Lessons learned from the Sentinel 3 LCA and Applications to a GreenSat

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Agenda

- **Context & Objectives**
- **Sentinel 3 LCA and hotspots**
  - Data Collection
  - LCA results
  - Hotspots identification
- **Applications to a GreenSat**
  - Greensat Study Logic
  - Some possible ecodesign options:
    - Additive manufacturing
    - Better facility management
- **Conclusion**

Context: Evolution of standards and industrial practice

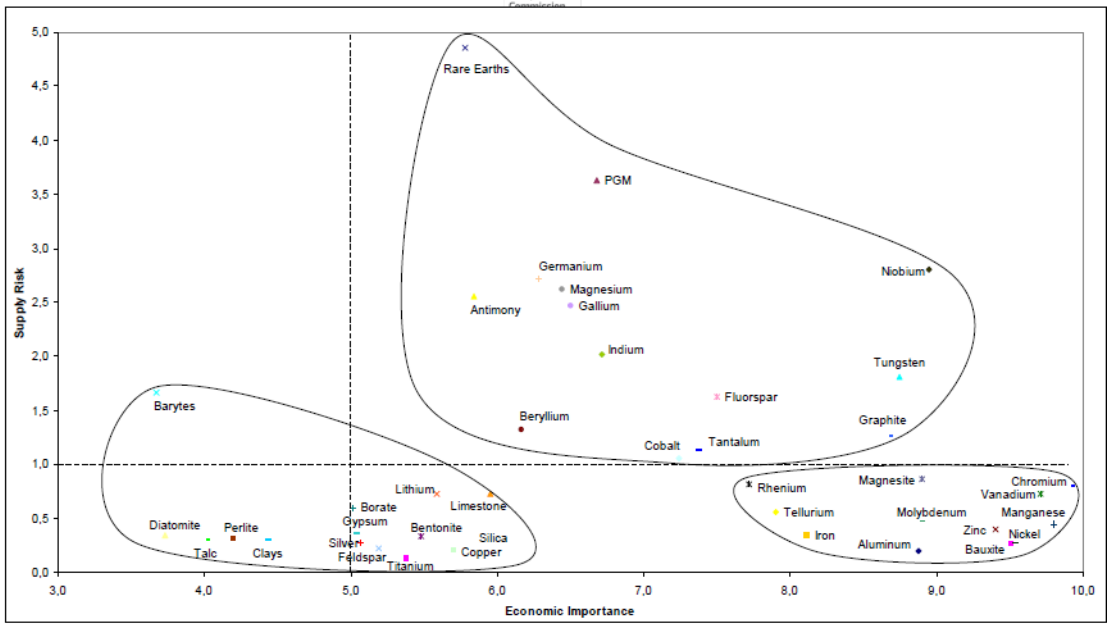
COP21·CMP11
PARIS2015
UN CLIMATE CHANGE CONFERENCE

REACH
COMPLIANCE

RoHS
COMPLIANT

SCOEL/REC/164
Hydrazine
Recommendation from the
Scientific Committee on Occupational Exposure Limits

Outcome



Ecodesign of a satellite

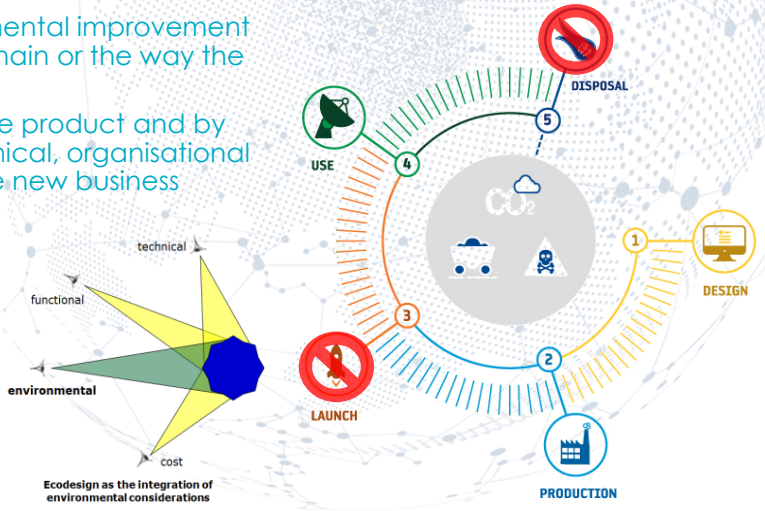
GreenSat Study Scope

"Eco-design is a preventive approach to mitigate the environmental impacts of a product as early as possible in the design phase, when main technological choices are not made yet. This approach is to be used as a decision support-tool." From the design perspective, different approaches are possible:

- "**Redesign**": this consists in performing a progressive environmental improvement of an existing product without questioning the whole value chain or the way the product provides the service to its users;
- "**Breakthrough innovation**": this consists in rethinking the whole product and by thinking "function", looking at different aspects such as technical, organisational and economic aspects, to come up with disruptive ideas, like new business models.

Ecodesign typically looks at the complete lifecycle of a product through the environmental point of view.

In the case of GreenSat, the **launch** and the **disposal phases** are excluded from the study scope as they are **already targeted by dedicated ESA ITTs.**



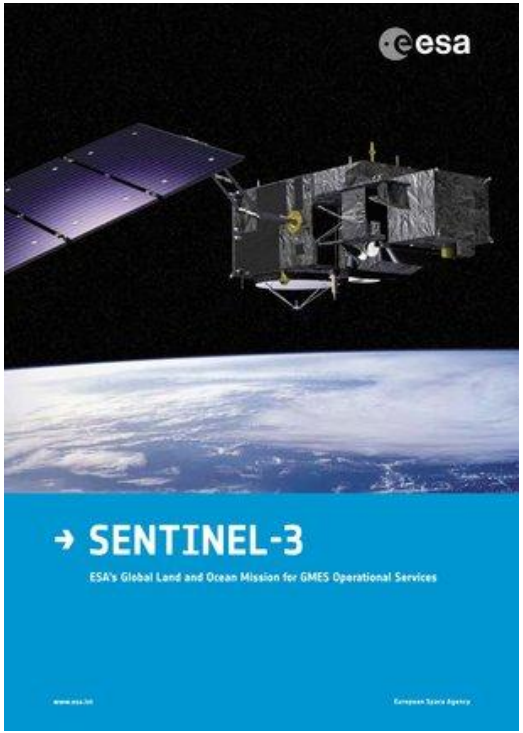
Objective: focus on environment or business?

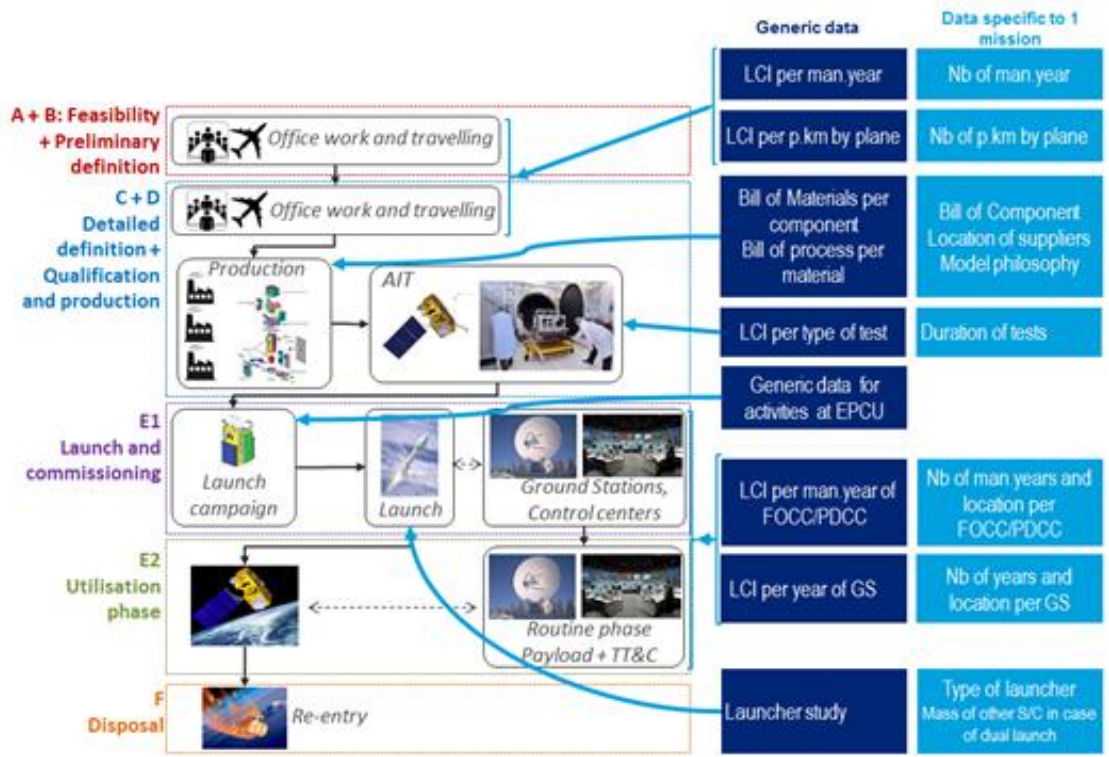
- **Both !**
  - **Protecting the environment**
    - → The first driver triggering initiatives
  - **Creating value for the company and its customers:**
    - **Market:** **differentiating offer** with e.g. less resource intensive products, cheaper in use
    - **Industry:** reducing dependence on critical resources → **intangible asset** for the future
    - **Communication:** Enhancing Thales' image and **responsibility**

Better competitiveness for today and tomorrow

Sentinel 3 LCA and hotspots

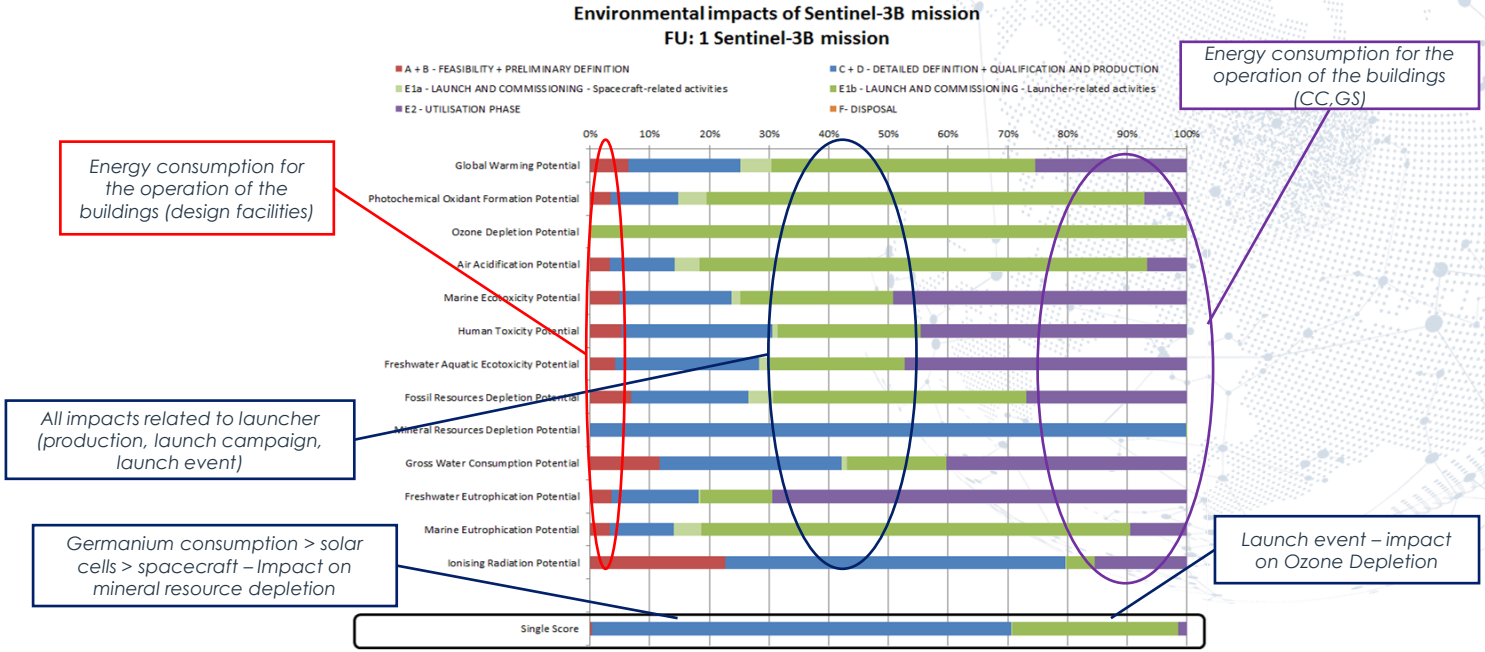
Sentinel 3 LCA Data collection





Previous Results from Sentinel 3 LCA

Environmental impacts OF Sentinel 3 are mostly due to Phase E1b (launch event), Phase E2 and Phase C+D (production of the S/C)



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Previous Results from Sentinel 3 LCA

Several contributors to the environmental impacts were identified

Among Sentinel 3's life-cycle steps, the main contributors are the following:

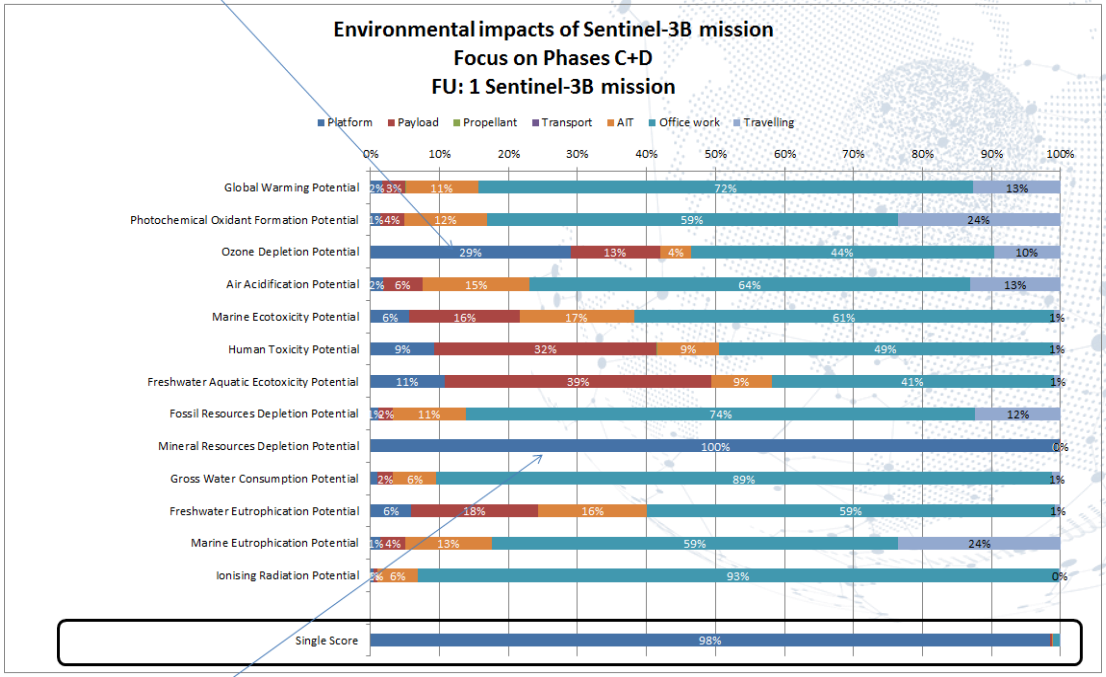
- **Phase E1b (launcher-related launch and commissioning activities)** is the largest contributor, especially for air pollution indicators: global warming, photochemical oxidant formation, ozone depletion and air acidification. Indeed, this phase includes all the impacts related to the entire lifecycle of the exploitation of one launcher. Note that the lift-off mass of the launcher is 137 t (with propellants) while the wet mass (i.e. with propellants) of the spacecraft is only 1.1 t.
- **The second main contributor to most impacts of Sentinel 3B is phase E2** (utilisation) which includes the operation of the satellite during the routine phase. It is the largest contributor for toxicity indicators, gross water consumption and freshwater eutrophication.
- **The third largest contributor to most impact indicators is phase C+D** (detailed definition, qualification and production) which includes the production of the spacecraft and all testing phases and all the office work dedicated to these activities (up to 100%, for the mineral resource depletion impact).

Other life-cycle steps have a lower contribution to the potential impacts of Sentinel 3B mission: Phase A+B has a contribution of about 10% on most indicators, while the contribution of Phase E1a is lower than 10% for all indicators.

Previous Results from Sentinel 3 LCA

Focus on Phases C+D

Harness system > PTFE production for cable coating



Power system > Solar cells production

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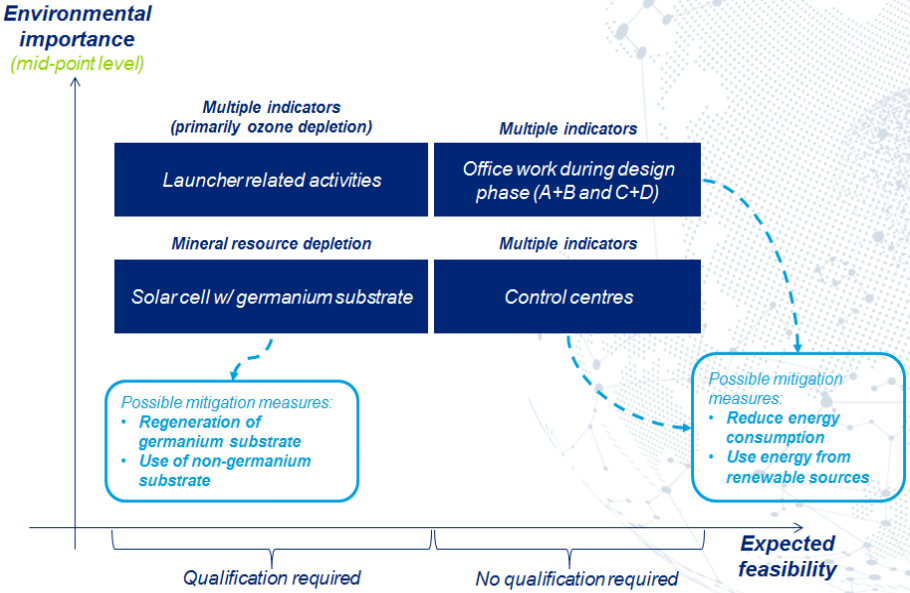
Previous Results from Sentinel 3 LCA

The study allowed to identify certain environmental mitigation options, that will be analysed in more detail in phase 1 & 2



Looking at possible mitigation measures, one can weight between 'Expected feasibility' and 'Environmental importance'

➔ ***The space segment should not be the only focus point: what happens on ground is also important.***

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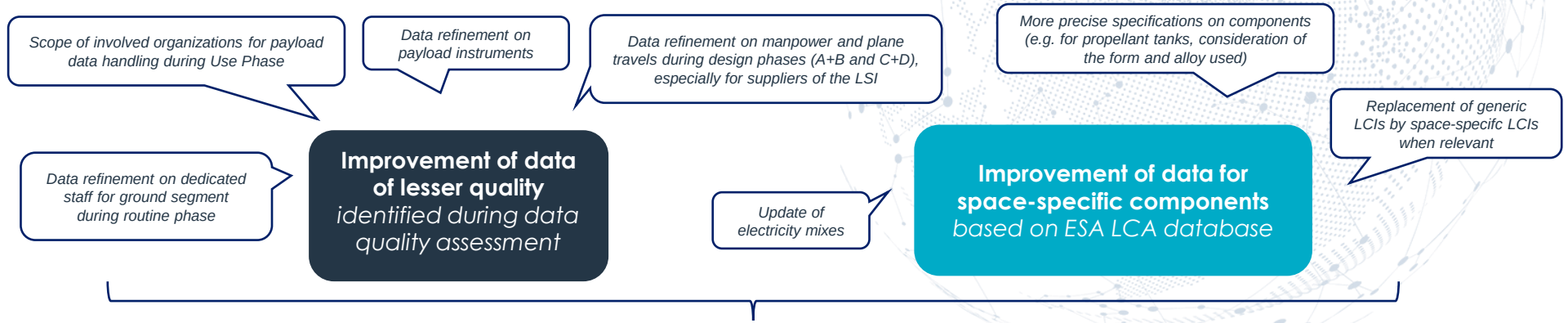
Ongoing work: Improving the existing LCA model through a 5th iteration

A LCA model is composed by:

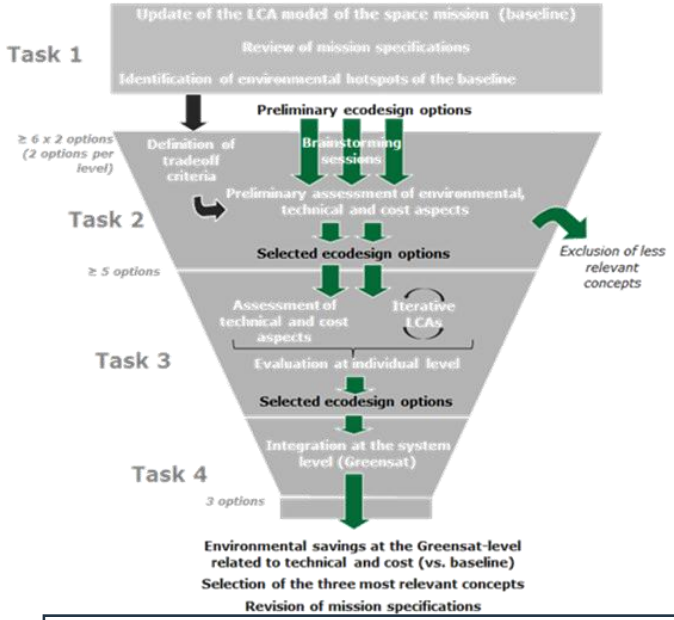
- **Activity data** (quantity of material X used, of electricity consumed, quantity of waste produced, etc.)
- **Environmental Data** (average environmental impacts of material X production, etc.) = Life Cycle Inventories (LCI)

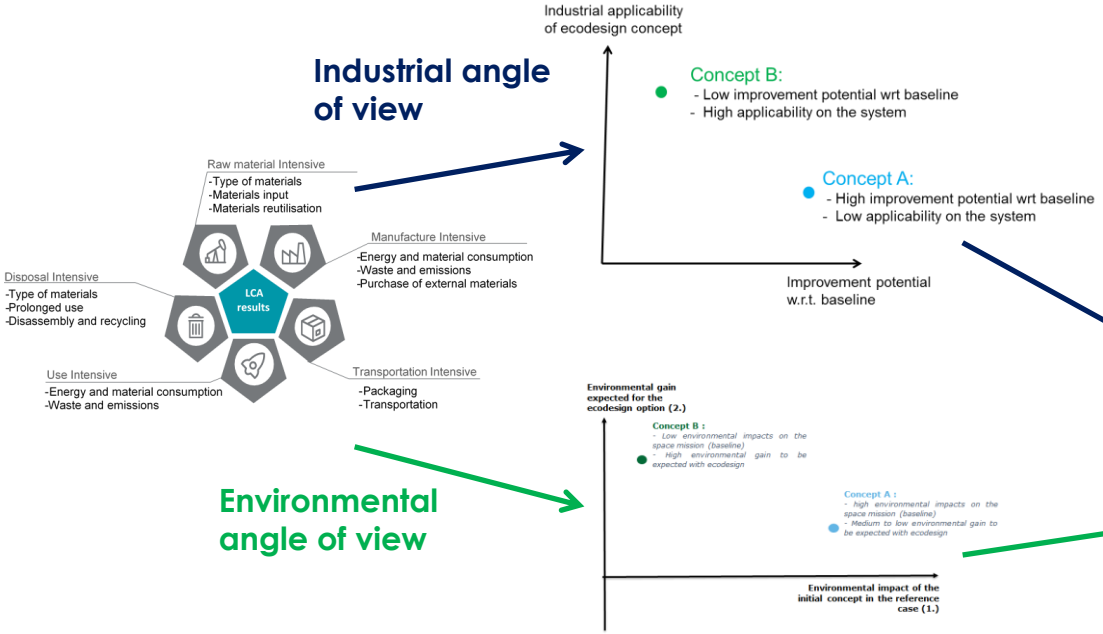


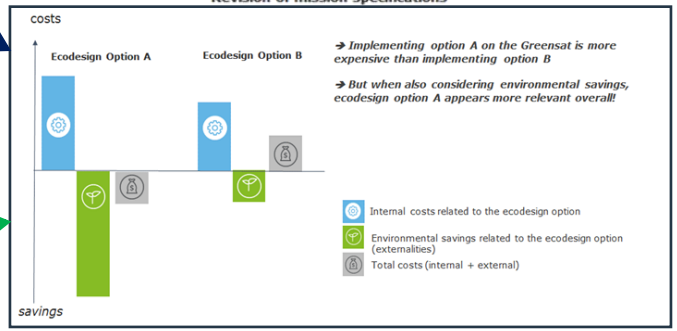
Applications to a GreenSat

GreenSat Study Logic

A funnel approach will be followed to identify the best ecodesign concepts and evaluate their potential gains using both an environmental and industrial point of view:

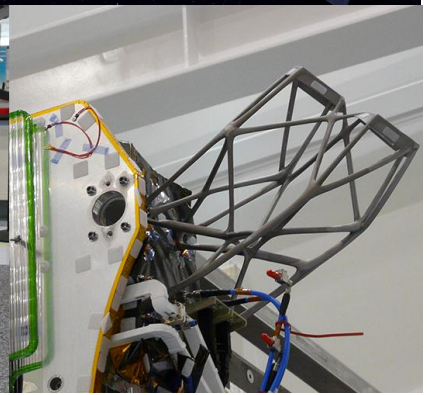






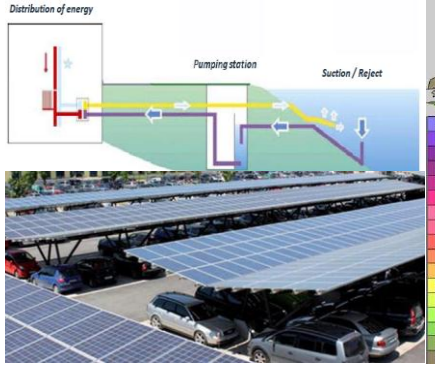
Example: Additive manufacturing:

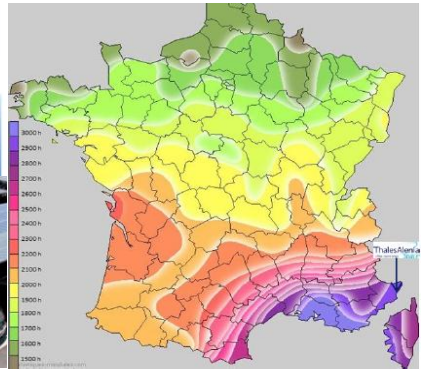
- Additive Manufacturing (AM) offers a significant reduction of waste material compared to classical subtractive manufacturing.
- The flexibility of the AM process allows for the introduction manufacturing practices which increase efficiency, by reducing the production and inspection steps and thus simplifying the production chain.
- The dramatic decrease in the amount of raw materials combined with topological optimisation, and possible reduction of life-cycle steps, which enables a valuable decrease in energy consumption and a reduction in the CO2 footprint.
- The obvious benefits in term of reduction of mass and manufacturing costs are crucial advantages for the space sector.



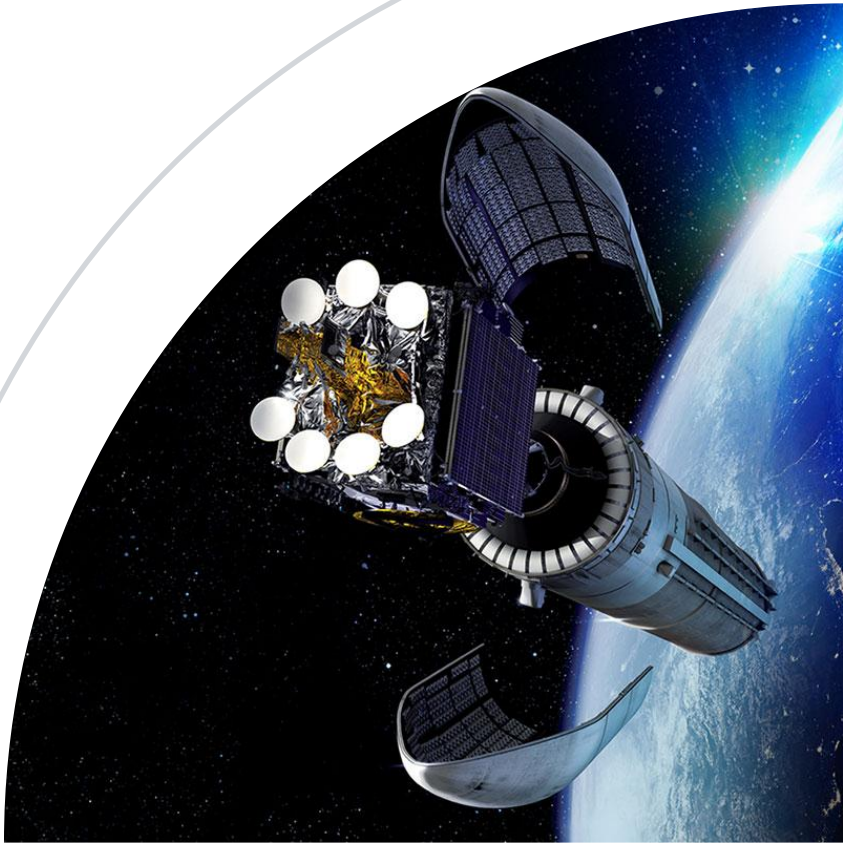
Example: More efficient facility management:

- According, to the LCA results, one of the main contributor to the environmental impact comes from the operations of our facilities → more efficient facility management
- This includes:
  - Better waste management and use of resources (i.e. water used for surface treatment)
  - Energy efficiency (i.e. replace traditional light fixtures by LEDs)
  - Adoption of ISO standards such as ISO14001, ISO50001,…
- Such initiatives at company level have allowed recording substantial savings
- Future initiatives could take advantage of our geographical location:
  - Use of a sea-water loop to cool down our installations
  - Use of solar photovoltaic for energy production





Conclusions



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Conclusions

- Ecodesign is an opportunity to rethink the whole design process of our products to make it more efficient while protecting the environment, thus creating value for our the company and its customers
- Previous LCA results suggests that the main contributor to the environmental impacts come (exclauding the launch phase) from the office works during the production and operation phases
- Some techniques exist that can make our designs more efficient both in term of environment and performance (e.g. additive manufacturing, green propellant, …)
- The main outcome of the GreenSat study will be to investigate all these options and find which are most suitable to be included in proposed technological roadmaps for maturation to TRL7

QUESTIONS?

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