



## **Environmental Expert Evaluation of ESA Space System Life Cycle Assessment Guidelines**

Clean Space Industrial Days – September 22, 2021

# Agenda

Introduction to the ESA LCA Handbook <i>ESA</i>	10 mins
Context and project objectives <i>Deloitte</i>	20 mins
Review of existing LCA methodologies <i>Deloitte</i>	
Preliminary findings: Review of the ESA LCA Handbook <i>Deloitte</i>	
Preliminary findings: Ecodesign initiatives in companies <i>Deloitte</i>	
Group discussion <i>Facilitated by ESA &amp; Deloitte</i>	20-30 mins





# ESA LCA HANDBOOK

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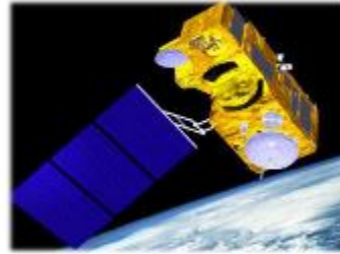
# ESA LCA approach – Handbook overview

ESA has performed LCA of the 3 different segments:

LCA Launch Segment



LCA Space Segment



LCA Ground Segment



ESA LCA Handbook



ESA LCA Database

Available under request

Available under ESA contract\*

The aim of the ESA LCA Handbook is to:

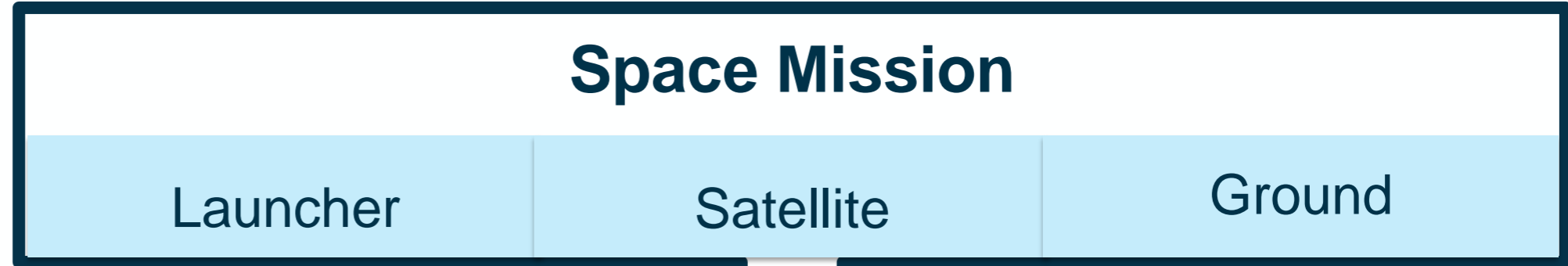
- ❖ Establish the **methodological rules** on how to correctly perform space-specific LCAs
- ❖ To **support the competitiveness of the European space sector** by sharing its knowledge with the European space actors
- ❖ Defining rules and guidelines to support a **consistent approach to LCA** within the European space sector
- ❖ **Promote and facilitate** the use of LCA within the space sector

To that end the handbook addresses the following:

- Explanation on **how to use** the handbook (for all user type)
- Introduction to the **LCA general methodology** (first time users)
- Specificities and difficulties of applying **LCA to the space sector**
- **Guidelines** that are taken into account when conducting a space LCA
- **Communication** of the LCA results

Aid LCA practitioners performing space sector LCAs at the following levels:

1 Functional Breakdown



2 Physical Breakdown





ESA wants to provide an up-to-date Handbook to facilitate and support the LCA activities by European Space stakeholders.

**First publication:** October 2016

**Currently undergoing:** activity to **critically assess the readiness** of the current Handbook

**Future: update** of the Handbook **by the end of 2022.**

The objective of this update include the following:

- ❖ To Critically review ESA LCA Handbook and guidelines developed for integration (e.g. GS)
- ❖ To identify gaps wrt. other similar guidelines
- ❖ To identify and propose relevant options for future updates (inc. eco-design)
- ❖ To review users feedback received



# How to get the Handbook?

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The handbook is available to anyone under request, please contact [cleanspace@esa.int](mailto:cleanspace@esa.int)

# Context and project objectives

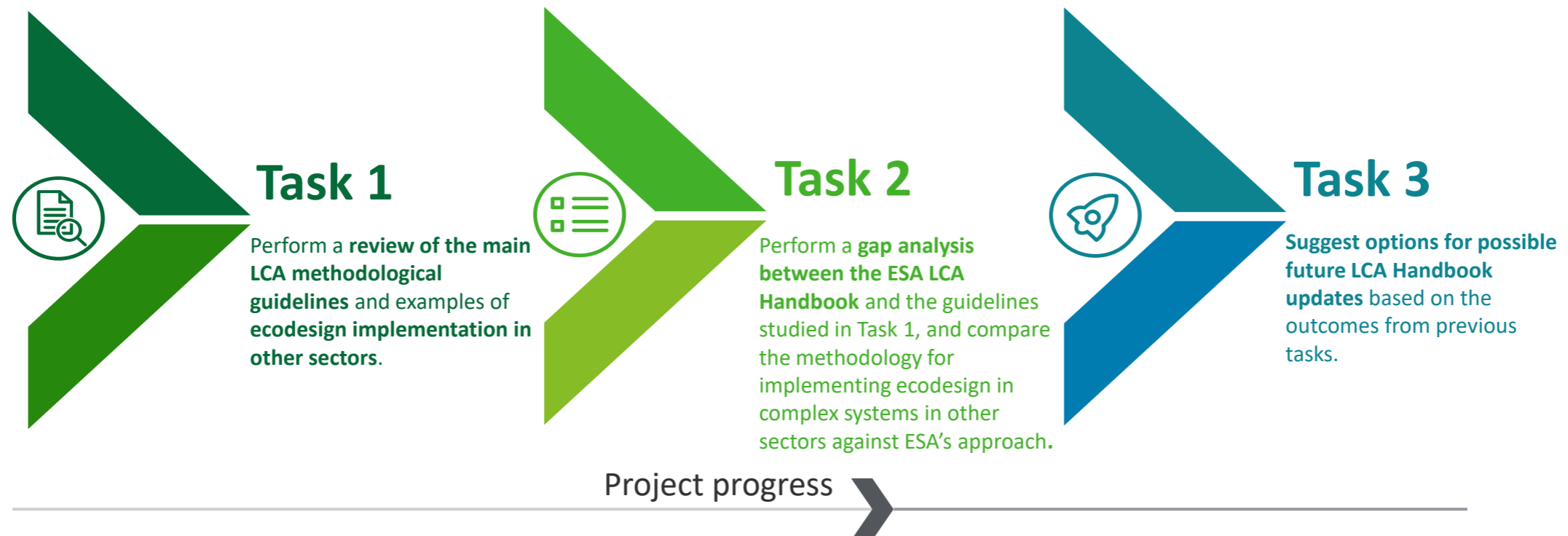
## Context: the ESA LCA Handbook and ecodesign in ESA projects

- The LCA Handbook has been used in various ESA LCA studies, and their **LCA results** were subsequently **used as a basis for evaluating and “ecodesigning” different segments of space missions**. Some examples include:
  - Ground Segment LCA study
  - Ground Station LCA study
  - GreenSat – Sentinel 3b
  - GreenSat – PROBA-V
- The table on the right summarises the different ecodesign approaches used in the four different projects.

Ecodesign aspect	Ground Segment LCA	Ground Station LCA Final	GreenSat – Sentinel 3B	GreenSat – PROBA-V
Segment	Ground segment	Ground segment	Space mission	Space mission
Type of ecodesign	Ecodesign	Environmental mitigation	Ecodesign	Ecodesign
Hotspot analysis	3 indicators of interest	all indicators	all indicators	all indicators
First identification of options	Brainstorming sessions with experts	Brainstorming sessions with experts	Brainstorming sessions with experts	Brainstorming sessions with experts
Trade-off criteria	Environmental, economic, technical	Environmental, economic, technical	Environmental, economic, technical	Environmental, economic, technical
% weight of environmental criteria	30%	50%	51%	Not specified
LCA of each option	Yes, on 3 indicators of interest	No	Yes (simplified)	Yes
Stage of ecodesign process when LCA was used	After trade-off & selection	N/A	Before trade-off	After trade-off & selection
LCA of whole system with final ecodesign options	No	N/A	Yes	Yes

# Main objectives of the project

- In order to keep ESA's leading position in the field of environmental impact assessment and ecodesign for space systems, but also to get the benefits of the experience recently gained through recent projects and make the Handbook even more useful and consistent with other existing guidelines, it is essential to **keep the Handbook up-to-date**. This project **aims at performing a review of the ESA LCA Handbook** to ensure:
  - Coherence with other European LCA guidelines, in particular the guidelines developed by JRC/EC and new recommendations on methods and environmental indicators,
  - Inspiration taken from how ecodesign is implemented in other sectors,
  - Proposal of options for inclusion on new space-specific LCA and ecodesign guidelines.



# Review of existing LCA methodologies



# Key reviewed LCA methodologies

Two main types of guidelines were reviewed as part of Task 1 of the project: the PEF and the International EPD System.

## The Product Environmental Footprint (PEF)



The PEF is an LCA-based method developed by the European Commission in partnership with voluntary organisations and companies. Its main objective is to develop a **harmonised methodology for modelling the environmental impacts associated with a product throughout its life cycle**.

The **PEF Guide** provides rules and recommendations for calculating a PEF and for developing methodological requirements specific to a product category, the Product Environmental Footprint Category Rules (PEFCR).

## The International EPD® System



The International EPD® System is designed to facilitate the development towards increased availability of product- and service-specific environmental performance information at a large scale and provide these in a format that is attractive to the market.

The programme has, as a main objective, the ambition **to enable and support organisations in any country to communicate quantified environmental information on the life cycle of their products** in a credible, comparable, and understandable way.

# Reviewed documents

A total of **16 documents** were reviewed.

## The Product Environmental Footprint (PEF)



- The **PEF 2013 guide** and **2019 update**
- 3 additional supporting documents:
  - Supporting information to the characterisation factors of recommended EF LCIA methods
  - Suggestions for the update of the EF LCA: Impacts due to resource use, water use, land use, and particulate matter
  - Guide for EF compliant data sets



## The Product Environmental Footprint Category Rules (PEFCR)

- The **PEFCR Guidelines**
- 4 specific PEFCRs for:
  - IT equipment
  - Uninterruptible Power Systems (UPS)
  - PV panels
  - Rechargeable batteries



## The International EPD® System



- The **EPD System General Programme Instructions**
- 5 specific Product Category Rules (PCRs):
  - Passenger commercial aeroplanes
  - Business jets
  - Rolling stock
  - Yachts
  - Corrosion protection of fabricated steel products



# Examples of learnings from the reviews

- The **PEF Guide** outlines a **rigorous and comprehensive set of requirements** and methodological points. The **PEFCR** complements methodological points in the PEF and apply them to products through the 21 product-specific PEFCRs.
- The **International EPD® System** has generally **less specific requirements**. The 100+ **product-specific PCRs** provide product-specific guidance.



	PEF guide	PEFCR	EPD System
<b>System boundaries</b>	Raw material extraction through processing, production, distribution, storage, use and end-of-life	<i>Same as PEF</i>	Downstream, core and upstream processes
<b>Environmental impact indicators</b>	16 environmental impact categories	<i>Same as PEF</i>	23 indicators: 7 enviro. Impacts, 8 use of resources, 3 waste production, 5 output flows
<b>Data quality assessment</b>	Mandatory and quantitative, using the DNM and the DQR formula	Same as PEF, with some minor adaptations of the DNM	Recommended (but no specific guidance)
<b>Environmental hotspot analysis</b>	Mandatory, identify “most relevant” impact categories, life cycle stages, processes and elementary flows	Toxicity related impact categories are excluded from analysis	Only a simple analysis required in confidential project report
<b>Product-specific guidelines</b>	/	21 PEFCRs	100+ PCRs

**Acronyms:**

- PEF** – Product Environmental Footprint
- PEFCR** – Product Environmental Footprint Category Rules
- EPD** – Environmental Product Declaration
- PCR** – Product Category Rules
- DNM** – Data Needs Matrix
- DQR** – Data Quality Rating

# Review of ESA LCA Handbook

## Preliminary findings

# Approach used to review the ESA LCA Handbook

## 1. Review

- **Review of ESA LCA Handbook** following the same format as for the other LCA methodologies to facilitate gap analysis
- Critical review of both methodological and editorial/structural aspects, incorporating **user inputs**

## 2. Gap analysis

*[under completion]*

- **Gap analysis with other LCA methodologies reviewed** in Task 1 (PEF & international EPD System)
- **Gap analysis with ESA reference documents**, namely previous LCA project reports (Ground Segment LCA, GreenSat, Ground Station LCA, ...)

## 3. Suggestions for the update

*[to be completed]*

- List of suggestions which can be integrated during the update of the ESA LCA Handbook



# Preliminary findings from the review

**Disclaimer:** the project team is still in the process of finalising some parts of the review and the gap analysis, so the findings presented here are only preliminary and are subject to change and be refined in the coming weeks and months.

- The main review points identified in the ESA Handbook thus far include:



## Methodological aspects

- Inclusions and exclusions from the **system boundary** could be refined based on return on operating experience.
- **Environmental impact categories and characterisation methods** can be outdated and not aligned with most recent LCA methodological frameworks.
- Practitioners are not clearly encouraged to collect specific/primary data: **data requirements** could be refined
- Guidance on data quality assessment could be provided.



## Editorial aspects

- The precise target audience of the Handbook could be clarified (i.e. is it aimed at novice or experienced practitioners?)
- The chapters and sections could be restructured for increased clarity for the reader.



These preliminary findings lay the ground for suggestions to ESA when updating the ESA LCA Handbook, but more insights from the space industry are needed to refine the suggestions and target them towards the most useful aspects.

# Ecodesign initiatives in companies

## Preliminary findings

# Ecodesign initiatives in companies

1.

Screening of ~50 major companies in 6 sectors with challenges similar to the space industry



2.

Pre-identification of ~12 companies most involved in ecodesign and sustainability

Based on **publicly available information** on ecodesign initiatives (website, sustainability reports, published scientific articles, etc), three criteria were evaluated for pre-selection:

- Use of LCA to assess product ecoprofiles
- Implementation of ecodesign in product development
- Implementation of ecodesign with LCA

3.

Interviews of 8 companies\* across the 6 sectors to understand the motivation and implementation of ecodesign approaches

The interviews aimed to **understand the ecodesign approach** used (methodology, tools, use of LCA, environmental impact indicators), the articulation with the product development process, and the results and impacts of adopting this ecodesign approach.

*\*Disclaimer: the project team is still in the process of conducting and finalising the analysis from these findings, so the interviewed company names cannot be disclosed at this stage.*

# Preliminary findings from ecodesign interviews

- The key take-away points thus far include:



**Environmental challenges** and ecodesign approaches are in fact **specific to each company**



**LCA** is overall **widely used** by other industrial sectors



Ecodesign can be based on LCA, but not only



Initially, companies based themselves on existing environmental guidelines (LCA guidelines, ISO 14001), and with increasing experience, **developed their own internal ecodesign guidelines**



**Multiple environmental indicators** are focused on, most notably: climate change, energy use, and recyclability



Both a **product-oriented** approach and a **site-level environmental management** approach are commonly used



**Collaboration between different actors in the supply chain** can facilitate data collection while complying with data confidentiality requirements

# Thank you for your attention!

## Before our group discussion, do you have any questions?

### Contacts:

- Sara Morales - [sara.morales@esa.int](mailto:sara.morales@esa.int)
- Augustin Chanoine - [achanoine@deloitte.fr](mailto:achanoine@deloitte.fr)

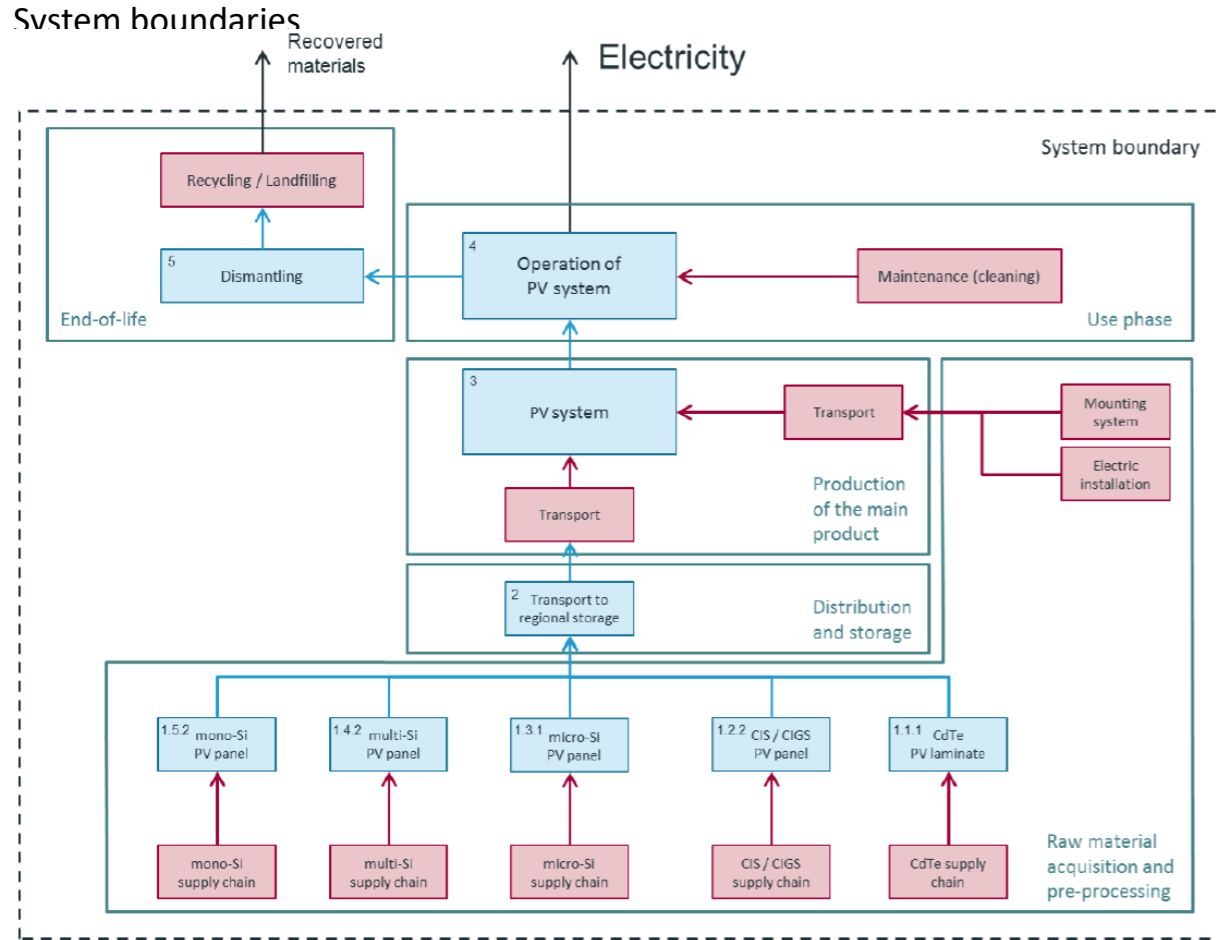


# Group discussion

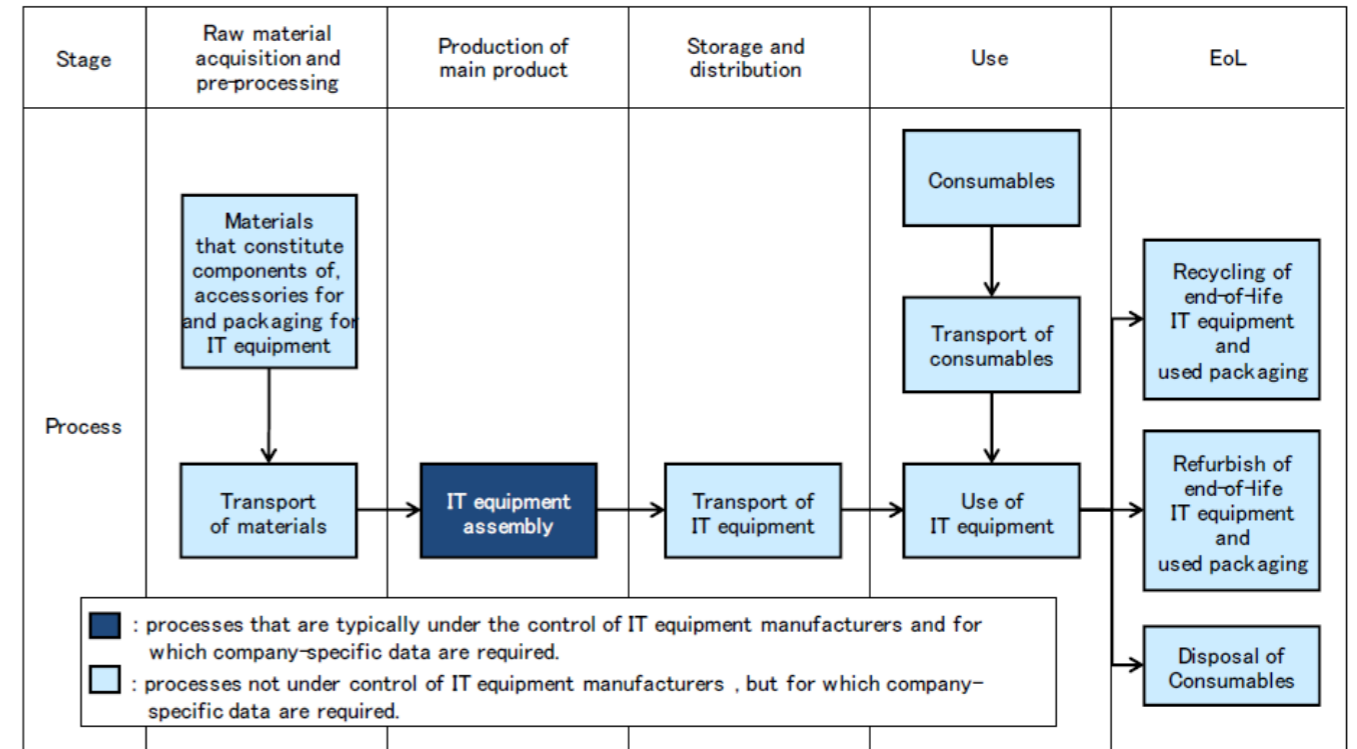
# Backup

# Reviewed PEFCRs: comparison of system boundaries (1/2)

## System boundary for PV modules

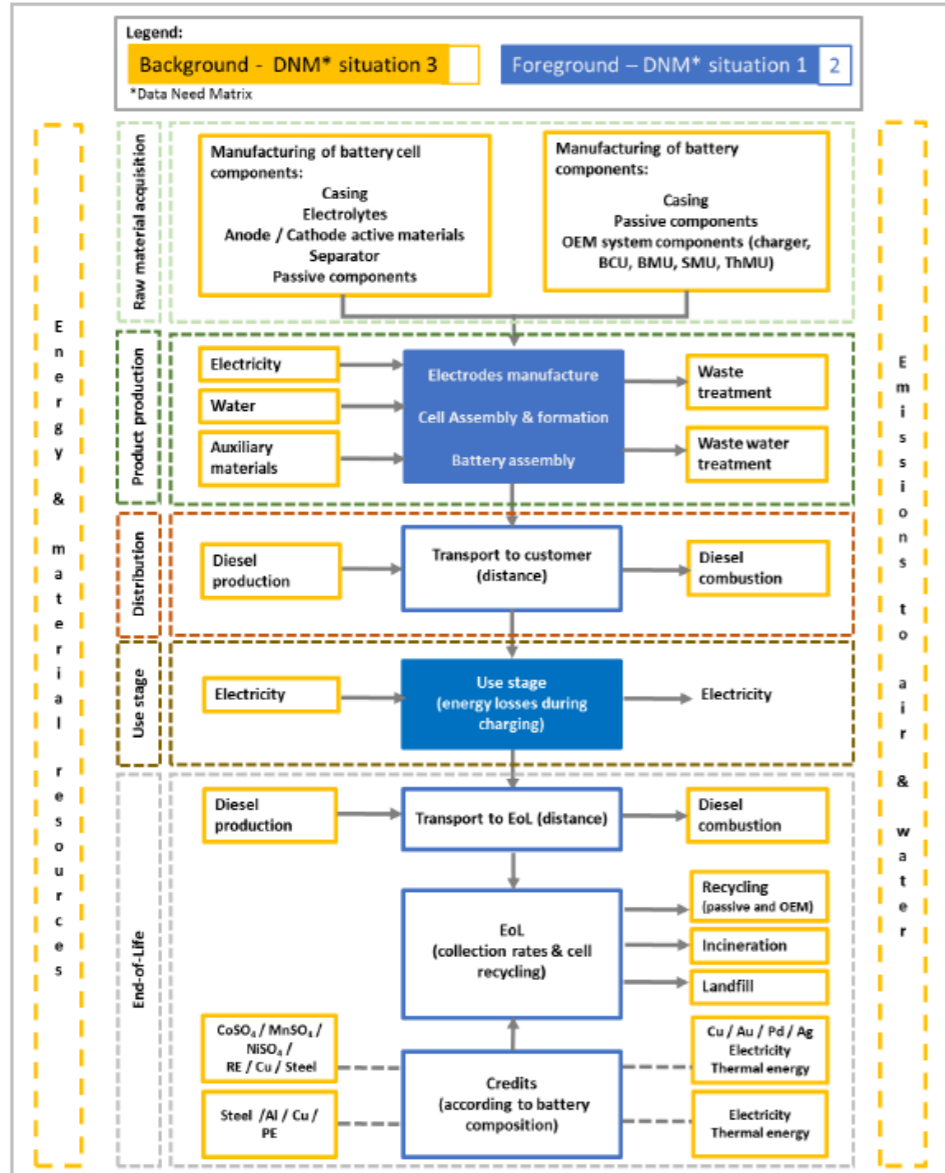


## System boundary for IT equipment

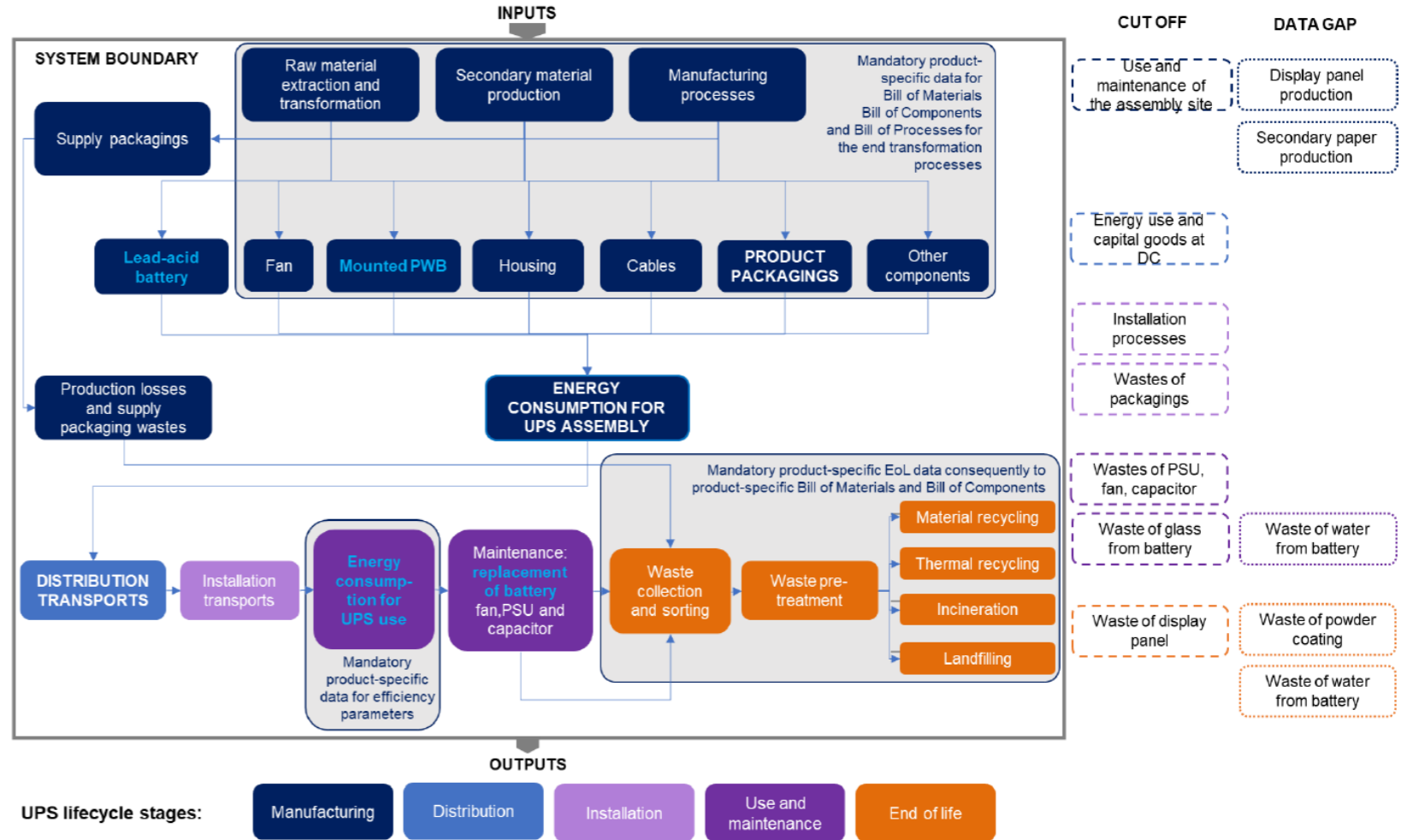


# Reviewed PEFCRs: comparison of system boundaries (2/2)

## System boundary for batteries



## System boundary for UPS



**Notes:** Processes in bold capital letters are processes expected to be run by the Applicant; Processes in blue bold are the most relevant of UPS' lifecycle

# The PEFCR Guidance: focus on the DNM

- A list of mandatory company-specific datasets needs to be determined, based on relevance in the EF profile, effort required to collect data, and quantity/time required to collect all mandatory data.
- For activity data and processes other than mandatory company-specific, the DNM is applied in a manner similar to the PEF 2019, except:
  - a differentiation of requirements is made between most relevant and non-most relevant processes,
  - for each Situation (1, 2 or 3), an extra option is added for non-most relevant processes. In this option, secondary data listed in the PEFCR can be used for non-most relevant processes, along with its default DQR values.
- The DNM in the PEFCR is shown on the right.

Table 35: Data Needs Matrix (DNM) – Requirements for the applicant of the PEFCR. The options indicated for each situation are not listed in hierarchical order.

		Most relevant process	Other process
<b>Situation 1:</b> process run by the company applying the PEFCR	<b>Option 1</b>	Provide company-specific data (as requested in the PEFCR) and create a company-specific dataset partially disaggregated at level 1 (DQR≤1.6)  Calculate the DQR values (for each criterion + total)	
	<b>Option 2</b>		Use default secondary dataset in PEFCR, in aggregated form (DQR≤3.0)  Use the default DQR values
<b>Situation 2:</b> process <u>not</u> run by the company applying the PEFCR but with access to company-specific information	<b>Option 1</b>	Provide company-specific data (as requested in the PEFCR) and create a company-specific dataset partially disaggregated at level 1 (DQR≤1.6)  Calculate the DQR values (for each criterion + total)	
	<b>Option 2</b>	Use company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain specific EF compliant datasets (DQR≤3.0)  Re-evaluate the DQR criteria within the product specific context	
	<b>Option 3</b>		Use company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain specific EF compliant datasets (DQR≤4.0)  Use the default DQR values
<b>Situation 3:</b> process <u>not</u> run by the company applying the PEFCR and without access to company-specific information	<b>Option 1</b>	Use default secondary data set in aggregated form (DQR≤3.0)  Re-evaluate the DQR criteria within the product specific context	
	<b>Option 2</b>		Use default secondary data set in aggregated form (DQR≤4.0)  Use the default DQR values



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