2		Appendix 2 • A2-P1 Part 1 is an example on GWP (while Land use and GWP are hardly covered as such in the LEAP doc). The equations are difficult to follow. • Then there is an example on N and P sparing – with a strict copy of the equations proposed earlier in the text – but no absolute value for N and P		The Appendices provides are simply examples. We are hoping that there will be real-life case studies coming up as soon as the guidelines are posted and accessible

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					dimension, hence the possible gain in % cannot be appraised. We miss the opportunity of a tangible demonstration • A2-P2 Part 2 is an example on reduction of CH4 emission factor in ruminants • A2-P3 Part 3 is an example on improved performance with welfare additives • A2-P4 Part 4 is an example on a change on feed composition for layers (redundant with A1, P1)		
113			Appendix 1	Te	Appendix one in its present version contains a very diverse set of references, from very robust ones to far less compelling ones. About Proteases FYI a recently published paper on the impact of protease on poultry production could be considered COWIESON, A.J., SMITH, A., SORBARA, J.O.B., PAPPENBERGER, G. and OLUKOSI, O.A., 2019. Efficacy of a Mono-Component Exogenous Protease in the Presence of a High Concentration of Exogenous Phytase on Growth Performance of Broiler Chickens. Journal of Applied Poultry Research, 28(3), pp. 638-646.		We do not consider this to be not an exhaustive list of all feed additives and should not be seen as a comprehensive review. We chose mostly synthesis papers.
114			Appendix 1	Te	Appendix one in the present version contains a very diverse set of references, from very robust ones to far less compelling ones. About feed efficiency		We do not consider this to be not an exhaustive list of all feed additives and should not be seen as a comprehensive review. We chose mostly synthesis papers.

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					For the effect on feed efficiency, the text would benefit from the reference to enzymes (at present in only quotes phytogenic substances and probiotic for ruminants). A wealth of papers highlights the roles of enzymes on supporting feed efficiency via enhanced nutrient digestibility Suggested papers for consideration ADEOLA, O. and COWIESON, A.J., 2011. Board-invited review: Opportunities and challenges in using exogenous enzymes to improve nonruminant animal production. Journal of animal science, 89(10), pp. 3189-3218. MEALE, S.J., BEAUCHEMIN, K.A., HRISTOV, A.N., CHAVES, A.V. and MCALLISTER, T.A., 2014. Board-invited review: Opportunities and challenges in using exogenous enzymes to improve ruminant production. Journal of animal science, 92(2), pp. 427-442. MUNIR, K. and MAQSOOD, S., 2013. A review on role of exogenous enzyme supplementation in poultry production. Emirates Journal of Food and Agriculture, 25(1), pp. 66-80. TORRES-PITARCH, A., MANZANILLA, E.G., GARDINER, G.E., O'DOHERTY, J.V. and LAWLOR, P.G., 2019. Systematic review and meta-analysis of the effect of feed enzymes on growth and nutrient digestibility in grow-finisher pigs: Effect of enzyme type and cereal source. Animal Feed Science and Technology,		

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					251, pp. 153-165. SUJANI, S. and SERESINHE, R.T., 2015. Exogenous enzymes in ruminant nutrition: A review. Asian Journal of Animal Sciences, 9(3), pp. 85-99.		
105 and 138				Ge	Bibliography Consider merging the two lists of references towards a unique one		Good idea but this will not be consistent with other guidelines

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Table proposed for featuring in the appendix (Kebreab el al. 2016 x LEAP doc)

	Pig									Poultry								
	Europe			North America			South America			Europe			North America			South America		
	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3
Feed characteristics																		
CP, % (1)	18.1%	13.8%	13.8%	21.2%	15.6%	15.6%	18.7%	15.8%	15.8%	26.5%	17.9%	17.9%	21.9%	19.9%	19.5%	29.3%	18.7%	18.7%
N, % (1)	2.90%	2.21%	2.21%	3.39%	2.50%	2.50%	2.99%	2.53%	2.53%	4.24%	2.86%	2.86%	3.50%	3.18%	3.12%	4.69%	2.99%	2.99%
P, % (1)	0.54%	0.54%	0.44%	0.53%	0.51%	0.41%	0.54%	0.49%	0.39%	0.73%	0.61%	0.51%	0.60%	0.59%	0.46%	0.51%	0.56%	0.42%
Additives implemented beyond vitamins and minerals																		
amino acids (1)	-	in	in	-	in	in	-	in	in	-	in	in	-	in	in	-	in	in
phytase (1)	-	-	in	-	-	in	-	-	in	-	-	in	-	-	in	-	-	in
Animal performance																		
Final weight, kg					100									2.5				
FCR (1)					2.75					2.01	1.85	1.85	1.80	1.70	1.70	1.80	1.70	1.70
Feed intake, kg					275					5.03	4.63	4.63	4.50	4.25	4.25	4.50	4.25	4.25
Average concentration of protein in tissues					19.50%									19.50%				
Average concentration of N in tissues					3.12%									3.24%				
Jones factor					6.08									6.02				
Average concentration of phosphorus in whole body tissues					0.50%									0.50%				
Nitrogen flow																		
N intake, kg (2)	8.0	6.1	6.1	9.3	6.9	6.9	8.2	7.0	7.0	11.7	7.9	7.9	9.6	8.8	8.6	12.9	8.2	8.2
N retention, kg (2)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
N excreted, kg (2)	4.8	3.0	3.0	6.2	3.7	3.7	5.1	3.8	3.8	8.5	4.8	4.8	6.5	5.6	5.5	9.8	5.1	5.1
Reduction vs A1	-	-39%	-39%	-	-40%	-40%	-	-25%	-25%	-	-44%	-44%	-	-14%	-16%	-	-48%	-48%
N efficiency	39%	51%	51%	33%	45%	45%	38%	45%	45%	27%	40%	40%	32%	36%	36%	24%	38%	38%
N excretion intensity, kg/kg animal production (2)	0.05	0.03	0.03	0.06	0.04	0.04	0.05	0.04	0.04	3.42	1.90	1.90	2.61	2.25	2.18	3.91	2.04	2.04
Phosphorus flow																		
P intake, kg (2)	1.5	1.5	1.2	1.5	1.4	1.1	1.5	1.3	1.1	2.0	1.7	1.4	1.7	1.6	1.3	1.4	1.5	1.1
P retained, kg (2)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
P excreted, kg (2)	1.0	1.0	0.7	1.0	0.9	0.6	1.0	0.8	0.6	1.5	1.2	0.9	1.2	1.1	0.8	0.9	1.0	0.6
Reduction vs A1	-	0%	-28%	-	-7%	-34%	-	-13%	-42%	-	-22%	-40%	-	-2%	-33%	-	14%	-29%
P efficiency	34%	34%	41%	34%	36%	44%	34%	37%	47%	25%	30%	36%	30%	31%	40%	35%	32%	43%
P excretion intensity, kg/kg animal production (2)	0.010	0.010	0.007	0.010	0.009	0.006	0.010	0.008	0.006	0.015	0.012	0.009	0.012	0.011	0.008	0.009	0.010	0.006

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(1) data proposed in Kebreab et al. 2016
(2) equations applied are the one proposed in the LEAP guidelines
in pink are parameters to be proposed as average parameters

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General comments: This document presents an excellent introduction to the issues that should be considered when using LCA to model the environmental impacts of feed additive supply chains. These guidelines could be considered a minimum level of quality when considering what to include in a feed additive LCA. While describing necessary components of an LCA, they are not sufficient for producing standardized, repeatable, comparable results across supply chains, products, or modellers. Two examples of where work remains to be done in standardizing an approach include:

- Each section offers very different levels of resolution on how to approach each component of the supply chain. From general process flow diagrams with classes of inputs/outputs (ex: "chemicals" and not which specific chemicals) to overly flexible recommendations on data source quality, to highly detailed recommended parametric equations for enteric emissions.
- Vague recommendations on how to define system boundaries maintains a lot of flexibility in how these systems can be modelled. This gives the modeller discretion in finding a most appropriate approach for the application of the LCA, at the cost of repeatability and standardization.

It is the opinion of this reviewer that significant progress towards the stated objective of the guidance is presented; "to provide a sufficient definition of calculation methods and data requirements on quality and transparency to enable consistent application of LCA across differing livestock supply chains". However there remains significant work outstanding for this document to stand on its own to achieve the above goal.

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USDA							
29		4.1.2.2.1	4	ge	Is there a recommendation on addressing soil carbon and water balances in feedstock cultivation? Carbon uptake and water consumption can be drivers for algal based feedstocks vs conventional soil based cropped feedstocks. How to address comparisons of these two production systems?		That belongs to the guideline for animal feed production and is mentioned there. Each system has its own challenges/benefits/environmental impacts and they are not necessarily comparable.
		4		ge	In identifying system boundaries, there is an inconsistent identification of what shall and shall not be included. 4.1.2.2.1 plant based processes include, 4.1.2.2.2 processes need to be considered, 4.1.2.3, processes that shall be included, if appropriate. The inconsistent application of the "shall" while still		Revised to remove "if appropriate" as suggested.

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					providing discretion “if appropriate” weakens the consistency of the system boundary definition.		
32		4.1.3		ge	The utility of the concept of conducting LCA through modules is unclear, the guidance is vague, and it seems the approach facilitates the modeller to include processes not described by the module’s system boundary.		More information is available in section 8.4.6 of the LEAP guideline on Environmental Performance of Animal Feeds Supply Chains, as written in the paragraph.
33	18	4.1.3		ge	Suggesting that data can be collected at undefined levels of aggregation makes consistency across studies and/or supply chains very difficult if not impossible.		This guideline is not made to facilitate “complete” comparability, e.g. the modeller still has the freedom to conduct analysis in a specific regional context and use relevant LCIA methods, e.g. TRACI in the US or RECEIPE in Europe, etc. The same applies for the level of process aggregation. If comparative studies should be conducted than the ISO14044 guideline should be followed in addition to this guideline.
Ajinomoto Animal Nutrition Europe							
ALL				Ge	Terms may, should, shall are not used consistently throughout the document	Add consistency by introducing link between methodological requirements and purposes of the study that can be supported	Added as much as possible
9	7			Ge	Amino acids are missing in the list	Add amino acids in the list	Done
6	22			ge	Correct name of organisation is Ajinomoto Animal Nutrition Europe instead of Ajinomoto	Replace Ajinomoto by Ajinomoto Animal Nutrition Europe	Corrected
17	13 and 19			Ge	There is a contradiction between lines 13 “these guidelines should be used” and line 19 “these guidelines shall be used”	Align sentence in line 13 with line 19	Aligned as suggested

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		3 and 4: background information and principles / background information feed additives		Te	There is a need to better distinguish what is provided as background information from the methodological recommendations. Including recommendations in section 3 is confusing,	Stick to background information in section 3 and 4and move methodological recommendations to part 2 and 3 (see some non-exhaustive examples in following comments)	We have made some revisions but fundamentally we are trying to keep consistency with other guidelines as it is intended to be used in conjunction with several of the LEAP guidelines that are already published.
26	4 and following			Ge	Recommendation on data use and level of disaggregation should not be part of background information. It is difficult to understand what is meant by level 1 and level 2 in the different schemes	Move this part to part 2 and clarify what is meant by level 1 and level 2.	This is given in 4.1.2, • Level 1: fully aggregated data of all unit processes • Level 2: fully or partly disaggregated data. Minimum requirement is the disaggregation of processes used for separation as shown in Figure 8. A more detailed description of the consequences of data aggregation can be found in the chapter 4.1.3. (modularity).
34	6,7,8			Ge	This part should be moved to section 4	Move this part to part 4	We have done some revision but ultimately try to keep it consistent with other LEAP guidelines
35	1 to 20			Ge	This part should be moved to section 4	Move this part to part 4	We have done some revision but ultimately try to keep it consistent with other LEAP guidelines
35	1 to 20			Te	In addition to be moved to section 4, this section should also be modified to avoid contradiction with LEAP guidelines on feed supply chains. It is specified in section 9 of LEAP guidelines on feed supply chains that “consequential use of system expansion using an avoided	To align with the LEAP guidelines on feed additives, the section should be modified as follows: Each of the life cycle modules can consist of several unit processes (see “Description of the 1 production processes”). However, it has to be	Amended as follows: In these cases three options shall be considered: - avoid aggregation of the process steps by subdivision. This

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					burden calculated through substitution is not compliant with these guidelines".	recognized that the allocation approach for multi-output systems requires that the maximum level of aggregation is defined by the occurrence of co-products at the unit process level. If the aggregation level is higher, allocation is more difficult to perform, which is illustrated with a virtual example in Figure 11. In Figure 11 input and output flows of 4 process steps are aggregated (e.g. due to confidentiality issues) and a co-product occurs at process step 2, then allocation is not a suitable approach because emissions of process steps 3 and 4 would be allocated to the co-product. In these cases two options shall be considered: - avoid aggregation of the process steps by subdivision. This option is the preferred one as it leads to more accurate results. Confidentiality issues can be managed when the study is performed using non-disclosure agreement. - Use allocation, and take into account that it was not possible to sufficiently disaggregate the process in the interpretation of the results	option is the preferred one as it leads to more accurate results. Confidentiality issues can be managed when the study is performed using non-disclosure agreement. - use substitution. However, substitution/crediting can have a substantial impact on the final results. As recommended in the LEAP Guidelines on animal feed supply chains, substitution shall only be used in situations where there is clearly no ambiguity about the avoided external production. In addition, it is recommended to conduct a sensitivity analysis to show the consequences of the modelling choice for substitution. - Use allocation, and take into account that it was not possible to sufficiently disaggregate the process in the interpretation of the results
35	20 to 22			Te	The reference to modularity is not relevant here, reference should rather be made to multifunctionality	Delete lines of replace reference to modularity by reference to multifunctionality (section 9 of leap guidelines on feed supply chains): More information on multifunctionality can be found in section 9 of the LEAP Guidelines on animal feed supply chains.	Corrected

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36	3			Te	Proteins and energy are not nutrients	Replace nutrient by nutritional	Corrected
36	6-7			Ge	Sentence does not ready very well	Replace by: Depending on the livestock production systems, the feed composition is limited by the availability of feed ingredients and cannot be modified easily. The feed can be produced at the farm level or by feed mills.	Replaced
36	11			ed		Nutritional constraints	corrected
36	12-13			ed	Sentence does not ready very well	Replace by each feed ingredient is characterized by nutritional values	Corrected
36	15-16			Ge	“In addition” does not apply to all situation	Replace “in addition” by “ in most of the cases”	corrected
36	23-23			Te	Avoid misunderstanding	Replace by “the nutritional characteristics of the feed remains unchanged”	corrected
42	23			Te	Allocation principles are not part of the scope	Remove allocation principles	corrected
43	8 to 10			Te	This recommendation is about the use of feed additives and should be moved to section 6	Move this section to part 3	We have made some revisions but fundamentally we are trying to keep consistency with other guidelines as it is intended to be used in conjunction with several of the LEAP guidelines that are already published.
44	14 to 15 and 20 to 30			Te	This recommendation is about the use of feed additives and should be moved to section 6	Move this section to part 3	We have made some revisions but fundamentally we are trying to keep consistency with other guidelines as it is intended to be used in conjunction with several of the LEAP guidelines that are already published.
45	33 to 35			Te	Regarding biogenic carbon, it is not necessary to model the flows regarding the biogenic carbon content of the product since it is a short carbon cycle. Modelling biogenic flows create	Remove requirement regarding biogenic carbon content.	We disagree with the comment: Methane from biogenic carbon as a significant impact on the GWP of livestock systems should not be ignored

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					unnecessary burden.		
46	16 to 17		Figure 12	Te	The process and the decision tree for data selection make sense but it is important to be careful and reduce the risk for data manipulation. It would make sense to establish a link between the potential use of a LEAP-compliant study and the type of data that is used. For example it should not be possible to communicate on the environmental benefits results of using a specific additive when dummy data have been used to assess the impact of the production of this additive.	In relation to the decision tree, add a table linking the purposes of a study that are allowed related to the data quality, making sure that comparisons can only be made when primary data are used.	The document should provide guidance on how to conduct relevant LCAs of feed additives, it is not made to facilitate complete comparison. For that purpose, this document can be used in addition to the ISO 14044. Look at paragraph 5.1 …"They can also serve to set progress and improvement targets (ISO, 2006b) and to provide a basis for reporting on the environmental impacts of products. However, these guidelines are not intended for the comparison of products or environmental performance labelling."
59-60			Table 2	Te	Weighted average concentration is confusing	Replace weighted average by concentration	Corrected
60			Table 2	Te	There is no recommendation regarding how DMD and DMI shall be assessed: measurement? Modelling?	Add clarification regarding how DMD and DMI shall be assessed.	Measured or modelled could be an optional approach with measured being the gold standard and the bases of best case data.
60			Table 2	Te	The definition of %Protein in milk is not clear: does it refer to true or crude protein?	Add clarification regarding the definition of %Protein in milk	Clarified
60			Table Te	Te	ECM: practitioners use different parameters for the equation	Explain the rationale behind the choices of the parameters and consider the possibility to use different parameters provided justification is provided	This is the most common way to use as a functional unit for milk producing animals
60			Table 2	Te	Standardized dry matter content for feed intake should be justified	Explain the rationale behind the 88% dry matter content	88% is the average DM in dry feeds This refers to the EU regulations that establish the content of additives on the basis of a feed containing 12 % of

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							moisture. If agreed by the TAG, we could work on a dry matter basis (DMI) as in ruminants. Also mentioned by a former reviewer.
60			Table 2	Te	The words “quantity” and “amount” are not used consistently throughout the table	Harmonize the use of quantity or amount	We try to use quantity throughout
60			Table 2	Te	$N_{retention}$ is not defined	Add a definition of $N_{retention}$	Done
62			Table 3	Te	For this table and all the following equations, the use of constant or averages (such as 18,45 or 1,04 should be explained	Explain the rationale behind the use of constant and averages	Done v
62	Equation 4		Table 3	Te	The energy content is standardized for all feed ingredients, whereas there can be a great variability	Give the possibility to use more accurate values for energy content of feed ingredients when primary data are available	This is based on the ruminant guidelines
66			Table 7	Te	There seems to be confusion between $N_{retention}$ and $N_{product.}$ It should be possible to calculate equation 11 from equations 1 and 2 and it is currently not the case.	Revise the equations	N retention and N product is the same, the word product changed by retention in the equation 11.
66					There is no guidance provided on how to assess retention	Provide guidance on how to assess retention by animals, instead from measurement, modelling or default factors (including justification for the choice)	All equations have been completely reorganized so hopefully it is easier to follow now.
67	3			Ed	Reference should be made to poultry guidelines instead of pigs	Replace pigs by poultry	replaced
70			Table 11	Te	The principles underlying the calculations are different from the ones used for pigs. What is the reason for that? The rationale for the N retention factor should also be explained	Align the underlying principles for pigs and poultry calculations	This is due to the difference in calculation of the Nitrogen excretion equation in the guidelines for poultry, compared to the pig guidelines.

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70	9			Ed		Replace allows by leads to	replaced
77	Equation 4		Table 21	Te	Feed intake is not the only parameter that may change. The level of CP can also change due to the use of feed additive	Add another equation introduction ΔCP	Agreed however CP is a constant for a stable feed component and its CP dilution can be measured or calculated. DMI is a variable.
28		4.1.2.2 and 4.1.2.2.1	Biomass extraction and Plant based biomass	ge	Have you considered including in the LCA the potential environmental benefits of the production/cultivation of different types of plants? Feed additives derived from terrestrial plants may be sourced from traditional soil-based cultivation. The cultivation of some plants has been shown to be effectively incorporated into crop rotation management practices by contributing to the increase of biodiversity increase yield, reduce disease incidence and enhance soil quality. Studies have found that by intercropping and using some tape of plants as a preceding crop provides many benefits for the local soil biodiversity, and that has a positive impact on the other crop production of the system. Most importantly sequestering carbon (C) through crop plantation is one of the ways to contribute to global climate change mitigation	Soil organic carbon measurements should be included in the LCA calculations. Please refer to the publication (Liu et al. 2016; https://doi.org/10.1007/s13593-016-0404-8)	There are also more aspects of cultivation that have similar impact (intercropping, no till, pesticides, etc). These aspects are included under the box Climate, soil, and pest management in figure 4. These aspects are out of scope for in depth detail in this guidelines for feed additives but are part of a general cultivation efficiency and environmental management of the front end of the system
39	31	4.2.4.1	Enteric methane emissions	te	We wish to underline additional work on methane reduction	Combination of plant-derived compounds namely garlic powder and bitter orange (Citrus aurantium) extracts, have effectively reduced methane production without impacting rumen fermentation *in vitro* (Eger et al., 2018; https://doi.org/10.3389/fmicb.2018.02094). Moreover, with *in vivo* confirmation, Vrancken et al. (2019;	Same response as above

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						https://doi.org/10.4236/ojas.2019.93024) showed a methane reduction of up to 38% in lactating dairy cows, while Roque et al. (2019; https://doi.org/10.1093/tas/txz133) showed a reduction of up to 23% in beef cattle.	

References

Liu, C., Cutforth, H., Chai, Q., & Gan, Y. (2016). Farming tactics to reduce the carbon footprint of crop cultivation in semiarid areas. A review. *Agronomy for Sustainable Development*, *36*(4), 69. https://doi.org/10.1007/s13593-016-0404-8

Eger, M., Graz, M., Riede, S., & Breves, G. (2018). Application of MootralTM Reduces Methane Production by Altering the Archaea Community in the Rumen Simulation Technique. *Frontiers in microbiology*, *9*, 2094. https://doi.org/10.3389/fmicb.2018.02094

Vranken, H., Suenkel, M., Hargreaves, P. R., Chew, L., & Towers, E. (2019). Reduction of enteric methane emission in a commercial dairy farm by a novel feed supplement. *Open Journal of Animal Sciences*, *9*, 286-296. https://doi.org/10.4236/ojas.2019.93024

Roque, B. M., Van Lingen, H. J., Vrancken, H., & Kebreab, E. (2019). Effect of Mootral—a garlic-and citrus-extract-based feed additive—on enteric methane emissions in feedlot cattle. *Translational Animal Science*, *3*(4), txz133. https://doi.org/10.1093/tas/txz133

Istituto Superiore di Sanità, Italy

10	19-20	Glossary		Inset a new item	One Health is an essential concept, going far beyond “zoonoses”, which is linked to the items discussed in this document	One Health here is considered as a conceptual framework linking the health and productivity of farm animals with the environment and human health and welfare	This was discussed intensively in tabling goal and scope of the Guidelines where we clearly excluded any feed additives such like antibiotics. Further all feed additives being placed on the market have to be approved and passed an intensive analysis on the safety of the production process of the product, the safety for humans, animals and the environment.

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							Therefore the comments are not appropriate.
16	After line 35	2. Scope	2.1 Environmental impact	Insert new paragraph	Linking LCA with One Health	In a One Health perspective, the evaluation of environmental impact should consider also that the use of feed additives may lead to an output of toxicologically relevant substances or potentially adverse microrganisms or toxins into to feed and food chains. This secondary pollution may derive rom animal excreta as well as from the disposal of manufacturing or farming waste. Examples may include trace elements or coccidiostats in manure, fertilizers or water bodies. Whereas these issues, are potentially relevant, they need being considered on a case-by-case basis and are outside the scope of this guideline	
19	After line 26	3. Background information and principles	3.2. Environmental categories	Insert new paragraph	Linking LCA with One Health	As mentioned above, in a One Health perspective the environmental impact assessment should consider also ecotoxicological aspects as well as the potential secondary pollution of feed/food chains. However, these aspects need being considered on a case-by-case basis for individual additives (European Food Safety Authority, 2019) and cannot be included in a general guideline on LCA	
40	After line 23	4.2 Use of feed additives	4.2.4.3. Nutrient, minerals and feed additive metabolites concentra	Insert new sentences	Linking LCA with One Health	Some of these components (eg, minerals, additive metabolites) may be relevant also to a One Healt h perspective, because of their toxicological and/or ecotoxicological properties. These issues neeed being evaluated on a case-by-case basis ((European Food Safety Authority, 2019)	

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			tions in the manure				
105	Betw wen line 25-26		Referenc es		Insert new reference	Up-to-date reference relevant to the environmental assessment of feed additives	European Food Safety Authority. Panel on Additives and Products or Substancesused in Animal Feed (FEEDAP), Guidance on the assessment of the safety of feed additives for the environment. EFSA Journal 2019; https://www.efsa.europa.eu/it/efsajournal/pub/5648
JRC, European Commission							
44	22	5.6		te	The sentence “in these cases where there may be considerable inter-annual variability in inputs, production and emissions…” is quite general and does not provide specific indications to the LCA practitioner. .	It is suggested to clarify the criteria to assess the importance of inter-annual variability and the situations in which the average data for more than one year should be considered	Recommendations are given for relevant cases, e.g. industrial production processes. Moreover, a link is provided to the LEAP-Guideline for animal feed production. In the text is stated: … “.In extensive production systems, it is common for important parameters to vary between years. For example, reproductive rates or growth rates may change based on seasonal conditions. In these cases where there may be considerable inter-annual variability in inputs, production and emissions, it is necessary for the one-year time boundary to be determined using data averaged over 3 years to meet representativeness criteria. An averaging period of 3 to 5 years is commonly used to smooth the impact of seasonal and market variability on agricultural products. “

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							We believe this provides sufficient guidance.
45	32-33	5.7.2		ge	It would be important to specify also that the distinction between biogenic and fossil carbon emissions should be kept when reporting the results. In addition, it would be useful to have indications on how to characterise biogenic emissions and which temporal gap can be considered for carbon storage (e.g. 100y).	It is suggested to add a paragraph in part 4 regarding the characterisation of biogenic carbon flows and how to report them	When we make reference to PEFCR and the SFIS PCRs we have rules how to manage fossil and biogenic carbon.
48	19	5.7.2		ge	Does “data sources” refer to the robustness of data sources?	It is suggested to add a brief description for “data sources” as done for the other aspects to be considered by practitioners	The description, which data should be used, is flexible enough to address relevant exceptions and sufficient strict to minimize cherry-picking
48-49	27-14	5.7.3 and 5.7.4		ge	The two sections refers to the same topic, hence it would be more clear if they were merged in one section	Proposed title for the merged section “Rules for the assessment of data quality”	Merged as suggested
101	12	7		ge	Substitute the “identification of most significant inventory data” with “elementary flows mostly contributing to environmental impacts”		For decision makers the “elementary flow” is difficult to grasp, activities or ingredients are in most cases more suitable. The practitioner should use the most appropriate language for explaining the results to the target person/group
104	3-15	7.4		ge	Normalization can be applied to identify the most important impact categories, as reported in the PEF guidance v 6.3, section 7.4.1. This should be clarified in section 7.4 on normalization and also a link between section 7.4 and section 7, lines 13 and 15, should be created.		We believe that PEF is EU-centric.
Agroscope							

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					Thank you for the opportunity to comment this important document. I hope you find my comments and recommendations constructive. Should you have questions concerning my suggestions and comments please do not hesitate to contact me at any time (daniel.bretscher@agroscope.admin.ch).		Thank you
10	32	Glossary		Ge	Definition of “Primary data” and “Secondary data” should be more specific.	Primary data are directly measured or collected data of specific activities within a particular product’s life cycle (e.g. energy use for the production of 1kg of a specific feed additive in a particular production plant). ➔ Adjust the definition of “Secondary data” accordingly.	Corrected as suggested
15	8	1.		Ge	As additional objectives, I would also include “sincerity”, “sobriety” or “seriousness” and “trustworthiness”. In the end, the purchaser of a livestock product is interested in these criteria.		We will have to stick with transparency and consistency
15	14	1.	stakeholder	Ge	This paragraph could be somewhat more specific: Policy makers might also be interested in the GL for the design of the agricultural policy (e.g. subsidies for feed additives or producer that use such). Additionally, the GL are also relevant for approval/accreditation of feed additives, or projects that use these (e.g. CO_2-compensation mechanisms). Additionally retailers, consumers, consumers’ organization and or labelling organizations are interested stakeholder. They need some kind of warranty for the		The list is not meant to be exhaustive, however, we have added the suggestions in the revised document.

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					beneficial effect of the feed additives.		
15	26	1.	Benefits	Ge	Proof for the efficacy and trustworthiness of the use of the feed additive.	Proof for the efficacy and trustworthiness of the use of the feed additive.	Trustworthiness is subjective and difficult to quantify with little relevance. It is important that the evaluation is based on scientific data
16	24	2.1.	Environmental impact	Ge	Water use is an important environmental impact that is not mentioned here.		Yes, because it is not part of the guidelines on animal production. In the Livestock Environmental Assessment and Performance (LEAP); there is a group dealing with water footprint.
18	15	2.2.	Application	Ge	"*Users of these guidelines shall not employ results to claim overall environmental superiority or to communicate overall environmental superiority of feed additives*". This I do not really understand. The use of feed additives is often to reduce environmental impact by improving performance or directly reducing environmentally harmful emissions. It is thus the primary interest of the user or producer of feed additives to claim environmental superiority in order to promote his products. In my understanding the LEAP-GL should provide a framework that guarantees a certain trustworthiness of these claims. Maybe the focus lies here on "<u>overall</u> environmental superiority". Then the word "overall" should be highlighted. However, this does not make a lot of sense since all feed additives that increase <u>overall</u> performance (e.g. increase in feed efficiency) increase also <u>overall</u> environmental impact.		Emphasis is put on 'overall'

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19	20	3.2.	Impact categories	Ge	Water and biodiversity should be mentioned here. Suggested citations: Steffen et al. 2015 : https://science.sciencemag.org/content/sci/347/6223/1259855.full.pdf Springmann et al. 2018 : https://www.nature.com/articles/s41586-018-0594-0		Biodiversity and water footprint are part of specific guidelines within the LEAP. The focus of this work was to link our guidelines on feed additives to guidelines on animal production.
23	4	3.5.	Consistency	Ge	Need of consistency could also be emphasized regarding other guidelines or conventions (e.g. global warming potentials for the accounting of GHG-emissions in CO_2 eq.).		This is covered by the transparency
23	8	3.5.	Accuracy	Ge	Bias and uncertainty shall not only be reduced but also be documented and disclosed.		Changed to: Bias and uncertainties shall be reduced as far as practicable. Sufficient accuracy shall be achieved to enable intended users to make decisions with reasonable confidence as to the reliability and integrity of the reported information. Remaining bias and uncertainty shall be documented and disclosed.
23	25	3.5.	Priority of scientific approach	Ge	What is “value choices”? Maybe this needs further explanations.		Value-choices is a well known term in the LCA community and also used in ISO 14044
24	19	4.1.1.	Product description	Ge	The expressions “primary data”, “default data” and “secondary data” are used here for the first time. I would suggest to make here a reference to the glossary or provide a short explanation because this is an important issue.		Same as above
27	20-25	4.1.2.1.	Figure 3	Ge	I do not really understand the figure. Is		Figure 3 has been revised taking the

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					level 2 just a more detailed version of level1? But then why are there the arrows from “Broth” to “Convening”, “Leaching” and “Precipitatoin”? I first was confused since I thought theses are material flows. Or is level 2 just a detailed diagram for the box “Broth”?		comments into consideration.
28	12-15	4.1.2.2.	Biomass extraction	Ge	“*Nutrients in fertiliser is determined by the fertility state of the growth media (soil or water) relative to requirements of the growing organisms and may be chemical or organic in nature, or waste nutrients from other processes.*” I find the sentence hard to understand. Does “Nutrients” mean the absolute amount of nutrients or the concentration of nutrients in fertilizers? Moreover, what is meant with “state of the growth medium”? I assume this is usually the nutrient availability of the soil. So is this altogether the method how to assess the amount of nutrients applied for the production of a certain output in the case that there are no primary data available (i.e. the exact amount of nutrients applied is unknown)? Anyway, this needs further clarification.		Reworded: “Nutrients added into the system as fertiliser is determined by the associated deficiencies of the growth media and those required to achieve optimum productivity of the system. These may be chemical or organic…”
29	1	4.1.2.2.1.	Figure 4	Ge	“Level 1” and “Level 2” are not indicated in the figure. The same is true for figure 5.		Editorial Add level 1 and 2 labels to the figures 4 and 5
35	2	4.1.3.	Allocation approach	Ge	The allocation approach is an important concept in LCA. I think further explanation on the different modes of allocation and their repercussions are needed. Maybe this information could be provided in a box. If no text is provided here, then I would at least suggest a reference to		This is addressed by previous comments

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					some LCA-Guidelines.		
36	17-19	4.2.1.	Feed composition	Ge		Feed additives may be used for improving the nutritional value of feed ingredients, by increasing their digestibility and/or by making nutrients present in these feed ingredients more available for the animals, particularly for monogastric animals (pigs and poultry).	Changed as suggested
38	8-9	4.2.2.	Reproduction and hatchability	Ge	Feed additives, which can increase the rate of fertility and hatchability, have positive effects on all environmental impact categories.	Any efforts to reduce waste and untreated hatchery disposal directly reduces ~~greenhouse gas emissions and groundwater contamination~~ any environmental impact.	We feel that this extrapolates too far
38	13	4.2.2.	Animal health and welfare maintenance	Ge	A general statement is missing here. See suggested text on the right. In this context, it might be good to discuss the general possibility of leakage, i.e. the possibility of an increase of environmental damage elsewhere, that it outside the observed system boundaries.	Any loss in production or production efficiency implicates an increase in production elsewhere to maintain overall production level. This again entails additional feed use with the respective environmental impacts elsewhere (→ leakage).	Added as suggested
39	33-34	4.2.4.2.	Gaseous emissions from manure	Te		Manure management, including storage, handling, and field application can be a source of emission of methane, nitrous oxide and ammonia.	Accepted
40	17-23	4.2.4.3.	Nutrient, minerals and feed additive metabolites concentrations in the manure	Ge	Here (or elsewhere in chapter 4.2.(4)) there should be a paragraph on the need for a systemic approach. Environmental emissions occur along the whole feed- and nutrient-chain and are often interlinked. Less nutrient losses at an early stage (e.g. in the stable) mean more nutrients in later stages (e.g. manure management and fertilizer application). Likewise changes in the digestive system (e.g. by reducing enteric fermentation)	Include a paragraph / box on the need for a systemic approach considering all effect along the feed- and nutrition- and animal production-chain and possible leakage.	We have attempted to add discussion addressing the comment in the guideline.

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					may alter manure properties (see e.g. Külling et al., 2002; Møller et al., 2014). The fact that an intervention in the feeding system may lead to repercussions elsewhere in the livestock production system cannot be emphasized enough. Külling, D.R., Dohme, F., Menzi, H., Sutter, F., Lischer, P., Kreuzer, M. 2002: Methane emissions of differently fed dairy cows and corresponding methane and nitrogen emissions from their manure during storage. Environmental Monitoring and Assessment, 79 (2): 129-150. Møller, H.B., Moset, V., Brask, M., Weisbjerg, M.R., Lund, P. 2014: Feces composition and ma-nure derived methane yield from dairy cows: Influence of diet with focus on fat supplement and roughage type. Atmospheric Environment, 94: 36-43.		
51	8-14	6.3.	Functional units	Ge	Additional functional units are often carcass weight and meat. Moreover, the functional units of (human digestible) calories and/or proteins could be mentioned. This allows to compare LCA data from different food items such as dairy products, pig meat and plant proteins.		We have added 'based on goal and scope' to capture some of the reviewer's suggestions.
51	10	6.3.	Functional units	Ge		1 kg of energy corrected (i.e. fat and protein corrected) ~~of~~ milk for milk producing animals (large and small ruminants)	Corrected
58	5-12	6.13.3.	Time coverage	Ge	The temporal system boundaries could be described more clearly. When the assessment period covers one year of production it should be clear, that all		The TAG discussed this issue and provided revisions to address the comment

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					associated activities should be observed. For a dairy cow this could mean, that also the rearing of replacement animals should be included in the analysis. In the case of the use of feed additives this means also, that it could be relevant whether the replacement animals also received feed additives or not. In the case that a feed additive is only provided during a limited time period (e.g. line seeds to reduce enteric fermentation are provided only during winter feeding) the overall environmental impact over a whole year should be considered. If the feed additive reduces enteric fermentation in winter by 20%, the overall reduction for the whole year and hence the reduction per kg of milk may only be 10%. A weighted average is thus need that considers the time period with and without feed additive.		
59	1	6.13.4.	Table 2	Ge	In the first column, the table contains names of parameters and numbers. It is not always clear, why some parameters are given as fixed values (e.g. retention factor for nitrogen for chickens). When parameters are not necessarily constant values it may be better to provide a variable name and a default value. Default values may be provided for all important parameters (or information on where such default values can be found; e.g. IPCC GL for national GHG inventories). Constant factors (e.g. the density of CH_4 under normal conditions) can then be provided in a separate table.		This is linked with the development of the equations in the guidelines on livestock production.
59	1	6.13.4	Table 2	Ge	The Modification factors for the different		We have reorganized on how the

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					parameters might be provided in an additional column to the right. Alternatively, the modification factors may be listed in a separate table together with the parameter name.		equations are presented so hopefully this will address the concern.
59	1	6.13.4	Table 2	Ge	0.92 is given as the default of 8% ash content in cattle manure. Further below, the “ash content of the manure” “A” is given as a factor that ranges usually between 0.1 and 0.2. This seems inconsistent (at least the format in which the numbers are presented). Are the later values applicable to all other livestock species except cattle? Furthermore, it is not stated whether the values apply to fresh or stored manure. Stored manure may have a higher ash content as bedding material and additional material from the stable floor are contained in the manure. Note that also the equations may have to be revised accordingly.		This was taken from the other LEAP guidelines in order to be consistent
60	1	6.13.4	Table 2	Ge	ENb: IT is explained that ENb is the number of eggs produced during the evaluation period. However, for all other parameters the specification “during the evaluation period“ is not provided. This should be made consistent or the issue of the evaluation period should be treated in more detail in chapter 6.13.1.		OK, consistency to be verified and modification to be done accordingly
60	1	6.13.4	Table 2	Ge	GE: Gross energy intake based on the total net energy. Do you mean net energy requirements?	Gross energy intake based on the total net energy requirement.	Changed as suggested
60	1	6.13.4	Table 2	Ge	ME/kg DM: The energy concentration per kg of dry matter: No information on the nature of the energy is given. Is it net energy, gross energy or any other kind of		This is in accordance with in the LEAP ruminant guidelines

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					energy? The abbreviation ME suggests that metabolizable energy is meant (ME is a common abbreviation for this). However, looking at the equations, this does not seem very likely. Another possibility is maintenance energy (on a net energy basis). Then, this should be distinguished from energy for "production". If you change the name of the parameter, all equations should be revised accordingly. Note that the abbreviation ME is also used on page 61. There additionally the term "maintenance" comes into play. This might further add to confusion.		
61	1	6.13.4	Table 2	Te	R_{MMS}: This is defined as the fraction of nitrogen degraded. However, degraded may be interpreted as transformed into another form (e.g. mineralization of nitrogen). Maybe the term "lost" may be more precise (e.g. volatilized as NH_3 or leached as NO_3^-). In fact both these processes may be important, the degradation (e.g. nitrogen is more prone to volatilization during application when it is mineralized during manure management) and the loss (less nitrogen is available for field application).		This relates to the definition given in the guidelines on livestock production.
62	1	6.13.4	Table 3	Ge	In order to facilitate navigation and cross references to the different equations I would suggest to use a double nomenclature: first the table number and then the equation number. The first equation in table 3 would then be 3.1. the second 3.2. etc.. This way the equations can be referred to unequivocally.		The equations are now reorganized so we hope it is more clear to follow.

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					Furthermore, a lot of the equation in the later tables 12-49 are just repeated without modification. The tables could be thus shortened and streamlined. With an overall streamlining of the respective chapter the guidelines could gain a lot of clarity. The outline in which the equations are presented could also be improved.		
63	3	6.13.4	Table 4	Te	Equation 8 differs in its layout from similar equations in other guidelines (e.g. IPCC guidelines). The layout could be changed in a way that the mechanistic basis of the process can be appreciated. Replacing the numbers with parameters name as suggested for table 2 might also help (in this case replace 0.92 by (1-ASH) and 1.04 by (1+UE; UE=urinary energy). This is just an example here. Many of the equations could be improved in this way and the guidelines might benefit a lot as clarity and transparency would be improved.	VS(kg) = DMI (kg) * (1+UE) * (1-DMD) * (1-ASH)	This is linked with the equations in the guidelines on livestock.
64	6	6.13.5.	Table 5	Ge	Equation 3-5: The equations for energy conversion (in this case from net energy to gross energy) is given only for small ruminants in table 5 and 6. At least it should also be mentioned for large ruminants but maybe also for all other livestock categories (maybe in a simpler way by just providing a conversion factor). A reason should be provided why the equations for energy conversion are provided in detail for ruminants and not for other livestock categories. Note that the energy conversion and linked to this the digestibility is of crucial importance for overall livestock production efficiency and		Same comment as above, with the use of equations from the livestock guidelines, which might not be consistent one with another.

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					merits a thorough and detailed discussion in the guidelines.		
66	6	6.13.6.	Table 7	Ge	Equation 9 and 10: For pigs the feed wasted is accounted for in these equations. However, this is not the case for all other livestock categories. Why not? It may be a good idea to provide a reason for this here (e.g. why feed wasted is so important for pigs and not for other species).		Same comment as above, in the pig guidelines, the wasted feed is considered but it is not in the other guidelines.
66	6	6.13.6.	Table 7	Te	Equation 15a/b: The energy density of methane is given here in another unit than in table 2. This might lead to confusion. Additionally, the number is not the same (typo?).	~~5.665e^{7}~~ → 55.65 MJ/kg * 1000 (J / kg methane)	Corrected
66	6	6.13.6.	Table 7	Te	Equation 16: In table 5 and 6 the density of methane is given as 0.67 kg/m^3. Here and in table 2 it is 0.662 kg/m^3. This is inconsistent.	Use consistent values throughout the whole document.	This comes from the equation in the livestock guidelines.
66	6	6.13.6.	Table 7	Te	Equation 17: The nomenclature is confusing and does not seem 100% right. It is not clear if the N_2O emissions refer to the emissions during housing or storage or both (note that for methane the subscript "housing" is used which eventually also should be revised / replaced by "storage" or "manure management"). The structure of the equation suggests that storage is meant as the losses (during housing?) are accounted for. In fact both during housing and storage emissions may occur. In the IPCC guidelines both processes are summarized in one equation where the amount of nitrogen excreted is used as a basis for the emission factor. If you want	$NitrousOxide_{housing}$ (kg) = $N_{excreted}$ (kg) * $EF_{housing}$ $NitrousOxide_{storage}$ (kg) = $N_{excreted}$ (kg) * (1 – $R_{housing}$) * $EF_{storage}$	Same comments as above concerning the use of equations. We are trying to make it a consistent as possible with the other LEAP guidelines

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					to split the two processes you might want to use equations that look similar to the suggestions on the right. For poultry the equation looks different (R_{MMS} does not occur). I did not look up the equations for ruminants but they may also be different. If there is a reason for the differences then it should be explained here. Otherwise the equations should be harmonized. Given the different processes along the livestock nutrition cascade a flow chart that demonstrates the different stages and emission processes and their connections may be helpful. This may be provided in a general introduction for all livestock species where the mechanistic background of the equations is explained in more detail. Note that this comment also applies to all other tables where this equation is used.		
69	4	6.13.7.	Table 10	Te	Equation 8: In other similar equations (e.g. in table 9) the concept of "1 – retention factor" is used. Why not here? Additionally the number "0.0182" is not explained in table 2. I suggest to use only parameter names in the equations and then explain them in table 2. Default numbers can also be provided in table 2. Note that this comment also applies to other tables.		Thank you. We tried to make it as consistent as possible to equations and explanations provided in other LEAP guidelines
70	8	6.13.9.	Modification of feed composition	Ge	No sub chapters are made here. When providing titles for subchapters, navigation in the text may be much easier (e.g. when looking for all information		Revised to take the comments into consideration.

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					related to a particular livestock species).		
71	20	6.13.9.	Table 12	Te	Equation 4 and 5: $delta_{nc}$ is used in both equations. However, phosphorous and nitrogen content may not be altered in the same amount. Thus, two different parameter names should be used. Note that this applies also for many other equations in other tables.		Agree in principle. Delta implies change and thus the values are understood to likely being not the same amount
73	5	6.13.9.	Table 16	Te	Equation 17: The conversion from N to N_2O is used here (44/28) however, not in other similar equations. This should be handled consistently in the whole document.		This is the same factor as in table 7 and relates to the equations in the guidelines for pigs.
76	8	6.14.10.	Feed efficiency	Ge	The concept of feed efficiency could be explained in more detail as it is of crucial importance. Feed efficiency has to do a lot with the ratio between net energy and gross energy (NE/GE) and hence with feed digestibility. This is also reflected in equation 3, 4 and 5 in table 5. Reference to these equations should thus be given when explaining feed efficiency.		Revised to address the comment
79	6	6.14.11.	Table 23	Te	As performance increases this could be due to increased digestibility, i.e. more feed energy is ending up in the animal products and less in the excrements. The excretion of VS and nutrients is thus affected by this. However, there is no respective equation for VS here. I suggest to control all tables and check if all excretion rates (VS and nutrients) have been covered correctly as I have the impression that there are other missing equations. If there is a particular reason for not including one of the equations this should be explained somewhere.		Without changing digestibility, conservation of feed energy otherwise lost as methane can improve performance OK, the VS could be modified due to DMD; but this is reflected in other tables. For consistency, the effects are individualised, and multiple effect shall use different equations.

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95	5	6.14.14.	Table 42	Te	Equation 2: $delta_{pc}$ is used both for EW and ENb. This may not be correct, as the values may be different (as suggested in the example on page 136 in equation 2). Two different parameter names should be used here.		Same comment as above.
97	8	Emission Factor	Emission Factor	Ge	Chapter number is missing.		Changed accordingly
97	8	Emission Factor	Emission Factor	Te	When an emission factor is altered (e.g. for enteric fermentation) it may well be that also the performance is altered as the underlying mechanisms are linked (e.g. less energy is converted to methane and more energy is thus available for performance). $Delta_{ef}$ and $delta_{pc}$ may thus be linked. These connections should be discussed in the text and reflected in the equations.		Same comment as above. The general approach is that, if there is more than one effect, the different equations should be modified accordingly.
98	3	Emission Factor	Table 47	Te	Equation 11 and 12: As already mentioned further above, Enteric fermentation and manure management are (or may be) linked (e.g. Külling et al., 2002; Moller et al., 2014). However, the alteration of the emission factor (i.e the methane conversion rate / factor) is often not the same. While emissions from enteric fermentation may be reduced by a particular feed additive, emissions from manure management may be enhanced because not all available substrate is fermented in the rumen and is thus excreted. It is thus not logical to apply the same $delta_{ef}$ in both equation 11 and 12. The parameter name should be different and the mechanistic basis of the alteration of the equations for enteric fermentation and manure management		Similar as the comments above

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					should be discussed in the text. Note that this comment applies also for table 48 and in a similar way possibly also to other tables. Külling, D.R., Dohme, F., Menzi, H., Sutter, F., Lischer, P., Kreuzer, M. 2002: Methane emissions of differently fed dairy cows and corresponding methane and nitrogen emissions from their manure during storage. Environmental Monitoring and Assessment, 79 (2): 129-150. Møller, H.B., Moset, V., Brask, M., Weisbjerg, M.R., Lund, P. 2014: Feces composition and ma-nure derived methane yield from dairy cows: Influence of diet with focus on fat supplement and roughage type. Atmospheric Environment, 94: 36-43.		
99	8	6.14.15.	Data quality assessment/rules	Ge	This chapter seems to me of crucial importance. The guidelines may be used as a standard for the accreditation of feed additives for important mechanisms such as CO_2 compensation projects, labelling, agricultural subsidy systems etc.. Much money and big interests may be involved (e.g., a governmental accreditation of a CO_2 offset mechanism for a feed additive that claims to reduce enteric fermentation will open up a huge global markets for the company producing the feed additive. See e.g. here https://www.businessgreen.com/digital_assets/b521d668-74f2-47d6-9859-62653aa7b9dc/BusinessGreen-Insight-Report.pdf). Hence, it is important, that the guidelines provide a clear and serious framework that guarantees the trustworthiness and the reliability of the		Agree that these aspects are crucial to those mechanisms of accrediting for products and ERF methodologies. These are guidelines for production and use of feed additives, this seems out of scope as more a mechanism of market and systems/methods security and confidence.

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					effect of the feed additive and at the same time minimizes the possibility of fraud. For this reason, I think it is indicated to extend this chapter and provide more guidance on the proof of efficiency of the effect of the feed additive and the verification of the claimed effect. This would involve more guidance on the scientific rigour, of the type of scientific study (methods used, time period of investigation, length of trial, measuring technique, repeated measures, thorough documentation, proof of independence…) and a proof of independent verification. Accreditation agencies that do not necessarily have a in depth understanding of the mechanisms at hand should be able to base a decision on clear and precise criteria defined here.		
122	13	Sensitivity Analysis	Table B5	Te	Equation 1, 5 and 8: The first value after the "=" seems wrong.	~~5.702~~ → 5.431	Corrected
125	12	Evaluated Scenario	Table B7	Te	As mentioned in the comments above $delta_{ef}$ may not be the same for enteric fermentation and manure management → use different parameter names and explain in the text.		Revised taking the comment into account
127	8	Sensitivity Analysis		Te		Decreased nitrous oxide production linked to ~~increased~~ decreased nitrogen excretion …	Corrected

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