

# 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







# **EcoDesign Scope**





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



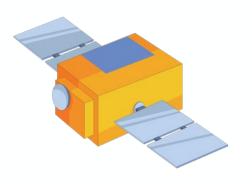
Environmental regulation

Finding alternatives to abide by legislations and avoid costly disruptions

#### **Life Cycle Assessment - Framework**





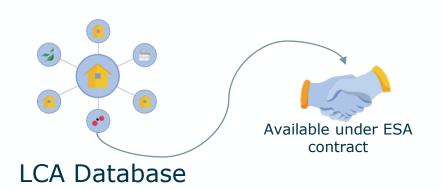


LCA Space Segment



LCA Ground Segment





### ESA's eco-design vision







#### → GREEN TECHNOLOGIES

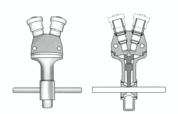
**Environmental Footprint** 

Ex: Efficient use of Ge



# Environmental Regulation

Ex: Replacement of pyrotechnic powders



#### **→ ESA PROJECTS**

- 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 2<sup>nd</sup> generation
- ...

### LCA & Ecodesign roadmap









LCA implementation in ESA projects



LCA Launch segment update



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

Framework









Framework consolidation









Eco-design implementation in ESA projects

2012

2015

2018

2021

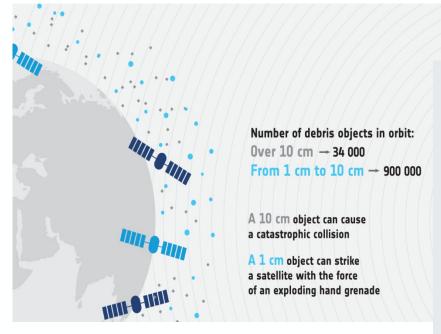
2025

2030

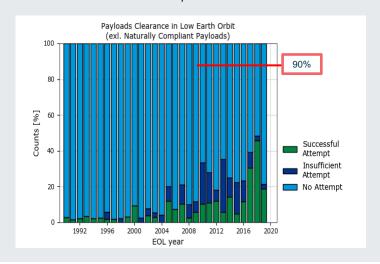


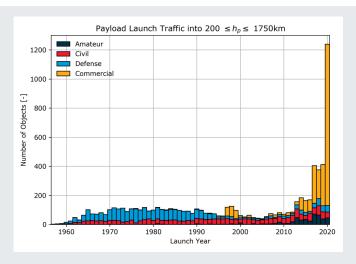
# Clean Space: Save the orbits now!





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 <u>significantly</u> <u>above 90% (with a goal of 99%)</u> and remaining orbital lifetimes after disposal well below 25 years



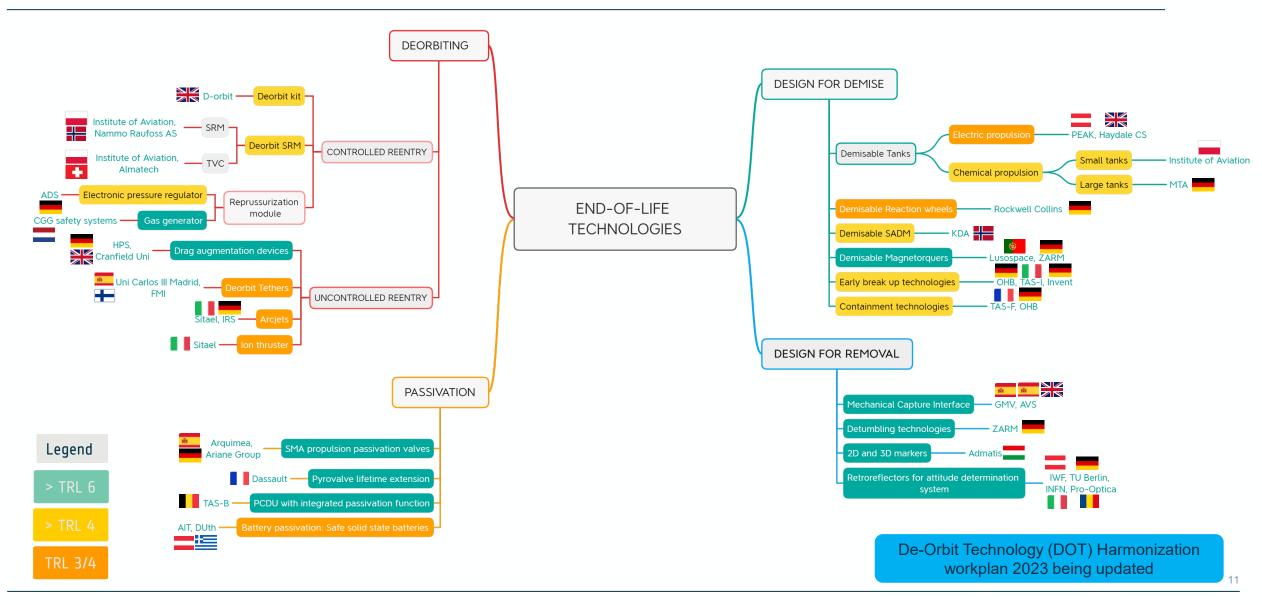


"In ESA we are implementing a policy that by 2030, we have a 'net zero pollution' strategy for objects in space, by consistently and reliably removing them from valuable orbits around Earth immediately after they cease operations. We need to lead by example here."

ESA Director General, Josef Aschbacher

#### End of Life technologies







# **Steps towards Zero Debris Approach**



#### Technology developments

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

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

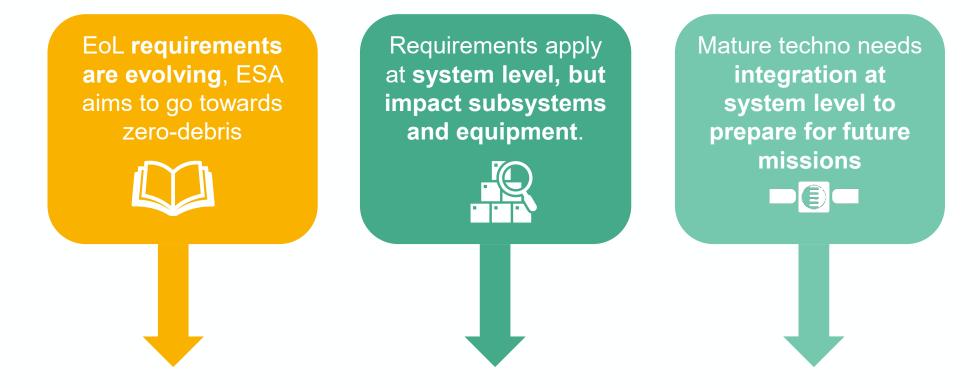


Future trends\*
Zero Debris Policy

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

#### **Next Steps – The European platforms need to evolve**





#### **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:

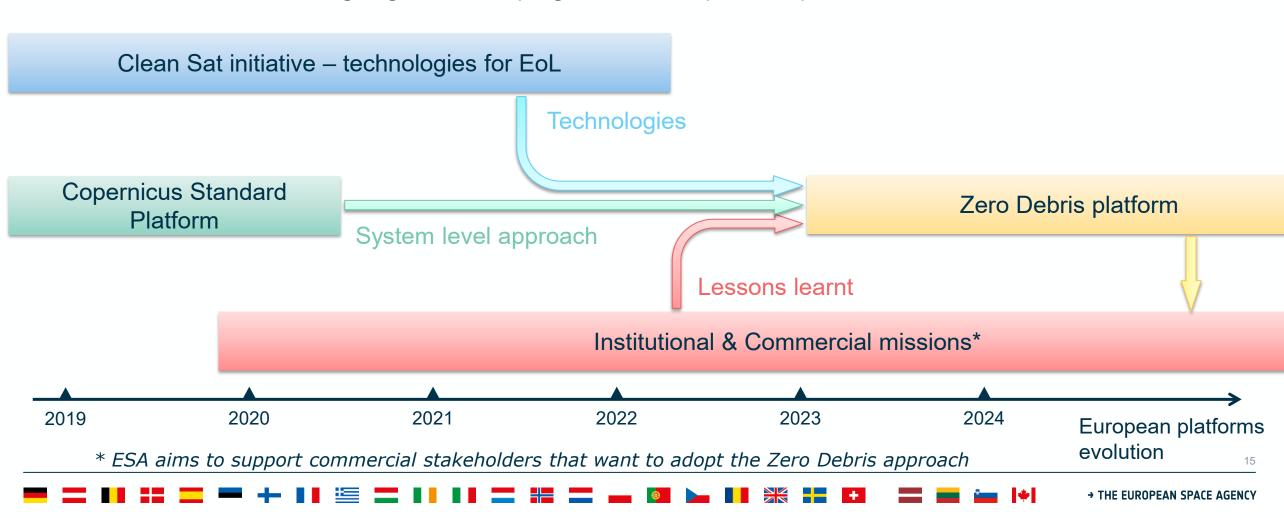
Fully demisable LEO platforms (LEO) Reduce the on-ground casualty risk and simplify EoL management Simplify EoL Modular implementations of controlled re-entry (LEO) De-risk and reduce cost of adaptation to controlled re-entry Zero Debris System resilience (LEO, MEO, GEO) Avoid failure Platform Avoid spacecraft failure in-orbit and support decision making Mitigatory operations (LEO, MEO, GEO) Functions to prevent the generation of debris in case of in-orbit failure Design for Removal (LEO, MEO, GEO) risks Ease removal by external servicer and decrease associated costs

In case of failure reduce

#### **■■** 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



#### 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