Clean Space
ESA's solution for a sustainable space sector

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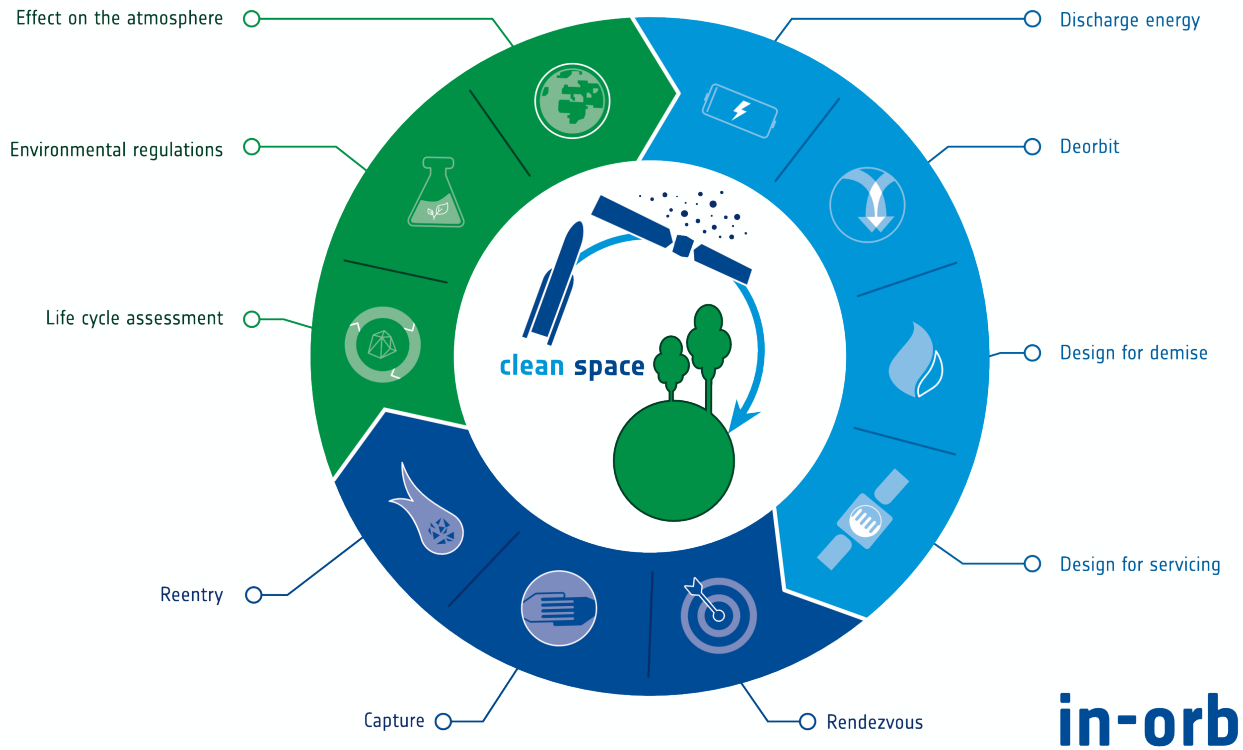
Clean Space

ecodesign

→ REDUCING IMPACTS

management of end of life

→ SPACE DEBRIS REDUCTION



in-orbit servicing

→ ACTIVE DEBRIS REMOVAL


EcoDesign

EcoDesign Scope

ecodesign

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 (ISO-standardised)

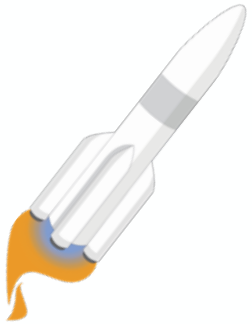
Ecodesign

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

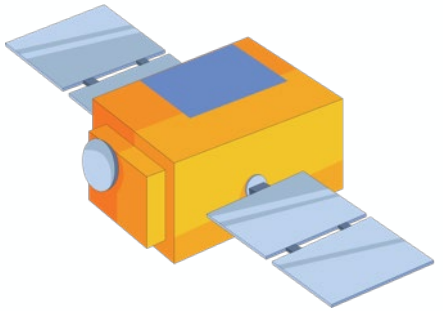
Environmental regulation

Finding alternatives to abide by legislations and avoid costly disruptions

Life Cycle Assessment - Framework

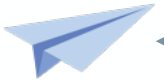


LCA Launch Segment



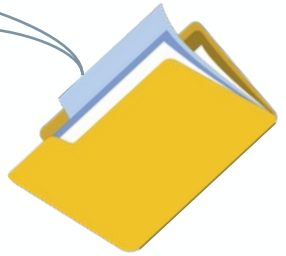
LCA Space Segment

LCA Ground Segment



Available under request by email to cleanspace@esa.int

1st of its kind published by ESA end 2016



ESA LCA Handbook

LCA Database

Available under ESA contract

ESA's eco-design vision

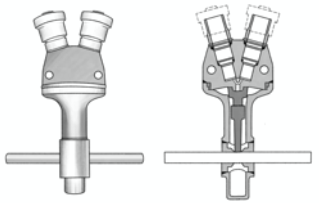
➔ GREEN TECHNOLOGIES ⟷ **➔ ESA PROJECTS**

Environmental Footprint

Ex: Efficient use of Ge

Environmental Regulation

Ex: Replacement of pyrotechnic powders



- **Ariane 6**
- **Earth Explorer 9 (Forum - phase A/b1& B2/C/D and SKIM Phase A/B1) & EE10 (Harmony)**
- **Copernicus Std platform**
- **Copernicus Expansion Missions**
- **Galileo 2nd generation**
- **…**

LCA & Ecodesign roadmap

LCA

LCA Launch segment

LCA Space segment

LCA Ground segment

LCA Launch segment - update

LCA implementation in ESA projects

Ariane 6
Earth Explorer 9 & 10
Copernicus Expansion Missions
Galileo 2nd generation
...

Framework

Framework definition
- LCA Handbook
- LCA DataBase

Framework update
- LCA Handbook
- LCA DataBase

Framework consolidation

Eco-Design

GreenSat
First Eco-design implementation

Green technologies roadmap

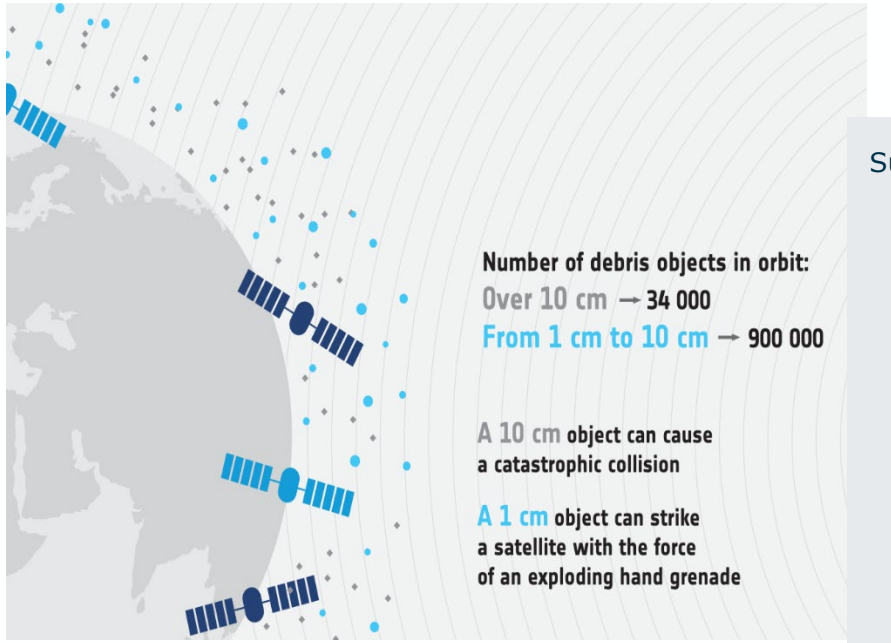
First **Green Technologies** development

Eco-design implementation in ESA projects

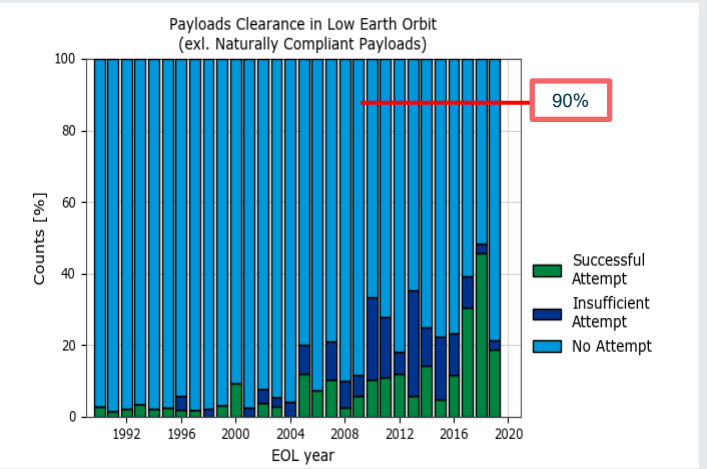
2012 2015 2018 2021 2025 2030

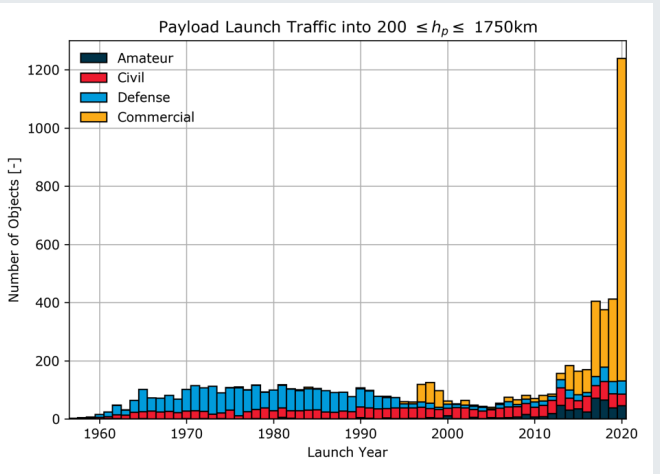

Management of End of Life

Clean Space: Save the orbits now!



Successful SDM application in LEO still below 30% while the current requirement is 90%





In the next 3 years there will be more satellites launched than in the past 60 years

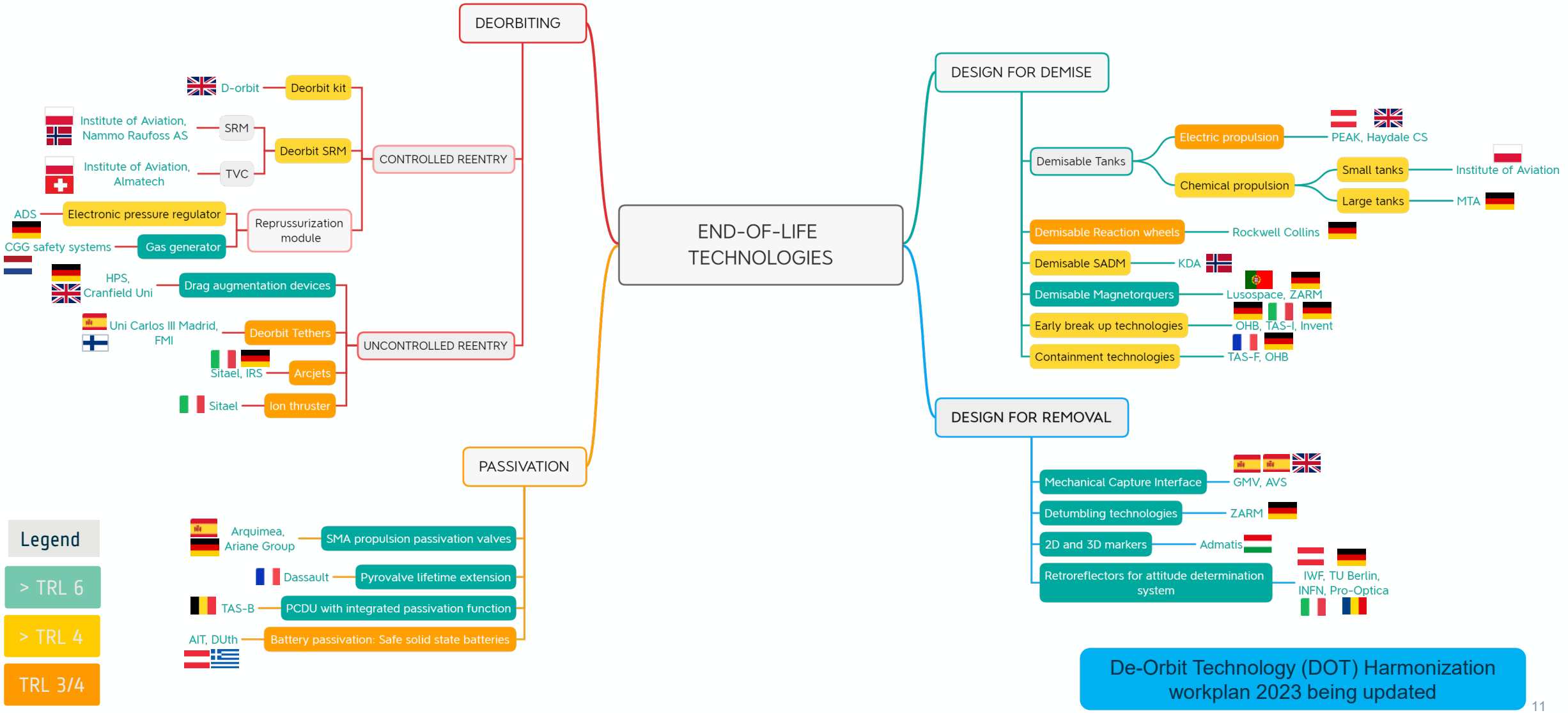
Space Debris Mitigation requirements have to become more demanding

In view of the increase in traffic, IADC already advises probability of successful disposal is significantly above 90% (with a goal of 99%) and remaining orbital lifetimes after disposal well below 25 years

“In ESA we are implementing a policy that by 2030, we have a ‘net zero pollution’ strategy for objects in space, by consistently and reliably removing them from valuable orbits around Earth immediately after they cease operations. We need to lead by example here.”

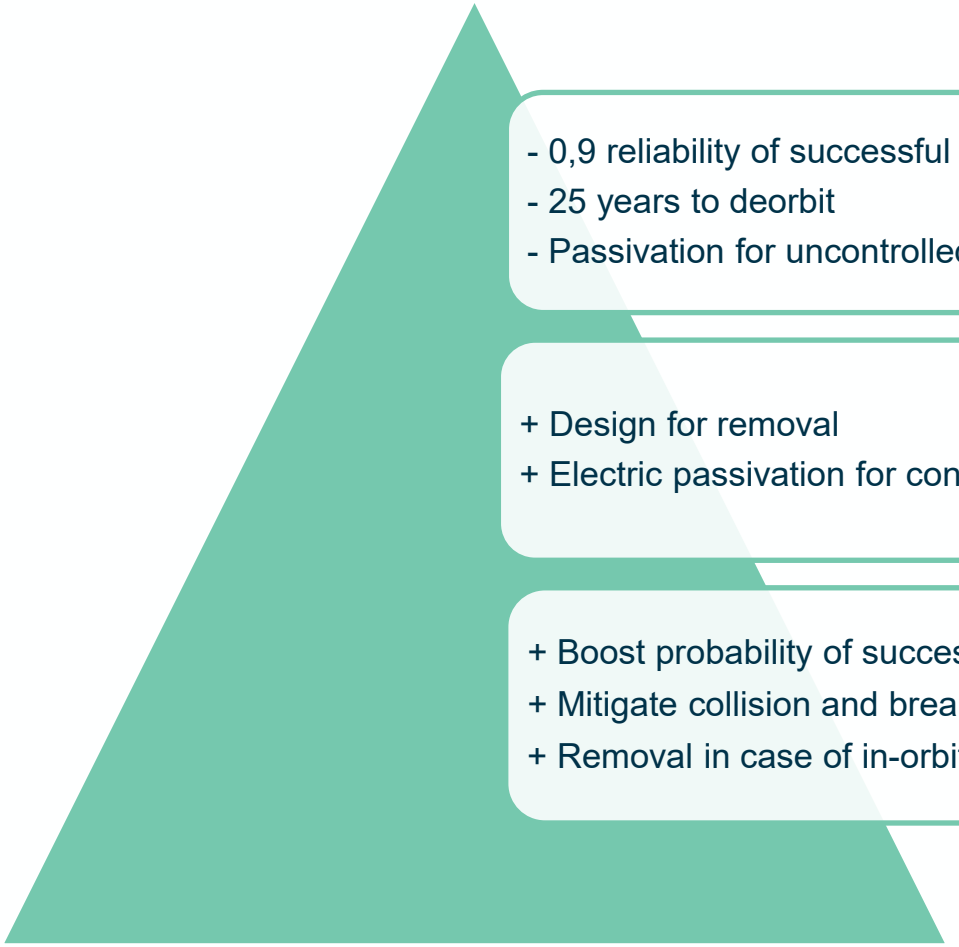
ESA Director General, Josef Aschbacher

End of Life technologies



De-Orbit Technology (DOT) Harmonization workplan 2023 being updated

Steps towards Zero Debris Approach



- 0,9 reliability of successful disposal
- 25 years to deorbit
- Passivation for uncontrolled reentry

Current Requirements

Technology developments

Pre-development of building blocks
(demisable equipment, passivation technologies, deorbit technologies, removal interfaces, etc)

+ Design for removal
+ Electric passivation for controlled reentry

Copernicus Expansion Requirements

- First Building blocks integration
- Standard interfaces for removal services

+ Boost probability of successful disposal
+ Mitigate collision and break-up risk
+ Removal in case of in-orbit failure

Future trends* Zero Debris Policy

** In view of the increase in traffic, IADC already advises probability of successful disposal is significantly above 90% (with a goal of 99%) and remaining orbital lifetimes after disposal well below 25 years*

Next Steps – The European platforms need to evolve

EoL **requirements are evolving**, ESA aims to go towards zero-debris

Requirements apply at **system level, but impact subsystems and equipment**.

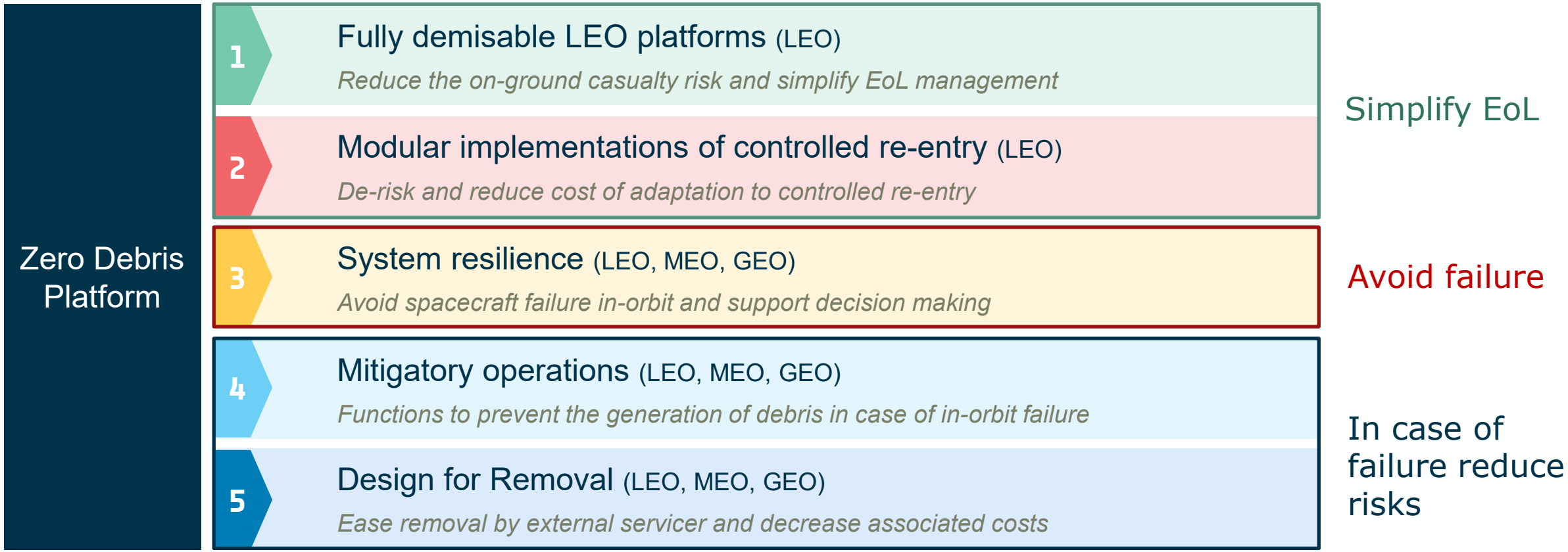
Mature techno needs **integration at system level to prepare for future missions**

Zero-debris Platform activity

- ✓ To **"bridge" the non-recurrent costs** and prepare future missions.
- ✓ Coordinated work with integrators and suppliers for evolution of the European product lines

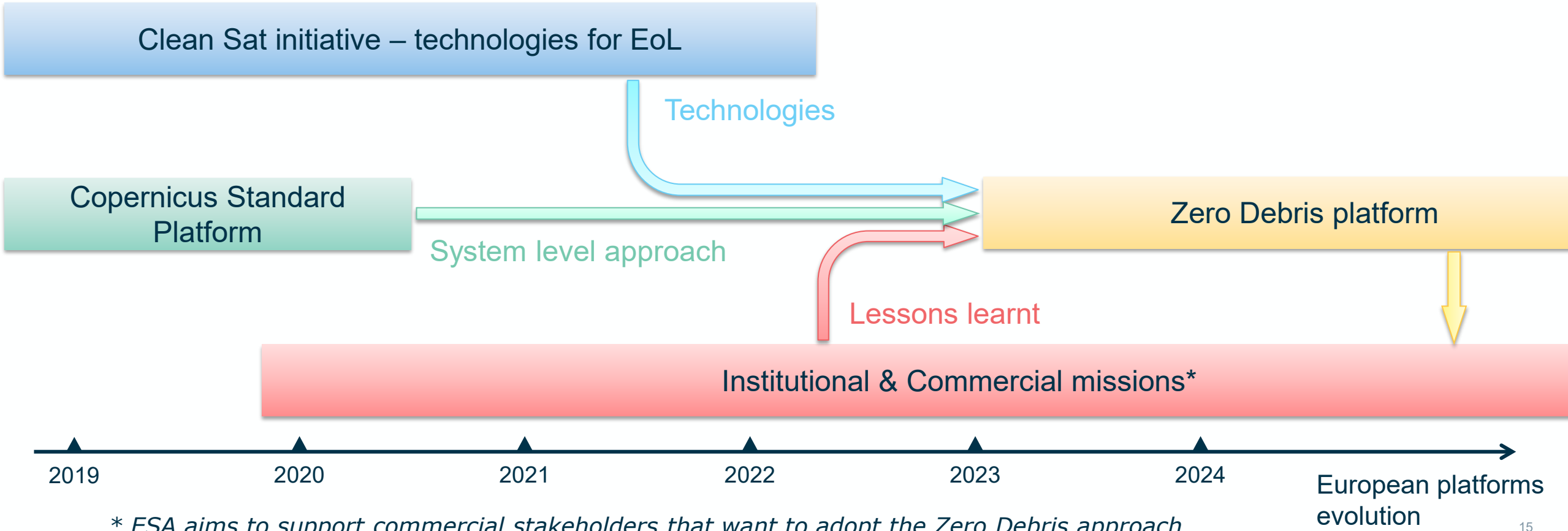
Scope of platforms evolution

ESA strategy for Zero-debris platforms evolution structured in 5 main goals:



The European platforms need to evolve

- Platform level activity will be proposed in CM22 through Space Safety Program (COSMIC) in close collaboration with EOP-Φ.
  - Discussions on-going with other programmes and possible partners



** ESA aims to support commercial stakeholders that want to adopt the Zero Debris approach*

Take home messages

Eco-design

- ✓ In the past years, ESA has developed a pioneer **Eco-design framework for space**, based on LCA.
- ✓ Quantification of the environmental impacts is **required in missions across the Agency**
- ✓ **Roadmap for Green Technologies** will be derived from the work with projects in line with their needs

End of Life technologies:

- ✓ **ESA aims to lead by example** and implementing a Zero-debris policy by 2030, this requires a leap forward and work at system level to integrate innovative EoL technologies in the future missions.
  - ✓ A **Zero-debris platform evolution activity is being prepared** within S2P COSMIC in close cooperation with EOP-Φ. Discussions on-going with other programmes.
  - ✓ ESA is available to support industry for the evolutions of their platforms and products to achieve a full compliance SDM and an alignment to Zero-debris policy