



EU Space R&I Activities

Strategic Research Cluster on Electric Propulsion – a status

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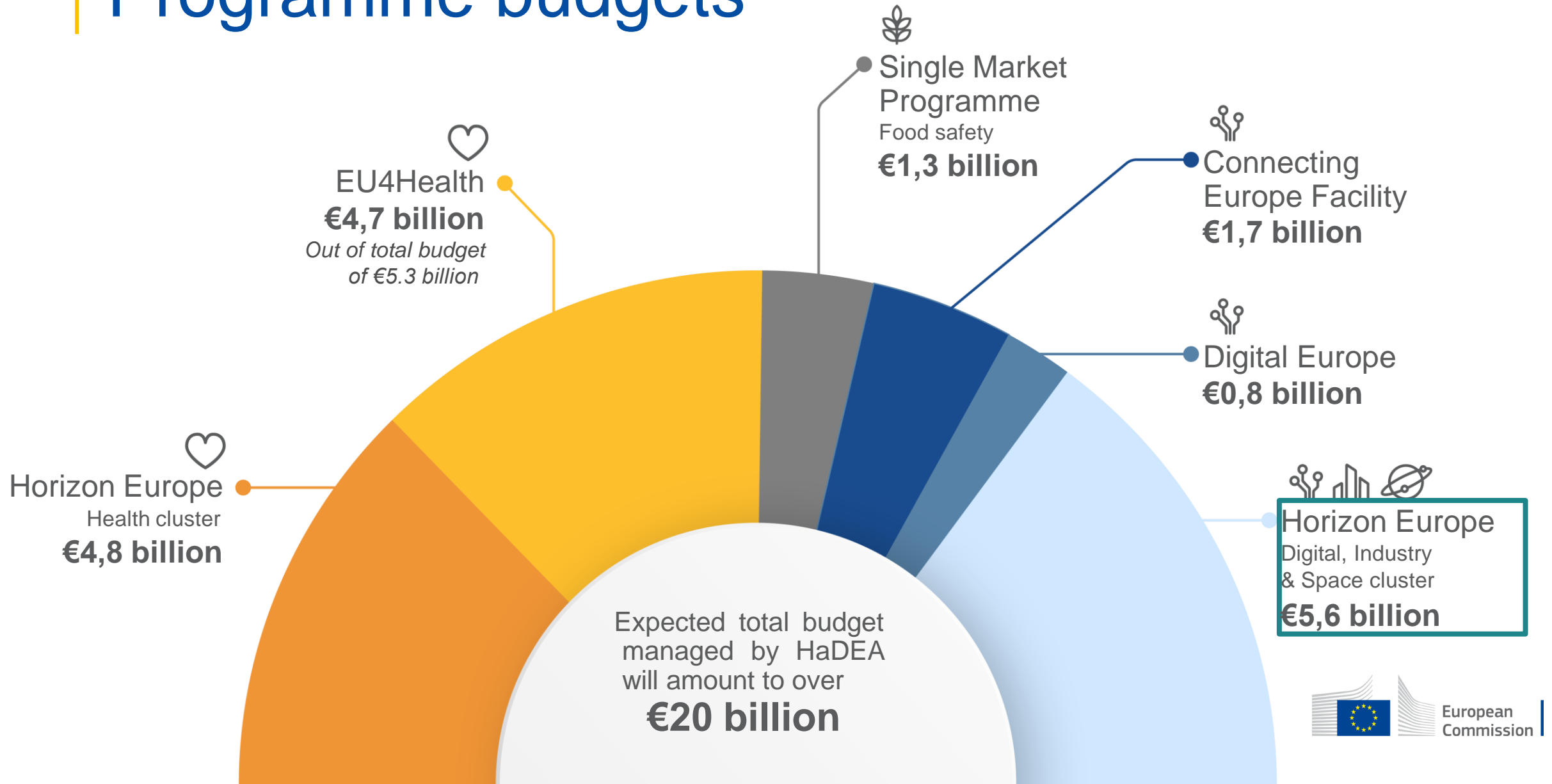
HaDEA — The European Health and Digital Executive Agency

Boosting Europe by building,
from earth to space, a healthy
society, a digital economy
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Established on 16 February 2021

Health
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HaDEA Programme budgets



The Strategic Research Cluster on Electric propulsion

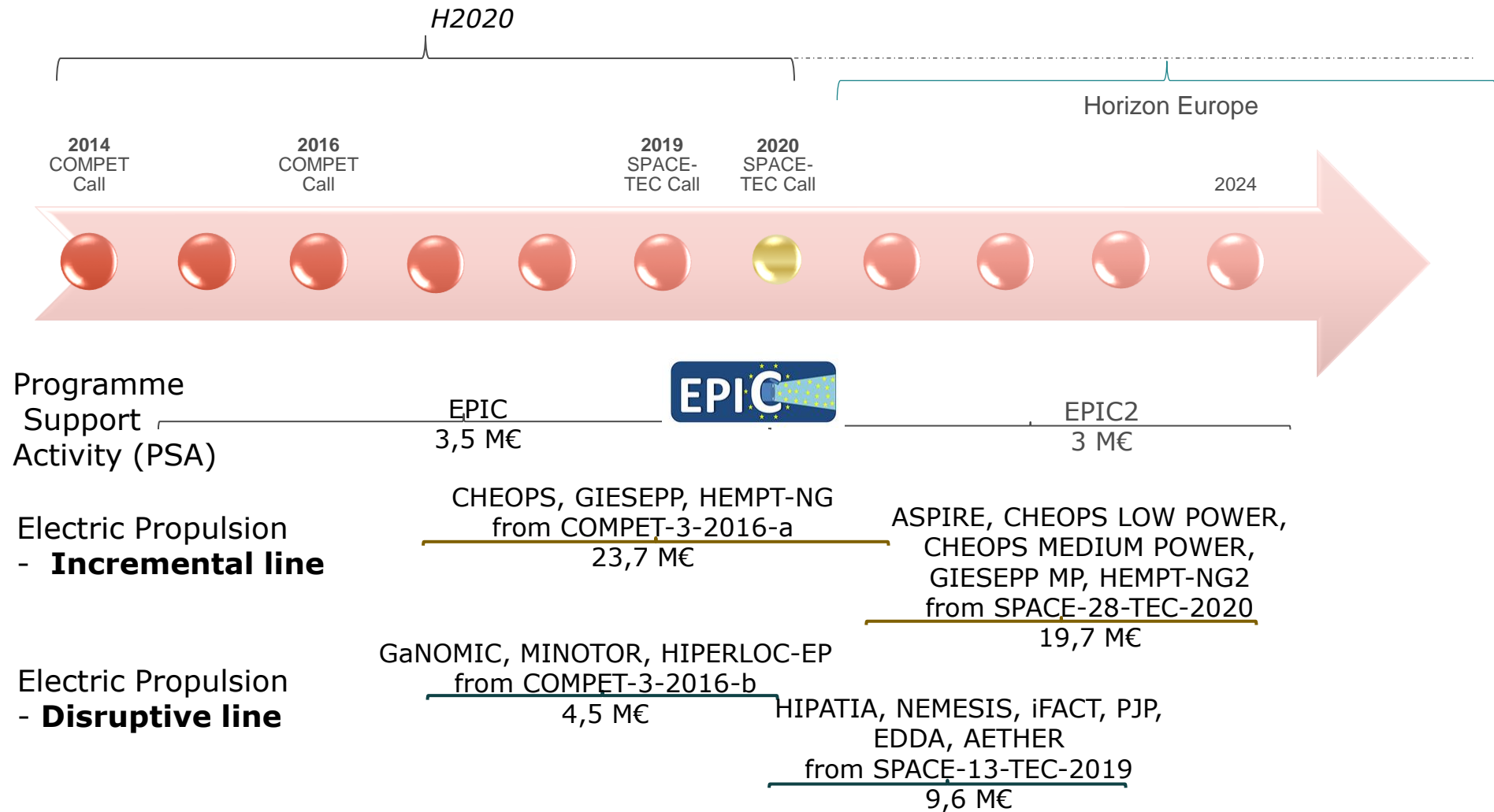
The **Strategic Research Cluster on Electric Propulsion** of the **Horizon 2020 Programme** started in 2014 with the selection of the Programme Support Activity (PSA) EPIC. <https://www.epic-src.eu/>

EPIC is coordinated by ESA and partners are from main National Space agencies and associations representing the industry. EPIC prepared the SRC roadmap and accompanied the Commission in preparation of Call topics and in follow up of operating grants results.

The SRC objective was to **strengthen the European EP scene** and run two lines of development: **Incremental line** (HET, GIE and HEMPT technologies), and **Disruptive line** (all other thruster concepts and new supporting technologies). Projects from the Incremental line (HET, GIE and HEMPT) will reach TRL 6-7 by 2023-2024 for the Low and the medium power ranges, and TRL 5-6 for the High Power.

With the current fast paced changing market of satellites, including for example increased interest in smaller satellites and in constellations, **the new Horizon Europe Programme supports further the European EP capacity** in this critical space system technology.

Electric Propulsion Strategic Research Cluster Timeline



Note: other notable H2020 funding from FET Open and SME instrument: DISCOVERER Un. of Manchester, Enpulsion IFM micro-thruster, ThrustMe EMBRACE (9,3 M€)

Project status – Disruptive line

- **HIPATIA – Helicon Plasma Thruster** – CDR held followed by further design improvement and tests to improve thruster performance – Completed 12/22
- **NEMESIS – new electrical material for cathodes** – applied on Exotrail and Justus Liebig Un. Giessen HET thrusters – achieved 100% purity C12A7 ceramic synthesis – Completed 3/23
- **iFACT – Advanced Cusp Thruster on iodine** with C12A7 electride neutraliser – 10W to 300W - implementation was Completed 6/22
- **PJP – Vacuum Arc Thruster** – 30W & more – IOD mission – main technology challenges, CDR completed, last tests results awaited. Completed 4/23
- **EDDA – Direct Drive architecture** for HET & HEMPT-based systems - successful coupling tests with thrusters @400V – Completed 05/22.
- **AETHER – Air breathing HET** sub-system; CDR held followed by tests - Project Completed 11/22

Project status – Incremental line

- ASPIRE – 20kW HET system with direct Drive Power Unit, TRL6 to be achieved by end 2023
- CHEOPS LP – Low Power HET – up to 1kW - to TRL6/7 by early 2024 – prepared for industrialisation
- CHEOPS MP – Medium Power HET – Dual mode for orbit raising (5-7kW) and Station keeping (3kW) – to TRL 6/7 by early 2024
- GIESEPP MP – Medium Power Gridded Ion Engine – Dual mode OR & SK up to 5kW – to TRL 6/7 by mid 2024
- HEMPT-NG2 – High Efficiency Multistage Plasma Thruster – 700W Low Power class - TRL 6/7 by end 2023

Conclusion - Status of the EP SRC



EU SPACE



- All projects from the 2016 Calls were completed by 2022
- Projects from the 2019 Call on disruptive technologies are ending in 2023
- Projects from the 2020 Call on the Phase 2 of the incremental EPS development will end in 2024
- **2020 Incremental systems:**
 - Follow the planned target **TRL objectives of Phase 2** for the three technologies: HET, GIE and HEMPT-NG and all power range are in good way to reach TRL 6 or TRL6/7.
 - The products under development are **focused on growing market needs for the next generation satellites.**
 - **Consideration on Propellant** are also address market needs and increased stress on costs.
- **Disruptive line** aims to **support new space applications**, such as **EP propulsion in VLEO**, low-cost and simplified design thrusters, new propellants (liquid and solid) and Building Block technology developments (e.g., direct drive, cathode materials)



Horizon Europe SRIA for Space

Outline of the Strategic Research and Innovation Agenda for Competitiveness and Access to Space

Foster Competitiveness

- Foster Competitiveness of end to end systems and associated services
- Future space ecosystems: on-orbit operations, new system concepts
 - New industrial processes and production tools
 - Enabling technologies
 - Contribution to space science

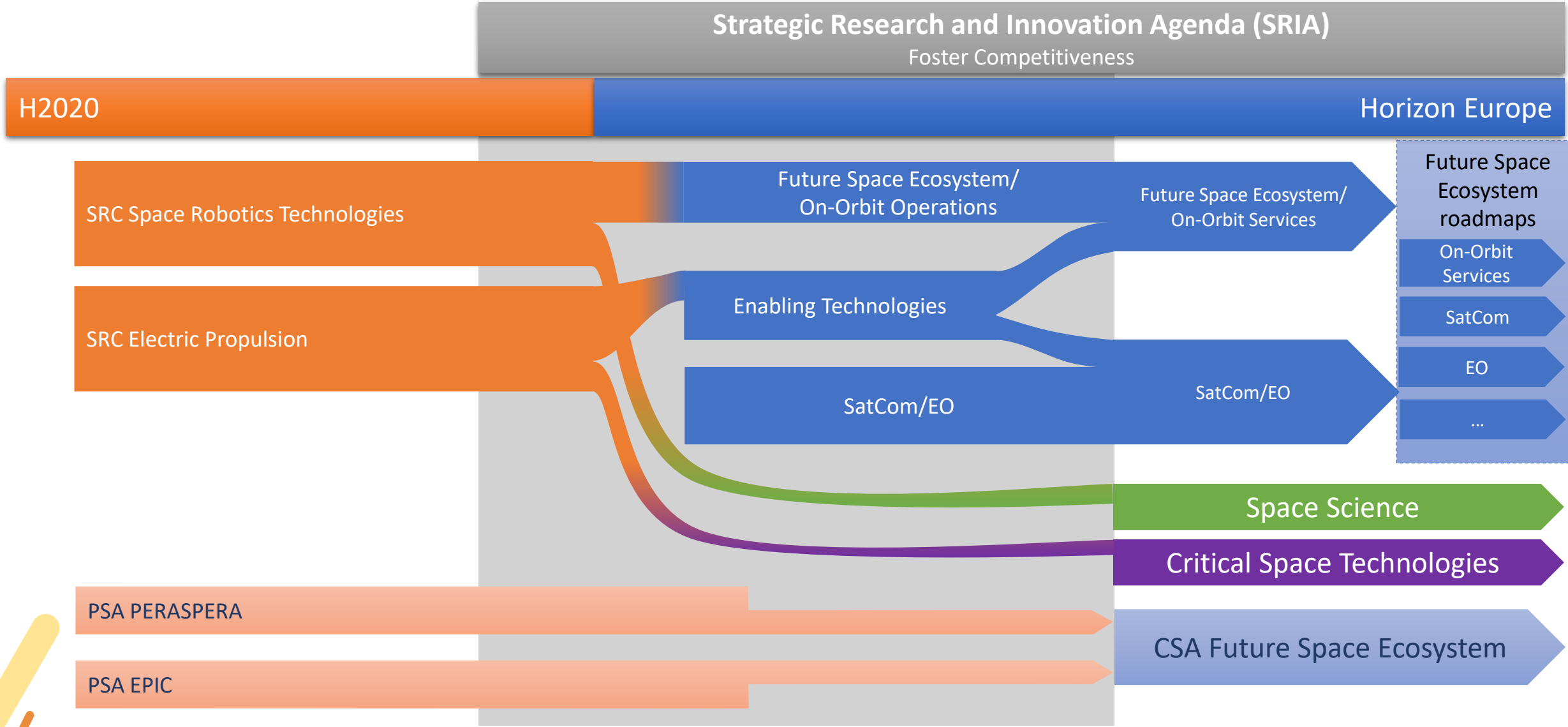
Reinforce access to space

- Innovation for competitiveness, targeting initial operational capability by 2030
- Disruptive concepts for access to space
- Fostering and enabling new commercial space transportation solutions
- Modern, flexible and efficient European test, production and launch facilities, means and tools

Synergies

- Technology non-dependence
 - Technology transfer
- Dual use and synergies with defence
 - Building on common technology roadmaps
- Standardisation and certification approaches

Evolution: Future Space Ecosystem and Enabling Technologies



Electric Propulsion in HEurope

HORIZON-CL4-2022-SPACE-01-12

Technologies and generic building blocks for Electrical Propulsion

Specific Conditions	
Expected EU contribution per project	between EUR 1 and 2 million
Indicative budget	EUR 5.1 million
Type of action	Innovation Action
Eligibility conditions	Security assessment
Technology Readiness Level	TRL 5-6 by the end of the project
Maximum number of projects	3

Scope: R&I on

1. Generic building blocks technologies for **thruster components**
2. **Electrical power** architecture and components
3. **Fluidic management** system and components

Selected proposals from the 2022 Call

- **CHEOPS-VHP-BB** – CHEOPS very High-Power Building Blocks
 - Start date 1/1/23
 - Key building blocks for VHP HET systems >20kW: system architecture vs missions, lifetime qualification approaches, manufacturability of key components
- **ECOPROPU** - Electrical COmpetitive PROPUlsion
 - Start date 1/123
 - Builds on GANOMIC to extend HET PPU mission capability and efficiency, developing 5 building blocks: anode module, digital processing module, magnet power converter, DAB DC and Planar transformer
- **DEEP-PPU** - DisruptivE Electrical Propulsion - Power Processing Unit
 - Start date 1/10/22
 - Volume and cost reduction for the PPU of GIE thrusters (GIESEPP MP) using GaN technology, COTS components, RFG module integration.

HORIZON-CL4-2023-SPACE-01-12: Future Space Ecosystem and Enabling Technologies

This topic aims at enabling efficient in-space services by focussing on target-oriented development and qualification of innovative, game-changing technologies, key technology building blocks as well as new applications and services for the future space ecosystem.

Scope: 2 areas

- **Generic building blocks technologies for electric propulsion systems** considering paradigms relevant for industrialization;
- **Technologies and concepts with a clear application, pathway to applications and business sustainability** in mind, e.g., innovative approaches for operations, next generation of services, enabling technologies, or serial production and manufacturing concepts, software for mission control, new hardware/software approaches to shorten development, test, integration time or re-use/re-cycle platform functionalities.

Indicative budget: **15.0 million EUR**
EU contribution per project: **0.5-2.5 million EUR**
Number of projects: **7**

Type of Action: **RIA**
Financial set-up: **Lump sum**
TRL: **(1) 4-6 / (2) 3-5**

- Proposals address only one area, which must be clearly identified.
- Proposals are expected to promote cooperation between different actors (industry, SMEs and research institutions)
- Proposals should explore relevant and promising solutions derived in Horizon 2020 activities, especially project results from the Strategic Research Clusters *Space Robotics Technologies* and *Electric Propulsion*.

HORIZON-CL4-2023-SPACE-01-13: Future Space Ecosystem: Management and Coordination Activity



Expected Outcomes

- Future Space Ecosystem roadmap focussing on in-space services, that take advantages of enabling technologies and of synergies between cluster 4 destinations and activities for the future space ecosystem maximising the market opportunities and benefits;
- Coherent principles, and guidelines and standards for On-Orbit Services supporting European actors implementing their business in this domain ensuring consideration of sustainability, safety and competitiveness.

Scope

- **Pathways to innovative and promising applications and services** taking into account new space approaches, enabling technologies as well as synergies with terrestrial sectors while making use of continuous market and trend analyses;
- **Pathways for quick maturation and space qualification** of game-changing/key technologies;
- Follow project(s) of other FSE calls to **support decisions regarding programmatic and strategy questions** and to **verify the applicability of the existing principles and guidelines** for future missions;
- Contribute to **international dialogue on recommendations for guidelines and standards for In-Space Services** based on the work done in the European Operations Framework (EOF) **supporting the European Commission in policy and standards development**;
- **Targeted dissemination and outreach activities for FSE activities** to showcase the paradigm shift and to facilitate support of European stakeholders, and to **promote EU Space R&I activities** in the future space ecosystem.

Indicative budget: 2.0 million EUR

EU contribution per project: 2.0 million EUR

Number of projects: 1

Type of Action: CSA

Financial set-up: Lump sum

TRL: -

➤ Active participation of industrial actors including SMEs in the consortium is expected.



HORIZON-CL4-2023-SPACE-01-72: Space technologies for European non-dependence and competitiveness

Recent geopolitical developments have highlighted the **urgency of increasing the effort on technological dependencies** therefore **safeguard the Union's strategic assets, interests, autonomy, and security.**

Expected Outcomes :

- **Reduce the dependence on critical space technologies and capabilities from outside EU** for the EU space programme components (i.e. Galileo/EGNOS, Copernicus, Gvsatcom and SSA) and other space applications;
- Develop or regain in the mid-term the **European capacity to operate independently in space;**
- Enhance the technical capabilities and overall **competitiveness of European space industry vendors on the worldwide market;**
- Open **new competition opportunities for European manufacturers by reducing dependency on export restricted technologies** that are of strategic importance to future European space efforts;
- Improve the overall European space technology landscape and complement and/or **create synergy** with activities of European and national programmes **either in the space or non-space fields.**

Indicative budget: **20.1 million EUR**

EU contribution per project: **2 to 3 million EUR**

Type of Action: **RIA**

TRL: **varies from 4 to 8**

HORIZON-CL4-2023-SPACE-01-72: Space technologies for European non-dependence and competitiveness



Eligibility: Participation is limited to legal entities established in Member States, Iceland and Norway

Technology lines supported in 2023 by the topic:

1. High speed DAC-ADC
2. Space qualified carbon fibre pre-impregnated material sources
3. Enhanced performance and space qualified detectors – IR range
4. Mid-power range electric propulsion thruster technology: Qualification of electrical propulsion thrusters and PPU's for power ranges up to 5kW
5. Mid-power range electric propulsion thruster technology: Development of new generation of thrusters based on non-dependent propellants (i.e. not Xe or Kr)
6. Replacement solutions for metallic lead (Pb)
7. High performance, cost effective multi - junction solar cells for space applications

Technical guidance document for further technical specifications for each of the areas.

Conclusions

Market conditions are changed

- The **COVID-19** crisis still has some impact on projects' schedules, mainly in terms of strained **access to laboratories and test facilities, and procurement** of materials and components.
- The **Russian – Ukraine** war has additional impact on **energy and propellant costs**. It caused the **Disruption of the supply chain, delays and uncertainty of procurement**, fluctuation of material price and their availability.
 - **Urgent need for action to reduce dependence on critical technologies**
- **Market demand is growing (growth of number of space missions, RU & UE suppliers away)**, while pressure for **cost reductions** remains, calling for;
 - **Accelerate industrialisation of solutions** for different segments (more particularly for LEO constellations)
 - **Products adapted to new applications in New Space ecosystem:** e.g. Choice of **alternative propellants**, lower **qualification** costs, new performance requirements
 - Supply chain consolidation, **double sourcing and development of European supply chains**

Conclusions

Next steps

- The projects funded from the **2022 Horizon Europe Call** will reinforce the preparation of the next generation incremental EPS currently under development.
- The **2023 Horizon Europe Call** is estimated to fund 4-5 more projects. Proposals received seem to address significant challenges, which remain to be covered both at EU/global market level.
- The **new CSA should continue the EPIC major contribution** in:
 - **Road-mapping** and advising EC and HaDEA regarding technical and programmatic matters
 - **Establishing European leadership** through competitiveness
 - **Integrating EP** within the development of **new space ecosystems**
- **Support to non-dependence of European capabilities** at global level within the 2020-2030 timeframe is re-energised in the coming work programmes

Thank you for your attention !