



Simplified Data Quality Rating

ESA Clean Space Office – Ecodesign Team

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EUROPEAN SPACE AGENCY

ESA Space Systems LCA Guidelines (ESSB-HB-U-005)

Context

- Provides guidelines on how to perform LCA for a space mission
- First published in 2016, coordinated by the CleanSpace office
- Regular critical reviews performed by experts



ESA LCA Handbook webinar: [Link](#)



Issue 2 (19th December 2025)

Updates w.r.t V1

- Modernise and infuse **Lessons Learned** from past projects
- Methodological updates
- **Alignment with the ESA Ecodesign Policy (inclusion of ecodesign and simplified LCA)**
- Formalise TNs into the Handbook
- Closer alignment with ECSS terminology
- Guidelines to communicate results
- And much more...

Outline

1. Scope
2. References
3. Terms, Definition and abbreviated terms
4. How to use this document
5. Specificities of LCA application to the space sector
6. Space sector **LCA** methodology
 - a. Mission
 - b. Space Segment
 - c. Space transportation Segment
 - d. Ground Segment
 - e. Equipment, Material and Processes
7. **EcoDesign** for Space Systems
8. Communications of results
9. Example: LCA of a battery module
10. **Annexes**

Annex D: Simplified LCA

*A streamlined LCA methodology focusing on a **limited level of detail** including **reduced scope, data collection, analysis and/or presentation of results** while providing valuable insights for **decision making** and without compromising the credibility of the outcomes.*

- The main objective is to **provide quick and cost-effective assessment**, comparison and trade-off for different design options with reduced data requirements to:
 - ✓ Support **decision-making early in design phase (EcoDesign)**
 - ✓ Support **prioritization and optimization of data collection** for future iterations.



Key challenges: Project Phasing

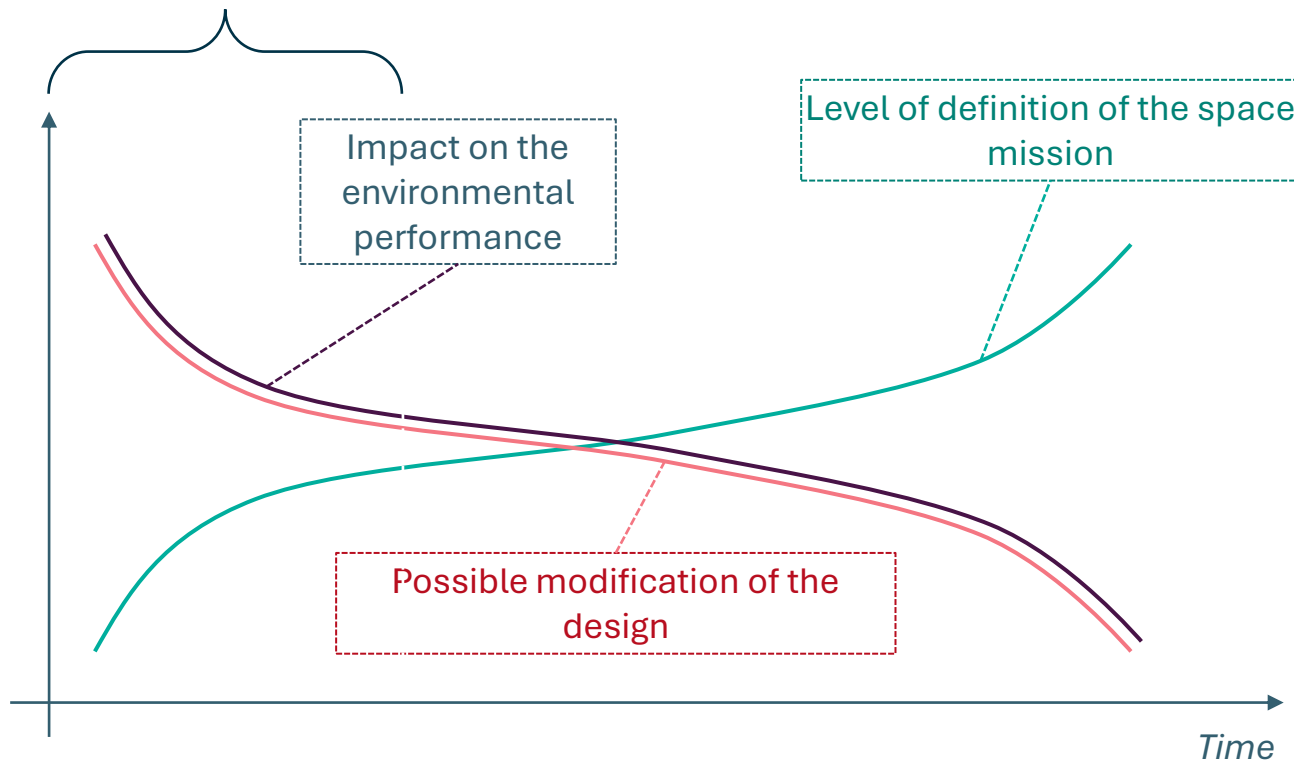
Most of the **environmental impacts** are **set by early design choices**



Ecodesign *must* be initiated as early as possible in the design process



The supporting Simplified LCA must rely solely on data that is available early in the design phase



According to ESA policy, EIP including potential EcoDesign solutions needs to be written at IPRev (~SRR)

Key Challenges: Data Availability

- Simplified LCAs are generally based on information that can be obtained at prime level without sending questionnaires to suppliers
- There is very limited to no primary data available

How to best prioritise data collection, or make ecodesign decisions, with the little data available?

Table D-3: Data availability at PRR and SRR

At PRR	Raw materials (identification and mass)	Processes (e.g. assemblies, integrations, surface treatments.)	Staff (e.g. development hours, travels, number of people)	Transport (km)	Testing (e.g. type of test, duration and plan availability)	Cleanroom usage (surface, time, class)
Segment	Not applicable	Not applicable	Available (c,h,j)	Not applicable	Not applicable	Not applicable
System (e.g. PFM, FM2)	Not applicable	Not Available	Available (c,h,j)	Available through secondary data (c)	Available through secondary data (c, j)	Available through secondary data (a,c, j)
Subsystem	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
Equipment	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available
At SRR	Raw materials (identification and mass)	Processes (e.g. assemblies, integrations, surface treatments)	Staff (e.g. development hours, travels, number of people)	Transport (km)	Testing (type of test, duration and plan availability)	Cleanroom usage (surface, time, class)
Segment	Not applicable	Not applicable	Available (C,J)	Not applicable	Not applicable	Not applicable
System (e.g. PFM, FM2,)	Not applicable	Available through secondary data (i,ii,vi)	Available (C,J)	Available through secondary data (C)	Available through secondary data (C,J)	Available through secondary data (A,C,J)
Subsystem	Not Available	Not Available	Available through secondary data (C)	Available through secondary data (C)	Available through secondary data (C,J)	Not Available
Equipment	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

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Simplified LCA “Data Quality Rating*”

Goal is to create a systematic framework to aid in interpreting simplified LCA results, helping to

- Prioritise data collection efforts for later phases
- Assess where EcoDesign could be useful

Requirements

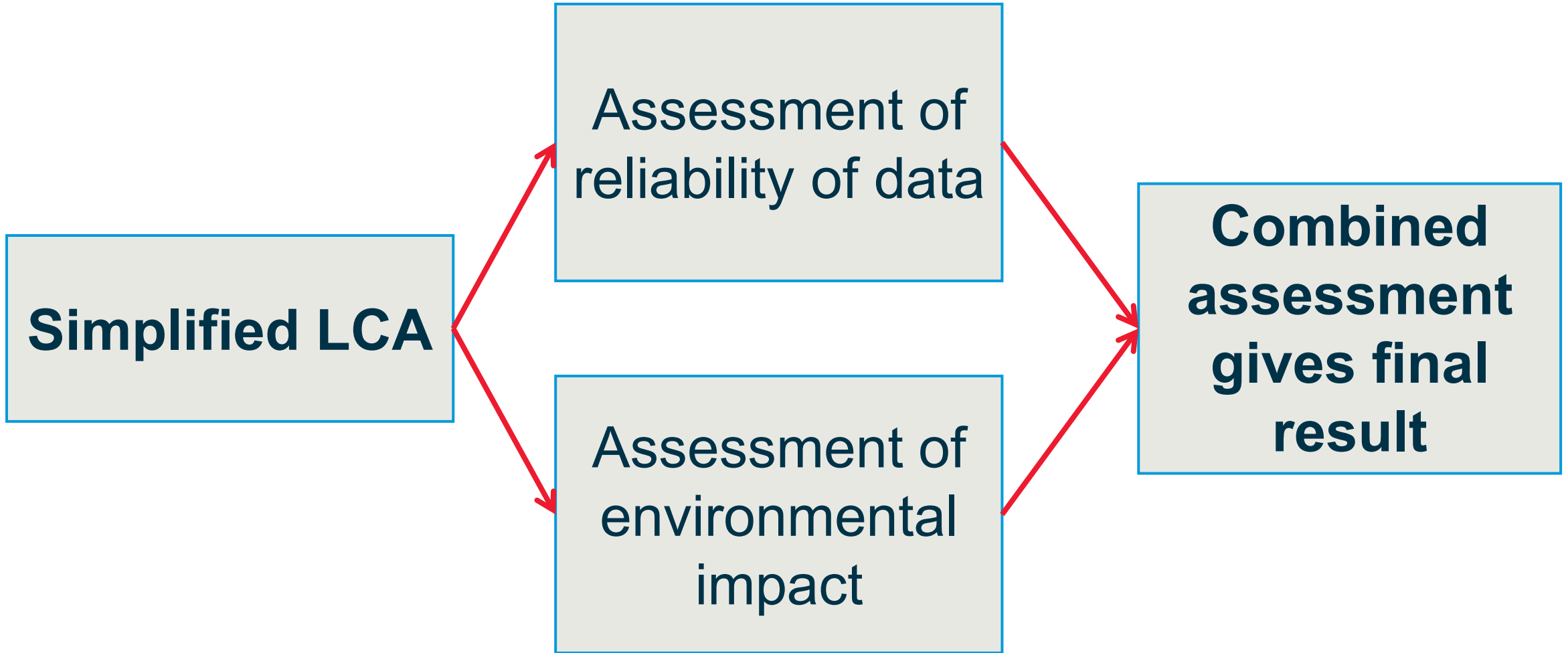
1. Needs to be usable at an **PRR-level or SRR-level** of data
 - Limited certainty on spacecraft parameters
 - Very limited primary data
2. Should be as **simple and quick as possible** whilst still allowing to justify decisions
 - Simplified LCA is designed to be streamlined
3. Ideally, **data prioritisation should aim to maximise DQR for later phases**

***Goal is not necessarily to be used as the basis of a formal rating or requirement**

**The methodologies in the
following slides are not
consolidated**

We want to refine it further
based on feedback from
industry and other actors
before making any part of it
official

Proposed Methodology for Assessment



At what level to make assessments and decisions?

For each model, Ecodesign and data collection are generally either done at the level of:

- Specific equipment and/or
- Subsystem and system level macro-activities (e.g. satellite transport to launch site)

Item	Level
Satellite Management Unit	Equipment
SADM	Equipment
PCDU	Equipment
Reaction Wheel (40 Nm)	Equipment
Remote Terminal Unit	Equipment
EPS Testing	Subsystem
Propulsion Subsystem Testing	Subsystem
Satellite-level clean room usage	System

Items and data are entirely fictitious

→ Proposal is to assess all the options similarly, as if they were at the same level

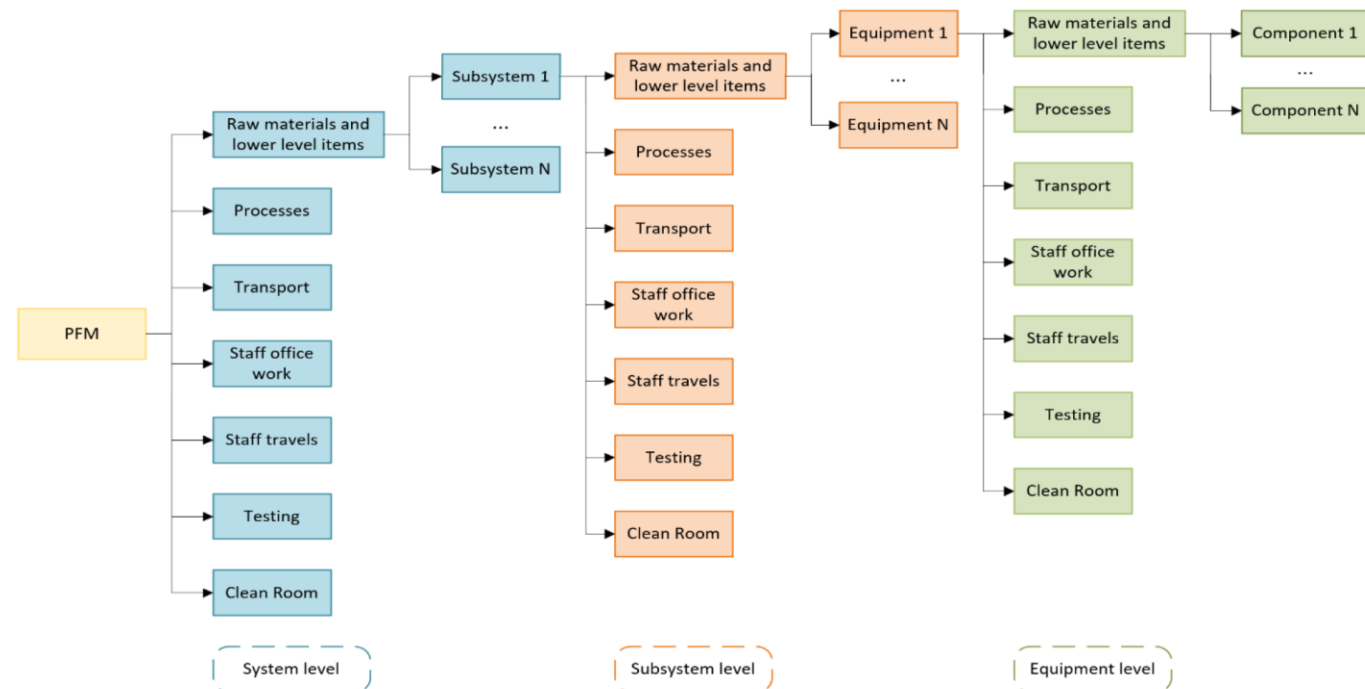


Figure B-1: New structure of the ESA space systems LCA guidelines

Environmental Impact

Item	Environmental Impact
Satellite Management Unit	Low
SADM	High
PCDU	Medium
Reaction Wheel (40 Nm)	Medium
Remote Terminal Unit	Medium
EPS Testing	Low
Propulsion Subsystem Testing	Low
Satellite-level clean room usage	High

Items and data are entirely fictitious

- General idea is to assign a ranking or rating to each item
- Simplest implementation would be a “traffic-light system” based on the ranking, for example based on single score
 - E.g. Top 20% are high, next 40% are medium, lowest 40% are green
- Could in principle be more complex
 - Quantitative
 - Taking into account different impact factors

Reliability of Data (Uncertainty of Estimation)

Item	Uncertainty of Estimation
Satellite Management Unit	High
SADM	High
PCDU	Low
Reaction Wheel (40 Nm)	High
Remote Terminal Unit	Medium
EPS Testing	Low
Propulsion Subsystem Testing	Medium
Satellite-level clean room usage	Low

Items and data are entirely fictitious

- General idea is to assess the uncertainty of the data used for the LCA
 - Most data would be secondary data in any case
- Several options:
 - Completely qualitative and based on practitioner's assessment
 - Similar to the full DQR, and based on flow classification
 - Based on mathematical quantitative uncertainties
 - Etc.
- End result in its simplest state would be again a traffic light system, but could also be quantitative

Combining the results

An item that should be **prioritised for data collection** is one that has:

- **High** uncertainty and
- **High** environmental impact

		Uncertainty		
		Low	Medium	High
Environmental Impact	Low	Lowest	Lower	Medium
	Medium	Lower	Medium	Higher
	High	Medium	Higher	Highest

How to
handle
“corner”
cases, and
trade-off
uncertainty
and potential
gain?

An item that should be **prioritised for Ecodesign** is one that has:

- **Low** uncertainty and
- **High** environmental impact

Environmental Impact	Uncertainty			
Low	Low	Medium	Lower	Lowest
	Medium	Higher	Medium	Lower
	High	Highest	Higher	Medium

Example: Data collection Prioritisation

Item	Environmental Impact	Uncertainty of Estimation	Combined Priority
Satellite Management Unit	Low	High	Medium
SADM	High	High	Highest
PCDU	Medium	Low	Lower
Reaction Wheel (40 Nm)	Medium	High	Higher
Remote Terminal Unit	Medium	Medium	Medium
EPS Testing	Low	Low	Lowest
Propulsion Subsystem Testing	Low	Medium	Lower
Satellite-level clean room usage	High	Low	Medium

Items and data are entirely fictitious

Example: Ecodesign Prioritisation

Item	Environmental Impact	Uncertainty of Estimation	Combined Priority
Satellite Management Unit	Low	High	Lowest
SADM	High	High	Medium
PCDU	Medium	Low	Higher
Reaction Wheel (40 Nm)	Medium	High	Lower
Remote Terminal Unit	Medium	Medium	Medium
EPS Testing	Low	Low	Medium
Propulsion Subsystem Testing	Low	Medium	Lower
Satellite-level clean room usage	High	Low	Highest

Items and data are entirely fictitious

Should environmental impact and uncertainty of estimation be given the same weight?

Should the weight of these differ between ecodesign and data collection prioritisation?

We want your input!

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DQR Presentation Feedback – Fill in form](#)



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THANK YOU!



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