

Goal 11: Space Debris Mitigation



Prevent the accumulation of debris in the Earth-Moon system to ensure safe and sustainable Lunar missions.

Goal 11 aims to remove space debris from Earth orbits, and prevent the occurrence of similar pollution on lunar orbits to ensure safe and sustainable missions. This goal focuses on the development of new technologies for debris removal, but also on preventing debris accumulation by encouraging international cooperation. Space debris is a global issue and therefore should be addressed by all nations involved in spaceflight in order to develop collective and lasting solutions, with associated targets and drivers listed in Table 4.12.

- Since the first satellite launched into Earth orbit in 1957, the number of human made objects launched into space has steadily increased (Dodge, 2013).
- According to ESA's Space Debris Office, as of January 2019, the total estimated mass of all space objects in Earth orbit is more than 8,400 tons, which include more than 34,000 objects larger than 10 cm, 900,000 objects from 1 cm to 10 cm, and 128 million objects from 1 mm to 1 cm (ESA Space Debris Office, 2019). Without regulation, a similar situation is likely to develop around the Moon, as illustrated in Figure 4.13.
- In terms of energy, debris collisions are similar to atomic explosions, resulting in additional tens of thousands of debris objects (Pelton, 2013). The main risk of debris resides in the possibility of a chain-reaction effect, called the Kessler effect (Kessler, et al., 2010). The potential consequences of space utilization without non-mitigation measures are illustrated in Figure 4.14.
- Unlike Earth, the Moon's atmosphere is negligible. Therefore, satellites cannot be disposed of through atmospheric incineration, and would impact the lunar surface causing potential danger to astronauts and facilities (Mann, 2013).

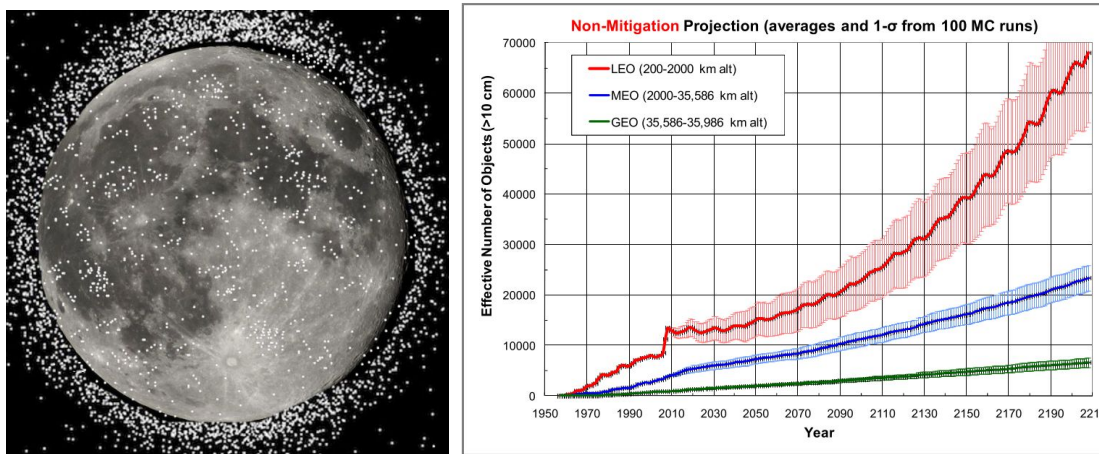


Figure 4.13. Visualization of orbital debris around the Moon (Mann, 2013) | Figure 4.14. Projection of the cumulative collision probabilities (Liou, 2010).

Table 4.12. Targets and drivers for Goal 11: Space Debris Mitigation

Targets		Drivers
11.1	Prevent the creation of new space debris.	11.11 Encourage the development of technology focused on space debris management and mitigation.
		11.12 Encourage the recycling of debris.
		11.13 Commit to actively avoiding collisions between lunar mission instruments.
		11.14 Develop solutions for active debris removal in Moon orbit.
		11.15 Encourage international coordination on space debris mitigation.
		11.16 Promote the development of servicing technology to extend the lifetime of satellites in orbit.
		11.17 Passivate all spacecraft by their end of life in order to prevent any accidental collisions.
11.2	Commit to active removal of existing debris.	11.21 Develop solutions for active debris removal in Earth orbit.
		11.22 Encourage international coordination on space debris mitigation.