

SPACE SYSTEMS SYMPOSIUM (D1)  
Enabling Technologies for Space Systems (2)

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CLEAN SPACE INITIATIVE: GUARANTEEING THE FUTURE OF SPACE ACTIVITIES BY  
PROTECTING THE ENVIRONMENT

**Abstract**

The sustainable use of space is a necessity and duty for Europe since a safe and secure space environment is a requirement for all current and future space activities. ESA, with its Clean Space initiative, will devote increasing attention to the environmental impact of its activities, both on ground and in space, including its own operations as well as operations performed by European industry in the frame of ESA programmes.

The Clean Space initiative organizes the implementation around four distinct branches, through the implementation of technologic roadmaps with clear goals:

**Eco-design** A broad understanding of the environmental footprint of space activities is paramount to be able to mitigate the risks of supply chain disruption from the early stages of the design. Industries must be provided with a harmonised framework of tools to consider environmental issues during the design phase. The most widely used tool is Life Cycle Assessment (LCA, ISO 14042) which has to be tailored for application to space missions.

**Green Technologies** ESA is considering Green Technologies as contributors to: • Using resources in a more sustainable way and reducing the energy consumption during the life-cycle of a space mission • Limiting and controlling the use of substances harmful to human health and bio-diversity • Managing the residual waste and polluting substances resulting from space activities Several green technologies to be developed for space applications will be studied such as additive manufacturing, green propulsion as well as new material/coating concepts.

**Debris Mitigation** The implementation of debris mitigation regulations requires a portfolio of technologies to be available in order to limit the impact on the mission. Clean Space aims at maturing these technologies up to TRL-6 so that future European missions could implement them readily.

In particular, concerning Debris Mitigation, Clean Space will address: • Passive de-orbit systems for uncontrolled re-entry of small LEO satellites • Active de-orbit systems • Design for Demise • Power and Propulsive Passivation • Propellant gauging devices • Debris risk modelling and measurements

**Debris Remediation** Clean Space aims to start the development and demonstration of technology developments streamlined with a system oriented in view of a mission to remove an heavy object beginning 2020.