



Welcome to the

CLEAN SPACE

DAYS 2024

08 - 11 October 2024  
ESTEC, The Netherlands

#CSD2024



# Future Steps in Space Safety

Holger Krag

ESA, Space Safety Programme Manager

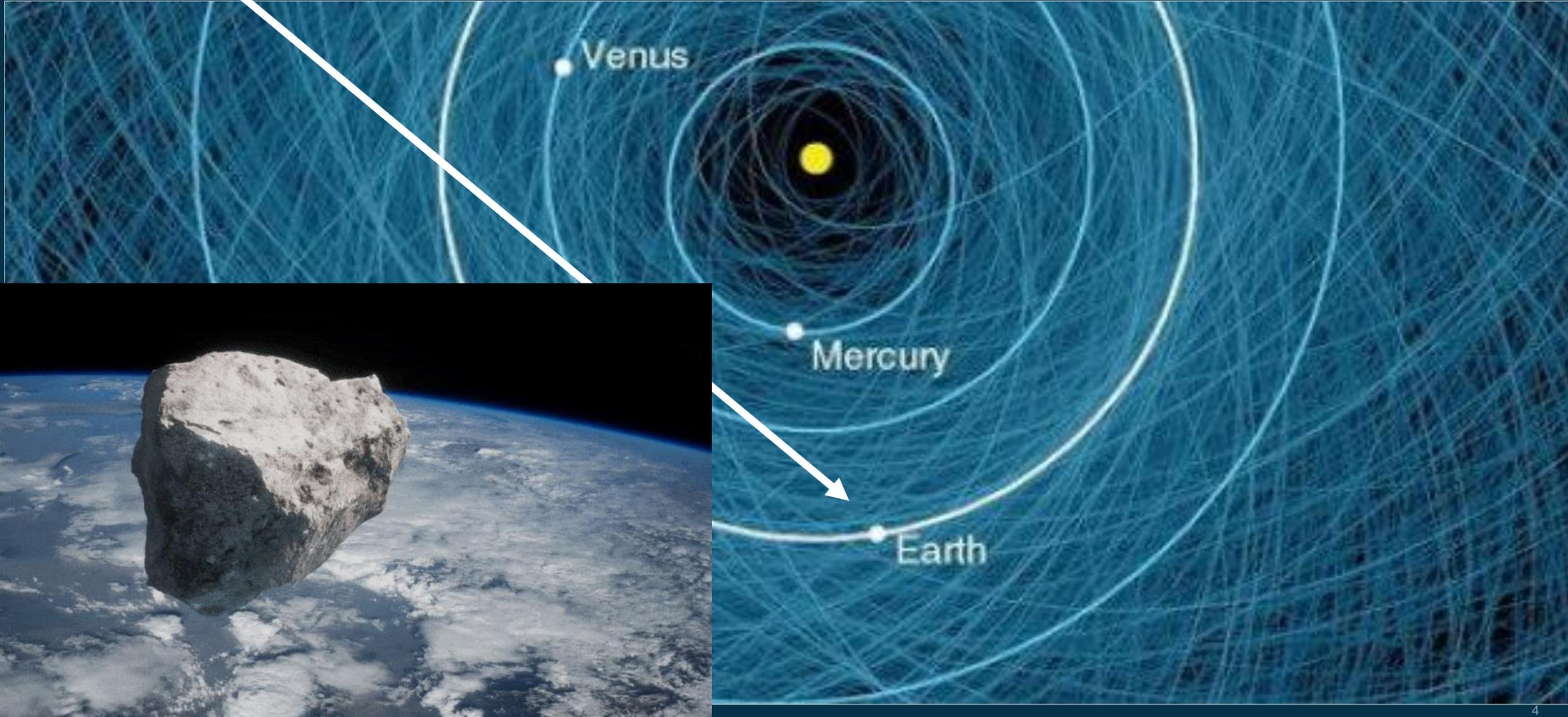
08/10/2024

ESA UNCLASSIFIED - For Official Use

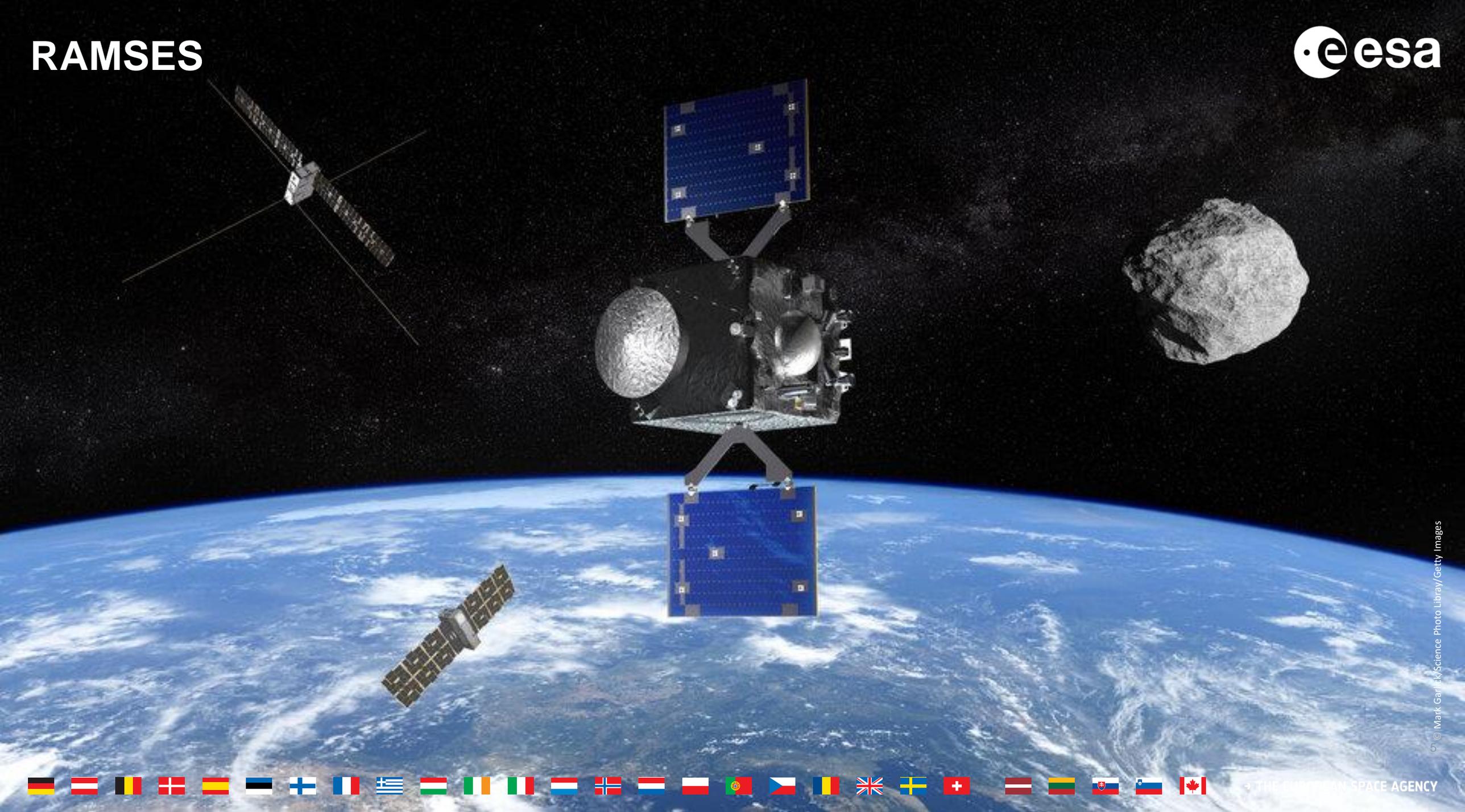
# Hera Launch



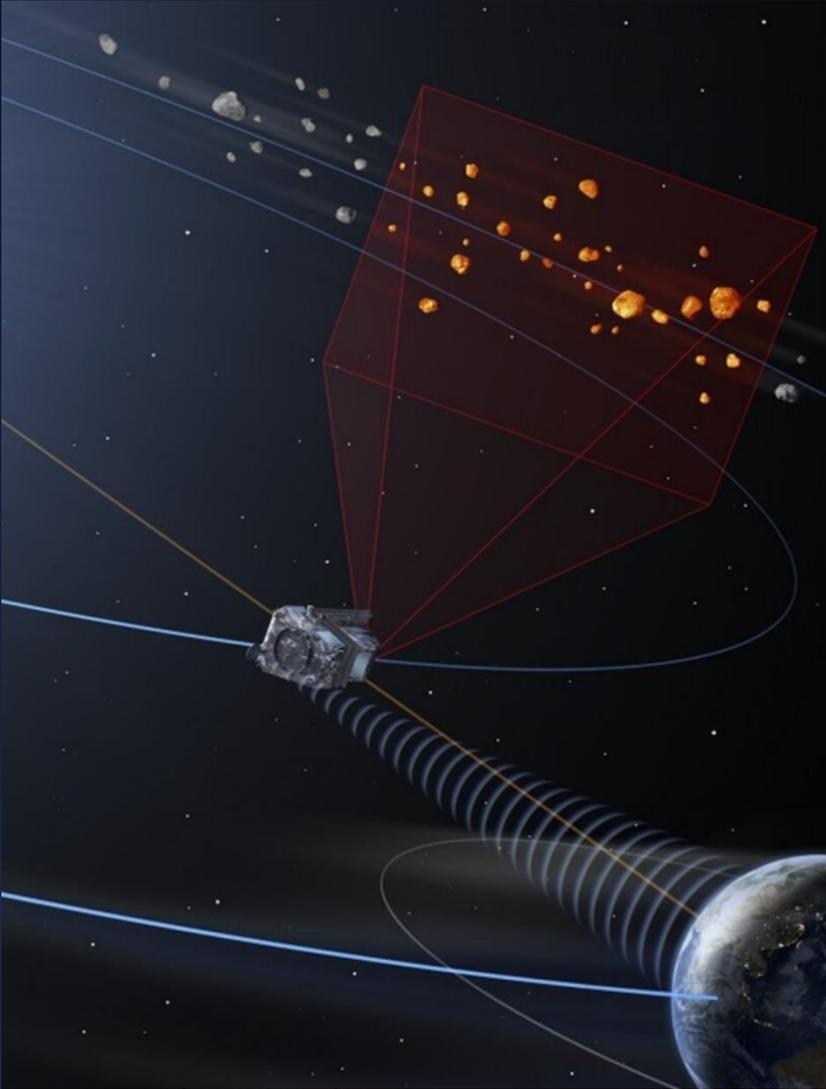
# We are here



# RAMSES



# Early Warning is Key

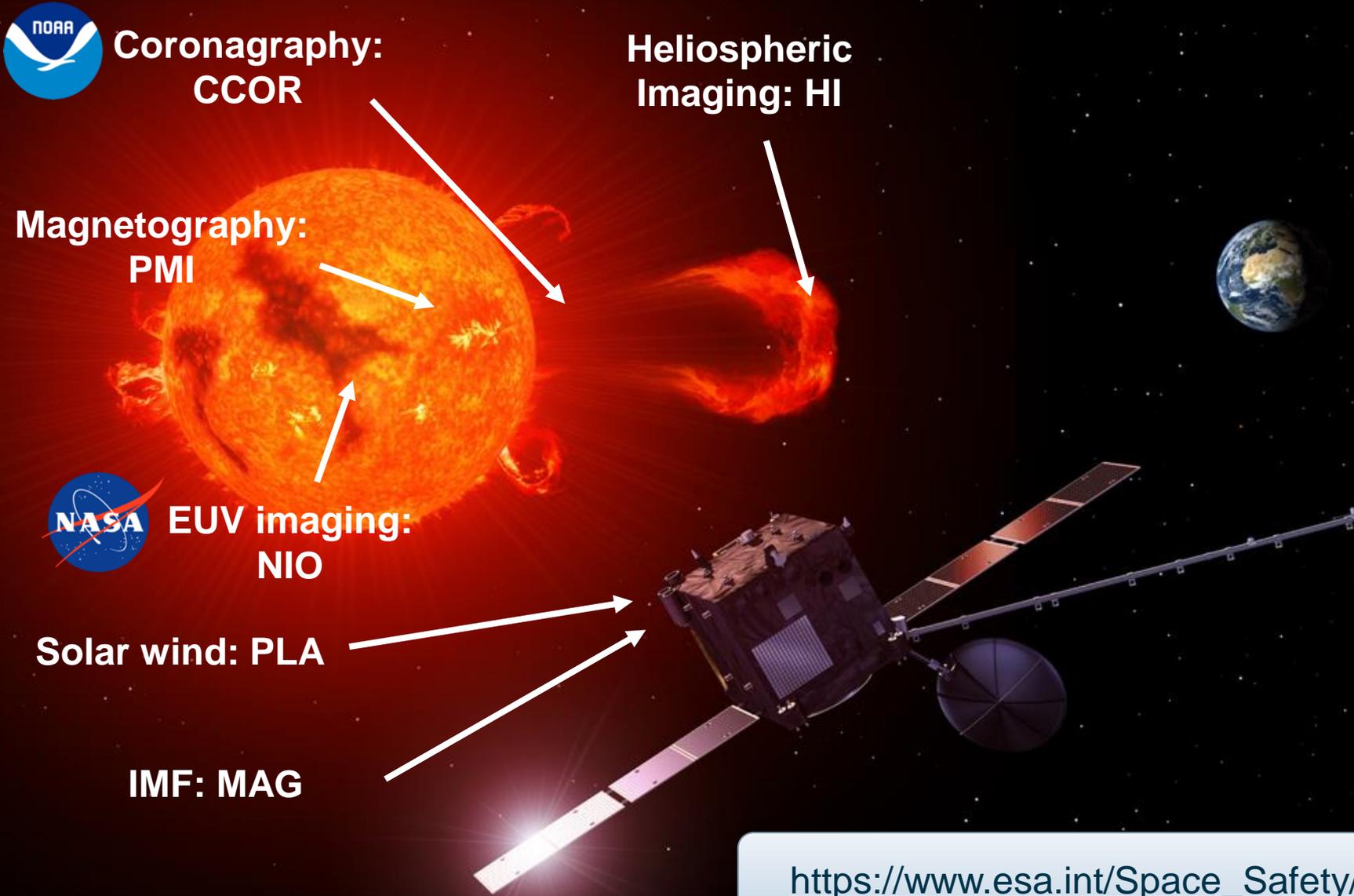




# Our Infrastructure at Risk



# Vigil mission to L5



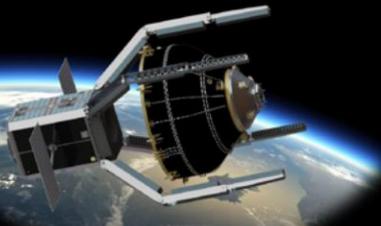
[https://www.esa.int/Space\\_Safety/Vigil](https://www.esa.int/Space_Safety/Vigil)

# Lining Up for a Zero-Debris Future



# Towards a Circular Economy in Space

DEBRIS REMOVAL



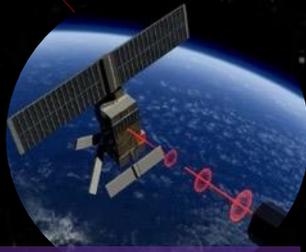
CS-1 Mission

TRANSPORTATION



PoC In-Space  
Transportation

INSPECTION



e.inspector

AOCS TAKEOVER/  
LIFETIME EXTENSION



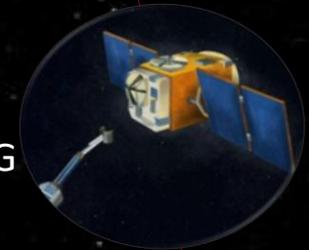
RISE Missions

ENCORE Mission

REFURBISH-  
MENT



ASSEMBLING /  
MANUFACTURING



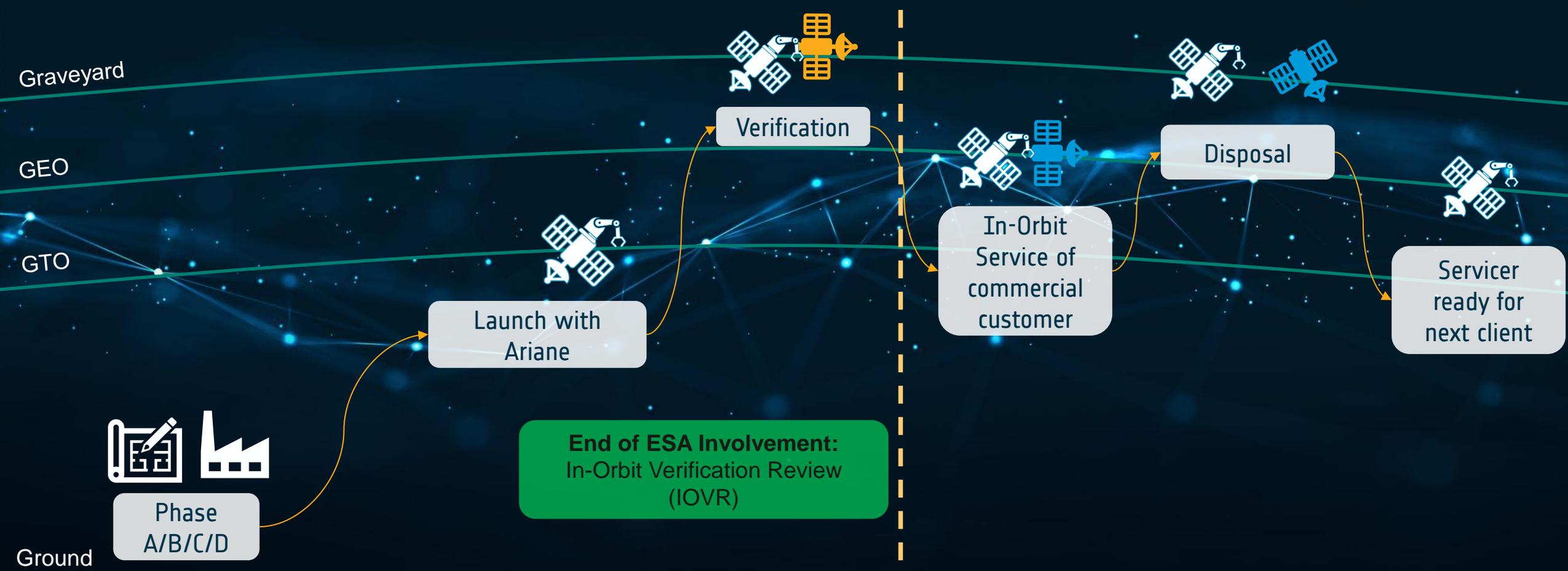
RECYCLING



# In-Orbit Servicing

## ESA RISE Mission (In-Orbit Verification)

## Service Provision



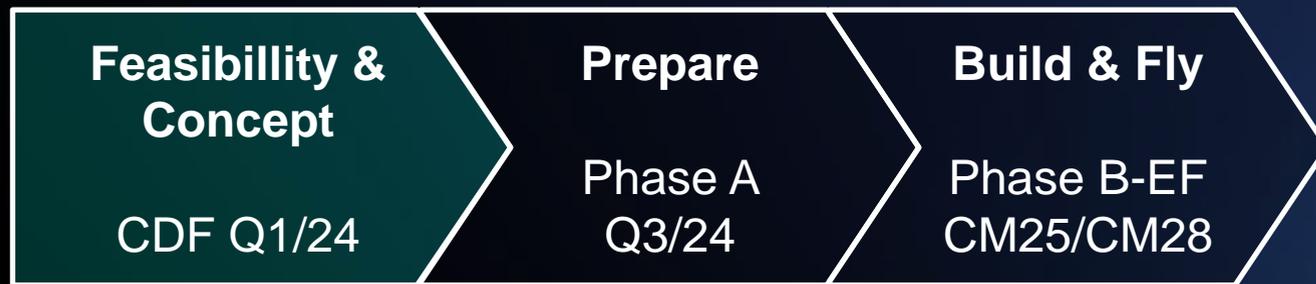
## LASER

- Demonstration of debris tracking and orbit determination
- Phase A/B1 for Momentum Transfer verification mission



## LUMOS

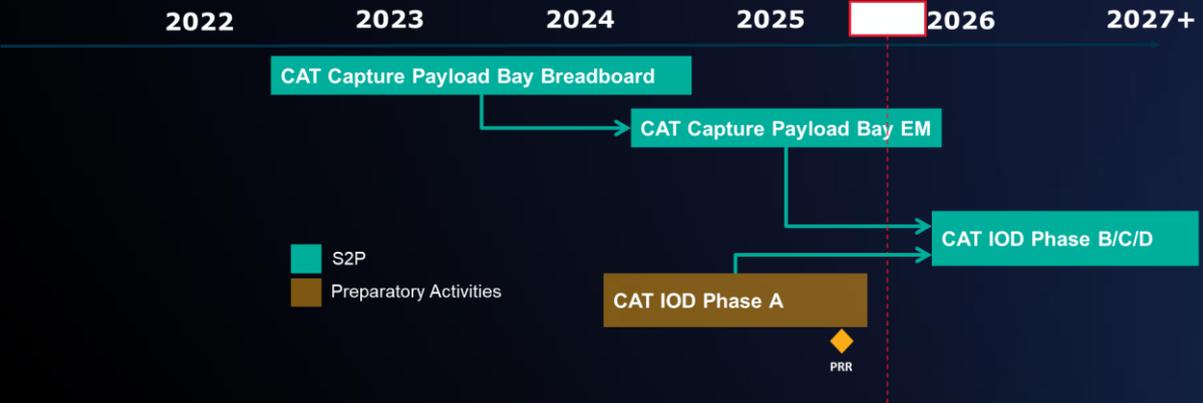
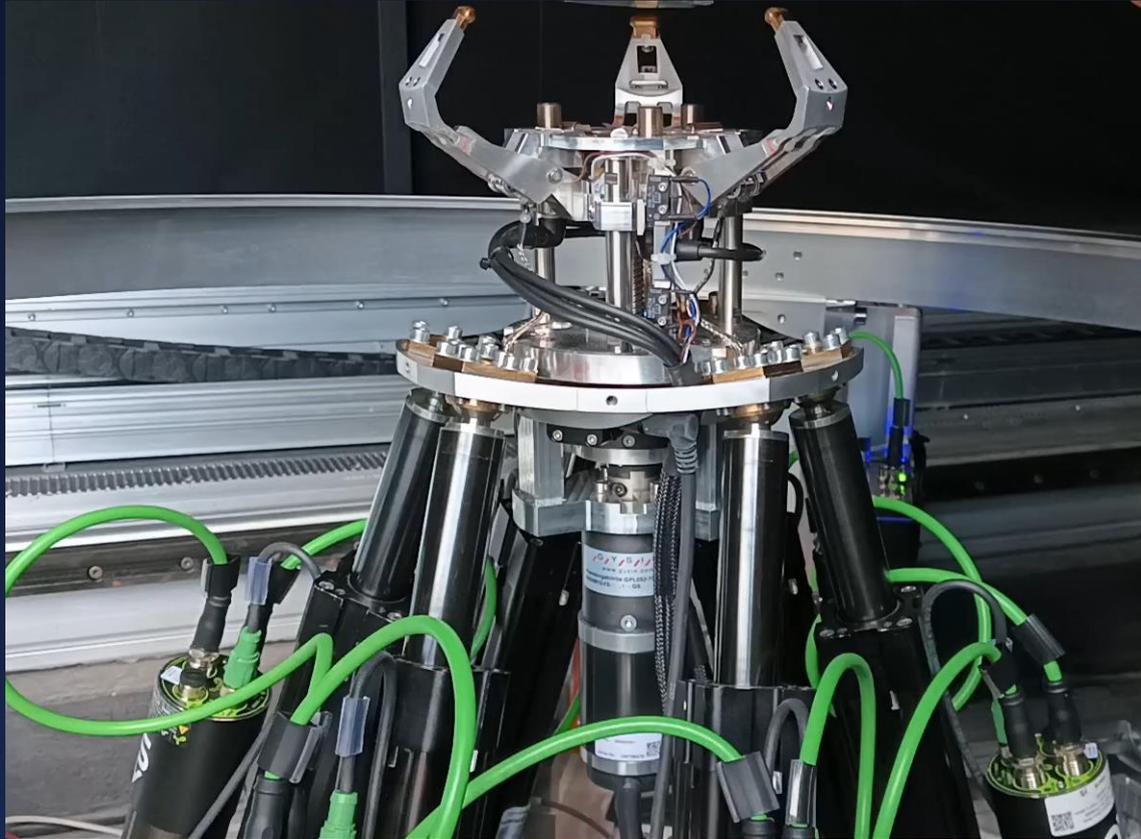
- CIS-Lunar Space Traffic Management

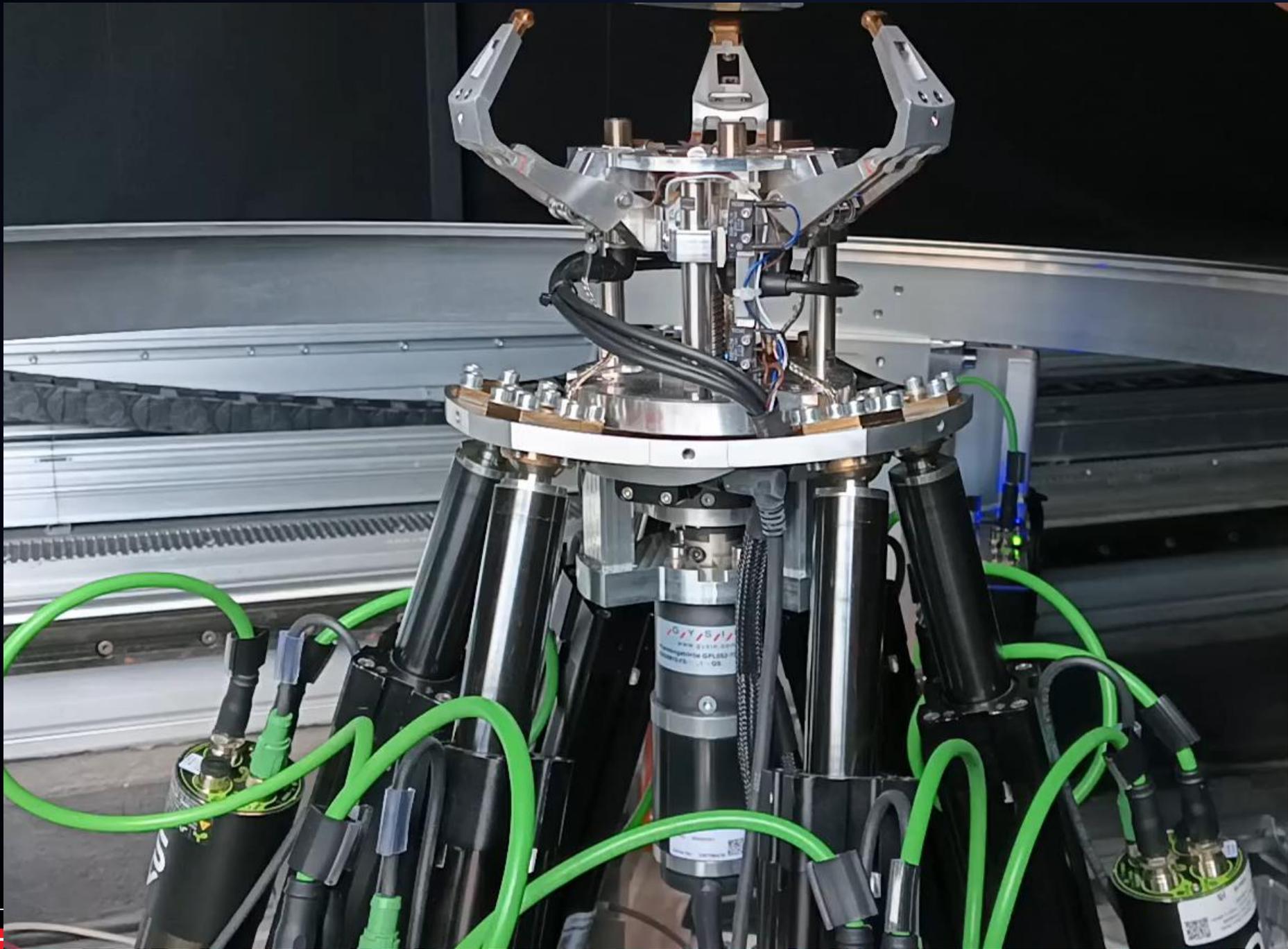


# COSMIC – Towards a Zero Debris Future

## CAT

- Demonstrating the Capture of a Cooperative target
- CATR Payload Bay achieved TRL4 – End-to-End test in laboratory environment
- LUR-1 satellite (launched) is first satellite to fly ESA’s removal interface





# Follow us on LinkedIn



<https://www.linkedin.com/showcase/esa-space-safety/>



## #SpaceSafety



# Status of the space environment

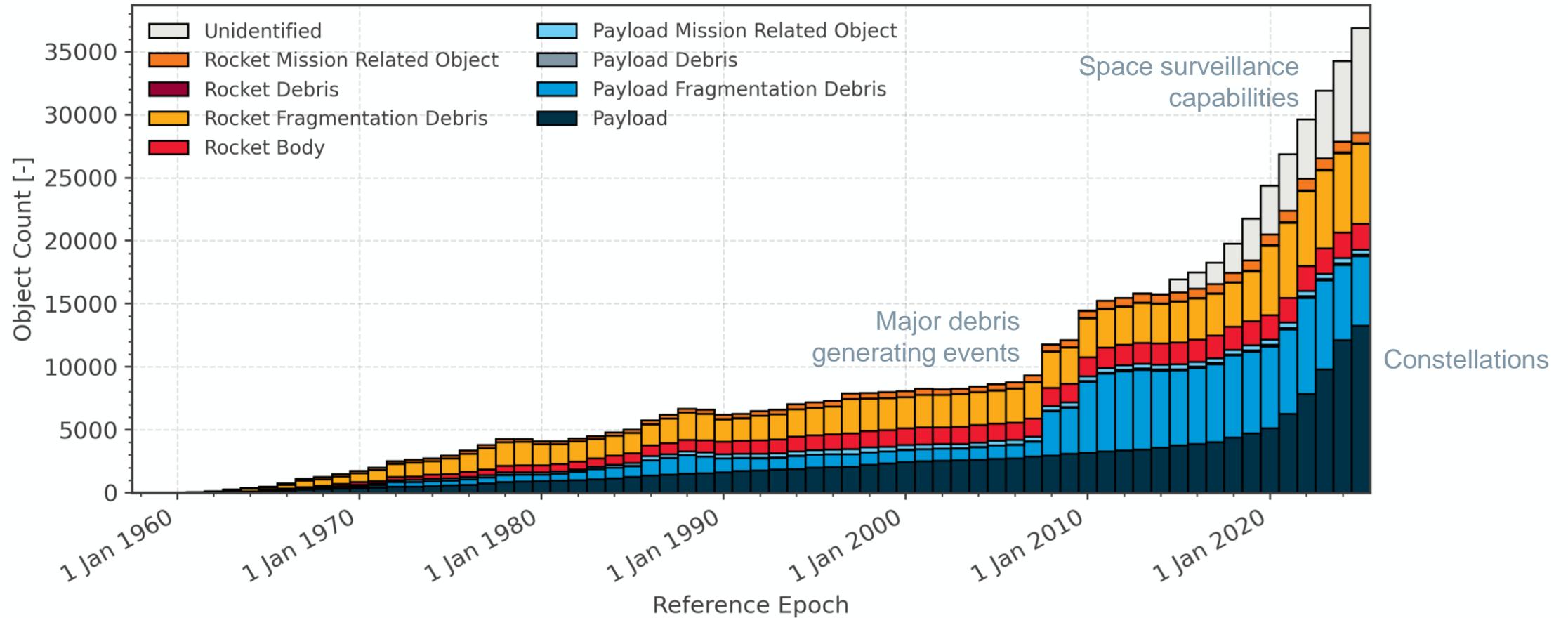
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Space Debris Office

Clean Space Days

08/10/2024

# Status of the space environment

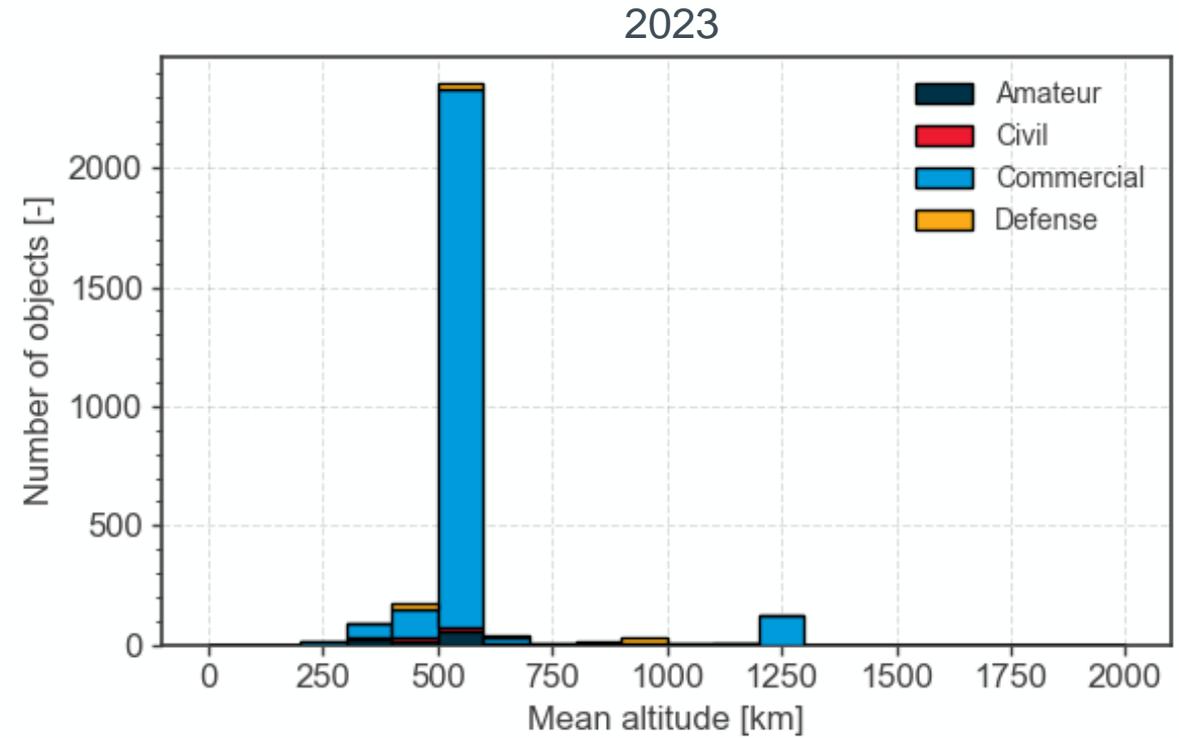
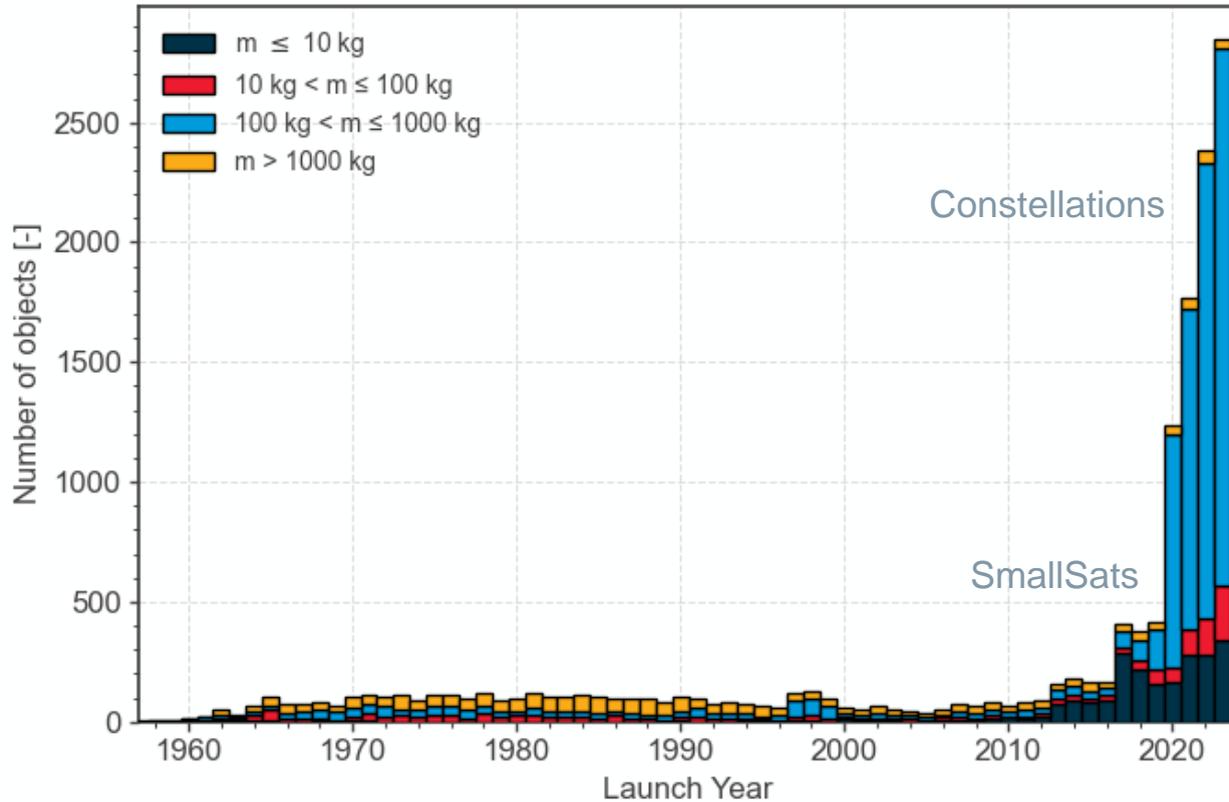


ESA space environment statistics



# Increasing space traffic

## Payload launch traffic into LEO

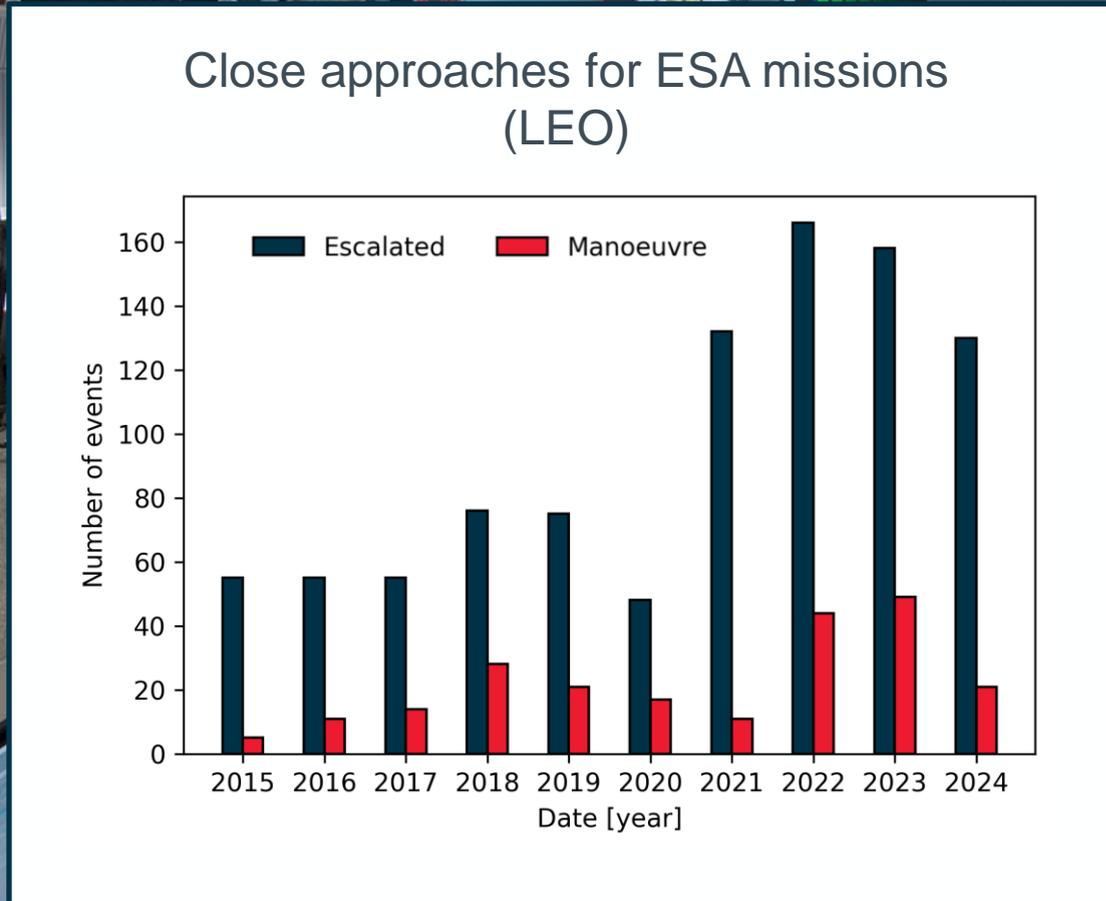


ESA's annual space environment report





# Operating in a congested environment



# Explosions still matter



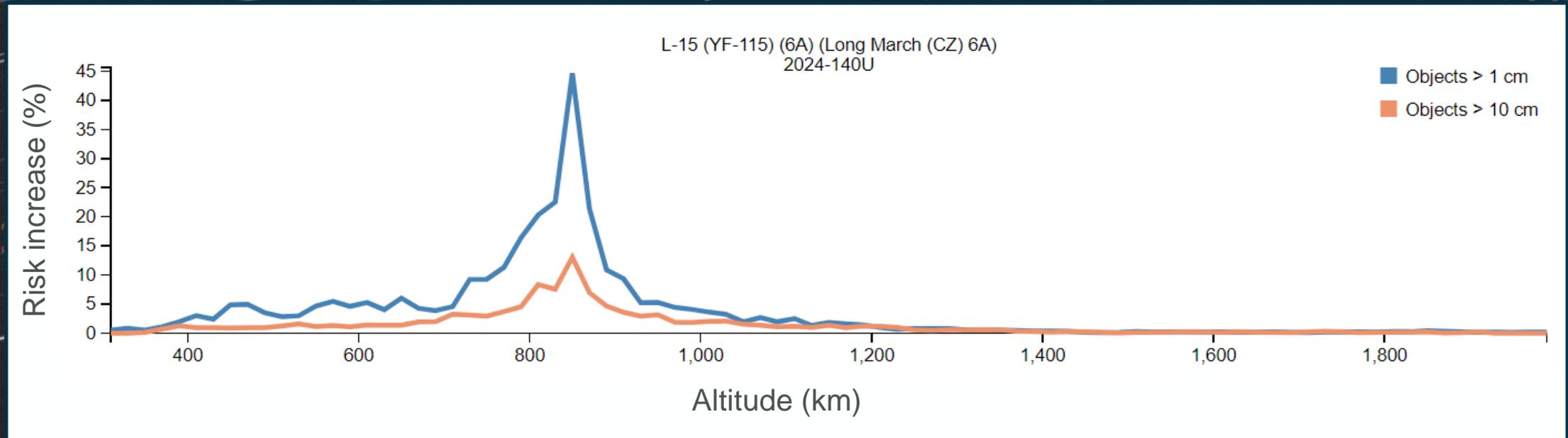
ATLAS 5 CENTAUR R/B #43227



Image credits: s2a systems 22

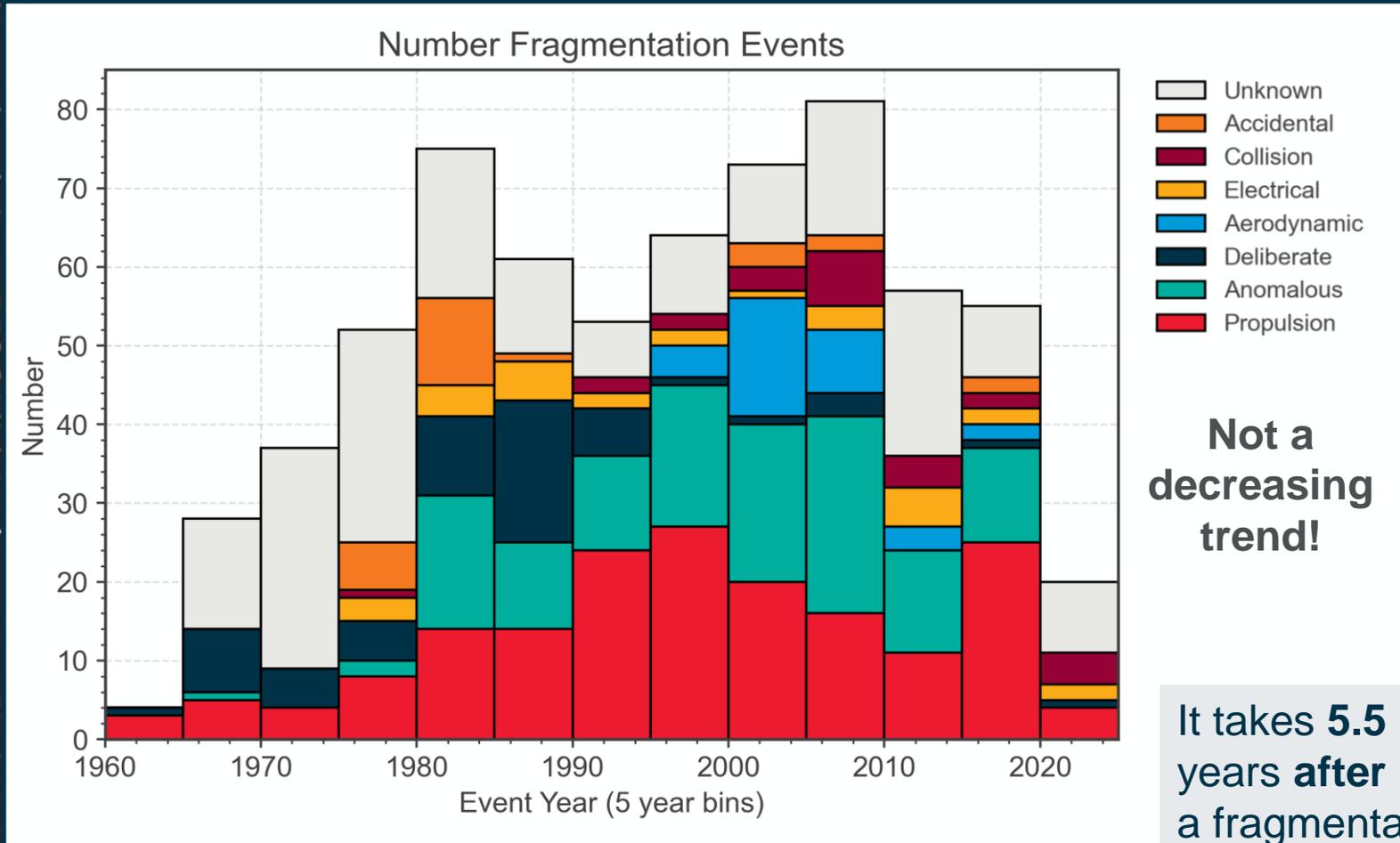
# Explosions still matter

3 explosions – 3 months



<https://fragmentation.esoc.esa.int/events>

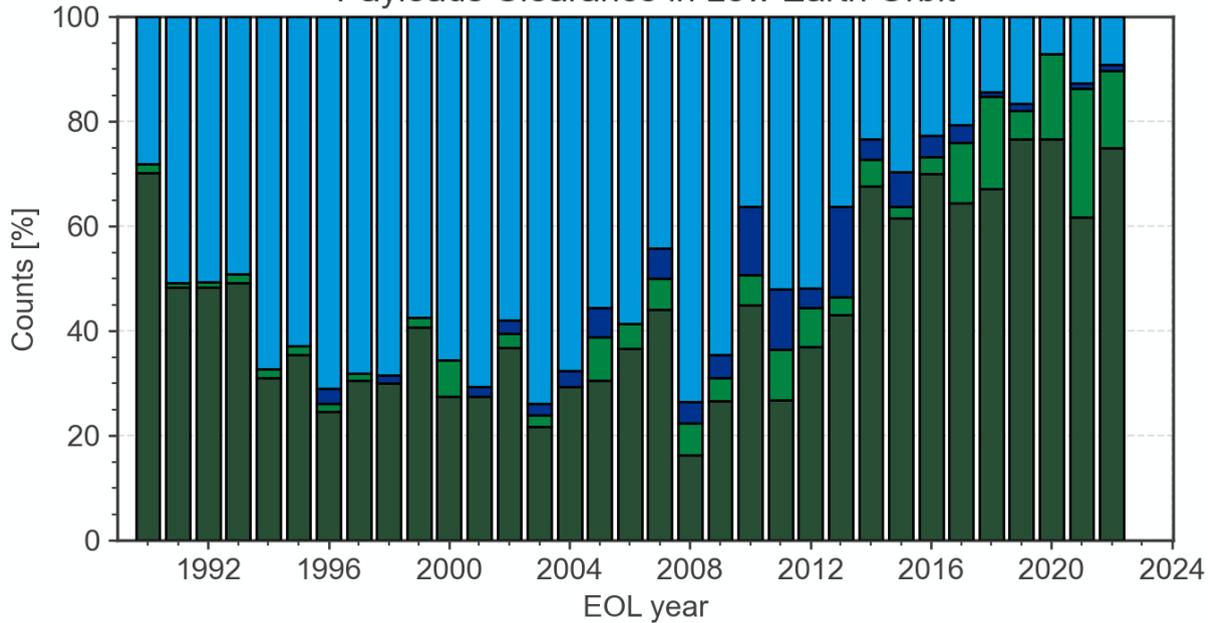
# Explosions still matter



Not a decreasing trend!

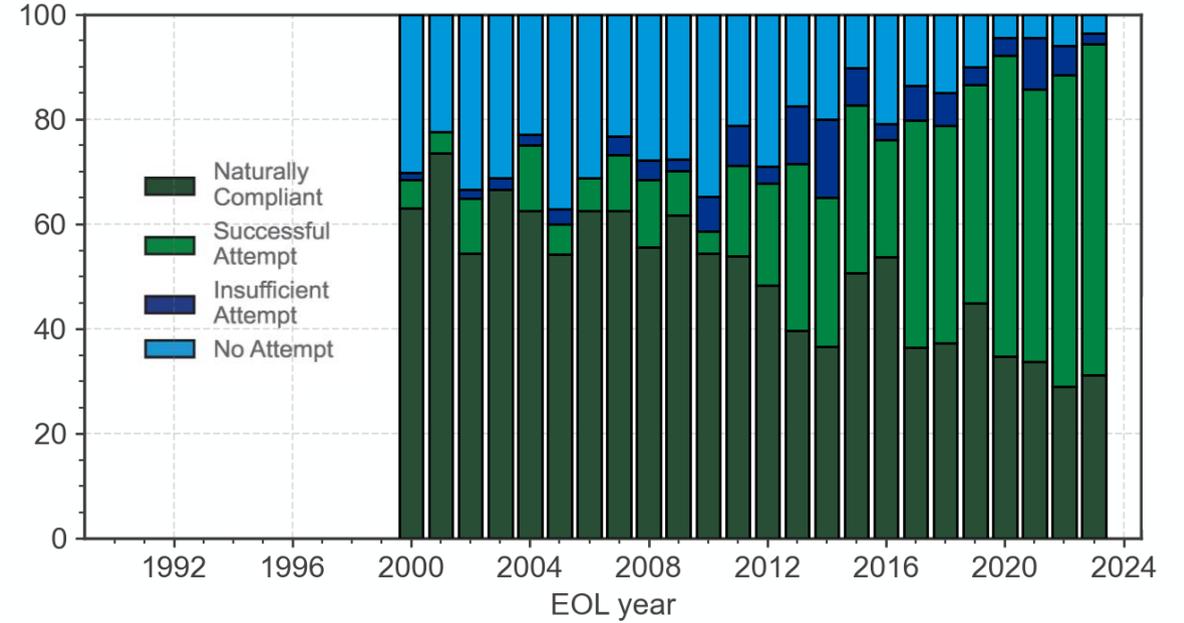
It takes **5.5** (mean) years **after launch** for a fragmentation event to occur

Payloads Clearance in Low Earth Orbit



Shift towards operations in naturally compliant orbits  
(lifetime < 25 years)

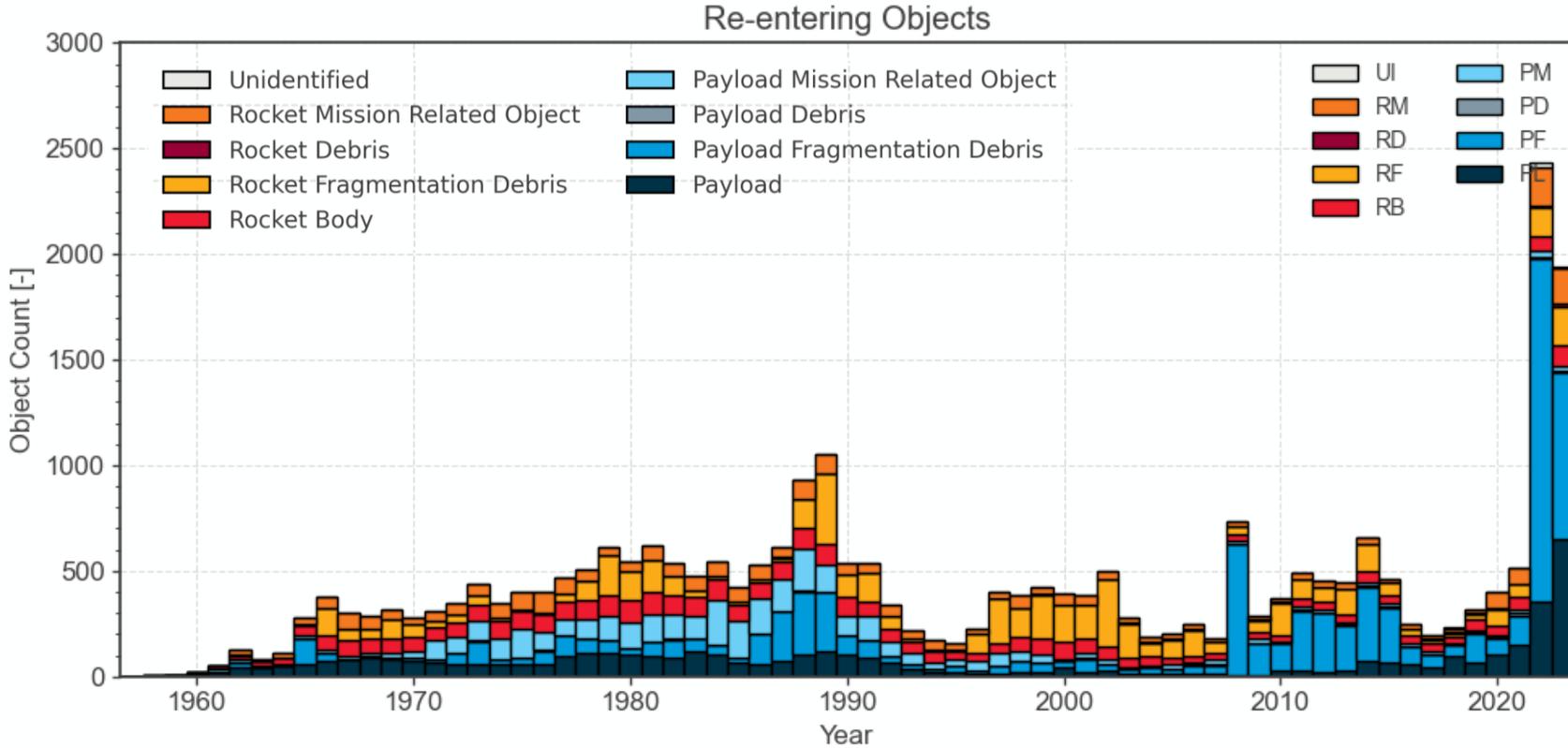
Rocket Bodies Clearance in Low Earth Orbit



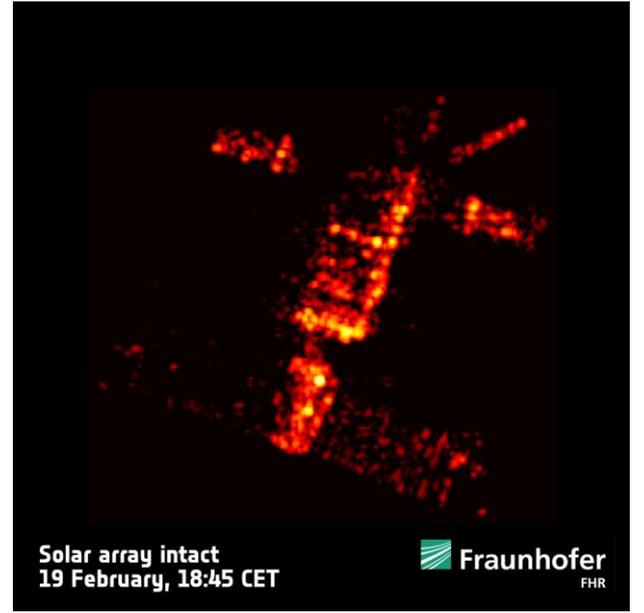
**Increasing** adoption of disposal through  
**controlled re-entry**

Compliance level for **non-naturally compliant**  
objects still far from targets

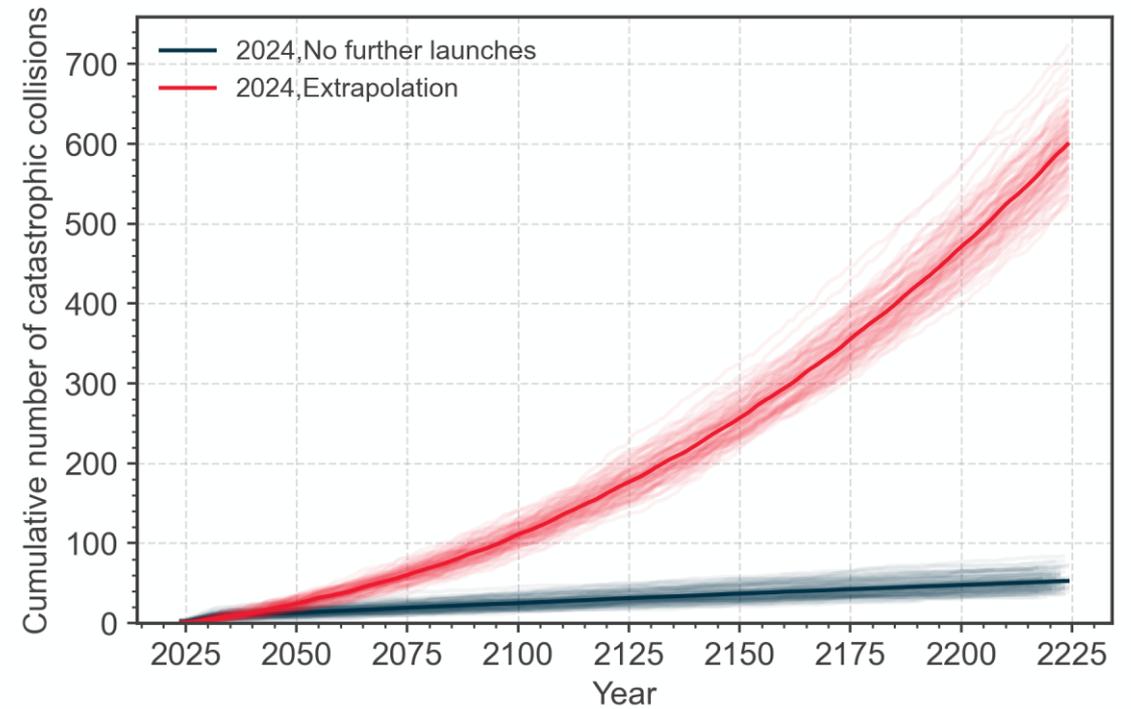
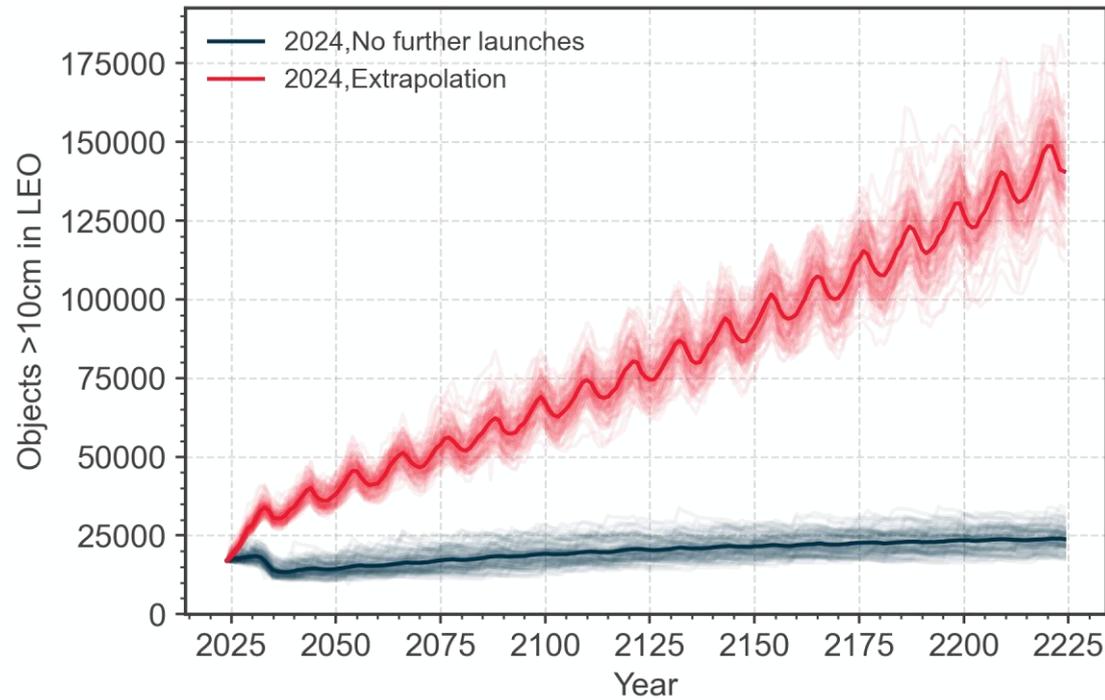
# Re-entry safety



2 intact objects re-entering every day



# Looking to the future



**Without further change, our collective behaviour is unsustainable in the long-term**

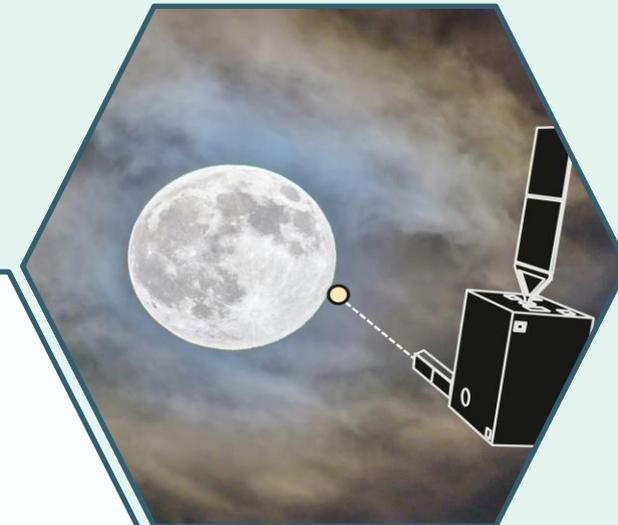
## Understanding demise during re-entry



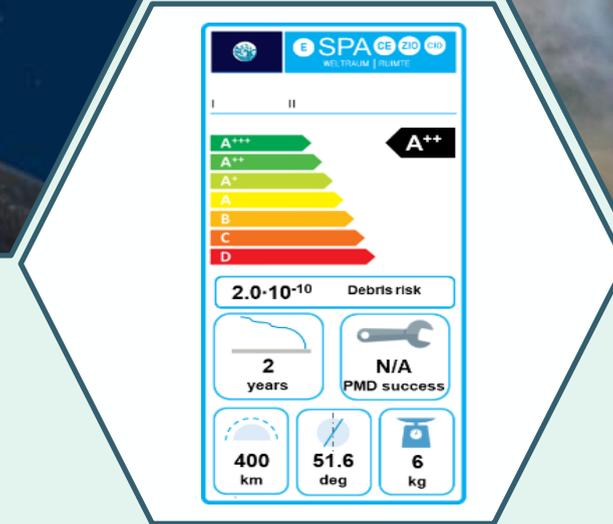
## Studying the small debris environment



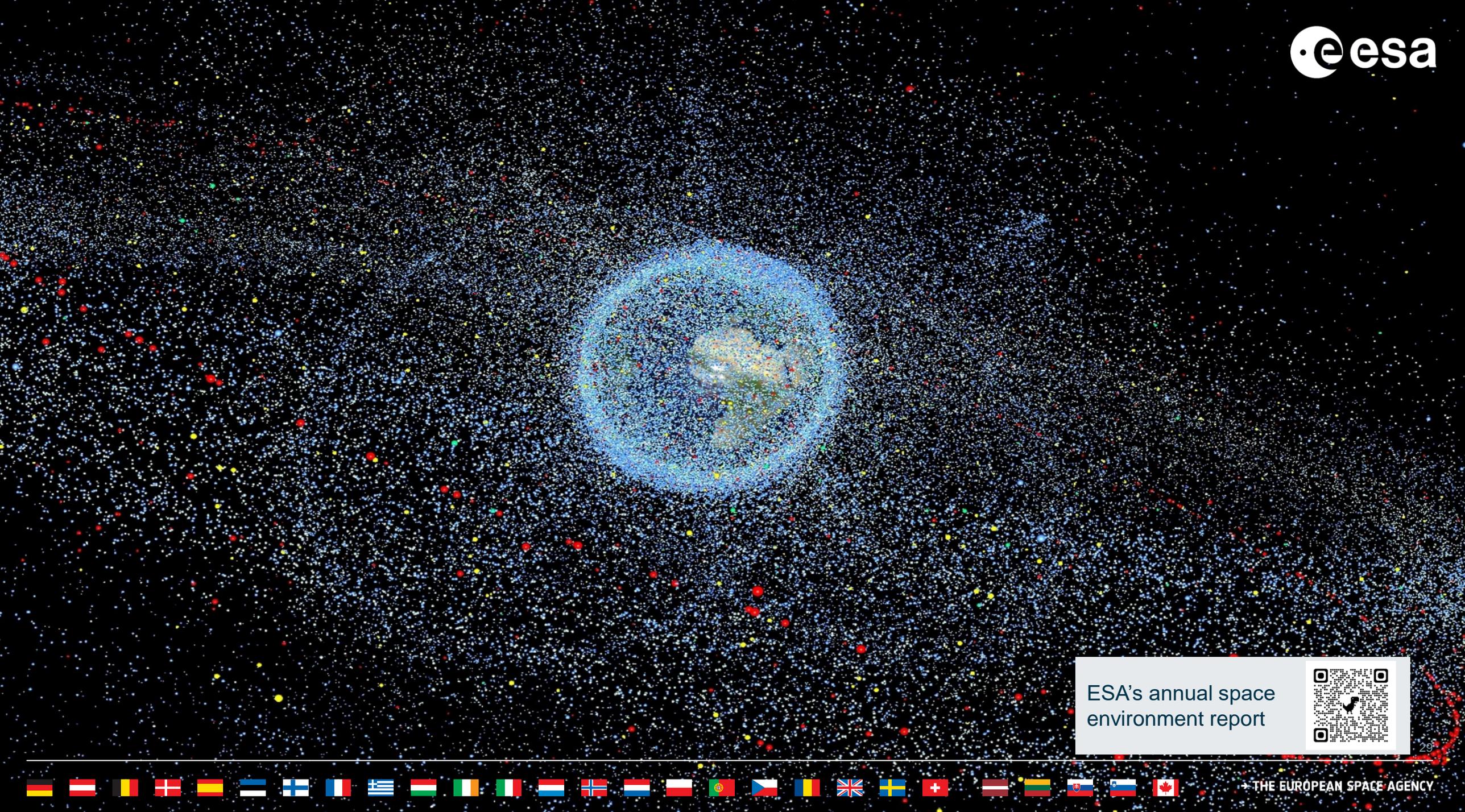
## Space debris beyond Earth



## Precision orbit determination



## Assessing the environmental impacts of space activities



ESA's annual space environment report



# Clean Space Introduction

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Tiago Soares,  
Clean Space Lead Engineer

# Building up Clean Space

First Official mention of Clean Space - 2012

## → AGENDA 2015

A Document by the ESA Director General

### 3.5 Priorities

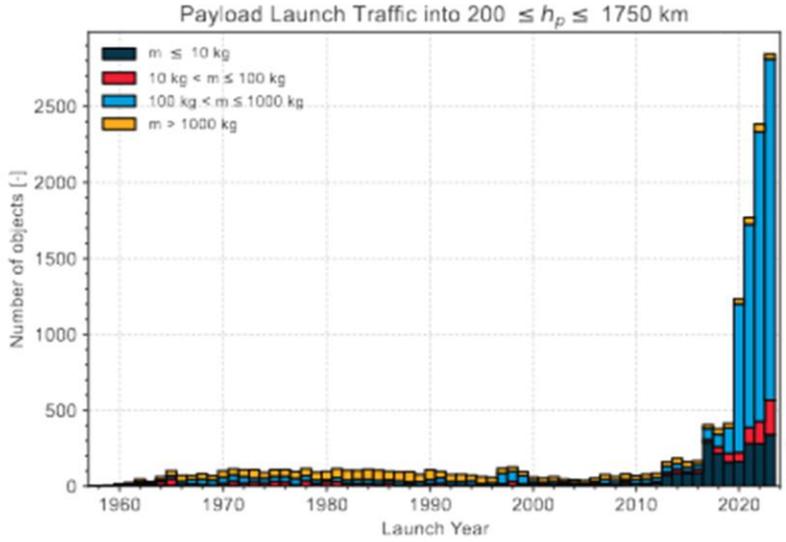
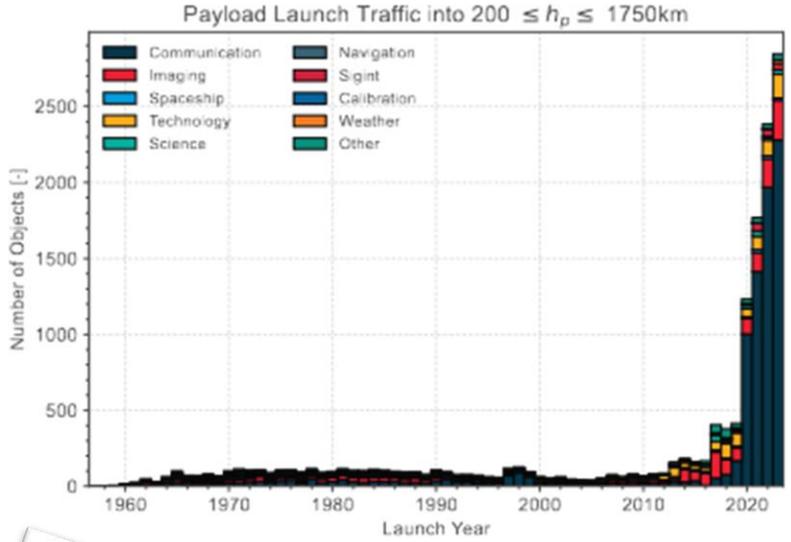
None of the above-defined goals and related activities can be considered as a luxury and they are all closely connected: scientific knowledge and competitiveness are two pillars upon which enhanced and new services can be delivered to citizens. Cooperative activities require also adapting to partners' calendars. **Clean space** cannot be dissociated from the development of space activities any more.



First Clean Space Industry Days 2014



# The Space Sector has changed.. a lot

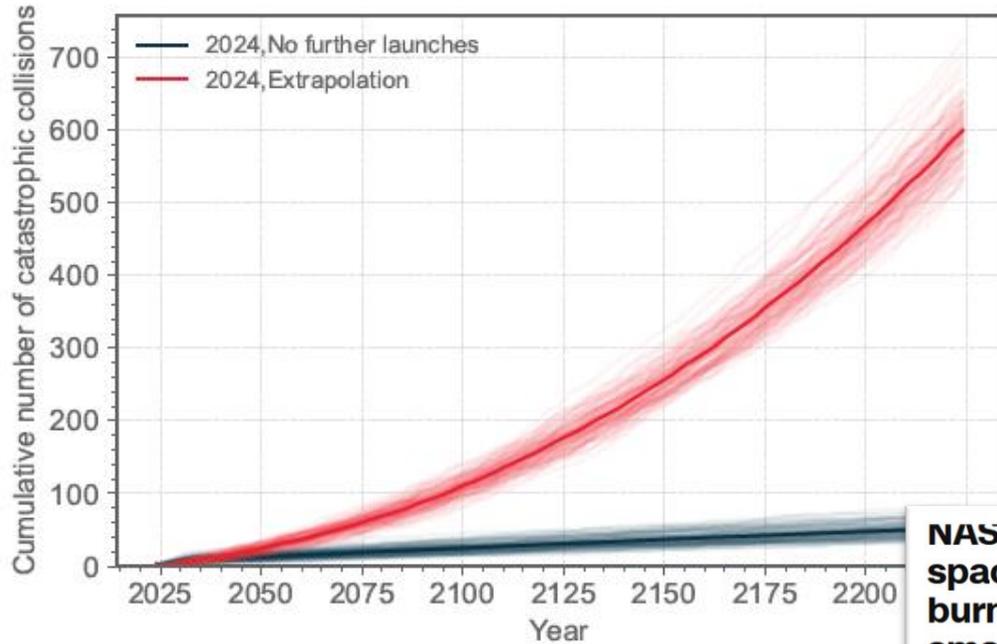


Space Exploration > Launches & Spacecraft  
**China launches 1st batch of satellites for planned 14,000-strong megaconstellation (video)**  
 News By Mike Wall published August 7, 2024  
 Assembly of the enormous 'Thousand Sails' network is underway.

A Starlink satellite has a lifespan of approximately five years and SpaceX eventually hopes to have as many as 42,000 satellites in this so-called megaconstellation.  
 The current V2 Starlink satellite version weighs approximately 1,760 lbs (800 kilograms) at launch, almost three times heavier than the older generation satellites (weighing in at 573 lbs or 260 kg), according to Spaceflight Now.

WORLD ECONOMIC FORUM  
 EMERGING TECHNOLOGIES  
**Space is booming. Here's how to embrace the \$1.8 trillion opportunity**  
 Apr 8, 2024

# It has never been so urgent to act

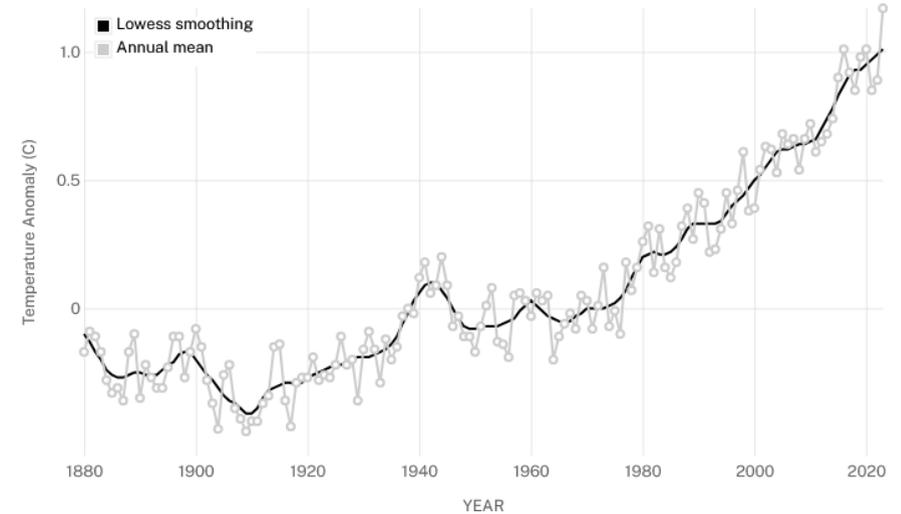


GLOBAL CLIMATE HIGHLIGHTS 2023  
**Copernicus: 2023 is the hottest year on record, with global temperatures close to the 1.5°C limit**

Space  
**Elon Musk's Starlink satellites could damage the environment for decades, study says**  
 Mega satellite constellations produce destructive gases when they burn up in atmosphere at end of service lives

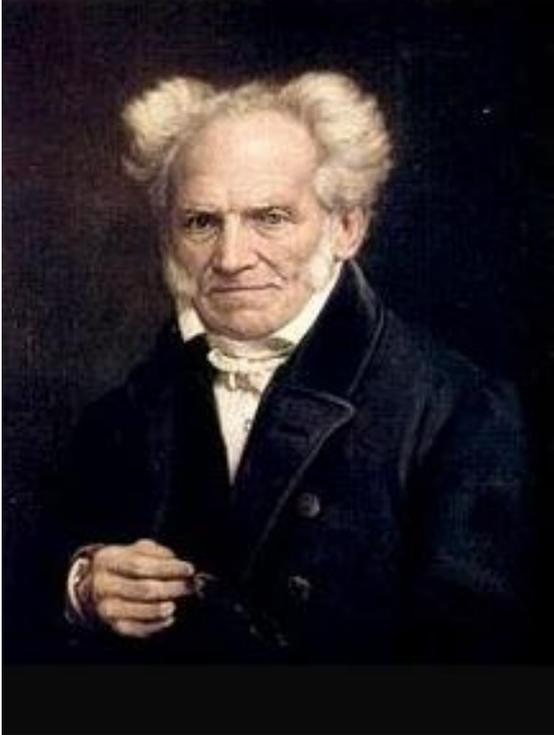
**NASA says it expected space station garbage to burn up. The debris smashed into a Florida home instead**

By Jackie Wattles, CNN  
 4 minute read · Updated 5:03 PM EDT, Wed April 24, 2024



Science / Space  
**Chinese rocket breaks apart in low-Earth orbit, creating a cloud of space debris, US Space Command says**

## Real change will never come without reaction



All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident.

(Arthur Schopenhauer)

WHAT IS THE HIGHEST PRIORITY FOR OUTER SPACE?



#CM22

# The world has changed – Regulation



Federal Communications Commission

Home / EDOCS / Commission Documents

## FCC Adopts New '5-Year Rule' for Deorbiting Satellites

**Full Title:** FCC Adopts New '5-Year Rule' for Deorbiting Satellites To Address Growth Of Orbital Debris

**Document Type:** News Release

**Bureau(s):** International, Media

**Description:** News Release (Agenda Item)

**Docket No:** 22-271, 18-31

**Related Document(s):** Report and Order - FCC '5-Year Rule' for Deorbiting Satellites

## S'adapter aux enjeux du New Space : Mise à jour de la Réglementation Technique associée à la Loi Spatiale Française (LOS)

Espace durable

La nouvelle réglementation technique associée à la loi spatiale française est entrée en vigueur le 1er juillet 2024.



FROM THE SMI 28 JUNE

## Markets Initiative a Carta

Forum for Space the Private Sector

## Regulating Access to Outer Space – The Italian Law on Space Economy

July 2024

Region: Europe

[READ FULL INSIGHT](#)

On 20 June 2024, the Italian Council of Ministers approved a legislative decree (the Reform) introducing, for the first time in Italy, a series of provisions on Space Economy. The purpose of the Reform is to regulate access to outer space by entities and private enterprises, which have driven the rapid growth of space commercialization in recent years.

## The European Space Law (EUSL)

What is the European Space Law (EUSL)?

On the 13th of September 2023, in the State of the Union, President von der Leyen presented Commission priorities for 2024.

The Letter of intent included an **initiative for an EU Space Law (EUSL)**. The legislative proposal envisages common EU rules addressing the **safety, resilience and sustainability** of

and others from ITU, UNOOSA, etc ...



# Momentum is growing... fast enough?

NEWS ARTICLE | 18 September 2024 | 1 min read

## Shape a sustainable future: engage in the development of a PEFCR for Space!



## NASA makes progress on space sustainability strategy

Jeff Foust July 14, 2024



Press release

## UK builds leadership in space debris removal and in-orbit manufacturing with national mission and funding boost

Two UK-based companies are designing missions to clear hazardous space junk alongside the launch of a new programme to back cutting-edge space technology.

## FCC fines Dish Network for botched satellite de-orbit

Jason Rainbow October 2, 2023



The RDOF program has authorized more than \$6 billion in funding to bring primarily fiber gigabit broadband services to more than 3,458,000 locations across the United States. Credit: SpaceNews/Caleb Henry

Home » News & Resources » News » Astroscale's ADRAS-J Continues to Make History: Successfully Demonstrates Fly-Around Observations of Space Debris

## Astroscale's ADRAS-J Continues to Make History: Successfully Demonstrates Fly-Around Observations of Space Debris

Posted July 30th, 2024

Posted in News



REPUBLIQUE FRANÇAISE

cnes

### DES NOUVELLES TECHNOLOGIES POUR LIMITER LES DÉBRIS

Pour limiter la prolifération de débris et assurer la pérennité des activités spatiales, le cadre légal se durcit. Avec la Loi sur les opérations spatiales, la France a été précurseur. Mais comment, dans ce contexte, permettre aux entreprises et industries françaises de rester compétitives en faisant face à ces nouvelles contraintes ? C'est l'objectif du CNES à travers le dispositif TechSpaceCare (T+SC) : depuis 2023, le CNES développe de nouvelles technologies qui feront la différence : limiter les débris tout en soutenant l'écosystème français.

<b>LE DÉTUMBLER</b> pour stabiliser l'attitude des débris	<b>EOLTS</b> pour localiser précisément les satellites	<b>UN BOUCLIER IMPRIMÉ EN 3D</b>
<b>Objectif :</b> éviter qu'un satellite égaré ne se mette en rotation planétaire et devienne difficile à approcher / réparer / éliminer.	<b>Objectif :</b> meux prévoir la trajectoire des satellites pour gérer plus précisément le trafic spatial.	<b>Objectif :</b> protéger les zones sensibles des satellites face à des débris jusqu'à 3 mm.
<b>EPASS</b> passiver les satellites en fin de vie	<b>UN SYSTÈME DE PROPULSION ULTRA-AGILE</b>	<b>UNE PUCE RFID</b> interrogeable depuis le sol
<b>Objectif :</b> éviter l'explosion des batteries de satellite en les déchargeant à la fin de leur vie.	<b>Objectif :</b> donner la mobilité nécessaire à tous les satellites pour réaliser des manœuvres anticollision.	<b>Objectif :</b> faciliter l'identification des satellites et débris depuis le sol, comme une voiture au télépilage.



Mature LCA databases for ESA projects and implement **Greener techno roadmap**

Launch the **EcoStars** initiative (phase A/B1)

Cross-cutting **Zero Debris Workplan** : make Zero Debris vision possible by 2030

Demonstration of Capture Payload Bay – **CAT mission** (phase B – E)

Mature **Circular Economy Mission Design** (phase A/B1) and IOS technology

Completion and Continuation of **ADRIOS missions**: CS-1, RISE, ENCORE



understand environmental impacts  
EcoDesign of all activities, **space sector environmental neutrality**



Put a stop to the increase of risk in orbit and on-ground due to space debris, a **Zero Debris future**



Transform the way space operations are conceived by enabling a **Circular Economy in Space**

# We are on this together!



## “If you love space, you must love Clean Space”

*J-J Dordain, CSD 2023*

41

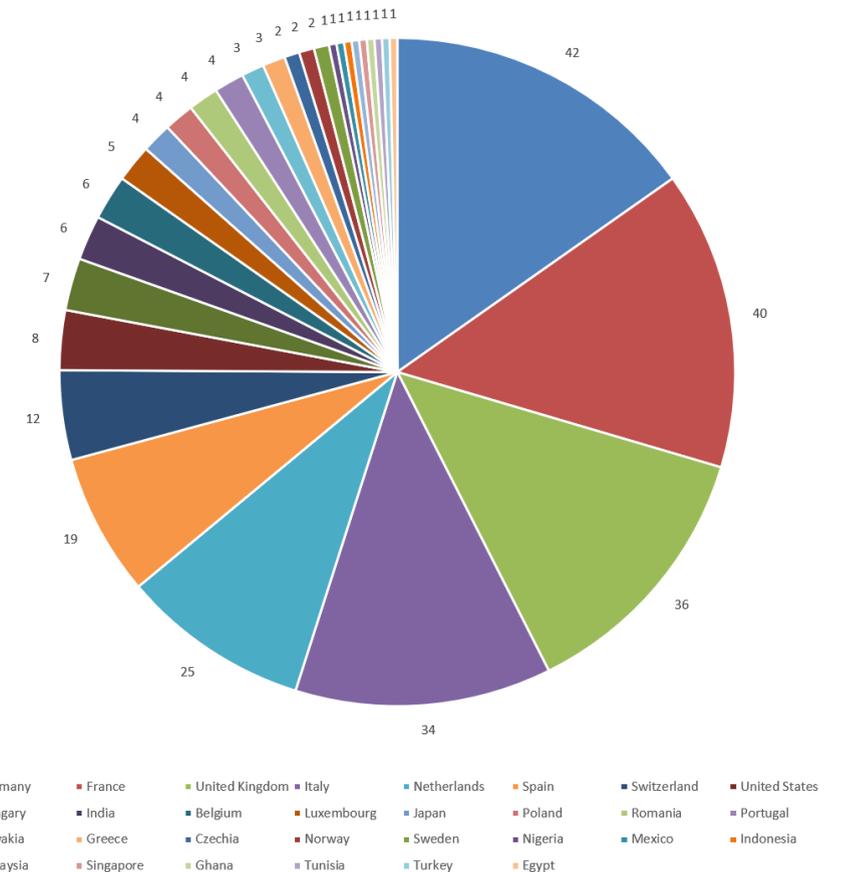


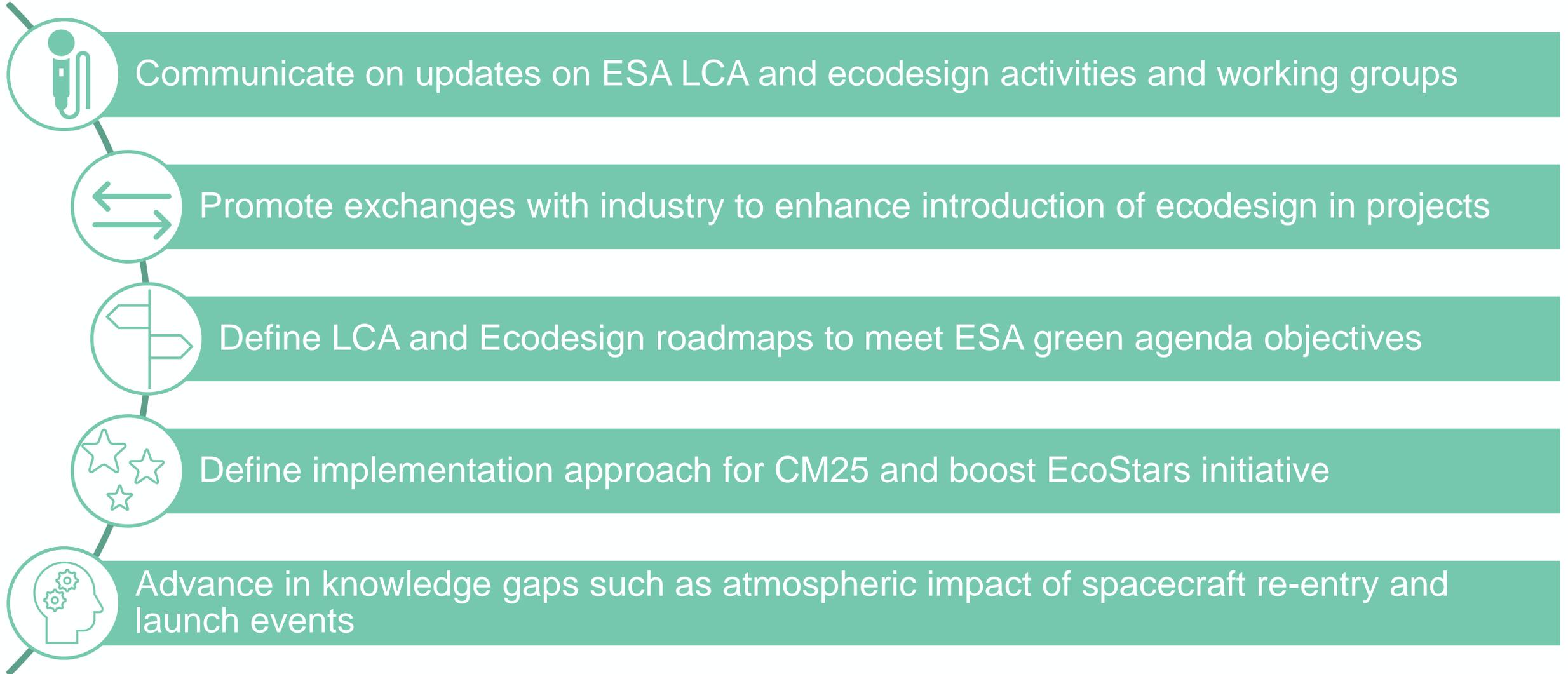
Attendants  
**325**

organisations  
**168**

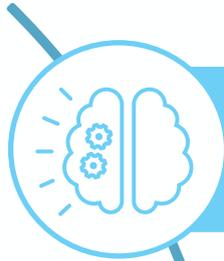
**158**  
Abstracts received

**30** Countries represented:

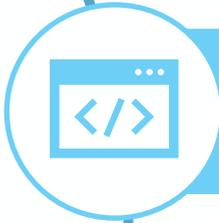




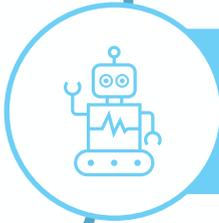




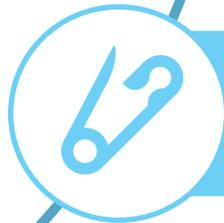
Exchange knowledge among Agencies, industry and academia on mission and system concepts for Active Debris Removal (ADR) and In-Orbit Servicing (IOS) missions, under preparation and implementation phases



To discuss the technical and programmatic aspects related with the current concepts for Space Circular Economy, the vision on IOS activities and the strategy for the future (at CM25 and beyond)



To share an overview of the current status of the technology development activities on the enabling technology for in-orbit servicing missions, with focus on robotics, servicing interface and GNC capabilities and technologies



To present the current status of the investigations on safety and commercial aspects of IOS, with presentation of the analysis on policy, guidelines and market

# Ecodesign

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Sara Morales  
Clean Space System Engineer



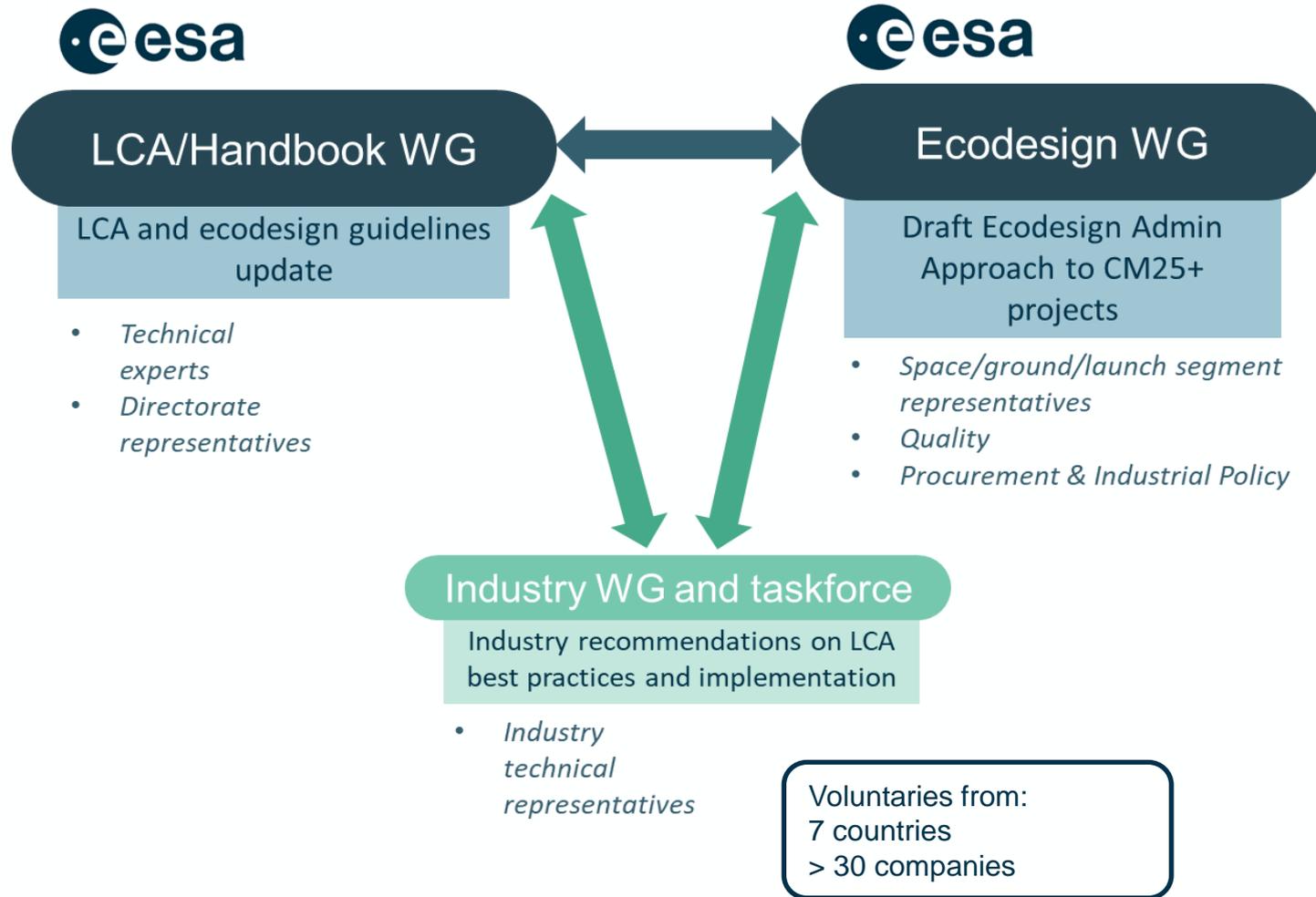
## Commitments

- Reducing the environmental **impacts generated by space missions**
- **GHG emissions:** Space programmes generate 69% of the total ESA impacts. Commitment to **reduce** by 28% by 2030

## Approach

- **Systematic use of Life Cycle Assessment (LCA)** to assess **mission impacts**
- Development of a **technology roadmap**
- Support to the space industry to **adapt to future regulations**

# Establishing the EcoDesign framework

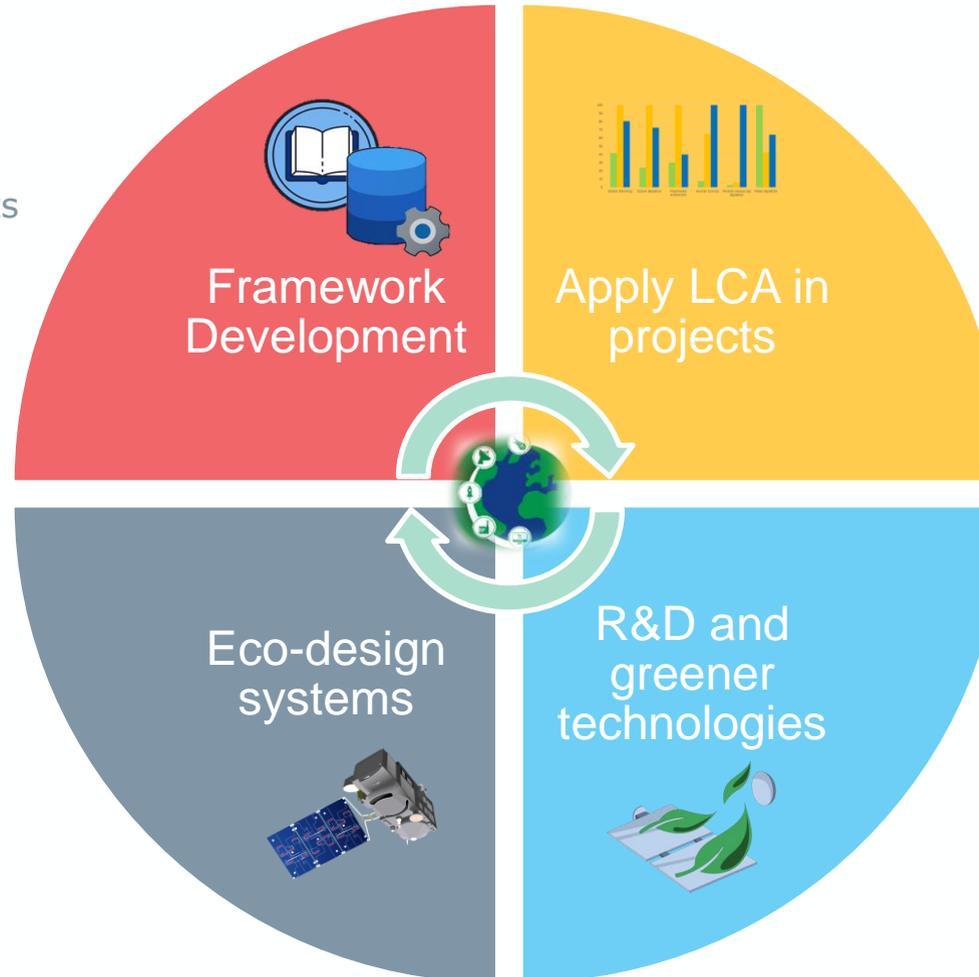


**Duration:** 9 months (March-Dec 2024)

## Programmatic and Technical framework: Ecodesign WGs

- ❑ **ESA LCA Database:**
  - ❑ Release of a new version!
  - ❑ Web: Space Debris Portal
  - ❑ Development of Generic Datasets
- ❑ **Handbook Update:**
  - ❑ Alignment to other Standards
  - ❑ Inclusion of feedback
  - ❑ DQR, questionnaires, etc
- ❑ **Simplified LCA**
  - ❑ 10 ESA study cases with LCA

- ❑ **System:**
  - ❑ EcoStar SysNova Campaign
- ❑ **Technologies:**
  - ❑ Toward Greener MAIT

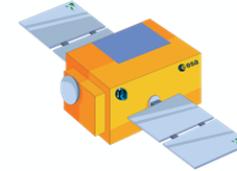
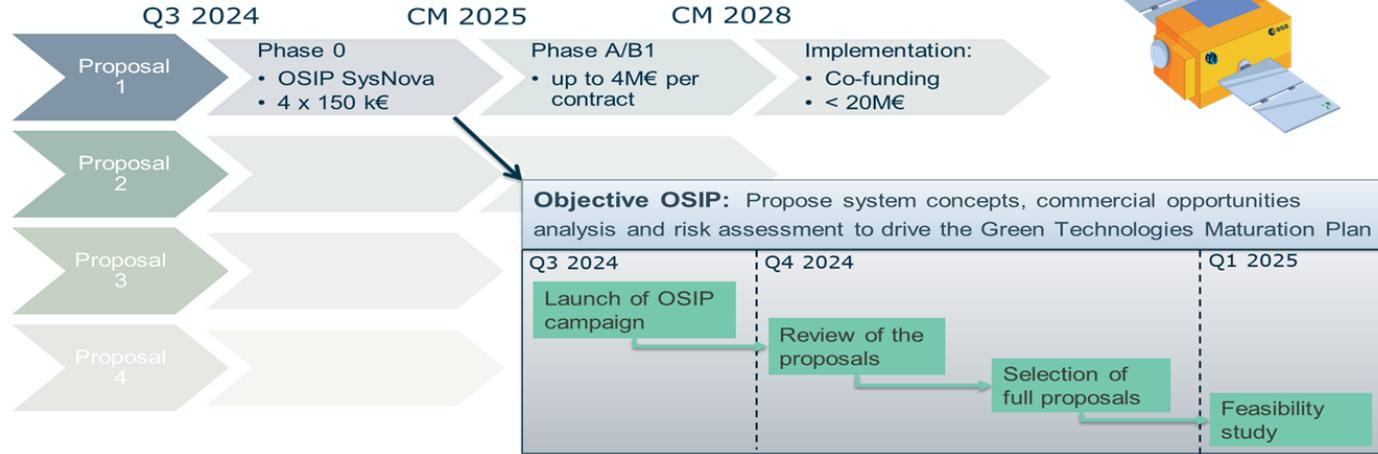


- ❑ **Systematic application:**
  - ❑ All directorates
  - ❑ Early and later phases
- ❑ **Lessons learned and feedback:**
  - ❑ Lessons Learned CDF
  - ❑ Ecodesign taskforce
  - ❑ PM forum consultation

- ❑ **Atmospheric impacts:**
  - ❑ OSIP campaign
  - ❑ Dedicated Workshops
  - ❑ Roadmaps
- ❑ **Data gaps:**
  - ❑ Impacts of testing
  - ❑ Impacts of sat constellations
- ❑ **Greener Technologies**
  - ❑ Greener propulsion system

# CM25 approach - EcoStar IOD & technology roadmap

**ECOSTAR IOD**  
**Objective:** Breakthrough in development, integration and demonstration of green technology in European space product-lines



**CM25 techno strategy:**

Top-down approach (industry led)

Green technologies

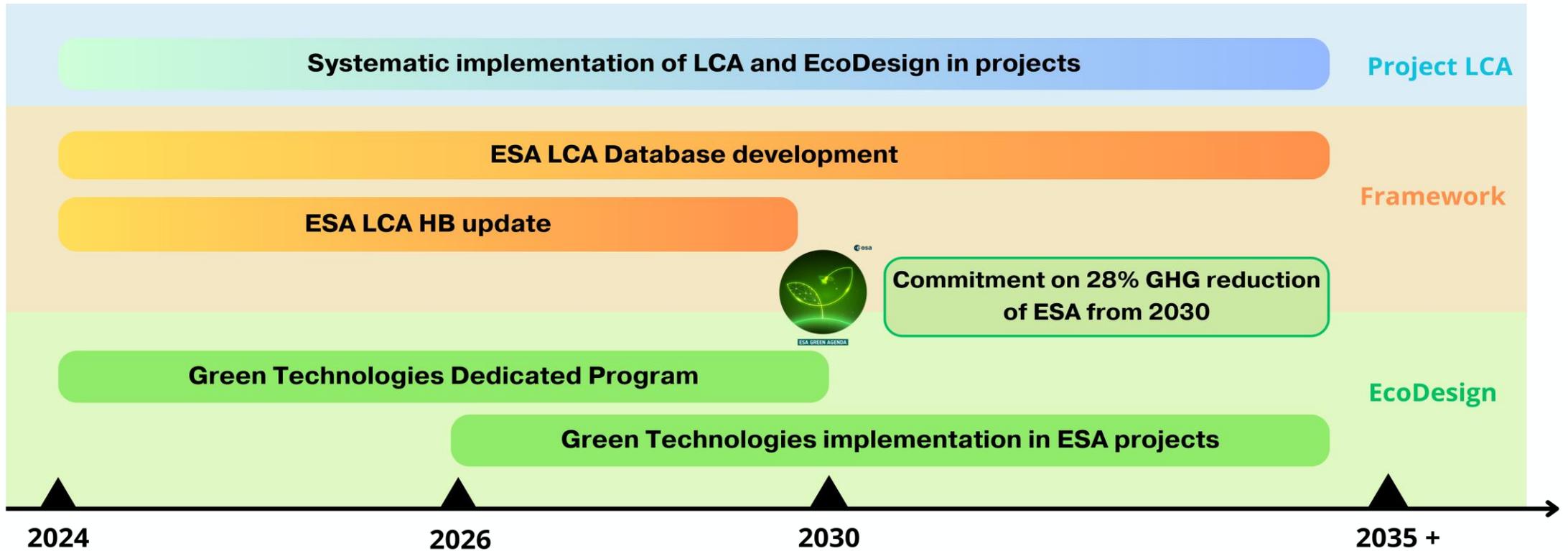
Possible funding programs (TBC): S2P, GSTP, TDE, etc

Ariane 6  
 Earth Explorer 9 & 10  
 Copernicus Expansion  
 Galileo 2<sup>nd</sup> generation  
 ...



# EcoDesign implementation roadmap

- Phased implementation of measures:
  - Short term approach to meet 2030 targets
  - Long term approach with transformative EcoDesign solutions across projects



# Zero Debris

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Tiago Soares  
Clean Space Lead Engineer

# Zero Debris Approach



# Where do we stand?



**ESA SDM Policy**

**ESA Technical dev**

**ZD Charter**

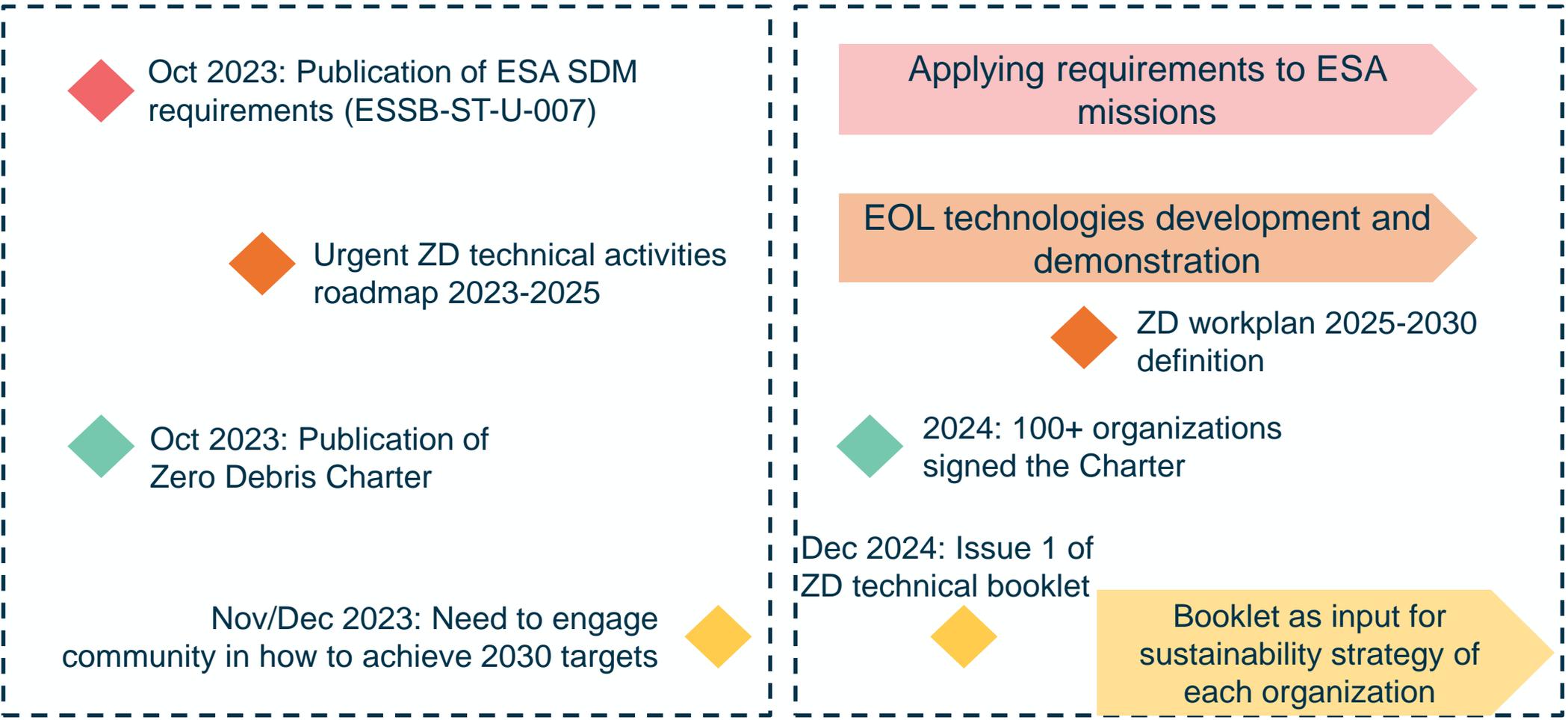
**ZD technical booklet**

## Building a vision

2024

## Making it real

2026



## Where we want to be by 2030? Zero Debris Charter



Published in  
Oct 2023



Signature  
ceremonies thr  
ough 2024



~ 100 signatories to  
be reached at IAC



## How to get there? Zero Debris Technical Booklet

How can the booklet be useful for each organisation ? As a support for :

- Defining **sustainability strategy** and **priorities**
- Engaging with the community for **collaboration**
- Identifying **contributions** and **needs**

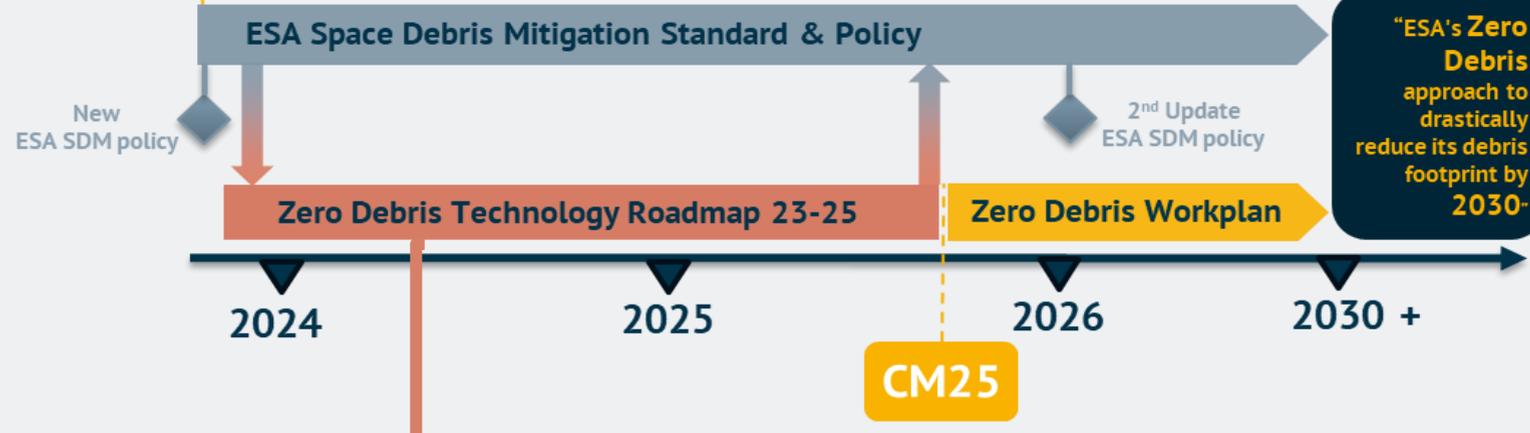


ZD Week – June 2024

# Making it real: ESA Zero Debris Roadmap 23-25

## Supporting European industry transitioning towards Zero Debris

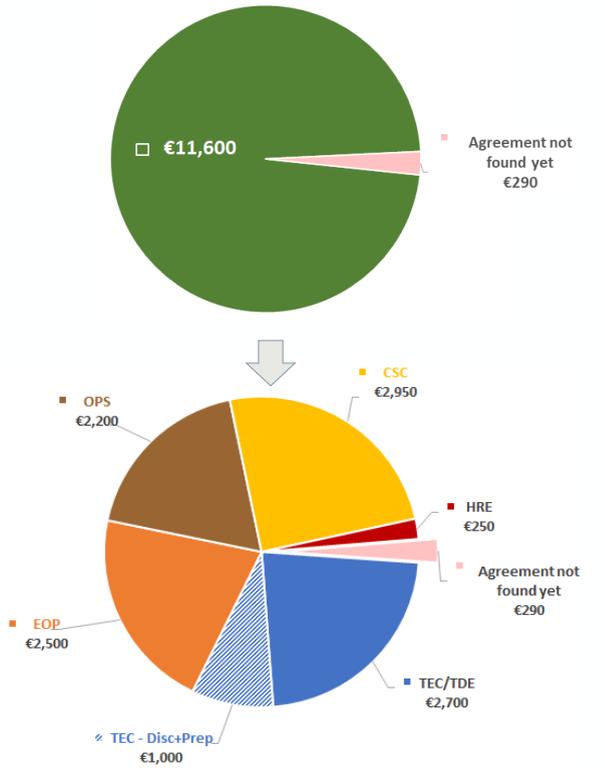
- 1 Support industry compliance in V&V to new ESA SDM Policy
- 2 Prepare CMIN25 & 2026 SDM Policy update, through system studies and mature critical technology



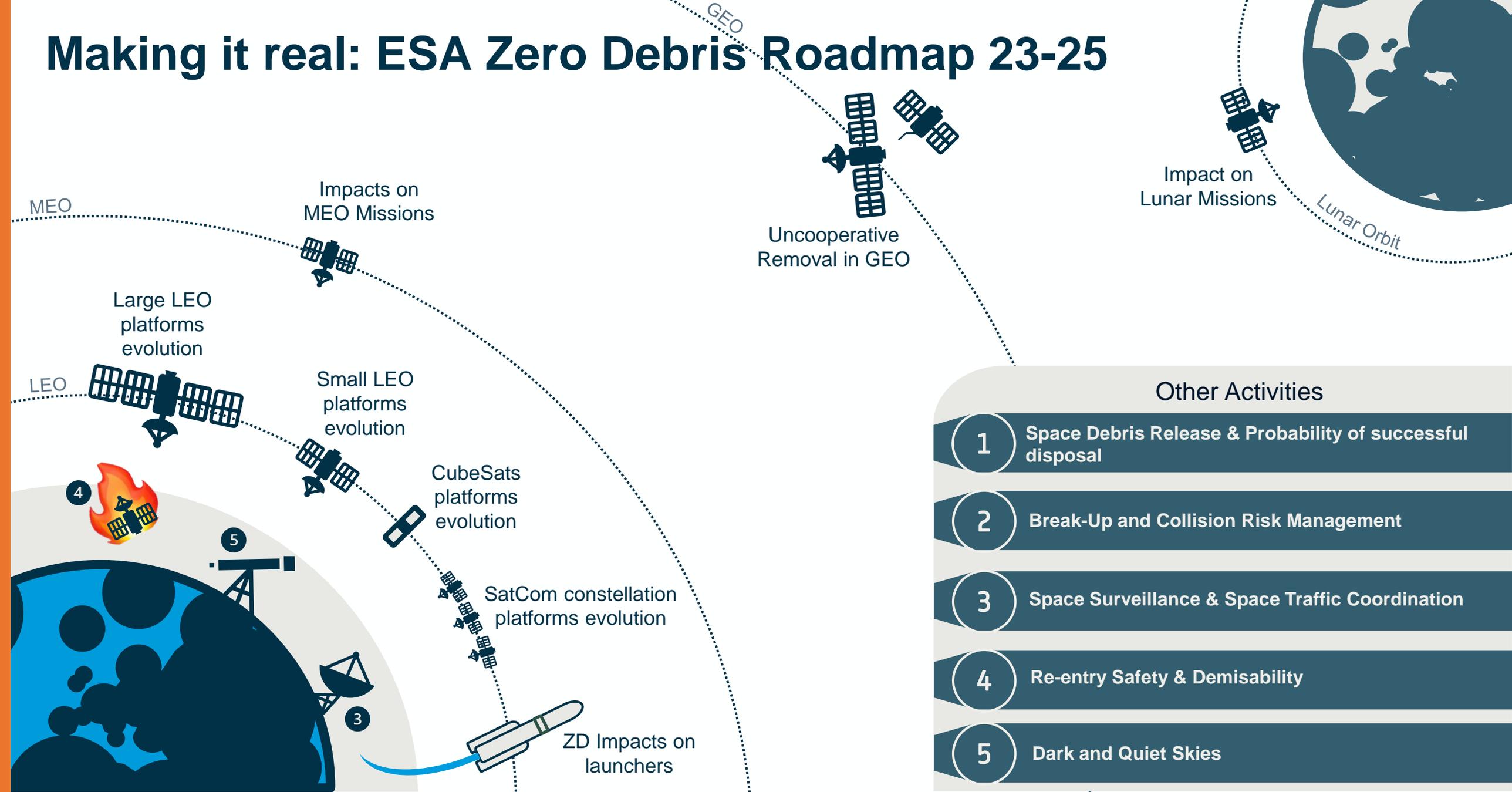
→ All ITTs to be released end 2024/early 2025 (see next slides)

## Current support across Directorates

Zero Debris Roadmap 23-25  
11.9 M€



# Making it real: ESA Zero Debris Roadmap 23-25



# ESA Zero Debris urgent activities: an opportunity (1/3)



## Evolution of platforms for Zero Debris implementation



24-P-M-OPS-11	Preparing future European LEO CubeSat platforms for Zero Debris compliance (CleanCube)	500 k€	TEC Preparation - OSIP – 5 winners Phase 0 (100k€/winner)	Campaign closed – waiting for final proposals
1A.129	Implications of a Zero-Debris Approach to Future Satcom Mission Design	350 k€	ARTES FP	ITT to be released early 2025
4A.104	Space debris compliant microsatellite platform for large satcom constellations	3.000 k€	ARTS AT	ITT to be released early 2025
E3CX-017	Impact and evolution of Zero Debris for Lunar Orbit	250 k€	ExPeRT	ITT to be released end 2024

## Probability of successful Disposal – Methodology & Tools



T725-802QQ	Framework for computation of probability of successful disposal	700 k€	TDE	ITT to be released end 2024
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## Probability of successful Disposal – Reliability, Health Monitoring



4A.103	Digital twin for lifetime assessment of low Earth orbit telecom constellation satellites	1.250 k€	ARTES AT	ITT to be released early 2025
T711-803SD	Robust atmosphere error modelling for sustainable operations	300 k€	TDE	ITT to be released early 2025
4G.047	Software execution environment for intelligent applications	700 k€	ARTES AT	ITT to be released on 20 Oct. 2024
4G.044	Onboard data handling sub-system, for autonomous satellites	1.400 k€	ARTES AT	ITT closing 15 November 2024
3E.024	In orbit experiment of autonomous deployment and early operations for telecom constellation satellites	7.000 k€	ARTES AT	ITT to be released early 2025
T701-801QQ	AI-based Failure Prediction to Improve Operational Payload Availability	350 k€	TDE	ITT to be released early 2025
T719-801MP	Disruptive propulsion technologies for CubeSat de-orbiting	600 k€	TDE	ITT to be released end 2024

## Probability of successful Disposal - passivation



4F.176	Power bus isolation device to achieve reliable electrical passivation	700 k€	ARTES AT	ITT to be released early 2025
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# ESA Zero Debris urgent activities: an opportunity (2/3)



## • Probability of Successful Disposal – Design for Removal (D4R) - adapt existing design to wider class of satellites

S2-CL-04	Markers to support navigation (MSN) - second generation development and low-cost design definition	550 k€	S2P	
1A.130	Standardised De-orbit Interface Definition for LEO Satcom-class Spacecraft (2 contracts)	400 k€	ARTES FP	ITT to be released early 2025

## • Active Debris Removal (ADR)



24-P-M-OPS-09	Uncooperative removal in GEO – Systems Impact and Analysis	500 k€	TEC Preparation - OSIP – 5 winners Phase 0 (100k€/winner)	Campaign to be KO early 2025
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## • Break-up and collision management



T711-806EP	Exemplifying standard methods for hypervelocity impact risk assessment	600 k€	TDE	ITT to be released early 2025
GT17-680SD	Integrated modelling of debris mitigation compliance assessments associated with interplanetary return trajectories	450 k€	GSTP	ITT closing 8 October 2024

## • SST & STC – upgrade Platforms

T811-802SD	Electromagnetic instrument for non-destructive on-orbit detection of mm-size space debris	400 k€	TDE	ITT to be released early 2025
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## • SST & STC – Tracking accuracy improvement and environment sampling



T711-804SD	Next generation of space objects population model	600 k€	TDE	ITT to be released end 2024
ZD-U-ST-04	Improved monitoring and associated upgraded operational support	1.200 k€	S2P, MOI	High TRL process improvements leading to improved accuracy in SST services partly supported through S2P competitiveness segment ( <a href="#">link</a> ) on case by case basis
T812-801GS	Daylight space debris laser ranging via emission on Fraunhofer lines	500 k€	TDE	ITT to be released end 2024
T711-801SD	Ensemble and surrogate modelling for debris environment long-term simulation	300 k€	TDE	ITT to be released end 2024
T509-801SD	Debris impact assessment to improve collision avoidance metric for telecommunication spacecraft	400 k€	TDE	ITT closing on 20 Oct. 2024



# ESA Zero Debris urgent activities: an opportunity (3/3)



## • Re-entry Safety & Demisability – Design for Demise (D4D): methods and tools



T711-805SD	Re-entry Risk Requirement Verification Methods	600 k€	TDE	ITT to be released on 13 Jan. 2025
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## • Re-entry Safety & Demisability – Design for Demise (D4D) - improve demisability at system and equipment level



T719-804MP	Demisable tank and fill&drain valve for CubeSat propulsion	450 k€	TDE	ITT to be released Spring 2025
4B.186	Demisable electric propulsion thruster for low Earth orbit telecom constellation	1.200 k€	ARTES AT	ITT to be released early 2025
	Demisable Optical Bench in Carbon Fiber Reinforced Plastic	800 k€	FutureEO	ITT to be released end 2024
	Demisable EO payload mechanical interfaces (bi-pods and brackets)	400 k€	FutureEO	ITT to be released end 2024
5A.081	Demisability of critical components of optical communication terminals for satcom constellations in LEO	500 k€	ARTES ScyLight	

## • Dark & Quiet skies – upgrade platform - Requirements and technology develop roadmap for satcom



1D.025	Designing Satcom Missions to Ensure Dark and Quiet Skies	300 k€	ARTES FP	ITT to be released before end 2024
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## Satellites platforms evolution

- System level integration & validation aspects
- Reliability and resilience of disposal systems
- De-orbiting Systems
- Passivation Systems
- D4D
- Dark and Quiet Skies



## Launchers evolution/adaptation



## Understanding impact and design and verification models development

- System studies
- Reliability and resilience
- Passivation
- D4D
- Dark and Quiet Skies
- Impacts of spacecraft re-entry on the Earth's environment



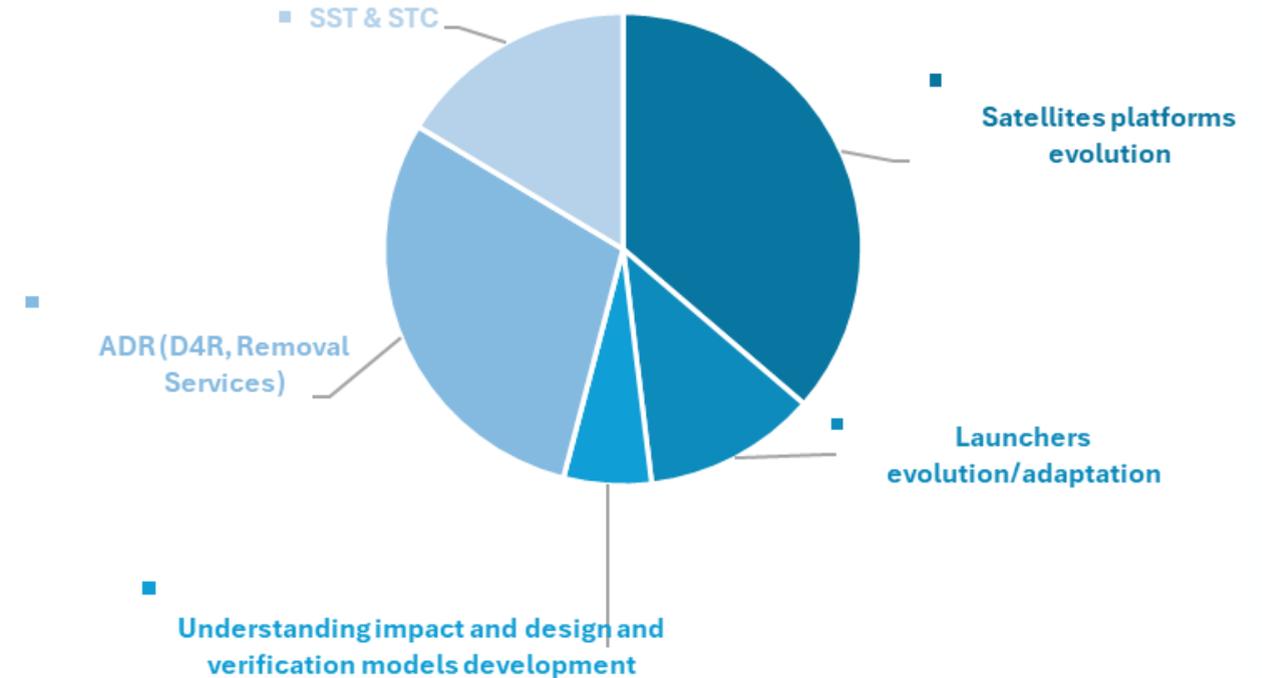
## ADR (D4R, Removal Services)

- D4R
- Removal Services (CAT, multi-debris removal studies, debris removal in protected regions...)



## SST & STC

CMIN25: ZD Workplan 2025-2028  
Distribution per Zero Debris topic across ESA



During these Clean Space Days, we invite you, the industry, to communicate your ideas on this Zero Debris Workplan 2025-2028



## How will ESA support the transition?

- **ESA SDM Policy updates** coming in **2026** and **2030**
- Zero Debris **Workplan implementation**
- Zero Debris as **common practice for missions**



## What can the Zero Debris community do?

- Zero Debris is a **collective effort!**

CSD objective: How can you contribute to making Zero Debris real?

# In-Orbit Servicing and Circular Economy

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Antonio Caiazzo  
Clean Space System Engineer

# ESA activities - 5 Elements of IOS

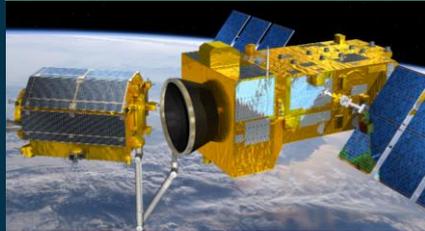
## Mission Implementation



**Purpose:** To implement Near Term IOS Opportunities:

- ADR and IOS Missions
- In-Space Transportations Missions

## In-Orbit Servicing System Studies



**Purpose:** To Define Long-Term In-Orbit Servicing Missions:

- Assembly
- Manufacturing
- Refurbishment
- Refueling
- Recycling

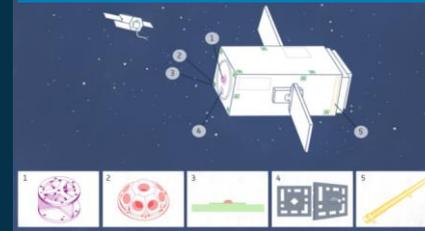
## Technology Developments



**Purpose:** To prepare technologies for future IOS mission concepts:

- Capture systems
- Rendezvous and close-proximity equipment
- Test Facilities

## Standardized Servicing Interfaces for Future Platforms



**Purpose:** To prepare future ESA missions:

- Capture interfaces
- Rendezvous markers
- System requirements
- Refueling interfaces

## Safe Close Proximity Operations



**Purpose:** To derive a methodology for ensuring sustainable close-proximity operations:

- Guidelines
- Handbook
- Verification Tools

# ADR & IOS Vision

## DEBRIS REMOVAL



ClearSpace-1



ELSA-M



CAT-IOD

## RENDEZVOUS & DOCKING



InSPoC-1



e.Inspector

## INSPECTION

2026

ADR and In-Space Transportation  
Preparation & Missions

S2P Missions

## REFILLING



InSPoC-2

## AOCS TAKEOVER



RISE

ENCORE

2030

IOS Preparation & Missions

## REFURBISHMENT



## MANUFACTURING



## RECYCLING

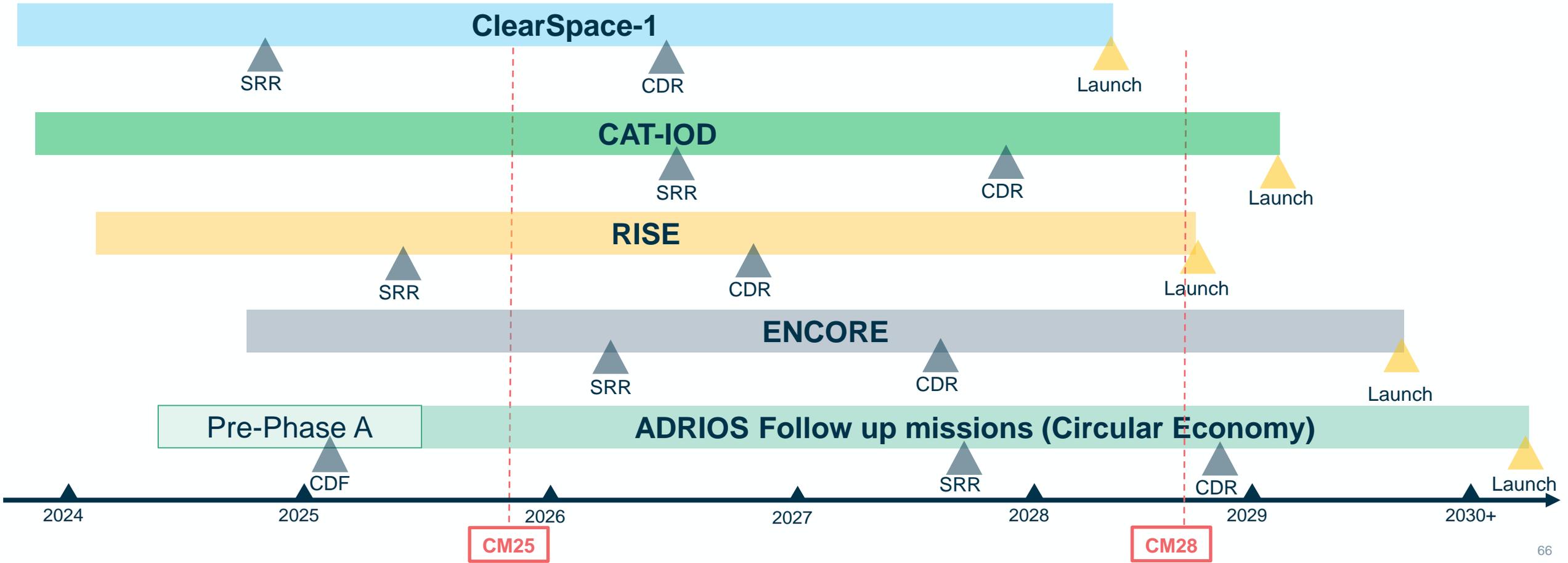


2040+

Circular Economy  
Preparation & Missions

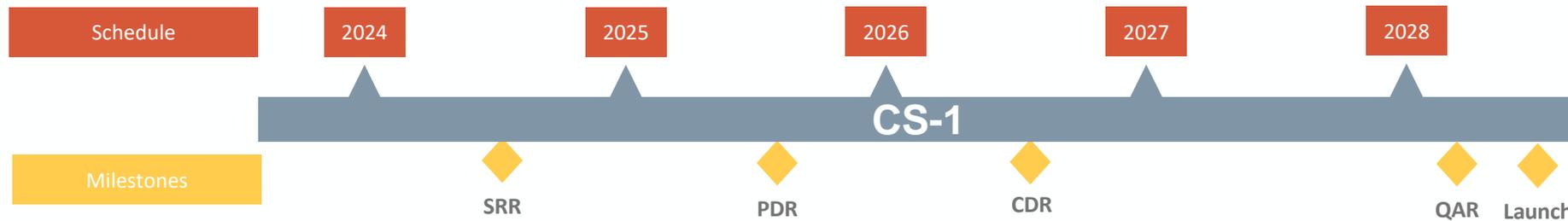
# S2P programme – ADRIOS overview

- Demonstrate and consolidate European leadership on ADR and IOS
- Enable development of ADR and IOS markets
- Capacity building in support of the development of a Circular Economy in Space



# ClearSpace-1 - Overview

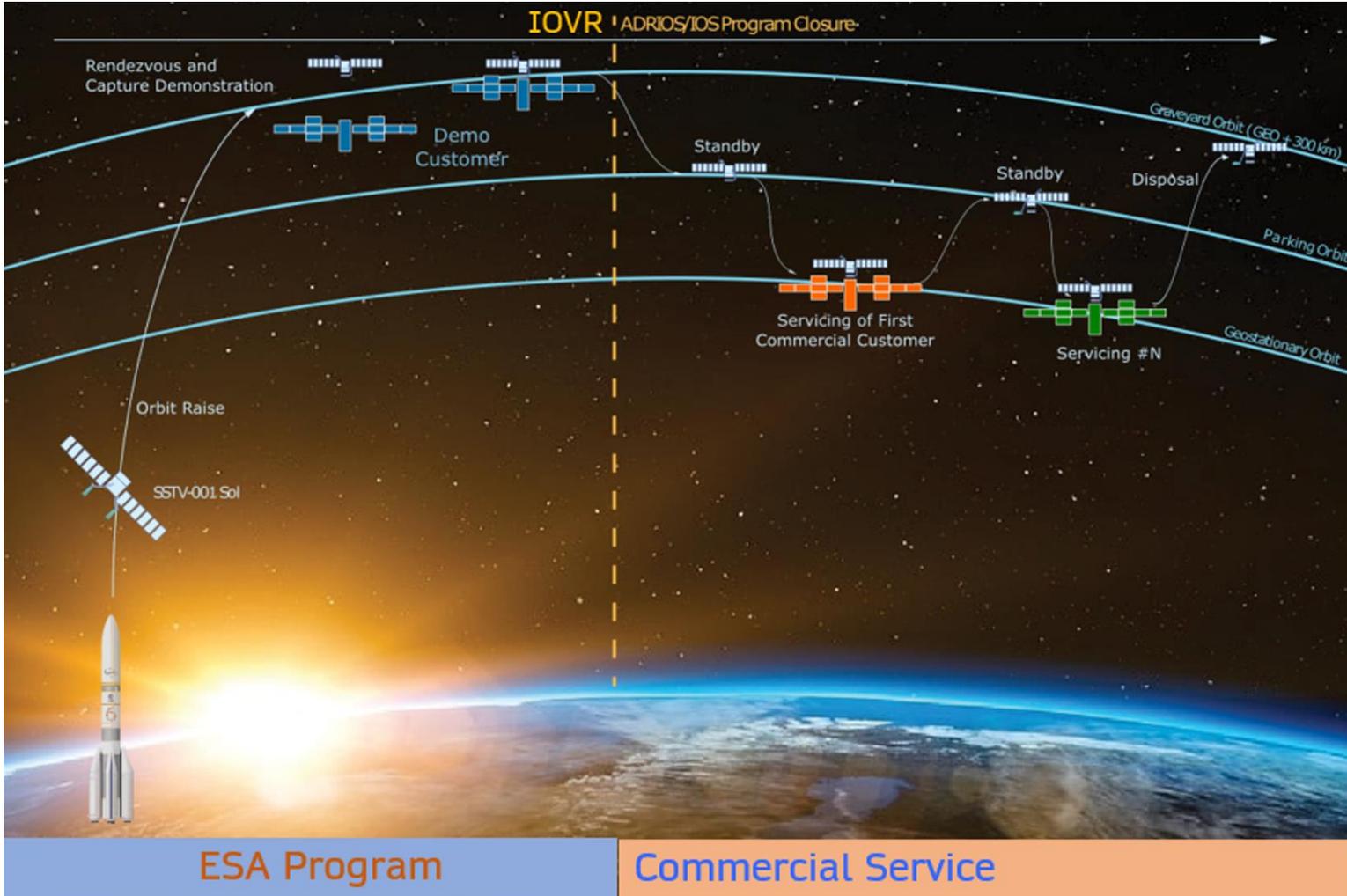
- ADR mission: client spacecraft is ESA-owned PROBA-1, orbit below 550 km
- Dedicated launch with direct injection mid-2028, uncontrolled stack re-entry by 2030
- 4 arms used to enclose and secure the client spacecraft
- Motion synchronisation to berth with non-cooperative client spacecraft



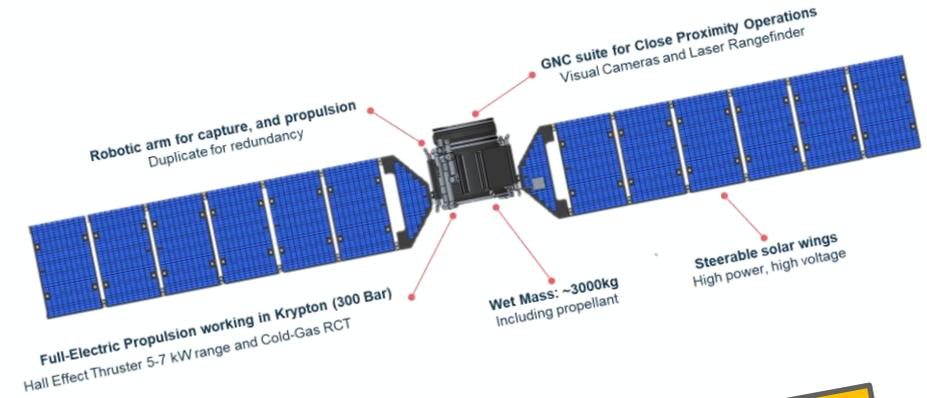
## Funding Overview

CM22	102 M€	CM22 approved funding
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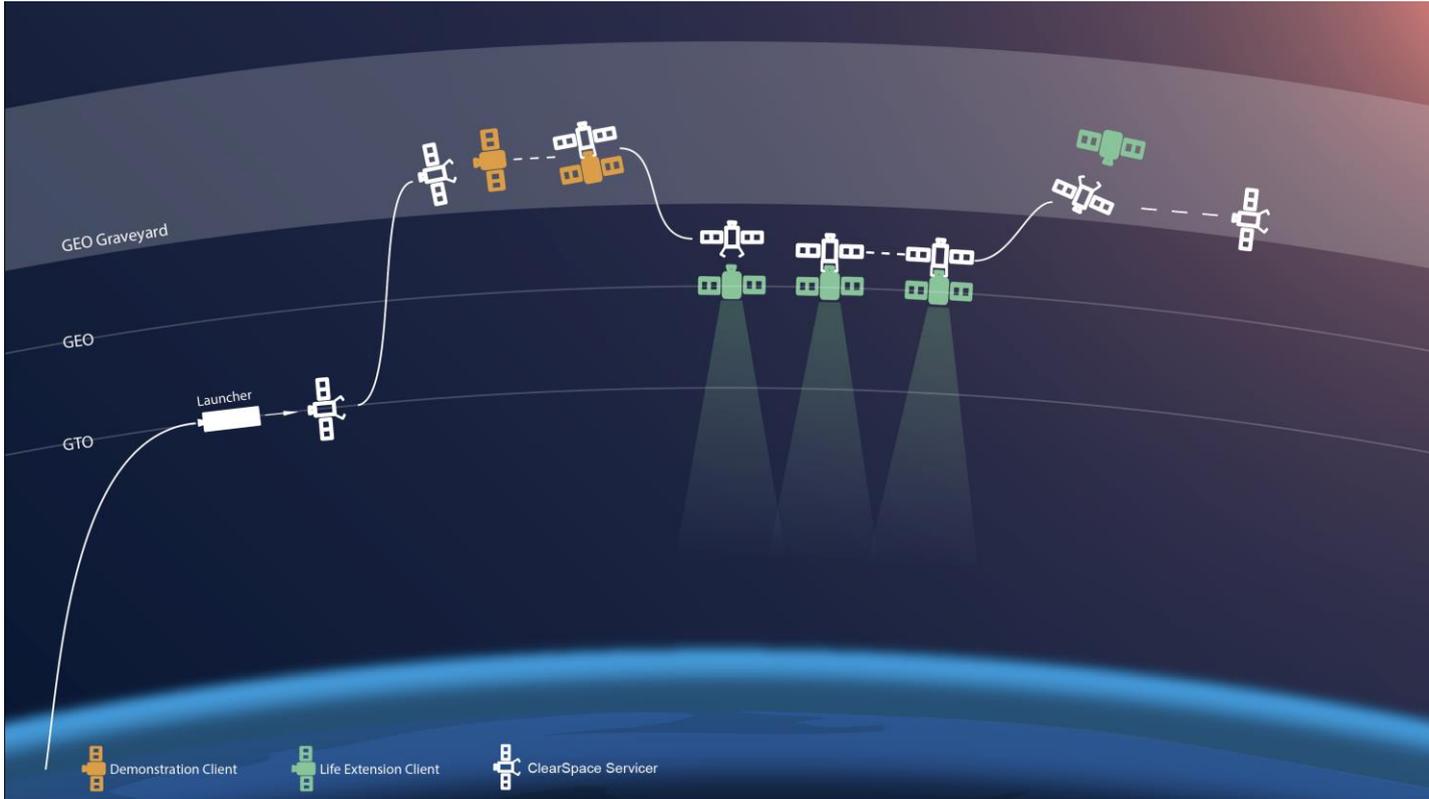
**TUESDAY 16:00 - 17:30**  
**@ESTEC - ESCAPE BUILDING (DANCE ROOM)**



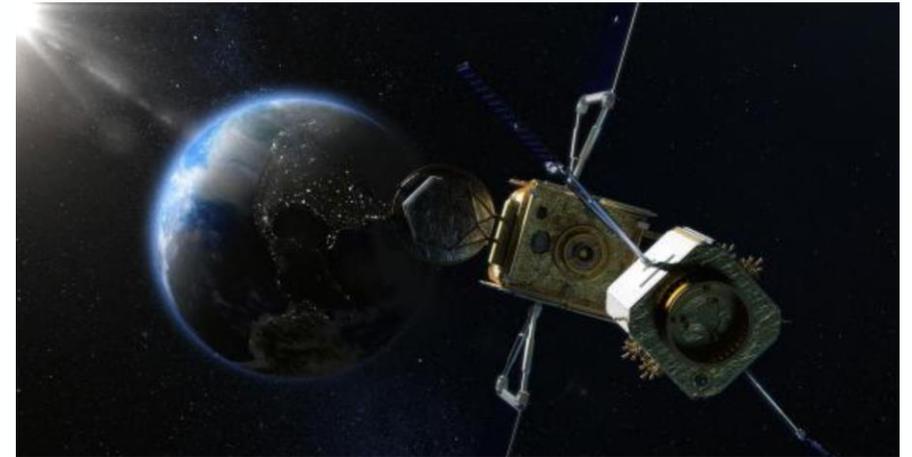
- IOS commercial mission to deliver AOCS takeover service for GEO satellites operators



**WEDNESDAY 11:30 - 13:00**  
**@ESTEC - ESCAPE BUILDING (TENNIS HALL)**



- IOS commercial mission to deliver AOCS takeover service for GEO satellites operators



## Funding Overview

CM25

150-200\* M€

*\*The programme proposal is currently being updated.  
This request includes:*

- **RISE Implementation - covering all remaining costs**
- **ENCORE Continuation**

# CAT IOD - Overview

- IOD of ADR mission using both mechanical devices, MICE and CAT
- Pre-phase A study aims to remove AVS LUR-1. Future missions to remove next generation of COPERNICUS (provided with a MICE device)

2022

2023

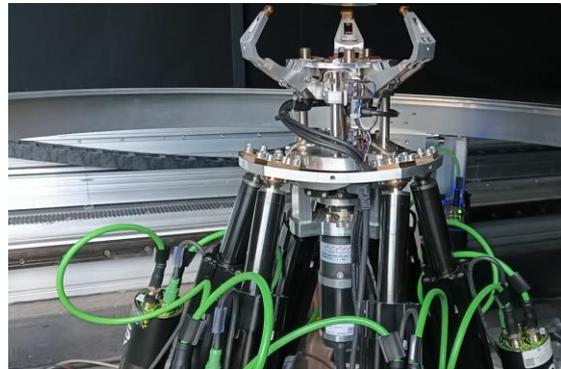
2024

2025

CM25

2026

2027+



Credits: GMV

CAT Capture Payload Bay Breadboard

CAT Capture Payload Bay EM

CAT IOD Phase B/C/D

CAT IOD Phase A

S2P

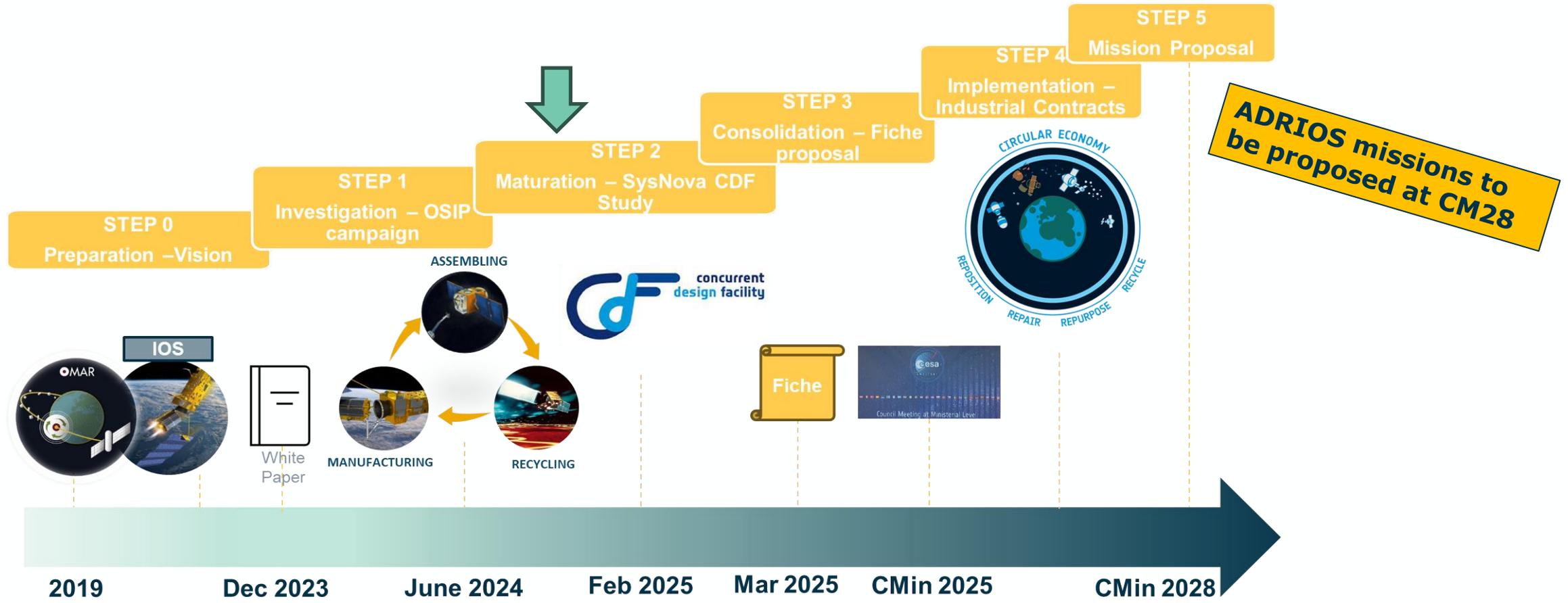
Preparatory Activities

TUESDAY 16:00 - 17:30  
@ESTEC - ESCAPE BUILDING (DANCE ROOM)

## Funding Overview

CM25	75 M€	Full funding in CM25 for launch in 2029
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# Way forward: Space Circular Economy at CMin25



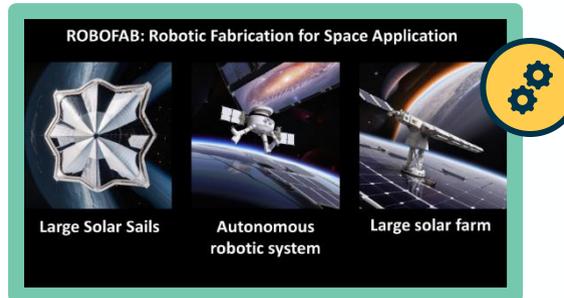
**CM25** : options as 2 phase A/B1 follow-up mission study + technology maturation  
**CM28** : phase B2 - E mission proposal

# Current Activities on the Space Circular Economy

**Present:** 5 activities (6 months, 100k) from September and October 2024.



**Astroscale (UK)**  
Satellite Refurbishment and Upgrading Services for Orbital Sustainability



**KINETIK Space (DE)**  
Robotic Fabrication for Space Applications



**Space scAvengers (SV)**  
Managed Recycling Orbit operated as a Multi-Agent System



**Growbotics (UK)**  
LOOP: commercial refurbishment mission of a spacecraft in GEO



**Thales Alenia Space (FR)**  
Recycling Space Plant

**THURSDAY 9:30 - 13:30**  
**@ESTEC - ESCAPE BUILDING (TENNIS HALL)**



## Advanced Space Robotics and GNC

In-Orbit Servicing missions rely on robotic capabilities to capture, manipulate, and service space objects. Modular design and interfaces will be necessary to perform more complex services.

WEDNESDAY 14:00 - 17:30 - ROBOTICS  
@ESTEC - ESCAPE BUILDING (TENNIS HALL)

THURSDAY 14:00 - 15:30 - GNC  
@ESTEC - ESCAPE BUILDING (TENNIS HALL)

## Policy, Guidelines and Market

Guidelines will be required to perform operations in a safe and responsible manner. Analysis of the markets are required to learn more on the commercial aspects



THURSDAY 16:00 - 17:30  
@ESTEC - ESCAPE BUILDING (TENNIS HALL)

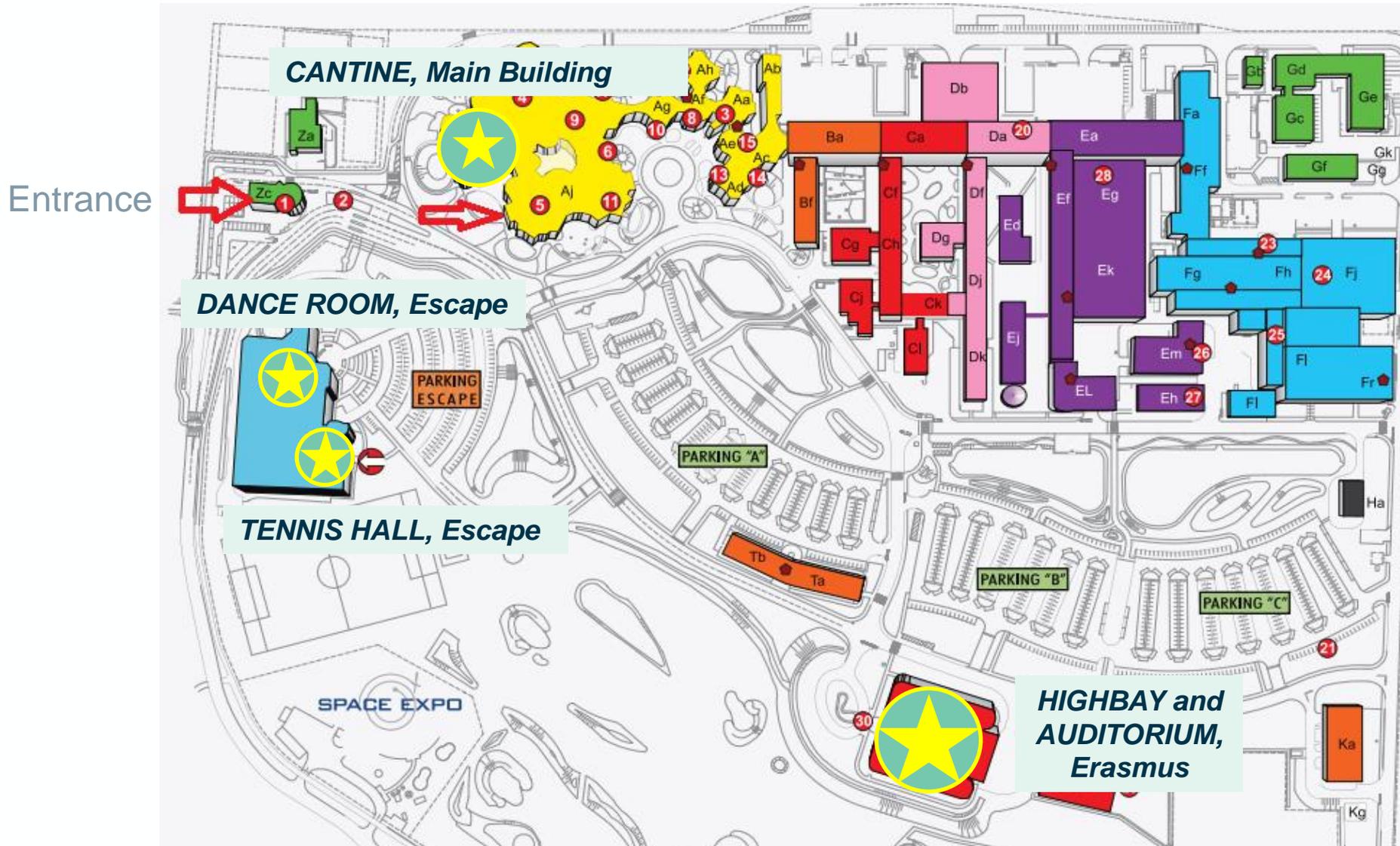
# Clean Space Days 2024 Organization

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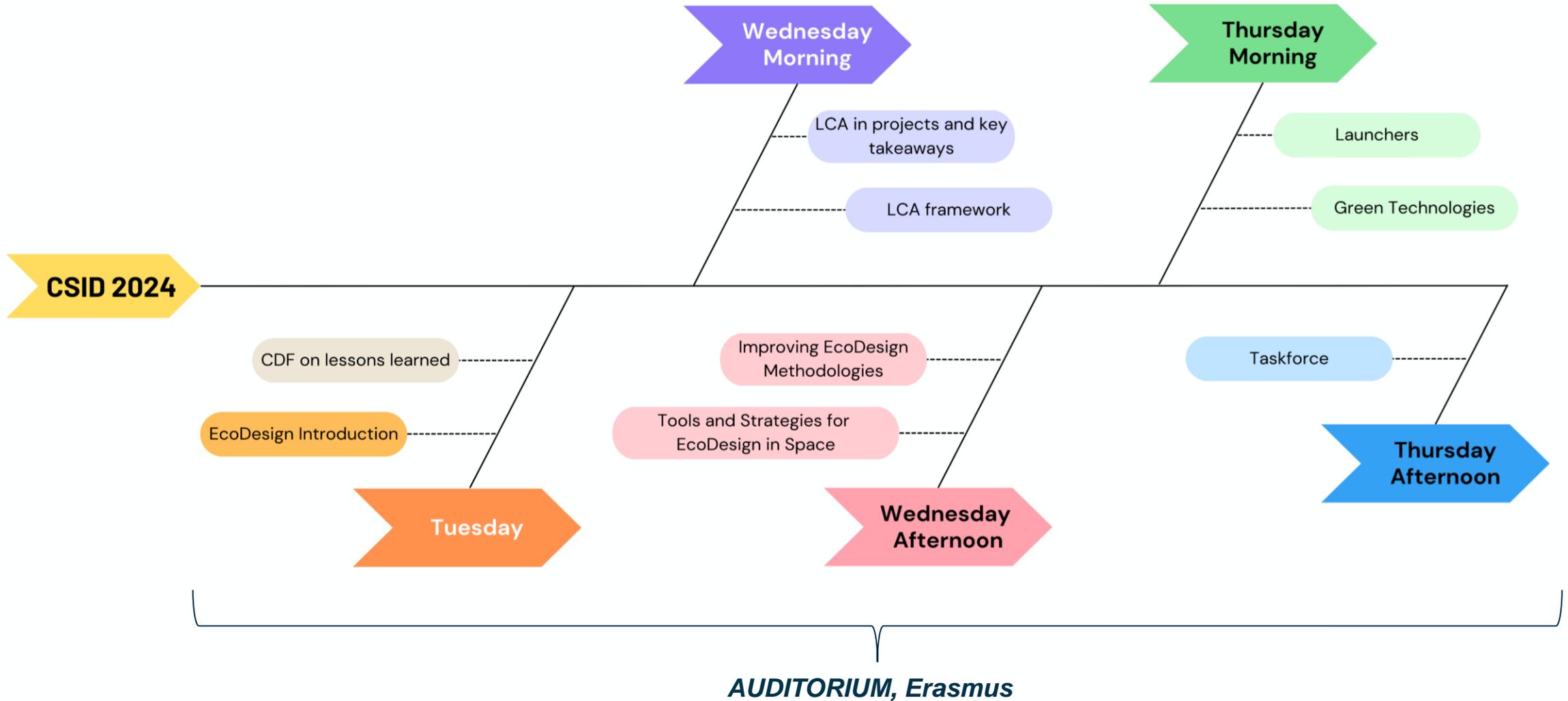
Bahar Karahan

Clean Space Intern

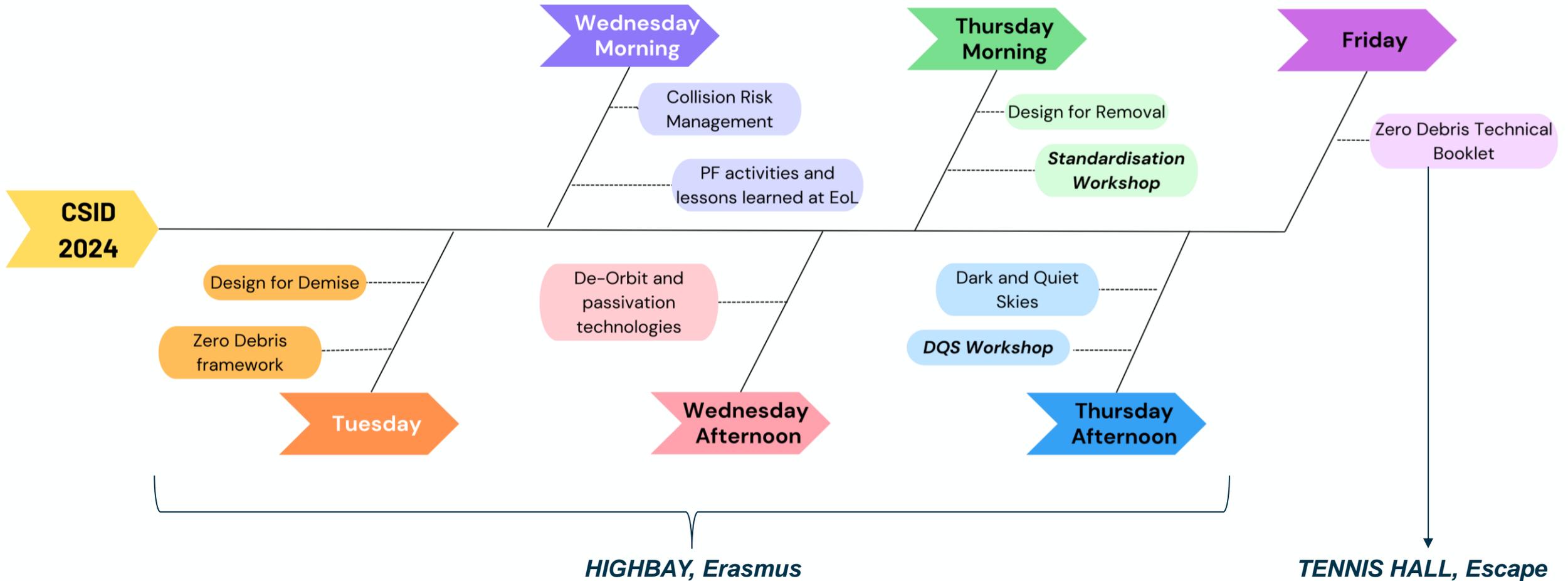
# Map of ESTEC



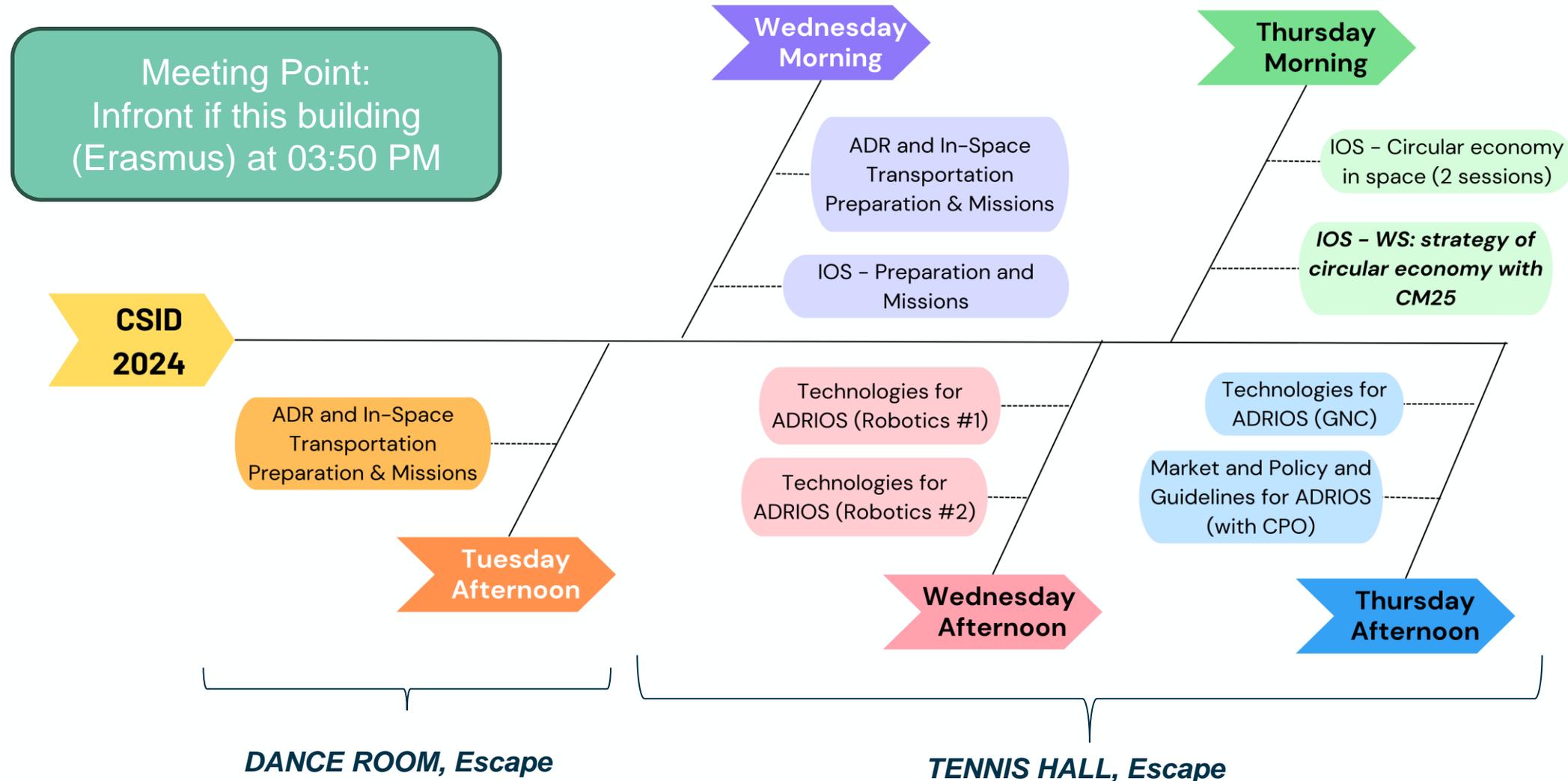
# CSD 2024 - Ecodesign sessions



# CSD 2024 - Zero Debris sessions



# CSD 2024 – In-Orbit Servicing sessions



# This Year: Poster Session



13 Posters



3 sponsored students



María de la Almodena Martín Gómez -  
Advanced Electrodynamic Tether  
Technology for Sustainable Debris  
Mitigation in LEO



Kevin Bongers - DEDRA: A Modular In-situ  
Detector for Monitoring Sub-millimetric Space  
Debris



Krystian Jakubczyk - Development and Verification  
of Demisable Inserts for Joining of Satellite Panels  
and Equipment

## Wednesday 09/10 - *Tennis Hall, Escape*

5:45 pm : Keynote - **Airborne Observation of the Cluster-II Salsa Re-entry**

- Speakers: Beatriz Jilete & Stefan Loehle

6:05 pm : Keynote - **Pathways towards Zero Debris: Legal Transformation, Economic Incentives and the Role of Young Space Professionals**

- Speaker: Isabelle Mierau

6:15pm : **Poster Session and Networking with cocktails**

## Thursday 10/10

5:45pm : **CSD 2024 Wrap-up**

- *Highbay, Erasmus*

6:15 pm : **Dinner**

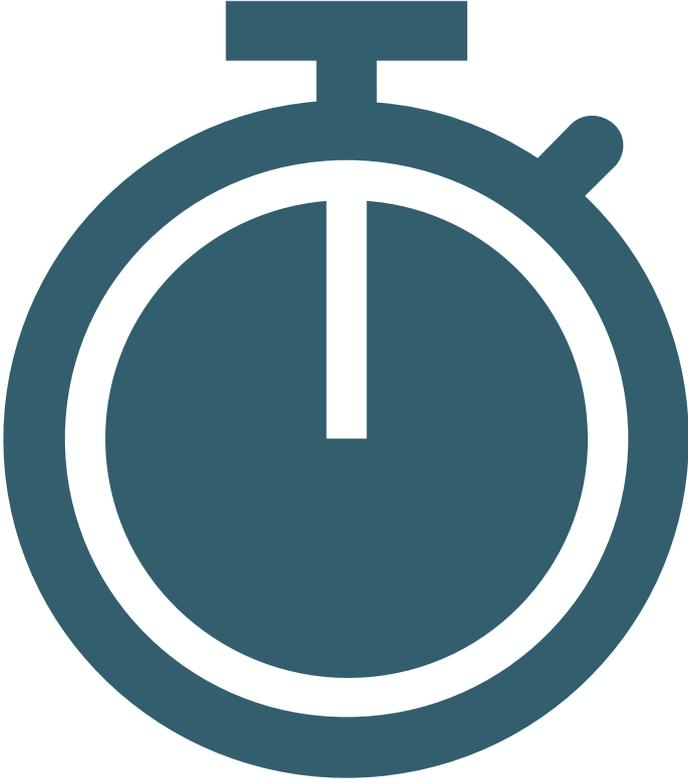
- *Canteen, Main Building*

Workshop on Friday to finalise Draft 2 for an Issue 1 before 2025

- **6 Working groups**
  - Prevent release of space debris
  - Guarantee timely and successful clearance
  - Prevent debris generation through break-up or collisions
  - Improve space traffic surveillance and coordination
  - Prevent casualties on ground
  - Understand and mitigate adverse consequences of space debris
- **Criteria: Reading the Booklet before the WS and enough space in the round table -10**

Zero Debris Technical Booklet  
Workshop - Working Group  
Registration





Stick to your presentation time

## Picture after welcoming during the break

If you don't want to be in the picture or any kind of other pictures taken by us: tell us and please step aside



Clean Space Industry Days  
16-19 October 2023  
ESTEC, The Netherlands

# Thank you!

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