

Analytical Tools and Algorithms for Life Cycle Assessment

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Since the early 90s, various analytical tools have been developed for Life Cycle Assessment (LCA) to help gaining insights on the results and to provide guidance for further action. These tools are useful not only for interpretation phase of an LCA but also for other phases, especially Life Cycle Inventory (LCI). In this presentation, a number of major analytical tools are reviewed focusing on their recent developments. Among others, key issue identification, input and output contribution analyses, structural path analysis and allocation algorithms are discussed with numerical examples. First, key issue identification method is introduced without using the conventional, first order approximation. Key issues are defined here following Heijungs and Suh (2002), where perturbation theory is utilized to identify key elements considering both their contribution to the results and uncertainty. The solution for the key issue identification in Heijungs and Suh (2002) is derived on the basis of first order approximation. An alternative method is possible, which gives an exact solution without using approximation. Second, the concept of input contribution analysis is introduced, where the key economic inputs to each process in a product system are identified. Third the structural path analysis and the solution to the, so called, 'thickness' problem are introduced. The 'thickness' refers to the relative contribution of a process to other processes in a supply-chain either in LCI or Life Cycle Impact Assessment (LCIA) result. This way of representation has been adopted by LCA software tools, and it has been a problem when there are feedback loops. Fourth, the use of consistent allocation algorithms expressed in matrix algebra are discussed with a numerical example. Finally, the areas need further developments and outlook are discussed.