Annex to the Discussion paper: Recommendations from the Dairy Working Group

Drawing from the GHG studies comparison, and further thoughts and research from member companies' experts, SAI Platform Working Group particularly recommends the following **critical choices** for the life cycle analysis:

- **Functional unit** is 1 kg of FPCM (Fat Protein Corrected Milk).
- **Scope & Objective.** Through the application of LCA, many differences may occur in terms of the critical choices (e.g. allocation principle, scope and system boundaries, inclusion of variability and uncertainty analysis etc.). These will have been determined by the specific goal and objectives of the individual studies. Important choices are the inclusion of:
    - *land use changes* which is especially relevant in relation to the deforestation needed for the production of feed crops specifically soy, but also land use changes made for grazing animals. Deforestation of important ancient rainforests ecosystems like the Amazon causes a quick release of CO_2 from the carbon that was embodied in the biomass and soils and it reduces the CO_2-sink capacity that the breathing forest contains. Even though we acknowledge the issue of land use change is important to be included for all LCA studies to ensure a level playing field for fair comparison, there is not a proper methodology yet. We encourage further research and to make a link between the IPCC workbook on land use change with the agriculture workbook.
    - *sequestration* of carbon by soils and biomass (permanent and temporary grass fields, maize, hay, other crops). We include the potential absorption of carbon from soils and biomass and release from tilling and crop rotation depending on land management practices.
    - *lifespan* and replacement rate of the animals for continuous improvement on cow yield, optimize the life of a cow and the number of cows.
- **Boundaries of a LCA** for our purpose is farm gate and contains both on and off dairy farm emissions. The key impacts of GHG emissions need to be included:
    - *On farm* 1) methane from enteric fermentation (± 40 %), 2) nitrous oxide from Nitrogen-fertilizer applied to grass fields and from manure management (± 20 %), 3) methane from manure management (± 10 %), 4) production of feed, 5) energy use on-farm;
    - *Off farm* (± 20-30 %) 4) carbon dioxide from fertilizer production, 5) nitrous oxide from N-fertilizer applied to crop fields, 6) carbon dioxide from transportation (of feed, fertilizer, pesticides and other inputs).
    - Based on the research, we think fertilizer production for both grassland and feed production should be included.
    - Further research is needed on production facilities like machines and building – which often are not included.

- The methodological **allocation** choice to link the impacts to co-products is critical. Until now most studies focus on the *economic* allocation (in an average currency e.g. dollars) due to an easier access to data. With such a choice however, the estimation of GHG emissions can fluctuate greatly due to external factors (such as price), making it difficult to communicate about progress with farmers and to compare results between countries (see below table for a summary of allocation types' strengths and weaknesses). We recommend doing more research on alternative allocation types such as:
    - *physical* inputs/outputs properties (mass, molar flows, energy or protein contents, volume),
    - *biological causality* or *physico-chemical* allocation (reflecting the causalities of production functions in dairy to determine average resource use, e.g. protein),
    - *system* allocation based on life cycle stage (e.g. growing, finishing stage in years) (ISO 14044, 2006; Guinée, 2002,2004; Feitz et al, 2007).

Allocation Type	**From 27 studies**	**Strengths**	**Weaknesses**
Economic	7 x	Relatively easy and data ready	Problem with comparisons over time due to price volatility and regional differences in price
Biological (or physico-chemical) causality	2 x	Steady over time, scientifically most sound	Difficult and complex, lacking data
Mass (solid matter)	0 x	Clear, not too difficult	Not only 'milk vs meat'; sometimes manure is sold too, e.g. how significant for roughage
Systems (age: first two years and finishing stage to meat)	2 x	Clear for milk vs meat	Not applicable to other areas. Not only 'milk vs meat'; e.g. how for skimmed milk vs cream?
No allocation (i.e. all to dairy)	9 x 4 x unknown	Easy	Higher impacts for dairy; implicit suggestion that all by-products are free of environmental impacts

Data used and level of detail. For data we recommend to use equations, emission factors and the three tiers activity data recommendations offered by the IPCC**.** The IPCC method is the most commonly and dominantly used method with an international reputation. 100 % of the surveyed studies refer to IPCC's global warming potential and almost all studies explicitly refer to IPCC method used for emission factors and equation.

We also recommend using the IPCC method for equations and emission factors for global warming potential and time frame considered of 100 years from the most appropriate tier. We recommend having as specific and detailed activity data (tier 3) for type of feed and fodder for calculating emissions from enteric fermentation. We also recommend further research in methods for including sequestration of carbon in soils and biomass (grass and crop fields).

List of methodologies and studies reviewed

The analysis and comparison in this report is based on twenty-seven methodologies. Seven different approaches from the SAI Dairy Working Group members:

1. Arla Foods by Kite Consulting
2. Campina, CONO, Friesland Foods by KWA/NZO
3. Danone by L'Elevage/INRA
4. Fonterra by AgResearch, CWWT, University of NSW, Scion
5. McDonalds by Adème
6. Nestlé by Ecointesys
7. Unilever by Wageningen University Animal Sciences Group (WUR ASG)

Twenty other studies:

8. LCA Wageningen University by Thomassen, 2007
9. LCA University College Dublin by Lovett et al., 2006
10. LCA University of Bonn by Haas et al., 2001
11. LCA AgResearch by Basset-Mens, Ledgard, Carran, 2008
12. IFCN Dairy Research Centre, 2008
13. DIAS (Danish Institute of Agricultural Sciences)
14. LCA Dairy Australia by Lundie, 2002
15. Forum for the Future1
16. Wageningen University BBPR/Dairywise
17. CLM Climate Yardstick
18. TMT Climate Yardstick (similarities with competing CLM)
19. Sainsbury by AB Agri/Whitegold
20. IMPRO/EIPRO
21. FAO (2006)
22. Carbon Trust Carbon Label
23. PAS2050
24. WBCSD/WIR GHG Protocol
25. IPCC
26. CE Delft
27. FCRN, Surrey U

[1] Forum for the Future was suggested by Richard Perkins (WWF) and Tara Garnett (FCRN). This methodology has a lot of similarities with more recent studies: Dairy Crest Direct/Marks & Spencer, CLA/CALM (UK business 'Climate Friendly Food' refers to this tool), but these are not included as they did not respond to any of my emails or phone calls.