How to promote sustainability in your mission design?

EPFL Handbook on Sustainable Practices of Space Mission Design

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Introduction

The space sector is increasingly aware of its **rising impacts** on the **environment**, **orbital resources** and **astronomy**. However, there is **a lack of centralized resource** which bundles the various technical solutions and best practices on how to limit the negative impacts. This leaves some engineers and managers without a complete overview on how to limit the impacts. **To fill this gap**, EPFL is developing a **Handbook on sustainable practices for space mission design**.

Goal

The **main target audience** for the handbook are **system engineers** who are at the early design stages of developing a space mission, and **managers** and decision-makers who wish to gain an over-arching insights. As such, the Handbook's goal is threefold:

- Provide a **general overview** of elements to consider during the design process of future space missions **to address sustainability concerns**.
- Offer recent **relevant resources** on technological solutions and operational best practices, to **simplify readers' further research**.
- Provide common **trade-off considerations** to equip the reader with sufficient knowledge **to assess the sustainability aspects** of their current design.

In short, the Handbook is a tool to gain knowledge on state-of-the-art best practices and recommendations for sustainable space mission design, as well as to understand where to look for further information.

Sustainability focus

The Handbook addresses:

- **Sustainability *for space*** : recommendations to reduce earth environmental impacts
- **Sustainability *in space*** : recommendations on how to preserve orbital resources and the dark and quiet skies.

Contents of the Handbook

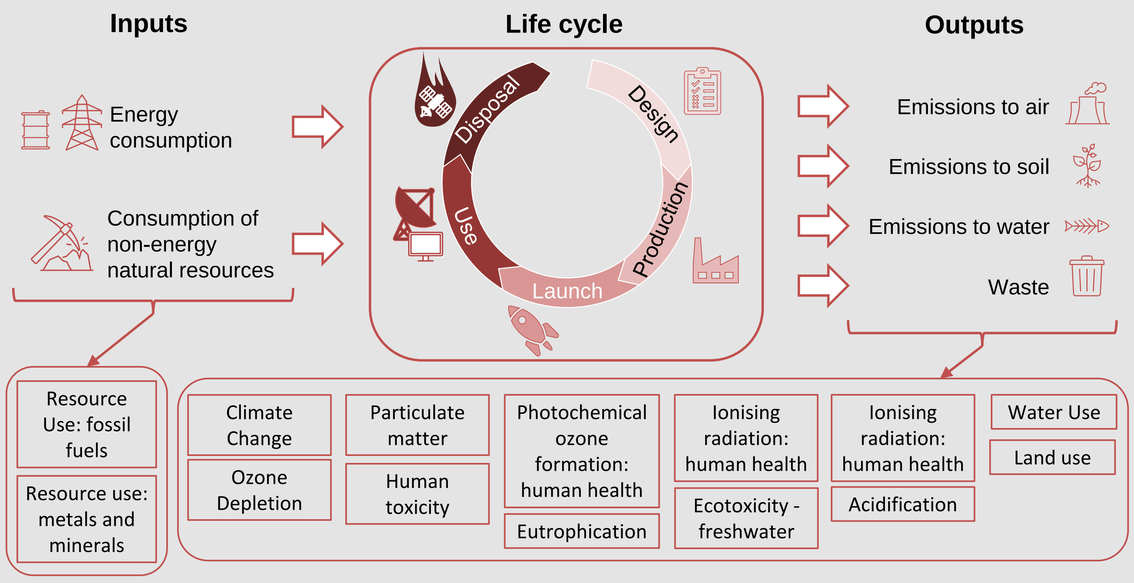
The handbook is currently aimed at the **Space Segment**. It contains the following:

- **General ecodesign considerations**
  - Life Cycle Assessment (LCA) as a methodology
  - Life Cycle phases and key considerations
- **Propulsion systems**
  - Key considerations per common propulsion system type
- **Hardware best practices**
  - Hardware for in-orbit servicing and active debris removal
  - Re-entry hardware considerations and design for demise
- **Operations best practices**
  - Space debris mitigation actions and collision avoidance strategies
  - End-of-life strategies
  - Space Situational Awareness and Dark & Quite skies considerations
- **Key performance indicators**
  - Environmental indicators and LCA single-score
  - Proposed space-specific indicators (e.g. "mass left in space")
  - Social and economical costs

For each topic, the handbook emphasizes the **design choices** and **best practices** that an engineer can opt for, and it highlights their benefits.

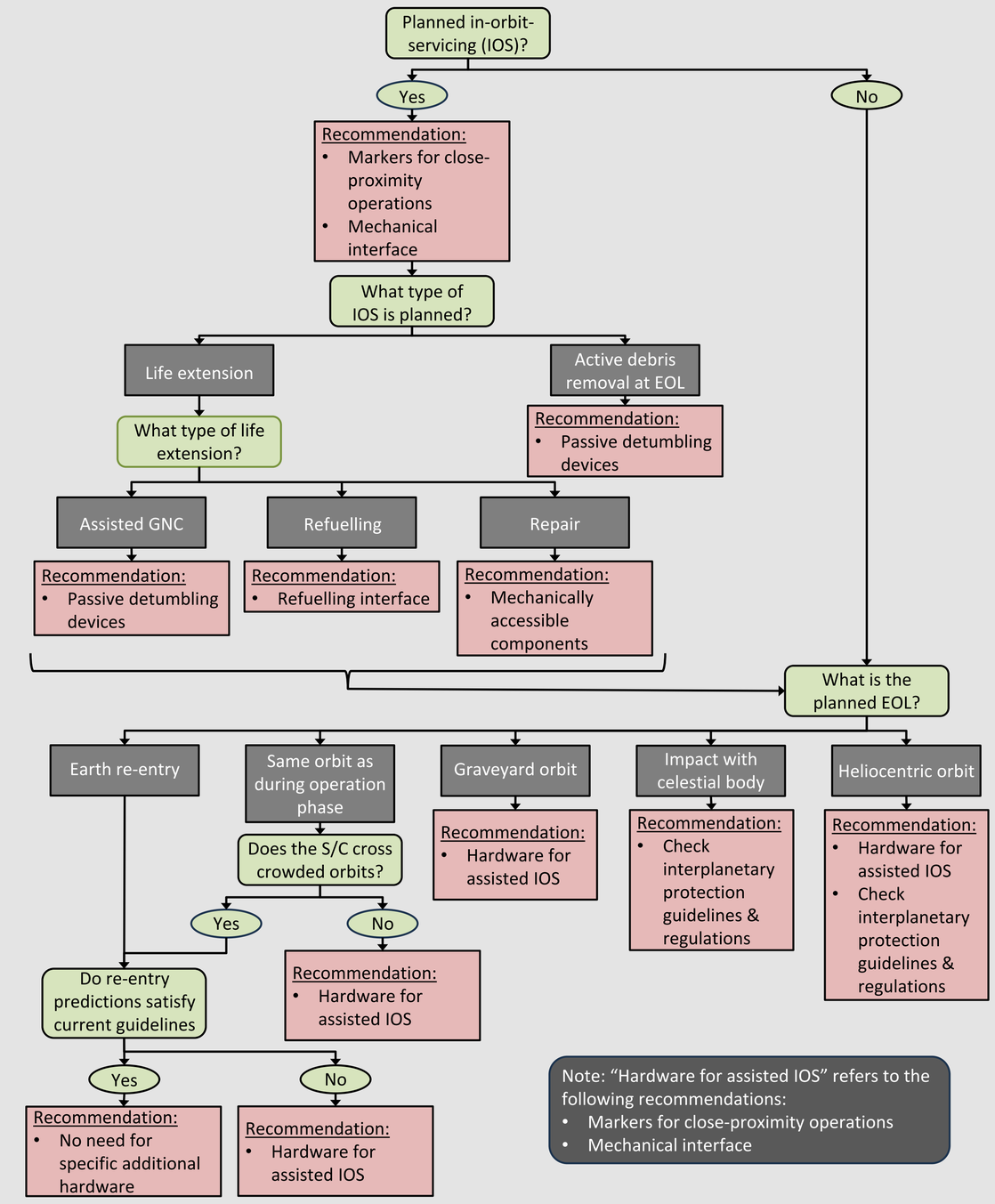
Life cycle assessment integrated in the handbook

Throughout the handbook, the reader is reminded to take into account **impacts** that may occur **throughout all life cycle phases**. For that, the use of **life cycle assessment**, depicted below, is encouraged and common misconceptions are discussed.



Hardware recommendation example

To give an indication of the type of advice given in the handbook, a diagram is placed below. It shows the **recommendations** given to readers on **hardware implementations** for missions which plan for **in-orbit-servicing (IOS)** to extend the mission life-time and for the **end-of life (EOL) phase** of the mission.



The handbook discusses each type of hardware in more detail, providing sources for further research.

Current state and future outlook

The handbook is in development and **seeks feedback from the space community**. Targeted to be launched in the coming months, it will be **publicly available** through EPFL's platform (www.infoscience.epfl.ch).

The EPFL Space Center is looking into **expanding the handbook** to include also the **launch**, **ground** and possibly **infrastructure segments** by means of student projects. As regulations, technologies and current practices are constantly evolving, the Handbook is meant to be updated on a regular basis to include the latest developments.

Conclusion

The EPFL handbook on sustainable practices of space mission design is **a tool to aid engineers and managers in the consideration of environmental and orbital resource impacts during the conception of new space missions**. Made publicly available in the coming months, it aligns with ongoing pressure to take sustainability into account in the space industry.

Contact and access to the Handbook

As the Handbook is in currently development, access to the document may be requested by sending an email to the main author, or by scanning the QR code on the right.

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