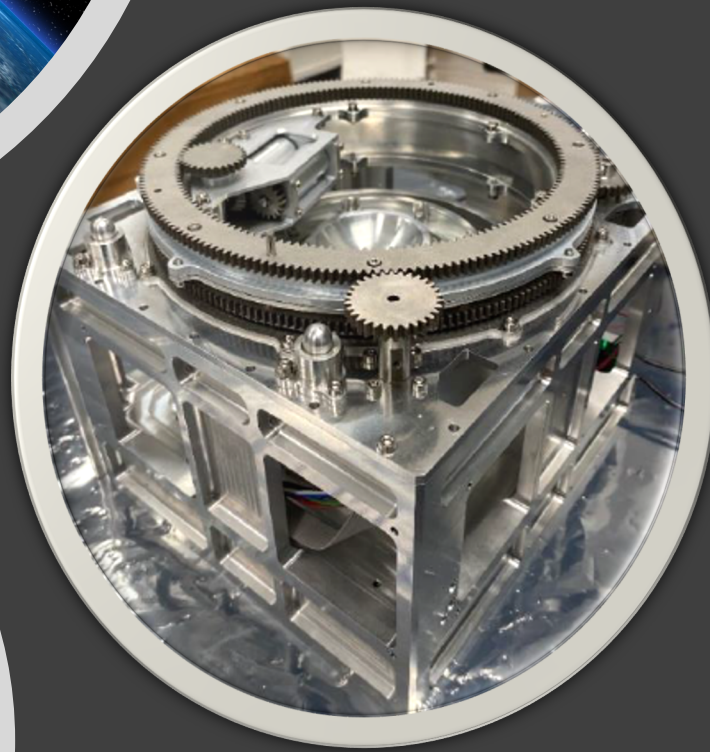




The E.T.PACK Project: a technological solution for the space debris proliferation problem

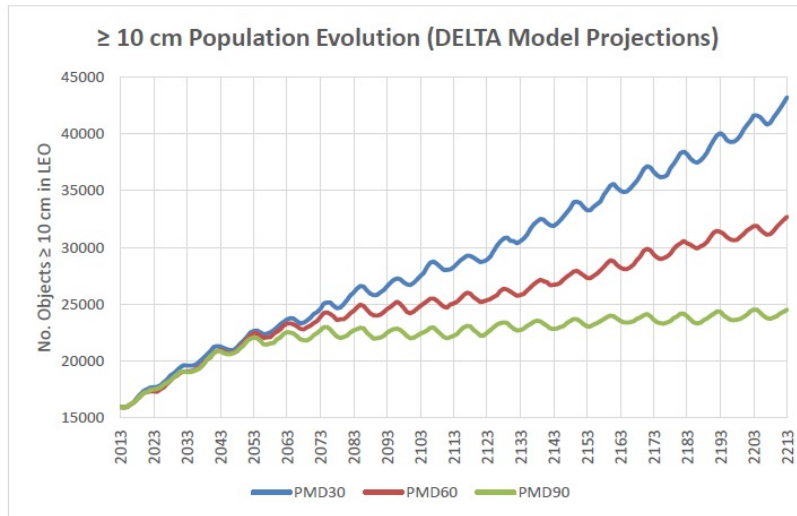
G. Sánchez Arriaga (UC3M), L. Tarabini Castellani (SENER Aeroespacial), E. Lorenzini (UNIPD), M. Tajmar (TU Dresden), K. Waetzig (IKTS Fraunhofer), and A. Post (ATD)



Contents

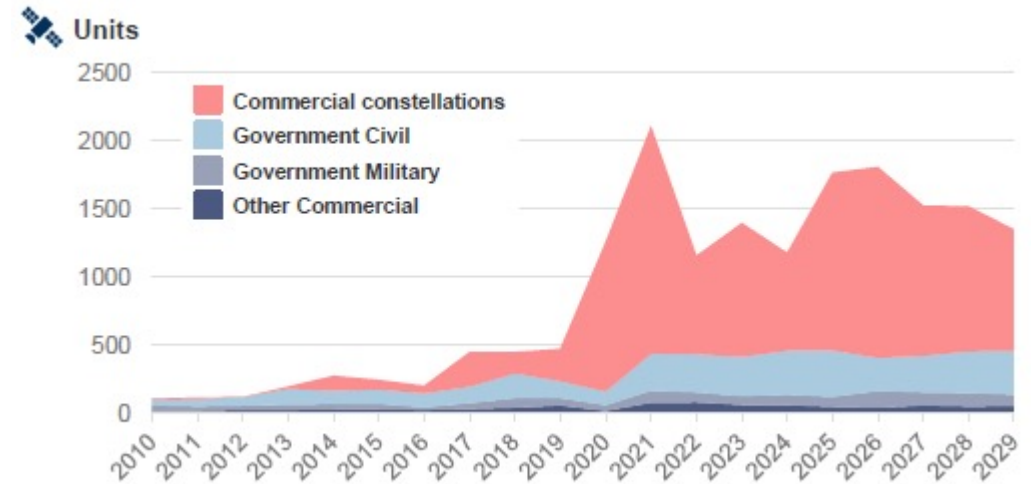
- The Space Debris Problem/Opportunity.
- Electrodynamic Tethers.
- The E.T.PACK Initiative.
- Conclusions.

The Space Debris Problem/Opportunity



Debris (>10 cm) average population evolution in LEO as a function of the success probability of post-mission disposal [ESA Figure for IADC AI 31.5]

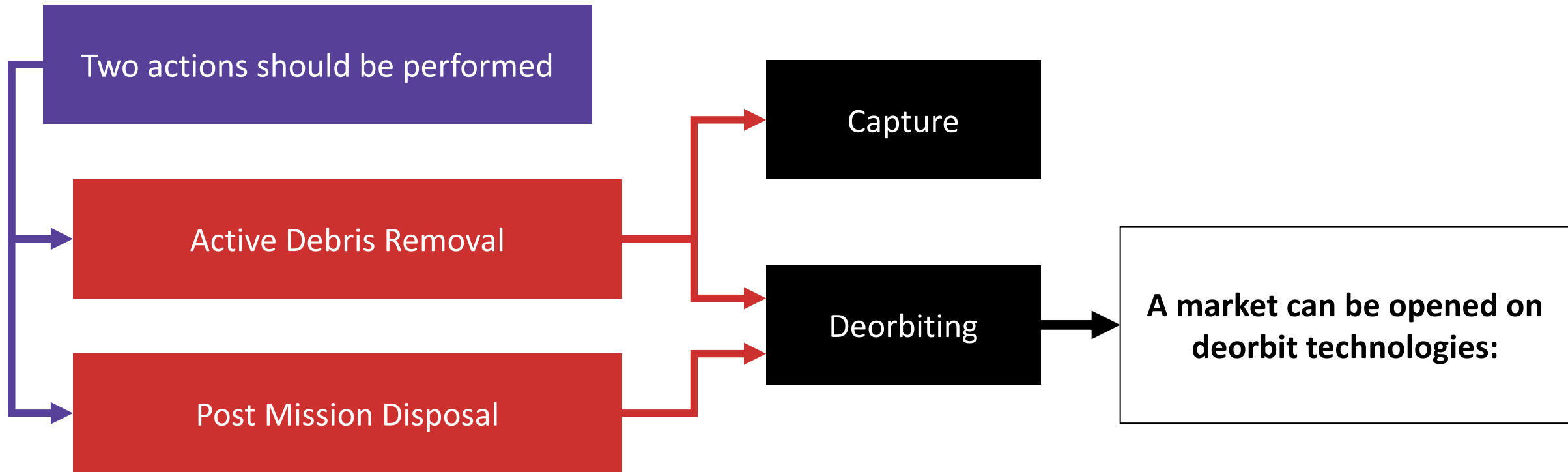
Space debris population is already unstable (Kessler Syndrome).



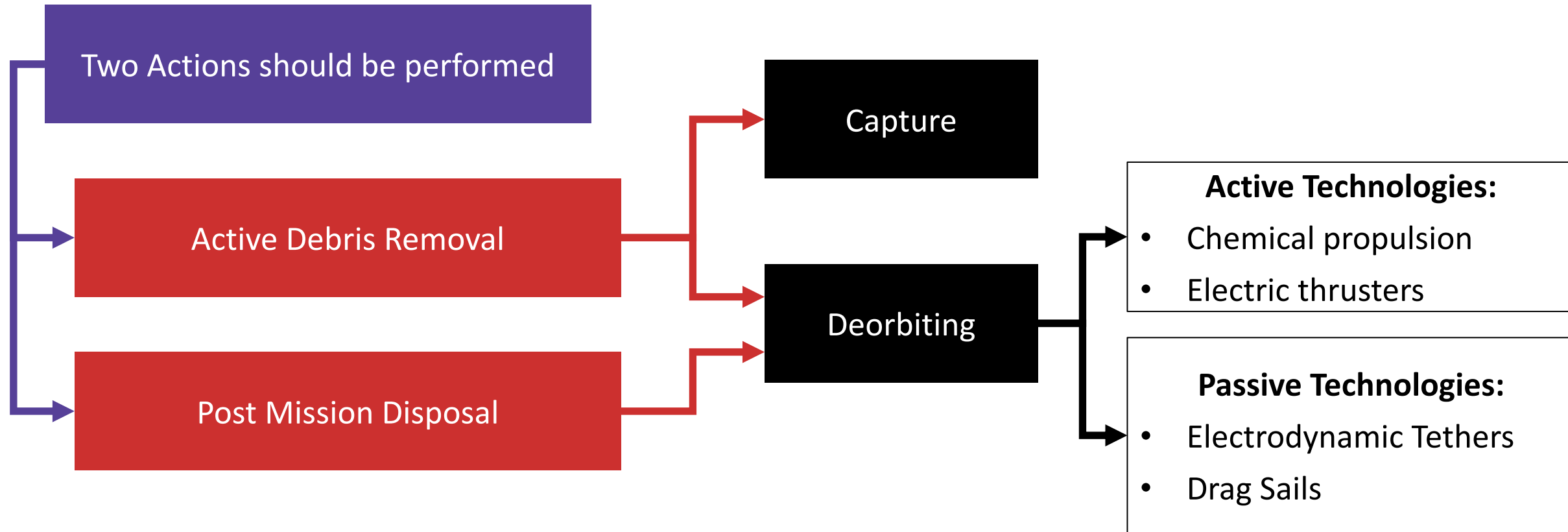
20 year of satellite demand. Source Euroconsult

The space sector will launch megaconstellations

The Space Debris Problem/Opportunity



The Space Debris Problem/Opportunity



Requirements of any Deorbit Technology¹

1. Bring de-orbit time below some threshold (25 years maximum).
2. Allow scalable design, reaching into multi-ton mass range.
3. Be a small fraction of its satellite.
4. Allow manoeuvres in case of long de-orbiting to avoid trackable debris.
5. Be reliable.

As discussed in [1], electrodynamic tethers can fulfil all the requirements (but technology development is needed).

¹J. Sanmartin presentation to the 51th Session of the Scientific and Technical Subcommittee (COPUOS, 2014)

Contents

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Video from TSG/MIT



$\Delta t \approx 0.02 \text{ s}$

**A passive drag
force without
propellant !**

The E.T.PACK Solution



the kit is bolt-on the spacecraft

Video prepared in the E.T.PACK Project

Tethers are propellant-less and reversible devices that can convert orbital into electrical energy and viceversa

A Tether in drag and thrust modes was demonstrated by the PMG mission (NASA) in 1993.

Main Tether Applications



Post-Mission
Disposal
(Drag)



Station-Keeping
(Thrust)



Active Debris Removal and
In-orbit Servicing
(Drag + Thrust)

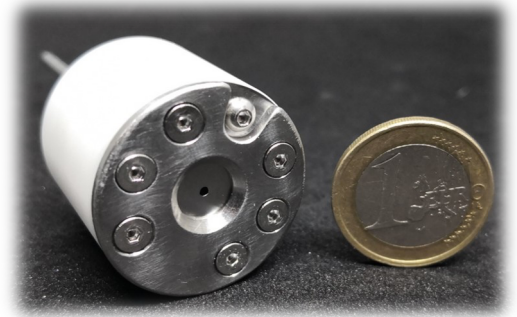
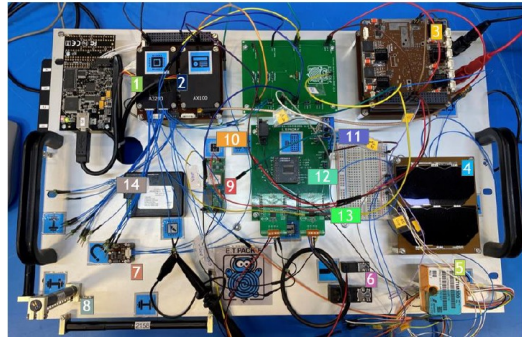
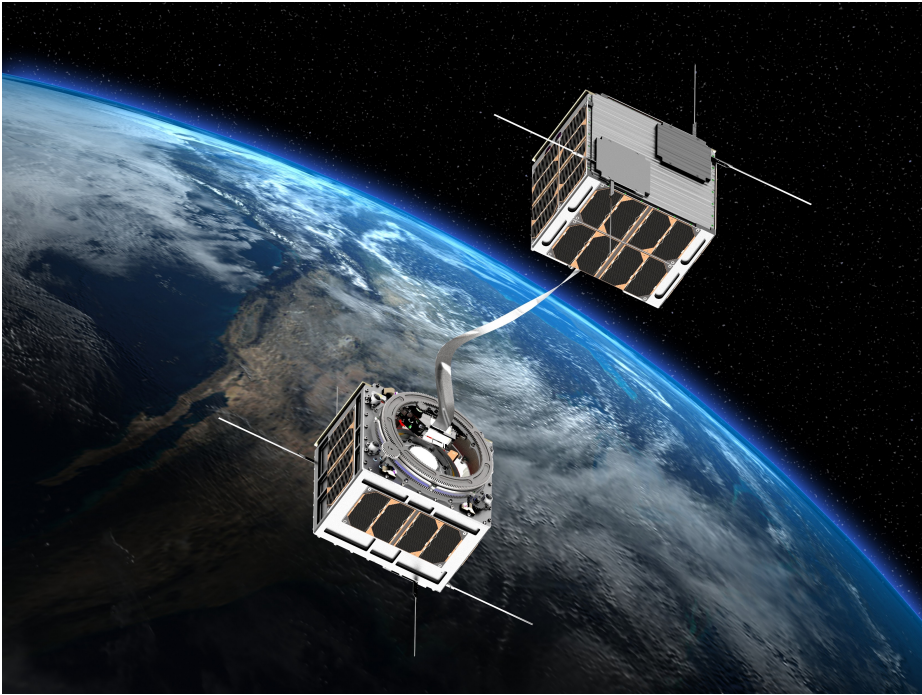
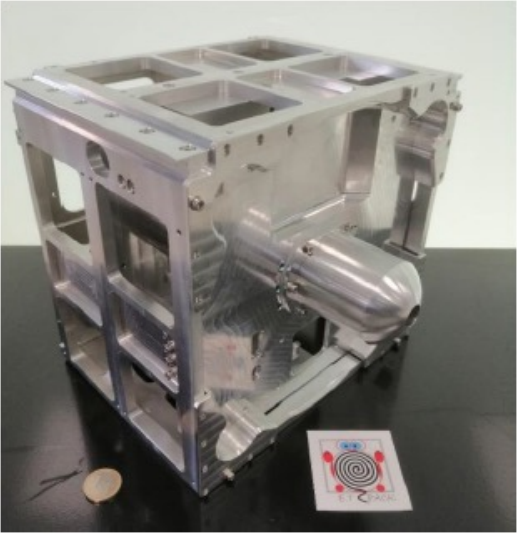
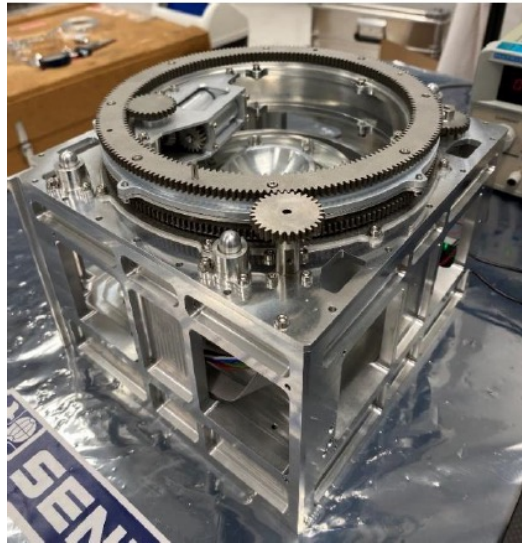


Scientific Missions
(Drag + Power + ...)

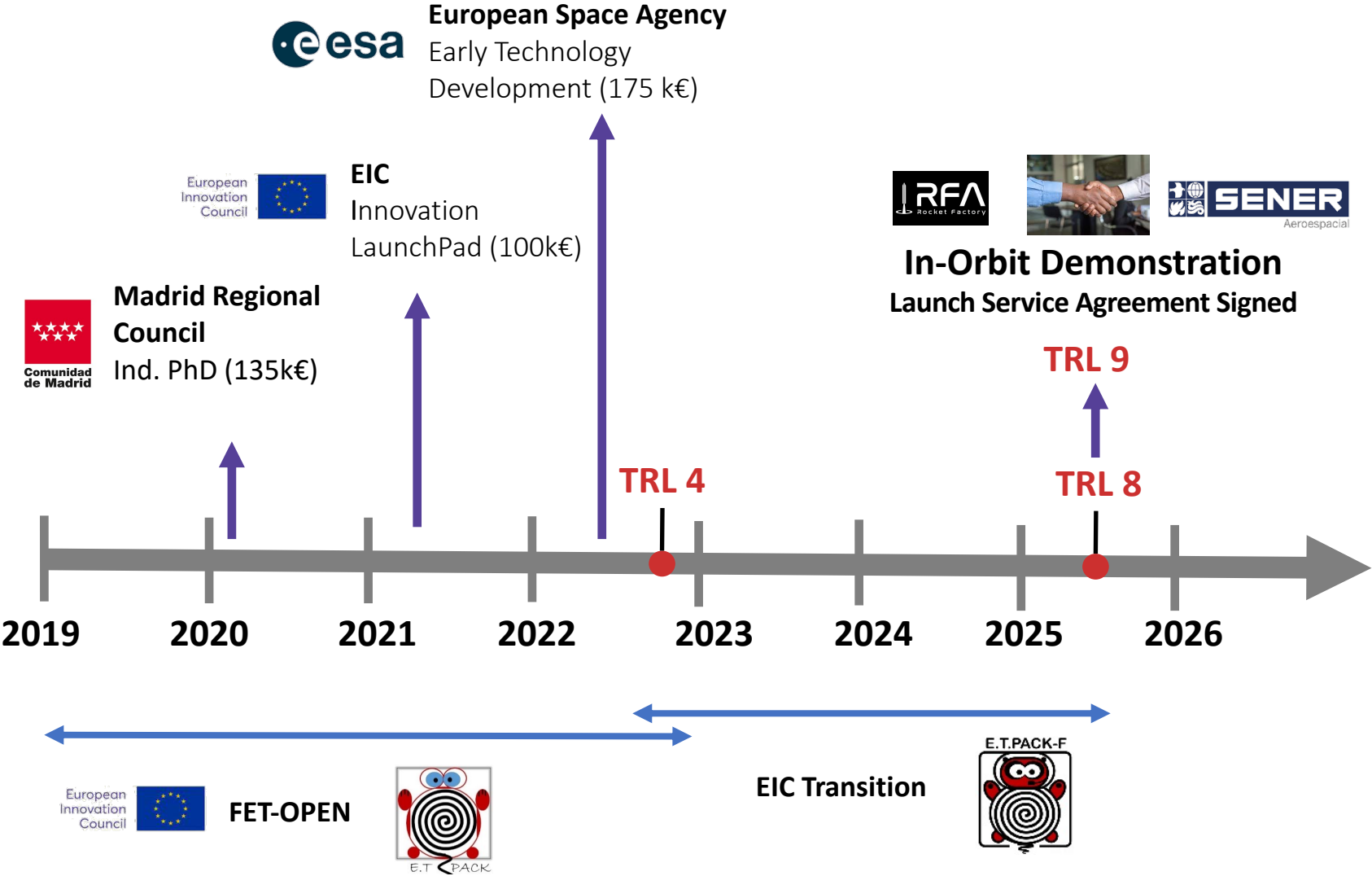
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E.T.PACK Project
Goal: Develop a deorbit device with TRL 4.
Budget: 3M€ (European Innovation Council)
Duration: 2019-2022



Roadmap of the E.T.PACK Initiative



Conclusions

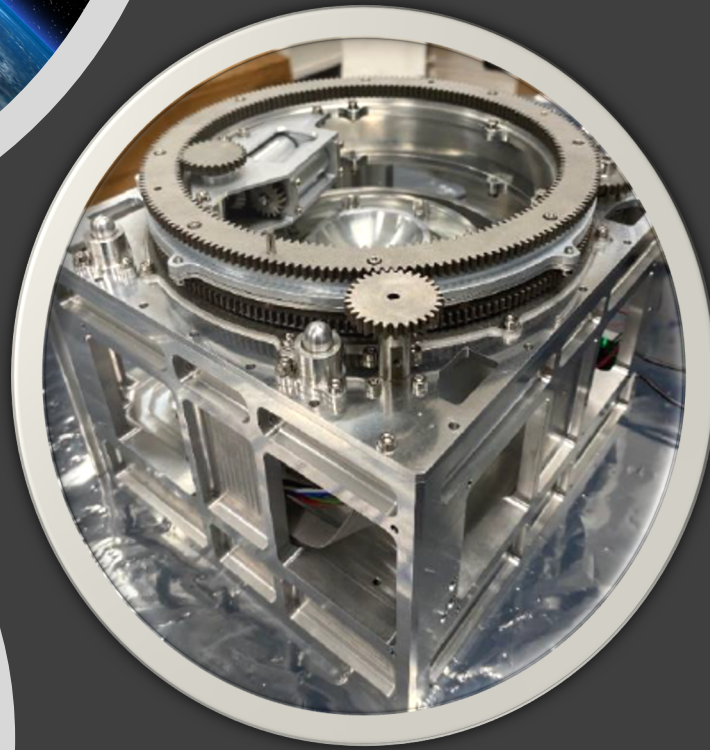
- The space sector needs to develop technologies to solve the space debris problem.
- New business opportunities will naturally appear.
- Actions from policy-makers are needed to accelerate the transition towards a sustainable use of the outer space.
- E.T.PACK deorbit device based on an EDT is currently at TRL 4.
- E.T.PACK funding has been secured to reach TRL 8 in 2024.
- E.T.PACK demonstration mission is planned in 2025.



Thank you for your attention

More information at

- The booth/exhibition installed at the VIC (until 15:00)
- www.etpack.eu
- gonzalo.sanchez@uc3m.es



June 8th, COPUOS 2022. 65th Session