

ADEO

Deployable Sail Deorbit Modules

Clean Space Days

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ADEO Team

ESTEC, Noordwijk | 09.10.20244



HPS

High Performance Space
Structure Systems GmbH
GERMANY



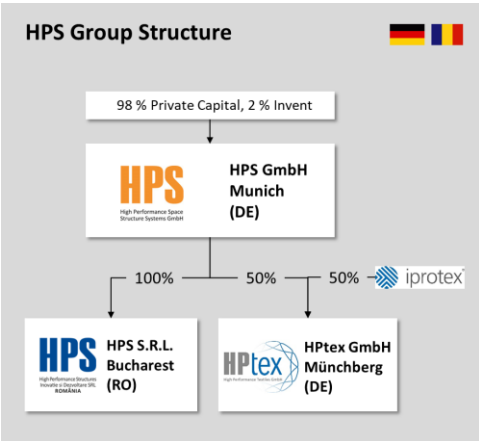
ADEO
DE-ORBIT SUBSYSTEM

ADEO - THE DEORBIT MODULE FROM LEO

1. Company Overview



HPS Group

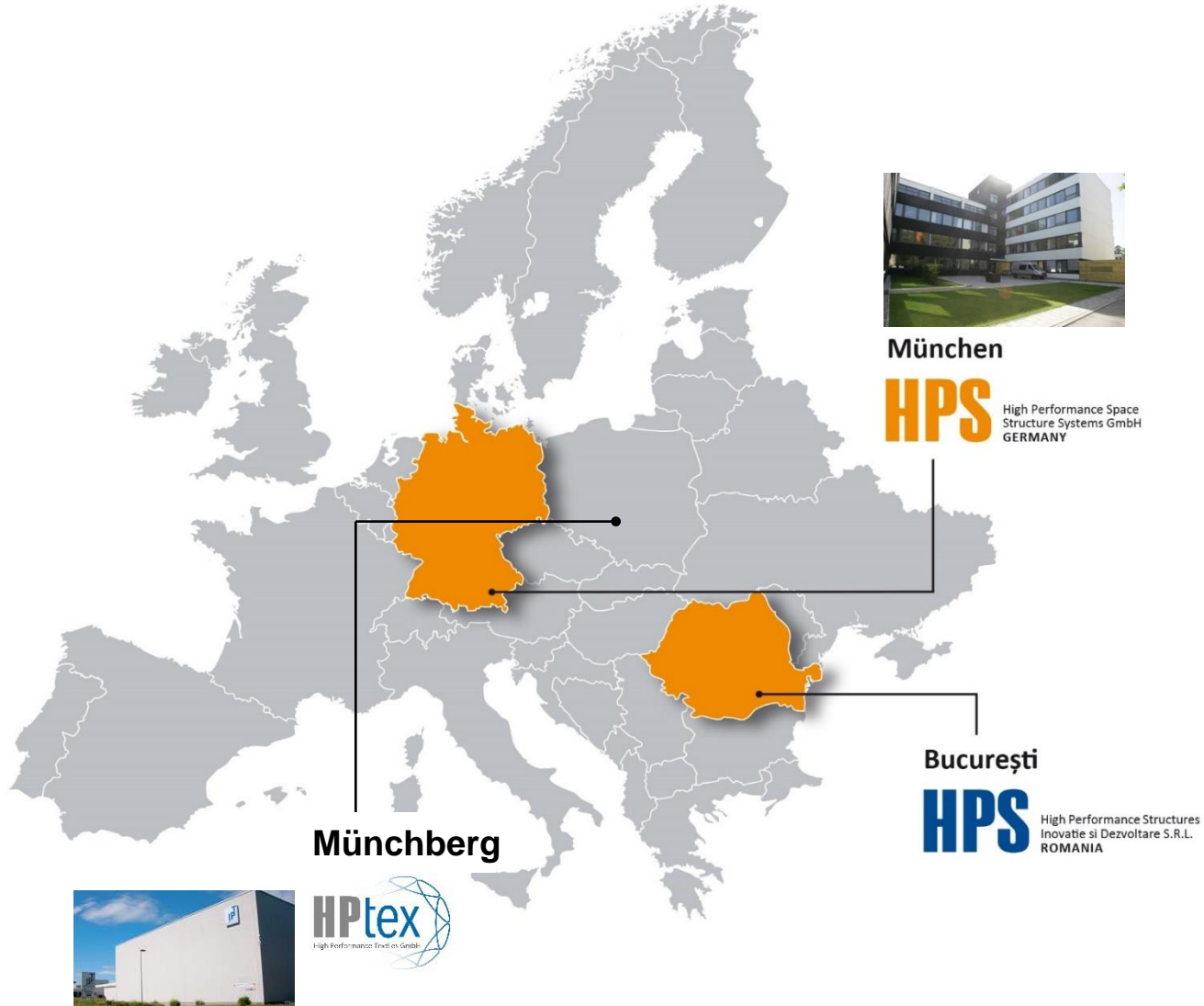


Number of Employees (2023):

- HPS Group: 80

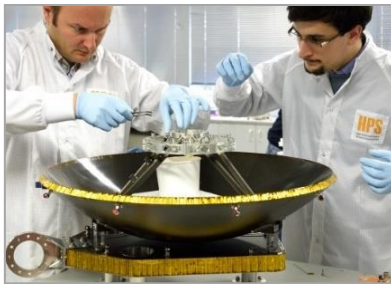
Turnover (2023):

- HPS Group: 14 Mio EUR

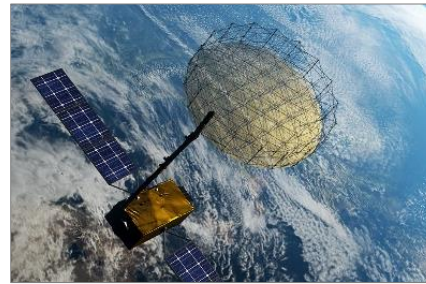


Product Portfolio HPS Group

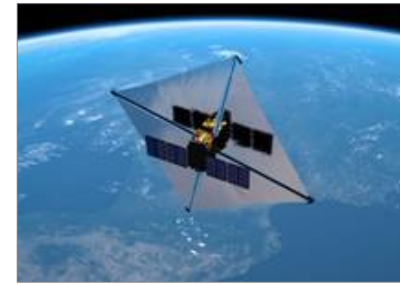
Solid Reflector
Antennas



Large Deployable
Reflector Subsystems



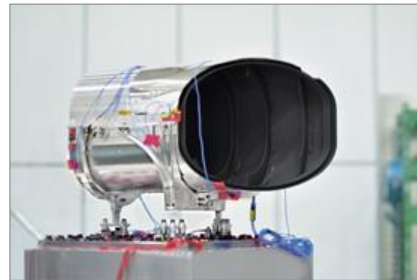
Deployable Deorbit
Sail Subsystems



Thermal H/W (Radiators,
Thermal Straps, MLI, etc)



Secondary
Structures



Antenna
Components



Mechanical Ground
Support Equipment



Other Products and Services: radiation protection caps, composite structures, engineering & integration service

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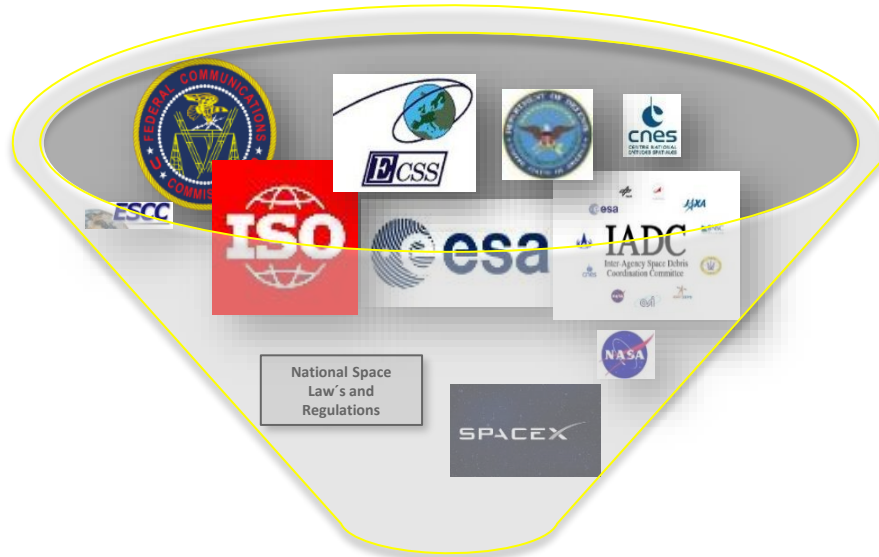
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ADEO - THE DEORBIT MODULE FROM LEO

2. Space Debris Situation & Regulations



Compliant with New Regulations?

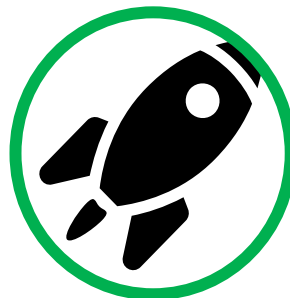


- **Launcher** Requirements (e.g. **SpaceX**)
- **FCC** Regulations
- **ESA Zero Debris Policy**
- **National Space Law's** and Regulations
- **UN** Space Debris Guidelines
- **IADC** Space Debris Mitigation Guidelines
- **ISO** Standards
- **ECSS** Standards
- **More**

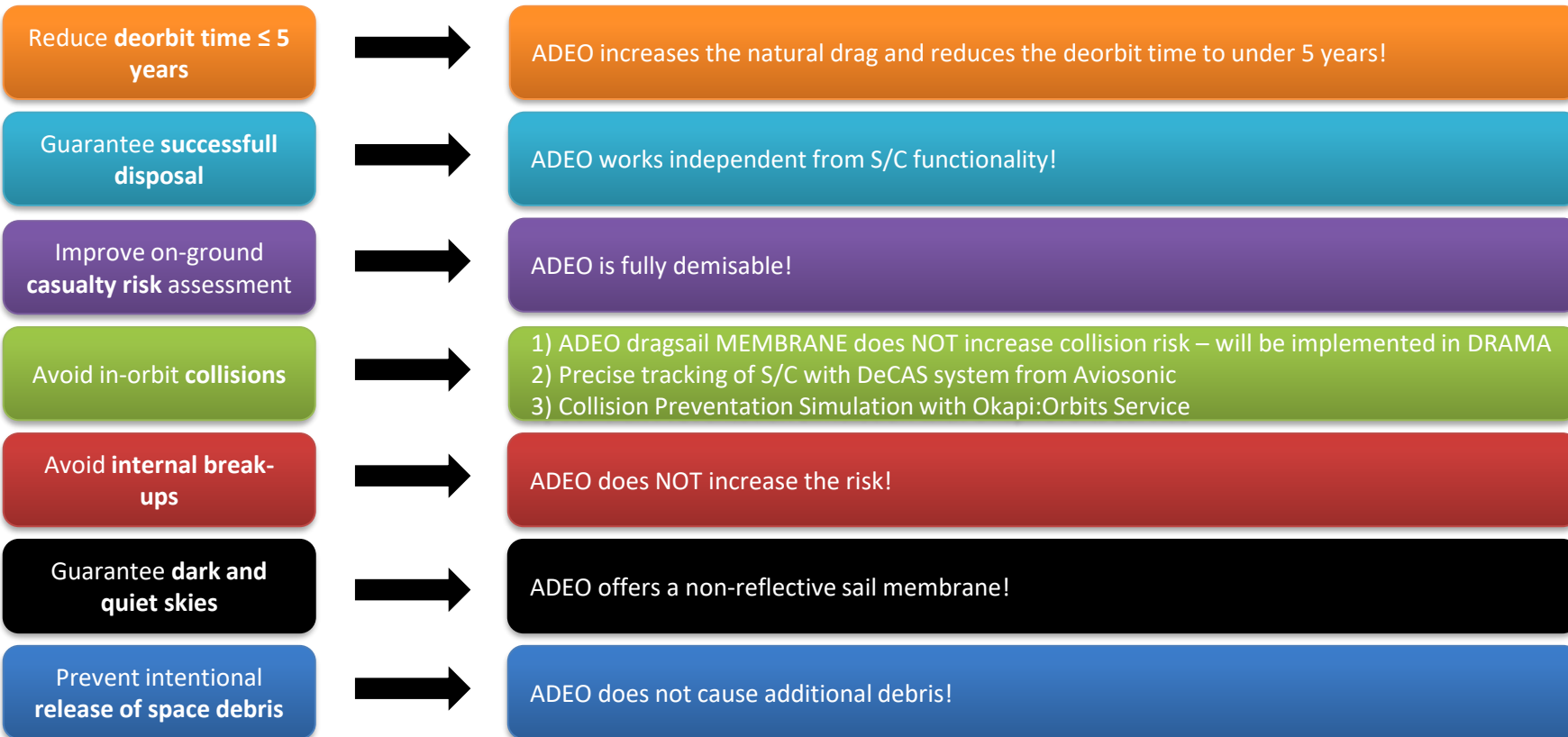
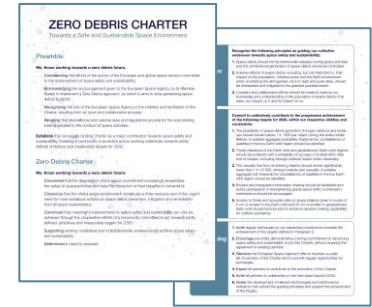
No Compliance = No Launch!



2024



How does ADEO help to be Compliant to New Regulations?



HPS

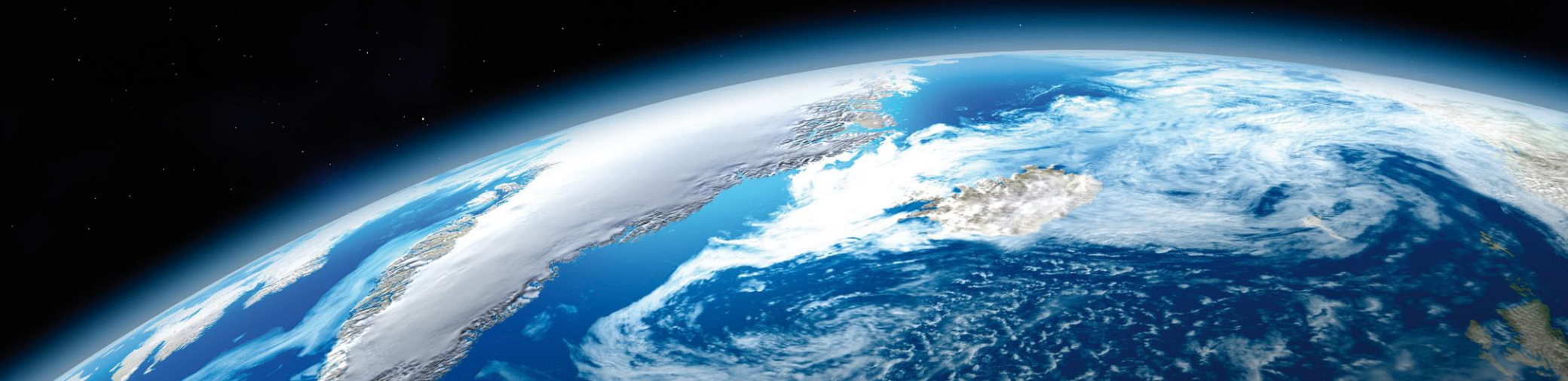
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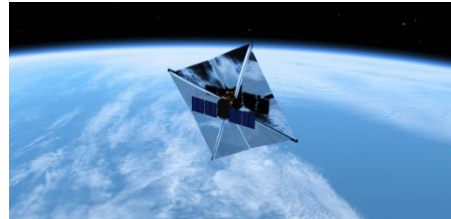
ADEO - THE DEORBIT MODULE FROM LEO

3. ADEO Product Description



HPS's contribution to the global challenge to reduce space debris with „ADEO“:

1. Deploy ADEO after „End-of-Business“ by one signal to a release nut and then: switch off the satellite („End-of-Life“)



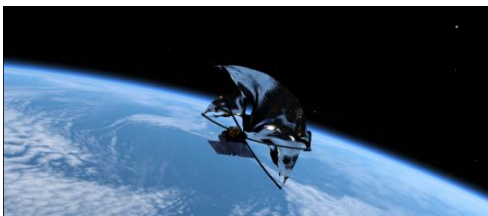
2. Increase natural drag in LEO and reduce quickly orbit height



Advantages:

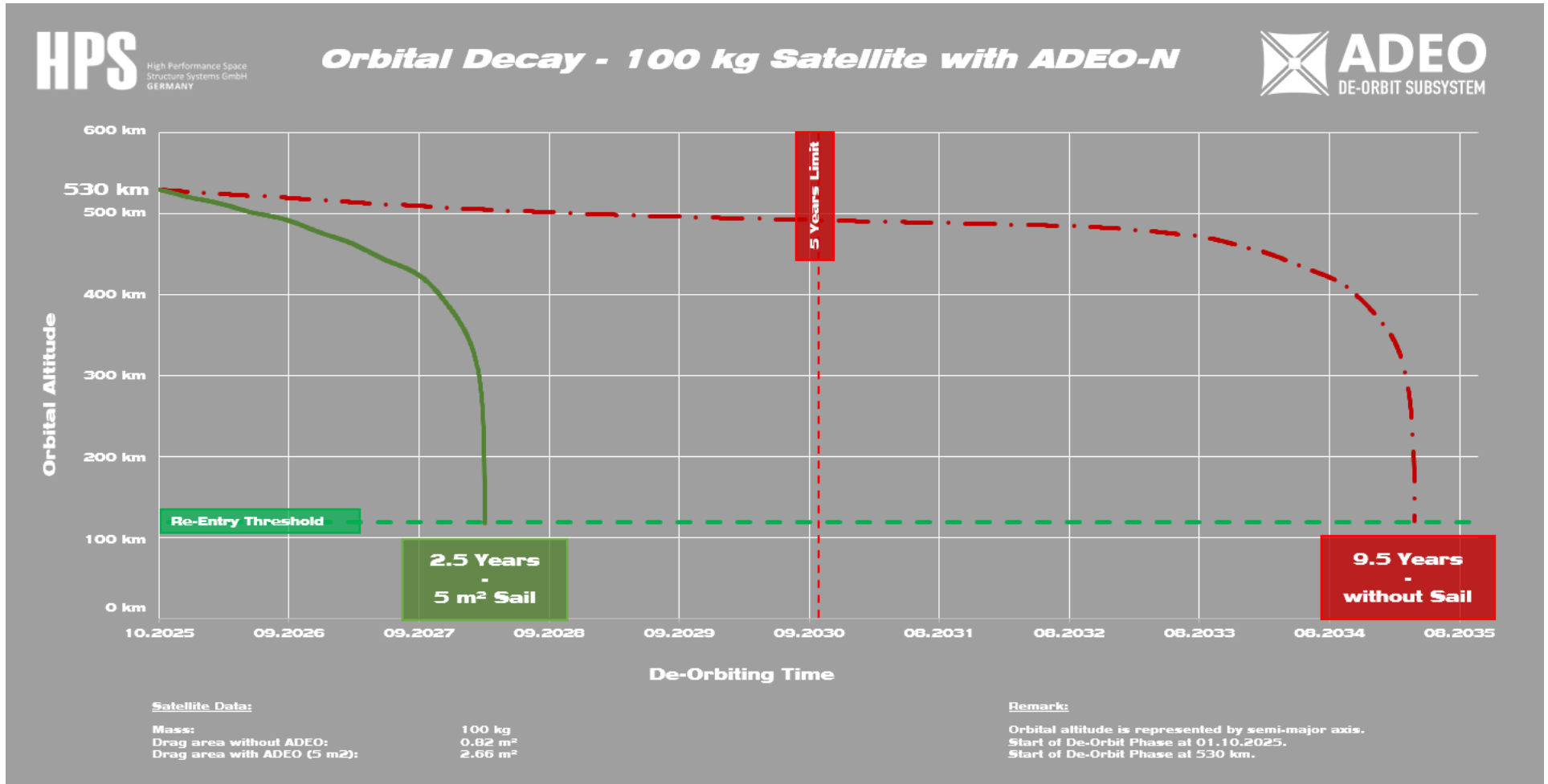
1. use of propulsion for business duration
2. low mass, low cost for ADEO (in comparison to propulsion)
3. no need for AOCS
4. no operations cost during deorbit phase
5. orbit position via NORAD data or other

3. Burn in dense atmosphere until „End-of-Mission“



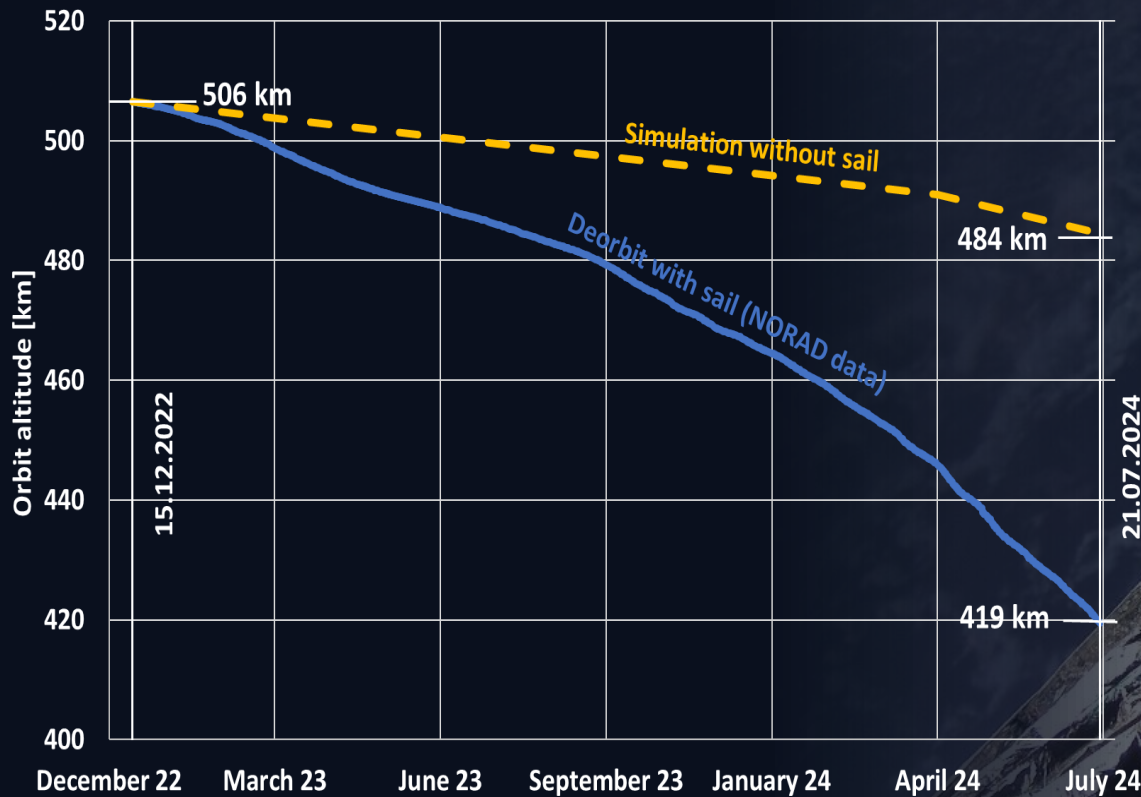


Deorbit Example



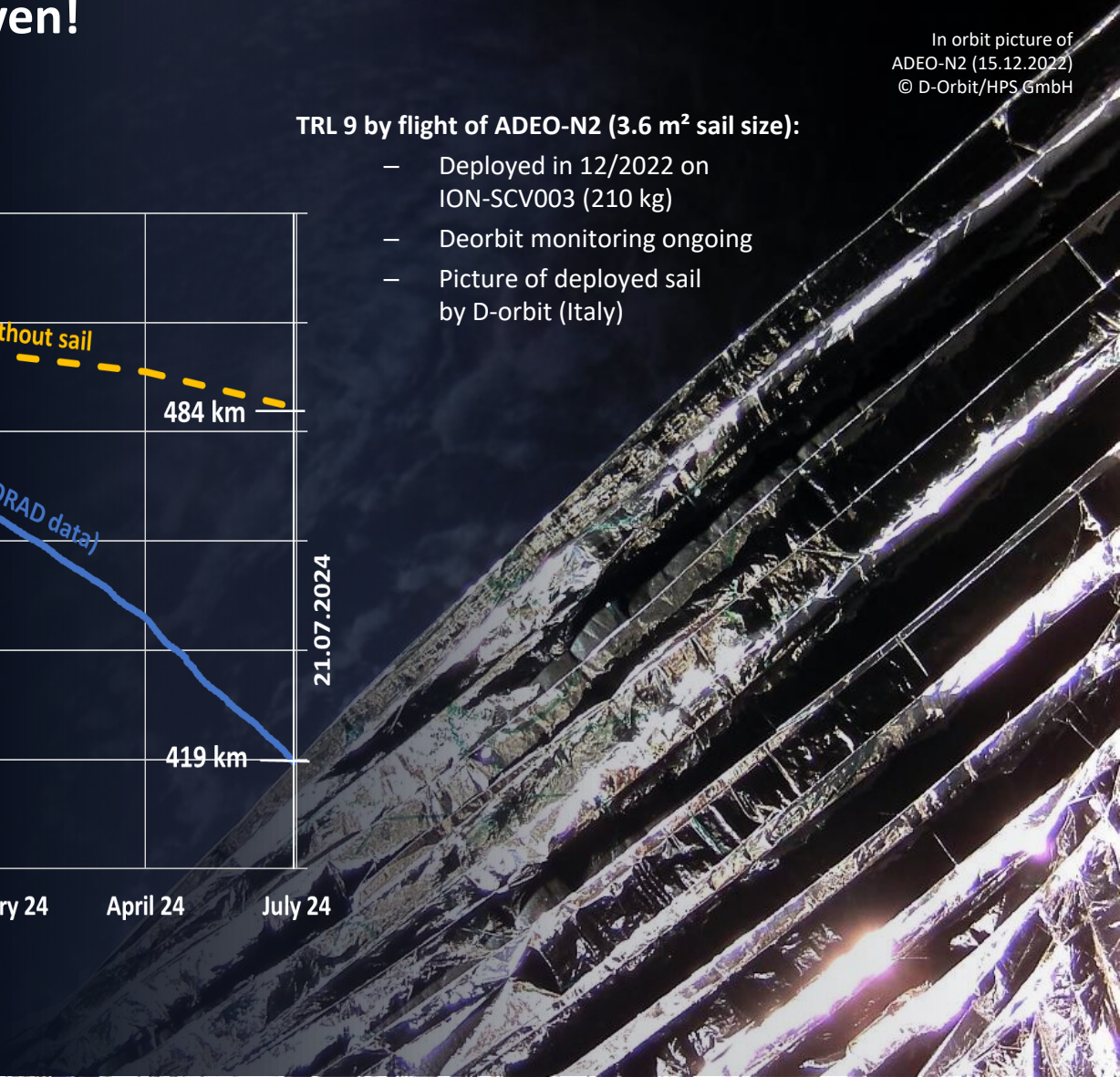
ADEO - Three Times Flight-Proven!

In orbit picture of
ADEO-N2 (15.12.2022)
© D-Orbit/HPS GmbH

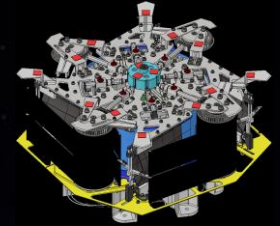
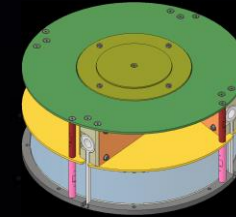
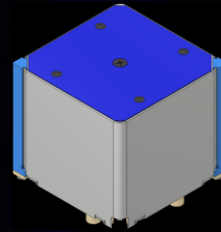
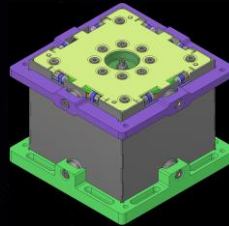
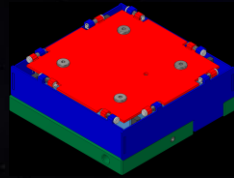


TRL 9 by flight of ADEO-N2 (3.6 m² sail size):

- Deployed in 12/2022 on ION-SCV003 (210 kg)
- Deorbit monitoring ongoing
- Picture of deployed sail by D-orbit (Italy)



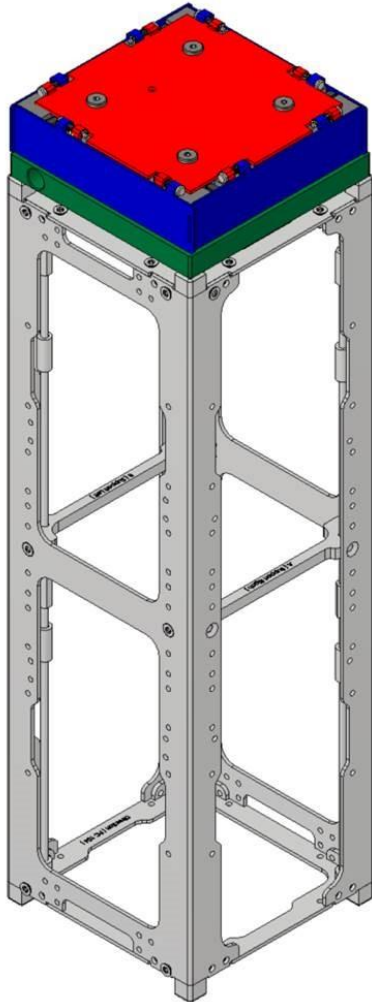
ADEO Product-Family



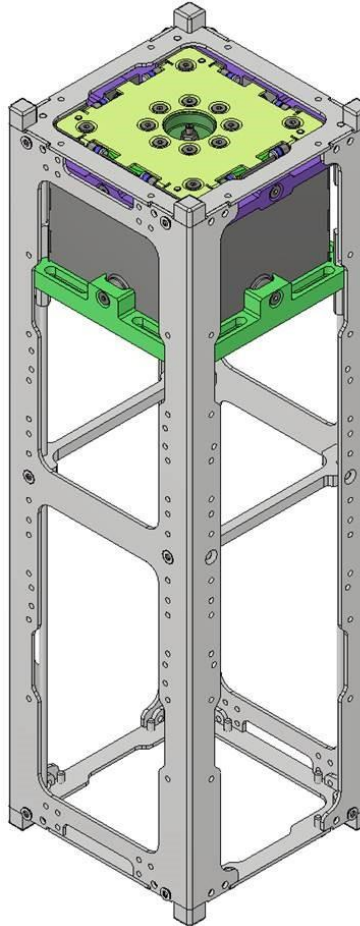
	ADEO-P (ico)	ADEO-C (ube)	ADEO-N (ano)	ADEO-M (edium)	ADEO-L (arge)
Satellite Masses	1 - 20 kg	5 - 50 kg	20 - 250 kg	100 - 700 kg	500 - 1.500 kg
ADEO Module Mass	0.45 kg	0.8 kg	0.8 kg	4.5 kg	9.5 kg
ADEO Module Size (stowed)	9.8 x 9.8 x 3.6 cm ³	9.5 x 9.5 x 7.2 cm ³	10 x 10 x 10 cm ³	Diameter 29 cm Height 13.4 cm	40.6 x 40.6 x 26 cm ³
Sail Area	1.7 m ²	3.4 m ²	5.0 m ²	15 m ²	25 m ²
Deployment Mechanism	Spring-based	Spring-based	Spring-based	Controlled continuous deploym. with spring	Electrical motor
Activation System	Pyro Cutter	Pyro Cutter	Pyro Cutter	Pyro Cutter	Release Nut
Mechanical Interface	4 x M4 thread	CubeSat Standard	4 x M5 thread (diam. 8.2 cm)	8 x M6 thread (diam. 27.5 cm)	8 x 7.0 mm hole (diam. 28/29 cm)
Electrical Interface	2 Wires (free ends)	4 Wires (free ends)	2 Wires (free ends)	4 Wires (free ends)	3 Connectors D-Sub HD15, RS-422
Electrical Power	12V @1A – 10 msec	>1V @3A - 25 msec	12V @1A – 10 msec	>1V @3A - 25 msec	24-38 V (<280 mW in Standby)



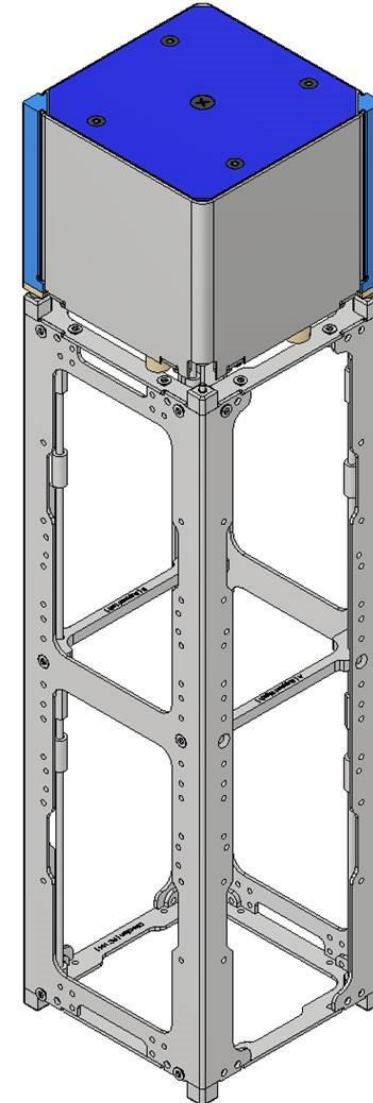
ADEO Integration on Cubesat



ADEO-P

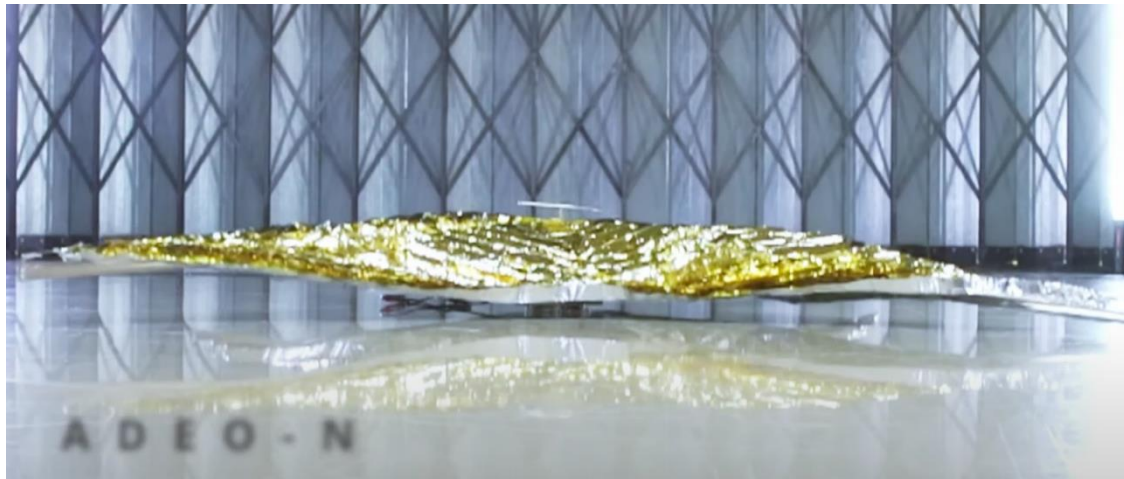
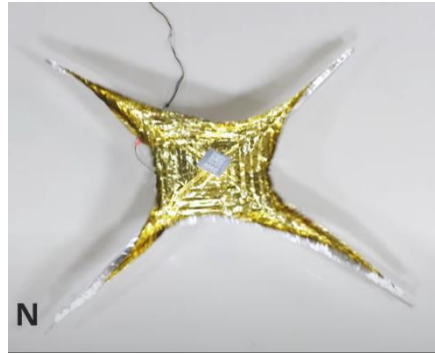
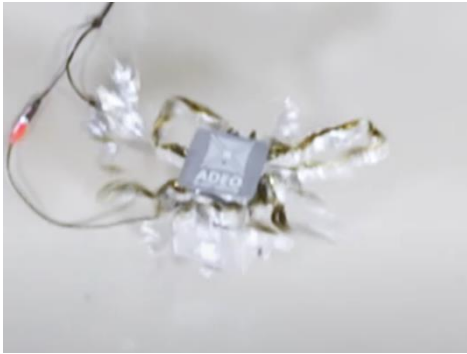


ADEO-C

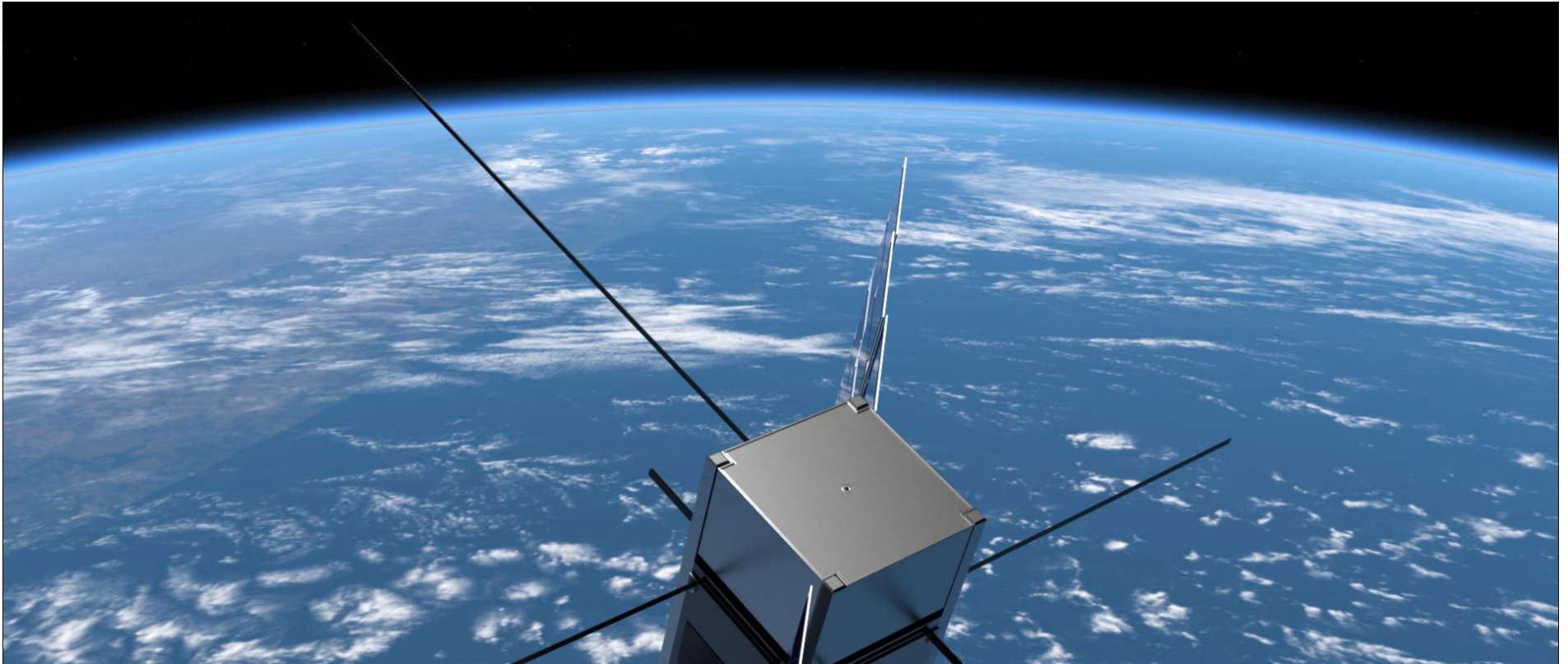


ADEO-N

ADEO-N deployment in less than 3 sec.



Example of Deployment of ADEO-N



ADEO Qualification Campaigns

- Start of dragsail activities under ESA contract (2000)
- Several flights, e.g. Electron Kickstage from RocketLab, ION from D-Orbit (first in 2018)
- Parabolic Flight (2019)
- Qualification largest sail - 25 m² (2023)
- Non-reflective sails and autonomous deployment: Ready by end 2024



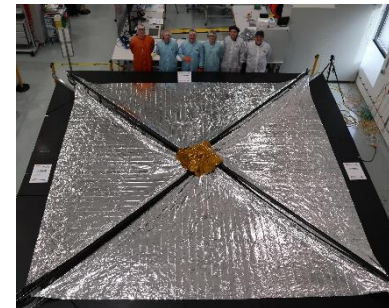
ADEO-N zero-g deployment test



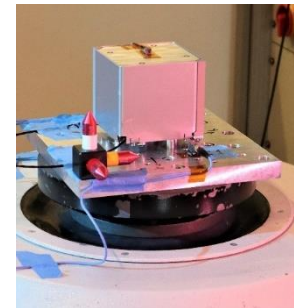
ADEO-N on Electron Kickstage
from RocketLab



ADEO-N deployment in hot TVAC
chamber



ADEO-L after ambient
deployment test



ADEO-N during
vibration test



TIME TO ACT

More than **30,000**
new **on-orbit spacecraft**
endanger mission
sustainability.

ADEO products are suitable for
satellites & launchers (1-700 kg)
de-orbiting from **LEO** (< 800 km)



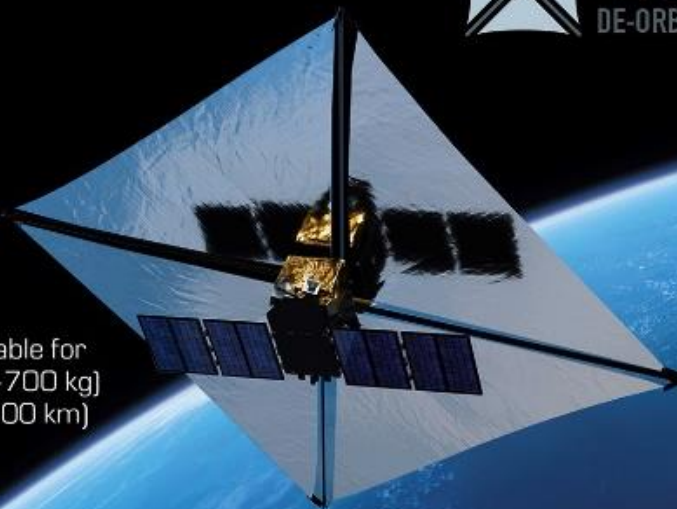
CleanGreenSpace Missions

Deorbit dead satellites and expended
launchers fast and reliably with our
deployable dragsail:



ADEO

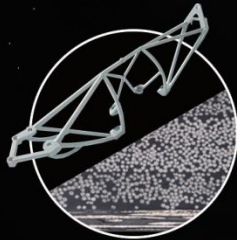
DE-ORBIT SUBSYSTEM



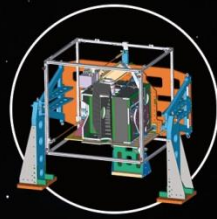
Let's Deorbit your Spacecraft Together!



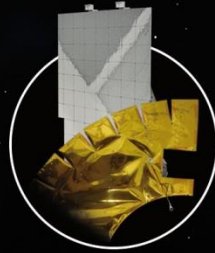
Engineering &
Integration
Services



New Materials &
Processes



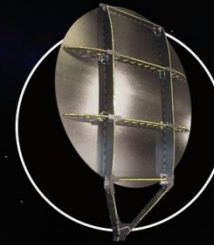
MGSE



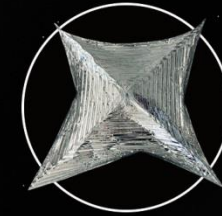
Thermal
Hardware



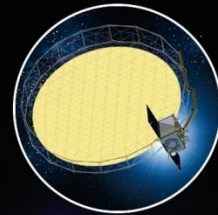
Lightweight
Structures



Reflector
Antennas



Deployable
De-orbit Sails



Large Deploy.
Reflector/
Boom Subsystems