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Horizon 2020 Work Programme for Research & Innovation 2018-2020

SRC In Space electrical propulsion and station keeping
SPACE-13-TEC-2019 Call Text and Guidelines
(Disruptive Technologies)

Presented at the H2020 Space Infoday 2018

Berlin, Germany, 14 November 2018

Jorge Lopez Reig

EPIC PSA / CDTI

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Content:

- SRC EPIC Roadmap
- SRC 2019 Call
- SRC 2019 Grant Guidelines and Requirements

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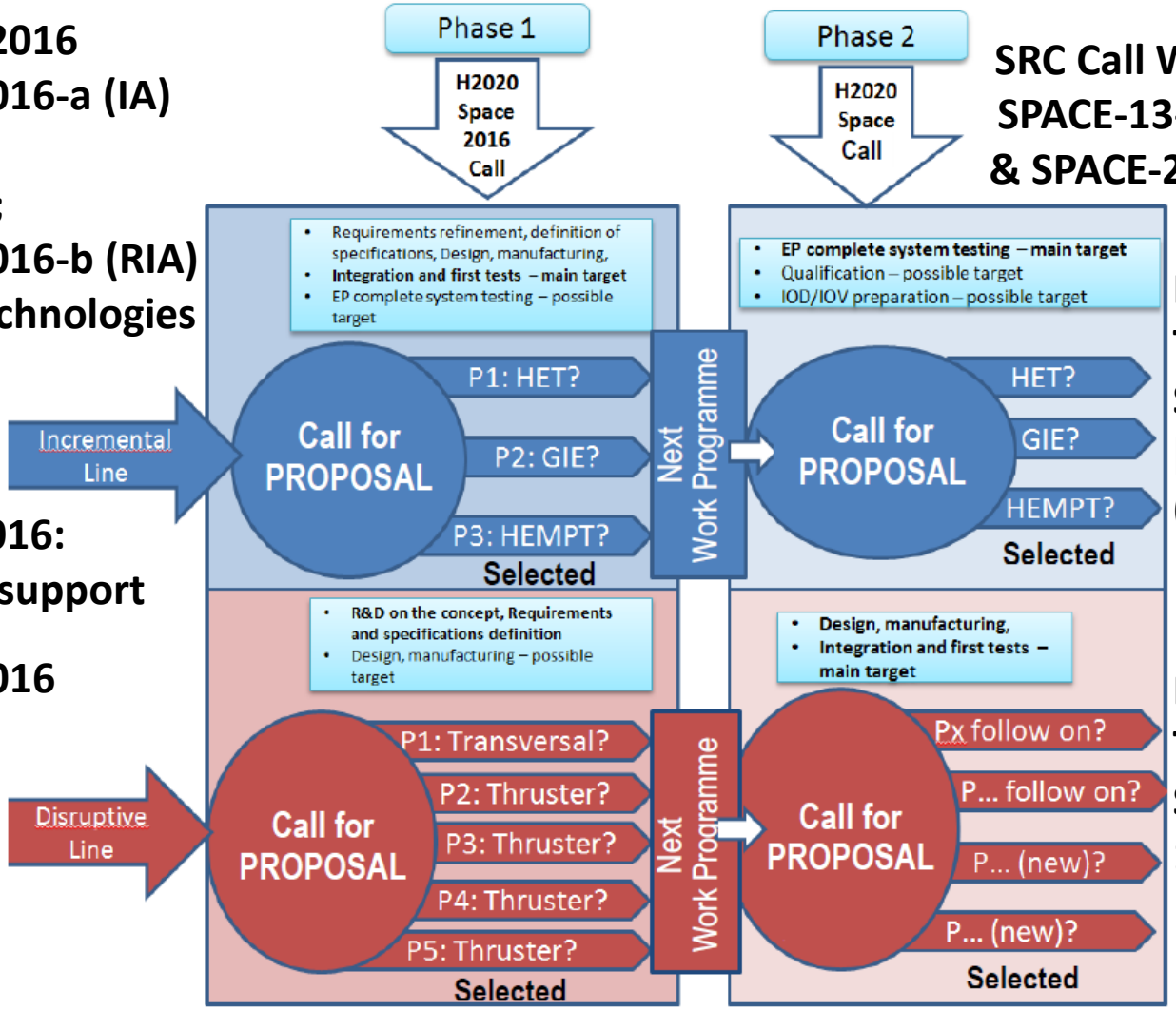
SRC EPIC Roadmap

SRC Call WP 2016
COMPET-3-2016-a (IA) Incremental Technologies;
COMPET-3-2016-b (RIA) Disruptive Technologies

COMPET-3-2016:
28,16 M€ EU support

COMPET-3-2016
OGs
CHEOPS
GIESEPP
HEMPT-NG
GANOMIC
HIPERLOC-EP
MINOTOR



SRC Call WP 2019 & 2020
SPACE-13-TEC-2019 (RIA) & SPACE-28-TEC-2020 (IA)

Incremental Technologies
SPACE-28-TEC-2020:
[24] M€ (Indicative) (IA)

Disruptive Technologies
SPACE-13-TEC-2019:
10 M€ (RIA)

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SRC EPIC Roadmap

Disruptive Technologies:

- The Disruptive Technologies, are very promising EP thruster concepts or transversal EP technologies which could disrupt the propulsion sector by providing a radical improvement in performance and/or cost reduction, leading to become the preferred technology for certain applications; or enable new markets.

- Promising EP thrusters are for example: Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), etc.

- Transversal EP technologies are for example radical innovations in Power Processing Units (PPU), magnetic nozzles, alternative propellants, etc.

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SRC 2019 Call

SPACE-13-TEC-2019

SRC In Space electrical propulsion and station keeping / Disruptive Technologies / Guidelines to be published by EC

*The **Disruptive Technologies**, are very promising EP thruster concepts or transversal EP technologies which could disrupt the propulsion sector by **providing a radical improvement in performance and/or cost reduction**, leading to become the preferred technology for certain applications; **or enable new markets.***

- ***Promising EP thrusters** are for example: Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance plasma thrusters (ECR), Magneto Plasma Dynamic thrusters (MPD), Pulsed Plasma Thrusters (PPT), micro-propulsion electric thrusters, etc.*

- ***Transversal EP technologies** are for example disruptive electric propulsion systems, such as power condition electronics, direct drive, magnetic nozzles, alternative propellants, testing techniques, materials, etc.*

Reccomended project size

Indicative budget

Type of action

1 M€ for activities starting from TRL<4

1 to 2 M€ for activities starting from TRL≥4

10 M€

Research and Innovation Actions

Participation of industry, including SMEs, is encouraged

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SPACE-13-TEC-2019

To be kept in mind:

- Proposals may target any part of the **technology readiness levels (TRL) scale**, in particular: *Breakthrough technologies starting at low or very low TRL (<4); Promising technologies starting at higher TRL (≥4).*
- Proposals shall include a **market analysis** detailing the targeted applications and the specific key advantages of the proposed technology.
- Proposals **shall not be based on technology lines mentioned in the call topic COMPET-3-2016-a** for incremental EP technologies (HET, GIE, HEMPT) .
- Requesting contribution from EU of **EUR 1 million for activities starting from TRL < 4** and of **EUR 1 to 2 million for activities starting from TRL ≥ 4**.
- Type of Action: **Research and Innovation Action (RIA)**
- Indicative budget: **EUR million 10.0**
- Opening: **16 Oct 2018;** Deadline: **12 Mar 2019**

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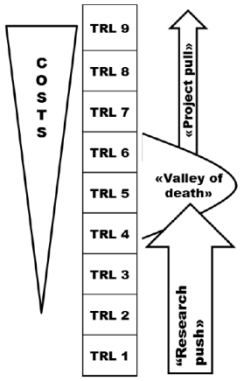
Technology Readiness Level (TRL)

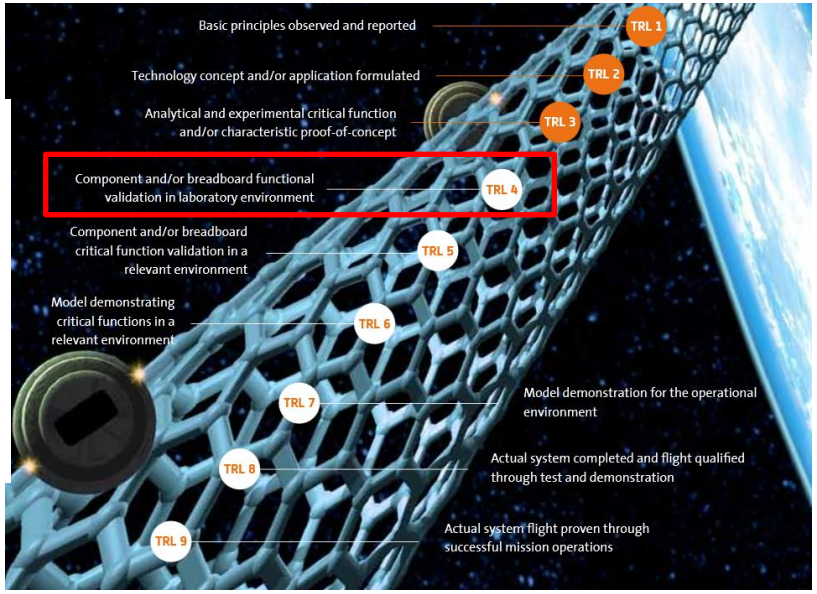
G. Technology readiness levels (TRL)

European Commission

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)





TRL 4: Component and/or breadboard functional verification in laboratory environment	Element functional performance is demonstrated by breadboard testing in laboratory environment. EUROPEAN COOPERATION FOR SPACE STANDARDIZATION (ECSS)	• Preliminary performance requirements (can target several missions) with definition of functional performance requirements. • Conceptual design of the element. • Functional performance test plan. • Breadboard definition for the functional performance verification. • Breadboard test reports.

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SRC 2019 Call

SPACE-13-TEC-2019

To be kept in mind:

- **Eligibility and admissibility conditions**: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:
  - **No beneficiaries of the grant agreement EPIC (640199) will participate** in consortia of proposals submitted under this topic of the call for proposals, with the exception of the DLR research institutes, Eurospace and SME4Space VZW.
  - A **maximum of two projects for transversal technologies** shall be selected for funding
- **Grant Conditions:** Grants awarded under this topic will be complementary to each other and complementary to grants awarded under topic COMPET-3–2014, sub-topic COMPET-3-2016-a and sub-topic COMPET-3-2016-b ("complementary grants"). In order to ensure a smooth and successful implementation of this Strategic Research Cluster (SRC), the beneficiaries of complementary grants ("complementary beneficiaries") shall conclude a written **"collaboration agreement".**

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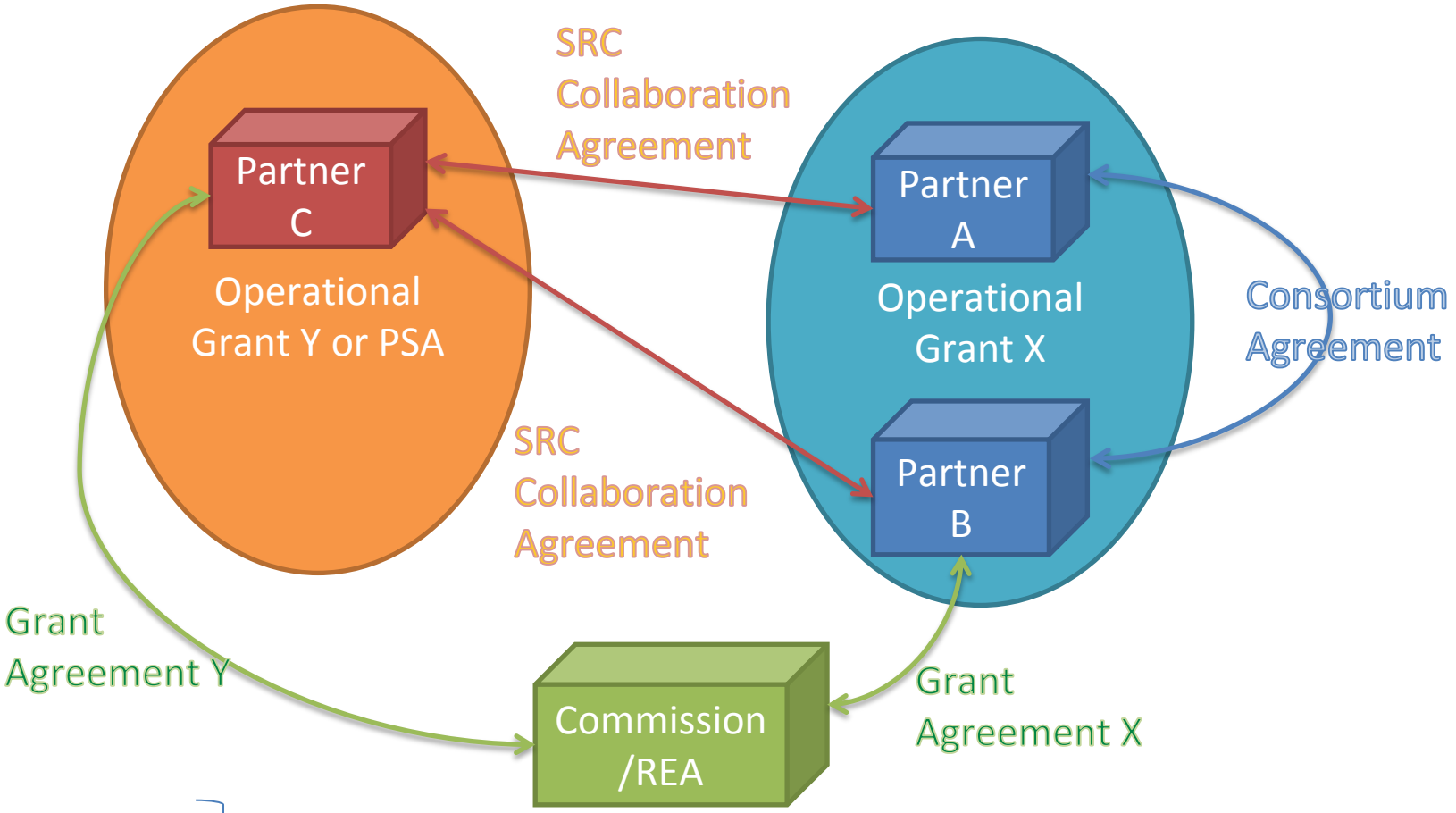
SRC Collaboration Agreement



A and C

B and C

Complementary Beneficiaries

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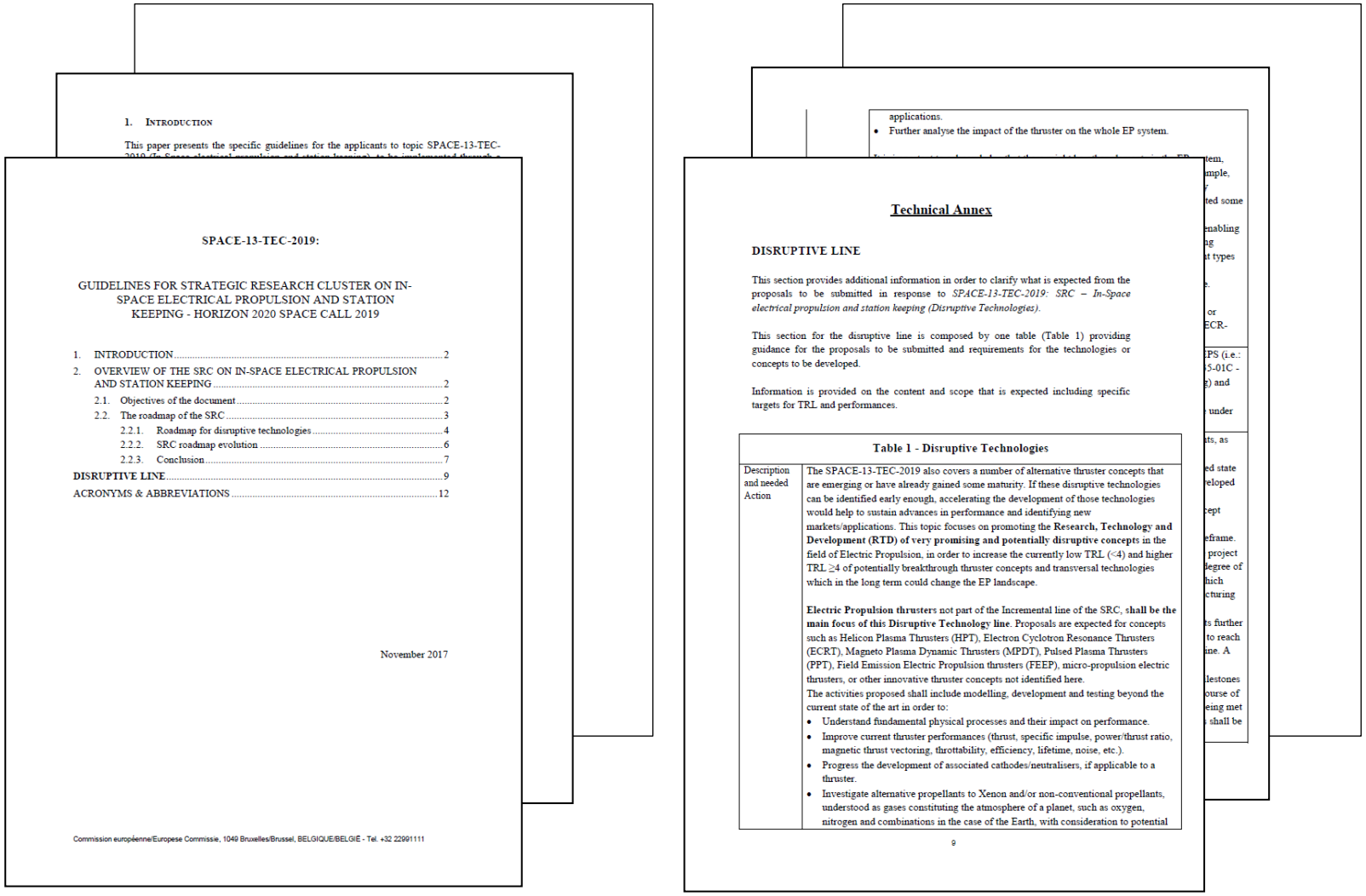

1. INTRODUCTION

This paper presents the specific guidelines for the applicants to topic SPACE-13-TEC-

SPACE-13-TEC-2019:

GUIDELINES FOR STRATEGIC RESEARCH CLUSTER ON IN-SPACE ELECTRICAL PROPULSION AND STATION KEEPING - HORIZON 2020 SPACE CALL 2019

November 2017

Commission européenne/Europese Commissie, 1049 Bruxelles/Brussel, BELGIQUE/BELGIË - Tel. +32 22991111

applications.

- Further analyse the impact of the thruster on the whole EP system.

Technical Annex

DISRUPTIVE LINE

This section provides additional information in order to clarify what is expected from the proposals to be submitted in response to *SPACE-13-TEC-2019: SRC – In-Space electrical propulsion and station keeping (Disruptive Technologies)*.

This section for the disruptive line is composed by one table (Table 1) providing guidance for the proposals to be submitted and requirements for the technologies or concepts to be developed.

Information is provided on the content and scope that is expected including specific targets for TRL and performances.

Table 1 - Disruptive Technologies

Description and needed Action	The SPACE-13-TEC-2019 also covers a number of alternative thruster concepts that are emerging or have already gained some maturity. If these disruptive technologies can be identified early enough, accelerating the development of those technologies would help to sustain advances in performance and identifying new markets/applications. This topic focuses on promoting the **Research, Technology and Development (RTD) of very promising and potentially disruptive concepts** in the field of Electric Propulsion, in order to increase the currently low TRL (<4) and higher TRL ≥4 of potentially breakthrough thruster concepts and transversal technologies which in the long term could change the EP landscape. **Electric Propulsion thrusters** not part of the Incremental line of the SRC, **shall be the main focus of this Disruptive Technology line**. Proposals are expected for concepts such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, or other innovative thruster concepts not identified here. The activities proposed shall include modelling, development and testing beyond the current state of the art in order to: • Understand fundamental physical processes and their impact on performance. • Improve current thruster performances (thrust, specific impulse, power/thrust ratio, magnetic thrust vectoring, throttability, efficiency, lifetime, noise, etc.). • Progress the development of associated cathodes/neutralisers, if applicable to a thruster. • Investigate alternative propellants to Xenon and/or non-conventional propellants, understood as gases constituting the atmosphere of a planet, such as oxygen, nitrogen and combinations in the case of the Earth, with consideration to potential

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The roadmap for disruptive technologies is based on currently known low and medium TRL concepts such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, and any other innovative electric thruster concepts, **but other thruster types are by no means excluded from it**. A specific topic to be addressed also by disruptive technologies could also be micro-propulsion for scientific applications (but not the ones based on HET, GIE and HEMPT technology).

Additional to thruster technologies, projects dealing with **transversal disruptive technologies** are welcomed. A transversal technology development could address elements which could be common to several thrusters. These are, for example concepts such us:

- direct drive enabling technologies,
- radical innovations in PPU,
- magnetic nozzles,
- alternative propellants,
- testing techniques,
- new materials,
- modelling and simulations codes,
- new PPU and electrical system architecture for EP,
- hybrid solution to drive different types of EP thrusters,
- any other promising and potentially disruptive concept not specifically mentioned, not necessarily related to the technology if is used in a disruptive way,

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Table 1 - Disruptive Technologies	
Description and needed Action	The SPACE-13-TEC-2019 also covers a number of alternative thruster concepts that are emerging or have already gained some maturity. If these disruptive technologies can be identified early enough, accelerating the development of those technologies would help to sustain advances in performance and identifying new markets/applications. This topic focuses on promoting the **Research, Technology and Development (RTD) of very promising and potentially disruptive concepts** in the field of Electric Propulsion, in order to increase the currently low TRL (<4) and higher TRL ≥4 of potentially breakthrough thruster concepts and transversal technologies which in the long term could change the EP landscape. **Electric Propulsion thrusters** not part of the Incremental line of the SRC, **shall be the main focus of this Disruptive Technology line**. Proposals are expected for concepts such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, or other innovative thruster concepts not identified here. The activities proposed shall include modelling, development and testing beyond the current state of the art in order to: • Understand fundamental physical processes and their impact on performance. • Improve current thruster performances (thrust, specific impulse, power/thrust ratio, magnetic thrust vectoring, throttability, efficiency, lifetime, noise, etc.). • Progress the development of associated cathodes/neutralisers, if applicable to a thruster. • Investigate alternative propellants to Xenon and/or non-conventional propellants, understood as gases constituting the atmosphere of a planet, such as oxygen, nitrogen and combinations in the case of the Earth, with consideration to potential applications. • Further analyse the impact of the thruster on the whole EP system. It is important to acknowledge that there might be other elements in the EP system, aside from the thruster, with the ability to provoke a radical disruption. For example, new Power Processing Unit (PPU) concepts or architectures could substantially decrease the overall cost of the system. It is therefore also important and expected some proposals exploring the potential for breakthrough innovation of **Transversal Disruptive technologies**, such as: radical new PPU architectures, direct drive enabling technologies, highly innovative magnetic nozzles, alternative propellants, testing techniques, new materials, simulations codes, hybrid solutions to drive different types of EP thrusters, testing techniques, or any other new concept belonging to the Transversal Disruptive EP technology category not specifically mentioned here. Proposals for thrusters in the Disruptive line should not be based on HET, GIE or HEMPT technologies, or its variants (e.g. micro-HET, micro-GIE, dual-HET, ECR-GIE, etc.).

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References	• Relevant ECSS Standards (www.ecss.nl) for the different elements of the EPS (i.e.: ECSS-E-ST-35C Rev.1 – Propulsion General Requirements, ECSS-E-ST-35-01C - Liquid and electric propulsion for spacecraft, ECSS-E-ST-10-03C - Testing) and for the relevant milestone documentation (ECSS-E-ST-10C). • Proposers are invited to consult other EPIC public documentation available under www.epic-src.eu (EPIC website)
Proposals indicative content	• Proposals shall include an initial work package dedicated to the requirements, as well as an analysis of the different potential impacts. • Proposals shall go beyond the present state of the art, preferably the expected state of the art at the time of completion if alternative technologies are being developed outside Europe. • Proposals shall explain and be ready to demonstrate how the proposed concept meets the disruptive definition proposed in this call topic and what is it the expected impact of the development in the EP landscape, including the timeframe. • Persistent monitoring of the state of art within the EP sector throughout the project will be important, and developments should ideally be planned with some degree of flexibility in order to be responsive to innovations not currently foreseen which could have a potential impact on EP systems (e.g. new materials or manufacturing techniques). • Proposals shall demonstrate the readiness and interest to carry developments further on through future calls, by including a long-term development plan aiming to reach the higher TRLs in 2023-2024 targeted in the EPIC Roadmap Disruptive Line. A Task in the project should be dedicated to this topic. • Proposals shall also include a validation and verification plan, including milestones and one or more validation and verification methods to apply through the course of the project, which would allow to verify how the development targets are being met and how the landscape disruption shall take place in the future. These plans shall be analysed in depth through a dedicated work package within the project.

	• Proposals shall seek synergies while avoiding duplications with already existing or planned developments by other entities in Europe, such as ESA, EU-FP, EU-H2020, National Space Programmes and commercial initiatives.
Expected Deliverables	At least the following Deliverable documentation has to be provided according indication provided in ECSS-E-ST-10C and include but it's not limited to: • Business Plan including Market Analysis, • SRR, PDR, and CDR (if applicable depending on the TRL) data packages including Technical Specification, System Design, Preliminary Design Report including justifications, Design and Development Plan, Test and Verification Plans, Test and Verification Reports, according to the relevant ECSS Standards. • Risk Assessment and Contingency Analysis report (yearly), • KPIs report (yearly), • Cost Assessment (development phases), • Dissemination and educational public material: Activity and results presentations, papers and articles presented, photos, posters, videos, professional communication and educational movies; and • Project website.

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Many thanks for your attention

For more information on Horizon 2020 Space:
https://ec.europa.eu/programmes/horizon2020/en/h2020-section/space

For more information on the EPIC PSA activities:
www.epic-src.eu

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