European Commission

SCIENCE FOR POLICY BRIEF

TRIMIS insights

Research and Innovation on Drones in Europe

HIGHLIGHTS

→ 152 European projects from the TRIMIS database focus on drone research and innovation. Their total budget exceeds 813 million EUR with EU contribution of over 500 million EUR.

→ R&I activities align with the European priorities as set in the Drone Strategy 2.0.

→ Significant technical progress has been made towards the development of U-space, drone vehicle concepts and their energy and propulsion systems.

→ Half of the projects explored environmental or socio-economic impacts of drones, mostly their impact on safety, security and privacy.

INTRODUCTION AND POLICY CONTEXT

In 2022, the European Commission published the Drone Strategy 2.0[a]. The document sets the framework to accelerate the development of the European drone sector and integrate large-scale commercial drone operations into European airspace. The strategy aims to accomplish several objectives related to drone transport safety, security, and sustainability. It also aims to advance innovation and competitiveness within the European Union (EU) drone sector, drive progress in the regulatory framework, and address social acceptability.

With this context this policy brief aims to highlight recent European research and innovation activities focusing on drones and their main achievements. Its content is based on an in-depth review of the scope and progress made by 152 R&I projects included in the Transport Research and Innovation Monitoring and Information System (TRIMIS) database.
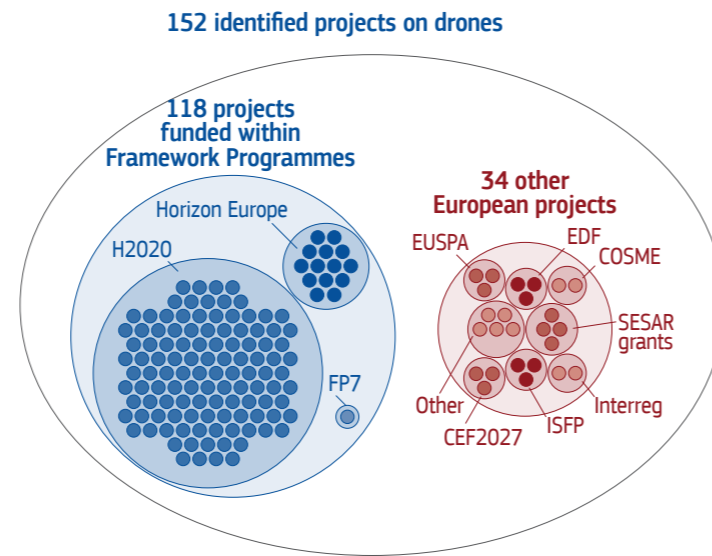
This analysis covers three main aspects: EU research and innovation in **drone technologies**, research on **environmental and socio-economic impacts of drones**, and research and innovation **support for policy initiatives**. Conclusions discuss future research and open policy questions.

Joint Research Centre

RESEARCH AND INNOVATION HIGHLIGHTS

The identified projects have been funded from a diverse variety of funding sources and programmes. Most are funded within Framework Programmes, primarily from Horizon 2020. They are all funded within main existing funding schemes. Remaining projects received support through ten different programmes. Moreover, The EU partnerships, particularly *Clean Aviation* and *SESAR 3 JU*, including their predecessors, played a crucial role in funding the projects that formed the foundation for this study.

The EU contribution varies from 50,000 EUR to over 50 million EUR per project. to over 56.7 million EUR. The average amount of EU contribution exceeds 3.3 million EUR. However, the median of EU contribution is lower (1.5 million EUR) due to high number of SME-1 projects with the lump sum of 50 000 EUR.

Overview of drone projects in TRIMIS database
and their funding source

152 identified projects on drones

118 projects funded within Framework Programmes
- Horizon Europe
- H2020
- FP7

34 other European projects
- EUSPA
- EDF
- COSME
- SESAR grants
- Other
- CEF2027
- ISFP
- Interreg

Active projects and their average monthly EU contribution
by source of funding in the period from October 2013 to January 2024

Number of projects
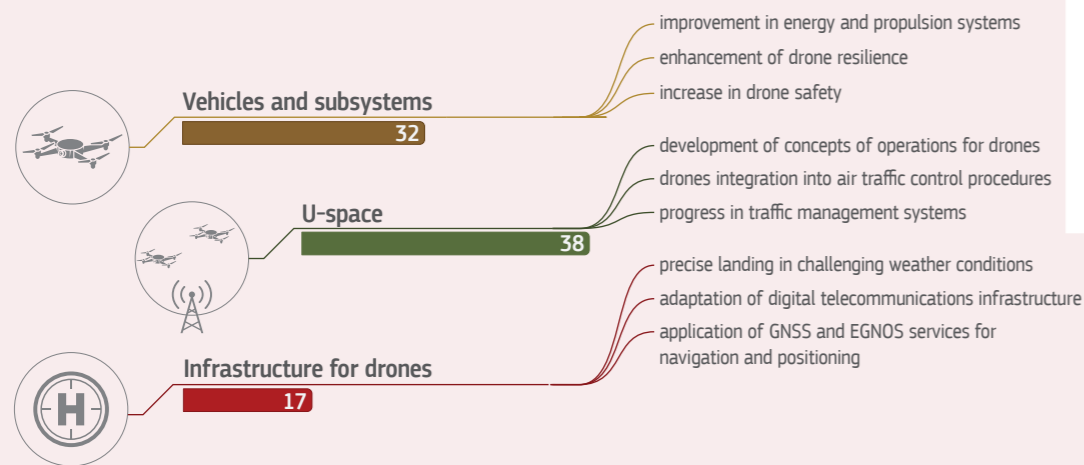
EU contribution (m EUR)

2014 2017 2020 2023
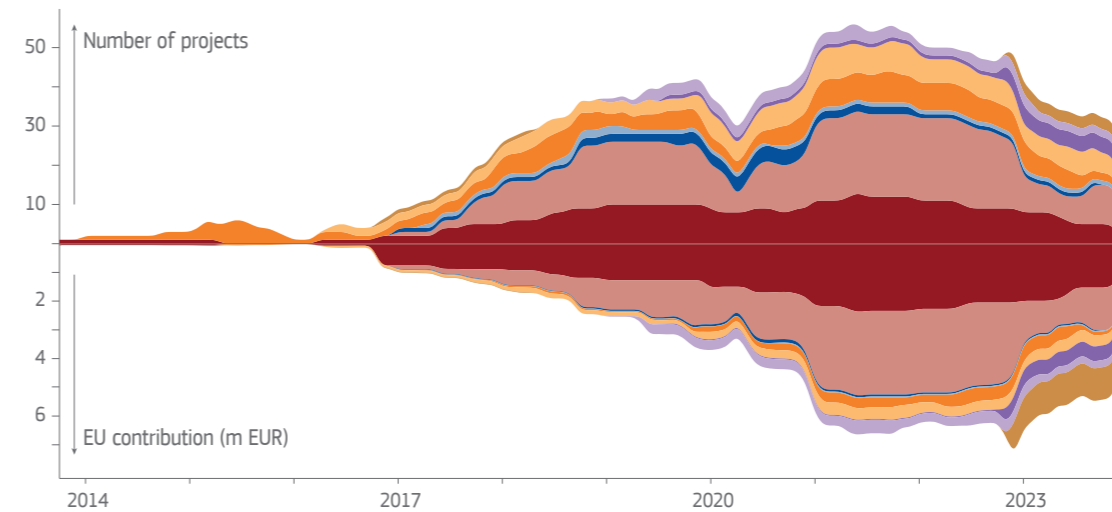
All the presented data is available at JRC Open Data Repository [c]

Total number of projects

European Defence	4
Governance and Security	5
CEF and Interrreg	5
Digital and space	15
SMEs and enterprises	37
Science and research	3
Clean Aviation	4
Digital Europe Sky	45
Sustainable Transport	21

Total EU contribution (m EUR)

|	
Sustainable Transport	135
Digital Europe Sky	160
Clean Aviation	4
Science and research	2
SMEs and enterprises	56
Digital and space	27
CEF and Interrreg	19
Governance and Security	23
European Defence	47

Key achievements in drone technologies
and number of projects with significant contribution by technology themes

Vehicles and subsystems 32
- improvement in energy and propulsion systems
- enhancement of drone resilience
- increase in drone safety

U-space 38
- development of concepts of operations for drones
- drones integration into air traffic control procedures
- progress in traffic management systems

Infrastructure for drones 17
- precise landing in challenging weather conditions
- adaptation of digital telecommunications infrastructure
- application of GNSS and EGNOS services for navigation and positioning

Support for policy

Over 72% of the analysed R&I projects address policy aims and contribute to the Drone Strategy 2.0 flagship actions. They focus on safety rules and requirements for airspace and aircraft, research and innovation strategies, and civil, security, and defence industry capabilities. The projects also contribute to integrating U-space with air traffic management and addressing specific operational risk assessment for drone applications.
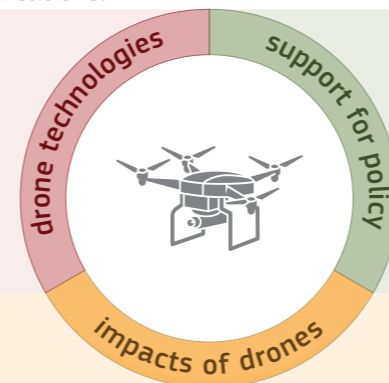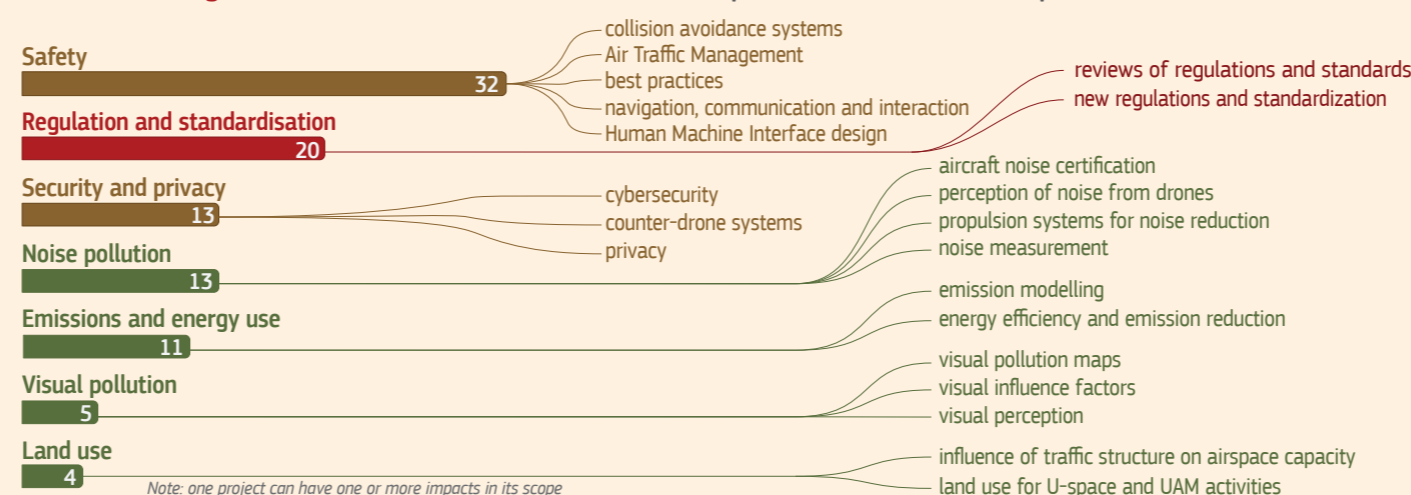
drone technologies / support for policy / impacts of drones
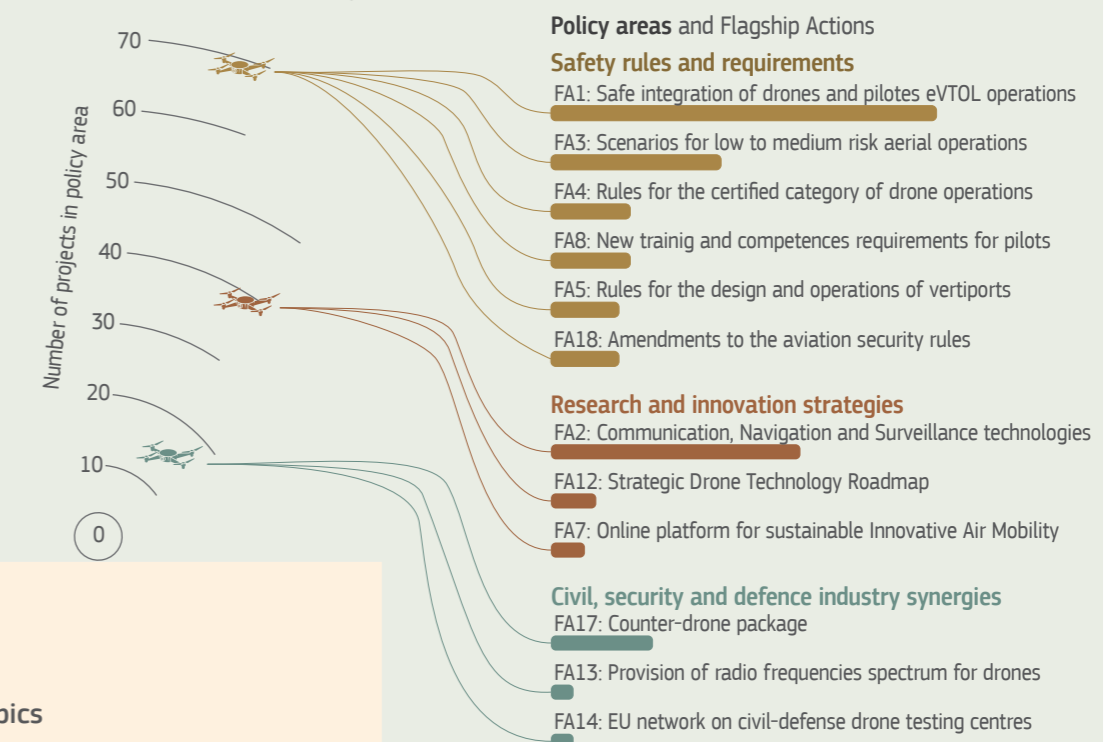
Progress in technologies for drones

Development has been noted in the technologies for the holistic design of drones. Achievements include advancements in propulsion systems, enhancing energy efficiency, extending range, and increasing payload capacity. Projects also improved safety of drones and their resilience in challenging conditions. U-space developments include traffic management in urban airspace, increased flight operation density, trajectory optimization, and communication. Progress included air traffic management integration into intermodal networks, better collision avoidance systems and efficient autonomous navigation. Large-scale demonstrations tested U-space concepts in operational environments. Projects also covered infrastructure for drones, including improved power supply, charging infrastructure, and landing systems.

Number of projects with environmental and socio-economic impact of drones
or works on regulations and standardisation in their scope and main research topics

Safety 32
- collision avoidance systems
- Air Traffic Management
- best practices
- navigation, communication and interaction
- Human Machine Interface design

Regulation and standardisation 20
- reviews of regulations and standards
- new regulations and standardization

Security and privacy 13
- cybersecurity
- counter-drone systems
- privacy

Noise pollution 13
- aircraft noise certification
- perception of noise from drones
- propulsion systems for noise reduction
- noise measurement

Emissions and energy use 11
- emission modelling
- energy efficiency and emission reduction

Visual pollution 5
- visual pollution maps
- visual influence factors
- visual perception

Land use 4
- influence of traffic structure on airspace capacity
- land use for U-space and UAM activities

Note: one project can have one or more impacts in its scope

Alignment of projects with policy areas and Flagship Actions

Number of projects in policy area

Policy areas and Flagship Actions

Safety rules and requirements
- FA1: Safe integration of drones and pilots eVTOL operations
- FA3: Scenarios for low to medium risk aerial operations
- FA4: Rules for the certified category of drone operations
- FA8: New trainig and competences requirements for pilots
- FA5: Rules for the design and operations of vertiports
- FA18: Amendments to the aviation security rules

Research and innovation strategies
- FA2: Communication, Navigation and Surveillance technologies
- FA12: Strategic Drone Technology Roadmap
- FA7: Online platform for sustainable Innovative Air Mobility

Civil, security and defence industry synergies
- FA17: Counter-drone package
- FA13: Provision of radio frequencies spectrum for drones
- FA14: EU network on civil-defense drone testing centres

Impact of drones

Half of the projects explored environmental or socio-economic impacts of drones or focused on regulations and standardisation. Safety was the most investigated topic, with progress achieved in air traffic management, collision avoidance systems, and human-machine interface design. Projects provided recommendations for urban air mobility safety, and proposed modifications to existing regulations. Advancements have been made in surveillance technologies and early warning systems. Also noise pollution and emissions have been widely explored.

RESEARCH NEEDS AND POLICY IMPLICATIONS

The rapid growth of drone technology research and innovation is reshaping aerial mobility and logistics. The open research areas cover addressing the environmental and socio-economic impact of drones, integrating new technologies such as artificial intelligence and robotics, and ensuring the safe and secure integration of drones into European airspace. Policy needs include fostering research and innovation, ensuring safe integration into European airspace, minimizing operational risks, addressing privacy and security concerns, and promoting environmentally friendly drone technologies.

Research needs in drone technologies

The current funding effort is largely oriented to U-space and digital infrastructure projects. However, there is equally a need for a strategic vision for unmanned aircraft technology. Critical drone technologies such as robotics and semiconductors, and dependence on third-country suppliers and know-how are not currently addressed. This indicates a need for further synergy between transport and digital EU partnerships. Additionally, collaborative efforts should be directed towards energy storage and propulsion systems for drones, based on collaboration with the BATT4EU and Clean Hydrogen partnerships. Physical infrastructure should equally be addressed following developments in vehicles and U-space. This topic will need to be addressed from urban planning and land use perspectives, as well as to meet charging requirements and grid integration.

Open questions in impacts of drones

The recent research covers a broad range of potential environmental and socio-economic impact of drones. It particularly focuses on various safety aspects of drone operations, surveillance technologies, and early warning systems as well as noise perception and measurement. However, there is a need for further research to address safety concerns, including certification procedures, market surveillance, and cybersecurity for urban air mobility technologies. Further studies should also focus on enhancing counter-drone systems, addressing privacy concerns, defining global standards for cybersecurity, and promoting a privacy culture within the commercial drone industry. Additionally, research should analyse suitable locations for new enabling infrastructure and the indirect influence of drones on land use patterns. Life-cycle assessment of drones under different operational scenarios, recycling or reuse of batteries, and evaluation of new propulsion systems from a life-cycle perspective are also crucial research topics. Further research is needed to understand the impact of noise from drones on local fauna. Finally, research is needed to define robust methodologies for quantifying visual impact of drones.

Support for policy initiatives

The reviewed research and innovation activities align well with the policy aims set in Drone Strategy 2.0, particularly on safety. Projects have contributed to integrating U-space with air traffic management, developing advanced U-space services, and conducting risk assessment for drone operations. Policy needs include fostering research and innovation, ensuring safe integration into European airspace, minimizing operational risks, addressing privacy and security concerns, and promoting sustainable drone technologies.

REFERENCES

[a] EC, *A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe*, European Commission, 2022.

[b] Stępniak M. et al., 2024, *Research and Innovation on Drones in Europe. An assessment based on the Transport Research and Innovation Monitoring and Information System (TRIMIS)*, Publications Office of the European Union, Luxembourg, doi: https://data.europa.eu/doi/10.2760/02357, JRC137334.

[c] Stepniak, M. et al., 2024: *Research and Innovation on Drones in Europe - list of projects*. European Commission, Joint Research Centre [Dataset] PID: http://data.europa.eu/89h/eb94ade1-42c3-4b5d-919d-5befd14e1f38

CONTACT INFORMATION

EU-TRIMIS@ec.europa.eu

DISCLAIMER

The Brief is based on the JRC Science for Policy Report [b].
The views expressed here are purely those of the JRC TRIMIS team and may not, under any circumstances, be regarded as an official position of the European Commission

EU Science Hub
joint-research-centre.ec.europa.eu