WEBINAR

ecoDesign: rationale, status and vision

TODAY'S SPEAKERS

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ESA System Engineer for:

- EcoDesign & LCA for space
- CleanSat – debris mitigation – End-of-life activities
- OMAR – in-Orbit Manufacturing Assembly and Recycling

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Sibyl-Anna de COURSON

ESA Trainee for:

- EcoDesign & LCA for space
- OMAR – in-Orbit Manufacturing Assembly and Recycling

TODAY'S MODERATORS

ANTONIO CAIAZZO

TIAGO SOARES

MARION MIRAILLES

AGENDA

1. RATIONALE: Environmental context
2. OVERVIEW: ESA context
3. THE VISION FOR ECODESIGN

Q&A

1. CONCEPT: LCA & Ecodesign
2. ESA LCA Database: Overview and Validation process
3. Q&A

RATIONALE:
Environmental context

Scope

EcoDesign branch

Is necessary to understand how much space activities pollute on Earth and to identify alternatives to reduce the environmental impacts

LCA (Life Cycle Assessment)

Assessing the environmental impact of the space missions during the whole life cycle

Eco-design

Identifying alternative processes or technologies that can be used to reduce these impacts

Environmental regulation

Find alternatives to avoid costly disruptions and reply to legislations

Context: European Level

Environmental protection is of main concern for European citizens

Most European countries adopted **environmental laws and practices**

EC published **European Green Deal** published in 2019

94% of the European Citizens think that protecting environment is very or fairly important

European Directives:

RoHS COMPLIANT

COMPLIANT · COMPLIANT · COMPLIANT
REACH

'Obsolescence risk'

Informative list (to support policies):
Critical Raw Materials

Broader sense:
Sustainability of the Space European **value chains**

Context: Space sector at international level

UN Sustainable Development Goals (SDGs)

United Nations

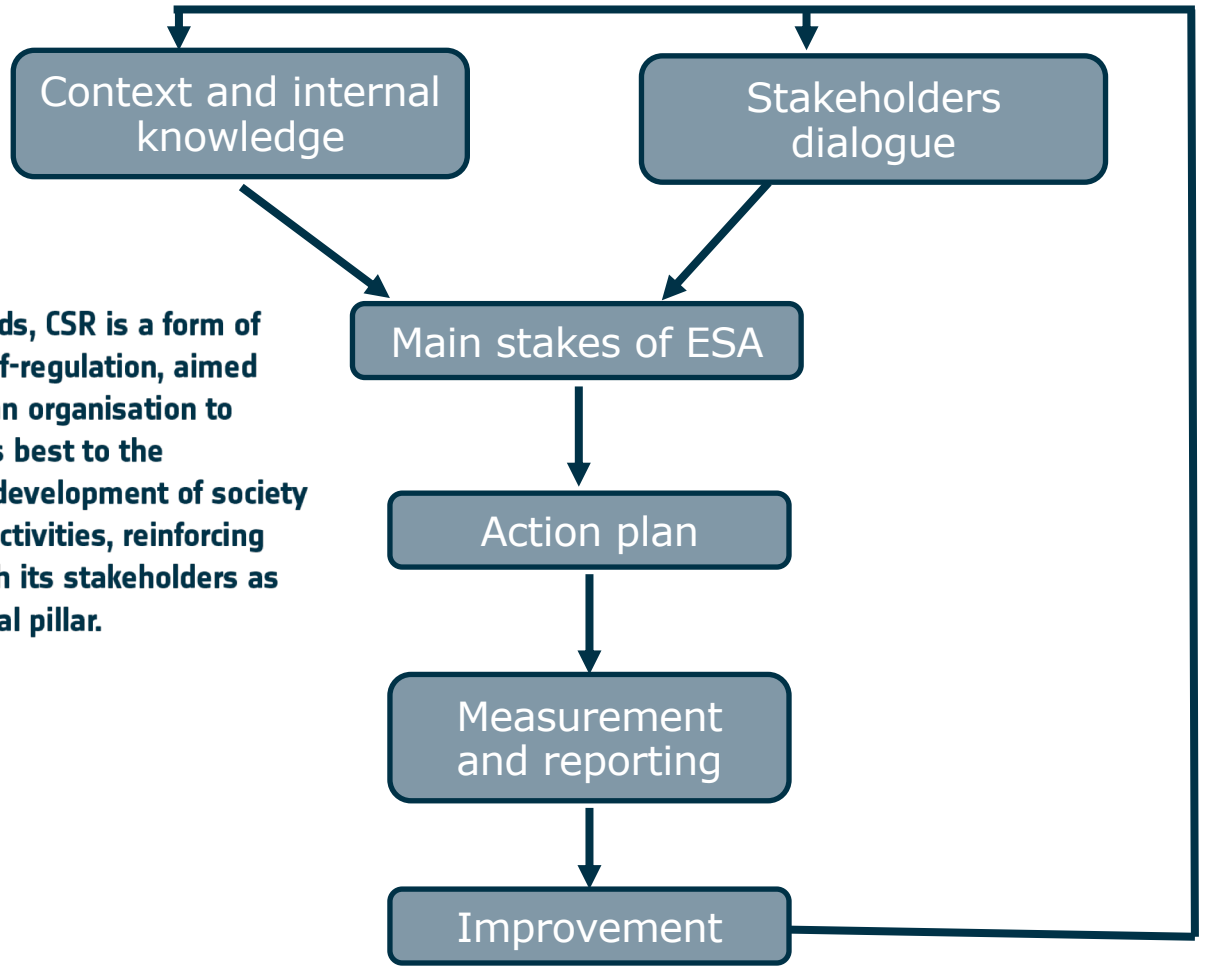
General Assembly

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-fourth session
Vienna, 30 January-10 February 2017

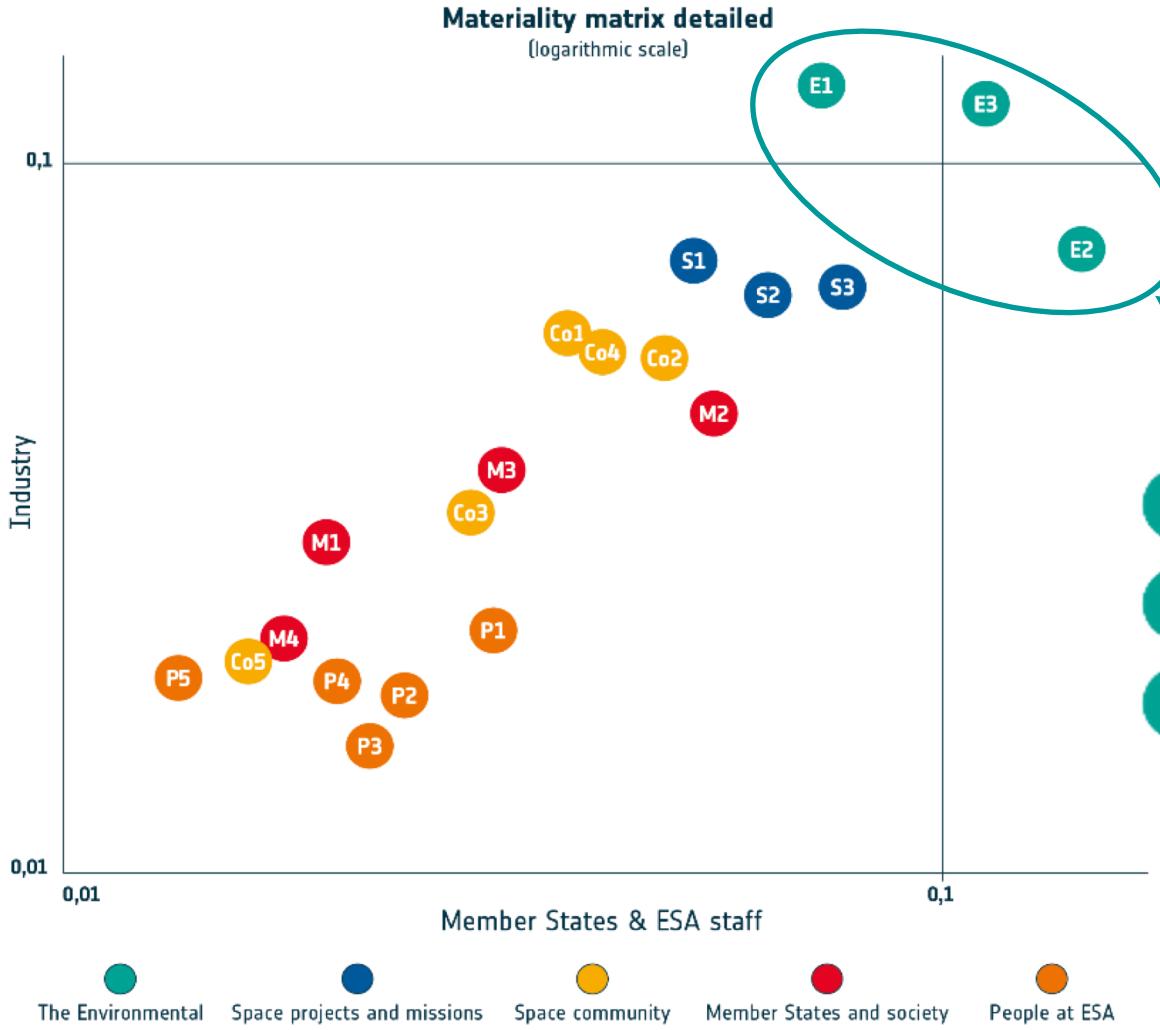
27.3 States and international intergovernmental organizations should promote the development of technologies that minimize the environmental impact of manufacturing and launching space assets and that maximize the use of renewable resources and the reusability or repurposing of space assets to enhance the long-term sustainability of those activities.

ISO 26000 – Our standard approach for Corporate Social Responsibility

In other words, CSR is a form of corporate self-regulation, aimed at enabling an organisation to contribute its best to the sustainable development of society through its activities, reinforcing dialogue with its stakeholders as a fundamental pillar.



ESA CSR stakes & challenges

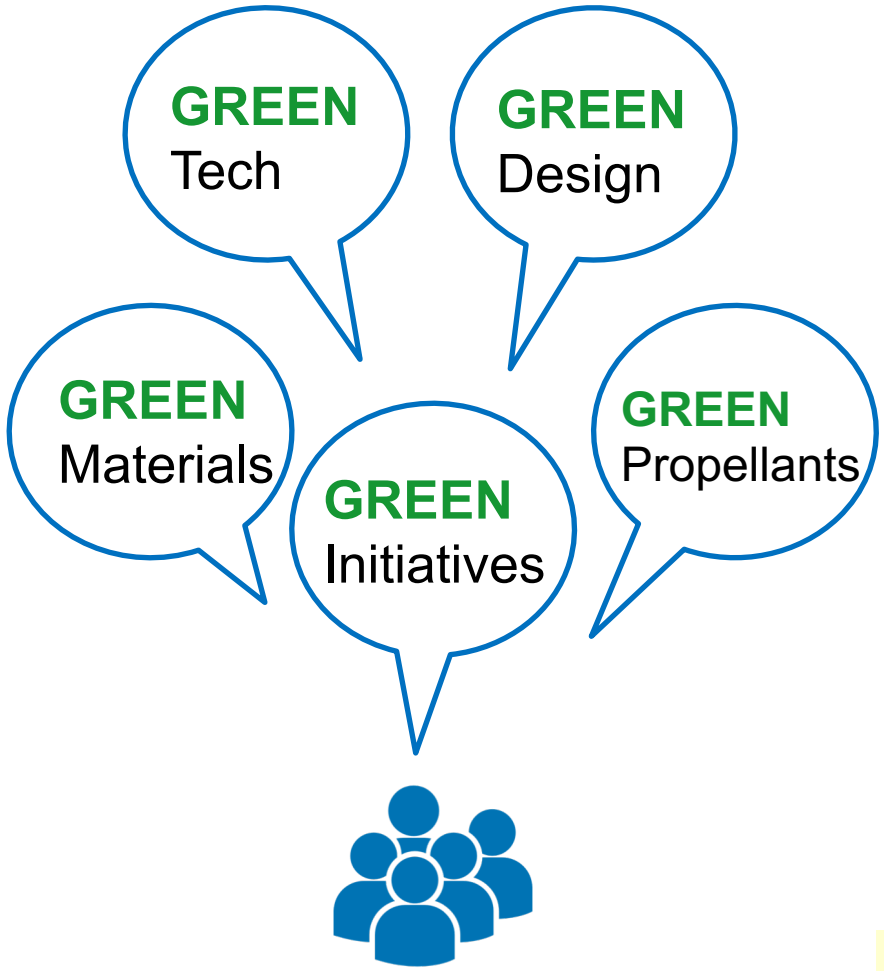


Environmental matters

- **E1** Environmental impact of space missions
- **E2** Environmental impact of sites & infrastructure
- **E3** Contribution to environment monitoring and protection

Overview:
LCA & Ecodesign
ESA context

Assessment of the environmental performance



It also works with '**Eco-friendly**'… ☺

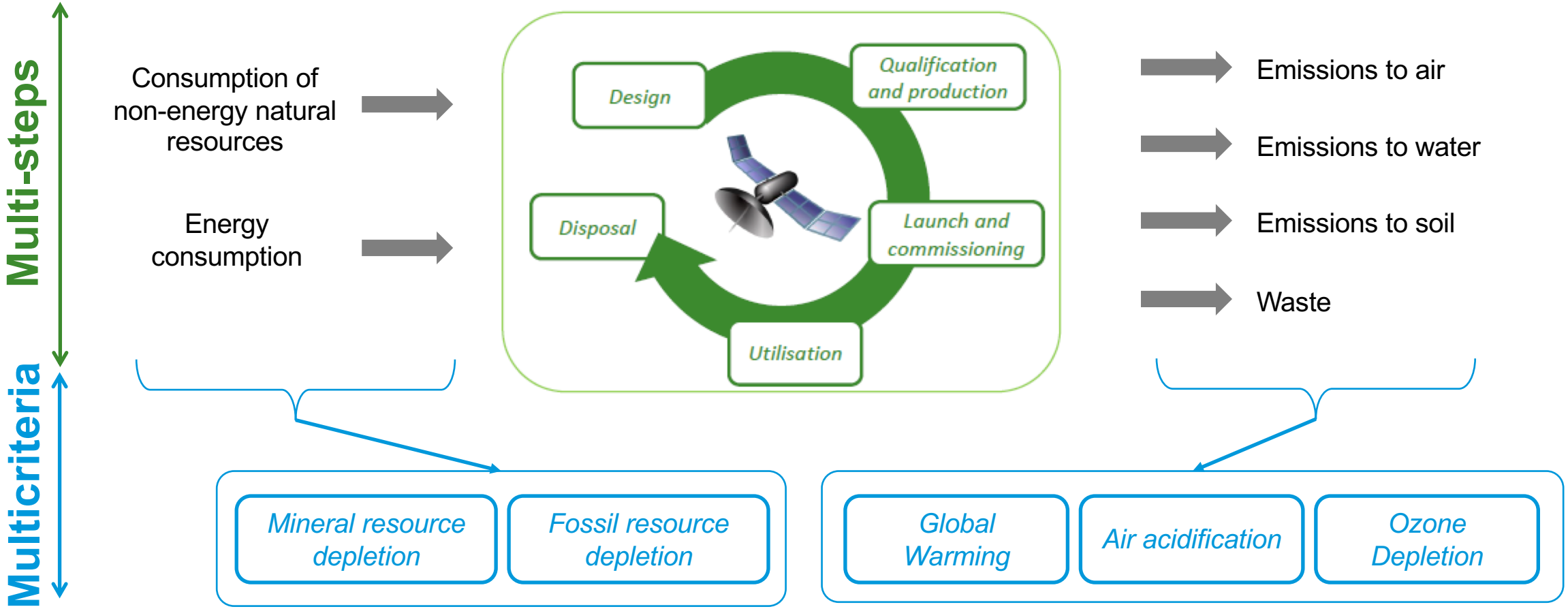
- Toxicity ? (impact on Human health)
- Eco-toxicity ? (impact on Ecosystems)
- Carbon Footprint ? (impact on Climate Change)
- Bio-based ? (Impact on resource depletion)
- Only compliant with the European legislation?

Reliable, comparable and verifiable information also plays an important part in enabling buyers to make more sustainable decisions and reduces the risk of 'green washing'. Companies making 'green claims' should substantiate these against a standard methodology to assess their impact on the environment. The Commission will step up its regulatory and non-regulatory efforts to tackle false green claims.

Brussels, 11.12.2019
COM(2019) 640 final

Life Cycle Assessment

To quantitatively assess the potential environmental impacts of a product or service

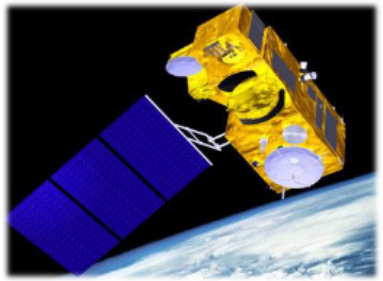


ESA LCA approach

ESA has performed LCA of the 3 different segments:

LCA Launch Segment

LCA Space Segment



LCA Ground Segment

Applying LCA to space is not straightforward:
Many Specificities!!

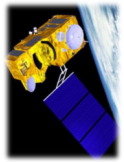
Specificities of LCA applied to space

LCA Launch Segment

- **Direct impacts in all layers of the atmosphere**

LCA Ground Segment

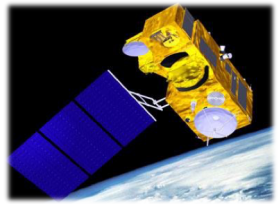
- **High energy consuming data centers**
- Big dedicated/specific infrastructures



LCA Space Segment

- **Low Production rates**
- Specific and power consuming tests
- **Long development cycles and R&D**
- Specific materials, propellants & components

EcoDesign – building a framework



ESA LCA Handbook

LCA Database

Available under request

Available under ESA contract*

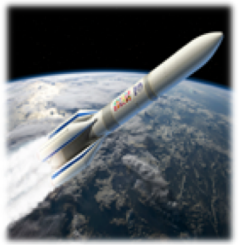
Ecodesign definition

Ecodesign aims to:

Improve the environmental performance of products and services via the assessment of their environmental impact at the design stage, **without reducing their quality or performance**.

Description of the activities: Implementation

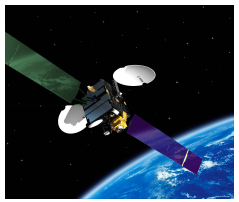
→ Green Technologies



→ ESA Projects

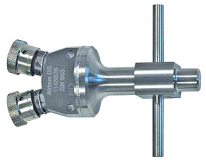
Environmental Footprint

Ex: Efficient use of Ge

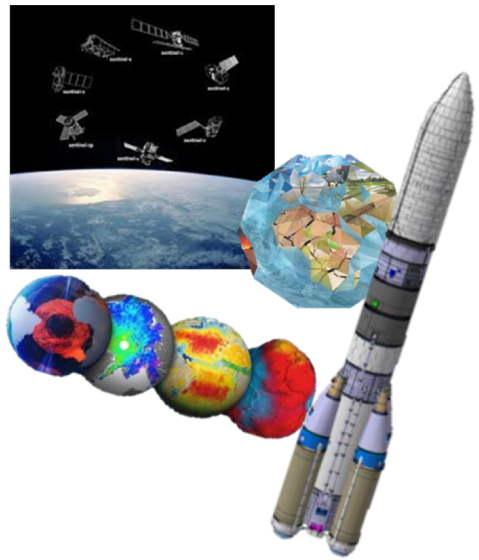


Environmental Regulation

Ex: Replacement of pyrotechnic powders



- **Ariane 6**
- **Earth Explorer**
- **Copernicus**
- **Galileo**

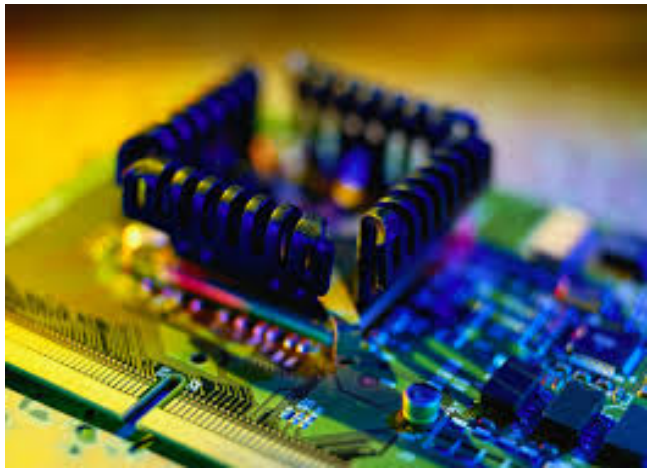


New activities

Program: TDE

Budget: 350 k€

Duration: 12 months



→ **Green Electronics:** ITT in EMITS open until 4th September

Objective: Analyse the different possibilities and to demonstrate the

effectiveness of mitigation actions through LCA of space electronics.

THE VISION FOR ECODESIGN

Creating Awareness:

Training on LCA and eco-design for space (2 day course)

- Opened to all European Industry and Academia
- 3 sessions performed (2016, 2018, 2019)

ecodesign

→ REDUCING IMPACTS

Main Aspects covered:

- Main principles of LCA and life-cycle thinking
- Specificities of LCA applied to the space sector
- How can sustainability be implemented in space missions, and what has been done on the topic of sustainability in the European space sector
- Theory and practical exercises

Furthermore: ESA visited 8 Universities & run a LCA board game in every Concurrent Session hosted by ESA Academy

The vision

Corporate Social Responsibility

AIRBUS DEFENCE & SPACE · OHB · ThalesAlenia Space · LEONARDO · AVIO · ariane GROUP

Creating awareness

- Training
- LCA game

Short term

Assess

Support European Space sector to assess and report environmental impacts.

- Handbook
- DataBase

Medium term

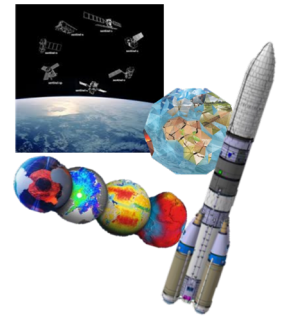
Mitigate

Eco-design and development of “green” technologies.

Long term

Integrate

- Contribution to Sustainable Space missions
- In space recycling



Summary

1. LCA is an ISO standardized methodology which prevents burden shifting (multistep and multi-criteria process)
2. LCA & eco-design can be applied to space after adaptation
3. Europe and ESA are world leader & reference for LCA and Ecodesign applied to space by creating framework thanks to the first LCA Database and Handbook for space systems
4. EcoDesign needs to be applied from early phases of the mission development
5. Opportunity for product development and innovation
    - Reduced costs due to lower material and energy consumption and avoidance of waste and harmful substances
6. Awareness is also necessary

Q&A

Life Cycle Assessment & eco-design concepts

Clean Space | 24/06/2020 | Slide 24

Definitions

Goal of study

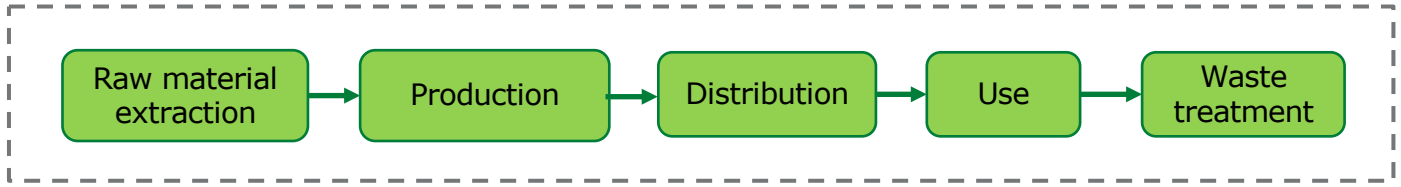
Compare the environmental impacts between reusable and disposable coffee cups.

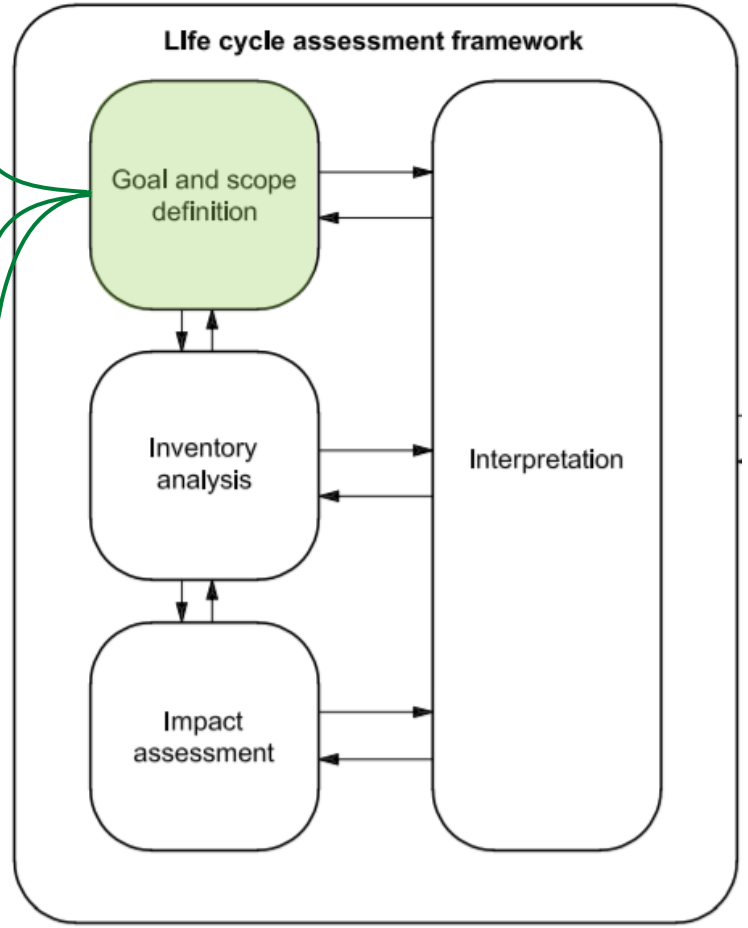
Functional Unit

To drink 2 cups of coffee per day for 500 days (1000 coffees)

 … vs 

System boundaries





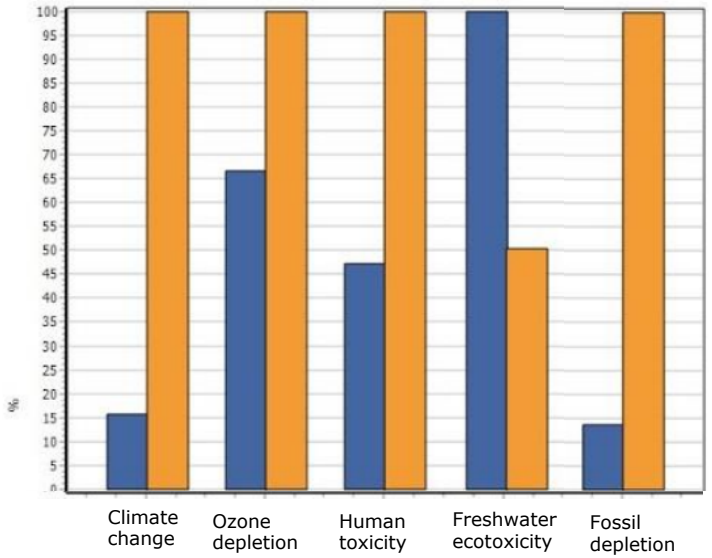
Ref: ISO 14040 - 14044

Definitions

Category	Inputs	Quantity
Materials	Paper	
Processes	Production process	
	Recycling of paper	
	Municipal waste collection by truck	
	Treatment of municipal solid waste	

Category	Inputs	Quantity
Materials	Raw materials	
Processes	Production process	
	Washing cycle (with detergent)	
	Treatment of municipal solid waste	

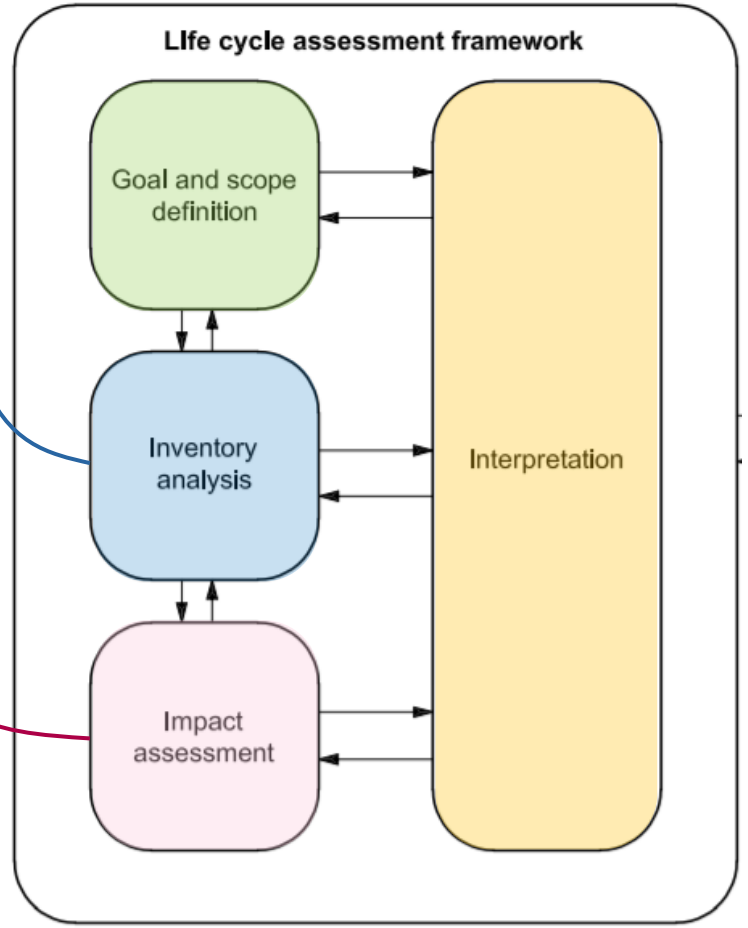
Inventory



Environmental results

Porcelain cup

Paper cup



Ref: ISO 14040 - 14044

LCA applied to space

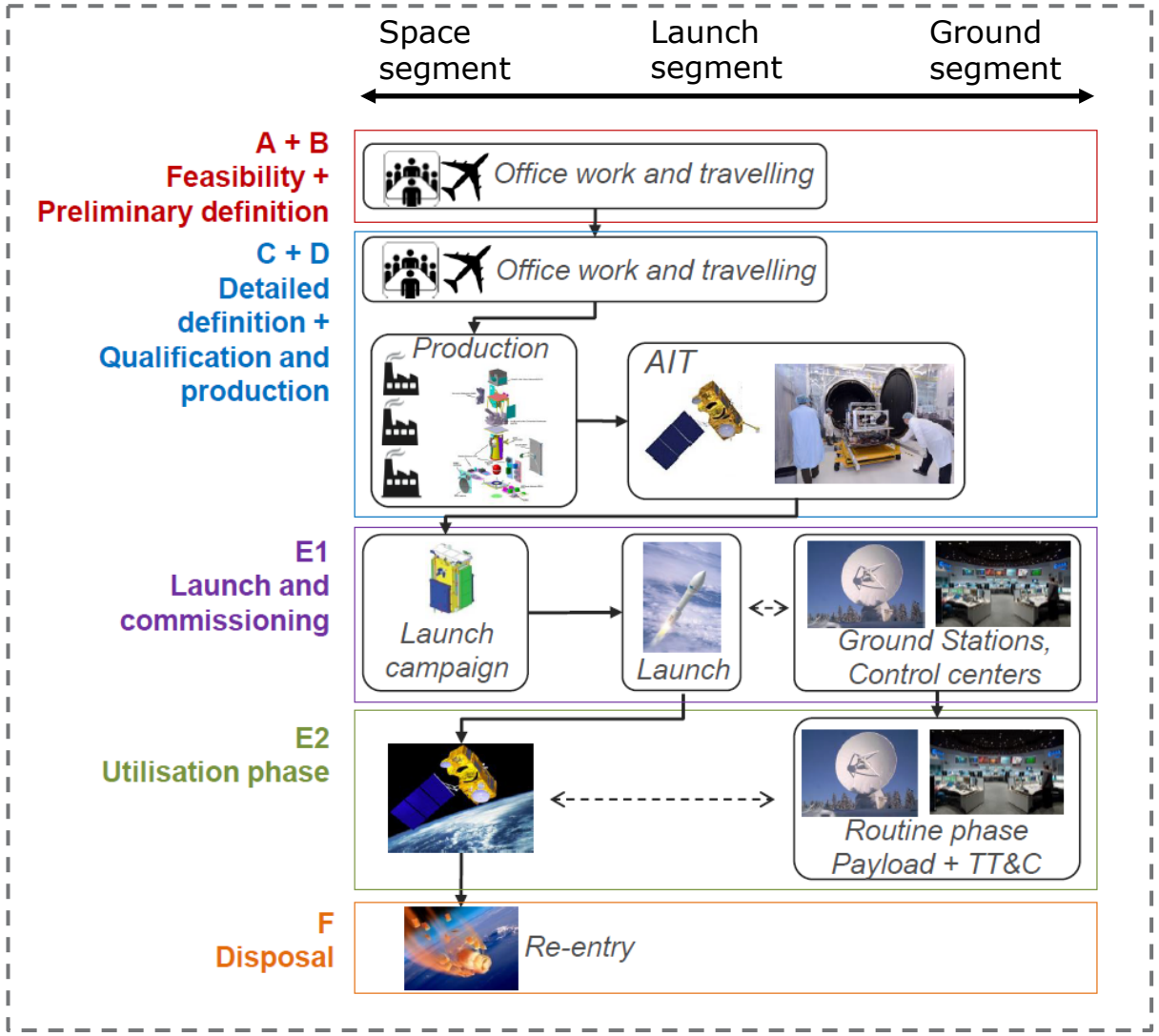
Goal of study

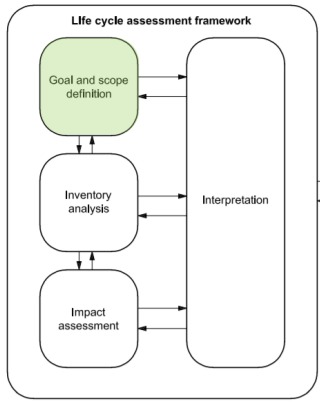
To assess the environmental impacts of the space mission

Functional Unit

One space mission in fulfilment of its requirements

System boundaries

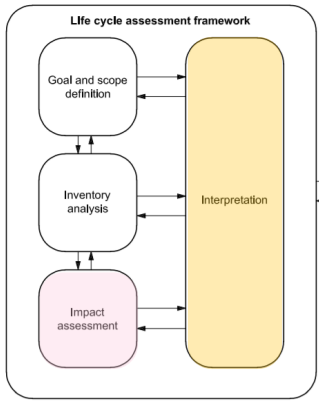




LCA applied to space

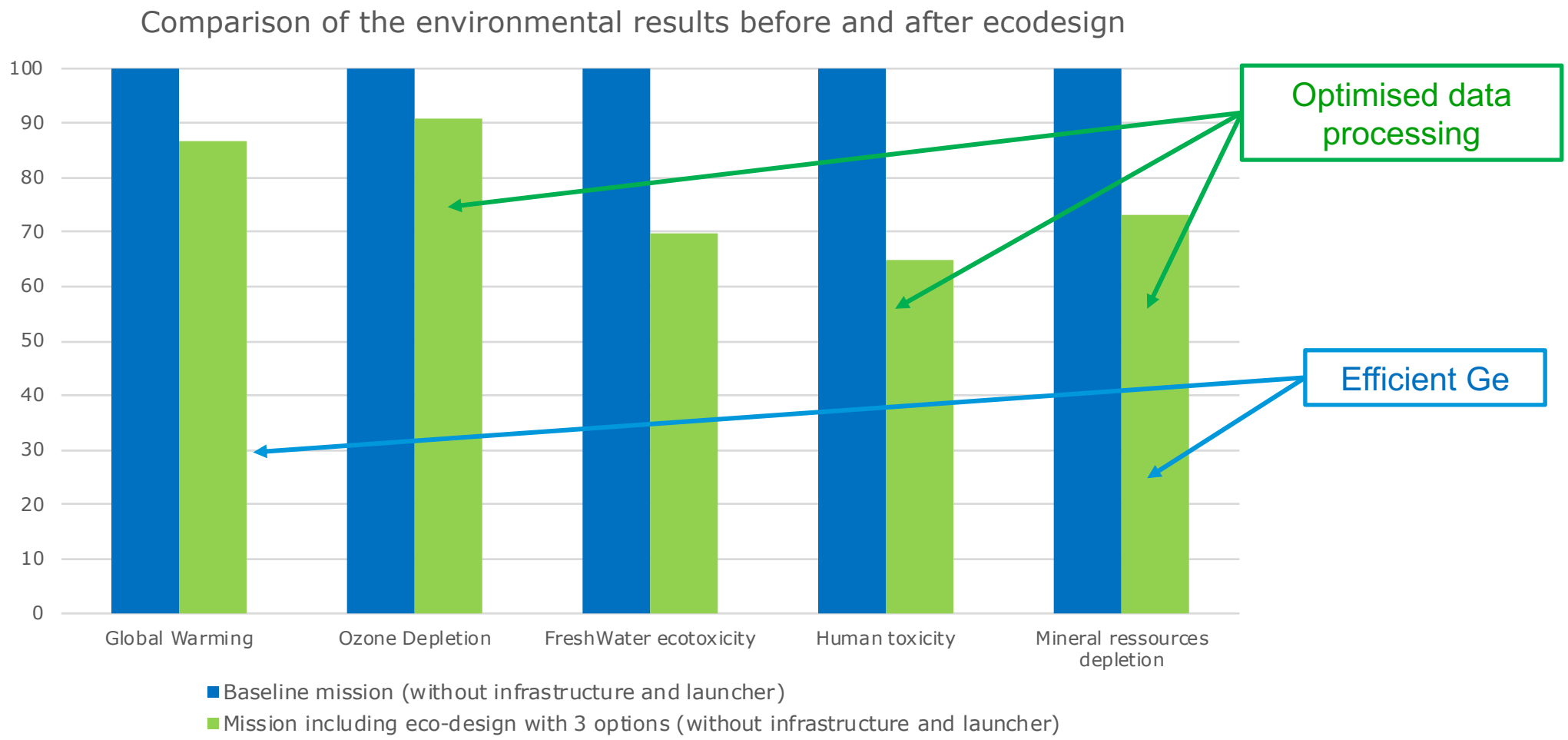
Environmental results

Interpretation



Source: GreenSat

GreenSat: Eco-design solutions and reduction



Source: GreenSat

Database: Overview and validation process

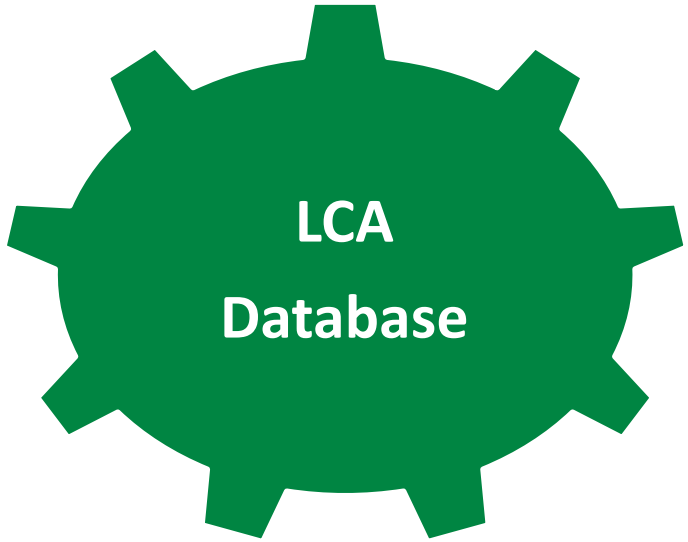
Introduction to the ESA LCA DataBase

Database creation:

Space Specific Materials & Processes LCA

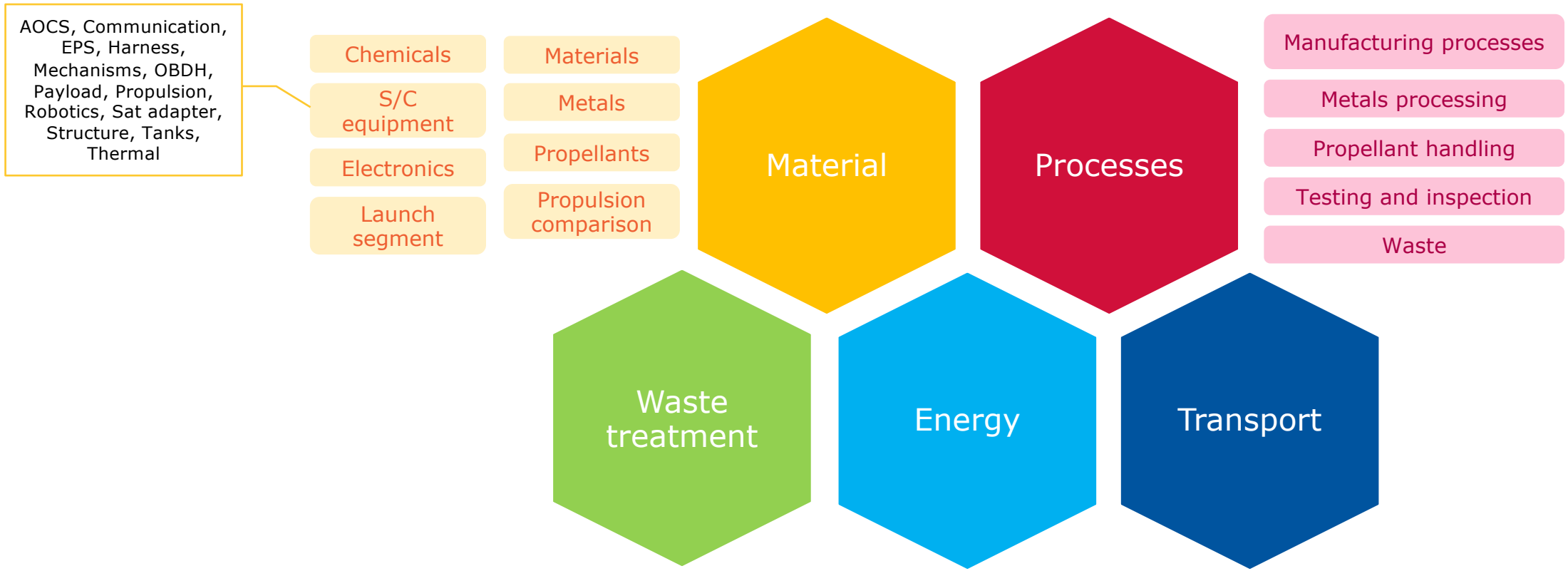
Space specific Propellants LCA

Projects: space missions LCA & GreenSat

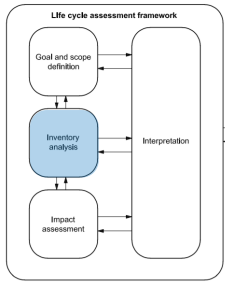


Introduction to the ESA LCA DataBase

Database structure:



Database usage and validation process



Satellite/mission

S/C equipment

software

equipment model

Dataset

Materials
Processes
Tests

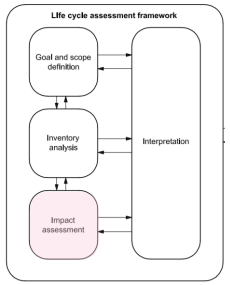
Combination

Satellite/mission model

Materials
Processes
Tests

Calculated by the software

Environmental results

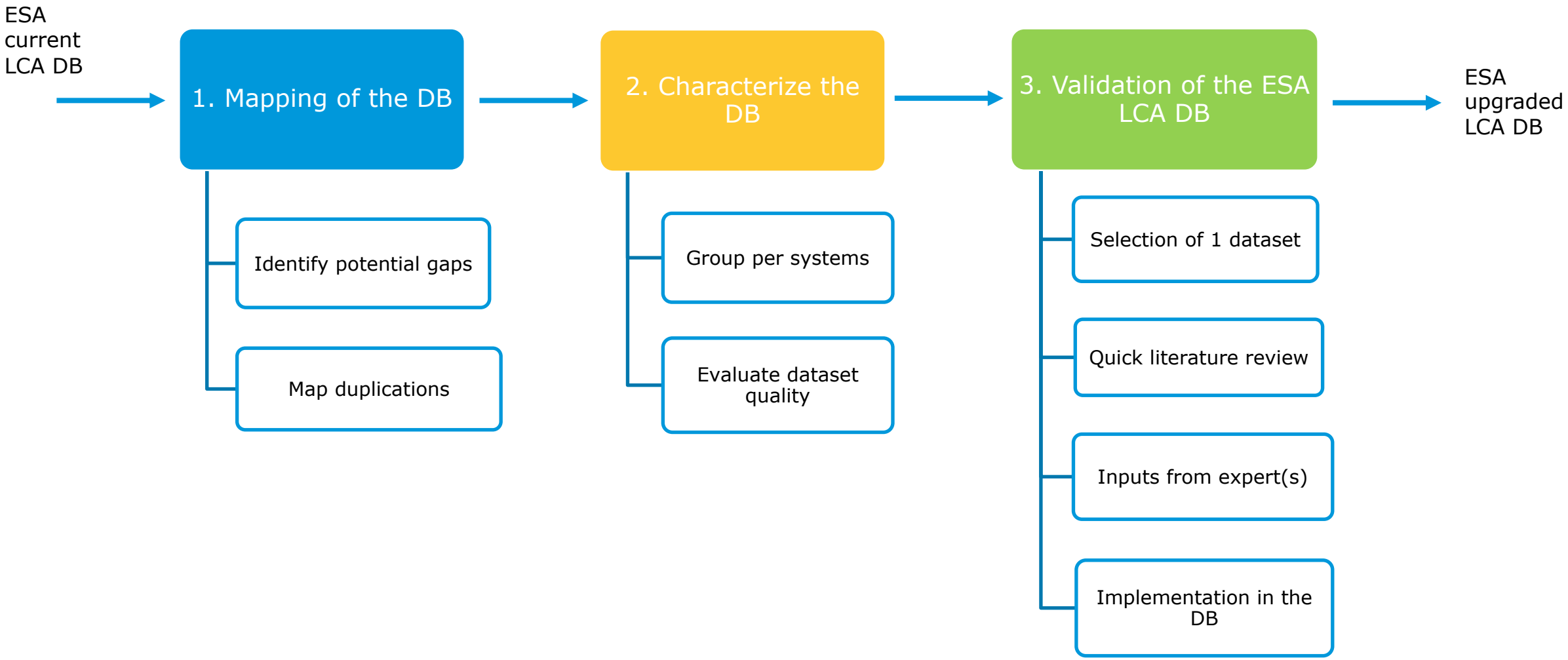


Main objectives of the DB validation:

- Crosscheck the data with experts
- Improve data quality
- Analyze how granularity of a dataset affects the environmental impacts

→ Reliable ESA LCA DataBase

Methodology for validation



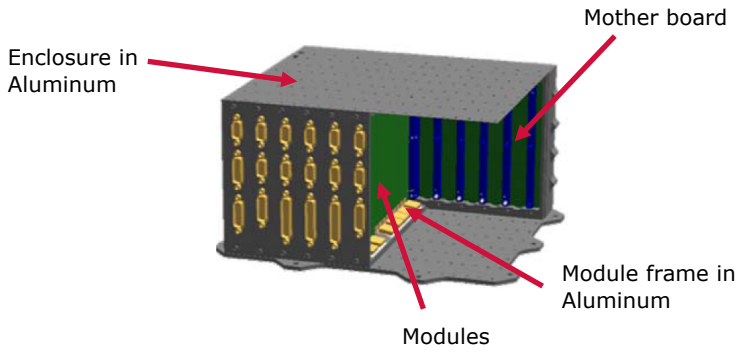
Poor quality vs good quality dataset

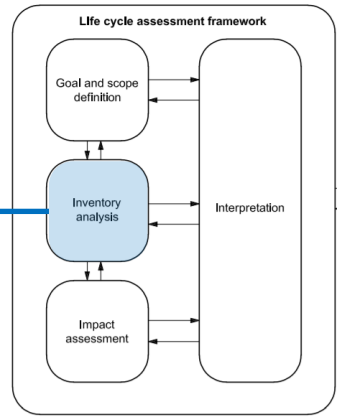
What is the difference between the validation process depending on the dataset quality?

Good quality	High level verification, gap identification, validation of the model
Medium quality	Gap identification, reuse of some inputs from the old dataset(s) to create a generic model.
Poor quality	Start from scratch and build the model with the expert, creation of a generic dataset to be used in future activities

Example of equipment - PCDU

1) Literature review
2) Meeting with expert
3) Inputs from expert (documentation, excel filling)
4) Modification of dataset





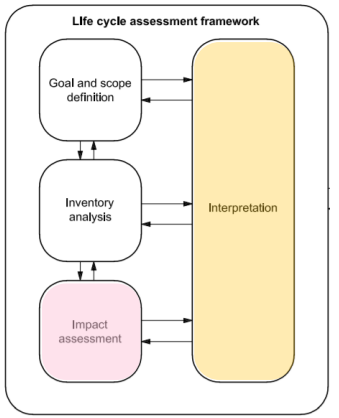
Inventory

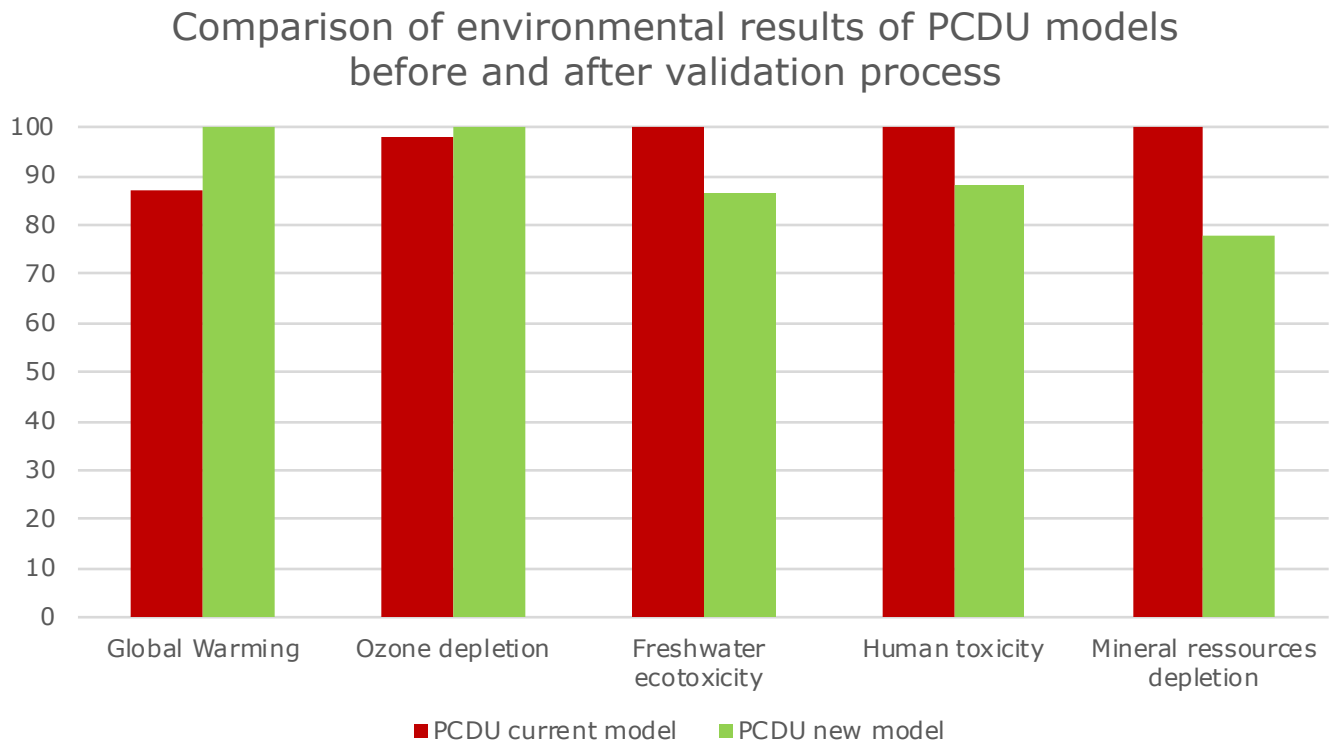
PCDU assembly – current model		X	kg
category	Inputs	total	unit
Materials	Aluminium (housing and frames)	[redacted]	kg
	PCB	[redacted]	kg
	Connectors	[redacted]	kg
	PCB flexible interconnection	[redacted]	kg
Processes	Sheet rolling	[redacted]	kg

PCDU assembly – new model		X	kg
category	Inputs	total	unit
Materials	PCDU housing	[redacted]	g
	Modules frames	[redacted]	kg
	Screws, Washers and nuts	[redacted]	g
	Assembly screws	[redacted]	g
	Bus bar	[redacted]	g
	Eyelet and solder lugs	[redacted]	g
	Mother board	[redacted]	g
	Modules PCBs	[redacted]	kg
	Solder bar	[redacted]	g
	Solder paste	[redacted]	g
	Mapsil coating	[redacted]	g
	Connectors	[redacted]	p
	PCB flexible interconnection	[redacted]	g
Processes	Screws, Washers and nuts passivation	[redacted]	m2
	Drilling	[redacted]	g
	Sheet rolling	[redacted]	kg
	Machining of aluminium	[redacted]	kg
	…	[redacted]	
Tests	Electrical test	[redacted]	
	Formal Test	[redacted]	
	Conformity control	[redacted]	
	Technological control	[redacted]	

The influence of granularity on LCA results

PCDU impacts before and after validation and modification.





Conclusion:

- The results are not predictable, it depends on the impact category
- Need to have reliable models

Confidentiality of information

2 versions of the ESA LCA DataBase:

Internal DB

Unit processes

- **Full visibility**
- Pros: Possibility to modify the inputs to adapt it to their technology

External DB

System Processes

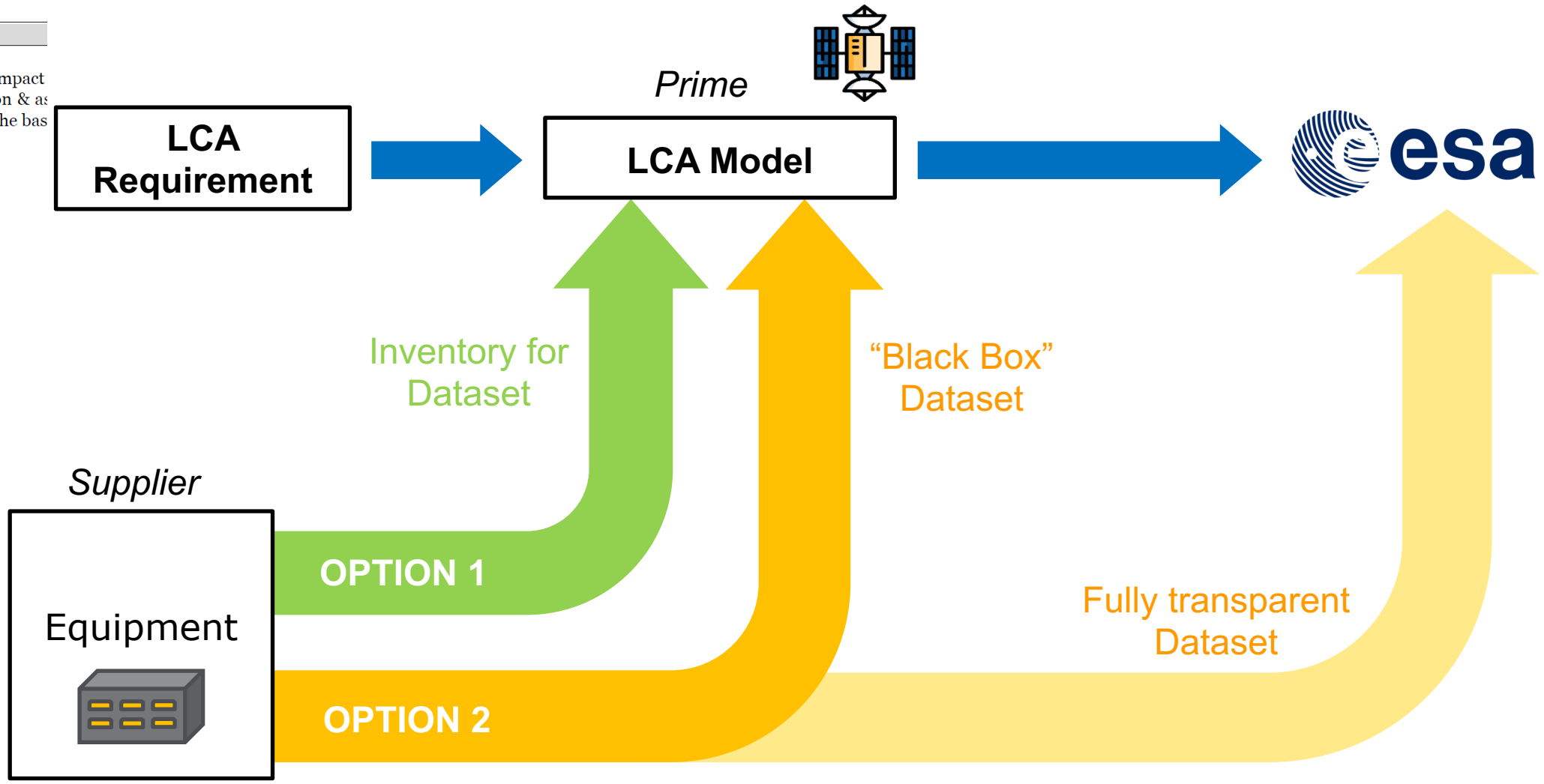
- No visibility on confidential information: **Black boxes** (no details of material, processes or energy consumption)
- Cons: No possible modification

Note: when low quality or not fully transparent datasets, penalties on environmental footprint are applied

Data flow – Dealing with Confidential Information

A6-SOW-1-RQ-076

Description:
The environmental impact considering production & as to that of A5 ECA on the bas



New activities

→ **ESA LCA Database:** ITT to be published in July

Objective: Continued operational activities and updates of the existing ESA Environmental Life Cycle Assessment (LCA) Database.

Program: S2P

Budget: 800 k€

Duration: 3 years

Clean Space Webinar Series

ecodesign

+ REDUCING IMPACTS

management of end of life

+ SPACE DEBRIS REDUCTION

in-orbit servicing

+ ACTIVE DEBRIS REMOVAL

Next webinar:
Cleanspace & Art & Education
23rd July

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Q&A

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