Life Cycle Environmental Impacts and Costs of Beer Production and Consumption in the UK

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Supplementary information: Data quality assessment

S1 Methodology

Data quality assessment has been carried out following the CCaLC methodology (CCaLC, 2014) as an indication of the level of confidence in the results. This methodology considers the following criteria for the LCA and LCC data (see Table S1):

- age:
- geographical origin;
- source;
- completeness; and
- · reproducibility, reliability and consistency.

Depending on the above, the quality of data is defined as:

- high;
- medium; or
- low.

Table S2 shows how the criteria in Table S1 can be aggregated to arrive at an overall Data Quality Indicator (DQI) - high, medium or low. For these purposes, each data quality criterion is assigned a weight of importance on a scale of 1-10. For example, as shown in Table S2, "Age of data" has the weight of 2, being twice as important as the geographical origin of data. Each data quality indicator is assigned (an arbitrary) maximum score for each criterion: e.g. the 'high' quality has a score of 3, 'medium' has 2 and 'low' has a score of 1 (see Table S2). Applying the weights of importance for each criterion and its maximum score for the respective quality indicators, the maximum score for each quality indicator is:

- 10 for low;
- 20 for medium; and
- 30 for high.

The following score ranges are adopted to indicate the quality of data:

- low: score in the range of 1-10;
- medium: score in the range of 11-20; and
- high: score range of 21-30.

It should be noted that the overall data quality will depend on both the quality of the particular datasets used as well as on the confidence on the quantity/amount of environmental burdens or costs for each part of the system.

The approach used for calculating DQI for a sub-system is shown in Table S3. Note that the quantity/amount is considered more important here than the quality of the dataset.

Once the data quality indicators have been calculated for each part of the system, a weighted approach is then applied for assessing the overall data quality of the whole system based on the percentage contribution of each life cycle stage to the life cycle impacts or costs. The overall data quality for the whole system is, therefore, calculated as:

$$DQ_{CF} = \sum_{n=1}^{N} I_n(\sum_{m=1}^{M} DQS_m)$$
 (S1)

where:

 DQ_{CF} - overall data quality of the system I_n – percentage contribution of each life cycle stage to the total impacts or costs (%) DQS_m – data quality (1, 2 or 3) for sub-system m.

The following ranges have been adopted for the overall data quality of the whole system:

- low data quality: $DQ_{CF} = 100 166$;
- medium data quality: DQ_{CF} = 167 233; and
- high overall data quality: $DQ_{CF} = 234 300$.

The above approach has been followed for both the LCA and LCC data quality analyses.

Table S1 Matrix of data quality indicators (CCaLC, 2014)

Data quality criteria Data		Data quality indicators	
	High	Medium	Low
Age of data	< 5 years	5 – 10 years	> 10 years
Geographical origin of data	Specific	Partly specific	Generic/average
Source of data	Measured and/or modelled based on specific data (e.g. company data or from suppliers)	Modelled using generic data from LCA databases; some data derived using expert knowledge	Mainly sourced from literature and/or estimated and/or derived using expert knowledge
Completeness of data	All inputs and outputs considered	Majority of relevant inputs and outputs considered	Some relevant inputs and outputs considered or known
Reproducibility, reliability and consistency of data	Completely reproducible/reliable/c onsistent	Partly reproducible/reliable/consist ent	Not reproducible/reliable/n ot known

Table S2 Aggregating individual data quality indicators to arrive at an overall DQI for each process (CCaLC, 2014)

Data quality criteria	Weighting for each criterion on a scale of 1 – 10 ^a	High quality Max score for each criterion:	Medium quality Max score for each criterion:	Low quality Max score for each criterion: 1	Example data quality assessment
Age	2	3	2	1	1 (Low)
Geographical origin	1	3	2	1	3 (High)
Source	3	3	2	1	2 (Medium)
Completeness	2	3	2	1	3 (High)
Reproducibility/reliability/consistency	2	3	2	1	1 (Low)
Maximum score		30 (max score) Overall score for High in the range: 21 – 30	20 (max score) Overall score for Medium in the range: 11 – 20	10 (max score) Overall score for Medium in the range: 1 – 10	19 (overall score) Data quality indicator: Medium

^aThe sum of all weights is 10.

Table S3 Aggregating the data quality indicators to arrive at an overall DQI for each sub-system or life cycle stage

DQI for LCI/LCC dataset	DQI for the amount entered by the user	Data quality of each sub- system of life cycle stage
High	High	High (3)
Medium	High	Medium (2)
Low	High	Medium (2)
High	Medium	Medium (2)
Medium	Medium	Medium (2)
Low	Medium	Low (1)
High	Low	Medium (2)
Medium	Low	Low (1)
Low	Low	Low (1)

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able S4 Beer in gl	ass bottle																		
law materials																			
			ty for amou	nt						LCI data q									
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aw materials	Source of data for a	Age	Geography	Source	Completer	Reproduci			Source of LCI data	Age	Geography	Source	Completen	Reproduci	DQA for LO		Process D	DQA	4
ight fuel oil	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Vater	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Diatomaceous earth	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
odium hydroxide (50		3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
hosphoric acid (75%	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
ulphuric acid (63% i	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Carbon dioxide, liquid	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
arley	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Vater (barley product	Ecoinvent (2010)	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
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		Aye a	oeography	20uice	Completer	2				Aye .	oeography	Ource	oumpieten	neproduct					4
ottle glass, green	Manufacturer	3	2	3	3	3	29	High	CCaLC (2010)	0	3	0	3	ა ი	30	High	High	3	1
teel	Manufacturer	3	2	3	3	3	29	High	CCaLC (2010)	3	3	3	3	3	30	High	High	3	
Paperboard	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	_3
																	Subsyster	m DQA	High (
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		2	1	3	2	2				2	1	3	2	2					
lectricity	Source of data for a	Age	Geography	Source	Completer	Reproduci	DQA for a	Qualitative	Source of LCI data	Age	Geography	Source	Completen	Reproduci	DQA for LO	Qualitative	Process D	DQA	
lectricity (UK grid, n	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	3	3	3	3	30	High	High	3	1
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Paperboard (to landfill		ა ი	2	0	3	0	29		PE (2010) PE (2010)	3	2	3	3	0	29		High	3	-
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Glass (to landfill)	Manufacturer	3	2	3	3	3	29	High	ELCD/PE (2010)	3	2	3	3	3	29 29	High	High		-
teel (to landfill)	Manufacturer	3	2	3	3	3	29	High	PE (2010)	3	2	3	3	3	29	High	High	3	
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laterial	Source of data for d	Age	Geography	Source	Completer	Reproduci	DQA for a		Source of LCI data	Age	Geography	Source	Completen	Reproduci	DQA for LO				
Barley malt (40 t truck		3	2	3	3	3	29	High	PE (2010)	3	2	3	3	3	29	High	High	3	
rimary packaging (3	Manufacturer	3	2	3	3	3	29	High	PE (2010)	3	2	3	3	3	29	High	High	3	
ackaged product to	Manufacturer	3	2	3	3	3	29	High	PE (2010)	3	2	3	3	3	29	High	High	3	3
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ey	0.1				Raw mate														+
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Table S5 Aluminiun Raw materials	n can system																		
Raw materials		Data qualit	ty for amou	nt						LCI data d	u olity								
		2	19 101 all100	3	2	2				2	1 1	3	2	2					
Raw materials	Source of data for a	Age	Geography			Reproduci	DOA for a	Qualitative	Source of LCI da	ta Age	Geography		Completer	Reproducil	DOA for L	Qualitative	Process F	OOA	
Light fuel oil	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010		2	3	3	3	29	High	High	3	
Water	Manufacturer	3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Diatomaceous earth	Manufacturer	3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Sodium hydroxide (50		3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Phosphoric acid (75%		3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Sulphuric acid (63% i	Manufacturer	3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Carbon dioxide, liquid		3	2	3	3	3	29		Ecoinvent (2010		2	3	3	3	29	High	High	3	
Barley	Manufacturer	3	2	2	3	3	29		Ecoinvent (2010		2	2	3	2	29	High	High	3	
Water (barley product		3	2	2	3	2	29		Ecoinvent (2010		2	2	3	3	29	High	High	3	
water (bariey product	Econwent (2010)	3	2	3	3	3	29	High	Econwent (2010	3	2	3	3	3	29	nigri	nigri	3	
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Primary packaging ty	Source of data for a	Age	Geography	Source	Completer	Reproduci	DQA for a	Qualitative	Source of LCI da	ta Age	Geography	Source	Completer	Reproducil	DQA for L	Qualitative	Process D	QA	
Aluminium can	Literature	3	3	2	3	3	27		CCaLC (2010)	3	3	3	3	3	30	High	High	3	
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		2	1	3	2	2				2	1	3	2	2					
Electricity	Source of data for a	Age	Geography	Source	Completer	Reproduci	DOA for a	Qualitative	Source of LCI da	ta Age	Geography	Source		Reproducil	DOA for L	Qualitative	Process F	OOA	
Electricity (UK grid, n		2	2	3	3	3	29		Ecoinvent (2010		3	3	3	3	30	High	High	3	
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																	Subsyster	m DQA	High (3)
Waste managemen	t																		
		Data qualit	ty for amou	nt						LCI data o	quality								
		2	1	3	2	2				2	1	3	2	2					
Waste	Source of data for a	Age	Geography	Source	Completer	Reproduci	DQA for a	Qualitative	Source of LCI da		Geography	Source	Completer	Poproducil	DOA for L	Qualitative		^	
Wastewater (to waste	Manufacturer	3	2	2						ta Age	Coograpin	Cource	Completel	Reproducii	DQA IOI L	-	Process L	JQA	
Aluminium (to landfill)	Literature		_	3	3	3	29	High	PE (2010)	ta Age 3	2	3	3	3	29	High	Process L High	3	
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		3	2	2	3	3			PE (2010)	ta Age 3 3		3	3	3 3	29	High	High	3	
		3	2	2	3	3			PE (2010)	3 3		3	3	3	29	High	High	3	3
		3	2	2	3	3			PE (2010)	ta Age 3 3		3	3	3 3	29	High	High	3	3 High (3)
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Material Barley malt (40 t truc Primary packaging (3	Manufacturer Manufacturer	2	1	3			DQA for al	High Qualitative High High	PE (2010) PE (2010) Source of LCI da PE (2010)	3 3 LCI data o	2 2 uuality	3 3 3	3 3	3 3	29 29 DQA for L	High High Qualitative	High High Subsyster Process E High High High	3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truc Primary packaging (3	Manufacturer Manufacturer	2	1	3			DQA for an 29 29	High Qualitative High High	PE (2010) PE (2010) Source of LCl da PE (2010) PE (2010)	3 3 LCI data o	2 2 uuality	3 3 3	3 3	3 3	29 29 DQA for Li 29 29	High High Gualitative High High	High High Subsyster Process E High High	3 3 m DQA DQA 3 3 3	3 High (3) 3 High (3)
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Table S6 Steel can s	murato m					1		1					T						1
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Naw Illaterials		Data qualit	ty for amou	nt						LCI data o	uality								
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Raw materials	Source of data for a		Geography	Course		Reproduci	DOA for a	Ouglitativa	Source of LCI data	_	Geography		Completen	Donroducil	DQA for LO	Ouglitativa	Process D	204	
		Age		Source	Completer	Reproduci				Age	Geography	Source	Completen	Reproducii					
	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
	Manufacturer	3	_	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Sodium hydroxide (50		3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Phosphoric acid (75%		3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Sulphuric acid (63% ii		3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Carbon dioxide, liquid		3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
Water (barley product	Ecoinvent (2010)	3	2	3	3	3	29	High	Ecoinvent (2010)	3	2	3	3	3	29	High	High	3	
																			3
																	Subsyster	m DQA	High (3)
Packaging																			
		Data qualit	ty for amou	nt						LCI data o	uality								
		2	1	3	2	2				2		3	2	2					
Primary packaging ty			Geography	Source		Reproduci	DQA for a	Qualitative	Source of LCI data	Age	Geography	Source		Reproducil	DQA for L	Qualitative	Process F	OOA	
Steel can	Literature	3	3	3	3	3	30	High	CCaLC (2010)	3	3	3	3	3	30		High	3	
Oteel can	Literature	3	3	3	3	3	30	riigii	CCALC (2010)	3	3	3	1	0	30	riigii	riigii	J	
																			1
																	0 1 1	DO 4	LE L (0)
																	Subsyster	m DQA	High (3)
Manufacturing																			
			ty for amou							LCI data o									
		2		3	2	2				2	-	3		2					
Electricity	Source of data for a	Age	Geography	Source	Completer	Reproduci	DQA for a	Qualitative	Source of LCI data	Age	Geography	Source	Completen	Reproducil	DQA for LO	Qualitative	Process D)QA	
Electricity (UK grid, m	Manufacturer	3	2	3	3	3	29	High	Ecoinvent (2010)	3	3	3	3	3	30	High	High	3	
																			3
																	Subsyster	m DQA	High (3)
Waste management																			
		Data qualit	ty for amou	nt						LCI data o	uality								
		2	1	3	2	2				2		3	2	2					
Waste	Source of data for a	۸۵۵		Source	Complete	Poproduci	DOA for o	Ouglitation	Source of LCI data			0							-
Wastewater (to waste			Geography							Age	Geography		Completen	Reproducib	DQA for LO	Qualitative	Process D	QA	
Steel (to landfill)		Age 3	Geography	3	Completer	3				Age	Geography	Source	Completen	Reproducib		Qualitative			
Oteel (to landilli)		3 3	Geography 2	3	3	3	29	High	PE (2010)	Age 3	Geography 2	3	Completen 3	Reproducit 3	29	High	High	3	
	Literature	3 3		3	3 3	3 3				Age 3 3	Geography 2 2	3 3	Completen 3 3	Reproducib 3 3					
		3 3		3	3 3	3 3	29	High	PE (2010)	Age 3 3	Geography 2 2	3 3	Completen 3 3	Reproducib 3 3	29	High	High	3	
		3 3		3	3 3	3	29	High	PE (2010)	Age 3 3	Geography 2 2	3 3	Completen 3 3	Reproducit 3 3	29	High	High	3	2
		3 3		3 2	3 3	3	29	High	PE (2010)	Age 3 3	Geography 2 2	3 3	Completen 3 3	Reproducit 3 3	29	High	High High	3	3
		3 3		3 2	3 3	3 3	29	High	PE (2010)	Age 3 3	Geography 2 2	3 3	Completen 3 3	Reproducit 3 3	29	High	High	3	3 High (3)
Transport	Literature	3 3	2 2	3 2	3 3	3	29	High	PE (2010)	3 3	2 2	3 3	Completen 3 3	Reproducit 3 3	29	High	High High	3	3 High (3)
Transport	Literature	3 3 Data qualit		3 2	3 3	3	29	High	PE (2010)	Age 3 3	2 2 uality	3 3	3 3	3 3	29	High	High High	3	3 High (3)
	Literature	3 3 3 Data qualit	2 2 2 ty for distan	3 2 2 nce 3	3 3	3 3	29 26	High High	PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3	3 3	3 3 3	29 29	High High	High High Subsyster	3 3 m DQA	3 High (3)
Material	Literature Source of data for c	3 3 3 Data qualit	2 2 ty for distar 1 Geography	3 2 2 nce 3	3 3	3 3	29 26 DQA for al	High High	PE (2010) PE (2010) Source of LCI data	3 3 LCI data q	2 2 uality	3 3	3 3	3 3 3	29 29 DQA for L0	High High	High High Subsyster Process E	3 3 m DQA	3 High (3)
Material Barley malt (40 t truck	Literature Source of data for of Manufacturer	3 3 3 Data qualit	2 2 ty for distar 1 Geography	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29	High High Qualitative	PE (2010) PE (2010) Source of LCI data PE (2010)	3 3 LCI data q	2 2 uality	3 3	3 3	3 3 3	29 29 DQA for L0 29	High High Qualitative	High High Subsyster Process E	3 3 m DQA	3 High (3)
Material Barley malt (40 t truck Primary packaging (3)	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distar 1 Geography	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29 29	High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High	n DQA OQA 3 3	3 High (3)
Material Barley malt (40 t truck Primary packaging (3:	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distar 1 Geography	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29	High High Qualitative	PE (2010) PE (2010) Source of LCI data PE (2010)	3 3 LCI data q	2 2 uality	3 3	3 3	3 3 3	29 29 DQA for L0 29	High High Qualitative	High High Subsyster Process E	3 3 m DQA	3 High (3)
Material Barley malt (40 t truck Primary packaging (3:	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distant Geography 2	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3:	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distant Geography 2	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3:	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distant Geography 2	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3 High (3) 3 High (3)
Material Barley malt (40 t truck Primary packaging (3: Packaged product to	Source of data for c Manufacturer Manufacturer	3 3 3 Data qualit	2 2 ty for distant Geography 2	3 2 2 nce 3	3 3	3 3	29 26 DQA for al 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	3 3 LCI data q	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3) Packaged product to DQA for system	Source of data for c Manufacturer Manufacturer Manufacturer	3 3 Data qualit Age 3 3 3 3	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3	2 Reproducii 3 3 3	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3) Packaged product to DQA for system	Source of data for c Manufacturer Manufacturer Manufacturer	3 3 Data qualit Age 3 3 3 3	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3	2 Reproducii 3 3 3	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3: Packaged product to DQA for system 60(3) + 21(3) + 15(3) +	Source of data for c Manufacturer Manufacturer Manufacturer	3 3 Data qualit Age 3 3 3 3	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 3	2 Reproducii 3 3 3 3 stage (subs	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3) Packaged product to DQA for system 60(3) + 21(3) + 15(3) + Key	Source of data for c Manufacturer Manufacturer Manufacturer Manufacturer + 3(3) + 1(3) = 300 (3 3 Data qualit Age 3 3 3 3	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 3 Life cycle Life cycle Raw mate	Reproducii 3 3 3 3 stage (subs	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3) Packaged product to DQA for system 60(3) + 21(3) + 15(3) + Key	Source of data for c Manufacturer Manufacturer Manufacturer Manufacturer Manufacturer Subsystem	3 3 Data qualit Age 3 3 3 3	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 Life cycle Life cycle Life cycle Packaging	2 Reproducil 3 3 3 3 3 3 Stage (subs Contribution 60%	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3: Packaged product to DQA for system 60(3) + 21(3) + 15(3) + Key	Source of data for of Manufacturer Manufacturer Manufacturer + 3(3) + 1(3) = 300 (Subsystem Weighting factor	Data qualities Age 3 3 3 High)	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 3 Life cycle Life cycle Raw mate Packaging	2 Reproducii 3 3 3 3 3 Stage (subs Contributic 60% 21% 15%	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3: Packaged product to DQA for system 60(3) + 21(3) + 15(3) + Key	Source of data for of Manufacturer Manufacturer Manufacturer **Subsystem** **Weighting factor Data quality for processors of the state of the stat	Data qualities Age 3 3 3 High)	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 Life cycle Life cycle Raw mate Packaging Manufactt Waste ma	Reproducii 3 3 3 3 Stage (subs Contributio 60% 21% 15% 3%	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3
Material Barley malt (40 t truck Primary packaging (3: Packaged product to DQA for system 60(3) + 21(3) + 15(3) + Key	Source of data for of Manufacturer Manufacturer Manufacturer + 3(3) + 1(3) = 300 (Subsystem Weighting factor	Data qualities Age 3 3 3 High)	2 2 ty for distant Geography 2	3 2 2 nce 3	2 Completer 3 3 3 3 Life cycle Life cycle Raw mate Packaging	Reproducii 3 3 3 3 Stage (subs Contributio 60% 21% 15% 3%	29 26 DQA for al 29 29 29	High High Qualitative High High	PE (2010) PE (2010) Source of LCI data PE (2010) PE (2010) PE (2010)	LCI data q 2 Age 3 3 3	2 2 uality	3 3 Source 3 3	3 3	3 3 3	29 29 DQA for L0 29 29	High High Qualitative High High	High High Subsyster Process E High High High	3 3 3 m DQA DQA 3 3 3	3

Table S7 Beer in gl	ass bottles																		
Raw materials																			
			ty for amou							LCC data	quality								
Dani arata dala	0	2	1	3	2	2	IDO A 6		Source of LCI data	2	Geography	3	2	2	DOA 6 I	0	Process D	20.4	
Raw materials	Source of data for	Age	Geograph	ySource	Complete	Reproduci				Age	Geography	Source	Completer	Reproduci		Medium		_	4
Light fuel oil Water	Manufacturer Manufacturer	3	2	3	3	3	29 29	High High	OECD (2007) United Utilities (2010)	3	2	1	1	1	12 16	Medium		2	
Sodium hydroxide (5		3	2	3	3	3	29	High	IChemE (2002)	3	1	1	1	1	14	Medium		2	
Phosphoric acid (75%		3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium		2	-
Sulphuric acid (63%	Manufacturer	3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium		2	
Carbon dioxide, liquid		3	2	3	3	3	29	High	Confidential (2009)	3	1	1	1	1	14	Medium		2	
Barley	Manufacturer	3	2	3	3	3	29	High	Indexmundi (2011)	3	1	1	1	1	14	Medium		2	
Water (barley produc		3	2	3	3	3	29	High	United Utilities (2010)	3	3	1	1	1	16	Medium		2	
()	(2000)							g	(2010)										
																			2
Packaging																	Subsyster	n DQA	Medium (
Packaging		Data quali	ty for amou	ınt						LCC data	quality								-
		2	1	3	2	2				2	1	3	2	2					
Primary packaging ty	Source of data for	Age	Geograph	Source		Reproduci	DQA for a	r Qualitative	Source of LCI data	Age	Geography	Source	Completer	Reproduci	DQA for L	Qualitative	Process D	QA	
Bottle glass, green	Manufacturer	3	2	3	3	3	29	High	Aliexpress (2010)/WRA	3	1	1	1	1	14	Medium	Medium	2	1
Steel	Manufacturer	3	2	3	3	3	29	High	LME (2011)	3	1	1	1	1	14	Medium	Medium	2	
Paperboard	Manufacturer	3	2	3	3	3	29	High	WRAP (2011)	3	3	1	1	1	16	Medium	Medium	2	2
·																	Subsyster	n DQA	Medium (
Manufacturing																			
		Data quali	ty for amou							LCC data	quality								
		2	1	3	2	2				2	1	3	2	2					_
Electricity	Source of data for		Geograph	ySource	 	Reproduci			Source of LCI data	Age	Geography	Source	Completer	Reproduci			Process D	_	4
Electricity (UK grid, r	Manufacturer	3	2	3	3	3	29	High	Electricityprices.org.uk	(3	3	1	1	1	16	Medium	Medium	2	
																	Cubayatay	- DOA	Madium (
Waste managemen	<u> </u>																Subsyster	II DQA	Medium (
waste managemen		Data quali	ty for amou	ınt						LCC data	quality								
		2	1	3	2	2				2	1	3	2	2					
Waste	Source of data for	Age	Geograph	Source			DQA for a	r Qualitative	Source of LCI data	Age	Geography		Completer	Reproduci	DQA for L	Qualitative	Process D	QA	
Wastewater (to waste		3	2	3	3	3	29	High	Scottish Water (201)	3	3	1	1	1	16	Medium		2	1
Paperboard (to landfi		3	2	3	3	3	29	High	WRAP (2010)	3	3	1	1	1	16	Medium		2	
Glass (to landfill)	Manufacturer	3	2	3	3	3	29	High	WRAP (2010)	3	3	1	1	1	16	Medium	Medium	2	
Steel (to landfill)	Manufacturer	3	2	3	3	3	29	High	WRAP (2010)	3	3	1	1	1	16	Medium	Medium	2	
																			2
																	Subsyster	n DQA	Medium
Note: Transport costs	are assumed to b	e included	in the mate	rial costs t	herefore Tra	nsport has	not been c	onsidered a	as a separate life cycle s	stage in the	LCC analy	sis.							
																	-		-
DQA for system			-			-				-						-	-		-
55(2) + 26(2) + 14(2)	+ 5(2) = 200 (Modi	um)																	
33(2) + 20(2) + 14(2)	+ 3(2) = 200 (IVIEUI	uiii)			Life cycle	stane (sub	system) co	ntribution to	total environmental imp	nacts									
Key						Contribution			total chimolimontal imp	Juoto									
,	Subsystem				Raw mate														
	Weighting factor				Packaging			İ											+
	Data quality for pr	ncess		1	Manufactu														
	Data quality for su				Waste ma														

Table CO Beer in al											Т								
Table S8 Beer in al Raw materials	iminium cans									-									
Raw materials		Data avali	ity for amou	4						LCC data	au alitu								
		2	1 101 amou	3	2	2				2		3	2	2					
Raw materials	Source of data for	Age	Geography				il DOA for a	Qualitative	Source of LCI data	Age	Geography		Completen		DOA for LO	Qualitative	Process [OOA	
Light fuel oil	Manufacturer	3	2	3	3	3	29	High	OECD (2007)	2	1	1	1	1	12	Medium		2	
Water	Manufacturer	3	2	3	3	3	29	High	United Utilities (2010)	3	3	1	1	1	16	Medium	Medium	2	
Sodium hydroxide (50		3	2	3	3	3	29	High	IChemE (2002)	3	1	1	1	1	14	Medium	Medium	2	
Phosphoric acid (75%		3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium	Medium	2	
Sulphuric acid (63% i		3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium	Medium	2	
Carbon dioxide, liquid		3	2	3	3	3	29	High	Confidential (2009)	3	1	1	1	1	14	Medium	Medium	2	
Barlev	Manufacturer	3	2	3	3	3	29	High	Indexmundi (2011)	3	1	1	1	1	14	Medium	Medium	2	
Water (barley product	Ecoinvent (2010)	3	2	3	3	3	29	High	United Utilities (2010)	3	3	1	1	1	16	Medium	Medium	2	
(*** • • • • • • • • • • • • • • • • • •								, , , , , , , , , , , , , , , , , , ,	, , , , , , , , , , , , , , , , , , , ,										
																			2
																	Subsyste	m DQA	Medium (2
Packaging																			
		Data quali	ity for amou	int						LCC data	quality								
		2	1	3	2	2				2	1	3	2	2					
Primary packaging ty	Source of data for	Age	Geography	Source	Complete	Reproduc	it DQA for a	Qualitative	Source of LCI data	Age	Geography	Source	Completen	Reproducil	DQA for LO	Qualitative	Process [DQA	
Aluminium can	CCaLC (2010)	3	3	2	3	3	27	High	LME (2011)/Letsrecycle	3	1	1	1	1	14	Medium	Medium	2	
	` ′								, , , ,										
																			2
																	Subsyste	m DQA	Medium (2
Manufacturing																			
Ţ.		Data quali	ity for amou	int						LCC data	quality								
		2	1	3	2	2				2	1	3	2	2					
Electricity	Source of data for	Age	Geography	Source	Complete	Reproduc	it DQA for a	Qualitative	Source of LCI data	Age	Geography	Source	Completen	Reproducil	DQA for LO	Qualitative	Process [DQA	
Electricity (UK grid, m	Manufacturer	3	2	3	3	3	29	High	Electricityprices.org.uk	3	3	1	1	1	16	Medium	Medium	2	
											1								2
																	Subsyste	m DQA	Medium (2
Waste management																			,
		Data quali	ity for amou	ınt						LCC data	quality								
				_									1.	2					
		2	1	3	2	2				2	1	3	2	2					
Waste	Source of data for	-	1 Geography				it DQA for a	Qualitative	Source of LCI data	Age	1 Geography		2 Completen		DQA for LO	Qualitative	Process [DQA	
Waste Wastewater (to waste		-	Geography 2				DQA for a	Qualitative							DQA for L0	Qualitative Medium		DQA 2	
	Manufacturer	-	Geography 2 2						Source of LCI data	Age							Medium	_	
Wastewater (to waste	Manufacturer	-	Geography 2 2				29	High	Source of LCI data Scottish Water (201)	Age 3					16	Medium	Medium	2	
Wastewater (to waste	Manufacturer	-	Geography 2 2				29	High	Source of LCI data Scottish Water (201)	Age 3					16	Medium	Medium	2	
Wastewater (to waste	Manufacturer	-	Geography 2 2				29	High	Source of LCI data Scottish Water (201)	Age 3					16	Medium	Medium	2	2
Wastewater (to waste	Manufacturer	-	Geography 2 2				29	High	Source of LCI data Scottish Water (201)	Age 3					16	Medium	Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill)	Manufacturer Literature	Age 3 3	2 2	Source 3 2	Complete 3 3	Reproduci 3 3	29 26	High High	Source of LCI data Scottish Water (201)	Age 3 3	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (:
Wastewater (to waste Aluminium (to landfill)	Manufacturer Literature	Age 3 3	2 2	Source 3 2	Complete 3 3	Reproduci 3 3	29 26	High High	Scource of LCI data Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill)	Manufacturer Literature	Age 3 3	2 2	Source 3 2	Complete 3 3	Reproduci 3 3	29 26	High High	Scource of LCI data Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill)	Manufacturer Literature	Age 3 3	2 2	Source 3 2	Complete 3 3	Reproduci 3 3	29 26	High High	Scource of LCI data Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill) Note: Transport costs	Manufacturer Literature	Age 3 3 se included in	2 2	Source 3 2	Complete 3 3 herefore Tra	n Reproduci 3 3 3	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system	Manufacturer Literature	Age 3 3 se included in	2 2	Source 3 2	Complete 3 3 3 herefore Tra	n Reproduci 3 3 3	29 26 not been co	High High onsidered as	Scource of LCI data Scottish Water (201) WRAP (2010)	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (:
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system	Manufacturer Literature	Age 3 3 se included in	2 2	Source 3 2	Complete 3 3 3 herefore Tra	n Reproduci 3 3 3	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system 72(2) + 8(2) + 20(2) +	Manufacturer Literature	Age 3 3 se included in	2 2	Source 3 2	Complete 3 3 3 herefore Tra	n Reproduci 3 3 3 nsport has stage (sub	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system 72(2) + 8(2) + 20(2) +	Manufacturer Literature are assumed to be 1(2) = 202 (Mediur	Age 3 3 se included in	2 2	Source 3 2	Complete 3 3 3 herefore Tra Life cycle Life cycle	n Reproduci 3 3 3 3 nsport has stage (sub Contribution 72%	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system 72(2) + 8(2) + 20(2) +	Manufacturer Literature are assumed to be 1(2) = 202 (Mediur	Age 3 3 3 included in	2 2	Source 3 2	Complete 3 3 3 herefore Tra Life cycle Life cycle Raw mate	n Reproduci 3 3 3 nsport has stage (sub Contribution 772%	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (
Wastewater (to waste Aluminium (to landfill) Note: Transport costs DQA for system 72(2) + 8(2) + 20(2) +	Manufacturer Literature are assumed to be 1(2) = 202 (Mediur Subsystem Weighting factor	Age 3 3 3 initial and a second	2 2	Source 3 2	Complete 3 3 3 herefore Tra Life cycle Life cycle Raw mate Packaging	n Reproduci 3 3 3 3 snsport has stage (sub Contribution 72% 88% 20%	29 26 not been co	High High onsidered as	Source of LCI data Scottish Water (201) WRAP (2010) s a separate life cycle sta	Age 3 3 age in the I	Geography 3 3	Source 1 1			16	Medium	Medium Medium	2 2	2 Medium (2

							_												
Table S9 Beer in st	eel cans																		
Raw materials		D								100 11	100								
		Data quali	ty for amou	int 3	2	2				LCC data		3	2	2					
Raw materials	Source of data fo	Age	Geography				it DQA for a	ar Qualitativ	Source of LCI data	Age	Geography				DQA for L	Qualitative	Process I	DQA	
Light fuel oil	Manufacturer	3	2	3	3	3	29	High	OECD (2007)	2	1	1	1	1	12	Medium	Medium	2	
Water	Manufacturer	3	2	3	3	3	29	High	United Utilities (2010)	3	3	1	1	1	16	Medium	Medium	2	
Sodium hydroxide (5		3	2	3	3	3	29	High	IChemE (2002)	3	1	1	1	1	14	Medium	Medium	2	
Phosphoric acid (75%		3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium	Medium	2	
Sulphuric acid (63%		3	2	3	3	3	29	High	ICIS (2010)	3	1	1	1	1	14	Medium	Medium	2	
Carbon dioxide, liquid		3	2	3	3	3	29	High	Confidential (2009)	3	1	1	1	1	14	Medium	Medium	2	
Barley	Manufacturer	3	2	3	3	3	29	High	Indexmundi (2011)	3	1	1	1	1	14	Medium	Medium	2	
Water (barley produc		3	2	3	3	3	29	High	United Utilities (2010)	3	3	1	1	1	16	Medium	Medium	2	
Trato: (baile) predae	2001110111 (2010)		_						Omitod Otimitod (2010)				1				.v.ou.u	_	
																			2
																	Subsyste	m DOA	Medium (
Packaging																	Oubsyste	III DQA	iviculairi (2
rackaging		Data quali	ty for amou	ınt	-					LCC data	quality		-						
		2	1 101 alliou	3	2	2				2		3	2	2					
Primary packaging ty	u Source of data fo	Ago	Geograph				il DOA for a	or Ouglitative	e Source of LCI data	Age	Geography	_			DOA for L	Qualitative	Process I	DOA	
Steel can	CCaLC (2010)	Age	Geography	youice	3	n Reproduc	30	High	LME (2011)/Letsrecycl		deography	Jource	Completer	reproduct	14	Medium	Medium	2	
Aluminium (can ends		2	3	3	3	3	30	High	LME (2011)/Letsrecycl		1	1	1	1	14	Medium	Medium	2	
Aluminium (can ends	s) CCaLC (2010)	3	3	3	3	3	30	nign	LIVIE (2011)/Letsfecycl	83	1	I	1	I	14	iviealum	iviedium	2	
																	0 1 1	DO 4	
													1				Subsyste	m DQA	Medium (2
Manufacturing																			
		Data quali	ty for amou	ınt	1					LCC data			4	_					
		2	1	3	2	2	ulaa			2		3	2	2	daa	da			
Electricity	Source of data fo	Age	Geography	ySource	Completer	Reproduc			Source of LCI data	Age	Geography	Source	Completer	Reproduci		Qualitative			
Electricity (UK grid, r	Manufacturer	3	2	3	3	3	29	High	Electricityprices.org.uk	3	3	1	1	1	16	Medium	Medium	2	
			1																-
																			2
																	Subsyste	em DQA	2 Medium (
Waste managemer																		em DQA	2 Medium (2
Waste managemer		Data quali	ty for amou	ınt						LCC data								em DQA	2 Medium (2
		2	1	3	2	2				2	1	3	2	2			Subsyste		2 Medium (2
Waste managemen		2	ity for amou	3			it DQA for a	ar Qualitativ	e Source of LCI data	_		•			DQA for L	Qualitative	Subsyste		2 Medium (2
	Source of data fo	2	1	3			it DQA for a	ar Qualitativ	Source of LCI data Scottish Water (201)	2	1	•			DQA for L		Subsyste		2 Medium (:
Waste	Source of data fo	2	1	3	Completer					2	1	•				Qualitative	Subsyste Process I	DQA	2 Medium (2
Waste Wastewater (to wast	Source of data fo	2	1	3	Completer 3		29	High	Scottish Water (201)	2	1	•			16	Qualitative Medium	Subsyste Process I Medium	DQA 2	2 Medium (2
Waste Wastewater (to wast	Source of data fo	2	1	3	Completer 3		29	High	Scottish Water (201)	2	1	•			16	Qualitative Medium	Subsyste Process I Medium	DQA 2	2 Medium (:
Waste Wastewater (to wast	Source of data fo	2	1	3	Completer 3		29	High	Scottish Water (201)	2	1	•			16	Qualitative Medium	Subsyste Process I Medium	DQA 2	2 Medium (:
Waste Wastewater (to wast Steel (to landfill)	Source of data fo e Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium	DQA 2 2	2
Waste Wastewater (to wast Steel (to landfill)	Source of data fo e Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast Steel (to landfill)	Source of data fo e Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast Steel (to landfill)	Source of data fo e Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast Steel (to landfill) Note: Transport costs	Source of data fo e Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2 Medium (2
Waste Wastewater (to wast Steel (to landfill) Note: Transport costs	Source of data for Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3	Reproduc 3 3	29 26	High High	Scottish Water (201) WRAP (2010)	Age 3 3	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast: Steel (to landfill)	Source of data for Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3 therefore Tra	Reproduc 3 3 3	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010)	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to waste Steel (to landfill) Note: Transport costs DQA for system 68(2) + 13(2) + 18(2)	Source of data for Manufacturer Literature	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3 therefore Tra	Reproduc 3 3 3 ansport has	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010) as a separate life cycle	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast: Steel (to landfill) Note: Transport costs DQA for system 68(2) + 13(2) + 18(2)	Source of data for the Manufacturer Literature s are assumed to be the source of the source of data for the source of the sourc	Age 3 3	Geography 2 2	Source 3 2	Completer 3 3 therefore Tra Life cycle Life cycle	Reproduc 3 3 3 ansport has stage (sub	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010) as a separate life cycle	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast: Steel (to landfill) Note: Transport costs DQA for system 68(2) + 13(2) + 18(2)	Source of data for the Manufacturer Literature s are assumed to be the source of the source of data for the source of the sourc	Age 3 3 3	Geography 2 2	Source 3 2	Completer 3 3 therefore Tra Life cycle Life cycle Raw mate	Reproduc 3 3 3 ansport has stage (sub Contributi 68%	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010) as a separate life cycle	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast Steel (to landfill) Note: Transport costs	Source of data for the Manufacturer Literature s are assumed to be the source of the source of data for the source of the sourc	Age 3 3 3 see included	Geography 2 2	Source 3 2	Completer 3 3 3 therefore Tra Life cycle Life cycle Raw mate Packaging	Reproduc 3 3 3 ansport has stage (sub Contributi 68% 13%	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010) as a separate life cycle	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2
Waste Wastewater (to wast: Steel (to landfill) Note: Transport costs DQA for system 68(2) + 13(2) + 18(2)	Source of data for the Manufacturer Literature s are assumed to be the source of the source of data for the source of the sourc	Age 3 3 3 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Geography 2 2	Source 3 2	Completer 3 3 therefore Tra Life cycle Life cycle Raw mate	Reproduc 3 3 3 stage (sub Contributi 68% 13% 18%	29 26 s not been	High High considered	Scottish Water (201) WRAP (2010) as a separate life cycle	Age 3 3 stage in the	Geography 3 3	Source 1 1			16	Qualitative Medium	Subsyste Process I Medium Medium	DQA 2 2	2