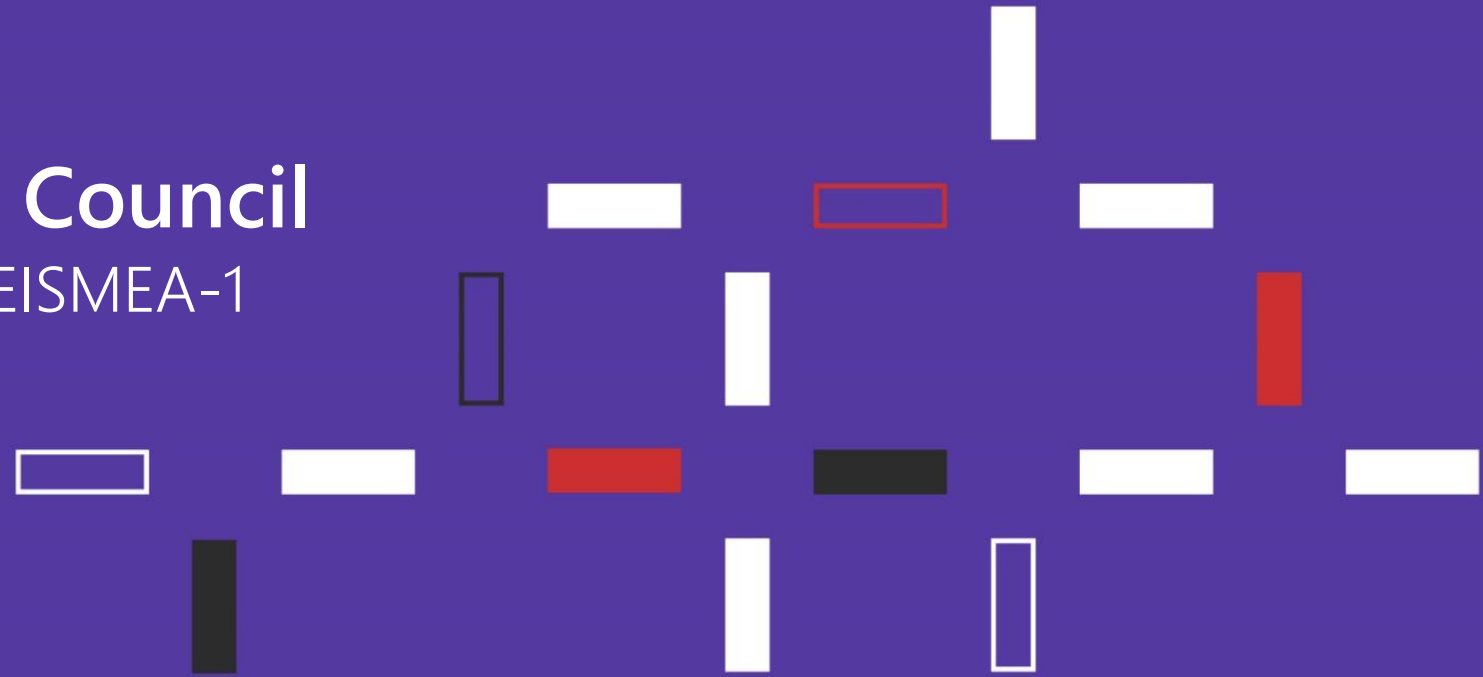
European Innovation Council

Backing visionary entrepreneurs

The European Innovation Council

Programme Managers Office, Unit EISMEA-1



Pathfinder Challenge

Strengthening the sustainability and resilience of EU space infrastructure

Stela Tkatchova, PhD

EIC Programme Manager for Space Systems

17th May, 2024

Introduction

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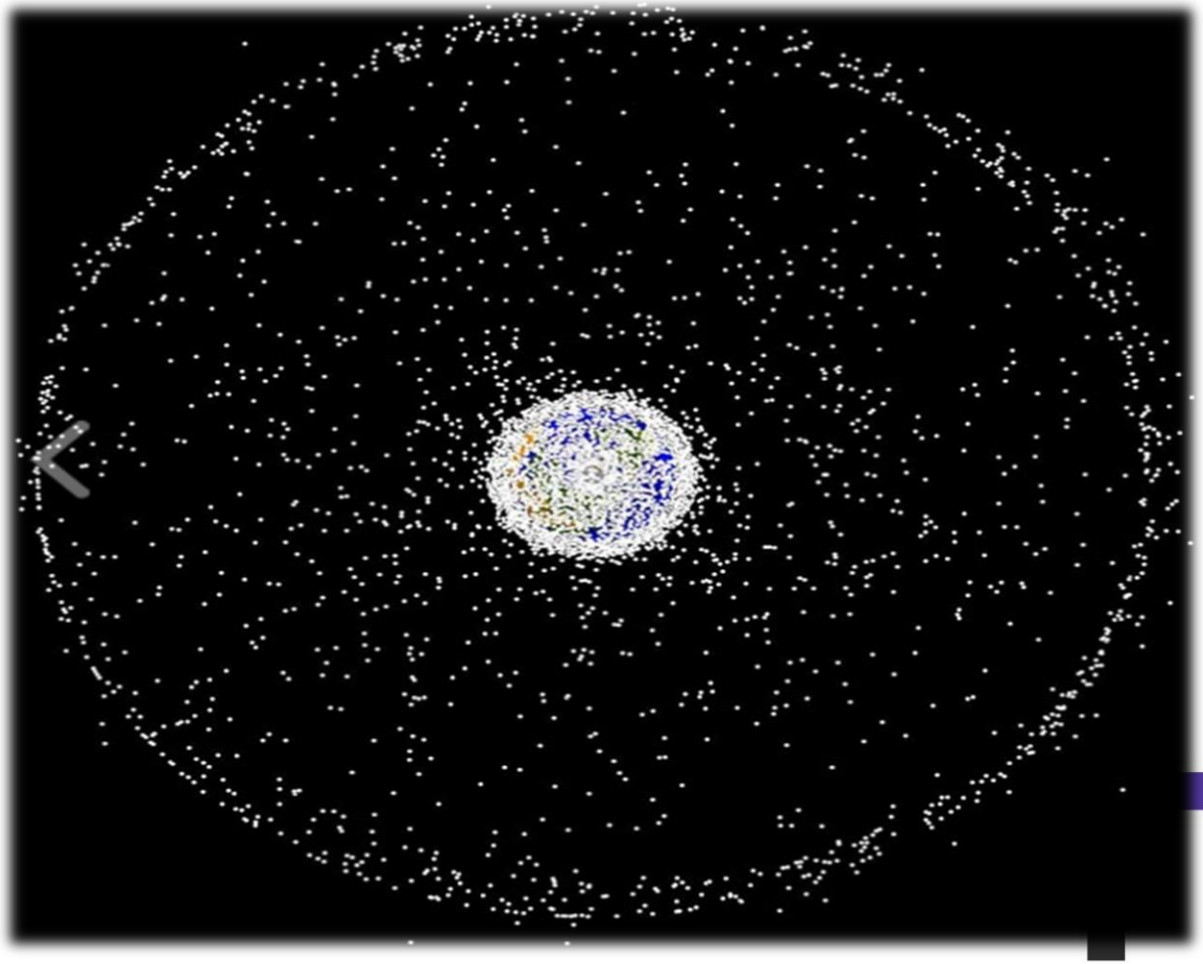
- **EIC role in the European space industry**
- **EIC space portfolio**
  - EIC Portfolio activities
  - EIC Success stories
- **EIC Space technology roadmap**
- **EIC Pathfinder**
  - Background
  - Objectives
  - Portfolio categories
  - Expected outcomes & impacts
  - Portfolio strategy plan
- **Future Outlook**



Courtesy: NASA ODOPO, ARES | Orbital Debris Program Office | Photo Gallery (nasa.gov)

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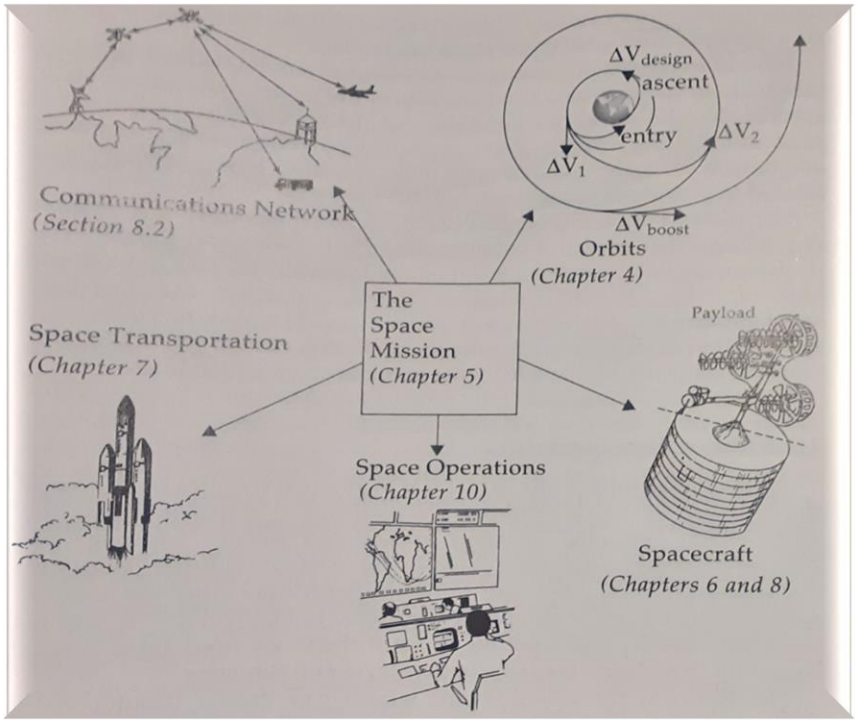
EIC role in the European Space Industry – Part I

- EIC funds **game-changing innovations** and **high-risk ideas** of space SMEs & start-ups, provides support in developing game-changing innovations, demonstration and commercialization through the complementary EIC schemes

- **EIC funds a diverse space portfolio**



Courtesy: ISU, Keys to Space

EIC Space Portfolio

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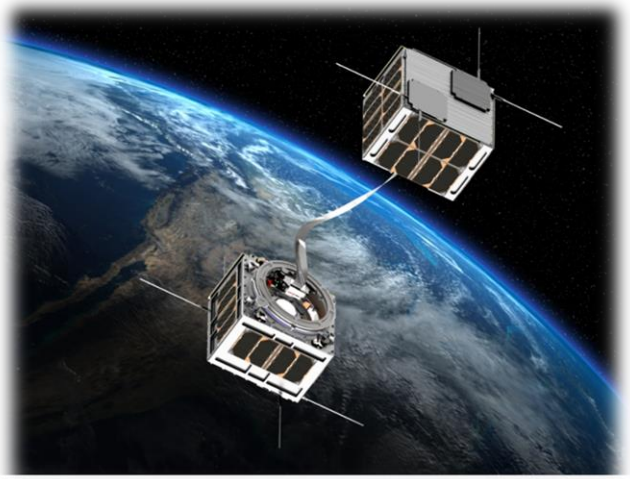
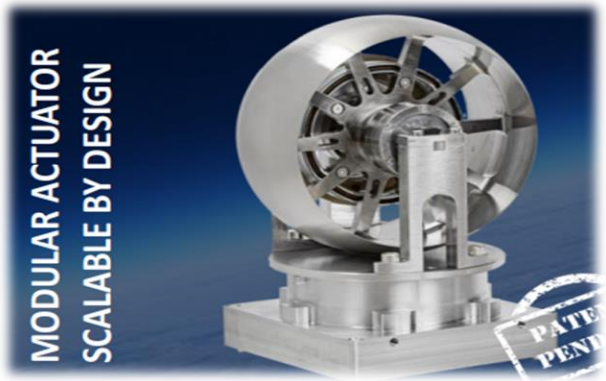
- **Space Debris Sustainability** - space debris monitoring, in orbit satellite servicing, etc.
- **Enabling Space Technologies** - actuators, high temperature superconductors, propulsion technologies, ionic liquid electrospray propulsion, optical intersatellite links, etc.
- **Earth Observation & Meteorology -** thermal infrared p/l, AI algorithms for precision agriculture, satellite-based SaaS, predictive monitoring



Courtesy: E.T.Pack-F project – EIC Transition



Courtesy: SATAGILITY - GO2Market – EIC Accelerator , VEOWARE

Courtesy: EMBRACE II-EIC Accelerator, THRUST ME

Courtesy: CASSIOPEE-EIC Accelerator, Share My Space

EIC Space Portfolio Activities

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- Pro-active Portfolio management –portfolio plan, project synergies, 1st Portfolio space meeting
- Fast track access to IOD/IOV flights for EIC space SMEs and start-ups & CASSINI Business Acceleration Services (BAS)
- Introduction of EIC space companies to potential space tech investors
- 16/11/2023 -Space Tech Bremen 2023 - initiated the panel " Disruptive innovation in benefit to smallsats enabling innovative space" with EIC beneficiaries
- 8/12/2023 - EU-Japan Centre webinar for EIC space beneficiaries, lecturers from JAXA and Kyoto RISH university
- 24/01/2024 - 16th European Space Policy conference pitching opportunity
- PM advice on early commercialisation
- T2M activities and BAS coaching in Transition

EU-Japan: promoting innovation in the space sector

December 08 2023

The European Innovation Council ("EIC") is Europe's flagship innovation programme to identify, develop and scale-up breakthrough technologies and game changing innovations. On the initiative of the EIC Programme Manager for Space Systems, Stela Tkatchova, the EU-Japan Centre, through its Space.Japan Helpdesk, and the EIC are co-organizing this webinar, aiming to strengthen the collaboration between the EU and Japan in the field of space industry. This activity is part of the EIC Space portfolio aiming to strengthen the EU-Japan relations in the space sector, in particular by giving the opportunity to EIC space beneficiaries the possibility to present their deep tech innovations to Japanese space stakeholders. This collaborative mission aligns with the EU-Japan Centre mandate to provide essential support for cooperation in space-related industries, enhancing collaboration between the two regions. Japanese and EU Space ecosystems are particularly complementary and should significantly benefit from such cross-fertilization

EIC Success stories

- Global recognition of **EIC beneficiaries**
- There were **5 launches** in 2023 in the context of three projects
- Copernicus programme as “Contributing Missions”: **Constellr, Promethee (SoE)**
- 1st CASSINI Business Acceleration Services (BAS): **DigiFarm, ROKUBUN (SoE) Promethee (SoE)**
- **Dawn Aerospace** and **DigiFarm** laureates of ESA rising stars 2023


deorbit device was begun under the **Electrodynamic Tether Technology for Passive Consumable-less Deorbit Kit-Fly, or E.T.PACK-F**, project funded by the European Innovation Council. In October, they began integrating their model with a 1-kilogram, 500-meter **aluminum tape tether** for electrodynamic drag. Plans call for the qualification, production and testing of a flight model in 2024 in preparation for a mid-2025 in-orbit demonstration funded by the **European Commission**. The E.T.PACK-F consortium is coordinated by the **Universidad Carlos III de Madrid**, in collaboration with the **University of Padova** in Italy, the **Technical University of Dresden** in Germany, the Spanish company **SENER Aeroespacial** and the German startup **Rocket Factory Augsburg**. ★

▼ A sample of the aluminum tape that a consortium of researchers plans to install on a satellite to test whether a spacecraft can be deorbited via electrodynamic-tether technology. Plans call for an in-flight demonstration in mid-2025.

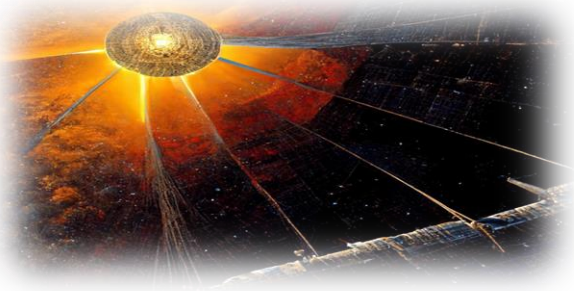
EIC space technology roadmap

EIC space technology roadmap

WP 2023

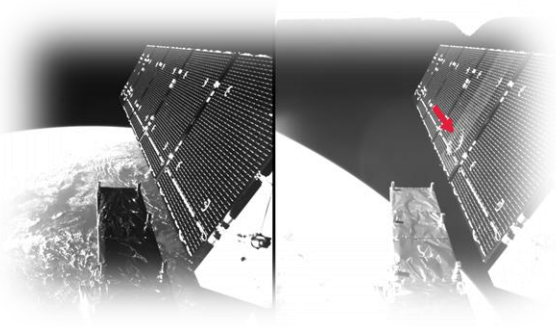
Pathfinder (TRL1-4): In space solar energy

- Collect
- Conversion
- WPT
- In space green propulsion



Accelerator (TRL6-9): "Customer driven" innovative space applications

- S/C inspection
- Collision avoidance
- Collection, recovery & reuse space debris
- IOS,ADR, EoL
- ISAM
- Microgravity platforms



WP 2024

Pathfinder (TRL1-4): Strengthening the sustainability and resilience of EU space infrastructure

- Space debris mitigation
- Space debris remediation
- In-space recycling and re-use of orbital assets (ISRROA)

EIC funds **game-changing and market-driven innovations** and **high-risk ideas** of space SMEs & start-ups

EIC Pathfinder

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Background - Part I

- Increased satellite launches, up to around 6,718 operational satellites in beginning of 2023 (Union Concerned Scientists)
- More than ***11,500 tonnes*** of space debris December 2023
- EU approach STM, ESA Zero Debris initiative, JAXA commercial removal of debris demonstration (CRD2)
- Increased ***need*** for collision avoidance capabilities, reliable space-based data and unified space traffic management
- Increased ***need*** for collection, recovering and transforming space debris
- The amount of catastrophic collision could raise very quickly
- Even with no future launches, the amount of space debris is increasing

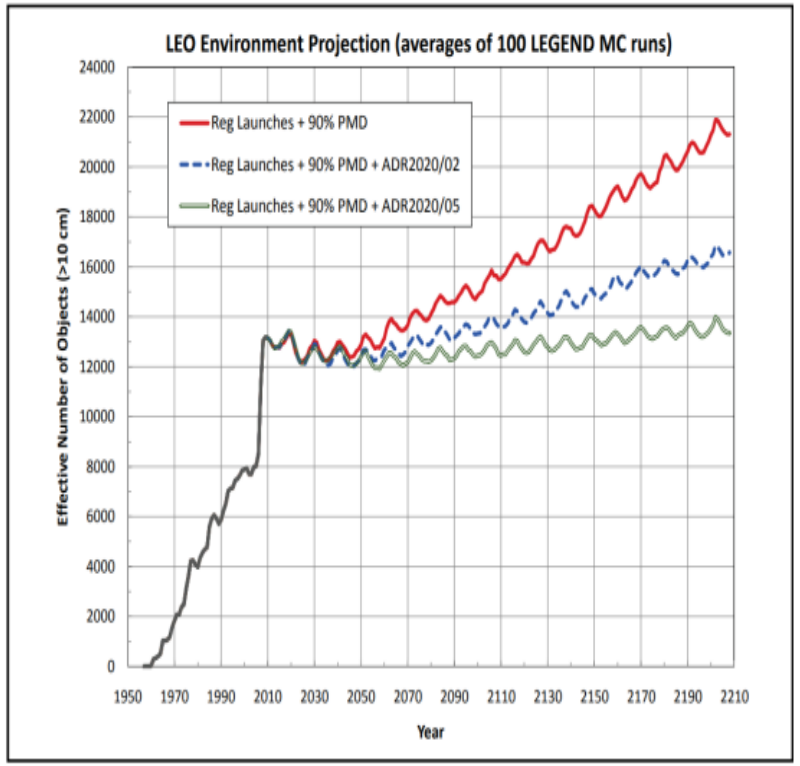

Figure 4. The evolution of trackable debris in LEO over a 200-year timescale. Each line assumes that PMD compliance has risen to 90 percent. The red line assumes that no debris removal occurs. The blue and green lines assume that 2 and 5 large debris objects are removed per year, respectively. Source: (NASA ODPO 2011)

Courtesy: NASA Cost and Benefit of Orbital Debris Remediation, 2023

Background - Part II

- Current satellites are built so that they **cannot be serviced nor recycled**
- **Explosions in orbit,** due to left-over energy- fuel, on-board batteries-onboard and rockets are contributing to space debris
- Lack of in-space repair capabilities of anomalies of s/c after launch
- Increase costs of space operations & avoidance maneuvers
- Important orbits may become unusable
- Europe cannot properly protect its satellites from debris

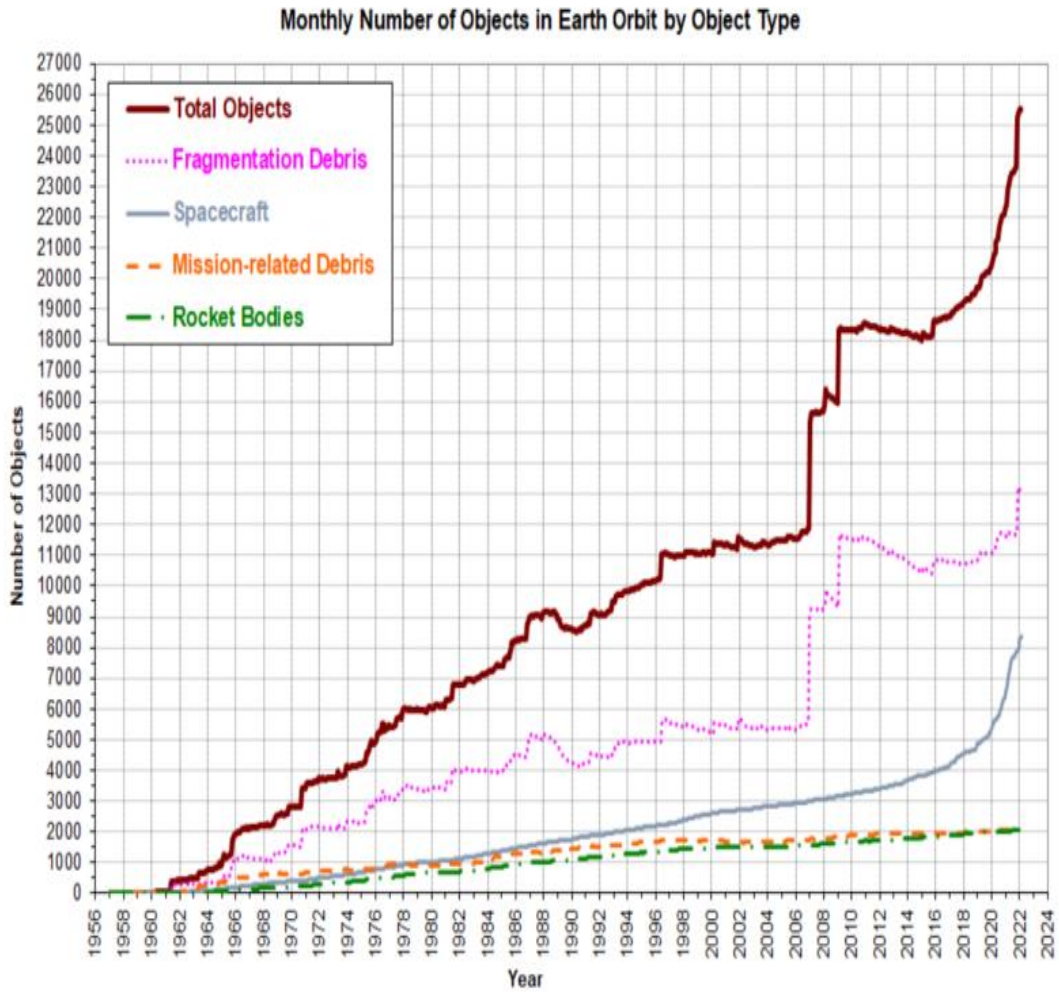

Figure 1. Trackable debris, by category, in Earth orbit since the beginning of the space age. The largest jumps in the number of objects are due to the Chinese ASAT test in 2007, the Iridium-Cosmos collision in 2009, and the Russian ASAT test in 2021. Credit: NASA's Orbital Debris Program Office (ODPO) (ODPO n.d.)

Courtesy: NASA Cost and Benefit of Orbital Debris Remediation, 2023

WP2024 EIC Pathfinder (TRL 1- 4) - Strengthening the sustainability and resilience of EU space infrastructure

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Goal

The challenge address the emerging need for green, compact and affordable de-orbiting solutions and in-space recycling of space debris

- Space Debris Mitigation & Remediation – using very little propellant
- In Space Recycling and Re-use of Orbital assets (ISRROA)
- Game changing innovations for collision avoidance, SSA, tools, etc.

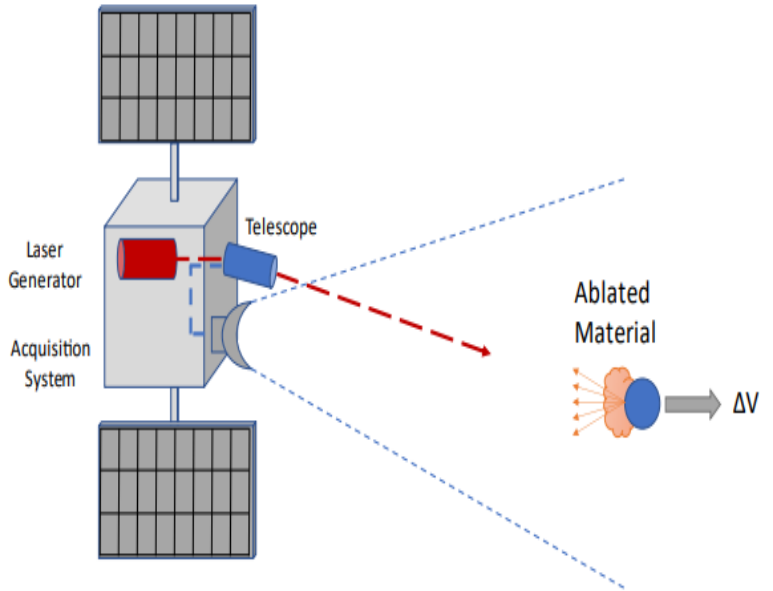


Figure 10. A space-based laser functions similarly to a ground-based laser; however, it requires much less powerful lasers and does not need adaptive optics to correct for atmospheric distortions to the beam.

Courtesy: NASA, L'ADROIT concept

Portfolio Categories

- Category I - Space Debris Mitigation
- Category II - Space Debris Remediation
- Category III - In-space Recycling and Re-use of Orbital Assets (ISRROA)

SPP1: Mitigation

SPP2: Remediation

SPP3: ISRROA

Shared components or potential complementarities among projects

Category I - Space Debris Mitigation

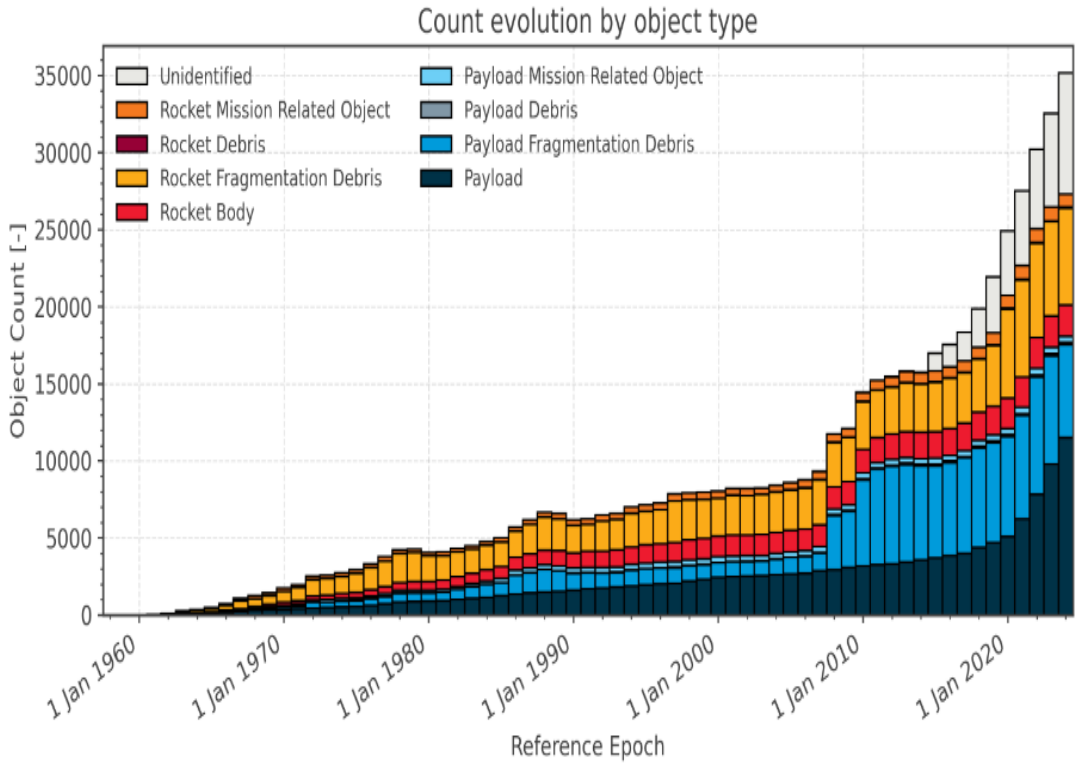
- In-orbit spacecraft/debris recognition and detection
- Collision avoidance models for risk analysis re-entry, close RPO, fragmentation
- Controlled debris mitigation - examples

  - reduce release of debris, s/c break-ups, debris shielding

  - s/c collision avoidance capabilities

  - s/c self -disposal, EoL

  - s/c passivation
- Other concepts for detection, identification & avoidance



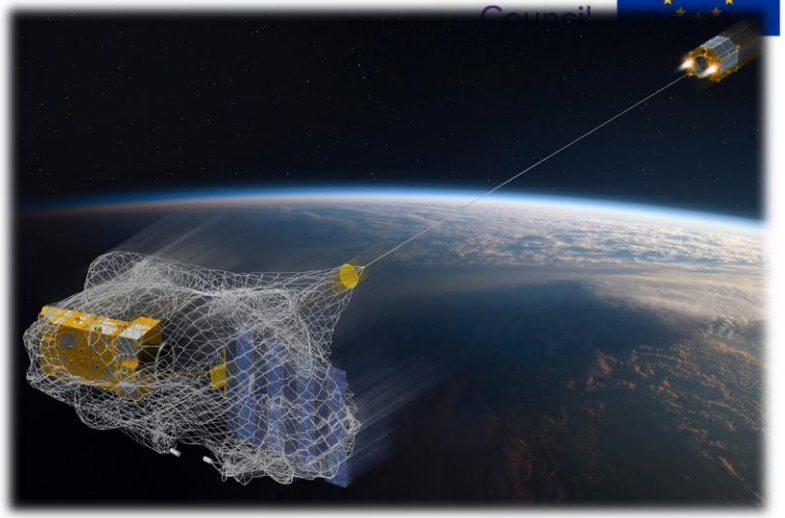
Courtesy: ESA, Space environment statistics [Space Environment Statistics · Space Debris User Portal (esa.int)]

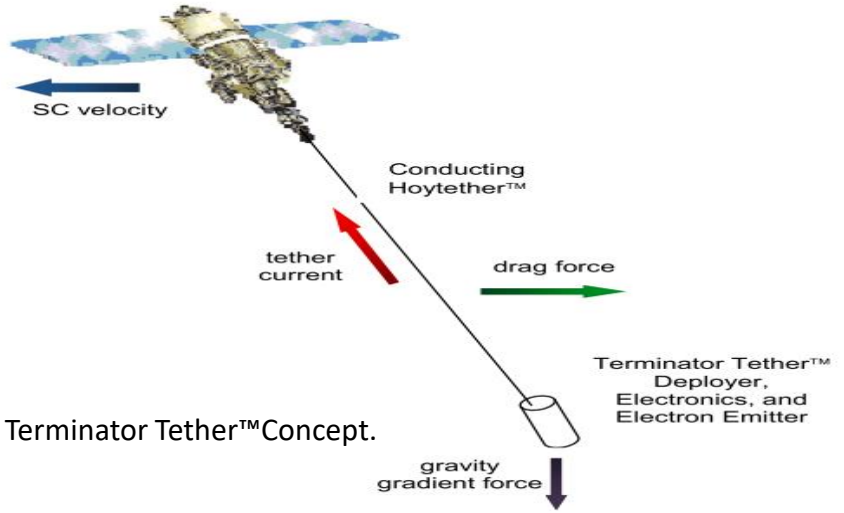
Category II - Space Debris Remediation

- Active debris removal - de-orbiting mechanisms, magnets, nets, harpoons, etc.
- Propellantless debris removal concepts
  - space-based laser, laser pushed lightsails
  - tethers
  - solar concentrators
  - ion beam shepherd methods
- Other concepts using very little propellent, self-standing or complementary to each other

For <u>cooperative</u> & <u>non-cooperative debris</u>

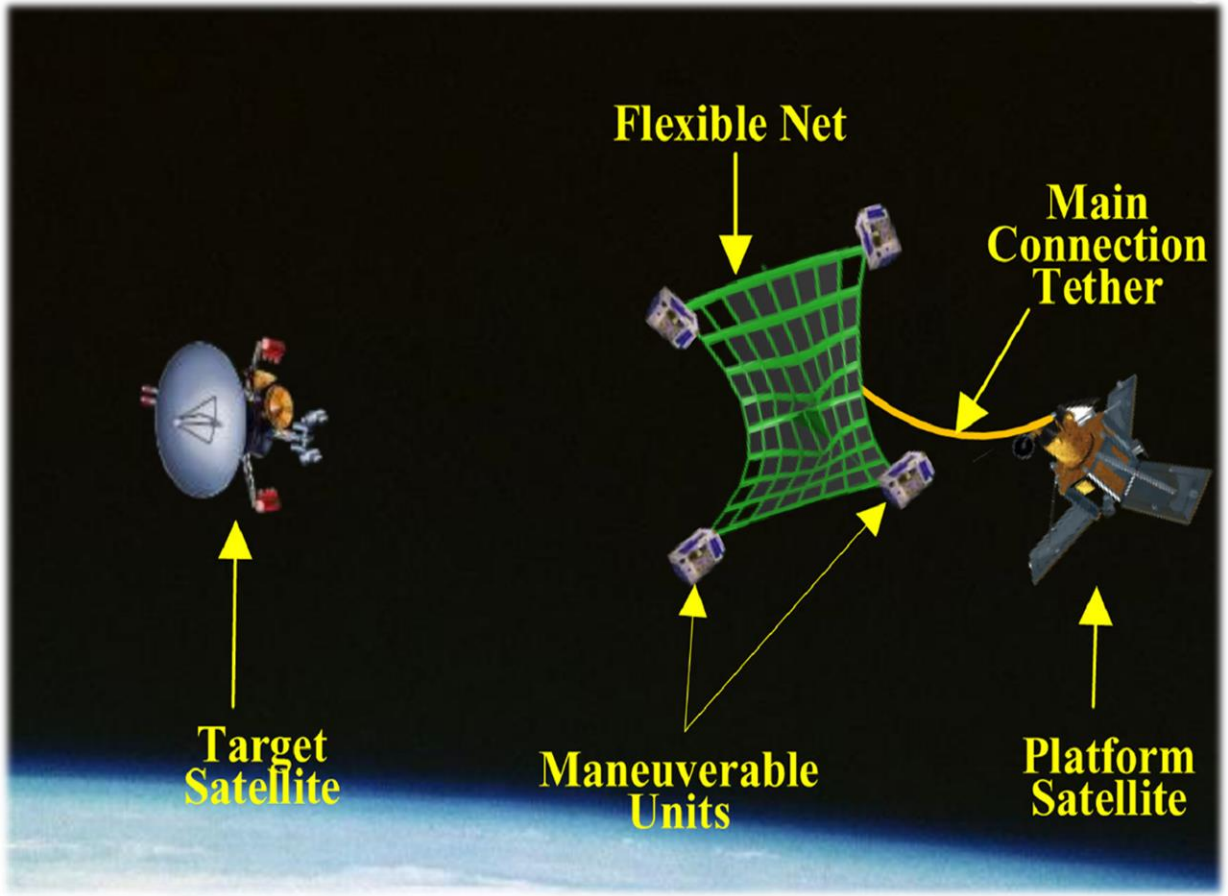
Courtesy: ESA

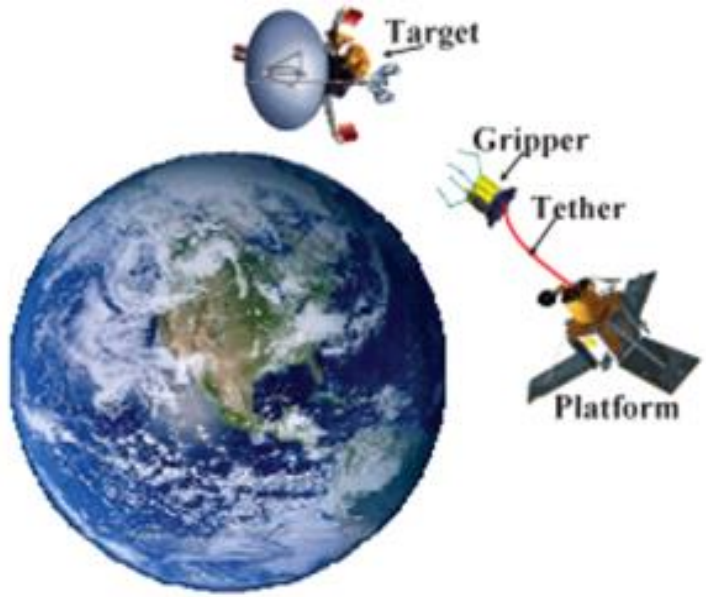




Courtesy: Terminator Tether™Concept.

Category II - Space Debris Remediation





Courtesy: TSNR Project, Capture dynamics and control of tethered space net robot for space debris capturing in unideal capture case - ScienceDirect

Courtesy: TSR Project, Novel Method of Monocular Real-Time Feature Point Tracking for Tethered Space Robots | Journal of Aerospace Engineering | Vol 27, No 6 (ascelibrary.org)

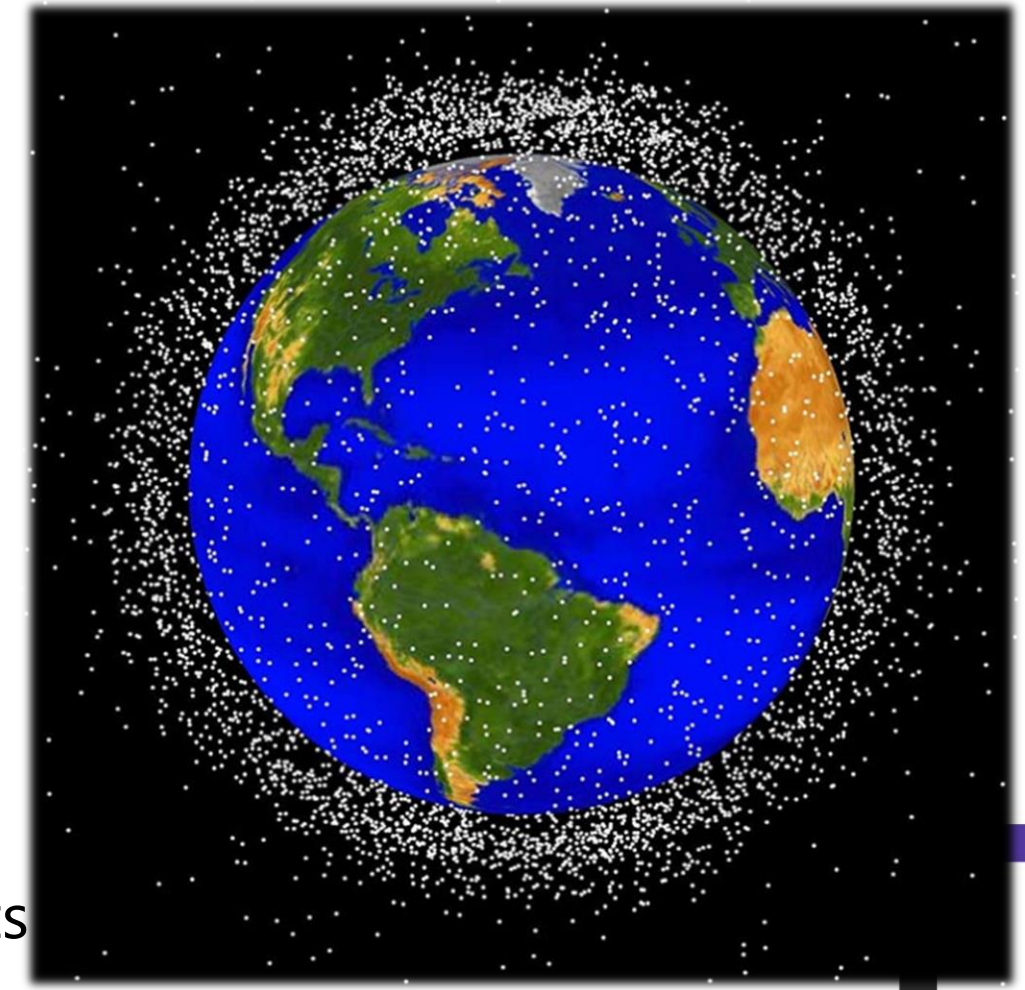
Category III - In-space Recycling and Re-use of Orbital Assets (ISRROA)

- Design & development of technologies, methods and processes for recycling or re-use

  - mechanical re-use or repair of parts/components

  - space welding and additive manufacturing

- Re-use of parts and components of defunct satellites or upper rocket stages
- Others for demonstrating reuse of orbital assets

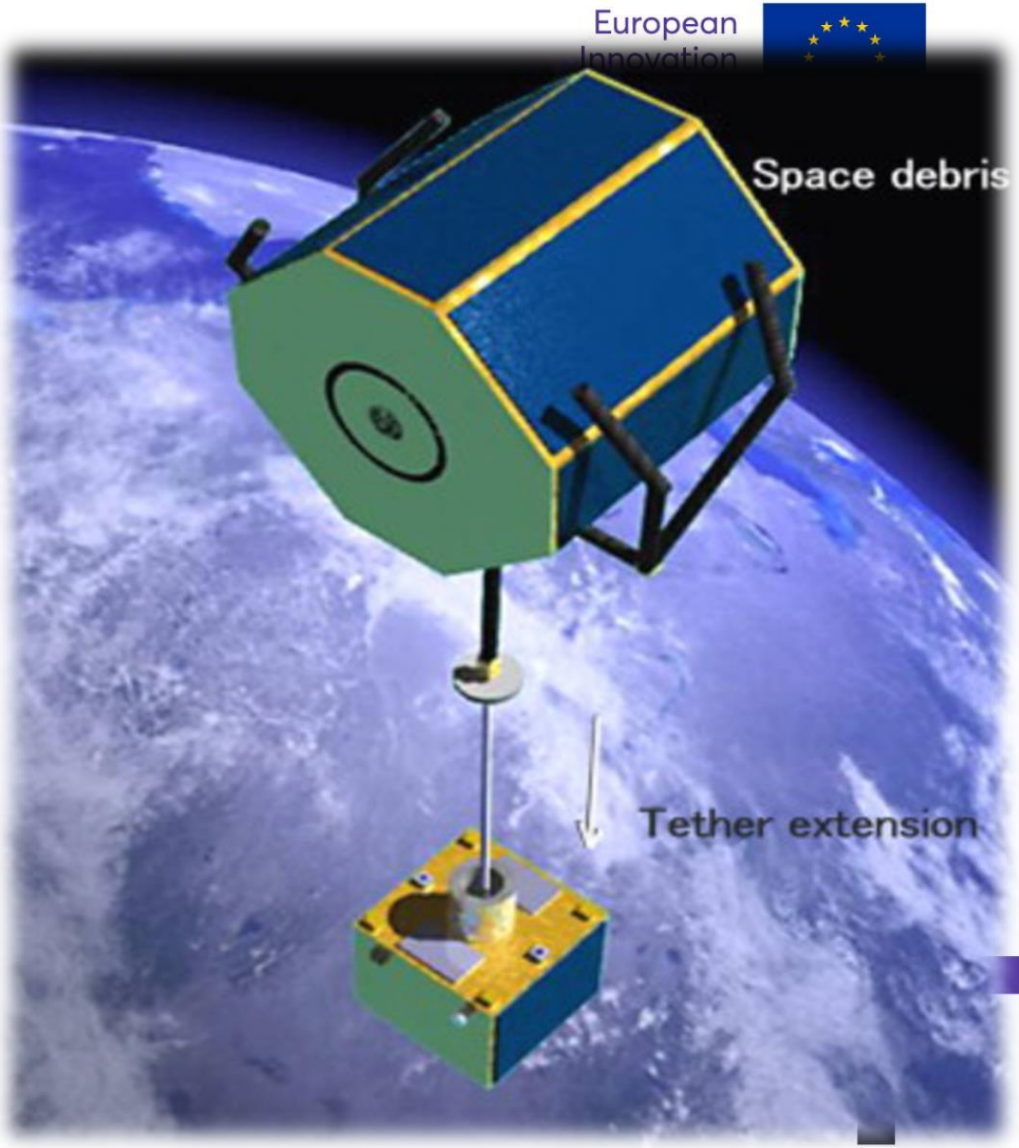


Courtesy: NASA ODOPO, ARES | Orbital Debris Program Office | Photo Gallery (nasa.gov)

Categories	Overall System/sub-system functions and solutions
Category I: Space debris mitigation	• Innovative concepts for in-orbit spacecraft recognition and space debris detection • Controlled Space debris mitigation • Innovations for space situational awareness (SSA) • Others
Category II Space debris remediation	• Active debris removal (robotic and de-orbiting mechanisms, magnets, nets, harpoons, etc.) • Propellant less debris removal (space-based lasers, laser pushed sails, tethers, solar concentrators, ion beam shepherd methods, etc.) • Others
Category III In-space recycling and re-use of orbital assets (ISRROA)	• Design & development of technologies, methods, and processes for recycling (mechanical, space welding and additive manufacturing) • Re-use of parts and components of defunct satellites or upper rocket stages • Others

Portfolio Consideration Principles

- A balance of projects between the three categories.
- Shared component(s) among the projects, in one or more of the categories.
- Complementarities among the components in different categories of the projects

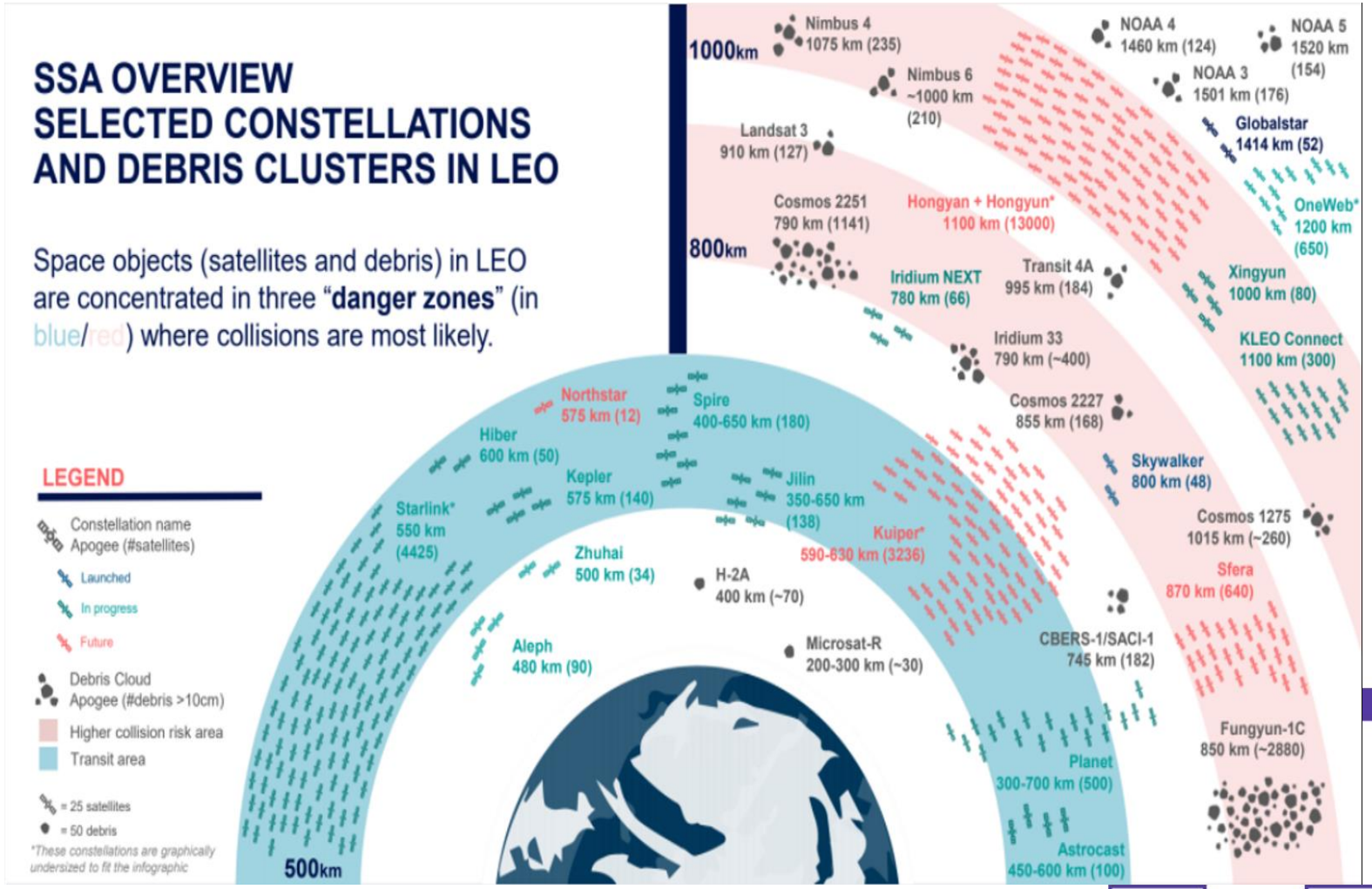


Courtesy: Shin Ichiro Nishida, Satomi Kawamoto, Yasushi Okawa, Fuyuto Terui, Shoji Kitamura, Space debris removal system using a small satellite - ScienceDirect

Protection of the EU Space Infrastructure

European Innovation Council

- All debris sizes
- All Orbits
- Cooperative and non-cooperative objects



Courtesy : Euroconsult Space Logistics Market report, used with permission

Expected Outcomes & Impacts

- Protect EU space infrastructure and the safe and secure space environment
- Green, compact and affordable de-orbiting solutions and in-space recycling of space debris
- Use very little propellant, concepts self-standing or complementary
- Innovative in-space services or solutions based on re-using orbital assets
- In-space Assembly and Manufacturing (ISAM)
- EU strategic autonomy for a secure, sustainable and safe space

Space Portfolio strategy plan

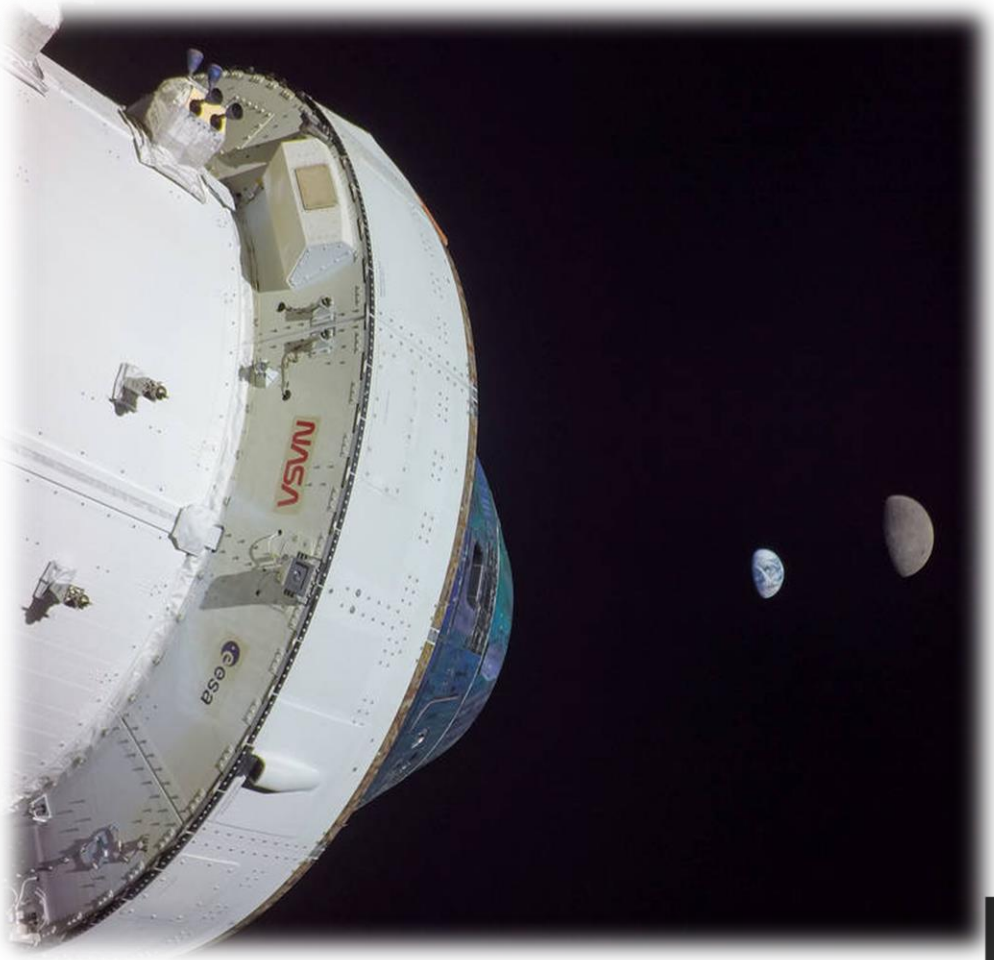
In your proposal add a dedicated WP for ***portfolio activities*** with at least ***10 person months***

- Technology - scientific/technological barriers
- Regulatory - ECSS flight qualification, test facilities
- Transition of technology to innovation - cost-benefit analyses, early commercialization
- Communication and dissemination

WP2024 information

European Innovation Council

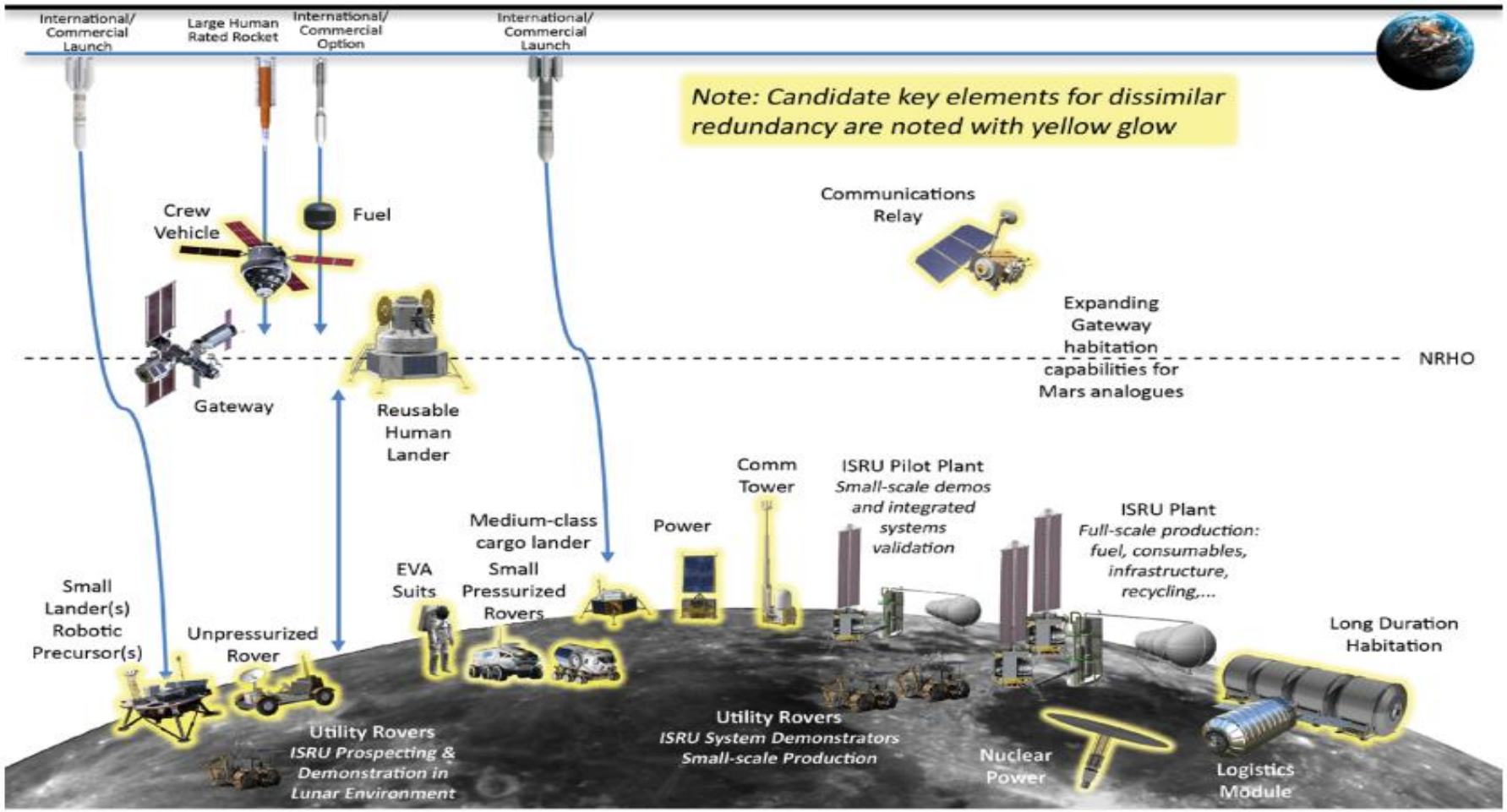
- **WP 2024 –** EIC 2024 work programme - European Commission (europa.eu)
- **Pathfinder Challenge guide –** EIC Pathfinder Challenges - European Commission (europa.eu)
- **Pathfinder deadline 16/10/2024**



Courtesy: NASA Orion image taken the 28/11/2022, imagery of the Earth and Moon together from its distant lunar orbit, including this image on Nov. 28, 2022, taken from camera on one of the spacecraft's solar array wings.

Wrap-up

- Long term future



Courtesy: International Space Exploration Coordination Group, Global Exploration Roadmap

Thank you!