

# EcoDesign 2018 - overview

CSID 2018

Speaker: Sara Morales

# ecodesign

→ REDUCING IMPACTS



# Technology development

Environmental impact of Launchers	€185,100	Finalised
Environmental Impact Assessment Analysis (3 contracts)	€600,000	Finalised
Space propellant Life Cycle Assessment (LCA)	€240,000	Finalised
LCA of manufacturing processes and space materials	€200,000	Finalised
REACH into LCA - integration of REACH results and rare materials into LCA	€150,000	On-going
Life Cycle Assessment Indicator for Space Debris	€75,000	On-going
LCA Training	€0	Finalised
Space system Life Cycle Assessment	€0	Finalised
Simplex Launcher	€5,500	Finalised
Ariane 6 Scaled	On-going	Finalised
LCA Game	€20,000	Finalised
Green	€400,000	On-going
Environment	€30,000	Finalised
Functional eco	€200,000	On-going
Phase 1 (2 parallel contracts)	€50,000	On-going
Experimental model	€500,000	On-going
Atmospheric impact of	€500,000	On-going
Atmospheric impact of Launchers	€720,000	On-going
Modelling of hot plume with passive	€200,000	On-going
Development of green polyurethanes	€295,000	On-going
Demisable Bio-composite materials	€340,000	Finalised
Sustainable Material concepts	€100,000	Finalised
Citric Acid as a Green Replacement for Stoffs	On-going	Finalised
High Power LED Based Switches (with LCA inside)	On-going	Finalised
REACH precursor activities and European obsolescence	On-going	Finalised
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Fingerprinting of materials and processes	€250,000	On-going
REACH treatment of the pyrotechnics initiators powder pre-development	€275,000	On-going
Chromates replacement testing	€200,000	On-going
IN-HRP thruster throughput extension material investigation	€300,000	On-going
LMP-1035 monopropellant qualification	€1,400,000	On-going
ECAPS IN thruster qualification	€1,900,000	On-going
<b>MAN based monopropellant assessment - CANCELLED</b>	€350,000	Finalised
Environmentally friendly hydrogen production	€150,000	Finalised
LMP-1035 system/component qualification needs evaluation	€200,000	On-going
Compatibility of Welded Propellant Systems with Green Propellants	€200,000	On-going
Surface Engineering for parts made by Additive Manufacturing - Step 1 (3)	€1,800,000	On-going
Verification methodology for parts made by Additive Manufacturing	€500,000	On-going
System impact of Additive Manufacturing Technologies Design Features 2	€500,000	Finalised
Development and test of Additive Manufactured space hardware (2 parallel)	€2,600,000	On-going
Development of a qualification approach for AM systems	€40,000	On-going
Friction Stir Welded Low Cost Titanium Propellant Tank	€1,500,000	Finalised

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e-Deorbit CDF study (internal)	-	Finalised
Service Oriented Approach (SOA) (2 parallel contracts)	€900,000	Finalised
System design Phase 1 (2 parallel contracts)	€2,250,000	Finalised
Vega upper stage standardisation	€150,000	Finalised
AVUM for ADR CDF study	-	Finalised
Phase B1 CDF study (2 parallel contracts)	€1,700,000	Finalised
e-Deorbit CDF study (internal)	€600,000	On-going
Phase D study for e-Deorbit CDF study	€250,000	On-going
CUBESAT technology for Active Debris Removal	€500,000	Finalised
Multispectral Sensing for Active Debris Removal	€700,000	On-going
Image Recognition and Processing for Navigation	€720,000	Finalised
Advanced GNC algorithms for ADR - Phase 1	€200,000	Finalised
On-Ground Validation of a Rigid Combo System (ODR)	€800,000	Finalised
Rendezvous, capture, detumbling and de-orbiting of a cooperative target	€280,000	Finalised
BOdies Under Connected Elastic Dynamics (BOUNE)	€120,000	Finalised
ISS Free Flying Experiment	€50,000	Finalised
Elastic tether design and dynamic testing	€300,000	On-going
Net parametric characterization and parabolic test (2 contracts)	€600,000	On-going
Harpoon characterisation, breadboarding and testing for ADR	€700,000	On-going
Assessment of a clamping based capture mechanism	€150,000	Finalised
Pre-development of clamping mechanism	€350,000	On-going
Active Debris Removal demonstration in laboratory condition experiment	€200,000	Finalised
Control and Management of Robotic for Active Debris Removal (COMRADE)	€1,000,000	On-going
Pre-development of LAR Gripper	€300,000	On-going
High Performance Avionics Solutions for Advanced and Complex GNC Systems	€1,000,000	Finalised
Debris Attitude Motion Measurements and Modelling	€250,000	Finalised
Investigation of de-tumbling solutions	€100,000	Finalised
Feasibility study of active debris mitigation for megaconstellations	€50,000	On-going
Space Servicing Vehicle Pre-Phase A CDF Study	-	On-going

**active debris removal**

Specifications for future LEO platforms compliant with SMI (3 parallel)	€450,000	Finalised
Assessment of global competitiveness impact for European LEO platforms of	€100,000	Finalised
Deployable Membrane	€400,000	Finalised
Architectural design and testing of the sub-system boom-sails	€600,000	Finalised
Environmental Aspects of Passive Deorbit Devices	€200,000	On-going
GNC for drag augmentation	€300,000	Finalised
Impact of controlled re-entry on spacecraft design	€250,000	On-going
SPACES CDF study	€400,000	Finalised
Testing and performance of the re-entry stage	€400,000	On-going
Thrust Vector Control	€350,000	On-going
Rapid Assessment	€500,000	Finalised
Simplified models	€250,000	Finalised
Development of an innovative re-entry stage	€300,000	Finalised
Uncertainty quantification in re-entry stage design techniques	€250,000	Finalised
Deorbitation, "design to demise" (2) of guidelines	€300,000	Finalised
Re-entry analysis for European launchers Upper Stages	€15,000	On-going
System approach to Design for Demise - MICRA (CDF of internal)	-	Finalised
Multi-disciplinary assessment Design for Demise - MICRA (CDF of internal)	€1,490,000	Finalised
Multi-disciplinary Design and Breadboarding (2) technologies - Early Break-up	€600,000	On-going
Design for Demise for LEO Optical Payloads (2 parallel)	€500,000	Finalised
Design and test of demisable space equipment, mission technologies	€500,000	On-going
Design and development drivers for demisable propellant tanks	€100,000	On-going
Compatibility of demisable materials with propellants	€230,000	Finalised
Enhancement of Flamatron operating capabilities	€700,000	Finalised
Characterisation of demisable materials (2 parallel con)	€660,000	On-going
ATV re-entry break-up infrared camera	€350,000	Finalised
Experimental demonstration of black-out attenuation	€350,000	Finalised
Characterisation of radio transmission black-out	€320,000	Finalised
System impacts of propulsion Passivation (2 contracts)	€600,000	Finalised
Helium batch/benching valve for end of life passivation	€1,200,000	On-going
Pyrotechnic valve lifetime extension qualification	€1,200,000	Finalised
Environmental impact on power systems after end-of-life	€1,200,000	Finalised
Spacecraft power system passivation system after end mission	€440,000	On-going
Battery Passivation	€350,000	On-going
Disposal strategies analysis for MED orbits (2 contracts)	€300,000	Finalised
Eol disposal for Lagrange-points and MED missions (2 contracts)	€480,000	Finalised
Envisat detailed analysis (co-funding EOP)	€700,000	Finalised
Reliability Model Enabling Satellite Life Extension and Safe Disposal	€50,000	On-going
Upper stages debris mitigation (internal)	€500,000	On-going
EC and CAM operations for disposal of mega-constellation satellites	€3,000,000	On-going
Optical in-situ monitor	€3,000,000	On-going
Space debris from spacecraft degradation products	€3,000,000	On-going
Impact Risk in LEO as a result of the Increase of Nano and Micro-Satellites	€250,000	On-going
Technology for improvement of re-entry predictions of European Upper Stages	€250,000	On-going
Fragmentation consequence analysis for LEO and MED (2 contracts)	€500,000	Finalised
Simplified models for spacecraft vulnerability (2 contracts)	€500,000	Finalised
Numerical Simulations for Spacecraft Vulnerability and Catastrophic Disruption	€500,000	On-going
Enhancement of S/C fragmentation and environmental evolution models	€300,000	On-going
Design for Removal: How to design S/C to support ADR (2 parallel contracts)	€500,000	Finalised

**spacecraft debris mitigation**



# EcoDesign



## EcoDesign is necessary to:

Understand how much space activities pollute and to identify alternatives to reduce the environmental impacts

### → LCA:

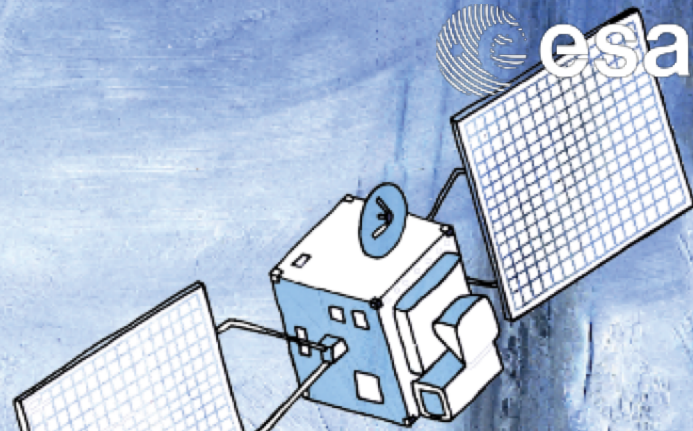
Assessing the environmental impact of the space missions during the whole life cycle

### → Eco-design:

Identifying alternative processes or technologies that can be used to reduce these impacts

### → Environmental Regulation:

Find alternatives to avoid costly disruptions





United Nations



## General Assembly

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**Committee on the Peaceful  
Uses of Outer Space**  
Scientific and Technical Subcommittee  
Fifty-fourth session  
Vienna, 30 January-10 February 2017

27.3 States and international intergovernmental organizations should **promote the development of technologies that minimize the environmental impact of manufacturing and launching space assets** and that maximize the use of renewable resources and the reusability or repurposing of space assets to enhance the long-term sustainability of those activities.

# EcoDesign – where are we now?

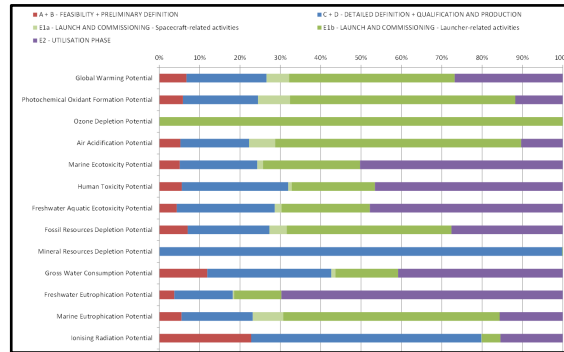
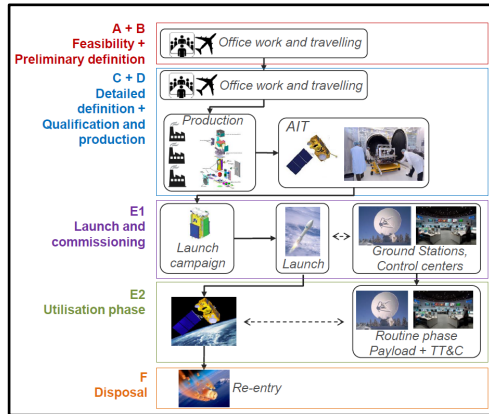
## LCA Launch Segment



## LCA Space Segment



## LCA Ground Segment

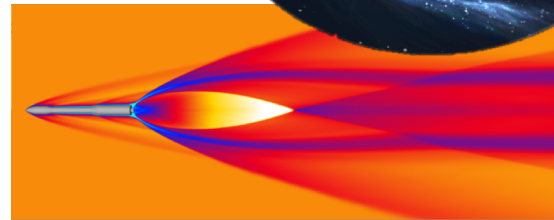
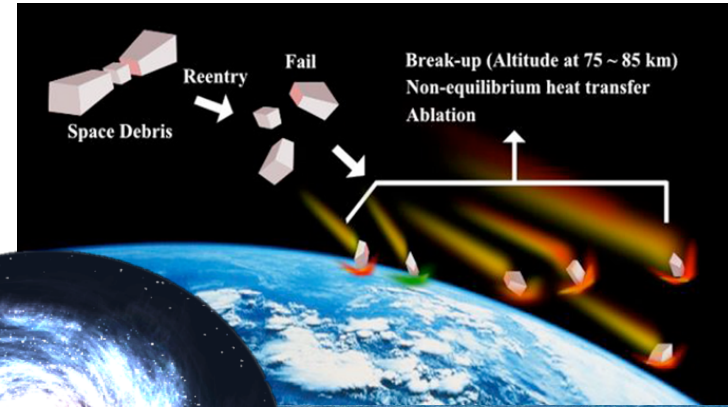


Many specificities of space

# Specificities of Space

## Additional Studies Performed:

- Space Specific Materials, Processes and Propellants LCA
- Space OPERA CDF Tool
- Ozone atmospheric impact
- Space debris indicator for LCA
- Atmospheric impact of demise
- Deep sea impact of falling launcher stages

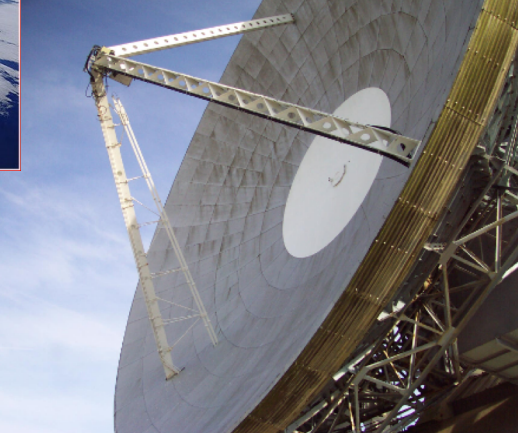
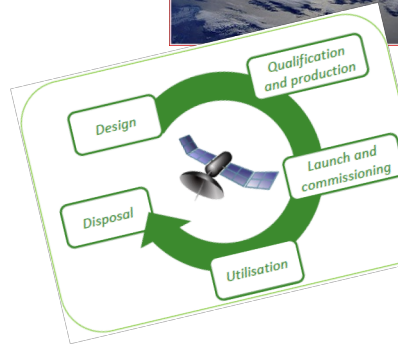




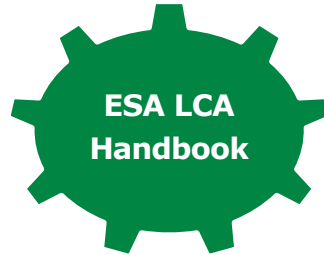
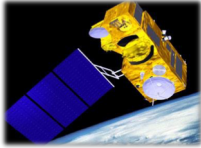
# Specificities of Space

On going LCA activities:

- GreenSat: 2 parallel studies
- Ground Segment LCA
- Ariane 6 LCA – First iteration
- REACH into LCA
- LCA Database Harmonisation



# EcoDesign – building a framework



An internal working group was created to produce an ESA handbook containing guidelines for **2 main types of LCA** in the space sector:

1

## Space Mission

Launcher

Satellite

Ground

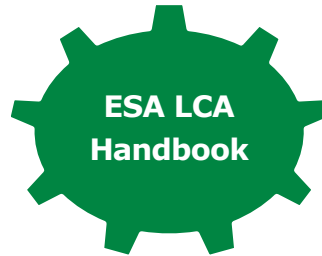
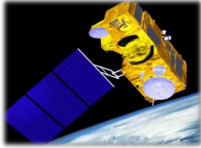
2

## Equipment/Component/Material/Process

Available to  
Industry



# EcoDesign – building a framework



# The space-specific database: a facilitator



## Ecodesign application seeks ready-made building blocks for space

- Materials: alloys, thermoplastics, honeycomb
- Manufacturing processes: conventional and additive manufacturing
- Electronic components
- Power system: photovoltaics, harness, batteries
- Propellants: Hydrazine, LMP,...

In **continuous evolution**: Idea to integrate/harmonise all the datasets coming from ESA studies and Industry inputs.

Available to  
Industry under  
contract

LCA Explorer

- Wizards
- Wizards
- Goal and scope**
- Description
- Libraries
- Inventory**
- Processes
- Product stages
- System descrip
- Waste types
- Parameters
- Impact assess**
- Methods
- Calculation set
- Interpretation**
- Interpretation
- Document Link
- General data**
- Literature refer

- Plant oils
- Plant production
- Plant seeds
- Ceramics
- Chemicals
- Construction
- Electronics
- ESA - Additional adaptations [in mass]**
- ESA - Comparative system assessment
  - 1.Propulsion systems
  - 2.Propulsion sub-systems
  - 3.Tanks
  - 4.Alloys
- ESA - Electrical components
- ESA - Imported processes
- ESA - Materials
- ESA - Metals
- ESA - Propellants
- Fuels
- Glass
- Market
- Metals
- Minerals
- Others

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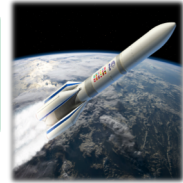
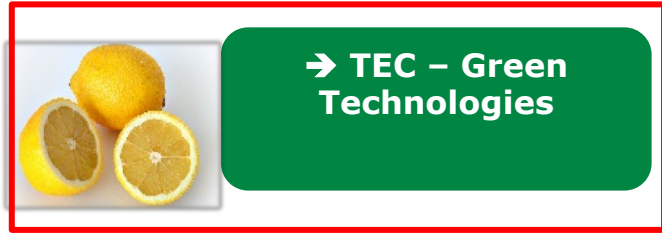
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Available to Industry under contract

ESA UNCLASSIFIED - For Official Use



**Reduce the environmental impact of the space sector by developing green technologies and applying ecodesign during space missions**



**Already underway in various activities and future activities**

*Technologies designed with the aim of decreasing their Earth environmental impact and comply with Environmental regulations*

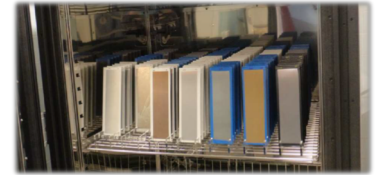
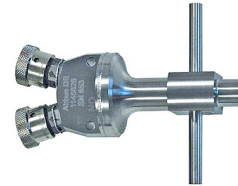
## Environmental Footprint

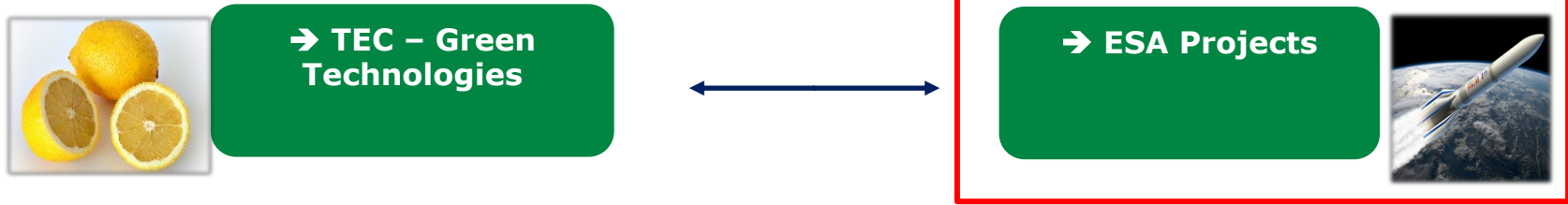
1. Ge waste reduction/ substitution
2. Electronics



## Environmental Regulation

1. Replacement of pyrotechnic powders
2. Chromates replacement testing





**Already underway in  
Ariane 6**

A6-SOW-1-RQ-076	<i>Title:</i> Environmental impact
<i>Description:</i> The environmental impact of the exploitation of the Ariane 6 launcher system (Life Cycle Assessment considering production & assembly, launch campaign, and launch event) shall be analysed and compared to that of A5 ECA on the basis of: <ul style="list-style-type: none"><li>• One launch</li><li>• Yearly equivalent P/L mass delivered in orbit.</li></ul>	
<i>Notes:</i>	
Expected answer	Due Item: [DRL-67]Environmental impact of the exploitation of the Ariane 6 Launcher System

## LCA package in EO satellites:

- **Earth Explorer 9** (FORUM and SKIM)
- Phase A/B1 of the **Copernicus Generic platform** (3 parallel contracts)
- Phase A/B1 Copernicus Extension (Optional)



- Open to all European Industry and Academia
- Planned for the end of the year (Dec 2018)
- 2 day course

## Main Aspects covered:

- Main principles of LCA and life-cycle thinking
- Specificities of LCA applied to the space sector
- How can sustainability be implemented in space missions, and what has been done on the topic of sustainability in the European space sector
- Theory and practical exercises

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# Creating awareness



- 7 Universities already visited
- 2 Universities more this year:
  - University of Stuttgart (December)
  - ISU (July)
- ESA Academy is using it systematically in each Concurrent Engineering Challenge (approx. 10 times per year)

# Let's keep in touch

→ Email us: [cleanspace@esa.int](mailto:cleanspace@esa.int)

→ Keep up to date by reading our blog: <http://blogs.esa.int/cleanspace/>

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# Back-up slides