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FOREWORD

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Having taken office as Director General of the European Space Agency (ESA) quite recently, it is my pleasure to state an ESA view on space and its future. This provides a context to the information listed in this edition European Space Directory, which once more constitutes a reference publication for the complete space sector.

Space has become part of our everyday lives. But space is not just nice to have. It is indispensable for our modern lifestyle and the functioning of our societies. Without space there would be no exact timing, no ubiquitous communication, no reliable energy provision and no financial transactions, just to name a few examples. Space provides infrastructures that would be too costly or complex to realize terrestrially.

There is also the security and defence dimension of space, an aspect that has become even more obvious in the wake of the Ukraine war. If our economies and societies depend on space nowadays, it might be ever more so when it comes to security. Whether in civil security at home, or during humanitarian operations abroad and even modern conflicts, states can no longer do without space data and every possible space-based resource can have a relevance in this regard, either directly or indirectly: positioning, navigation and timing, remote sensing, secured communications, and even science.

Given this reliance, space assets need to be protected from natural threats, such as solar flares, to man-made threats like cyber attacks, spoofing, jamming, blinding, eavesdropping, or debris caused by voluntary destruction.

And of course, space has an important economic dimension. The global space industry could generate revenue of US\$ 1 trillion or more in 2040, up from currently US\$ 350 billion.

Against this backdrop, space is witnessing global changes and undergoing a fundamental transformation. This evolution, or even revolution, is often referred to as “New Space”. It comprises various elements. On the technical side, it features new trends and challenges like mini or nano satellites, mega constellations, and the use of Artificial Intelligence and Machine Learning. On the non-technical side there are new actors – often private ones from outside the traditional space sector –, new business models, new sources of funding like venture capital and an evolving political and regulatory context.

In parallel, commercial space activities are growing quickly. New Space approaches have led to smaller, narrow purpose focused satellites and reduced launch cost. This has led to lower prices of space products and services and to faster innovation cycles.

ESA is ready to take up this challenge. Our guideline is the ESA Agenda 2025, which was published last year. ESA Agenda 2025 features five main priorities:

- Strengthening ESA-EU relations
- Boosting commercialization for a green and digital Europe
- Developing space for safety and security
- Addressing critical program challenges
- Completing the ESA transformation

In a nutshell, ESA's Agenda 2025, sets out a vision for how Europe can seize the opportunity of the current revolution in space activities to help make a green, digital, safe and inclusive world. Current flagship programmes such as Copernicus, Galileo and potential futures ones such as Secure Connectivity will continue to be a focus for collaboration between key European stakeholders, first and foremost ESA and the European Union.

But new initiatives will also be needed, and partners need to coordinate their collective efforts efficiently.

In October last year, I called upon a High-Level Advisory Group to make recommendations on the main societal challenges representing priorities for this reinforced cooperation. The Group underlined the importance of accelerating the use of space in Europe through realizing the benefits of space by so called Accelerators and Inspirators. Three Accelerators and two Inspirators have been suggested:

The “Space for a Green Future” Accelerator will provide European decision-makers, industry, and society with essential tools and solutions to reach the objectives of the Green Transition. Digital Twins of the Earth will allow to perform predictive scenario analysis. Green Transition Information Factories will provide tools to monitor compliance and the results of their efforts at local and global scales. New quantum sensors will enable measurements of essential Earth processes at unprecedented precision. The Space for a Green Future accelerator constitutes a decisive step to act and directly contribute to the decarbonization challenge. It will deliver space solutions for smart green transportation reducing CO₂ emissions, and it will support smart management of energy grids.

The Rapid Resilient Crisis Response Accelerator will improve Europe's response to crisis events related to climate change as those events are dramatically increasing in frequency, severity and impact. It will help save lives and reduce the cost of crisis to the citizens and society. It will enable more timely and resilient action in extreme weather events but also during climate-induced emergencies and natural disasters. It will help to ensure uninterrupted supply of clean water, energy, and food, and will allow the re-establishment of critical telecommunications and transport infrastructures as well as industrial supply chains. It will also stimulate more commercial service offers in this domain.

The PROTECT Accelerator will ensure Europe's ability to protect assets from space debris and space weather interferences. For this, it will establish the actionable information and timely warnings that Europe needs to prevent disruption of economically vital space and ground infrastructure and guarantee European independence in accessing and operating in space. The PROTECT Accelerator will build on existing initiatives, enhance competitiveness of the European space sector and follow a coordinated European approach. As one of the objectives, it will foster the sustainable use of orbits by preparing the technology for debris-free spaceflight, including active removal and in-orbit servicing technologies. It will contribute to the establishment of an operational space debris system. And it will establish an operational space weather system.

The three Accelerators proposed are chosen as the priorities for Europe's collective efforts to increase the use of space for the benefit of its citizens, the environment and the economy. They

will be excellent investments – because the cost of not accelerating is enormous. As an example, the journal Nature estimates that if human beings fail to reduce greenhouse gas emissions to the levels designated in the Paris Agreement, the economic cost could reach as much as \$792 trillion by 2100.

All three Accelerators share characteristics that make them stand out from all other possible areas of activity. First, the problems they tackle are of such a scale, significance and rate of growth that they must be urgently addressed at a European level. Second, space has either an extraordinary advantage over or essential contribution to comparable terrestrial solutions. Finally, the wide range of public and private sector actors involved means that collective coordination and collaboration is essential. In line with this approach, the Accelerators will consist of building blocks to allow for a tailored and flexible geometry.

On top of the three Accelerators the High-Level Advisory Group advised to consider two Inspirators. The first one would consist of preparatory steps towards a sample return mission from icy moons of giant planets. Such an icy moon sample return mission would greatly reinforce European leadership in space science and demonstrate Europe independence for deep-space capabilities, including power, large space structure management, high data-rate deep space optical communications and refuelling. The mission would also help answering one of the oldest questions of mankind: Is there life outside Earth?

And as a second inspirator, it was suggested to investigate the technical, political, programmatic and economic relevance of developing European-made human-rated space transportation solutions. The capacity to launch astronauts into space would provide Europe with outstanding opportunities to play the role it deserves in future international endeavours related to space exploration.

At their meeting in Matosinhos in November 2021, ESA's Member State ministers mandated ESA to take forward the development of the Accelerators and Inspirators. The High-Level Meeting of European ministers in charge of space matters at Toulouse also expressed strong support in February 2022.

ESA's Ministerial Meeting in November 2022 will be the next important milestone in getting ready for the future. There, ESA will propose an attractive suite of programmatic elements to its Member States, and it will also ask seed funding for the Accelerators and Inspirators. Climate change and sustainability solutions, along with activities to open up new markets, will be central components of the package.

The overall volume to be suggested is around 16 B€ including 2 B€ for commercialisation activities – money well invested in the future of Europe and its citizens.