Space Environment Capacity

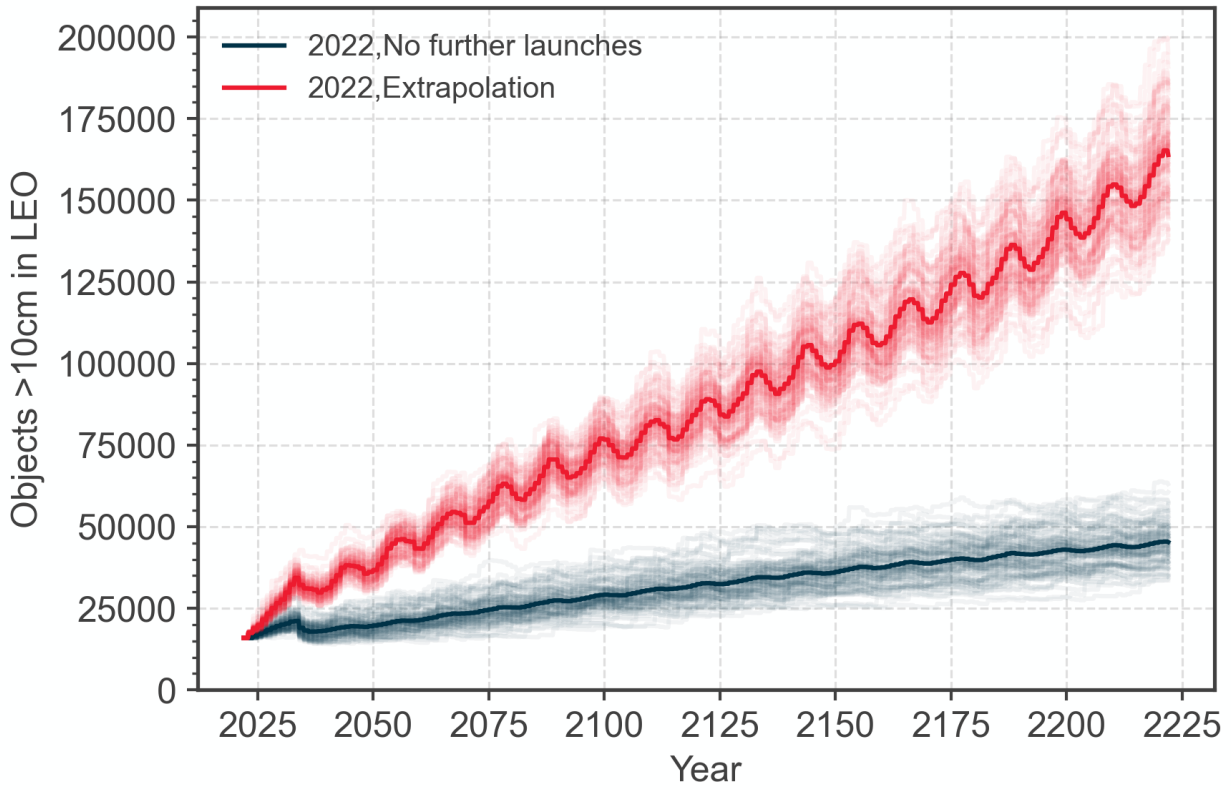
Francesca Letizia, Stijn Lemmens

ESA ESOC

20/04/2022

Sustainability of Space Activities

Implementation of guidelines

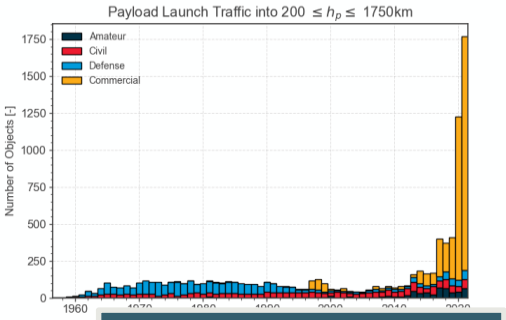


ESA's Space Environment Report, 2022

Limits of current guidelines

Missing links with

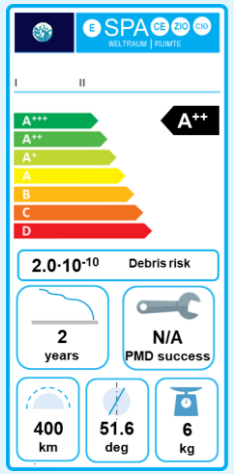
The objective of sustainable spaceflight

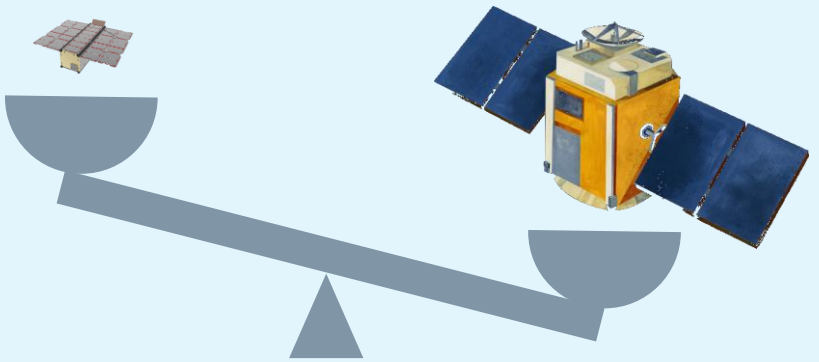


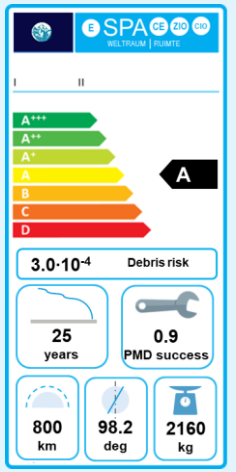
The dynamics of the space environment

The different ways of being compliant

Towards space environmental impact assessments







Missions **compliant** with SDM guidelines can still have significant different **risk levels** in terms of potential **debris generation** and **debris environment impact**

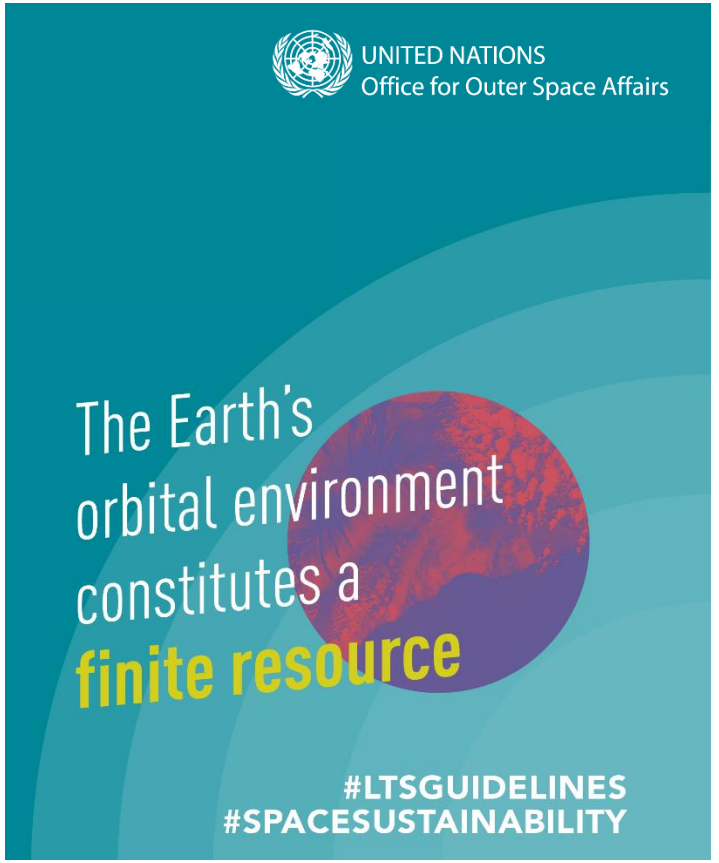
Can one measure for each mission

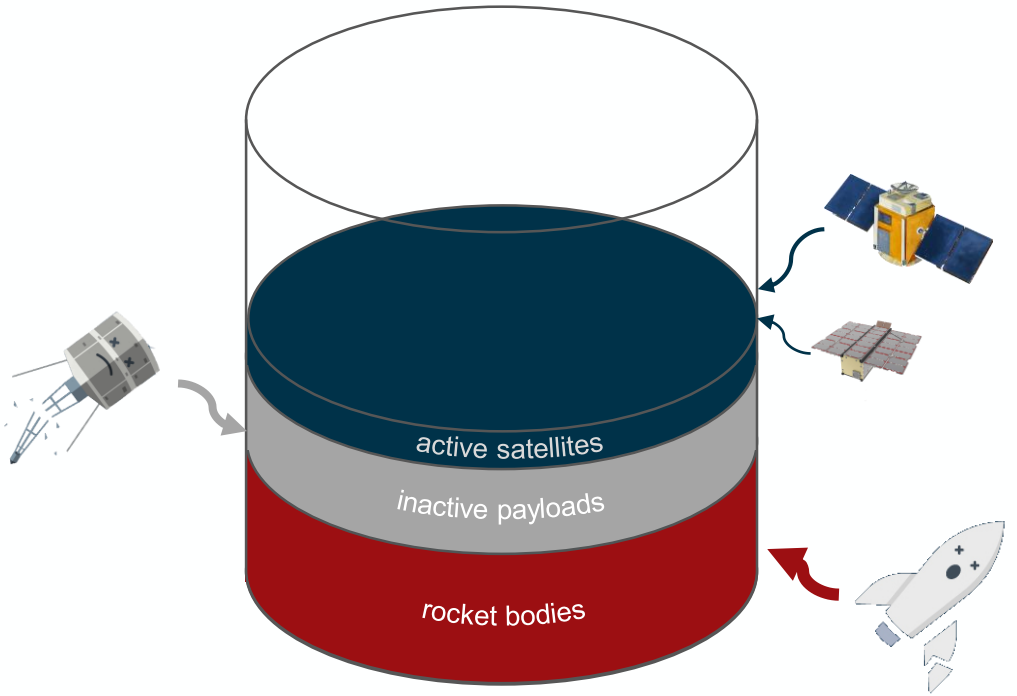
- How detrimental is it to its **orbital neighbours**? (short-term)
- How does it contribute to the **Kessler syndrome**? (long-term)

Use of a **risk metric** at single mission level

F. Letizia et al, ASR 58(7), 2016
F. Letizia & S. Lemmens, 8th ECSD, 2021

Space Environment Capacity - definition





Space Sustainability
Equitable access to safe operations in space, now and in the future

Space Environment Capacity
number & type of missions compatible with the stable and low risk evolution of the environment

H. Krag, S. Lemmens, F. Letizia, 1st ICSSA, 2017

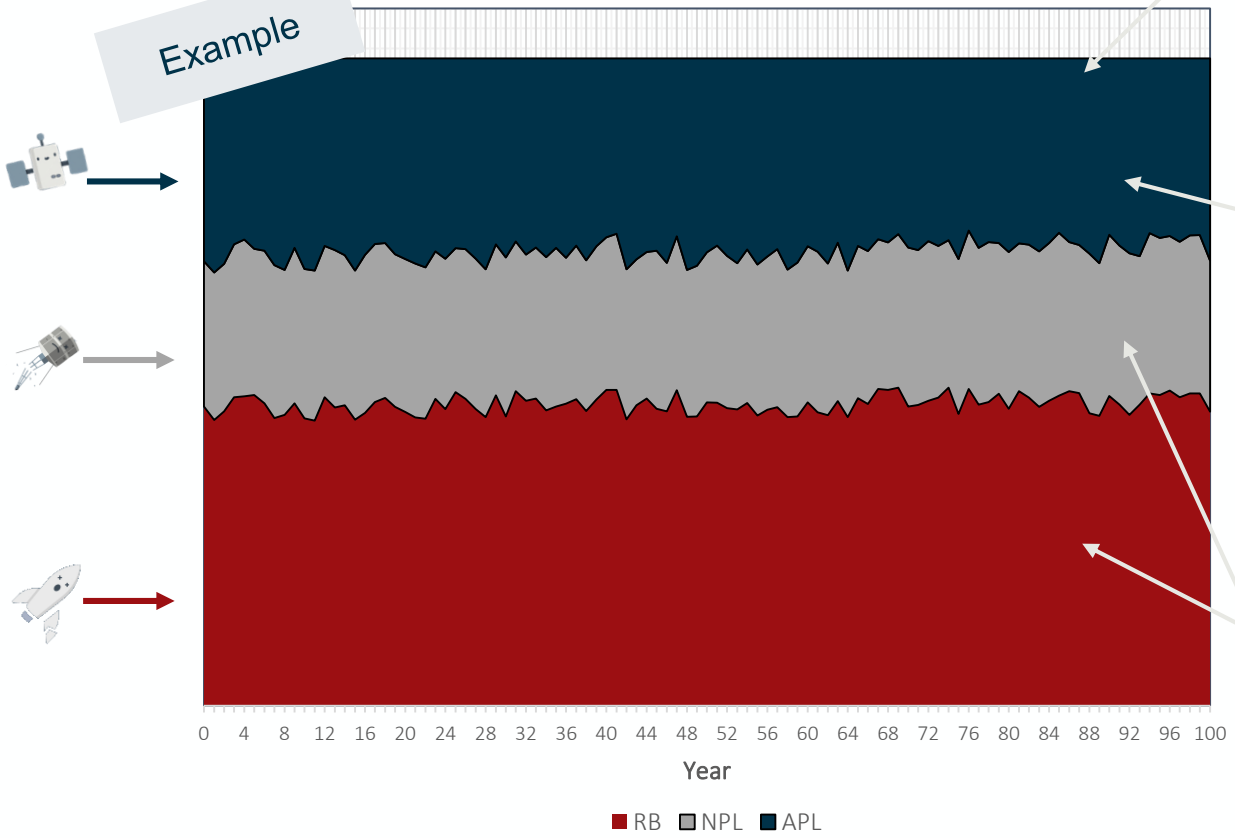
Space Environment Capacity - concept

number & type of missions compatible with the stable and low risk evolution of the environment

Ceiling
(total aggregated risk)

Can be estimated through long-term simulations of the environment (e.g. baseline scenario)

Example



Capacity available for new&active missions

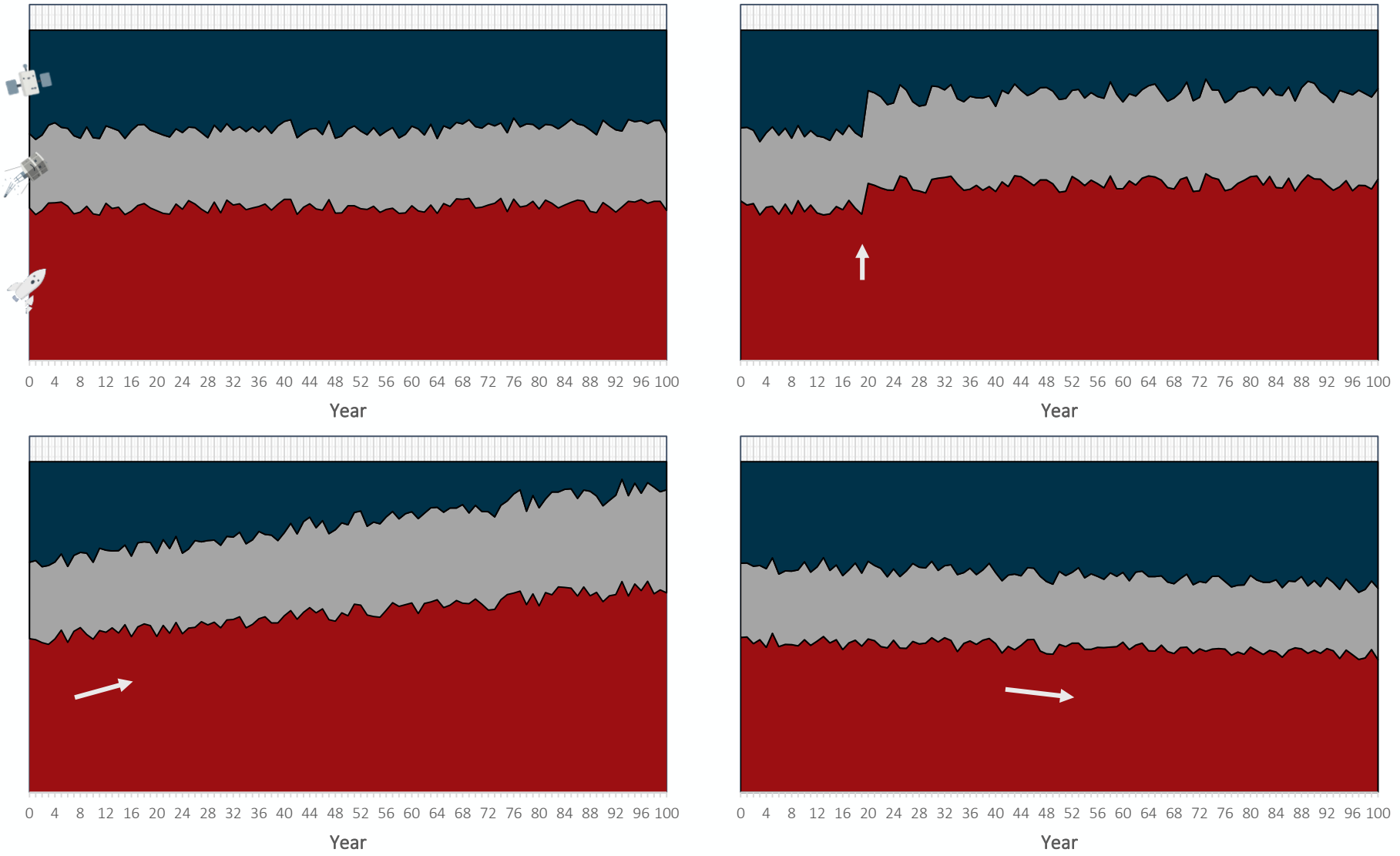
Could use allocation mechanism

Capacity consumed by non-functional objects

Changes dynamically with the evolving environment

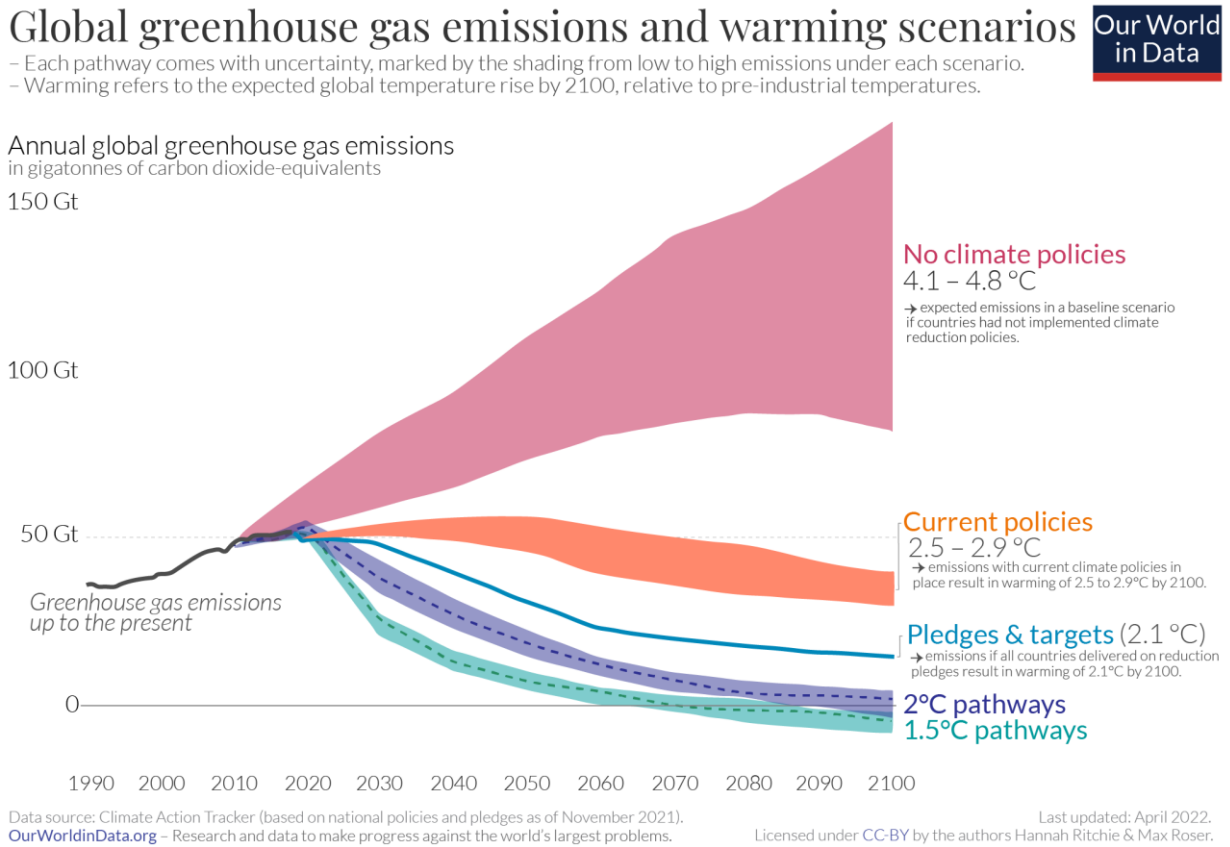
RB: Rocket Bodies | **NPL**: Inactive payloads | **APL**: Active payloads

Space Environment Capacity - scenarios

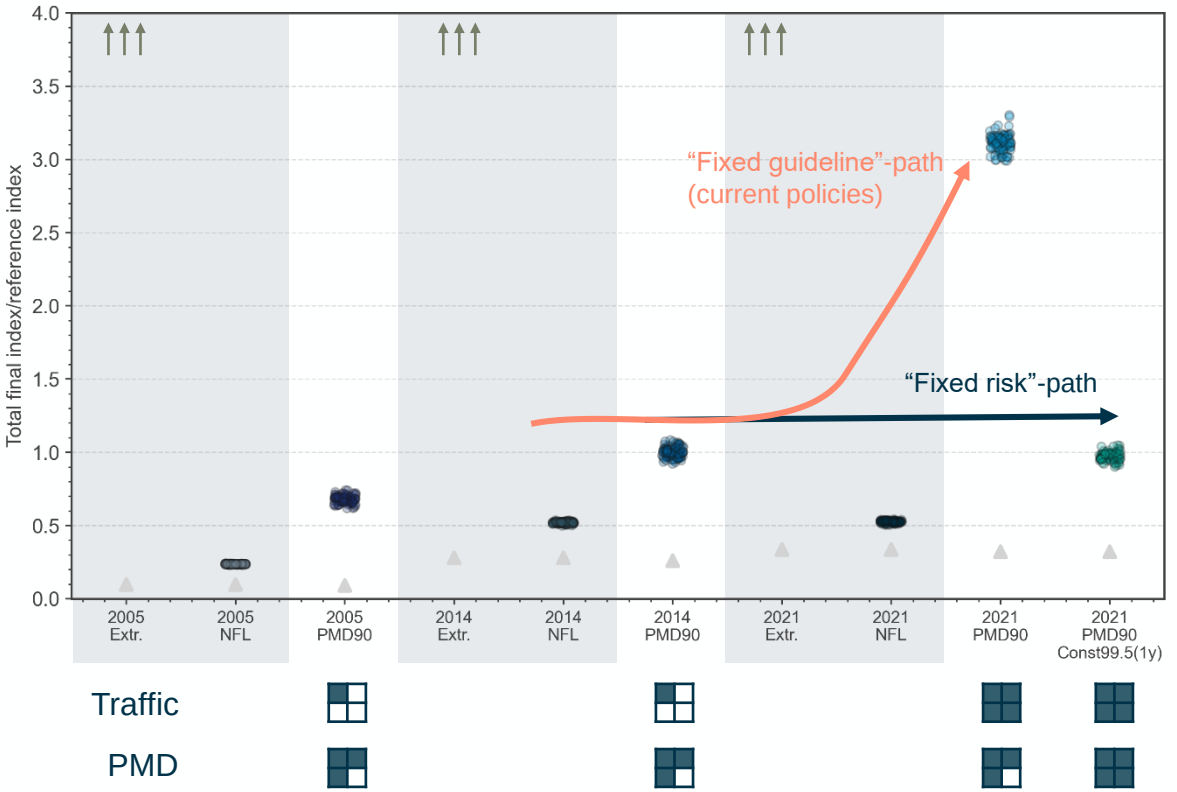


RB: Rocket Bodies | **NPL**: Inactive payloads | **APL**: Active payloads | **PMD**: Post-Mission Disposal | **ADR**: Active Debris Removal

Space Environment Capacity - targets



Risk level with respect to a reference scenario (e.g. 2014 PMD90)



Methodology to track a baseline evolution
e.g. to achieve an *acceptable* change rate

F. Letizia, B. Bastida Virgili, S. Lemmens, 72nd IAC, 2021

Francesca Letizia | Stijn Lemmens
ESA/ESOC Space Debris Office (OPS-SD)
Robert-Bosch-Str. 5, 64293 Darmstadt, Germany
T +496151902079 | +496151902634
francesca.letizia@esa.int | stijn.lemmens@esa.int
http://www.esa.int/debris