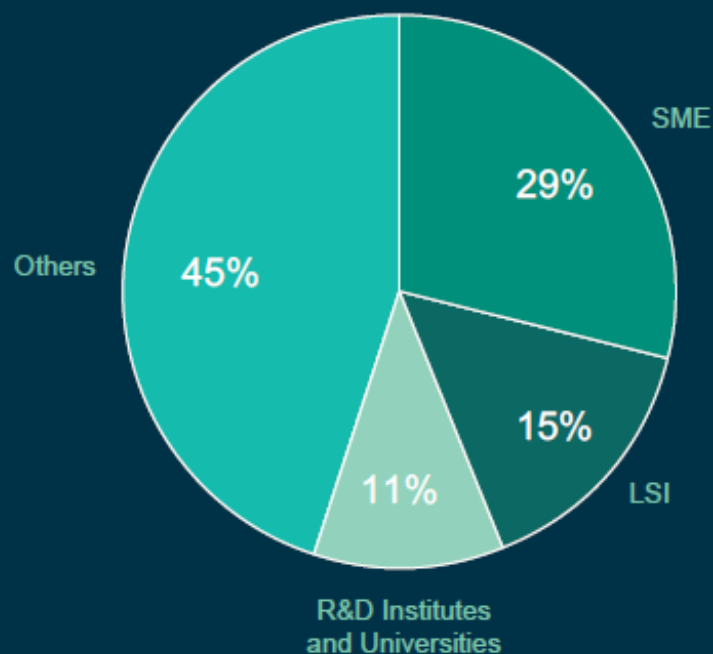


General Support Technology Programme (GSTP)

Matthew Bullock, TEC-TI
Directorate of Technology, Engineering and Quality



GSTP's mission



- For more than 30 years, the GSTP has been developing leading-edge space technologies that enable missions and support the competitiveness of European industry
- GSTP allows companies of all sizes as well as research and academic organisations to perform technology developments and demonstrations
 - Building capacities, fostering innovation and creating and improving products and services
- GSTP is an optional ESA programme with the participation of all ESA Member, Associate and Co-operating States
 - 27 Participating States in total

Completed activities per competence domain

GSTP: 2023 at a glance

Around 600 running activities

110 activities completed

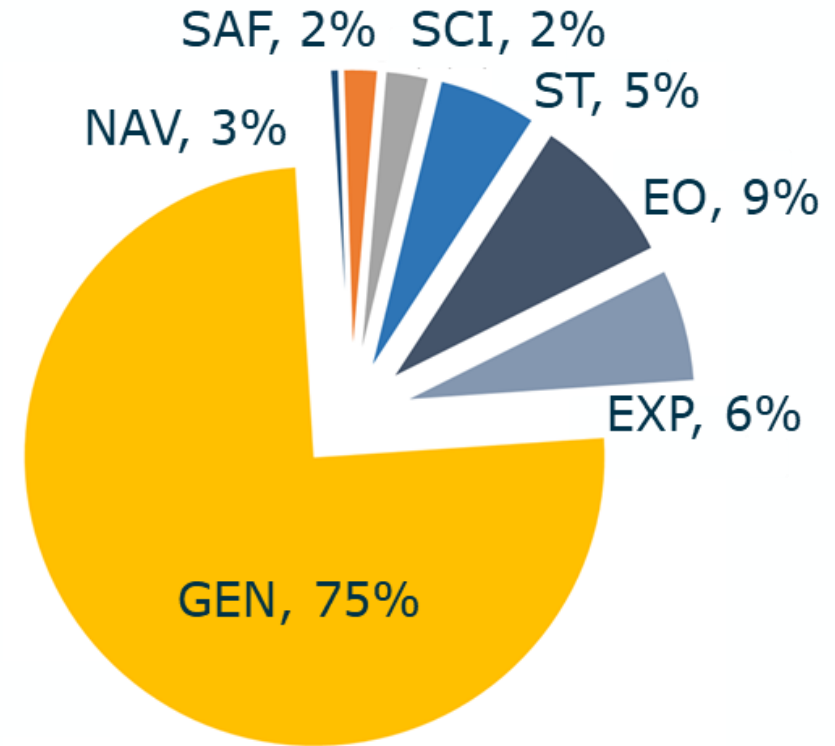
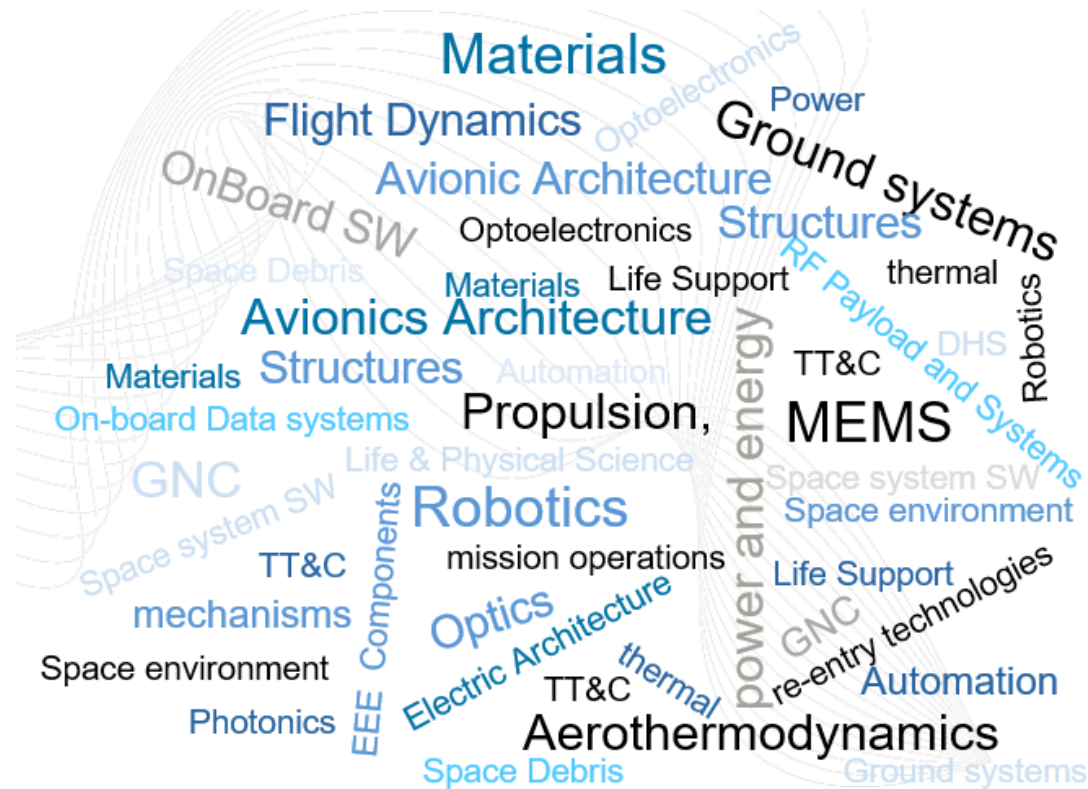
140 technology development and demonstration activities initiated, representing over 110 MEuro in contracts



GSTP Participating States



- 27 ESA Member, Associate and Co-operating States are subscribed to GSTP
- It is possible to propose activities and to bid for activities with partners from these States



GSTP addresses practically all technology areas for generic or specific application needs for the space segment as well as the ground and space transportation segments

GSTP activities



Photo of the ICE-Cube thruster chip

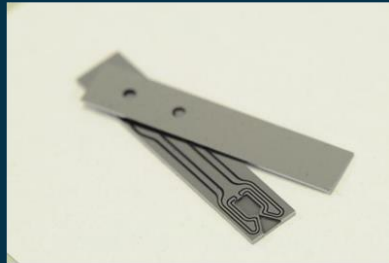


Photo of the thruster chip with cover

Development of the Iridium Catalyses Electrolysis Cubesat Thruster (URA Thrusters)



Compliant Mechanism Based on Additive Manufacturing (CSEM)



Miniature Active Pixel Sensor based Star Tracker Engineering Qualification Model (TERMA)



Additive manufacturing for novel structural components (CATEC) (demonstrated in JUICE)



Reconfigurable telemetry transmitter for Earth observation satellites (TESAT)

GSTP STRUCTURE



ELEMENT 1: DEVELOP



- Supports technology developments up to qualification, capacity building & ESA technology aims.
- Compendia, Work Plan.
- Frameworks.



ELEMENT 2: MAKE



- Industry initiated and driven co-funded activities to strengthen competitiveness.

COMPONENTS

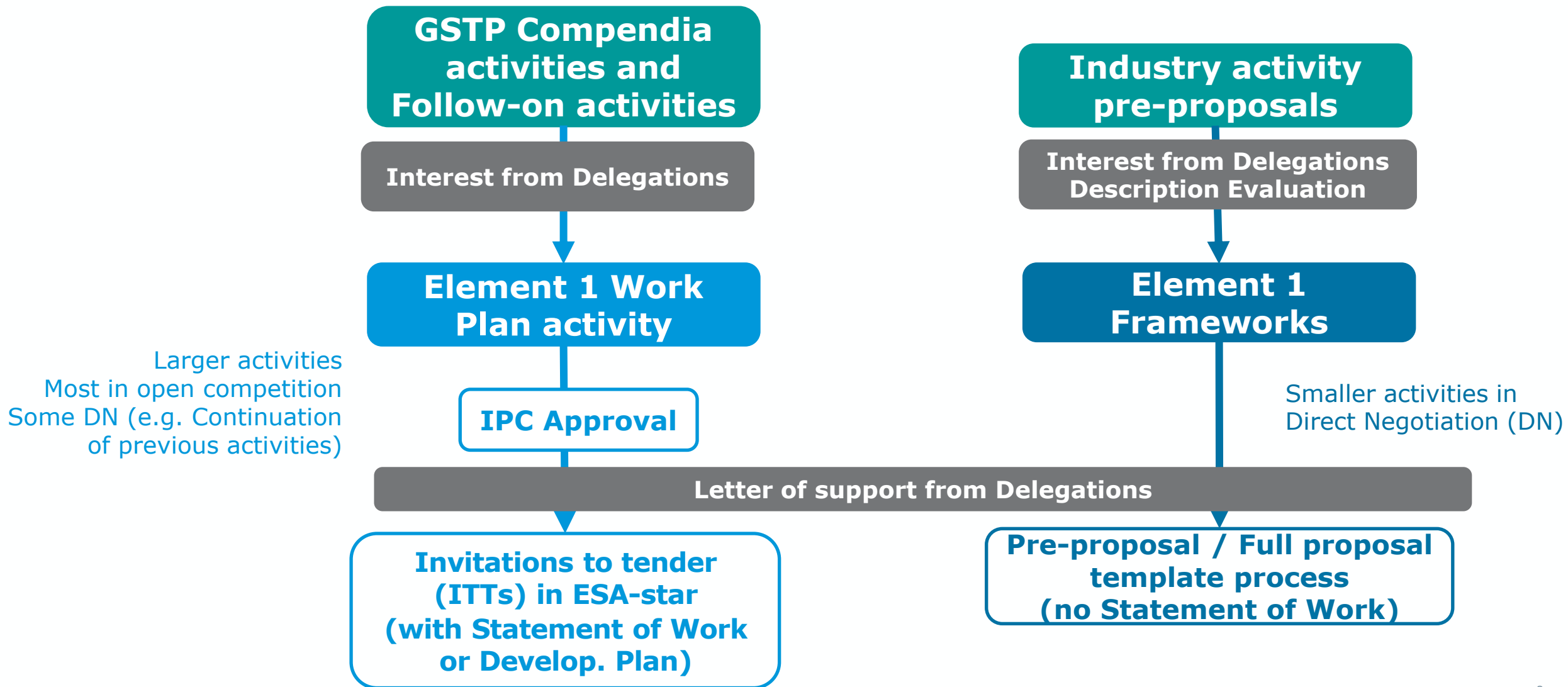
PRECISE FORMATION FLYING COMPONENT
EEE Space Component Sovereignty for Europe
EuropeanN Devices Using Radioisotope Energy
(ENDURE)



ELEMENT 3: FLY



- On-ground and in-orbit demonstrations of technologies in need of acquiring in-orbit validation.





GSTP ELEMENT 1 DEVELOP



Compendia 2022: under execution

ESA Driven:

- Generic Technologies

Industry Driven:

- **Artificial Intelligence** - Edge/AI on Board, GNC, Mission Operations
- **Digitalisation** - Data Management, MBSE, Simulation, Digital Twin
- **Quantum Technologies** – Quantum Sensing, Atom interferometers, Atomic frequency standards, Quantum Computing, Quantum Memories...
- **Cybersecurity**



- Publication in November 2022
- Since Feb 2023, 35+ activities have been included in GSTP WP
- Targeting implementation 2023/25





GSTP Element 1



esa-star Publication

esastar-publication.sso.esa.int/news/details/737

News ESA Tender Actions Non ESA Tender Actions ESA Interacts Supporting Documentation

esa-star Publication News

GSTP Element 1 "Develop" Compendia 2022

Publication Date: 28/10/2022 | Last Update On: 08/11/2022 09:00 CET | Classification: Procurement Related News

Restricted by Entity Codes: NO | Restricted by Countries: YES | Restricted to SME Entities: NO | Restricted to LSI Entities: NO | Visible to National Delegates: YES

The GSTP Element 1 "Develop" Compendia 2022 includes a list of candidate activities for the GSTP E1 "Develop" Work Plan in the following technology themes:

- Generic Technologies ... Read more

Attachments:

- Cover letter GSTP E1 Develop Compendium 2022.pdf
- GSTP Element 1 Develop Compendium 2022 - Generic Technologies.pdf
- GSTP Element 1 Develop Compendium 2022 - Artificial Intelligence.pdf
- GSTP Element 1 Develop Compendium 2022 - Digitalisation.pdf
- GSTP Element 1 Develop Compendium 2022 - Quantum Technologies.pdf
- GSTP Element 1 Develop Compendium 2022 - Cybersecurity.pdf

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More Details... Access

ESA UNCLASSIFIED - Releasable to the Public

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GSTP ELEMENT 1 "DEVELOP" COMPENDIUM 2022: ARTIFICIAL INTELLIGENCE

THE EUROPEAN SPACE AGENCY

<https://esastar-publication.sso.esa.int/news/details/737>

ESA UNCLASSIFIED - Releasable to the Public

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2. LIST OF ACTIVITIES

GEN - Generic Technologies – Artificial Intelligence

CD3 - Avionic Systems

Programme Reference	Activity Title	Budget (k€)
Guidance Navigation and Control (GNC)		
GT11-601SA	Machine learning for attitude and orbit control systems failure detection isolation and recovery applications	650
GT11-602SA	Artificial intelligence techniques for spacecraft attitude control and estimation	750
GT11-603SA	Advanced verification and validation techniques for neural network-based AOCS/GNC systems	600
GT11-604SA	Deep neural network for robust satellite model matching	500
GT11-605SA	Robust real-time constrained optimal control using machine learning	600
GT11-606SA	AI-based GNC/AOCS systems validation and verification evolution	1,000
AI on the Edge		
GT11-607ED	On-board detection of space weather events	500
GT11-608SW	Qualified software machine learning toolkit for space hardware	900
GT11-609ED	Architecture for offline processing and machine learning in mass-memories	800
GT11-610EF	Reference onboard datasets for evaluation of machine learning models	800
GT11-611EF	Closed loop AI cognitive synthetic aperture radar	1,200
GT11-612ED	AI based end-to-end satellite failure management and prognostic	1,400
GT11-613ED	On board processing enablers for AI for operations	500
GT11-614ED	Advanced heterogeneous inference data processing module	2,000
Total CD3		12,200

Page 6/47
GSTP Element 1 Develop Compendium 2022 - Artificial Intelligence
Date of issue: 28/10/2022 Issue: 1 Revision: 0

THE EUROPEAN SPACE AGENCY



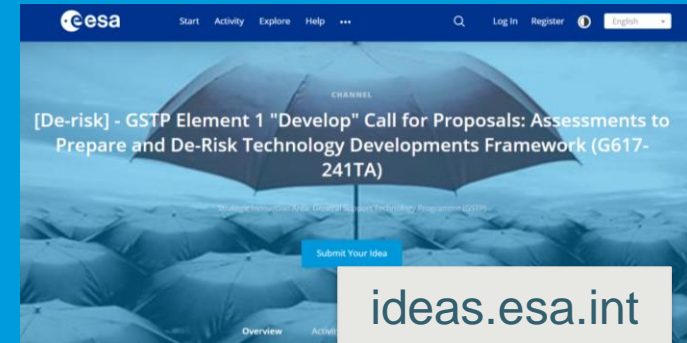


ELEMENT 1 - De-risk framework



G617-241TA, Assessments to prepare and de-risk technology developments

Approved by IPC in November 2016 "...to allow for assessments that will help prepare and de-risk potential development activities".



Procurement using a template

- Max budget: €250 K
- Max duration: 9 months

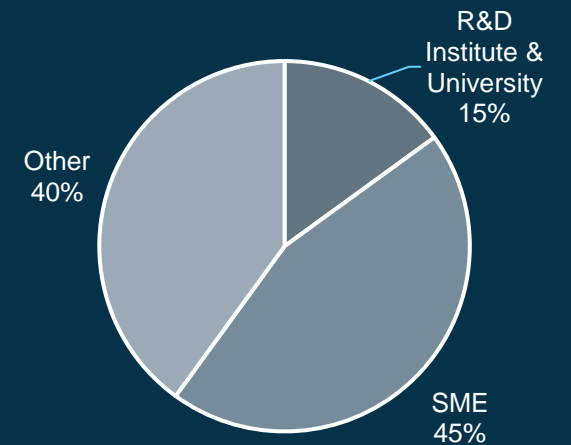
Follow-on using a template

- No budget limit
- No duration limit
- ~ 35% de-risk are continued

~40 de-risk initiated / year

- >200 de-risk so far
- ~ €35 M overall budget

Company Type



Permanent Open Call in ESA-Star





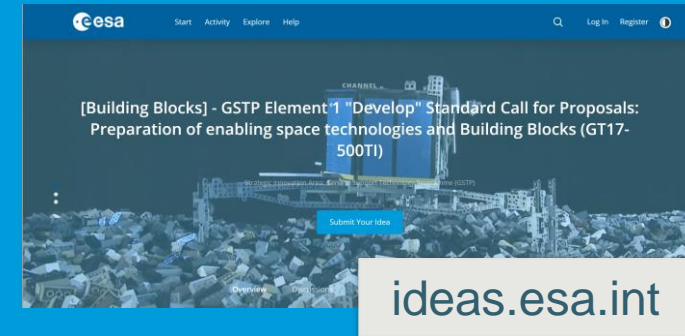
ELEMENT 1 – Building Block framework



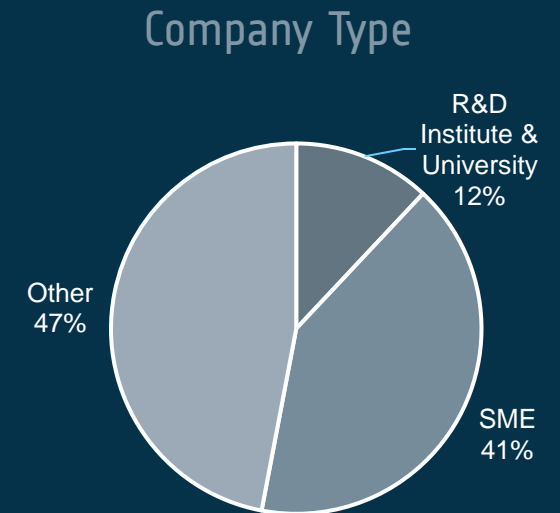
GT17-500TI, Preparation Of Enabling Space Technologies And Building Blocks Framework

Approved IPC April 2018 and updated October 2022 (operative from mid March)

“...to prepare and to develop enabling capabilities and the associated building blocks for space related systems and the associated sub-systems.” Targeted and coordinated development of capabilities across different GSTP Participating States



Procurement using a template <ul style="list-style-type: none"> • Max budget: €1 M • Max duration: 24 months 	~20 activities initiated / year <ul style="list-style-type: none"> • 100 activities so far • ~ €43 M overall budget
---	--



Permanent Open Call in ESA-Star



Framework procurement process



[Building Blocks] - GSTP Element 1 "Develop"



[De-risk] - GSTP Element 1 "Develop"

Initial contact between bidder and National Delegation (no ESA involvement)

ideas.esa.int

Not-Official ESA procurement

Communications allowed with ESA Technical Officer and GSTP

Outline Proposal in OSIP

Outline Proposal evaluation

Activity scope refinement

Official ESA procurement

Communications allowed only through ESA assigned Contract Officer

Proposal submission using ESA-Star

ESA-star

TEB & Negotiation

Commitment

GSTP ELEMENT 2 MAKE

Announcement Of Opportunity

2020: First full year with the current structure

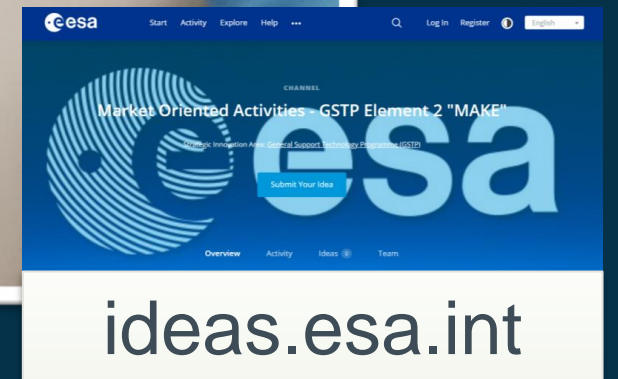
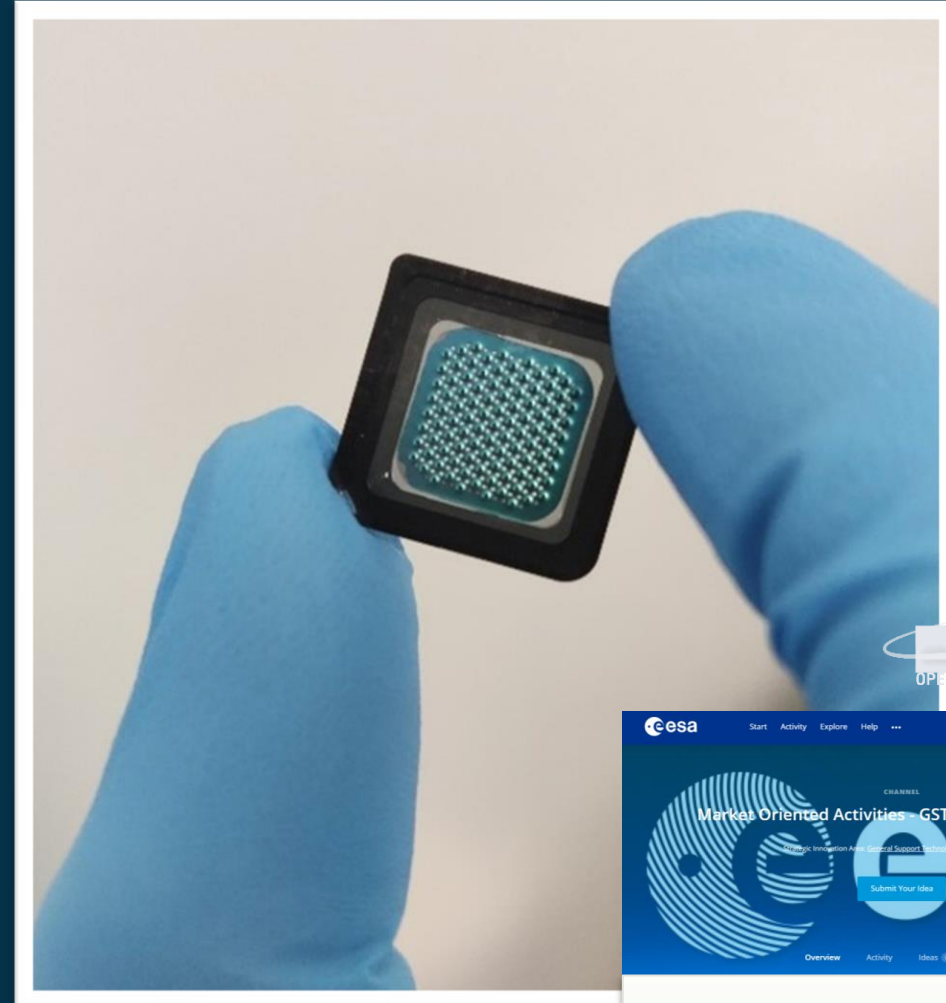
3 segments:

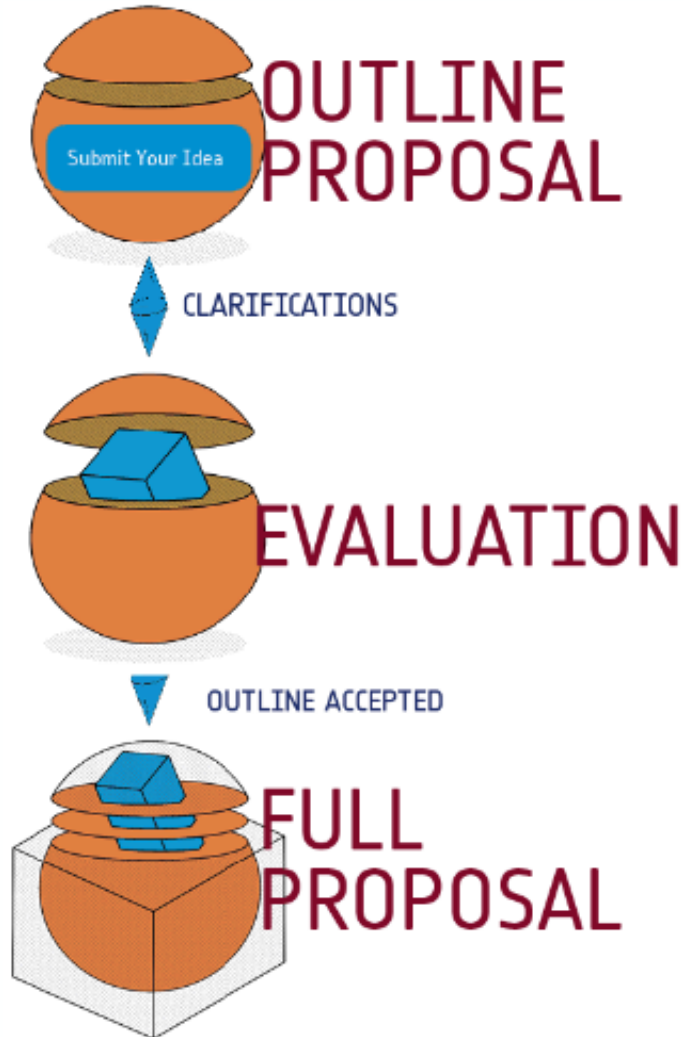
- Market Oriented Opportunities,
- Strategic Opportunities and
- Implementation of National Priorities

Use of OSIP channel (ideas.esa.int) for outline proposal evaluations.

2020 – 2023: significant increase in proposals received

25-30 activities committed per year (€30 M - €35 M)





ideas.esa.int

OUTLINE PROPOSAL EVALUATION CRITERIA

- Clarity and credibility of the business opportunity and market context (for segment 1) or the strategic opportunity and market context (for segment 2)
- Credibility and quality of the technical requirements, technical solutions versus activity objectives
- Credibility and quality of the proposed development plan, deliverables and schedule
- Credibility and quality of the bidder's background, experience and facilities
- Credibility and quality of the cost breakdown



GSTP ELEMENT 3 FLY



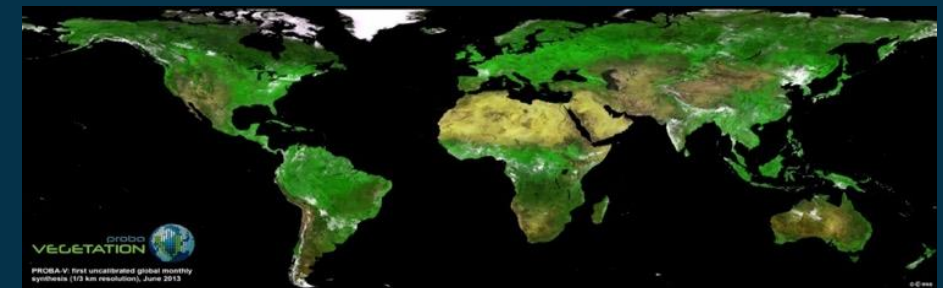
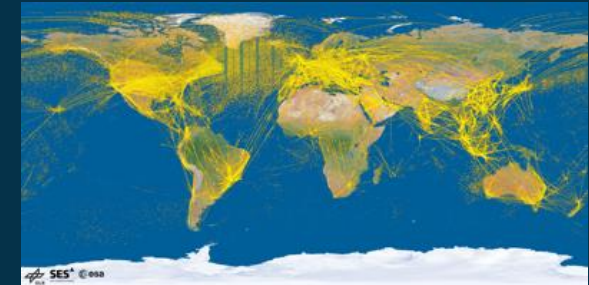
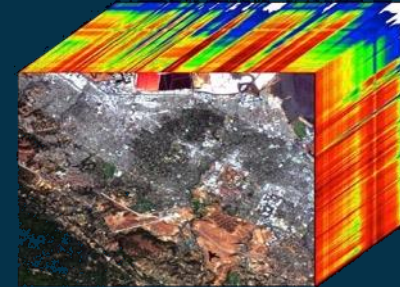
Facilitate Technology Demonstrations

The main objectives related to Element 3 are to:

- Ensure the successful implementation of the Missions and In-Orbit Demonstrations currently in preparation.
- Identify/prepare new mission/IOD opportunities.
- Expand and enhance the demonstration approach.

Opportunities cover:

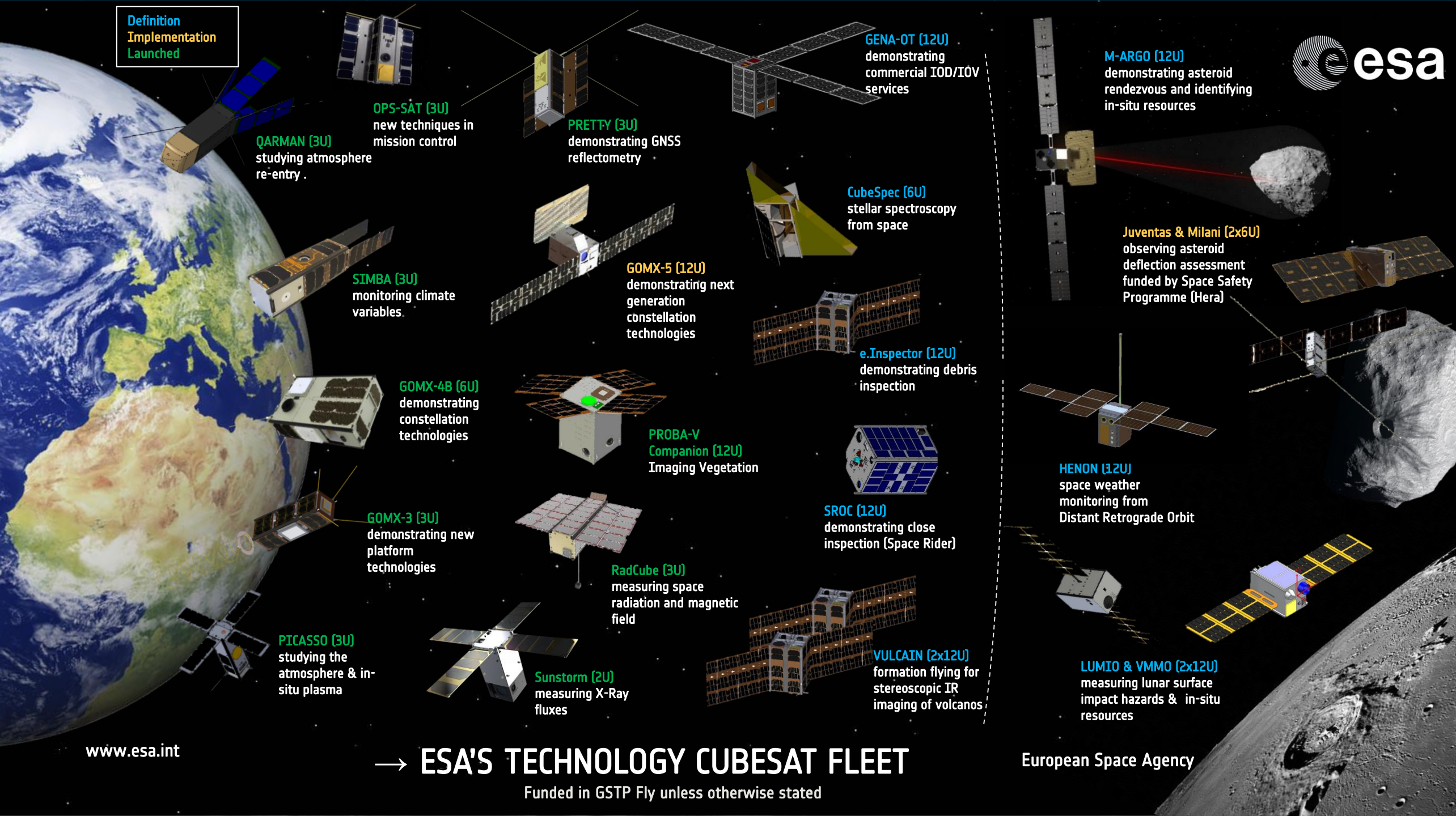
- Demonstration of technology (e.g. platform units, Li-ion batteries).
- Demonstration of techniques (e.g. ADS-B, hyper-spectral, ...).
- First demonstrations of potential capabilities.



Cubesat framework



Definition
Implementation
Launched



QARMAN (3U)
studying atmosphere re-entry

OPS-SAT (3U)
new techniques in mission control

PRETTY (3U)
demonstrating GNSS reflectometry

GENA-OT (12U)
demonstrating commercial IOD/IOV services

M-ARGO (12U)
demonstrating asteroid rendezvous and identifying in-situ resources

SIMBA (3U)
monitoring climate variables

GOMX-5 (12U)
demonstrating next generation constellation technologies

CubeSpec (6U)
stellar spectroscopy from space

Juventas & Milani (2x6U)
observing asteroid deflection assessment funded by Space Safety Programme (Hera)

GOMX-4B (6U)
demonstrating constellation technologies

PROBA-V Companion (12U)
Imaging Vegetation

e.Inspector (12U)
demonstrating debris inspection

HENON (12U)
space weather monitoring from Distant Retrograde Orbit

GOMX-3 (3U)
demonstrating new platform technologies

RadCube (3U)
measuring space radiation and magnetic field

SROC (12U)
demonstrating close inspection (Space Rider)

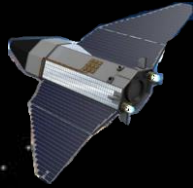
PICASSO (3U)
studying the atmosphere & in-situ plasma

Sunstorm (2U)
measuring X-Ray fluxes

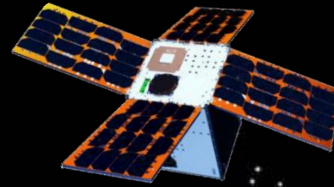
VULCAIN (2x12U)
formation flying for stereoscopic IR imaging of volcanos

LUMIO & VMMO (2x12U)
measuring lunar surface impact hazards & in-situ resources

SMALLSAT MISSIONS



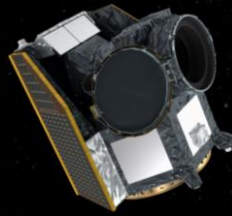
SkimSat (VLEO)
electric propulsion



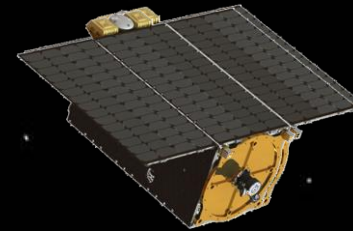
PVCC
Earth
Vegetation



PCDSat
Electric propulsion
Flying Deployer IOD



CHEOPS
CHaracterising
ExOPlanet Satellite



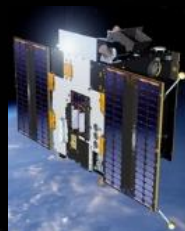
uHETSat
electric propulsion



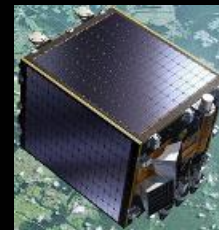
Proba-3 (HEO)
Sun Corona study
& Formation Flying



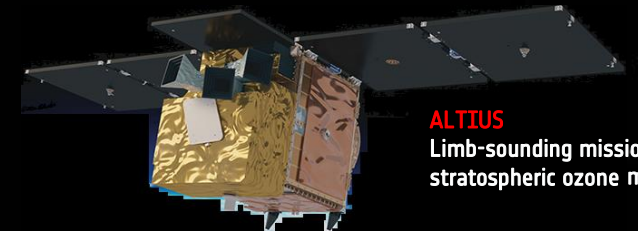
Proba-1
Autonomous operations



Proba-2
Solar observation



Proba-V
Earth
Vegetation



ALTIUS
Limb-sounding mission measuring
stratospheric ozone measuring

Launched
To be launched 2024
To be launched



esa-star procurement portal

a source for:

- Registration of new companies to do business with ESA
- Invitations to tender
- News/Procurement related announcements: GSTP Compendia Publication

www.esastar-publication.sso.esa.int



Open Space Innovation Platform channels/campaigns for submitting ideas, and outline proposals



www.ideas.esa.int



Shaping the future website

- Articles on the latest GSTP funded space technology R&D developments
- GSTP annual reports



www.esa.int/Enabling_Support/Space_Engineering_Technology/Shaping_the_Future



GSTP Conclusions/Summary

For 30 years, GSTP allows companies of all sizes and research and academic organisations to perform technology developments and demonstrations.

- more than 150+ activities are started per year in **27 Participating Countries**

Activities are implemented through:

- **Element 1 Work Plan activities**, building on the GSTP Compendia and large industry driven activities
- **Element 1 Frameworks** (De-risk, Building Block), for smaller industry driven activities
- **Element 2 AO** for market oriented co-funded industry driven activities
- **Element 3** for technology demonstrations (in-orbit...) as well as missions