Appendix 2. Critical appraisal of LCAs (based on Drew, 2021)

Drew (2021) developed a critical appraisal *pro forma*, based on Weidema's guidelines for critical review of LCA (Weidema, 1997). This scoring system consists of 16 appraisal criteria, which are divided between the different phases of an LCA. It addresses a range of study quality indicators, such as internal validity, external validity, consistency, transparency, and bias. The percentage score provides an indication of the overall study quality. A higher score indicates a higher overall study quality. The points that can be obtained are displayed in the column labeled "appraisal criteria".

Appraisal criteria	Indicator(s)	Key effect modifiers	Sherman (2012)	Thiel (2018)	Hu (2021)	McGain (2021)
Phase 1: Goal & Scope (13 points)						
Study goal is clearly stated, including the study's rationale (1), intended application (1), and intended audience (1)	Transparency		3	3	3	3
Lifecycle assessment method is clearly stated (1)	Transparency	Process-based life-cycle assessment, which is well suited to product-level analysis, may underestimate environmental impacts (i.e. from truncation error); economic input-output lifecycle assessment (EIO-LCA), which uses aggregate data and is well-suited to sector-level analysis, may overestimate environmental impacts	0	1	1	1
Functional unit is clearly defined and measurable (1), justified (1), and consistent with the study's intended application (1)	Consistency		3	3	3	2
The system to be studied is adequately described with clearly stated system boundaries (1), lifecycle stages (1), and appropriate justification of any omitted stages (1)	Transparency; Bias	Assessments with narrow system boundaries that exclude a number of lifecycle stages are prone to underestimating life-cycle environmental impacts	3	2	3	3
The system covers production (1), use/reuse (1) and disposal (1) of materials and energy (half mark if only for energy and vice versa)	Internal Validity, Completeness		3	3	2	3
Phase 2: Inventory analysis (7 points)						
The data collection process is clearly explained, including the source(s) of foreground material weights and energy values (1); the source(s) of reference data (e.g. inventory database; 1); and what data are included (e.g. production and disposal of unit processes; 1)	Transparency, Internal Validity		3	3	3	3
Representativeness of the data is discussed (1), differences in electricity generating mix are accounted for (1), and the potential significance of exclusions or assumptions is addressed (1)	Internal validity; External validity		2	2	2	3
Allocation procedures, where necessary, are described and appropriately justified (1; mark given if no allocation used)	Transparency; Bias		1	1	1	1
Phase 3: Impact assessment (6 points)						
Impact categories (1), characterization method (1), and software used (1) are documented transparently	Transparency		3	2	3	2
Results are clearly reported in the context of the functional unit (1) (0.5 if graphically, 0 if only normalized results reported)	Consistency; Transparency		1	1	0.5	1
A contribution analysis is performed and clearly reported (1), and hotspots are identified (1)			2	2	2	2
Phase 4: Interpretation (9 points)						

Conclusions are consistent with the goal and scope (1) and supported by the impact assessment results (1)	Internal validity; Consistency		2	2	2	2
Results are contextualized through the use of sensitivity analysis (1) and uncertainty analysis (1)	Internal validity		0	0	0	2
Limitations are adequately discussed (1), and the potential impact of omissions or assumptions on the study's outcomes are described (1)	Bias		1	1	1	1
The assessment has been critically appraised (i.e. peer review if journal article or independent, external critical review if report/thesis; 1)	Bias		1	1	1	1
Source(s) of funding and any potential conflict(s) of interest are disclosed (1), and are unlikely to be a source of bias (1)	Bias		1	0	1	2
		Total (/35)	29	27	28.5	32
		Percentage score	**83%**	**77%**	**81%**	**91%**