European Space Technology Harmonisation

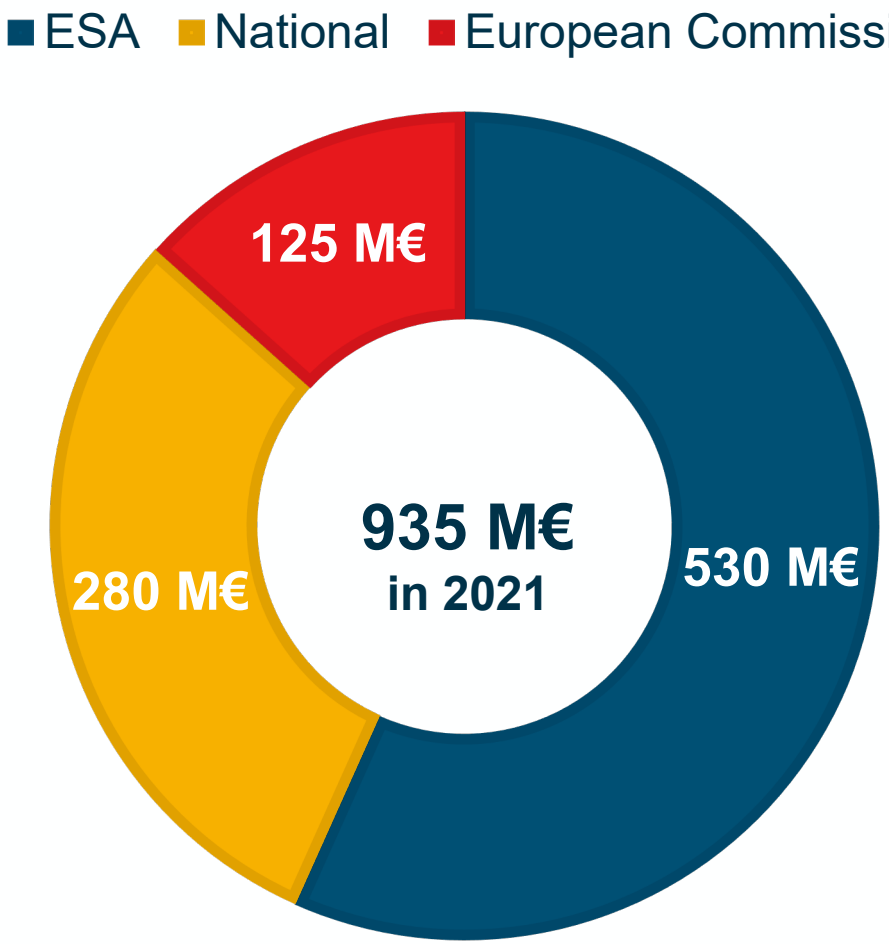
The European-wide collaboration to coordinate future space technology development

Edmund Williams
Head of the Technology Coordination and Planning Office
Directorate of Technology, Engineering and Quality (D/TEC)

01/06/2023

ESA-TECH-HO-2023-001618

EUROPEAN SPACE TECHNOLOGY R&D BUDGET



Ref: ESTMP 2022

European institutional budgets spent in space technology R&D activities in 2021.

These activities cover developments, primarily up to TRL 6.

MANDATE

"To provide for and promote, for exclusively peaceful purposes, ***cooperation*** *among European states in* ***space research and technology*** *and their space applications."*

ESA Convention - Article II Purpose

ESA MINISTERIAL COUNCIL 2001

The ESA Ministerial Council, in Edinburgh, on November 2001, invited the ESA Director General and the Member States, together with the other players(*) in the space sector, to:

- Pursue the programmatic coordination and harmonisation of technology programmes in Europe and prepare the European Space Technology Master Plan (ESTMP)
- Define roadmaps and harmonised implementation schemes for the development of critical technologies, involving industrial funding as appropriate

(*) including European Commission

EUROPEAN SPACE TECHNOLOGY R&D

EUROPEAN

european space technology harmonisation

ESCC European Space Components Coordination

esa EUROPEAN DEFENCE AGENCY European Commission

JTF on Technology Non-Dependence

....

European Mapping, Roadmaps, Strategies

INDIVIDUAL

esa

ESA Technology Strategy, Compendia, Roadmaps,…

ESA Technology Programmes (TDE, GSTP,…)

European Commission

Horizon Europe SRIA

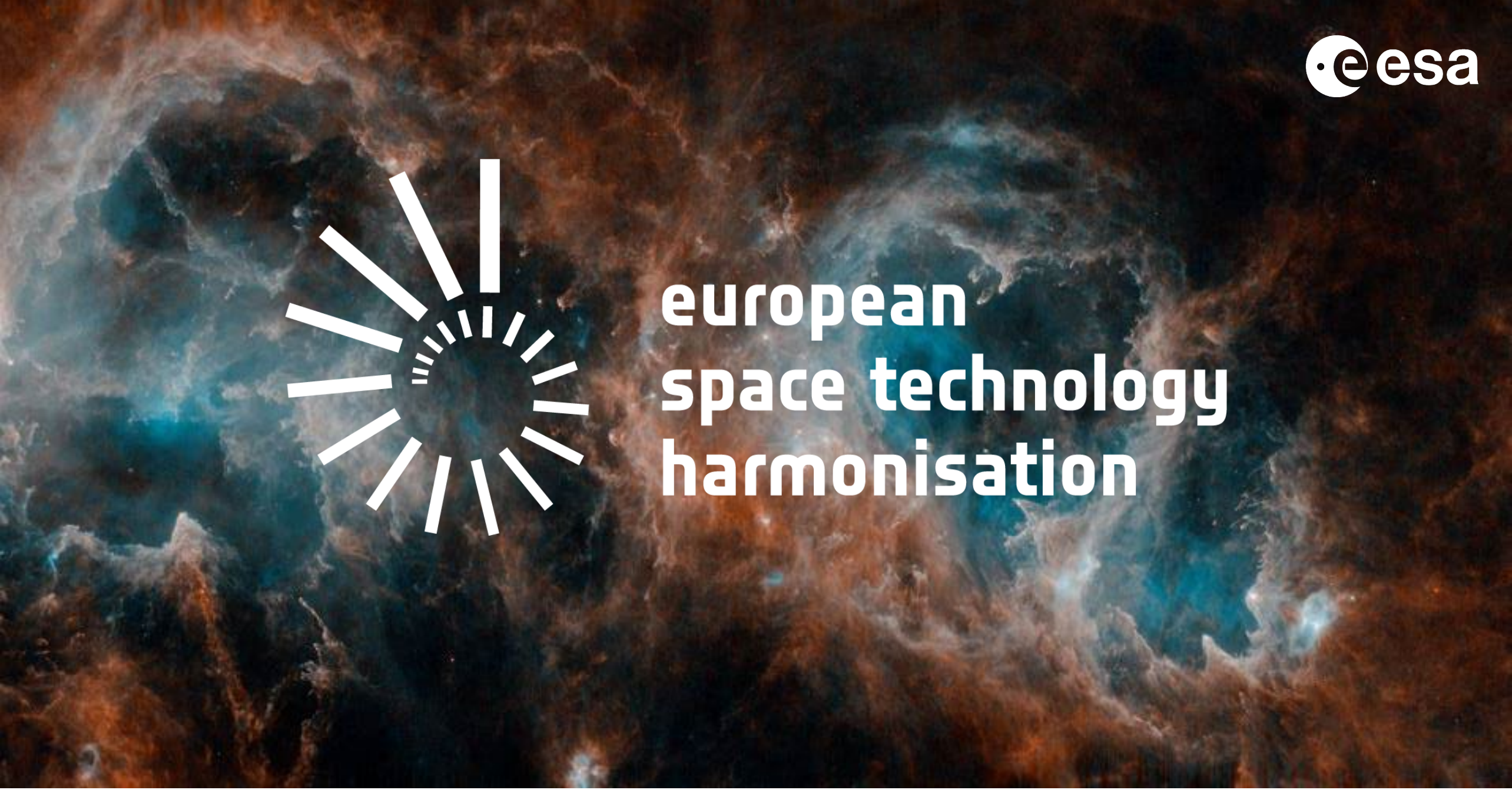
EU Programmes: Horizon Europe,…

National Institutions

National strategies, Roadmapping

National Technology Programmes, …

....


esa
european
space technology
harmonisation
→ THE EUROPEAN SPACE AGENCY

OBJECTIVES

Fill strategic gaps & minimise unnecessary duplications.

Consolidate European strategic capabilities.

Achieve a coordinated & committed European space technology policy & planning.

Contribute to ensuring continuity & coherence between technology & industrial policies.

OVER 20 YEARS OF HARMONISATION

2000/2001 Harmonisation started with pilot case

2001 Ministerial Council

2002 European Space Technology Master Plan (ESTMP) first issued

2006 Creation of the IPC-THAG advisory group

THAG Technology Harmonisation Advisory Group

2009 EC-ESA-EDA Non-dependence process defined based on Harmonisation

2011 Major review of Harmonisation to further refine the process

2013 100th Harmonisation Roadmap agreed and released

2014 European Space Technology Harmonisation Conference – ESTEC

2017 ESTMP jointly published with the European Commission

2020 Introduction of systematic Market Assessment studies

2021 Revised Harmonisation consultation process

47 TECHNOLOGY TOPICS

Micro And Nano Tech. - MEMS Pressure Sensors, MOEMS and RF-MEMS
Optical Detectors
Photonics
Actuators Building Blocks for Mechanisms
Additive Manufacturing
Coatings
Composite Materials

Cryogenics and Focal Plane Cooling
Deployable Booms & Inflatable Structures
Heat Transport Equipment and Systems
Printed Circuit Boards and Electronic Assembly Technologies
Pyrotechnic Devices
Solar Array Drive Mechanisms
Tech. for Hold Down and Release Mechanisms, and Deployment Mechanisms
Technologies for Optical Passive Instruments (Stable & Lightweight Structures, Mirrors)
AOCS Sensors and Actuators
Avionics Embedded Systems

On-Board Computers, Data Handling Systems and Microelectronics
On-Board Software
On-Board Radio Navigation Receivers
TT&C Transponders and Payload Data Transmitters
Electromagnetic Compatibility

Electrochemical Energy Storage
Power Management and Distribution
Solar Generators and Solar Cells

Array Antennas and Periodic Structures
Critical Active RF Technologies
Frequency and Time Generation and Distribution (Space & Ground)

Microwave Passive Hardware
Lidar Critical Subsystems
Optical Communication for Space
Power RF Measurements & Modelling
Reflector Antennas
Technologies for Passive Millimetre & Submillimetre Wave Instruments

Automation and Robotics
Life Support Technologies

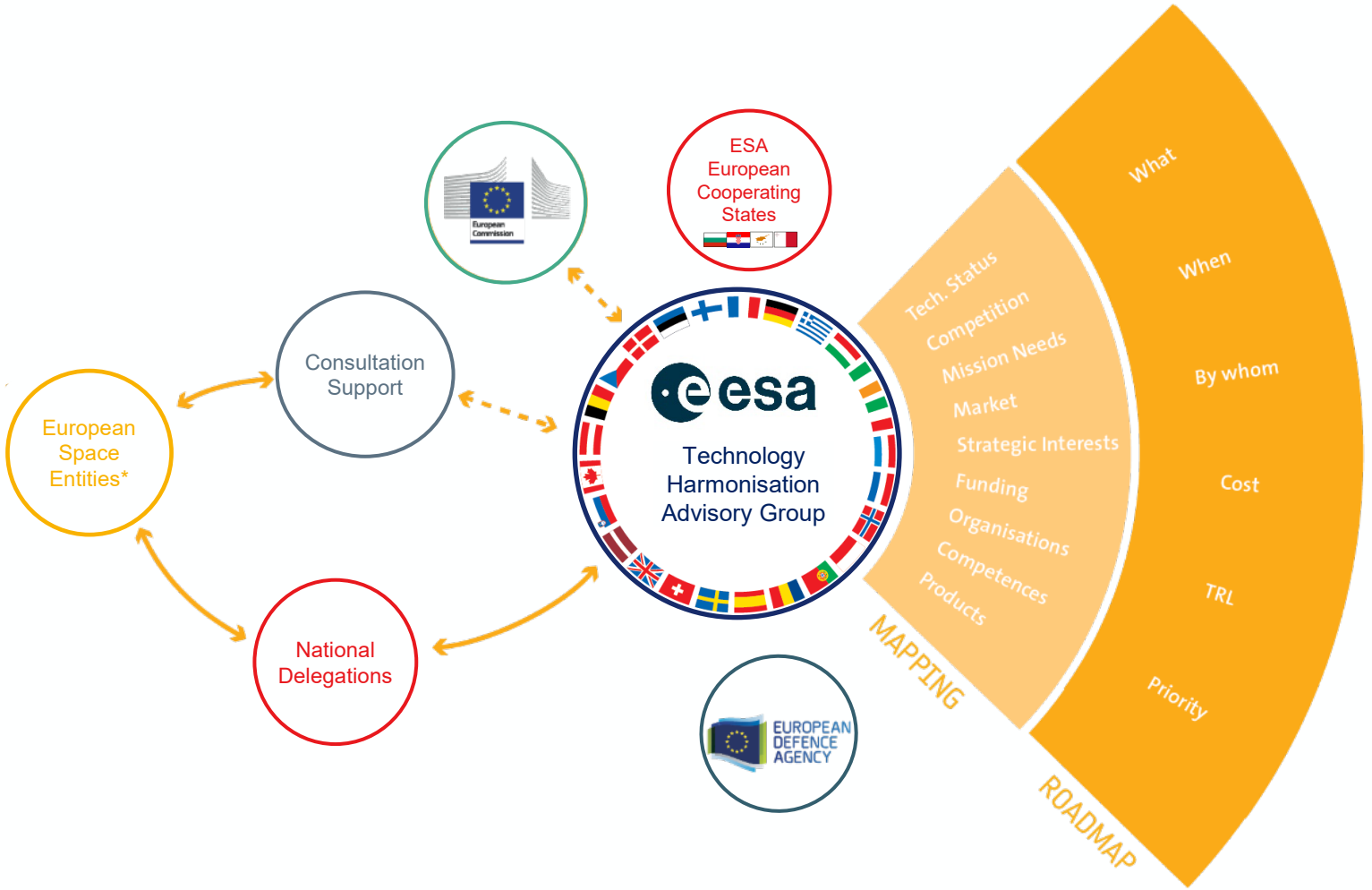
Cubesat Propulsion
Chemical Propulsion - Components (including Tanks)
Electric Propulsion Technologies
Fluid Mechanic and Aerothermodynamics Tools

Functional Verification and Missions Operations Systems
Ground Station Technology

Big Data from Space
Model Based for System Engineering
System Modelling and Simulation Tools

De-orbiting Technologies
Radiation Environments & Effects

AN INCLUSIVE COLLABORATION



- 2 decades of Harmonisation
- Up to 10 topics per year
- 30+ countries involved
- Over 1,000 European Space Entities involved through open consultations
- Over 50 ESA experts involved per year

** Industry incl. SMEs, R&D Organisations, Academia, Associations*

FROM MAPPING TO ROADMAP

ESA leads the Harmonisation. ESA Experts provide the technical knowledge and drive the elaboration of the Technology Harmonisation Dossiers (THDs) and Roadmaps (RMs).

MAPPING CONSULTATION

Space Entities may provide feedback on draft THDs

ROADMAP CONSULTATION

Space Entities may provide high-level feedback on draft Roadmaps

Mapping Phase | **Roadmap Phase**

MAPPING MEETING

Open and free for all European Space Entities to join

ROADMAP MEETING

Meeting between ESA, National Delegations and the European Commission. Final Roadmaps are agreed by National Delegations

ESA | Space Entities | THAG | European Commission

FROM MAPPING TO ROADMAP - THD

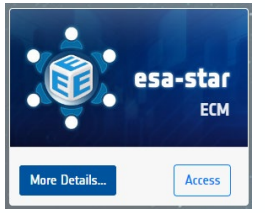
ESA Experts provide the technical knowledge and drive the elaboration of Technology Harmonisation Dossiers (THDs) and Roadmaps (RMs) including assessing the inputs received through internal ESA reviews across the agency and with Delegations, and through the open consultations with Space Entities.

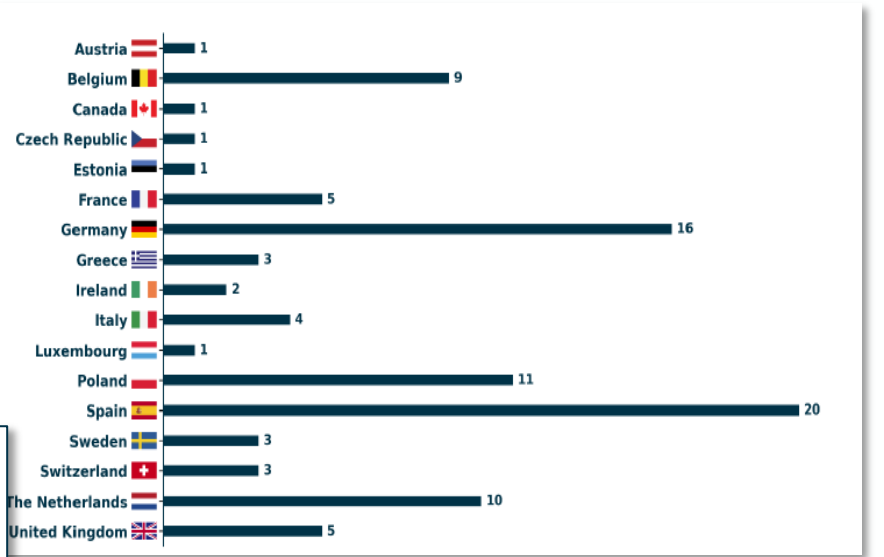
Technology state-of-the-art & European Capabilities

Market Assessment *with Euroconsult*

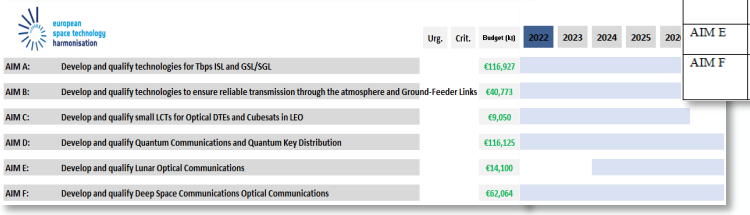
Tracking of past Roadmap

New Roadmap (next 3-5 years)





Ref.	Title	Description
AIM A	Develop and qualify technologies for Tbps ISL and GSL/SGL	AIM A refers to technologies for links to reach 1 Tbps through WDM of 100 Gbps channels. It will serve networks like Laser Light and HYDRON and primarily refers to technologies of the transceiver
AIM B	Develop and qualify technologies to ensure reliable transmission through the atmosphere and Ground-Feeder Links	AIM B refers to all technologies involved that can enable a reliable link to be maintained through the atmosphere. This refers primarily in techniques dealing with the Ground Terminal Optics for Feeder Links to GEO/MEO Satellite Optical Transport Network
AIM C	Develop and qualify small LCTs for Optical DTEs and Cubesats in LEO	AIM C refers to high capacity Optical DTEs primarily from LEO Earth Observation Satellites and Small Sats
AIM D	Develop and qualify Quantum Communications and Quantum Key Distribution	AIM D refers to Quantum Communications and QKD
AIM E	Develop and qualify Lunar Optical Communications	AIM E refers to Optical Communications for the lunar distances (the Moon and cislunar area)
AIM F	Develop and qualify Deep Space Communications Optical Communications	AIM F refers to beyond the Moon distances Optical Communications until Saturn



FROM MAPPING TO ROADMAP - MAPPING

ESA leads the Harmonisation. ESA Experts provide the technical knowledge and drive the elaboration of the Technology Harmonisation Dossiers (THDs) and Roadmaps (RMs).

MAPPING CONSULTATION

Space Entities may provide feedback on draft THDs

Mapping Phase

MAPPING MEETING

Open and free for all European Space Entities to join

ESA | Space Entities | THAG | European Commission

CONTRIBUTE TO

- The state-of-the-art in your technology domain
- Identify key issues
- Express future development needs in Europe
- Voice your view on the market situation
- Ensure your company's competences are reflected.

BENEFIT FROM

- Learning about the current state-of-the-art, future technology needs and trends, main players
- Gaining visibility
- Networking with both ESA Experts and other European Space stakeholders
- Exploring new potential partners & business opportunities
- Gaining further insight into market trends and future technology developments and opportunities

FROM MAPPING TO ROADMAP - ROADMAP

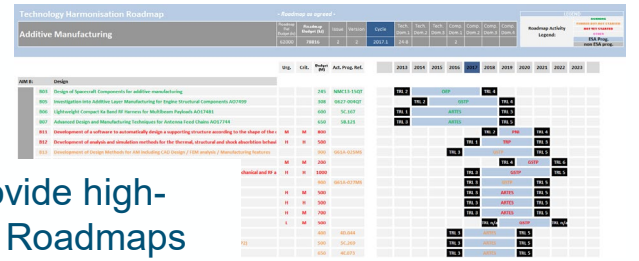
ESA leads the Harmonisation. ESA Experts provide the technical knowledge and drive the elaboration of the Technology Harmonisation Dossiers (THDs) and Roadmaps (RMs).

CONTRIBUTE TO

- Highlight development gaps
- Identify unnecessary duplications
- Assess the continuity of critical activities
- Ensure key issues are addressed

BENEFIT FROM

- Obtaining early access to planned Roadmaps
- Having a chance to contribute to a common view on future developments
- Comparing your own development plans with the Harmonisation Roadmaps to support strategy decision-making or identification of aligned areas of interest



ROADMAP CONSULTATION

Space Entities may provide high-level feedback on draft Roadmaps

Roadmap Phase

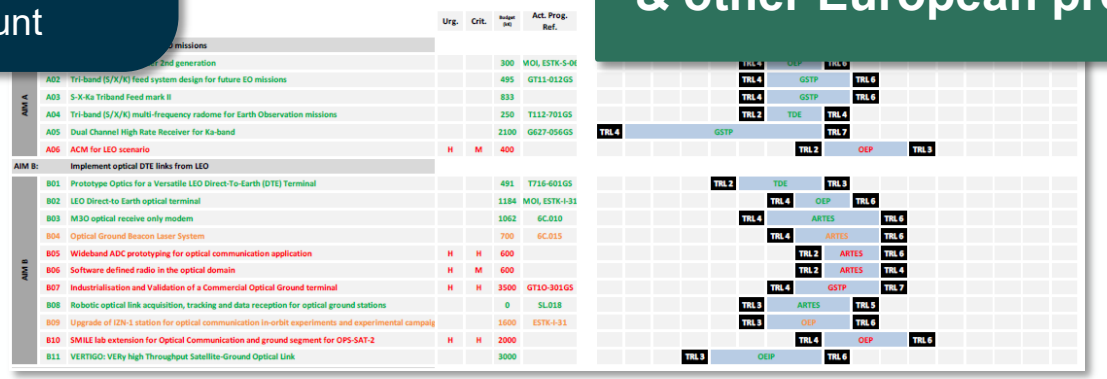
ROADMAP MEETING

Meeting between ESA, National Delegations and the European Commission. Final Roadmaps are agreed by National Delegations

ESA | Space Entities | THAG | European Commission

HARMONISATION OUTPUTS

European harmonised and coordinated technologies with conclusions reflected in:



Harmonisation Document Management System (HDMS)

Request access to harmo@esa.int from a corporate account

Agreed Roadmaps used as a guide in the definition of technology development Work Plans at ESA, national delegations & other European programmes

Implementation tracking

PARTICIPATE AS A EUROPEAN SPACE ENTITY

Harmonisation is voluntary and based on transparency and exchange of information.
Involvement of all stakeholders is crucial to the success of this European initiative

European Space Entities are invited to join Harmonisation

- Industry
- R&D Organisations
- Academia
- Associations

Participation channels

National Delegations

At the core of Harmonisation and involved at every step.

Contact your National Delegates:

- Ms. Liselott Krokstedt
- Mr. Christian Hansen

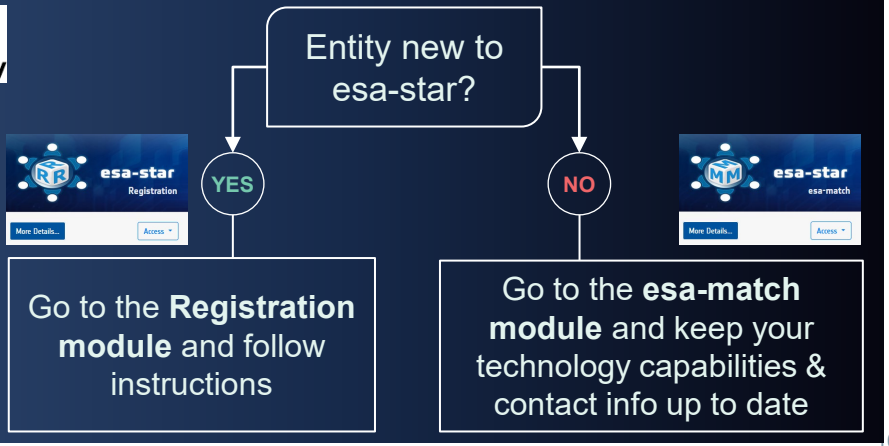
Rymdstyrelsen
Swedish National Space Agency

European Space Agency

esa-star: registration & tendering system and single access for all activities including Harmonisation.

Contact us at harmo@esa.int

https://doing-business.sso.esa.int/

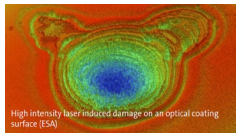


TOPICS 2023 – CYCLE 1

Cycle 1 - Finalisation

Harmonisation Topics

Coatings



Frequency and Time Generation and Distribution – Space & Ground

Reflector Antennas

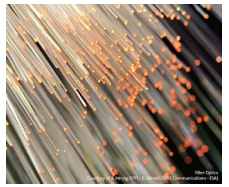
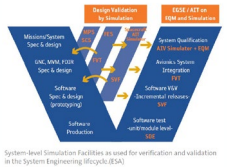
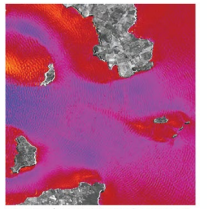
Life Support Technologies (Bioreactors and Membrane-based Processes)

De-Orbiting Technologies

Event	Date
Space Entities Mapping Consultation	☑ Nov 2022 – Jan 2023
Mapping Meeting	☑ 17 – 19 Jan 2023
Space Entities Roadmap Consultation	☑ Mar 2023
Publication of Technology Harmonisation Dossiers and Roadmaps	*Q4 2023*

TOPICS 2023 – CYCLE 2

Cycle 2 - Ongoing

Harmonisation Topics	Event	Date
 Photonics	Space Entities Mapping Consultation	Closing on the 6th Jun 2023
Chemical Propulsion – Components 	Open for registration **Mapping Meeting** https://atpi.eventsair.com/2nd-cycle-2023-harmonisation-mapping-meeting	13 – 15 Jun 2023
 System Modelling and Simulation Tools	Space Entities Roadmap Consultation	Sep – Oct 2023
Big Data from Space 	*Publication of Technology Harmonisation Dossiers and Roadmaps*	*Q1 2024*

TOPICS 2024 - Planned

Cycle 1

Harmonisation Topics

Cryogenics and Focal Plan Cooling

AOCS and GNC Systems

Electrochemical Energy Storage

Technologies for Passive Millimetre and Sub-Millimetre Wave Instruments

Technologies for Optical Passive Instruments (Stable & Lightweight Structures, Mirrors)

Cycle 2

Harmonisation Topics

Composite Materials

Power Management and Distribution

Electromagnetic Compatibility

Fluid Mechanics and Aerothermodynamic Tools

Cubesat Propulsion

EUROPEAN SPACE TECHNOLOGY MASTER PLAN

- **Yearly publication**
- **Unique reference** on European Space Technology
- **2021 ESTMP is the 18th Edition, the 5th jointly published with the European Commission (EC)**
  - Over a 100 contributors: 31 countries, EC, European Defence Agency (EDA), ESA programme and experts
  - ESTMP content:
    - *A snapshot of the space sector in the global context*
    - *European Institutional space technology budgets*
    - *Overview of all ESA/EU (31) Member States organisation of national space technology and budgets*
    - *Technology Harmonisation and roadmaps*
    - *ESA technology programmes*
    - *EC and EDA technology programmes and initiatives*
- **2022 ESTMP** (19th Ed.) is a **brochure edition** for the 2022 ESA Council at Ministerial published in November 2022. It is publicly available under this link.
- **2023 ESTMP** (20th Ed.) will be a full ESTMP (including National pages) expected Oct 2023

JTF ON CRITICAL SPACE TECHNOLOGIES

- In September 2008, a high-level workshop on **Critical Space Technologies for European Strategic Non-Dependence** was held with ESA, European Commission, European Defence Agency, industry and other stakeholders
  - **ESA, Commission, and EDA agreed to join forces and created a Joint Task Force**
- The European **Non-Dependence [JTF] process** was launched for the first time in 2009, and since then has been establishing joint **Lists of Actions**
- The **2023 round of the JTF process has been kicked-off on 17 May 2023** with an ESA, Commission and EDA joint event.

2023 4Q		2024		
JTF Kick-Off Event in Brussels	**Mapping Meeting** Exchange of Stakeholders on Technology Dependencies	**Industry Meeting** Consultation with Industry	**Meeting w/ Member States** Approve the JTF Action List for Technology Non-Dependence	**Preparing Roadmaps** on selected items

Exact dates of meetings will be published shortly

CONCLUSIONS

Involvement of all stakeholders is crucial to the success of this European initiative

PARTICIPATE

National Delegations (THAG)

At the core of Harmonisation and involved at every step.

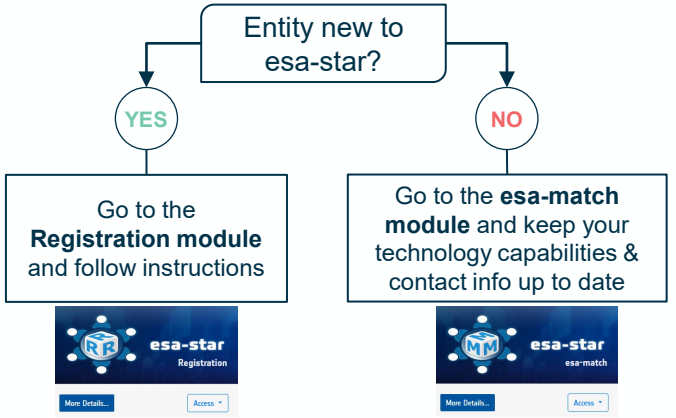
Contact your National Delegate:
- Ms. Liselott Krokstedt
- Mr. Christian Hansen

Rymdstyrelsen
Swedish National Space Agency

European Space Agency

esa-star: registration & tendering system and single access for all activities including Harmonisation.

Contact us at harmo@esa.int

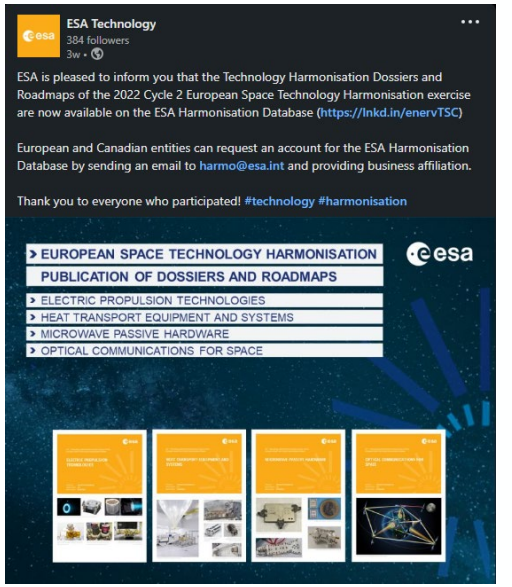


ACCESS

European harmonised and coordinated technologies with conclusions reflected in:

- 47+ Technology Harmonisation Dossiers
- 47+ Harmonisation Roadmaps
- European Space Technology Master Plan (ESTMP)

FOLLOW



Follow us in LinkedIn
ESA Technology
for updates

More info at
https://technology.esa.int/page/harmonisation

Thank you for your attention

european
space technology
harmonisation

https://technology.esa.int/page/harmonisation

ESA Harmonisation Team
harmo@esa.int