ARTES 4.0 Generic Programme Line Business Applications - Space Solutions
ACTIVITY DESCRIPTION

“Space for Sustainable, Connected and Liveable Cities”

THEMATIC CALL FOR PROPOSALS

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Table of Acronyms

AoF	Authorisation of Funding
APQ	Activity Pitch Questionnaire
ARTES	ESA Advanced Research in Telecommunications Systems Programme
BASS	ESA Business Applications and Space Solutions
ESA	European Space Agency
FP	Full Proposal
GNSS	Global Navigation Satellite Systems
OP	Outline Proposal
OSIP	Open Space Innovation Platform
PSI	Project Security Instruction
SatCom	Satellite Communications
SatEO	Satellite Earth Observation

1. OVERVIEW

This document presents an overview of “Space for Sustainable, Connected and Liveable Cities”, thematic call for proposals issued under the ARTES BASS, 5G and 4S programme lines. The call offers the opportunity to companies to bring forward their business propositions for the development of space-based services to improve citizens’ quality of life and to support city administrators in performing their tasks in a more efficient and sustainable manner.

2. BACKGROUND AND RATIONALE

It is well known that cities are facing numerous challenges that arise from rapid and changing population growth and as well from the effects of climate change. Over 140 experts from 65 countries came together in Riga, Latvia from 16 to 19 April 2024, to draft the outline of the Intergovernmental Panel on Climate Change (IPCC)’s Special Report on Climate Change and Cities[1]. Several trends, challenges and opportunities were identified for scoping this report which includes urban development, urban emissions, urban carbon cycle, heat islands and urban overheating, air pollution, digital communication and transport amongst others.

Rapid increase in the population and consequent migration to the cities lead to an urban development which is often not harmonized and structured. The process may result in cities which are lacking housing and basic infrastructures and hence cannot support a healthy development of the communities. Inequality in standard of living means that those with lower incomes can only afford houses with limited access to basic services (e.g. education, health) or any amenities. Cities undergoing rapid growth are at risk of outbreaks of violence as competition over scarce resources and space intensify[2].

The lack of affordable housing triggers the *urban sprawl phenomenon* which is the rapid expansion of the urbanization of the countryside. In other words, as the urban core/inner city areas become less and less available, citizens expand to areas which are far from the city center and that have low-density population. The issue is that although land may be cheaper, there is a consequent loss of agricultural and open land and increased pollution and congestion. This can contribute to a lower environmental quality[3].

Due to intense concentration of people and related economic activities, air pollution in cities is often higher than in other areas. Unfortunately, air pollution is not the only type of pollution which cities need to deal with as urban waste management is also increasingly important. As cities grow, they also struggle to procure all energy they need for. Ideally they should rely at large extent on clean resources (e.g. solar, electrical) but this not always the case which negatively contribute to pollution.

[1] https://www.ipcc.ch/2024/04/12/scoping-meeting-special-report-climate-change-and-cities/
[2]https://www.sciencedirect.com/science/article/pii/S1877343523001033
[3]https://www.studysmarter.co.uk/explanations/geography/challenges-in-the-human-environment/urban-issues-and-challenges/#:~:text=Urban%20issues%20can%20arise%20from,for%20all%20growing%20urban%20areas.

The challenges described until now are -to different extents- common to all cities, the problem is then exacerbated as each city has its own unique set of questions and issues to solve. This fragmented situation emerged distinctly during the several bilateral ESA had with cities and towns which are participating in the Smart and Green Cities Task Force. Here below the most recurring use cases, as outlined by the city practitioners, have been categorized. It is worthwhile to mention that some cities have expressed interest to act as pilot user to validate in pre-operational scenario the developed solutions.

3. OBJECTIVES OF THE CALL

The objective of this call for proposals is to support proposals for feasibility studies and demonstration projects for space-based services to support Industry in the development of sustainable services which benefit both big cities and small- and medium-size towns. Topics of relevance (but are not limited to) are listed here below:

Sustainable Cities (Urban Sustainability)

- **Requalification of abandoned industrial areas**: the deindustrialization process which has started in the last 50 years has posed a new challenge to several cities especially in Europe. With the trend of globalization of trade and markets for several manufactured goods (e.g. automotive, chemical, steel), thousands of warehouses and factories have been abandoned. These industrial ruins generate a series of negative externalities in terms of visual, noise and safety for the city and they are also an environmental threat because they become a wasteland and the risk of potential contamination with the soil, water etc. Cities are well aware of that and have started several projects aimed at the requalification of the abandoned industrial buildings to create innovative sustainable neighbourhood with e.g. multipurpose mall, urban parks, modular houses, and others. Before planning a project of urban improvement, the local administrators need to get a thorough assessment of the current situation because often they do not have all relevant data of that particular industrial area. For example, it is important to know the status of air quality in the surroundings, information on the current buildings in terms of potential capacity of solar-based energy, status of connection to the urban centre, availability of communication, and others. In order to install of solar panels it is required to acquire data on e.g. inclination of the roof, area available in the roof, duration of sun exposition, material, etc. .
- **Local energy production**: Smart cities are increasingly turning to renewable energy sources to power their infrastructure. Solar panels[4], wind turbines, and advanced energy

[4] https://www.researchgate.net/publication/377807519_Solar_power_integration_in_Urban_areas_A_review_of_design_innovations_and_efficiency_enhancements

storage solutions will be integrated into the urban landscape to reduce carbon footprints and enhance energy resilience. Energy harvesting offers a solution to the current energy problem facing Internet of Things (IoT) networks by enabling the physical or chemical extraction of ambient energy from natural or artificial environmental sources. Europe's march towards smart cities is underpinned by the development of local energy systems. These systems are not merely infrastructural projects; they are social endeavours that bring communities together, empowering them to take ownership of their energy futures[5].

- **Circular economy**: Cities account for 85% of global GDP generation and are also huge collectors of materials and nutrients, accounting for 75% of natural resource consumption. Cities also produce 50% of global waste and 60-80% of greenhouse gas emissions[6]. Smart cities are embracing circular economy principles to reduce waste and promote sustainability. Initiatives such as recycling programs, waste-to-energy projects, and the promotion of eco-friendly products and practices will be at the forefront of urban sustainability efforts. Implementing the circular economy in cities can bring tremendous economic, social, and environmental benefits.

Connected Cities (Urban Infrastructure)

- **City walkability:** A walkability score is a measure of how easy it is to walk to amenities, services, and other destinations from a specific location. This score considers factors such as proximity to shops, restaurants, parks, public transportation, and more. The walkability of a neighbourhood or commercial property can significantly impact its value and desirability. Commercial properties with high walkability scores tend to attract more foot traffic and potential customers. Businesses located in areas with high walkability scores benefit from increased visibility and accessibility, leading to higher sales and profitability.
- **Optimizing traffic flow:** several cities have a good overview of the vehicles moving in the urban territory at a given moment thanks to the data collected by in-situ sensors, however, still they frequently struggle with traffic congestion, leading to increased travel times, pollution and ultimately reduced quality of life. Developing more efficient and sustainable urban transportation systems, reducing congestion and improving safety, require an optimization of the traffic flow. The local administrators know how many cars can be present but they need information on the general pattern of the movements: where are they coming from? where are they heading to? what is the time distribution of the traffic over 24 hours?
- **Improving street lighting management**: improving the distribution of lights in the streets is a matter of security as well of energy efficiency. and pollution for the wildlife as it can affect the animal behaviour and the sky Once installed, street lights are rarely,

[5] https://www.beesmart.city/en/smart-city-blog/renewable-energy-in-urban-communities-a-path-to-sustainable-urbanization

[6] https://www.ellenmacarthurfoundation.org/cities-and-the-circular-economy-deep-dive

if ever, taken out therefore it is of paramount importance to design and plan them properly and install them correctly. If they are distributed too densely there might be waste of energy and increased pollution, if they are too sparse vehicle and pedestrian safety could be at risk. Smart sensors could be used also to monitor the lights in the streets for on-going maintenance savings, long-term energy savings and to facilitate short return on investment. As street lighting account for about 30-50%[7] of a city's total electricity consumption, impacting the energy demand of the city, guidelines and solutions offering energy savings while preserving citizens' safety are required.

- **Affordable housing:** a lack of affordable housing causes issues in equality and adequate housing conditions. Cities and local authorities need to embrace a novel strategy which sees at the center the promotion of efficient access and use of innovative processes such as circular and modular building, production of renewable energy as well as engagement models to empower residents and local communities[8]. A better knowledge of the surrounding environment, the resources available and an adequate land use planning are certainly useful instruments that the city administrators can use for effective affordable housing provision. Moreover in the planning of new housing it should be taking into account **the accessibility to urban infrastructure** (e.g. including transport systems, water supply, sanitation, energy networks, waste management, and digital connectivity). As needed such infrastructures need to be upgraded or expanded. Sustainable urban development means following integrated approaches that are responsive to the needs of local stakeholders, communities and the natural environment which reduce pollution and preserve natural resources with improvements in transportation and housing, public safety and health and social amenities[9].

Liveable Cities (Urban Environment)

- **Air pollution:** SDG target 11.6.2, aims to reduce the environmental impact of cities by improving air quality[10]**.** Cities are critical actors in driving climate ambition forward, reducing air pollution and improving human health and well-being. If more cities tackle climate change and air pollution together, this will amplify collective efforts to limit the rise in global temperature to 1.5° C. As such, it is vital that today's urban economies and infrastructure projects do not set cities on a path to high-carbon and high-pollution futures[11]. Outdoor and indoor air pollution cause respiratory and other diseases and are important sources of morbidity and mortality. WHO data show that almost all of the global population (99%) breathe air that exceeds WHO guideline limits and contains

[7] https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/streetlight-epc_guide-european-en.pdf
[8]https://single-market-economy.ec.europa.eu/sectors/proximity-and-social-economy/social-economy-eu/affordable-housing-initiative_en
[9]https://toposmagazine.com/sustainable-urban-development/
[10] https://www.who.int/teams/environment-climate-change-and-health/air-quality-energy-and-health/policy-progress/sustainable-development-goals-air-pollution
[11] https://unu.edu/article/tackle-climate-change-and-air-pollution-together

high levels of pollutants, with low- and middle-income countries suffering from the highest exposures.

- **Managements of urban parks** as any other green areas in the cities need to be well designed to be integrated in the land use and need as well adequate maintenance to ensure that their vital functions are intact, for instance, to mitigate urban heat island effects by creating cooling buffer zones and by creating areas shaded. Urban parks are successful natural carbon sinks with high potential sequestration. Urban vegetation and greenery are promoted as a successful mitigation measure for climate change due to their ability to capture carbon for the growth of the vegetation[12]. For many countries in Europe- and not only- develop a strategy to make heating and cooling more efficient and sustainable is a priority and cities can not step back, they must put forward solutions to improve energy consumption from the buildings and to increase the outdoor comfort conditions by cooling the temperature. Green areas as mitigate the effects of urban heat islands facilitate the achievement of both goals. The green spaces provide comfort to the nearby occupants and to improve energy efficiency of their houses and they also improve the urban air quality by reducing the air pollutants.

4. SPACE ASSETS AND DIGITAL TECNOLOGIES

Satellite technologies and data have a significant role to play within prospective services:

Earth observation (EO): SatEO for mapping and monitoring environmental conditions such as urban sprawl, boundary/feature delineation and change detection, air quality measurements, soil quality, heat signatures and fire detection. It can also support the development of Digital elevation/surface models and topography measurements.

Example of applications supported by SatEO include:

- Mapping of urban sprawl and spatial analysis enabling planners to design efficient infrastructure, optimise land use, and monitor environmental changes.
- Integration of satellite derived air pollution data with ground-based monitors to develop spatially resolved maps of air pollution
- Digital Twin generation for asset management and planning
- Provision of mapping information, feature characterisation, boundary delineation and change detection.
- Monitor and manage natural resources to assist in the site selection for new housing or other type of urban infrastructure projects.

[12]https://www.sciencedirect.com/science/article/abs/pii/S2213138822001163

SatEO observations can also provide time-series data which are important to assess the impact of new projects.

Satellite navigation (SatNav): GNSS enables ubiquitous high accuracy PNT technologies to support accurate and seamless positioning provided by GNSS, 5G and other complementary terrestrial and on-board systems. GNSS is also needed to geo-locate the data measured in the urban territory on pollution, environment, light etc

Example of applications supported by SatNav include:

- Providing context-specific navigation and proximity notifications to help citizens and visitors know what's happening around them.
- Supporting smart traffic management by monitoring vehicle movements and traffic patterns. Real-time traffic updates and navigation assistance helping alleviate congestion.
- Location based services and navigation analytics to keep visitors safe and crowds flowing.
- Providing route optimisation for both traffic and walkability.
- Enhance navigation for emergency services ensuring faster response times, making streets safer.

Satellite Communication (SatCom): SatCom play a vital role in providing robust and reliable connectivity to support smart city infrastructure. A smart city uses Internet of Things (IoT) to collect real time data to better understand how demand patterns are changing and respond with faster and lower-cost solutions. The existing 4G network was designed primarily to enhance mobile data services, however it still suffers from numerous limitations. These limitations include poor support for simultaneous connections, high power consumption and too high a price per bit. 5G is expected to unlock the potential of the IoT and be a driving force for the smart city by addressing and overcoming these issues. 5G wireless connectivity can also help eliminate the need to run cabling to IoT devices

Example of applications include:

- Enhancing the number of connected nodes, so that several IoT devices (smart streetlights, smart building, air pollution sensors, surveillance cameras etc) can be connected through the same ecosystem.
- Smart parking systems to provide a robust connection between a network of vehicle occupancy sensors and a Cloud-based management system.
- Smart waste management systems to notify authorities when containers are full, optimizing pick-up schedules.
- Delivering quick and reliable, machine-time communication with greatly reduced latency.

- Support emergency response efforts, keeping first responders and city officials in communication with one another when terrestrial networks may be down or severely damaged.

5. SCOPE OF THE CALL

The proposals submitted under this Call for Proposals shall address the smart cities domain with innovative user-driven downstream services which rely on using satellite technology/data (any of those mentioned above).

The Bidder has two options for addressing use-cases in their proposal: either address the optional use-cases included in the Annexes (available on the website), or address other use-cases and requirements related to the Call by involving other customers or users directly. If choosing the latter, the Bidder must provide letters of interest from these potential customers as evidence of their support, which should be attached to the Outline Proposal (the second step in the application process). Both options will be considered equally in the evaluation process

The service provider shall be identified and be part of the bidding team to ensure the commercial operational roll-out of the proposed service following completion of a demonstration project.

This Call for Proposal covers two types of activities:

1. **Feasibility Studies** which provide the preparatory framework to identify, analyse and define new potentially sustainable services.

   The applications and/or services covered by the proposed Feasibility Studies must:

   - **Be customer - and user-driven:** proposals should demonstrate a clear understanding of user needs and present a strong potential for sustainability.
   - **Leverage integrated space assets:** propose a service demonstrating the benefits of the utilisation of integrated space assets.
   - **Include a plan to test business hypotheses:** a plan should be included that details how the user desirability, technical feasibility, and commercial viability of the service will be tested.
   - **Target marketed readiness:** Aim to evolve the targeted applications and services to marketability and operational roll-out, potentially through a Demonstration Project after successful completion of the Feasibility Study

2. **Demonstration Projects** dedicated to the implementation and demonstration of pre-operational services.

   The applications and/or services covered by the proposed Demonstration Projects must:

   - **Be customer- and user-driven**: Active user involvement is essential throughout the project, including their participation in defining requirements, validating results, and contributing to the pilot activities.
   - **Showcase the value of space assets**: Proposals must clearly demonstrate how the utilisation of space technologies provides a distinct advantage, with a strong potential for long-term sustainability.
   - **Deliver measurable socio-economic benefits**: The project should quantify its impact, highlighting improvements in efficiency, sustainability, or other key outcomes that align with user and societal needs.
   - **Ensure user participation**: Representatives from the target user communities must actively engage in the project, including participation in the pilot phases to ensure alignment with their requirements and expectations.

The goal of Demonstration Projects is to validate pre-operational services in a real-world environment, paving the way for scaling and operational deployment.

To apply to a demonstration project, the Bidder is required to have addressed the key technical and business risks associated with the proposed project, and to have established a solid business plan including clear support from prospective customers.

6. PROCUREMENT APPROACH

The proposals submitted in reply to the call shall be implemented in the context of ARTES 4.0 Generic Programme Line “Business Applications – Space Solutions”, “Space Systems for Safety and Security” (4S) and “Space for 5G/6G and Sustainable Connectivity” Strategic Programme Lines in coordination with National Delegations.

The Bidder shall submit first an Activity Pitch Questionnaire, and following evaluation, may be invited to submit the Outline and Full Proposal. The Activity Pitch Questionnaire (APQ) template provided by ESA shall be used. This is considered as entry point for companies to submit their idea, providing a simplified and single point of access to the ESA ARTES framework.

The price of activities carried out in a given State are charged against the contribution of that State in the programme. A letter of Authorisation of Funding (AoF) from the relevant National Delegation is therefore required as part of the Full Proposal. The Bidder is however advised to inform the relevant National Delegation(s) when submitting the Pitch. The contact information of the National Delegates can be found here:
https://artes.esa.int/national-delegations.

The Agency will admit for evaluation only (Outline and Full) proposals from a bidding team composed of a company and/or organisations (be it Prime or Subcontractor) residing in any of those states that subscribe to the Programme under which you wish you submit your proposal:

I) **for the ARTES 4.0 BASS Generic Programme Line:** Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Sweden, Switzerland and the United Kingdom.
II) **for the ARTES 4.0 Space for 5G/6G and Sustainable Connectivity Strategic Programme Line:** Austria, Belgium, Finland, Germany, Greece, Hungary, Ireland, Italy, Luxemburg, the Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom and Canada.
III) **for the ARTES 4.0 Space Systems for Safety and Security (4S) Strategic Programme Line:** Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxemburg, Norway, Portugal, Romania, Spain, Switzerland, the United Kingdom and Canada.

7. PROCESS AND SCHEDULE

It is planned for the call for proposals to be opened on **28th March 2025** until **30th September 2025**, 13:00 CET.

7.1 Timeline and procedure

The Bidder shall submit first an **Activity Pitch Questionnaire,** and following evaluation, may be invited to submit the **Outline Proposal** and subsequent **Full Proposal.** The Activity Pitch Questionnaire (APQ) template provided by ESA shall be used, which is considered as entry point for companies to submit their idea. The details of the APQ can be found here: Open Space Innovation Platform - OSIP - Channel: APQ for ARTES Downstream Business Applications

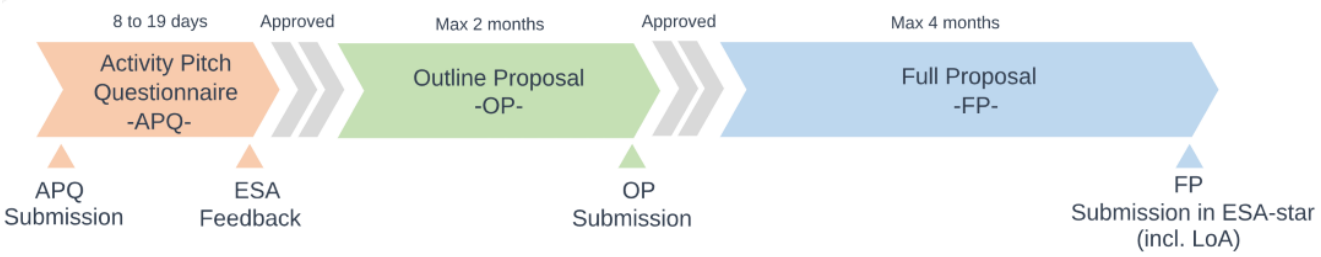

Figure 11: Application steps

This Call is planned to be implemented according to the following stepwise approach.

Step 1: APQ Submission

In Step 1, the interested Bidders are requested to submit their proposal(s) based on a short Activity Pitch Questionnaire (APQ) template made available by ESA that can be downloaded from the Thematic Call website. The pitch should provide the initial idea of what the Bidder would like to propose, elaborated on the basis of the thematic areas and either the use cases proposed by ESA's partners or others selected by the Bidder. If the Bidder has the relevant information available to them, they may consider completing the supplementary questions (AP5) in the APQ template as part of the APQ+, which may allow to skip Step 3 below, at ESA's discretion.

Should the bidder wish to cooperate with any of the listed partners in the annexes, they shall give to the Agency the authorisation to distribute the activity pitch questionnaire to these stakeholders by explicitly stating it in the Activity Pitch Questionnaire. Subject to such authorisation, the Agency will follow up distributing the APQ to the bidder's authorised stakeholder(s) and liaise with them to facilitate interactions with the Bidder.
The completed Activity Pitch Questionnaire (APQ) shall uploaded using the online web submitter, ESA's open space innovation platform (OSIP) in the channel named "APQ for ARTES Downstream Business Applications".

Multiple Pitches with different ideas can be submitted.

It is strongly recommended that the interested Bidder liaises from the beginning with the relevant ESA Member States Delegates.

Step 2: APQ Evaluation

In Step 2, following an assessment of the pitch by ESA, ESA will provide feedback to the company, aiming to provide a reply within 10 working days following the deadline for submission of the pitch.

It is recognised that some interactions with the Bidder may be required, and ESA may therefore consult with the Bidder and may offer support in providing further clarifications, aimed at better shaping the Outline Proposal(s). Dialogue sessions may be organised individually with potential partners prior to Step 3.

ESA might also consult, when necessary, with the relevant National Delegation(s) for orientation and will provide key information (e.g. title, cost, price, subcontractor) to the relevant National Delegation(s).

Subject to a positive evaluation of the pitch and the Bidder having informed the National Delegation(s), the Bidder will be notified by ESA and invited to submit an Outline Proposal. Note that the APQ+ can act as a substitute for the Outline Proposal, thus if having adequately answered the additional questions included in the APQ+, the Bidder may be able to skip Step 3.

Step 3: Outline Proposal Submission

In Step 3, the Bidder will submit the Outline Proposal, based on a template provided by ESA, with letter(s) of interest from users/stakeholders. The Outline Proposal expands upon the pitch

with a more extensive level of details. The Bidder will be allowed 2 months from ESA's approval of the APQ to the submission of their Outline Proposal. The outline proposal shall be submitted on the OSIP platform under the channel "Outline Proposal for ARTES Downstream Business Applications – Feasibility Studies/Demonstration Projects".

Step 4: Full Proposal Submission

In Step 4, subject to a positive assessment from ESA and in-principle support from the National Delegations, the Bidder will be invited to submit a Full Proposal on ESA-STAR in accordance with BASS programme line. The Bidder will be allowed 4 months from submission of their Outline Proposal to submit their Full Proposal on ESA-STAR.

A letter of Authorisation of Funding (AoF) from the relevant ESA National Delegation is required as part of the Full Proposal. The Bidder is however advised to inform the relevant National Delegation(s) when submitting the Pitch. The details of the National Delegates can be found here: https://artes.esa.int/national-delegations.

After the Bidder have submitted a Full Proposal with the Authorisation of Funding (AoF) from the relevant National Delegation(s) and following a positive assessment by ESA, the proposed activity will be approved for implementation.

7.2 Evaluation Criteria

The evaluation process is non-competitive, as each proposal will be assessed individually on its own merits, according to the evaluation criteria applicable for CALL FOR PROPOSALS FOR DOWNSTREAM APPLICATIONS IN ARTES 4.0 (esa star ref.: 1-10494).

More information for the assessment of the APQ and outline proposal stages can be found on the OSIP page "APQ for ARTES Downstream Business Applications".

More information on the evaluation criteria for the final proposals can be found within the document "Appendix 1 to AO/1-10494/20/NL/CLP (Issue 2.2) " which can be found on ESA-STAR at the following link under "Tender conditions".

8. GENERAL CONDITIONS

The submissions and all correspondence relating to it shall be in English.

The tender shall not contain any Classified Information, whether in the APQ, Outline Proposal or in the Full Proposal. To avoid any confusion with Classified security markings, the unclassified protective marking used by the Tenderer in the proposal shall not contain the terms: "Restricted", "Confidential", or "Secret".

However, should the Tenderer consider necessary to include Classified Information in the tender, the Tenderer shall inform beforehand the ESA Security Officer.

The Tenderers are informed that Classified Information can be shared with ESA only in compliance with the Project Security Instruction (PSI) duly established by the Agency beforehand and subject to the approval by the ESA Member States.

The Agency will treat commercially sensitive or proprietary information confidentially and solely for the purpose of the assessment of the response.

Expenses incurred in the preparation and dispatch of the response to the announcement will not be reimbursed. This includes any expenses connected with a potential dialogue phase.
The announcement does not bind the Agency in any way to place a contract. The Agency reserves the right to issue amendments to the announcement.