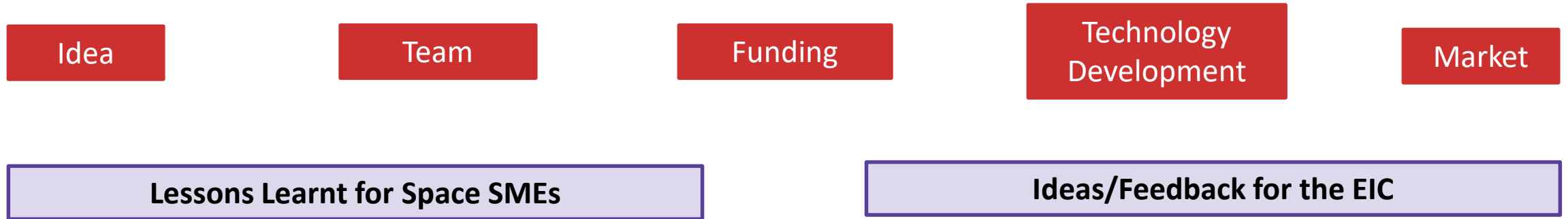


The E.T.PACK Initiative: Lessons learnt for Space SMEs

Prof. Gonzalo Sánchez Arriaga. Associate Professor. Universidad Carlos III de Madrid

The Journey: From Idea to Market



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Idea

Team

Funding

Technology
Development

Market

Lessons Learnt for Space SMEs

Ideas/Feedback for the EIC



Lorentz Force in the Lab

**A passive drag
force without
propellant !**



Lorentz Force in Space



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The Team

The long trip through the desert (2012-2019)

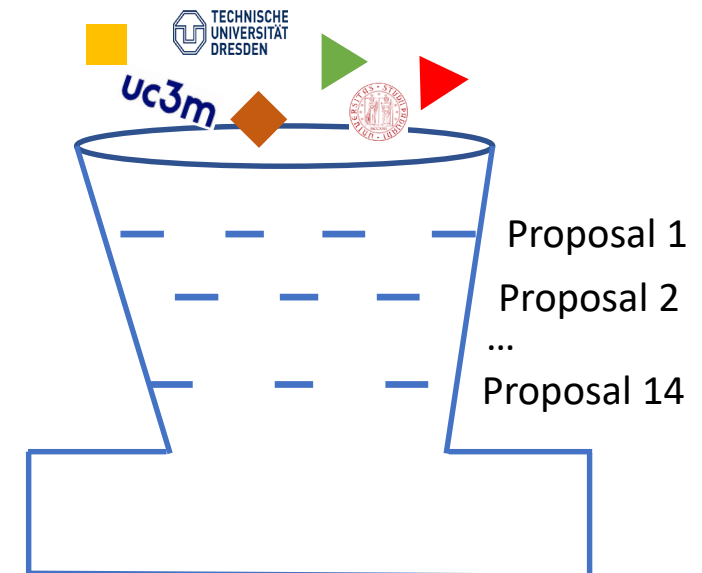
- Intense work on the preparation of a consortium with the required technological competences and commitment.
- Contact with tens of companies, universities and research centres.
- Seminars and meetings with several ESA divisions.
- Preparation and submission of more than 14 (rejected) proposals.
 - ERC-StG proposal (1.5 M€): A-ranked and recommended for funding, but not funded due to budget limitations.
 - FET-OPEN proposal E.T.PACK (3M€): 2 submissions (2nd submission was ranked in the first position of the reserve list!)



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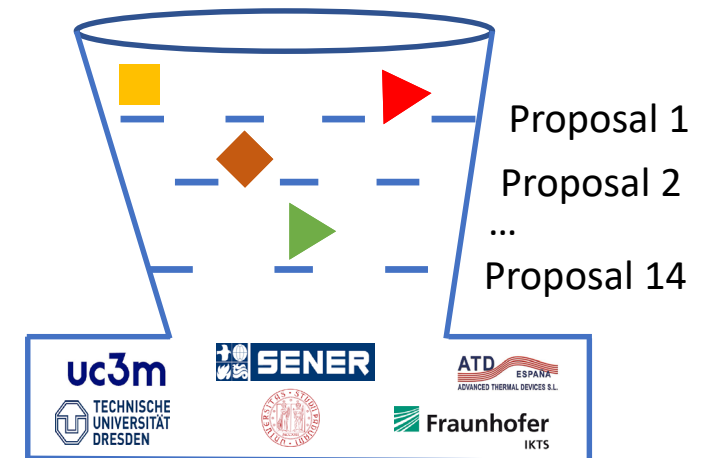


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E.T.PACK was funded after its third submission in 2019 !



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2. Put an university in your team: knowledge, m@n/power, cost, stability.
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Ideas/Feedback for the EIC

1. Keep flexible the “idea-call matching”.
2. Keep flexible “team structure”: the space sector has special needs.

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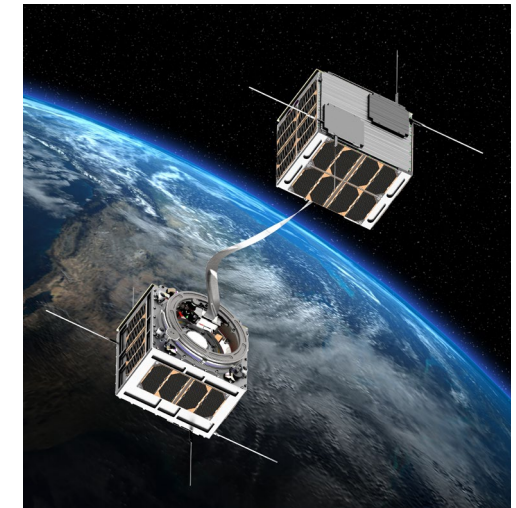
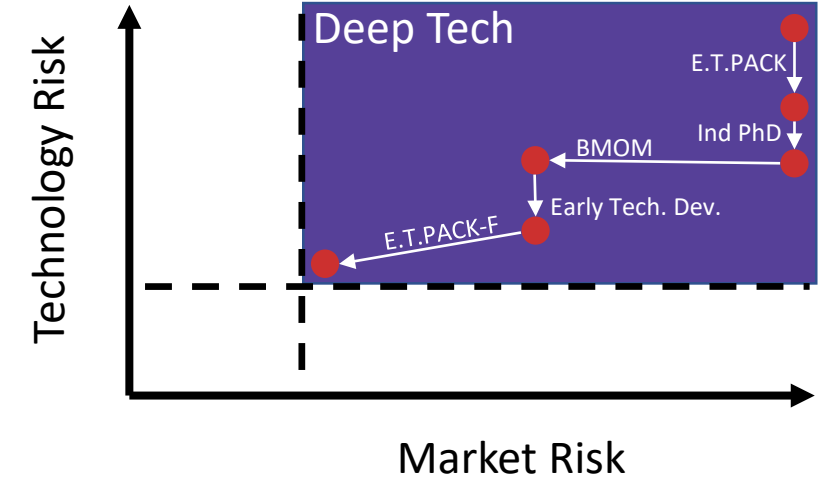
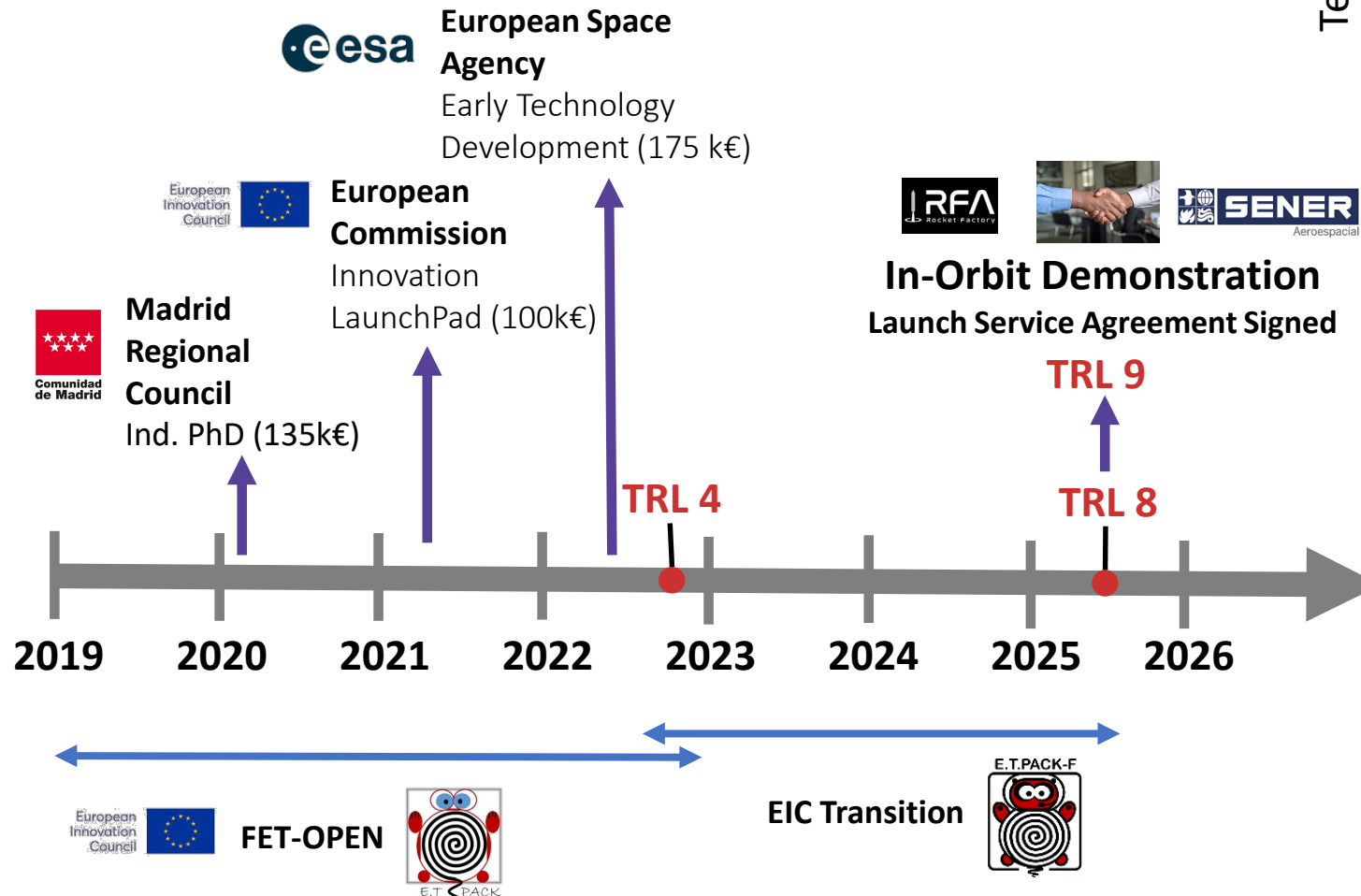
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CHALLENGE

Developing a compact and reliable product



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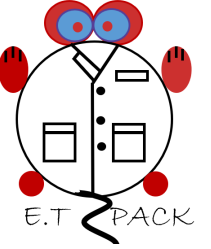
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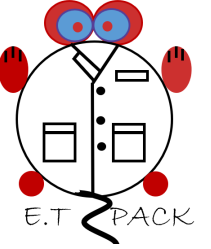
Strategy

- Control the risk: Development plan with an “onion” structure.
 - Core: safe and achievable, but still disruptive. For instance: tether + hollow cathode
 - Other layers of increasing complexity and risk. For instance: tether + Electron Field Emitter, Low-W Tether
- Product diversification: each part of the deorbit device has the potential to become a stand-alone product.

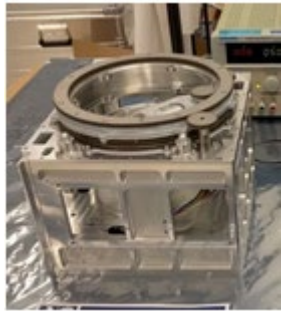
Advantages of the strategy

- Whether EDTs will triumph or not, E.T.PACK will impact economy and society.
- If the Deorbit Device is successfully demonstrated in orbit, then all the products will reach TRL 9.
- This is the perfect strategy for keeping the consortium motivated and committed.

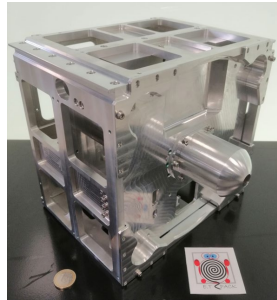
Technology Development of the Deorbit Device



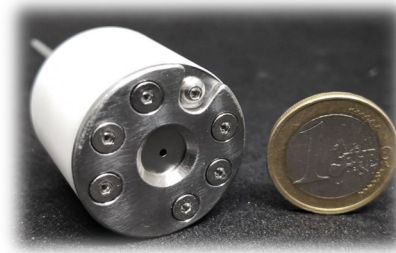
Hardware



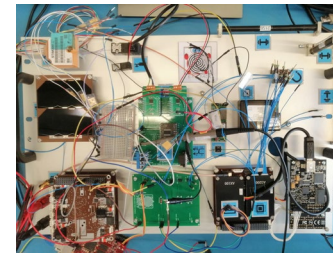
Deorbit Device



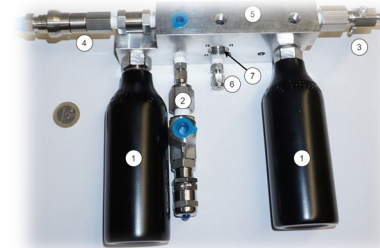
Electron Emitter



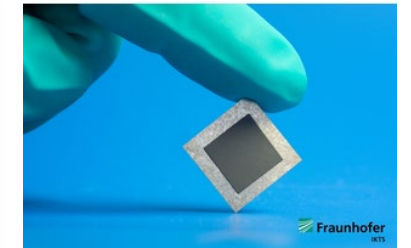
Avionics



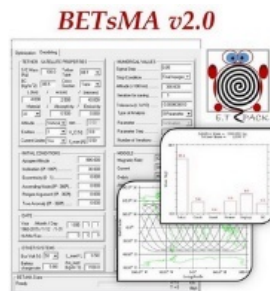
Cold Gas



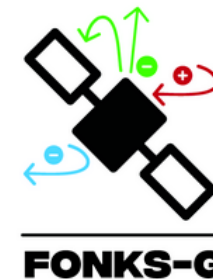
Low-W Coating



Software



Mission Analysis



Emissive probes and Spacecraft Charging



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4. Use EIC: services and reputation to attract additional partners and funding.
5. **Diversify your innovation and have a plan B.**

Ideas/Feedback for the EIC

1. Keep flexible the “idea-call matching”.
2. Keep flexible “team structure”: the space sector has special needs.
3. EIC reputation can help projects and innovators: awards.
4. **Use funded projects to enhance EIC visibility: applicants, internally (EC), and society.**



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

Main Tether Applications



International Space
Station



Jupiter Mission



Post-Mission
Disposal
(Drag)



Station-Keeping
(Thrust)



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

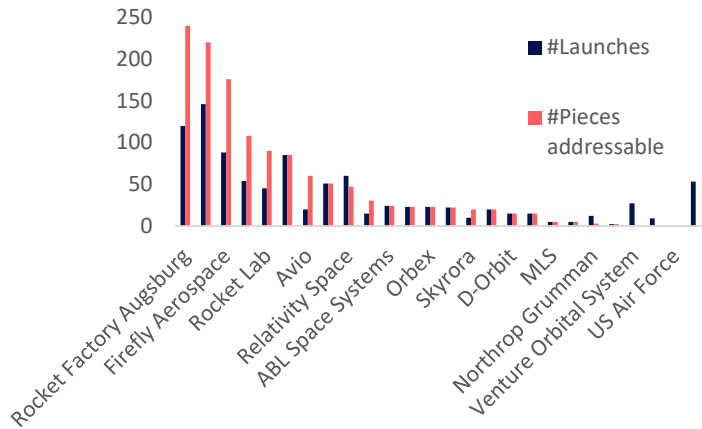


Scientific Missions
(Drag + Power + ...)

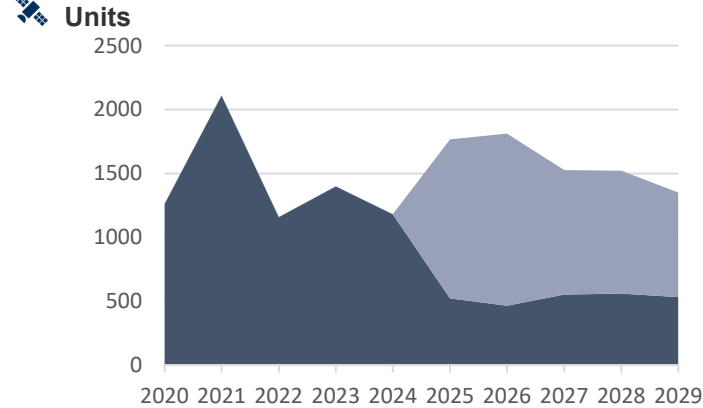
A Tether in drag and thrust modes was demonstrated by the PMG mission (NASA) in 1993.

Study made by Euroconsult in the Innovation Launchpad project BMOM

Launcher market technically addressable over 5 years

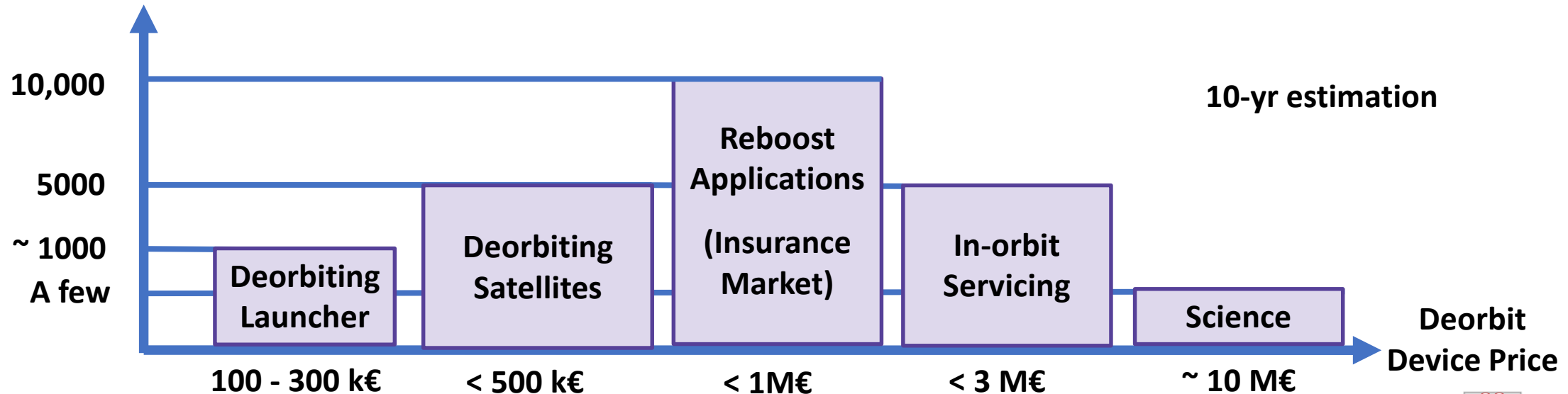


Satellite market technically addressable over the years



RFA joined us in E.T.PACK-F
In the short term, focus on
the launcher market

Number of
Units



The impact of space technologies is well-beyond business

1

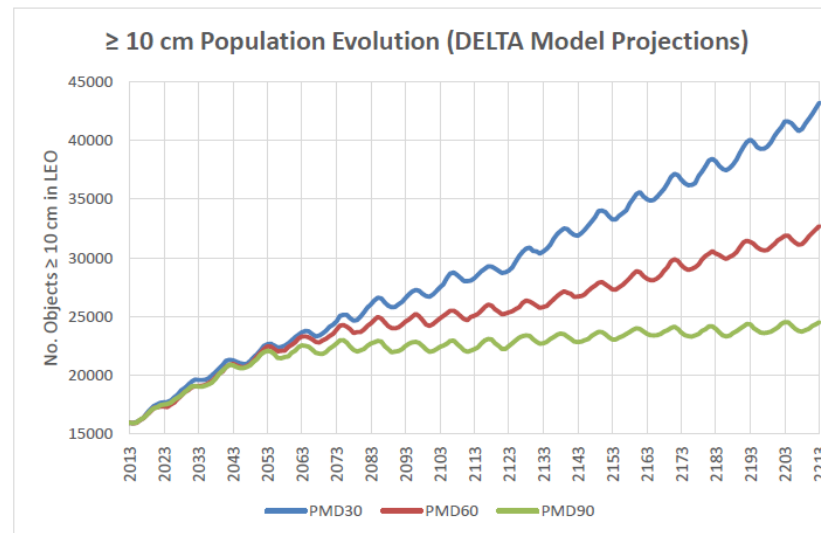
Competitiveness

Europe can be the first with access to a reversible and propellant-less **product** for in orbit propulsion.

2

Sustainability

We have the responsibility to stabilize the space debris population (and conventional technologies failed)



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]

Figure 7. Debris (≥ 10 cm) average population evolution in LEO as a function of the success probability of post-mission disposal in orbits with a residual lifetime of 25 years [ESA figure for IADC AI 31.5]

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5. Diversify your innovation and have a plan B.
6. **Early contact with customer: prepare your products and attract more funding.**

Ideas/Feedback for the EIC

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3. EIC reputation can help projects and innovators: awards.
4. Use funded projects to enhance EIC visibility: applicants, internally (EC), and society.
5. **Although not so profitable as other areas, EIC help is crucial for the space sector, which is critical for safety, security, and sustainability.**



Conclusions

- The EIC was perfect for E.T.PACK because it broke the vicious circle:
Unmatured technology -> High risk -> No funding -> Unmatured technology
- Why did E.T.PACK fit with the EIC and not with other public bodies and private investors ?
 - The EIC was open-minded and flexible (in terms of technologies, ideas and team composition).
 - EIC balanced business/risk with environmental sustainability considerations (long term view and social impact).
- EIC support for E.T.PACK's allowed to
 - Change the status of Electrodynamic Tethers in Europe (TRL, understanding, credibility, etc.)
 - Move the deorbit device from “an idea” to the lab (E.T.PACK, 2019-2022, TRL 4)
 - Secure the funding to move the deorbit device from the lab to space (E.T.PACK-F, 2022-2025, TRL 9).
- Even after the IOD, we will still have an “herculian task” in front of us: **put our products in the market.**



Thank you

Prof. Gonzalo Sánchez Arriaga
Universidad Carlos III de Madrid
www.etpack.eu
gonzalo.sanchez@uc3m.es