

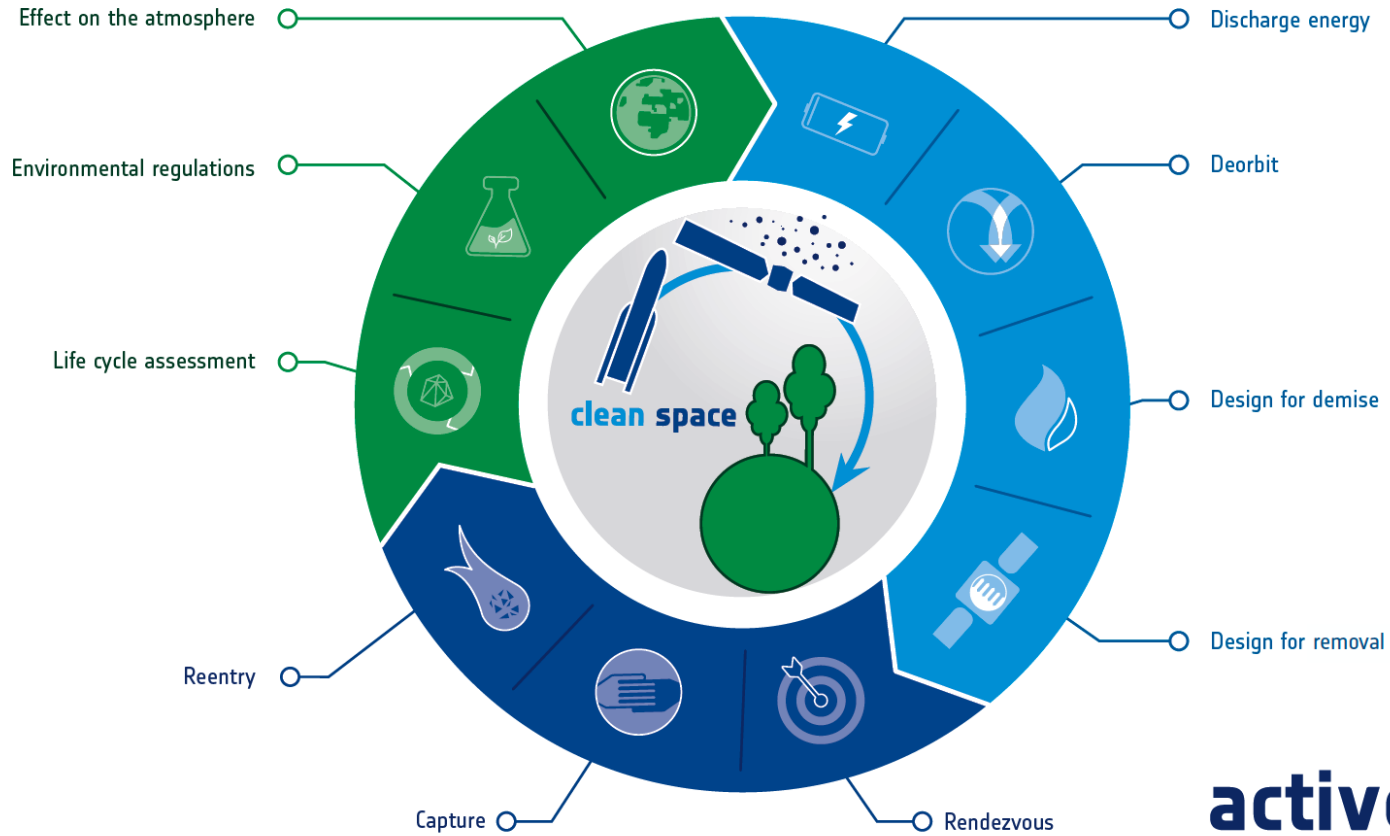


Clean Space

Luisa Innocenti, Head of Clean Space office



“ *Guaranteeing the future of space activities
by protecting the environment* ”



active debris removal

Understand how much space activities pollute and identify alternatives to reduce the environmental impacts





General Assembly

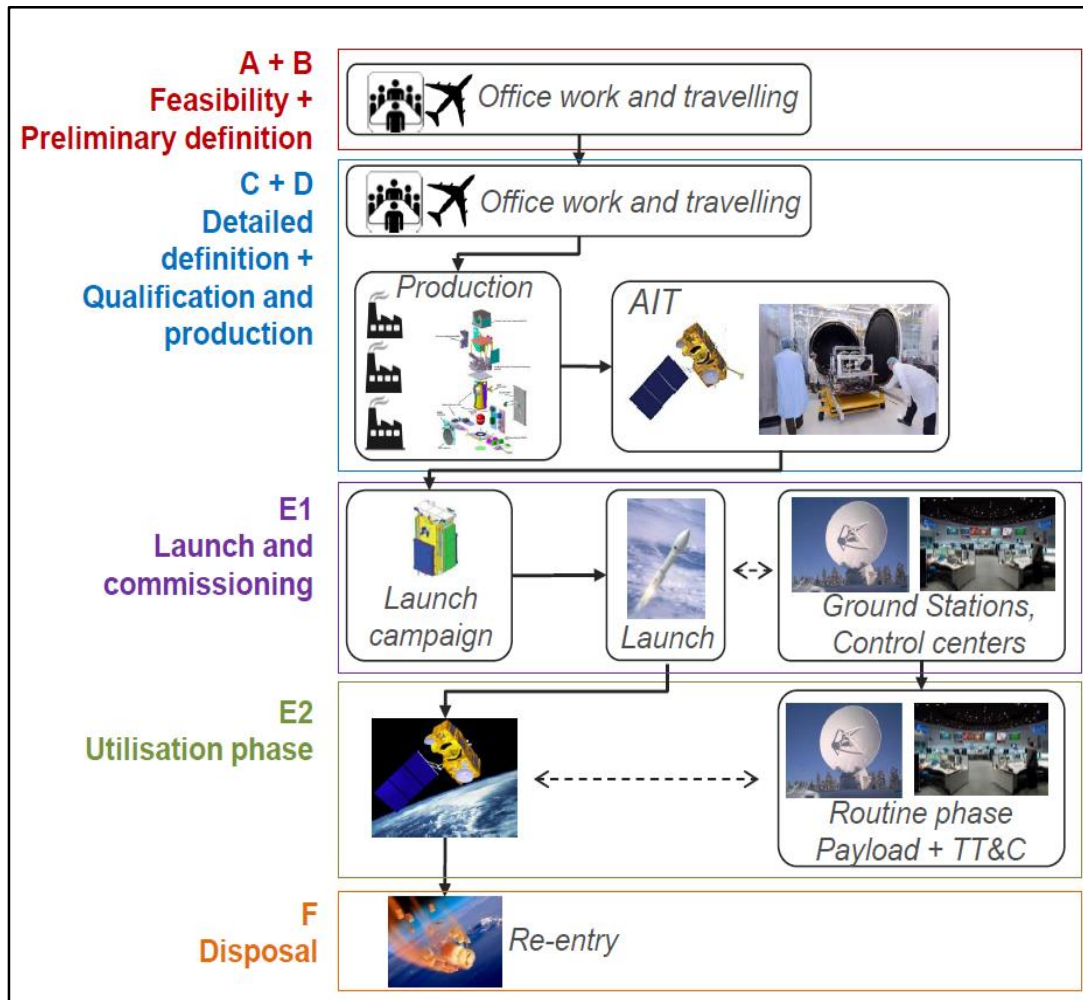
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**Committee on the Peaceful Uses of
Outer Space**
Scientific and Technical Subcommittee
Fifty-sixth session
Vienna, 11–22 February 2019

Guidelines for the Long-term Sustainability of Outer Space Activities

D1.3 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.

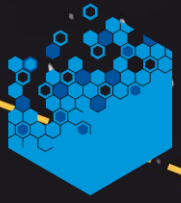


Using the Life Cycle Assessment (LCA), ESA assessed the environmental impacts of:

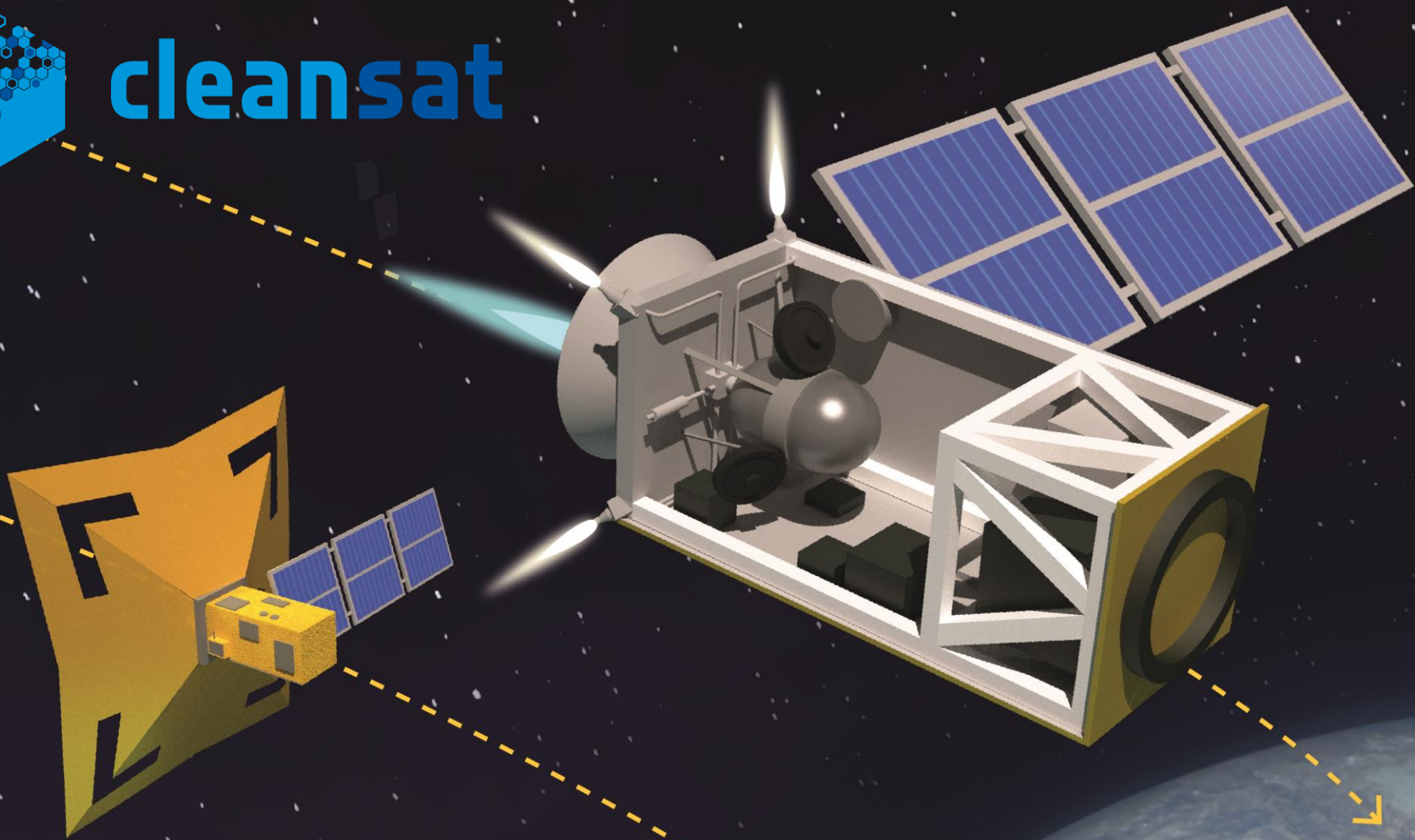
- the entire European launchers family and,
- space missions during their whole life cycle

Leading to:

- the development of the 'Space system Life Cycle Assessment guidelines' and,
- Eco-design requirements in
 - Ariane 6 and
 - Future EO satellites



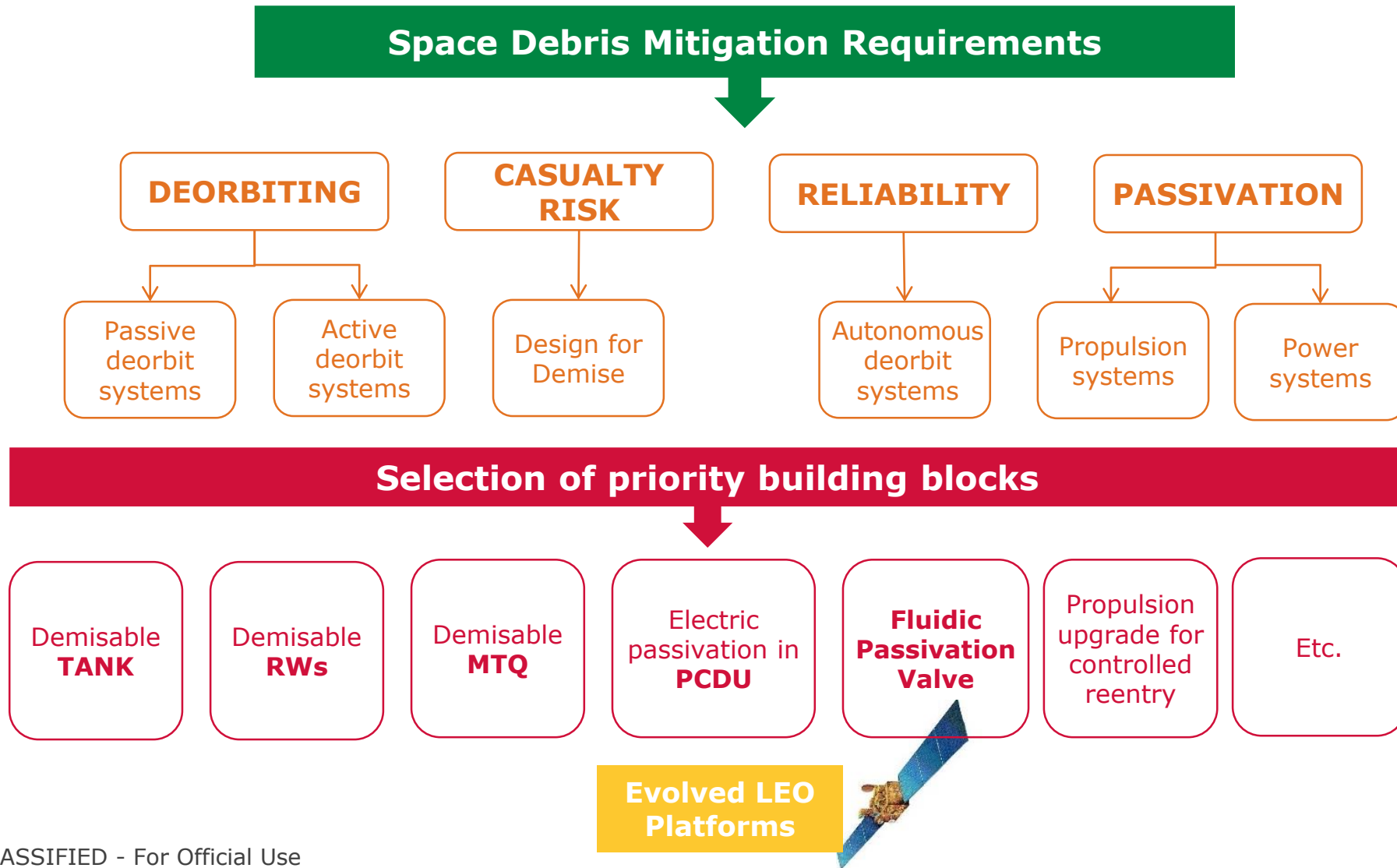
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ESA UNCLASSIFIED - For Official Use



European Space Agency

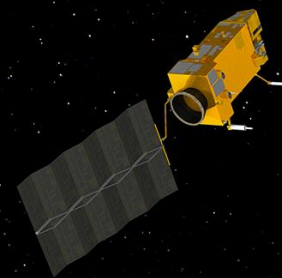
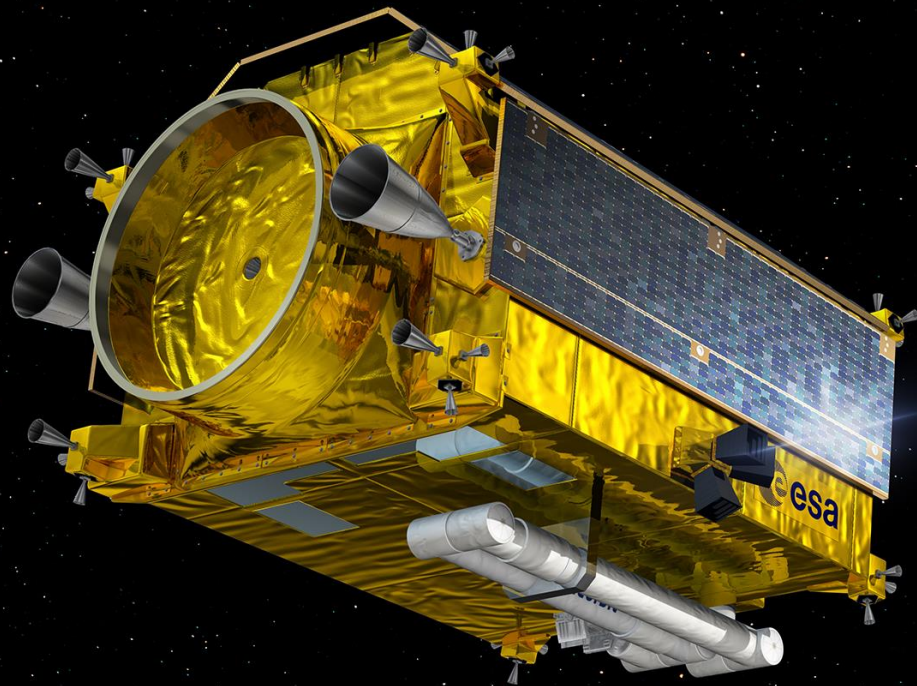


RW: Reaction Wheel

MTQ: Magnetorquer

PCDU: Power Conditioning and Distribution Unit

ACTIVE DEBRIS REMOVAL



e.Deorbit Mission Scenario



Service Offer Request objectives



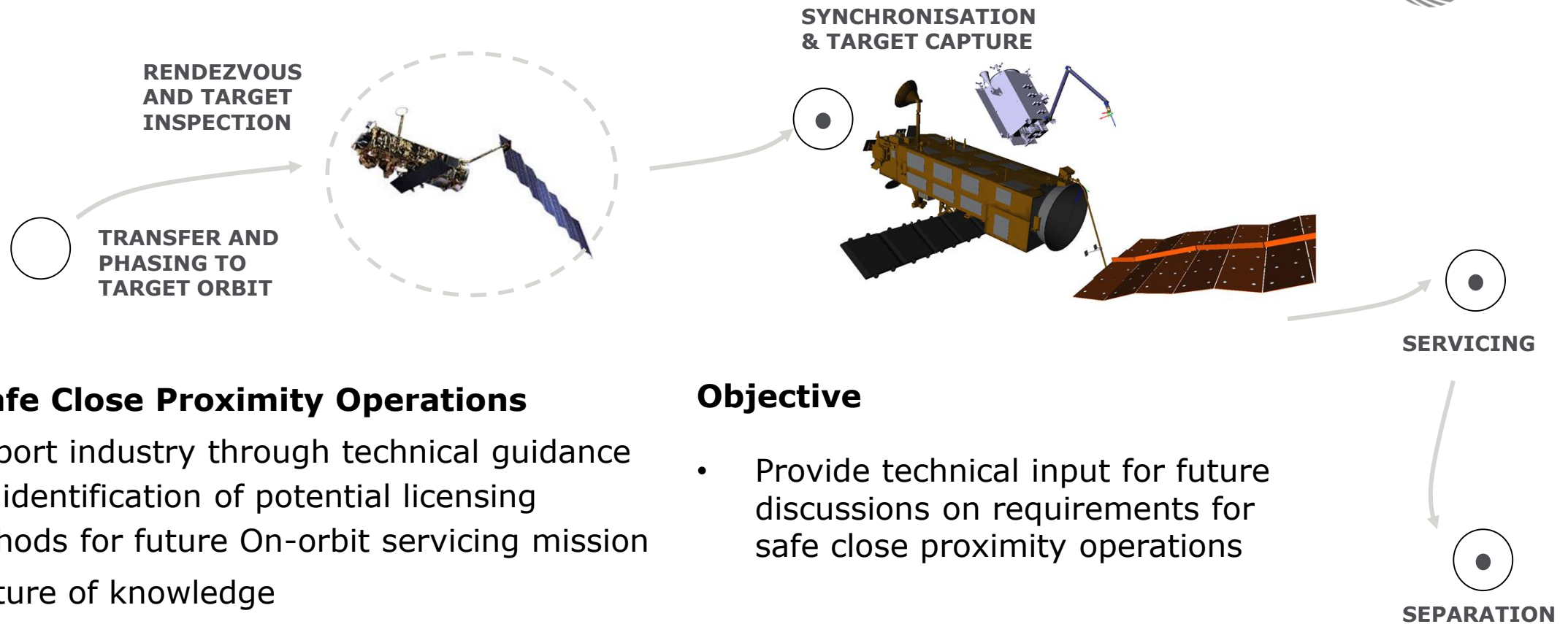
SeR-01 Remove from orbit ESA debris with a total mass greater than 100 kg no later than 2025 ('initial Service')

SeR-02 Demonstrate feasibility of critical technologies enabling other (commercial) in-orbit servicing opportunities

SeR-03 Provide a robust business model for in-orbit servicing activities beyond the Service to be provided to ESA

SeR-04 Comply to space debris mitigation requirements

Sustainable Close proximity operations



Why Safe Close Proximity Operations

- Support industry through technical guidance and identification of potential licensing methods for future On-orbit servicing mission
- Capture of knowledge
- **Protection to the orbital environment and other assets**
- Enable international engagement

Objective

- Provide technical input for future discussions on requirements for safe close proximity operations

Main messages



Europe and ESA are developing:

- **EcoDesign** of space activities in order to evaluate environmental impacts of space missions, identify hotspots and drive the selection of green technologies
- **CleanSat** to prioritise and develop technologies for a proper management of satellites' end of life. High cooperation with the Copernicus programme is in place
- **Active Debris Removal** is being pursued as an anchor institutional mission through the Service Offer Request issued by ESA on ADR and in-orbit servicing.

→ **SAFEGUARDING SPACE AND
OUR PLANET**

#Space19plus

#CleanSpace



Enabling Space Servicing Vehicle Capabilities



Rendezvous

Cooperative:

Target satellite is stabilized and will not 'react' to a capture

Noncooperative: Target satellite is non-operational and therefore tumbling.

Orbital Considerations

Active Debris Removal



Capture

Prepared:

Target satellite contains aids for rendezvous and interfaces for capture

Unprepared:

Target satellite does not have dedicated aids or interfaces.



Refuelling

Electrical or chemical propellant transfer



Manipulation

Target satellite requires repair (e.g. replace MLI) or assembly of modules



Tug

Low ΔV

For providing station keeping

High ΔV

Target satellite requires orbital transfer

High ΔV High Thrust

Target satellite requires reentry



*No electric propulsion



An example: demisable tanks

- Change of materials towards more demisable ones (e.g. Aluminium instead of Titanium)
- Relocation of tanks inside the structure to ensure an earlier exposure to the flow

