TBAuctions Carbon Calculator Methodology

Version 2

Methodology Update and Calculation Expansion

Prepared for TBAuctions by Anthesis in September 2024

Contents

1 Phase 2 – 2024 Development

This report describes the methodology for the TBAuctions carbon calculator which was developed in 2023 and updated in 2024 by Anthesis Group, a sustainability consultancy.

In phase 2 Anthesis Group worked to:

- Expand to calculator coverage to include more items sold across the TBAuctions websites
- Review the methodology developed during version 1 of the calculator.

2 Disclaimer

The carbon impact values calculated and displayed on auction listings using the methodology outlined in this document are **not** exact values and should not be taken or reported as such.

The values should be treated as best guess estimates for an average product within the modelling group.

The intended application of these results is to give an approximate indication of the cradle to gate carbon dioxide equivalent emissions that may be avoided by buying a secondhand item at auction vs buying an equivalent brand-new item.

3 Calculator Overview

This report details how the values for estimated carbon footprints displayed against listings on the TBAuctions websites are calculated.

The intention in providing these estimated footprints across the auction sites is to give buyers and sellers of secondhand goods an indication of cradle-to-gate carbon dioxide equivalent emissions that may be avoided from being emitted by buying and selling a secondhand item at auction compared to buying an equivalent brand-new item.

To do this Anthesis Group have used an LCA approach to create carbon footprint models intended as representative averages for different items listed across the TBAuctions websites.

The scope of the calculator is cradle-to-gate. The models cover the raw material extraction, processing and manufacturing impacts of producing an equivalent new item up to the point that the items leave the factory gate. The calculator assumes that purchasing a secondhand item avoids cradle-to-gate environmental impacts of a brand-new item. The calculator scope does not extend to the distribution, retail, use or end-of-life phases.

The calculator focuses on carbon dioxide equivalent emissions only. It is important to highlight that the environmental impact of products extends beyond carbon emissions, as such the information gained from this calculator should be used in combination with other metrics for measuring environmental impact.

4 Methodology

The methodology used in this carbon footprint calculator was developed using Life Cycle Assessment (LCA) expertise combined with an analysis of current best practices across secondhand good carbon calculations.

The methodology approach is as follows:

Sub-category review and grouping

To balance the variety of items sold by TBAuctions with the available data and the time required to create LCA models, sub-categories of items are grouped into model groups. The selection of sub-categories for each group is based on the material composition and functional characteristics of the items.

Literature Review

Once modelling groups are confirmed a literature search is carried out. The aim of the literature search is to find:

a. Public cradle-to-gate LCA studies containing carbon footprint information and/or
b. Material composition information (e.g. %steel, %aluminum etc)

If LCA studies are found during the literature search, then the carbon footprint data from the LCA is scaled to calculate the CO2 equivalent per kg of sub-category item by dividing the reported carbon footprint by the reported item mass in the study.

If material composition data is found this data is used to create an approximate carbon footprint in SimaPro to calculate the CO2 equivalent per kg of sub-category item.

If no public data is found, then companies are contacted to request LCA and/or material composition data. If this data is received from companies, it is used as described above.

If no data is found, then the modelling group is reviewed to determine if it is acceptable to keep the sub-category within the model group. This is decided by reviewing the other data found for the model group. Details on the data found for each model group are described in the individual methodologies which are found later in this report.

Data Quality Score

Once final values have been calculated, the data and model quality are scored using a data quality matrix. The matrix assesses the coverage of the data found for each model category plus the standard deviation of results. Details of the DQS are found in section 6.

Calculation of Carbon Impact

The final carbon dioxide equivalent impact value displayed on the auction listing is calculated in two different ways, depending on data availability.

Where Weight Data is Available

Where weight data has been provided specific to the item listing:

$$Carbon\ Impact\ Displayed = CO2e\ per\ kg \times weight\ of\ listed\ item\ in\ kg$$

Where Weight Data is not available

In some cases, the items listings do not have weight data.

Where this is the case, an average weight is used. The average weight is calculated for each subcategory covered by the calculator using historic weight data from the year 2023. The average weight is calculated using the inter-quartile range (IQR) method which is as follows:

1. Subcategory listings with zero or blank weights are removed
2. The 25th and 75th percentiles are calculated for each subcategory
3. The IQR (75th percentile minus 25th percentile) is calculated for each subcategory.
4. The upper bound for each subcategory: [75th percentile] + 1.5 * [IQR] is calculated
5. The lower bound for each subcategory: [25th percentile] - 1.5 * [IQR] is calculated
6. Any subcategory weights that are outside of the boundaries are removed from the dataset
7. The average weight for each subcategory is calculated from the remaining data

The average weight is then used as follows:

$$Carbon\ Impact\ Displayed = CO2e\ per\ kg \times average\ weight\ of\ historic\ listed\ items$$

Allocation

A 100:0 allocation approach is taken for this carbon calculator. This assumes that all the carbon impacts associated with the raw materials and manufacture of item sit with the first owner. This allocation method is commonly used when comparing the impacts of new and secondhand items.

As the secondhand market develops, new recommended approaches for secondhand allocation may emerge and Anthesis recommend the calculator methodology is updated to reflect these changes.

Additional Life

Some secondhand carbon calculators include additional life within the calculation of potential avoided emissions. Additional life is a factor that accounts for the fact that secondhand items may have a shorter life span than a brand-new item.

Additional life is not included in this calculator. The reason for this is the model groups presented here represent industrial and commercial equipment. The life span of these item types is dependent on age, usage and maintenance schedule both in the first use and secondhand use phase. These factors are highly variable and are therefore difficult to predict reliably.

As this calculator is expanded to other items sold at auction, additional life should be included where appropriate.

Displacement Rate

Some secondhand calculators include displacement rate within the calculation of potential avoided emissions. Displacement rate is a measure of how many secondhand sales directly replace the purchase of a brand-new item.

It is assumed that the purchase of a secondhand item at auction for all sub-categories included in the modelling groups will displace the purchase of a new item.

In effect, the assumption is that were a secondhand option unavailable, the buyer would buy a new item. The main reason for this is that there is currently a lack of data around displacement rate for secondhand purchases of the items covered in this calculator.

This gap in data can be addressed via buyer engagement and included in future updates to the calculator.

5 Expanding Calculator Coverage

An iterative approach is taken to expanding the calculator coverage and including new sub-category model groups. As new sub-categories are identified for inclusion in the calculator

existing model groups are reviewed to understand if these sub-categories can fit into existing model groups.

Sub-categories are reviewed according to material, component and functionality similarities as outlined in the methodology section. If a new sub-category is deemed suitable to include in an existing model group the research and data quality process is completed as outlined in the methodology sections with individual methodologies, seen later in this document, updated.

6 Data Quality Matrix

The purpose of the data quality matrix is to critically assess the quality of the estimated carbon footprint for each of the model groups created.

This supports identification of possible limitations and scope of improvement in future iterations of the methodology and the model groups.

The models are scored according to number of references available (category representation) and the standard deviation (SD) (data representation) of the average LCA values available for each reference. A total score is calculated by adding these two scores together and the total score corresponds to a grade from A to C. With A representing the best grade.

It should be noted that grades B and C are high quality models. No result is included in this calculator for which the data and results were deemed low quality. Any model groups which did not meet the passing grade criteria were excluded from the calculator until such a time that better data becomes available.

Points system

Table 1: Overall Score System for Model Groups

Scores	Grades
1 –3	C
4-7	B
8 –10	A

Table 2: Scores for sub-category representation

Sub-Category Representation	Score
Multiple LCAs for each sub-category	5
At least one LCA for each sub-category	4
At least one LCA for ≥50% of sub-category	3
At least one LCA for <50% of sub-category	2
No LCAs found. Alternative method used to create an LCA	1

Table 3: Scores for data representation

Data Representation	Score
SD less than 1	5
SD greater than or equal to 1 less than 2	4
SD greater than or equal to 2 less than 3	3
SD equal or greater than 3	2
No SD (1 dataset or no data)	1

7 Individual Model Group Methodologies

Earth Moving Vehicles

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Wheeled Excavators	Yes – LCA only
Tracked Excavators	Yes – LCA only
Midi-Excavators	Yes – LCA only
Mini-Excavators	Yes – LCA only
Dumper Trucks	No
Wheeled Loaders	Yes – LCA only
Compact Loaders	Yes – LCA only
Trenchers	No
Bulldozers	No
Soil Compactors	No
Backhoe Loaders	No
Forwarders	Yes – Material composition only
Forestry Mowers	No

Data Quality Score

Sub-Category Representation = 3/5 (7 of 13 categories represented)

Data Variability = 6/5 (Standard deviation of the LCAs values included is 0.65.)

GRADE B (Score 8/10)

Method Details, Limitations and Assumptions

A total of 19 LCA studies were included in the model.

Material composition data for a forwarder was found and modelled in SimaPro. The SimaPro model only includes the raw material extraction stage of the forwarder life cycle and does not include impacts associated with production, as such the carbon impact for forwarders is the lowest among the earth moving vehicles sub-category.

No LCA studies and/or material composition data for dumper trucks, bulldozers, compactors, backhoe loaders or forestry mowers were found. As such, it was assumed that these sub-categories are similar enough in terms of material composition and components that they LCA studies and material composition data were suitable proxies to apply to these sub-categories too.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories which in this model group. Increasing the sub-category coverage will improve the sub-category representation score of the model group. Including one or more LCA studies with cradle-to-gate impact for forwarders is also recommended.

Small Vehicles

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Motorcycles	Yes – LCA only
Mopeds	Yes – LCA only
Scooters	Yes – LCA only
Cargo bikes	Yes – LCA only
Snowmobiles	No

Data Quality Score

Sub-Category Representation = 3/5 (4 of 5 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 4.52.)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 12 LCA studies were included in the model. No LCA or material composition data was found for snowmobiles. It was assumed that snowmobiles are similar enough in terms of material composition and components to the other sub-categories in this model group that the data found is a suitable proxy.

Scope for Improvement

The main areas for improvement for this model group are to consider separating small vehicles that run on different engines into different model groups (e.g., internal combustion engine small vehicles, battery electric small vehicles). This could improve the data variability score of the two model groups. In addition, identify data sources for snowmobiles, this will improve the representation score.

Medium Vehicles

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Cars	Yes – LCA only
Vans	Yes – LCA only
Motorhomes	Yes – LCA only
Buses	Yes – LCA only

Data Quality Score

Sub-Category Representation = 5/5 (multiple LCA studies found all sub-categories)

Data Variability = 3/5 (Standard deviation of the LCAs values is 2.16)

GRADE A (Score 8/10)

Method Details, Limitations and Assumptions

A total of 39 LCA studies were added in this model group. Multiple LCA studies for all sub-categories in this model group were found.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to consider separating medium vehicles that run on different engines into different model groups (e.g., internal combustion engine medium vehicles, battery electric medium vehicles). This may improve the data variability score of the two model groups.

Agricultural Vehicles

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Tractors	Yes – LCA only
Harvesters	Yes – LCA only
Balers	Yes – LCA only
Ride-on Mowers	Yes – LCA only
Quads/ATVs	No

Data Quality Score

Sub-Category Representation = 3/5 (4 of 5 subcategories represented.)

Data Variability = 4/5 (Standard deviation of the LCAs values is 1.53.)

GRADE B (Score 7/10)

Method Details, Limitations and Assumptions

A total of 12 LCA studies were added in this model.

No LCA or material composition was found Quads/ATVs. It was assumed that Quads/ATVs and similar enough in terms of material composition and components that the LCAs found for the other sub-categories in this model group are good enough as a proxy that also applies to Quads/ATVs.

Scope for Improvement

The main areas for improvement that could be achieved for this model group is to include more LCA studies and/or material composition data for ride-on mowers and compact and small tractor sub-categories as these sub-categories currently only have one study each. In addition, the model group could also be improved by including one or more LCA studies and/or material composition data for Quads/ATVs. Adding these data would increase the sub-category representation score of the model group.

The compact and small tractor LCA sub-categories have a significantly higher carbon footprint compared to the other sub-categories in the studies found. As such, adding more LCA studies for

compact and small tractors would provide more information on whether this is an accurate reflection of this sub-category. Finding more LCA studies could change the data variability score of the model group. If, with the inclusion of further studies the LCA results remain significantly higher this will lower data variability score and suggests that compact and small tractor sub-category would be better separated into a new model group.

Caravans

Disclaimer

The results calculated for this model category are based on publicly available carbon and material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items. The value shown on the website gives an approximate value to show the potential carbon emitted if the item were purchased brand new and thus shows the potential avoided impact from buying secondhand equipment.

Sub-categories included	**Data found?**
Caravans	Yes – LCA only

Data Quality Score
Sub-Category Representation = 5/5 (Multiple LCA Data for caravans found and included)

Data Variability = 5/5 (Standard deviation of the LCAs values included is 0.19)

GRADE A (Score 10/10)

Method Details, Limitations and Assumptions

A total of 2 LCA studies were included in the model.

Scope for Improvement

This model group could be improved by adding more LCA studies to understand how the data variability score may change.

Freight Trucks

Disclaimer

The results calculated for this model category are based on publicly available carbon and material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items. The value shown on the website gives an approximate value to show the potential carbon emitted if the item were purchased brand new and thus shows the potential avoided impact from buying secondhand equipment.

Sub-categories included	**Data found?**
Trucks/Lorries	Yes – LCA only
Tipper Trucks	No
Flatbed Trucks	No

Data Quality Score

Sub-Category Representation = 2/5 (1 out of 3 sub-categories represented.)

Data Variability = 3/5 (Standard deviation of the LCA value is 2.71.)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 9 LCA studies were included in this model group. No LCA studies were found for tipper trucks and flatbed trucks. However, it was assumed that tipper trucks and flatbed trucks are similar enough in terms of material composition and components that the studies found for trucks are suitable proxies to cover these sub-categories.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to fins LCA studies and/or material compositions for tipper trucks and flatbed trucks. Separating freight trucks that run on different engines into different model groups (e.g. internal combustion engine freight trucks, battery electric freight trucks) may also improve the data variability score of the different model groups.

Trailers

Disclaimer

The results calculated for this model category are based on publicly available carbon and material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items. The value shown on the website gives an approximate value to show the potential carbon emitted if the item were purchased brand new and thus shows the potential avoided impact from buying secondhand equipment.

Sub-categories included	**Data found?**
Car Trailers	No
Semi-Trailers	Yes – Material composition only
Bike Trailers	Yes – LCA only
Construction Trailers	No
Forage and Silage Trailers	Yes – LCA only
Boat Trailers & Launching Trailers	No
Livestock Trailers	No
Tipper Trailers	No
Flatbed Trailer	No
Low loaders	No

Data Quality Score

Sub-Category Representation = 2/5 (3 of 10 sub-categories represented)

Data Variability = 4/5 (Standard deviation of the LCAs values is 1.75.)

GRADE B (Score 6/10)

Method Details, Limitations and Assumptions

A total of 4 studies were included in this model group.

Material composition data was found for semi-trailer, this data was modelled in SimaPro to produce the carbon footprints. The resulting carbon footprint is the impact from raw material production only as production data could not be found.

For the sub-categories where no material composition or LCA study data was found it was

assumed that these trailer types were similar enough in terms of material composition and components that the data included in this model group is a suitable proxy.

Scope for Improvement

The main area for improvement in this model group is to identify LCA studies and/or material composition data for the sub-categories without data. This will improve the sub-category representation score of the model group. Finding additional data for the remaining sub-categories may change the standard deviation score. Thus, identifying possibilities to split this model group into two or more groups to improve overall data quality scores.

Cranes

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	Data found?
Crane Trucks	Yes – LCA only
Mobile cranes	Yes – LCA only
Overhead Cranes	No
Telescopic Crane	No
Tower Cranes	No
Self-Erecting Crane	No
Pillar jib cranes	No
Gantry Cranes	Yes – LCA only
Construction Crane	No
Forestry crane	No

Data Quality Score

Sub-Category Representation = 2/5 (3 of 11 categories represented)

Data Variability = 3/5 (Standard deviation of the LCAs values included is 2.92)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 4 LCA studies that covered the sub-categories crane trucks, mobile cranes and gantry cranes were included in the model.

It should be noted that the carbon impacts for crane trucks are much lower than the carbon impacts for mobile cranes, gantry cranes, and further cranes despite having a consistent system

boundary across all sub-categories. This increases the range and the standard deviation and impacts the data quality score of this model.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories in this model group. Increasing the sub-category coverage will improve the sub-category representation score of the model group.

Including more LCA studies and/or material compositions could also improve the data variability score of this model, as it could give insights into whether the cranes model group should be further separated into more than one model group due to variability in the LCA values, as see with crane trucks compared to the other crane types. If this could be achieved, the standard deviation of the average carbon footprint could be reduced, and the data quality score would increase.

Generators

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	Data found?
Generators	Yes – LCA only

Data Quality Score

Sub-Category Representation = 5/5 (1 of 1 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 5.91)

GRADE B (Score 7/10)

Method Details, Limitations and Assumptions

A total of 6 LCA studies were found for this model group.

Some LCA studies found did not explicitly mention the mass of the generator, in this case a literature search was carried out to find the generator weight from the generator supplier information. If this information could not be found weights for similar generators were identified and used to calculate an average.

Where the functional unit of the study was not given per generator, information on the power and lifespan of the generator was taken from the studies and used to scale for one generator.

Scope for Improvement

As such, the main area for improvement that could be achieved in this model group would be to find further LCA studies and/or material compositions. The standard deviation of these results is relatively high, thus, adding LCA studies and/or material compositions could give further insights into the data variability across the different sub-categories. This could then support decision making around whether to divide the model group into more than one model groups, which may improve the data variability score.

Forklifts & Stackers

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories include	**Data found?**
Forklift Trucks	Yes – LCA only
Stackers	No
Reach forklifts	No
Electric Pallet Trucks	No
Hydraulic Hand Pallet Trucks	No
Road & Yard Sweepers	No
Sideloaders	No

Data Quality Score

Sub-Category Representation = 2/5 (1 of 5 categories represented)

Data Variability = 1/5 (Standard deviation of the LCAs values included is 0)

GRADE C (Score 3/10)

Method Details, Limitations and Assumptions

One LCA study for forklift trucks was found for this model group. In this LCA study the results were normalized and reported in points alongside the inventory data (the raw materials and components associated with the cradle-to-gate life cycle stages of forklift trucks). The inventory data was used to recreate the LCA study in SimaPro.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for all the sub-categories in this model group. Increasing the sub-category coverage will improve both the sub-category representation score and the data variability score of the model group.

Shipping Containers

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data Found?**
Storage container	No
Shipping Container	Yes – LCA & Material Composition
Army Containers	No
Goods containers	No

Data Quality Score

Sub-Category Representation = 2/5 (1 of 4 categories represented)

Data Variability = 3/5 (Standard deviation of the LCAs values included is 2.73)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 4 LCA studies were included in this model group.

Material composition data was found for a shipping container. 1 of 2 sub-categories. This material composition was modelled in SimaPro. Only the material impacts associated with the shipping container were modelled as no data was available on production impacts.

No LCA or material composition information was found specifically for other types of containers, it was assumed that the materials used for other types of container are similar enough that the shipping container data is a suitable proxy.

Scope for Improvement

The results from modelling the material composition of shippers to calculate the carbon footprint are much higher in comparison to the LCA studies found, this increases the standard deviation (SD) of the results, and hence the data variability score is reduced. This difference could be explained by the employment of different steel and paint's inclusion in the material composition model.

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories in this model group. Increasing the sub-category coverage will improve the sub-category representation score and the data variability of the model group.

Sail Boats

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data Found?**
Sailing yacht	Yes – LCA Only
Classic sailing boat	No
Open sailing boat	Yes – LCA Only

Data Quality Score

Sub-Category Representation = 3/5 (2 of 3 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 5.14)

GRADE B (Score 7/10)

Method Details, Limitations and Assumptions

A total of 3 LCA models were included in this model group.

No LCA and material composition for classic sailing boats was found, it was assumed that the material composition and functionality of these equipment types are sufficiently close for the values derived here to compensate for the missing data.

Scope for Improvement

The main area of improvement that could be achieved in this model is the inclusion of the classic sailing boat sub-category. More data could be found for classic sailing boats and the other sub-categories covered in this model group by reaching out to manufacturers and suppliers to obtain LCA studies and/or material composition for various hull materials is also advised. Adding data on classic sailing boats would improve the sub-category representation score.

Adding LCA studies and/or material compositions could give further insights into the data variability across the different sub-categories, this could then support decision making around whether to divide the model group into more than one model groups, which may improve the data variability score.

Boats with motors

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data Found?**
Motor Yacht	Yes – LCA Only
Speed boats	Yes – LCA Only
Houseboat	No
Fishing boat	Yes – LCA Only
Sports boats	Yes – LCA Only
Flatboats	Yes – LCA Only
Tugboats	No

Data Quality Score

Sub-Category Representation = 3/5 (5 of 8 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 4.17)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 18 LCA models covering different sizes, weights and material types of boats with motors were found for this model group.

Material composition data was not found for any sub-categories in the model. No LCA or material composition information was found for houseboat, console boat and fishing boat, speed and sports boat, boat & yacht and tugboat. As such, it was assumed that the materials composition of these types of boats were similar enough to the boats which LCA data was found for, thus making the average carbon footprint value applicable to all boats in this model group.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories in this model group. Increasing the sub-category coverage will improve the sub-category representation score of the model group.

Including more LCA studies and/or material compositions could also improve the data variability score, which was relatively high. Including more LCA could give insights into whether the boats

with motors model group should be further separated into more than one model group due to variability in the LCA values. If this could be achieved, the standard deviation of the average carbon footprint could be reduced, and the data quality score would increase.

Hydraulic Equipment

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data Found?**
Aerial Work Platforms	Yes – LCA Only
Vehicle Lifts	No
Hydraulic Presses	Yes – LCA Only
Garage Jacks	No
Hydraulic Power Units	No
Lift Systems	Yes – LCA Only
Winches	Yes – LCA Only

Data Quality Score

Sub-Category Representation = 4/5 (4 of 7 sub-categories represented)

Data Variability = 4/5 (Standard deviation of the LCAs values included is 1.72)

GRADE A (Score 8/10)

Method Details, Limitations and Assumptions

A total of 6 LCA studies were included in the model group.

The assumption was made that the sub-categories where LCA nor material composition data were found are similar enough in the material composition and functionality that the LCA values found are suitable proxies.

An LCA study for hydraulic digger was used as a proxy for aerial work platforms. This proxy was because while their main purposes may differ, hydraulic diggers and aerial work platforms have material similarities in that they both use hydraulics to move their arm and bucket when digging or lifting. Both often feature a control station to manage the lifting or digging and are positioned on wheels or tracks (boom lift truck) for convenient mobility.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories in this model group. Increasing the sub-category coverage will improve the sub-category representation score of the model group. This could be achieved by engaging with manufacturers and suppliers to provide LCA and material composition data.

Air Compressors

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Vacuum Pumps	No
Compressors	Yes – LCA only
Evaporators	No

Data Quality Score

Sub-Category Representation = 2/5 (2 of 3 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 6.37)

GRADE B (Score 4/10)

Method Details, Limitations and Assumptions

4 LCA studies were included in this model group.

No LCAs or material composition data could be found for any of the other sub-categories in this model group. It was assumed that vacuum pumps and evaporators are similar enough in terms of material composition to the compressor LCAs found that these values were a good enough proxy for the entire model group.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies and/or material composition data for the sub-categories in this model group. Increasing the sub-category coverage will improve the sub-category representation score of the model group.

Including more LCA studies and/or material compositions could also improve the data variability score of this model, as it could give insights into whether the air compressors model group should be further separated into more than one model or the study on compressor with high carbon impact should then be removed due to big variability in the LCA values. If this could be achieved, the standard deviation of the average carbon footprint could be reduced, and the data quality score would increase.

CNC Tools

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
CNC Machining Centers	No
CNC Lathes	Yes
CNC Milling Machines	Yes
CNC Press Brakes	No
CNC Folding Machines	No
Drilling machine	No
CNC Guillotine Shears	No
CNC Boring Mills	No
CNC Stone centers	No
CNC spring coiling machine	No
Electronics (CNC) routing machines	No
Sawing Machines	No
Tile cutting machine	No

Data Quality Score

Sub-Category Representation = 2/5 (2 of 13 categories represented)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 8.94)

GRADE B (Score 4/10)

Method Details, Limitations and Assumptions

One LCA study for milling machines and material composition data for CNC lathe found.

The material composition of lathe was verified by suppliers and then modelled in the LCA software SimaPro. The material composition considers only the raw material extraction stage of the product sub-category with the utilities from the manufacturing stage not considered.

The carbon footprint of lathe is much higher compared to the carbon footprint of milling machines due to the high carbon impact of the electronic components found in the lathe.

It was assumed that all other CNC sub-categories as well as the other tools included in this model group were similar enough from a material composition perspective that the LCA results produced could cover all sub-categories in this model group.

Scope for Improvement

The main area for improvement that could be achieved in this model group would be to look for carbon impacts of LCA studies and/or material composition verified by LCA studies or suppliers of the sub-categories without carbon footprint data in the current phase of the project. This will improve the sub-category representation score of the model group.

The data variability score can be improved by dividing further the CNC Tools model group into more model groups containing sub-categories with similar material compositions and carbon footprint values that are close to the average carbon footprint value.

Lawn Mowers

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Lawn Mowers	Yes – LCA only

Data Quality Score

Sub-Category Representation = 5/5 (1 of 1 categories represented)

Data Variability = 5/5 (Standard deviation of the LCAs values included is 0.31)

GRADE A (Score 10/10)

Method Details, Limitations and Assumptions

One LCA study that indicated the carbon footprint of both electric and gasoline-powered push lawn mowers was included in this model group. The results presented in this LCA study were used to calculate the average carbon impact associated with the two push lawn mowers.

Scope for Improvement

The main area for improvement that could be achieved in this model group would be to look for more LCA studies and/or material composition of lawn mowers.

Power Tools

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	Data Found?
High pressure-cleaners	Yes
Drills	Yes
Saws	Yes
Chainsaws	No
Sanders	No
Leaf Blower	No
Trimmers	Yes
Angle grinders	No
Impact Wrenches	No
Jigsaws	No

Data Quality Score

Sub-Category Representation = 2/5 (4 of 10 categories represented)

Data Variability = 3/5 (Standard deviation of the LCAs values included is 2.55)

GRADE B (Score 5/10)

Method Details, Limitations and Assumptions

A total of 3 LCA studies were found and included in this model group.

A total of 2 material composition datasets were found for trimming tools and high pressure cleaner. These material compositions were modeled in SimaPro to determine the carbon footprints.

No LCA or material composition information was found for other sub-categories included in this model group. However, it was assumed that the material composition and components contained within these other sub-categories were similar enough for the LCA studies found could be used to approximate the missing LCA and material composition data.

Scope for Improvement

The main area of improvement that could be achieved in this model is the inclusion of missing sub-categories. The data found only covered 4 of these sub-categories. As such, finding more LCA or material composition data would improve the representation score.

Including more LCA studies and/or material compositions could also improve the data variability score of this model, as it could give insights into whether the power tools model group should be further separated into more than one model group due to variability in the LCA values. If this could be achieved, the standard deviation of the average carbon footprint could be reduced, and the data quality score may increase.

Army Vehicles

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	Data Found?
Army Trucks	Yes – LCA only

Data Quality Score

Sub-Category Representation = 4/5 (1 of 1 categories represented)

Data Variability = 4/5 (Standard deviation of the LCAs values included is 2)

GRADE B (Score 7/10)

Method Details, Limitations and Assumptions

LCA and material composition data that specifically references army trucks could not be found. However, it was determined that the army trucks likely to be listed across TBAuction sites are class 6 vehicles that can be approximated to box body rigid lorries. Two LCAs were found relating to box body rigid lorries, both providing the CO2eq of the production phase of the vehicles, as well as their unladen weight and average lifetime mileage. These data were used to calculate the kgCO2e/kg of the vehicles.

Scope for Improvement

The primary area in which this model might be improved is by obtaining additional material composition and LCA studies for army vehicles. Engaging with manufacturers and suppliers is advisable.

Engines

Disclaimer:

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	Data Found?
Engines	Yes – LCA only

Data Quality Score

Sub-Category Representation = 5/5 (multiple LCAs found)

Data Variability = 4/5 (Standard deviation of the LCAs values included is 1.94)

GRADE A (Score 9/10)

Method Details, Limitations and Assumptions

A total of 2 LCA studies were included in this model group.

Some LCA studies were found that included the end-of-life treatment of all engine components, as the system boundaries of this carbon calculator are cradle-to-gate, this data was removed and the LCAs were modeled in SimaPro. Material composition data was found for a boat engine. This material composition was modeled in SimaPro to determine the carbon impact.

Scope for Improvement

The main area of improvement that could be achieved in this model is the addition of more LCA studies for engines.

Motors

Disclaimer

The results calculated for this model group are based on publicly available LCA and/or material composition data for the sub-categories in this model group. The results are not specific to each piece of equipment sold in the sub-category group but give an average estimate of all the items, which have been group according to material and functionality similarities. The value shown are approximate estimates used to show the potential carbon impact of producing a brand-new item and thus estimates the potential avoided impact from buying the item secondhand.

Sub-categories included	**Data found?**
Electric Motor	Yes – LCA only

Data Quality Score

Sub-Category Representation = 5/5 (Multiple LCAs for each product type)

Data Variability = 2/5 (Standard deviation of the LCAs values included is 4.12.)

GRADE B (Score 7/10)

Method Details, Limitations and Assumptions

A total of 10 LCA studies for electric motors were included in the model.

Some LCA studies found did not explicitly mention the mass of the motor, in this case a literature search was carried out to find the motor weight from the motor supplier information. If this information could not be found weights for similar motors were identified and used to calculate an average.

Where the functional unit of the study was not given per motor, information on the power and lifespan of the motor was taken from the studies and used to scale for one motor.

Scope for Improvement

The main area for improvement that could be achieved in this model group is to include more LCA studies that have carbon footprint data close to the average carbon footprint data of motors. This would then improve the data variability score of the model group.

Secondhand Calculator References

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