IN-DEPTH

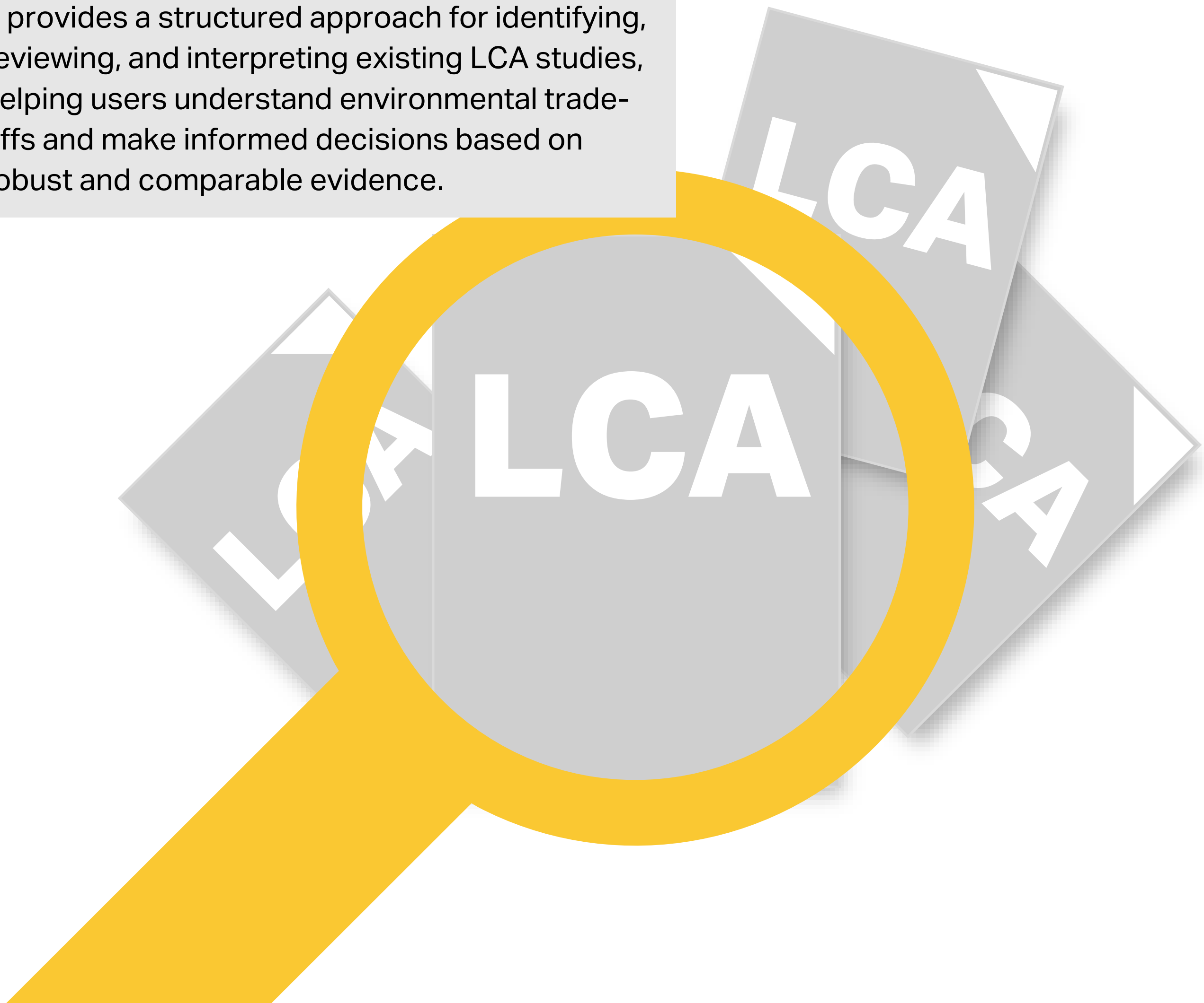
Comparing Single-Use Plastic Products and Their Alternatives

Guidance on the use of life cycle assessment in airline decision-making

September 2026

This guidance provides a practical framework for reviewing and comparing life cycle assessments (LCAs)of single-use plastic products and alternative solutions in the aviation sector.

It provides a structured approach for identifying, reviewing, and interpreting existing LCA studies, helping users understand environmental trade-offs and make informed decisions based on robust and comparable evidence.



About

This guidance was prepared by the International Air Transport Association (IATA) with support from WRAP.

IATA is the trade association for the world's airlines, representing over 370 airlines accounting for some 85% of global air traffic. We support many areas of aviation activity and help formulate industry policy on critical aviation issues.

WRAP is a global environmental action NGO transforming our product and food systems to create Circular Living. We examine sustainability challenges through the lens of people's day-to-day lives. We transform the systems that provide the products we consume. We catalyse action from policy makers, businesses, NGOs and citizens to make it happen.

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Executive summary

A Life Cycle Assessment (LCA) is widely recognized as one of the most comprehensive tools for evaluating the environmental impacts of products and services. As airlines seek to reduce the use of single-use plastic products (SUPP) and evaluate alternative solutions, LCAs are increasingly used to inform procurement, operational, and sustainability decisions. However, variations in study design, system boundaries, functional units, assumptions, data sources, and impact categories can make results difficult to interpret, compare, and apply consistently.

This document provides a practical framework for assessing the suitability of existing LCAs and using them to support evidence-based decisions in the aviation sector. While bespoke studies may be appropriate in some circumstances, users often rely on published LCAs, supplier assessments, academic literature, and industry reports. The guidance therefore focuses on reviewing, interpreting, and, where appropriate, adapting available evidence while recognizing the limitations of studies developed outside the aviation context.

The guidance outlines a step-by-step process for defining a decision context, conducting a literature review, evaluating the relevance and quality of individual LCAs, and comparing findings across multiple studies.

By promoting a consistent evaluation of LCA evidence and greater transparency in decision-making, this guidance seeks to help airlines and the broader aviation value chain make more informed choices regarding products and materials, while supporting environmental objectives and circular economy principles.

Introduction

About this guide

This guide aims to help users make informed choices when interpreting and using Life Cycle Assessments (LCAs) to inform decisions about item substitution in the aviation sector, particularly for passenger service and comfort items and cargo wrappings. It focuses on substituting single-use plastic items with reusable alternatives but can also be applied to non-plastic items and to comparisons between different single-use items. The guidance draws on the principles set out in IATA's Life cycle assessment methodology for single-use plastic products in the airline sector, with an emphasis on using third-party LCAs rather than commissioning a bespoke study.

The guide is structured as two flowcharts:

1. **Workflow – Flowchart 1** takes you through the process of using LCAs to inform a decision, focusing on problem formulation, acquiring suitable sources, and using these to inform a decision.
2. **Review – Flowchart 2** is referenced as a subprocess in Flowchart 1 and is carried out for each LCA study you wish to use. It outlines the process of reviewing each study and assessing its robustness and applicability to the decision.

Each flowchart box is accompanied by a guidance note that provides additional support and recommendations for each step of the process. Each box is hyperlinked to its guidance note for ease of access.

The intended use of this guide is for the user to begin with a question to be answered and then proceed through a review of the available literature, most likely using the findings of multiple studies to support a decision. It is not recommended to use a single LCA to inform a decision without reviewing the range of available evidence. LCAs are too sensitive to differences in scope, system boundaries, and assumptions for a single, off-the-shelf LCA to be a reliable basis for an important operational decision.

Despite this, you may find yourself reviewing a specific LCA (perhaps provided by a supplier or a client) with the aim of assessing how robust it is. If so, this guidance will support you in this process, particularly the guidance in Flowchart 2.

What is Life Cycle Assessment (LCA)?

An LCA is a structured method for assessing the environmental impacts of a product or service across its life cycle. It asks: what resources are used, what emissions and waste are created, and where in the life cycle do these impacts occur?

LCA provides an objective, quantitative account of a product's impact across its life cycle, enabling users to understand trade-offs between products and services. For example, replacing a single-use plastic item with a heavier reusable item may reduce waste but increase impacts elsewhere through manufacture, washing, transport, or aircraft fuel burn. Similarly, heavier reusable alternatives to cargo wrapping can impact fuel burn and/or load efficiency, in which case, LCAs can reveal these trade-offs.

Limits of an LCA

An LCA should not be treated as providing a single correct answer to an operational question. LCAs depend on assumptions, data quality, modeling choices, impact categories, and the question the study was designed to answer. Two LCAs can reach different conclusions because they use different functional units, system boundaries, geographies, reuse rates, recycling assumptions, or electricity mixes.

Extra caution is needed in an aviation context. Many LCAs of cups, cutlery, packaging, textiles, or reusable items are based on household, catering, retail, or municipal waste contexts. Such studies will not reflect inflight use, route length, aircraft weight, international catering waste rules, airline loading practices, or the realities of preparation for reuse. This can affect their relevance to the airline sector.

It is also important to be realistic about what LCAs can and cannot do. LCAs can provide useful quantitative information on the environmental impacts of a given product or service when used in a specific context. They cannot tell you:

- Which decision is "best" from an environmental perspective.
- What the social impacts of a decision are. Social LCAs have been conducted but are less established and standardized than the conventional environmental LCA framework outlined in ISO 14040. For those interested in this emerging field, ISO 14075 sets out principles and guidance to inform social LCAs.
- Whether a decision makes economic sense or is affordable.
- Whether a decision is positive or negative regarding passenger experience.
- Whether a decision is compliant with environmental laws and regulations.

LCAs cannot make decisions for you, but they can be a useful input to a decision-making process.

A note on user requirements

This guidance has been provided to support non-LCA practitioners in using LCAs to inform decision-making. LCAs are complex and sensitive to assumptions and study design. This guidance therefore assumes some familiarity with LCAs but does not require detailed knowledge or experience in constructing them. It is more important to have a good understanding of the topic area covered by the LCA. This will be important in evaluating whether the data and assumptions in a study are applicable in an aviation context and, if not, the significance of any differences and whether the study can be amended to improve compatibility.

Some parts of the Flowchart 2 guidance require more detailed LCA knowledge than others, particularly the optional steps for modifying studies that would otherwise be assessed as unsuitable for the aviation context. These steps may require the user to deconstruct a study and amend or rebuild specific life cycle stages. We have aimed to make them as user-friendly as possible, but if they prove challenging, you may choose to skip them, downgrade the study's usefulness, seek support from colleagues, or commission external advice. Where a step is likely to be more technically demanding, the relevant flowchart box is colored yellow, and this is also noted in the guidance notes.

1. Work overview

Figure 1: Flowchart 1 - Workflow

1.1. Start

Return to Flowchart 1

Begin by working your way through Flowchart 1 step by step. When you reach the subprocess box "review each LCA for suitability," move to Flowchart 2 for each study you are considering before returning to Flowchart 1.

1.2. Have you produced a decision / problem statement?

Return to Flowchart 1

When assessing whether and how an LCA can help to inform a decision, it is essential to have a clear understanding of the specific decision you need to make.

The following flowchart and guidance assume an understanding of the question to assess whether the scope and system boundaries of the study are appropriate. A clear definition is also important for informing the literature search criteria used to look for additional information.

Decisions can be broadly categorized into three levels of sensitivity, and these affect how this guidance should be applied, as shown in Table 1 below.

Table 1: How guidance should be applied

Intended purpose	Is this guidance suitable?	How guidance should be applied
Internal, low impact. Decisions that are likely to have a low impact relative to the overall impact of activities, and where there is no intention to make public-facing environmental claims.	Yes	LCAs classified as supplementary data in the literature review can be included in the decision as supporting evidence, provided the limitations are clearly documented and understood by stakeholders.
Internal, high impact. Decisions do not involve public-facing environmental claims but may have a more significant environmental impact.	Yes	Supplementary data in the literature review should be used as background context and supporting evidence only. They should not be used to justify a decision.
Externally facing / publicly communicated environmental claims.	For defining the decision and background only	Guidance may be useful when gathering evidence to refine a decision context or options for comparison, but it should not be used as the basis for public environmental claims. If a decision is accompanied by an environmental claim based on LCA data, you must conduct a full ISO 14044-compliant LCA. Third-party LCAs of other products cannot serve as the basis for claims and cannot be directly supported by this guidance. For guidance on conducting a full LCA, see IATA's Life cycle assessment methodology for single-use plastic products in the airline sector.

Example problem statements include:

- Our organization wished to compare two cutlery options for inflight meal service. Option 1 is disposable plastic, while option 2 is reusable metal cutlery. To reduce flight weight, Option 2 will be washed at airport facilities while another set is loaded for the next flight. These product options perform the same function but have different materials, manufacturing processes, use phases, and disposal routes. Because environmental impacts occur across multiple life cycle stages and trade-offs may exist between impact categories (e.g., climate change, water use, and resource depletion), an LCA is required to quantify and compare the impacts of each option and identify the environmentally preferable alternative.
- Our company is considering replacing our current single-use cargo wrap with a reusable alternative material to reduce our environmental impact. However, we do not know whether the proposed change would result in lower impacts when the full life cycle is considered. We will undertake a review of published LCAs to compare the environmental performance of the two packaging options and inform our decision.

The problem statement should be seen as a living document. It is likely that the research will reveal new dimensions to the issue that you may not have considered, as LCAs are a good source of information on the most appropriate indicators to use. For example, a study might highlight the importance of a particular activity, suggest that some environmental indicators are more (or less) relevant than initially thought, or even suggest new product or service options. If this happens, log the change on the problem statement. This will help to inform your next steps and ensure a consistent approach.

1.3. Define and document the question

Return to Flowchart 1

Produce a problem statement, including:

- A description of the decision.
- The options to be compared.
- Stakeholders within your organization who need to be consulted or informed (e.g., finance, customer experience team, catering team, compliance).
- An assessment of how sensitive the decision is.

Finally, record your initial position on which environmental impact measures you wish to base the decision on and the rationale behind choosing them. This can be based on a range of factors. For example, your company might have internal targets around reducing greenhouse gas emissions or water use. Or an existing supplier's LCA might highlight ecotoxicity or resource depletion as a significant impact area for the product or service you consider changing. Add these to your problem statement.

1.4. Determine data requirements and conduct a literature search

Return to Flowchart 1

Once you have a clearly defined decision, the next step is to conduct a literature review to locate the most relevant evidence. This step is important and should not be skipped because you already have an LCA you wish to use. LCAs can vary in scope, system boundaries, and assumptions, meaning LCAs of very similar product systems can give different results. Decisions based on third-party LCAs should not be based on a single study without further evidence. This process provides background and contextual information that is helpful when assessing whether studies are appropriate and gives an indication of how robust your conclusions are. A decision based on several LCAs, where all the published evidence reaches a similar conclusion, is likely to be more robust than a decision based on a single published study or where the evidence is contested.

Begin the literature search by defining the types of sources that you want to assess and how you will conduct the research. Sources of evidence include:

- Academic papers.
- Trade bodies.
- LCAs from suppliers and other companies.
- NGOs.

Means of conducting a literature search might include:

- Reaching out to colleagues, trade bodies, and suppliers for LCA studies.
- Searching the web for relevant terms (e.g., "LCA reusable vs. disposable plastic cutlery"; "LCA of reusable cutlery in aviation").
- Accessing academic databases (Google Scholar, JSTOR, BASE, Semantic Scholar, etc.).
- Using an AI tool to search for potential studies. Used carefully, AI tools can be used to locate sources. See the example AI search prompt in Appendix 1.
- Reviewing the references in the papers you locate using the methods above. This "snowball" approach can be an effective way of expanding the number of relevant studies in your review.

Once you have assembled your studies, begin by skimming the abstracts or executive summaries of each report to assess which may or may not be relevant.

If insufficient studies are available, alternative evidence routes include:

- Engaging with suppliers to request existing LCAs or to ask if they would be willing to commission one.
- Adapting comparable studies that cover similar products, services, or contexts, clearly documenting any assumptions or limitations (see Step 9).
- Using light touch or screening LCAs for lower-risk internal decisions or to test key assumptions and decide whether a more detailed assessment is needed. This could involve using LCA software such as SimaPro, which is less time- and resource-intensive than a full ISO 14040-compliant LCA.
- Commissioning a bespoke LCA for high-impact decisions or externally facing / publicly communicated environmental claims.

1.5. Subprocess: review each LCA for suitability

Return to Flowchart 1

The literature review phase is where you assess the relevance of the evidence in each study and categorize it into one of three categories:

- Core evidence.
- Supplementary evidence.
- Rejected evidence.

The details of this process are outlined in Flowchart 2. Review each study following the steps in the subprocess before returning to Flowchart 1.

1.6. Compare and summarize the results

Return to Flowchart 1

You should now have at least one, and hopefully several, LCAs that you can use to support your decisions with an acceptable level of robustness and reliability. Some of these may be studies you can use directly as provided, while others may have been supplemented or amended during the review process. All the LCAs under consideration should provide figures that are reasonably comparable.

A useful next step is to compare the results. This can be done in a number of ways.

Box-and-whisker plot

If the data are highly comparable, then a box-and-whisker plot (see Figure 2) can be useful to show the range of options and impacts side by side. In a box-and-whisker plot, the central line shows the median, and the box boundaries show the 25th and 75th percentiles. The whiskers show the lowest and highest values. If the individual scores for each option are plotted across at least five studies, this will show the middle value from each study and the range of values across studies.

Figure 2: Box-and-whisker plot comparing three hypothetical products' greenhouse gas impacts

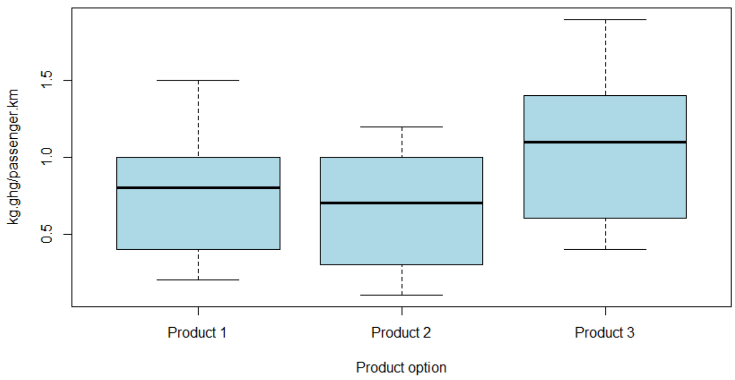


Figure 2 shows that there is considerable overlap between studies, particularly for options 1 and 2, but that, on balance, Product 2 may be the best option because the median value and "worst case" estimates are lower for Product 2 than for Products 1 and 3. If using this method, provide details on the studies used and note any issues that may affect comparability.

Present the data in a table

Another way to present the data, especially useful if there are concerns around comparability, is in a tabular form using > and < signs to indicate which products are preferable (e.g., P1 > P2 might mean Product 1 is preferable to Product 2). This allows qualitative comparison of results, identification of studies, and annotation of any issues, as shown in Table 2.

Table 2:Example of tabular comparison

Study	Result	Notes
Ref 1	P2 > P1 > P3	Original is ISO 14044 compliant; adjusted functional unit for aviation
Ref 2	P1 > P2 > P3	Supplier LCA from the manufacturer of P1. Aviation-specific. Lacks external review.
Ref 3	P2 > P3 > P1	The functional unit is per passenger, not per passenger-kilometer. Older study (2011).
Ref 4	P2 > P3	LCA literature review study with qualitative data only. Does not cover P3. Supplementary data only.

While this approach lacks the quantitative precision of the box-and-whisker plot, it allows comparisons across different functional units (provided each is adequate to answer the question). It also allows the presentation of qualitative data, as shown on the bottom row. This can be especially useful where a document is not an LCA but a review article comparing and contrasting multiple LCA studies; these have the advantage of collating lots of data but tend to lack directly comparable quantitative data.

When comparing data, be sure to conduct a separate comparison for each impact indicator in the problem statement (or for each criterion for which data are available). It is rare for an option to score well on all impact criteria, so it is important to understand each indicator individually and be aware of the environmental trade-offs.

When summarizing the evidence, look for a consistent picture to emerge. Are studies generally in agreement at least on the ranking of options, if not the exact magnitude of the impacts? This suggests that there is reasonably robust evidence to inform the decision. On the other hand, if there is a high level of disagreement between studies, additional research may be needed before making high-impact decisions (see Table 1). However, disagreement does not mean that evidence cannot be used. The available evidence may be conflicting but still indicate that one option is preferable, albeit with greater uncertainty.

The final decision may also be guided by factors such as cost, customer experience, or regulatory compliance. Environmental impacts should also be assessed alongside a product or service's primary function. In the case of cargo wrapping, for example, improper wrapping alternatives may pose risks to flight safety or cause cargo damage, spoilage, or loss.

When multiple factors influence a decision, you may wish to consider using Multi-Criteria Decision Analysis (MCDA). MCDA is a structured approach for comparing and ranking alternative decisions. It can demonstrate how environmental evidence has been considered alongside other factors such as cost, customer experience, and operational considerations, and how trade-offs have been assessed. For further guidance, see sources such as the Government Analysis Function[1] or Department for Energy Security & Net Zero[2].

1.7. Use results to inform decision

Return to Flowchart 1

Now that the evidence has been assembled and consultation with relevant stakeholders has been completed, it is time to make the decision. Remember that the LCA cannot:

- Make a decision for you.
- Account for anything beyond the environmental impact categories included in the studies reviewed.
- Account for other business-related issues, such as cost, user experience, etc.

However, it can contribute evidence to the discussion and help to inform the decision. It may be useful at this stage to rank your decision criteria in order of importance to focus on the elements that matter the most for your decision.

[1] An Introductory Guide to Multi-Criteria Decision Analysis.
[2] Use of Multi-Criteria Decision Analysis in options appraisal of economic cases.

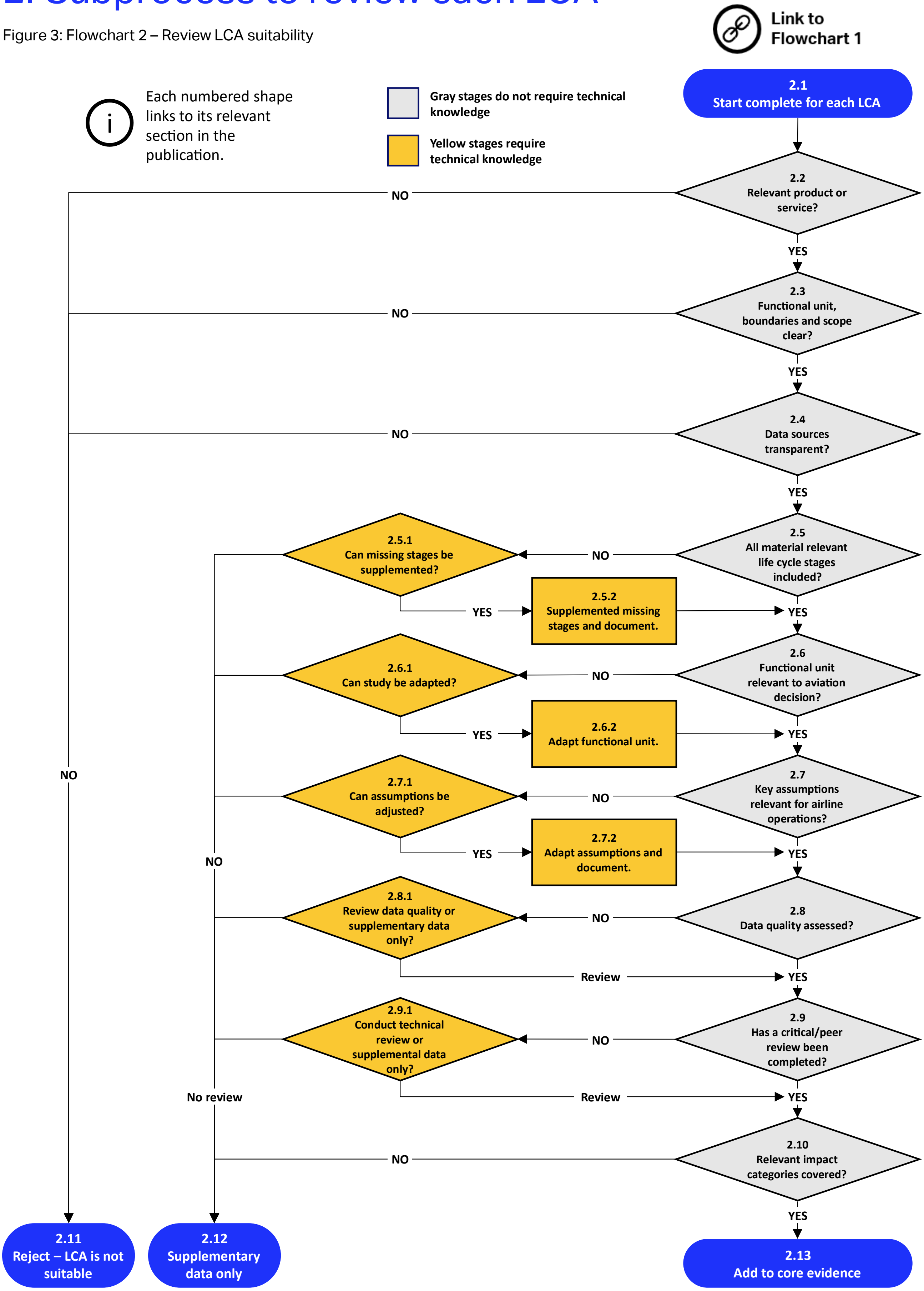
1.8. Document the decision

Return to Flowchart 1

Finally, document the decision and the reasons why it has been made, along with any assumptions or caveats. This includes any conflicts of interest, for example, whether the LCA was created by an organization that has a commercial interest in the results.

2. Subprocess to review each LCA

Figure 3: Flowchart 2 – Review LCA suitability



2.1. Start: complete for each LCA

Return to Flowchart 2

Use this flowchart as a structured screen. It does not replace expert review, but it will help you decide whether a study is suitable for the evidence base, should be used only as supplementary information, needs adjustment or review, or should be rejected.

The aim is not to find a perfect LCA, but to understand what each study can reliably tell you and where the findings should be treated with caution.

2.2. Is the product or service relevant?

Return to Flowchart 2

Is the LCA about the same or a similar product or service as the decision you are trying to make?

Start by looking beyond the name. A study of plastic cups might cover a broadly similar physical product, but in a way that is not relevant to the decision you need to make. Are the cups assessed in the study similar to those that the decision concerns (in terms of weight, polymer choice, etc.), and is it being used in a comparable product system?

A cup used in a café, a takeaway disposable cup, a reusable cup used in a closed-loop office system, and a cup used onboard an aircraft all perform a similar function, but the systems around them may be very different.

Does the item need to meet similar food safety, hygiene, durability, storage, handling, or operational requirements?

Even if the study does not align perfectly, it might still be useful in informing the decision. For example, a non-aviation LCA of reusable cups may provide useful information on production impacts, washing, and the importance of reuse rates, but may lack appropriate end-of-life assumptions and impacts on fuel use.

2.3. Are the functional unit, scope, and boundaries clear?

Return to Flowchart 2

The functional unit is a quantified description of the primary function or service provided by a product system, used as the basis for comparison in an LCA study. All LCAs must have a functional unit expressed in these terms. “One cup,” for example, is not a valid functional unit for an LCA because it fails to take account of potential differences in functional performance between LCAs. Such studies should be rejected. An ideal functional unit for an aviation context might be the provision of 1,000 passenger drink services on a defined flight type, or the provision of passenger drinks at a particular service level per passenger-kilometer. For cargo wrapping, functional units may include the consolidation, restraint, and protection of 1 metric ton of cargo over 1,000 km of air transport, or 1 m^3 of cargo consolidated, restrained, and protected over 1,000 km.

The scope explains what the study is trying to assess and why. It should state the purpose of the study, the intended use of the results, the audience, and whether the study is intended to support a comparison between options.

The system boundary defines which life cycle stages and processes are included. It should make clear whether the study includes raw material extraction, manufacturing, packaging, distribution, use, washing, preparation for reuse, transport, and end-of-life.

If these elements are unclear, you may not know what has been counted, what has been excluded, or whether the compared options are being treated consistently.

Look for clear statements of the functional unit, reference flows, included processes, exclusions, cut-off rules, allocation methods, data sources, assumptions, and limitations. A good study should allow the reader to understand what was modeled without ambiguity.

If the functional unit, scope, or boundaries are missing or unclear, the study should be rejected for decision-making. If it contains some useful generic information, it may be retained as supplementary data only.

2.4. Are the data sources transparent?

Return to Flowchart 2

An LCA should allow the reader to understand where the data came from and how the results were produced.

Check whether the study identifies its data sources for materials, manufacturing, energy, transport, washing, product weights, waste treatment, and impact assessment methods. It should be clear whether the data are primary data from a supplier or airline, secondary data from an LCA database, literature values, estimates, or assumptions made by the practitioner.

Transparency does not mean that every confidential dataset must be published in full. Some commercial data may be redacted. However, the study should still explain which data were used, what was omitted, why it was omitted, and whether the omission affects interpretation.

Do not base decisions on studies that provide only final results with little explanation. Without transparent data, you cannot judge whether the study is relevant, whether assumptions are realistic, or whether the results can be adapted.

Also, check whether the data is up to date and geographically relevant. A study using old energy mixes, generic global data, or production assumptions from a different region may still be useful, but this should be understood, and the limitations documented.

If data sources are not transparent, the study should normally be used only as supplementary data. If the lack of transparency affects key conclusions, reject it.

2.5. Are all materially relevant life cycle stages included?

Return to Flowchart 2

This question asks whether the study includes the life cycle stages that could reasonably affect the conclusion.

For aviation passenger service items, the main stages to check are raw material extraction, material processing, product manufacture, packaging, distribution, storage, airline loading, onboard use, preparation for reuse, washing or reconditioning, reverse logistics, and end-of-life.

The word "materially" is important. Not every small process will affect the decision. But if a stage could change the ranking between options, it should be included or at least considered. For example, washing may be central for reusable cups or cutlery. Aircraft fuel burn may be important where alternatives differ significantly in weight and are carried over long distances. End-of-life may matter when one option assumes recycling or composting, which is not realistic for airline waste. Examples of stages for reusable cargo wrapping alternatives (reusable covers or thermal blankets), as well as other reusable cargo items such as containers, include inspection, cleaning, repair, repositioning when needed, and reverse logistics.

Look carefully for omissions. Some studies focus only on production. Some exclude transport. Some assume municipal recycling, where airline waste is likely to be incinerated or managed under international catering waste controls. Some reusable product studies assume high reuse rates but do not account for losses, breakage, washing, or return logistics.

If all material stages are included, continue. If key stages are missing, consider whether they can be supplemented.

2.5.1 Can missing stages be supplemented?

Return to Flowchart 2

This question applies where an LCA is relevant and potentially useful but excludes one or more life cycle stages that could materially affect the result. Examples might include washing or reconditioning, reverse logistics, aircraft fuel burn associated with product weight, or realistic end-of-life treatment for airline waste.

Begin by considering whether the omission is material. A missing stage is material if including it could meaningfully change the results, alter the ranking of the options, or affect the confidence that can be placed in the conclusion. If the omitted stage is minor and unlikely to affect the decision, it may be sufficient to record it as a limitation and continue.

Where the omission could affect the conclusion, consider whether it can be supplemented reliably. Supplementation is appropriate only where:

- The original functional unit, reference flows, and system boundary are sufficiently clear.
- The study provides enough detail to identify what has already been included.
- Suitable data are available for the missing stage.
- The supplementary data can be converted to the same functional unit.
- The supplementary source is reasonably compatible in terms of geography, technology, time period, allocation method, and impact assessment method.
- The additional stage can be included without double-counting.

The data source should also reflect the intended aviation context as closely as possible. For example, municipal waste data may not represent the treatment of international catering waste.

If the stage can be supplemented transparently and proportionately, proceed to the next step. If it cannot, use the study only as supplementary evidence, or reject it where the omission makes the results materially misleading.

2.5.2 Supplement the missing stages and document any changes

Return to Flowchart 2

When you supplement missing stages, treat the work as a transparent adjustment to the evidence. Do not present the supplemented result as though it were part of the original LCA. Start by recording:

- The missing life cycle stage.
- Why it is relevant to the decision.
- What the original study included and excluded.
- Whether the stage will be added quantitatively or considered qualitatively.

Next, select the most suitable source available. This might include airline operational data, supplier information[3], airport or waste contractor data, published LCA studies, recognized life cycle databases, or assumptions from IATA guidance. Record why the source is appropriate and how the data were converted to the study's functional unit.

Check that the additional data do not overlap with processes already included in the original study. Where the supplementary source uses a different allocation method, system boundary, or impact assessment method, either reconcile the differences or record them as limitations.

Where uncertainty is important, use a range or scenarios rather than a single central estimate. Relevant scenarios may include:

- Short, medium, and long-haul routes.
- Different end-of-life routes.
- Low, medium, and high reuse rates.
- Alternative washing or return logistics arrangements.

Apply the supplementation consistently across the options being compared. For example, if end-of-life assumptions are revised for one option, check whether equivalent changes are required for the others.

Keep the original and supplemented results clearly distinguishable. The review record should state:

- The source and quality of the supplementary data.
- The calculations and conversions used.
- Any assumptions, allocation choices, or scenarios.
- Which impact categories have been updated.
- The remaining uncertainty and limitations.

If only one impact category has been supplemented, such as climate change, it does not imply that the full environmental profile has been revised. Present the adjusted result as the reviewer's analysis based on the original LCA, not as a revised conclusion of the original authors.

Advice on how to account for the impact of product weight on marginal fuel burn during the use phase of the product life cycle is given in Appendix 2.

2.6. Is the functional unit relevant to the aviation decision?

Return to Flowchart 2

A functional unit may be clear but still not relevant to a decision in an aviation context.

For example, a study may assess "one reusable cup over its lifetime of 100 uses" or "packaging to protect and transport 1kg of a given product from manufacturer to end consumer." These may be valid within the original study, but they may not match the operating conditions that are involved in your decision.

Ask whether the functional unit reflects the decision the airline is making. Is the question about one passenger drink service, one passenger meal service, one item loaded per flight, one item used per passenger, or one

[3] Supplier data is often useful here as it may be more product specific than generic data from a life cycle database. If a supplier is reluctant to share information that cannot be obtained from another source you may wish to consider offering a non-disclosure agreement to access the data. If a supplier is reluctant to offer environmentally relevant information under NDA, and you are prioritizing environmental considerations in your decision, you may wish to reconsider your relationship with the supplier for the purposes of the decision.

cubic meter of cargo protected over a specified distance? Does it reflect the number of items loaded, not just the number used? Does it account for spares, wastage, return logistics, or reuse?

Aviation decisions often need a functional unit that includes the service delivered and the operating context. Route length, aircraft type, loading practice, and reuse system design may all affect the result. A functional unit that ignores these factors may still be useful for background understanding but may not be sufficient for comparison.

If the functional unit is directly relevant (or sufficiently relevant), continue. If it is not relevant but can be translated into an aviation-relevant basis, move to the adaptation step. If it cannot be translated, use the study only as supplementary information or reject it if it is likely to mislead.

2.6.1 Can the study be adapted?

Return to Flowchart 2

This box applies when the study is relevant but does not use the right functional unit or system framing for the airline decision.

Adaptation means translating the study into a more useful basis for comparison without creating a new full LCA. It may involve converting results from “per item” to “per passenger service” or “per transportation of 1 tonne of cargo”, from “per kg of material” to “per 1,000 uses”, or from “per product lifetime” to “per flight sector.”

Where possible, the functional unit converted to should align with IATA guidelines on commissioning and conducting LCAs by accounting for impacts on fuel use. The recommended functional unit for food and beverage services is the provision of the service per passenger-kilometer or cargo tonne/km. See IATA’s LCA guidance for more information.

Ask whether the original study gives enough information to make this conversion. You will need the original functional unit, product weights, reference flows, number of uses, system boundaries, and life cycle stage results. If these are not available, adaptation may be inaccurate.

Adaptation is most defensible when the source LCA is transparent, and the change is simple. For example, if a study reports impacts per cup and gives cup weight, lifetime, and washing assumptions, you may be able to convert the results to a passenger beverage service (e.g., one passenger beverage on a medium-haul flight). If the study provides only a headline result with no supporting detail, adaptation will not be possible.

Do not adapt a study simply because you want it to fit or because it is the only data source to hand. Adaptation must be carried out carefully to ensure robustness and to prevent impacts from being omitted or double-counted, and this depends crucially on the original study providing sufficient granularity to do so. Adaptation should preserve the original function and should be clearly documented.

2.6.2 Adapt the functional unit

Return to Flowchart 2

When adapting a functional unit, the aim is to restate the study on a basis that reflects the airline's decision.

Start by determining the exact functional unit as stated in the study. Then, determine the functional unit needed for your decision and compare. For example:

- Study: “One disposable cup used once”
  Relevant: “The number of single-use disposable cups required to provide drinks to a passenger over a 1,000km flight”

- Study: "1 kg of stretch film"/"one reusable cargo cover over 100 uses"
  Relevant: "Securing one tonne of cargo transported 1,000 km by air"
- Study: "One reusable fork over 500 uses"
  Relevant: "The number of reusable forks required to provide meals to a passenger over a 1,000km flight"

Next, identify the reference flows. The quantities of each product system are needed to deliver the functional unit. For a single-use option, this may be one item per service, plus associated packaging. For a reusable option, it may include the item, replacements due to loss or damage, washing, transport, storage, and end-of-life. For the functional units given above, the number of units required may be less than 1. If a fork is reused 50 times, then each individual use accounts for one fiftieth of the lifetime impacts of the fork (including washing, backhauling, etc.).

Document every conversion. State whether you used product weights, supplier data, airline operational data, assumptions from the study, or your own estimates.

Do not present adapted results as if they were the original study's conclusions. They are your interpretation or screening adjustment, based on the source LCA.

2.7. Are key assumptions relevant for airline operations?

Return to Flowchart 2

Do the study's assumptions reflect the way the product would be used in practice in the aviation sector?

A study may be technically sound in its original context but still unsuitable for airline decisions if its assumptions do not apply to the intended use. For example, a reusable cup system in an office may assume local washing and high return rates and will not consider aircraft weight impact. These assumptions may not be useful for onboard use.

Check assumptions on product weight, flight distance, number of items loaded, number of items actually used, spares, wastage, cabin class, route type, storage, handling, cleaning, backhauling, waste segregation, recycling, composting, incineration, and landfill. For reusable products, pay attention to expected lifetime, loss, breakage, theft, washing, drying, inspection, repacking, and return transport. Unloading reusable cutlery for washing at the airport and loading a new set for the next trip will have different impacts versus backhauling all used cutlery to a central washing location. For cargo products, it is also recommended to assess assumptions relating to Unit Load Device (ULD) build configurations, safety standards, cargo density, transfer points, export regulations, security inspections, and expected damage rates.

Also, check whether the study reflects aviation-specific waste constraints. Waste from international flights may not be handled like normal municipal waste due to regulations around international catering waste, etc. Claims about recyclability or compostability should be treated cautiously unless the study reflects actual airline and airport waste routes.

The key question is whether the assumptions are close enough that the study can inform the decision. If not, ask whether they can be adjusted. If they cannot, use the study only as supplementary data.

2.7.1 Can assumptions be adjusted?

Return to Flowchart 2

This question applies when the LCA is relevant, but some assumptions do not align with airline operations.

It may be possible to adjust assumptions where the study is transparent, and the relevant parameters can be changed. For example, you may adjust reuse rates, end-of-life routes, electricity mixes, product weights, flight distances, washing energy, or recycling rates. You may also test scenarios for short, medium, and long-haul flights.

Before adjusting, ask three questions:

1. Is the assumption important? Do not spend time adjusting minor assumptions that will not affect the decision.
2. Is there a better aviation-specific value? Supplier data, airline data, caterer data, airport waste data, or recognized aviation guidance may be available to help fill gaps. If not, you may be able to measure or inspect operations to obtain the relevant data.
3. Can the adjustment be made, given the level of detail provided in the LCA? For example, if a study provides only a single overall result and no stage breakdown, it will not be possible to adjust a single assumption without distorting the result.

Adjusted assumptions should be documented and tested. If changing a plausible assumption reverses the conclusion, the study is not robust enough to rely on when making decisions.

If assumptions can be adjusted transparently, continue. If they cannot, retain the study as supplementary data only, unless the assumption is minor and unlikely to change the result.

2.7.2 Adjust assumptions and document any changes

Return to Flowchart 2

For each adjustment, record four things: the original assumption, the revised assumption, the reason for the change, and the data source used. For example:

> Original assumption: 80% recycling at end-of-life.
> Revised assumption: incineration based on airline waste routes. Impact assessment based on the Ecoinvent global inventory for mixed municipal waste incineration.
> Reason: the original municipal recycling assumption is unlikely to apply to international catering waste.
> Source: airline or waste contractor data.

Use conservative assumptions where evidence is weak. If several plausible values exist, consider presenting a range or a set of scenarios. This is especially important for reusable products, where results may depend heavily on the number of uses, loss rate, washing system, etc.

Be careful not to adjust only the favorable parts of a study. If you adjust the end-of-life for one option, check whether comparable changes are needed for the other. If you adjust climate impacts but not other impact categories, this should be stated clearly.

Keep a record of the original result, the adjusted result, and the reason for the adjustment, and present the adjustment in a way that is transparent and clearly not part of the original study. This makes the review auditable and helps subsequent users understand how much of the conclusion stems from the original LCA and how much from the review process.

Table 3 includes examples of how to resolve three challenges with a disposable plastic food-serving tray LCA. These are simplified examples of how to supplement life cycle stages and adjust assumptions and functional units. For more guidance, see IATA's Life cycle assessment methodology for single-use plastic products in the airline sector.

Table 3: How to address challenges with an LCA of a disposable plastic food-serving tray

Problem	How to resolve	Action
The LCA covers the life cycle from cradle to grave but does not include any use phase impacts. This is relevant in an aviation context because of the impact of weight on fuel burn.	Establish use phase impacts.	Select three representative flight distances based on IATA's *Life cycle assessment methodology guidance*. For example, 2,000km, 4,000km, and 7,000km flights (see Table 7 on marginal fuel burn, p. 26). Use Table 7 to locate marginal fuel burn or, if your aircraft is not represented in the table, seek fuel consumption data from colleagues. Then calculate the fuel burn for each flight distance, based on the product's weight. Assess the emissions associated with this fuel burn and add them to the inventory for each flight distance.
The LCA presents the impacts for each life cycle stage separately but assumes that trays are recycled at the end-of-life. Your operational constraints require them to be incinerated.	Adjust end-of-life impacts.	Subtract the end-of-life emissions from the inventory of impacts in the LCA. Using the tray's material composition, determine the emissions associated with its incineration. This could be done using a life cycle assessment database such as Ecoinvent. Add these new emissions to the inventory.
The functional unit is the serving of one drink. This is a reasonable unit, but you would like to express the function in terms of providing a passenger with a service over 1 kilometer.	Adjust the functional unit.	To convert the preferred functional unit for a given flight distance, recalculate the inventory for the product by dividing it by the flight distance in kilometers.

2.8. Has the data quality been assessed?

Return to Flowchart 2

It is important that the data is robust and relevant enough for the purpose of the study. A data quality assessment should consider aspects such as age, geography, technology, completeness, representativeness, precision, transparency of sources, consistency, and source reliability. For example, recent supplier-specific manufacturing data may be stronger than old generic database data. Airline-specific waste data may be stronger than generic municipal waste assumptions.

Do not assume that a study is of high quality simply because it is detailed or uses an LCA database.

Look for a data quality matrix, data quality ratings, uncertainty analysis, or a clear discussion of data limitations within the LCA. The study should identify which data are strong, which are weak, and which assumptions matter the most to the results. For more guidance on assessing data quality, see section 2.6.4 in the IATA LCA Guidance.

For airline decisions, data quality issues often arise around product weights, number of uses, washing systems, route distances, loading practices, and end-of-life routes. These may be more important than small differences in upstream manufacturing data.

If data quality has not been assessed, the study may still be useful for internal screening, but confidence is lower. Consider internal review, sensitivity testing, or external review before using it as core evidence.

2.8.1 Review data quality or use the LCA as supplementary data only

Return to Flowchart 2

Where a study does not contain an adequate assessment of data quality, or where there is not enough confidence that the study is robust enough for the intended use, you should either restrict the use of the study to background information or conduct a more detailed review.

An internal review may be sufficient for internal decision-making. This could involve a sustainability professional, procurement lead, operational colleague, or someone with LCA experience checking the study references against the data quality matrix provided in Appendix 3 and recording any issues or limitations.

An external reviewer needs to be independent of the study authors and competent in LCA. For aviation decisions, they should also understand aviation operations or be supported by someone who does.

When considering a review, ask yourself whether it will resolve the uncertainty or whether the evidence is fundamentally too weak. If a review can help, proceed to review. If not, reject or keep only as supplementary data.

2.9. Has a critical / peer-review been completed?

Return to Flowchart 2

When reviewing an LCA, check whether the study has been subject to critical review or peer-review and record this clearly. Critical review and peer-review are not the same as general assurance processes and provide additional confidence that a study has been independently scrutinized.

Lack of critical or peer-review should not automatically disqualify a study from being used for internal decision-making. Many supplier- or screening-based LCAs are not externally reviewed but may still be useful. However, the absence of peer or critical review should reduce confidence in the findings and be reflected in the evidence assessment. The review status should be used alongside the previous checks in this guidance to determine how much confidence to place in the study and whether it is suitable for the core evidence base, should be treated as supplementary evidence only, or rejected entirely.

A critical review, in ISO LCA terms, is a process for checking whether an LCA is consistent with the principles and requirements of the standards. It should consider the methods, data, interpretation, limitations, and reporting. For comparative assertions disclosed to the public, reviewing requirements are more demanding. Making public claims that compare the environmental benefits or impacts of specific products, requires conducting a bespoke, aviation-specific LCA on the products being compared and is outside of the scope of this guidance.

Academic publications are typically peer-reviewed, but the quality of review varies widely, and even a strong review does not guarantee that the study is suitable for your decision. A peer-reviewed study may still use a functional unit, geography, waste route, or assumption that does not fit aviation. When using an LCA to inform a decision, the responsibility for ensuring that the study is robust and applicable and that the data are correct lies with you, not the author or the publisher.

When assessing review status, consider:

- Whether the study states that it has been peer-reviewed or critically reviewed.

- Who reviewed it and whether the reviewer was independent or had been sponsored by a funder with a vested interest in the result.
- What aspects of the study were reviewed?
- Whether reviewer comments or a review statement are available.

Unreviewed studies may inform internal screening if they are transparent and relevant. They should not be used as direct evidence for material decisions, and they should not be used when making public claims. Take additional care to check the functional unit, system boundaries, data sources, assumptions, data quality, and interpretation. If these checks identify important weaknesses, or if the study is opaque or difficult to verify, downgrade it to supplementary evidence or reject it where appropriate.

Where multiple studies are available, you should give greater weight to peer-reviewed studies, provided these are also relevant to the decision. A reviewed study should not be preferred over an unreviewed one if it uses an unsuitable functional unit, geography, waste route, or operating context. Equally, an unreviewed supplier or screening LCA may still provide valuable internal evidence if it is transparent, relevant, and performs highly against the assessment criteria in this guidance.

When presenting or summarizing the evidence, record the review status of each study (for example, peer-reviewed, externally reviewed, internally reviewed, or unreviewed) and explain how this affected the level of confidence assigned. Clearly documenting the review status can help other users understand the strengths and limitations of the evidence.

2.9.1 Conduct an internal or external technical review, or use the data as supplementary only

Return to Flowchart 2

This box applies when a study has not been critically or peer-reviewed, or when the review status is unclear.

The purpose of a technical review is to decide whether the study is suitable for the decision it will inform. The review should not simply ask whether the numbers look reasonable. It should check whether the study's goal, scope, functional unit, system boundary, assumptions, data quality, impact categories, and interpretation are suitable for the decision. While a technical review cannot replace a peer-review, it provides an additional safeguarding step to help ensure that the study is robust and relevant to your decision.

An internal technical review is most appropriate when decisions are identified as low impact or when the evidence is used for background understanding or early screening. The process for conducting such a review is the same as the review steps already outlined in the flowchart. It should be conducted by someone with appropriate technical experience in working with LCAs and is intended to give a second opinion on your initial assessment. It should still be documented. Record who reviewed the study, what checks were made, and what limitations were found.

An external technical review is recommended where the decision is significant, the study is being used to support procurement, the result is sensitive, or the evidence may be shared outside the organization.

2.10. Are the relevant impact categories covered?

Return to Flowchart 2

Impact categories are the environmental impacts assessed in the LCIA phase of LCA, such as climate change or resource depletion, using characterization models to quantify impacts. These are often divided into mid-point indicators and endpoint indicators. Climate change is one impact category, but it is not the whole picture of the environment. Additional examples are included below in Table 4.

Table 4: Relevant impact categories

Impact category	What it measures	Typical unit
Climate change (Global Warming Potential)	Greenhouse gas emissions contributing to climate change	kg CO_2-eq
Water use	Freshwater consumed or deprived	m^3
Acidification	Emissions causing acid rain	kg SO_2-eq
Eutrophication	Nutrient pollution of water and soil	kg PO_4^{3-}-eq or kg N-eq
Ozone depletion	Emissions damaging the stratospheric ozone layer	kg CFC-11-eq
Photochemical ozone formation (smog)	Formation of ground-level ozone	kg NMVOC-eq
Resource depletion	Consumption of fossil fuels or mineral resources	MJ or kg Sb-eq
Land use	Land occupied or transformed by the product system	$m^2 \cdot$year
Particulate matter formation	Fine particle emissions affecting human health	kg $PM_{2.5}$-eq
Human toxicity	Potential harm of chemical emissions to human health	Comparative Toxic Units (CTUh)
Ecotoxicity	Potential harm of emissions to ecosystems	Comparative Toxic Units (CTUe)

A study that assesses only greenhouse gas emissions can be useful, but it should not be used to claim that one option is better overall for the environment. Other relevant categories may include resource use, water use, land use, acidification, eutrophication, particulate matter, human toxicity, ecotoxicity, ozone depletion, and waste-related indicators.

The relevant categories depend on the decision. For example, switching from plastic to paper or fiber-based products may change water use, land use, eutrophication, or forestry-related impacts. Switching from single-use to reusable items may reduce waste but increase water, energy, and detergent use through washing. Switching to heavier items may affect aircraft fuel burn and climate impacts.

Look for whether the study reports results by impact category rather than relying on a single score. Single scores can be helpful for communication in some contexts, but they hide trade-offs and depend on weighting choices.

If only climate change is covered, treat the study as climate-specific evidence. It may still be useful, but the conclusions must be framed carefully. If the decision requires a broader environmental judgment, either seek additional evidence or keep the study as supplementary data.

2.11. Reject - LCA is not suitable

Return to Flowchart 2

Rejecting a study means it should not be used as evidence.

This outcome is appropriate where the study is insufficiently relevant, seriously methodologically flawed, opaque, or likely to mislead. Examples include a product or service mismatch, an unclear functional unit, unclear system boundaries, missing material life cycle stages, unrealistic assumptions, no usable data sources, or conclusions that go beyond the evidence.

Rejection should be documented briefly and neutrally. For example:

- "This study assesses household use and does not provide enough information to adapt the results to inflight service."
- "This study is a product-level carbon footprint; it does not have a functional unit based on a customer service function."
- "This study does not disclose system boundaries or data sources, so the results cannot be interpreted reliably."

A rejected study may still be mentioned in an appendix if needed for transparency, or part of it (e.g., a clearly presented breakdown of a manufacturing or disposal life cycle stage) may be used to inform the assumptions in another, more robust study, but it should not be included in the core evidence base.

The purpose of rejection is quality control. It protects the final decision from being influenced by evidence that is not fit for purpose.

2.12. Supplementary data only

Return to Flowchart 2

This outcome applies where a study is not strong enough to form part of the core evidence base but still contains useful circumstantial information.

Supplementary studies can help identify hotspots, assumptions, data gaps, potential trade-offs, and questions to ask suppliers. For example, a non-aviation reusable cup LCA may not be suitable for direct comparison, but it may show that reuse rate and washing assumptions are critical. A packaging study may not align with airline waste routes, but it may provide useful information on material production impacts.

Use supplementary evidence carefully. It should not be averaged with core LCA results or used to rank options unless the basis of comparison is compatible. Do not allow supplementary data to become hidden decision evidence.

Record why the study was classified as supplementary. For example:

- Useful for understanding production impacts, but not aviation specific.
- Contains relevant washing data, but the functional unit does not match passenger service.
- Provides climate results only and omits end-of-life.

Supplementary evidence is often valuable in narrative synthesis. It can explain why results differ between studies, where evidence is uncertain, and what further data are needed. It can also inform the scope of a future aviation-specific LCA.

2.13. Add to core evidence

Return to Flowchart 2

This outcome means the study is suitable to include in the main evidence base for the literature review stage.

It does not mean the study is perfect, definitive, or sufficient on its own. It means the study is relevant, transparent, and complete enough to help inform the decision, within its stated limitations.

A study added to the core evidence base should normally have a relevant product or service, a clear functional unit, a clear scope and system boundaries, materially complete life cycle coverage, realistic or adjustable assumptions, transparent data sources, adequate data quality assessment, a suitable review status for the intended use, and relevant impact categories.

When adding a study to the core evidence base, record the reason for inclusion alongside any limitations. For example, the study may be strong on production impacts but weaker on aviation at the end-of-life. It may be suitable for internal screening but not for public comparative claims. It may cover climate change and resource use, but not water or toxicity.

Core evidence should be compared carefully. Do not combine studies mechanically if their functional units, boundaries, or assumptions differ. Instead, summarize what each study shows, under what assumptions, and how relevant it is to the airline decision.

The final decision should draw on the core evidence base and consider operational feasibility, safety, regulatory requirements, passenger experience, cost, and strategic priorities.

Glossary

Acronyms

AI – Artificial Intelligence

GWP – Global Warming Potential

LCA - Life Cycle Assessment

LCI – Life Cycle Inventory

LCIA – Lyfe Cycle Impact Assessment

SUPP - Single-Use Plastic Products

ULD - Unit Load Device

Definitions

Cradle-to-grave - Assessment that considers impacts at each stage of a product life cycle from resource extraction to disposal.

Cut-off rules - Guidelines used to exclude inputs or outputs from an LCA study if they are below a specified threshold, such as 3% of total material or energy flows.

End-of-life - The final stage in a product's life cycle, which involves waste treatment options such as disposal, incineration, or recycling.

Functional unit - A functional unit is the reference unit for the study, covering the service being provided (what), the extent to which it is provided (how much), its quality (how well) and its duration (how long).

Impact category - Environmental impacts assessed in the LCIA phase of LCA, such as climate change or resource depletion, using characterization models to quantify impacts. These are often divided into mid-point indicators and endpoint indicators.

Life Cycle Assessment (LCA) - A technique developed to better understand and address the environmental impacts at each stage of a product's life cycle (cradle-to-grave).

Life Cycle Inventory (LCI) - The LCA phase where inputs (e.g., materials, energy) and outputs (e.g., emissions, waste) are quantified for each stage of the product life cycle.

Life Cycle Impact Assessment (LCIA) - The phase of LCA that evaluates potential environmental impacts using indicators such as global warming potential, water use, or human toxicity. LCIA translates emissions and resource use into impacts.

Marginal fuel burn - The incremental increase in aircraft fuel consumption caused by additional weight, often expressed as kilograms of fuel per kilometer per kilogram of added load.

Mid-point indicator - A measure used in LCIA that quantifies environmental impacts at an intermediate stage in the cause-effect chain, such as global warming potential (GWP) or acidification, without linking to final damage.

Passenger-kilometer - The transport of one passenger over one kilometer of distance. For example, a flight that transports 100 passengers over 100 kilometers accrues 10,000 passenger-kilometers.

Recycling - Treatment or processing of waste materials into new products for further use.

Reference flow - The measurable quantity of goods or services necessary to deliver the defined functional unit. For example, the quantity of cutlery needed for a single passenger over the duration of a flight.

Reuse - The practice of using a product more than once, for the purpose for which it was originally intended. Reuse often involves ancillary processes such as inspection, cleaning, refurbishment, or repair.

Scope - Explains what the study is trying to assess and why. It should state the purpose of the study, what is considered in the analysis, the intended use of the results, the audience, and whether the study is intended to support a comparison between options.

Sensitivity analysis - A method to determine how variations in key assumptions or parameters (e.g., weight, return rate) affect the outcomes of an LCA study.

Single-use plastic products (SUPP) – Products made from plastic that are only used once and then disposed of, either during the provision of goods and services to airlines, or items that are used on board by passengers and/or crew.

System boundaries - Beginning and end points of the life cycle that is being assessed.

Weighting - The process of assigning importance to impact categories in LCIA, often based on policy or stakeholder priorities, to produce a single aggregated score.

Appendices

Appendix 1: Example AI literature search query

You are a researcher supporting an aviation-sector life cycle assessment review. The review concerns the environmental impacts of reusable versus disposable trays used for passenger meal service in commercial aviation.

Search online for published life cycle assessment studies that could inform this question. Use the attached IATA LCA guidance as the screening framework.

Include studies directly about aircraft meal trays, if available. If few or no aviation-specific studies exist, include the most relevant adjacent studies, such as LCAs of reusable versus single-use meal trays, food-service trays, catering ware, airline catering items, reusable food-service systems, or comparable reusable/disposable food-contact products. Do not include sources that discuss sustainability, recycling, or packaging without presenting an LCA, carbon footprint, or life cycle inventory.

For each potentially relevant study, assess:

- Product and use case relevance to aviation meal trays.
- Whether the study compares reusable and disposable systems.
- Functional unit and whether it is suitable or adaptable for passenger meal service.
- System boundary (including production, transport, use, washing or preparation for reuse, and end-of-life).
- Treatment of reuse cycles, breakage/loss rates, washing, logistics, and end-of-life.
- Whether aviation-specific factors, especially weight-related fuel burn, are included or could be added.
- Impact categories considered.
- Geography and date.
- Transparency, peer-review status, and apparent data quality.
- Main limitations for use in aviation sector decision-making.

Return a maximum of 20 results. Rank them from most to least promising. For each result, provide:

- Full citation.
- Link or DOI.
- Short description of the study.
- Relevance rating: High / Medium / Low.
- Reason for the rating.
- Key limitations or cautions.
- Whether the study is directly usable, usable with adaptation, or only useful as background evidence.

Exclude sources where you cannot verify that an LCA, carbon footprint, or life cycle inventory was conducted. Clearly state where no aviation-specific evidence was found.

Appendix 2: Accounting for marginal fuel burn

The impact of the weight of alternative items on marginal fuel burn is relevant in the context of any aviation decision. This can be accounted for using the marginal fuel burn estimates provided in IATA's Life cycle assessment methodology for single-use plastic products in the airline sector (see p. 26, Table 7).

Environmental impacts from additional fuel use can be calculated using a mini-life cycle assessment (e.g., using Ecoinvent data and appropriate LCA software).

If this is not possible, a CO2-only impact estimate can be produced using the conversion factor provided in the CORSIA Eligible Fuels – Life Cycle Assessment Methodology. The factor given in the CORSIA guidance for jet fuel is 89gCO2e/MJ. If a lower heating value of around 34.7Mg/l is assumed, this equates to approximately 3.09 kg CO2e/l or 3.8kg CO2e/kg.

For example, if a passenger service option being considered adds a weight of 100g per passenger, over a 5,000km flight in an A330-300, this equates to 0.011kg of additional fuel burn per passenger across the whole flight, or 0.000011kg per passenger-kilometer. Using the CORSIA guidance, this equates to an extra 0.042kg of CO2 per passenger on a 5,000km flight, or 0.0000418 kg per passenger-kilometer.

Appendix 3: Data quality matrix template

Each data point used in the LCA should be assessed using the data quality matrix and scored from Very Good to Very Poor based on the following criteria.

Table 5: Data quality assessment criteria

Indicator	Very Good	Good	Fair	Poor	Very Poor
Reliability of the data source	Verified data based on measurements	Verified data partly based on assumptions	Estimated data	Non-verified data	Unknown or very uncertain data
Completeness	Representative data for all regions and time periods	Representative data for most regions and time periods	Representative data for some regions and time periods	Data gaps exist	Unknown completeness
Temporal correlation	Less than 3 years difference	Less than 6 years difference	Less than 10 years difference	Less than 15 years difference	Unknown age or >15 years difference
Geographical correlation	Data from the same area	Data from similar areas	Data from broadly similar areas	Data from distant areas	Unknown data or from distant regions
Technological correlation	Same technology	Similar technology	Broadly similar technology	Distantly related technology	Unknown or very different technology

Table 6: Data quality matrix, draft template

Data source	Role in LCA	Reliability	Completeness	Temporal correlation	Geographical correlation	Technological correlation
...	...	...	...	...	...	...

For more information on data quality, see IATA's Life cycle assessment methodology for single-use plastic products in the airline sector.