UK – Germany Space Sector Comparative Study

Wales and Baden - Württemberg in focus

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Executive Summary

This report compares the space ecosystems of the United Kingdom (UK) and Germany, with a particular focus on Wales and Baden-Württemberg, to identify areas of complementary strength, strategic gap, and practical opportunity.

It is intended to support more informed bilateral engagement between both nations, and both regions, with emphasis on collaboration, foreign direct investment, and export potential. The work also supports implementation of the Wales – Baden-Württemberg Shared Statement of Cooperation and the UK – Germany Kensington Treaty by providing a clearer evidence base for future engagement (Welsh Government, 2023; UK Government, 2025)[1],[2].

The analysis shows that both the UK and Germany are major European space actors, but with somewhat different profiles. The UK has built a strong position in commercially oriented space activity, small satellite manufacturing, downstream applications and services, satellite communications, navigation-related services, and professional support services. Its strategic challenge is less about the existence of capability than about scaling, adoption, sovereign depth in selected areas, and translating technical strength into broader market capture. Germany, by contrast, is defined by the depth of its engineering base, research infrastructure, manufacturing capability, and strong role within European cooperation. Its central challenge is to convert this strong institutional and industrial position into faster NewSpace growth, stronger commercial scaling, more competitive access-to-space capability, wider downstream uptake, and greater resilience in security-relevant and digital infrastructure domains.

At regional level, Wales and Baden-Württemberg show a similarly complementary relationship. Wales has developed a space ecosystem that is notable for agility, strong test and evaluation potential, and a growing identity in applications and niche advanced manufacturing. Its main challenges relate to scale, depth, and ecosystem completeness, particularly in finance, anchor customers, larger-scale manufacturing, broad downstream adoption, and some of the enabling layers needed to commercialise and retain growth. Baden-Württemberg, meanwhile, is a key space-enabled industrial region in Germany, with deep strengths in engineering, specialist manufacturing, propulsion-related activity, testing, and research-led innovation. Its main challenges lie in scaling start-ups, strengthening downstream digital and data-enabled commercialisation, developing more integrated affordable mission architectures, and broadening the commercially oriented workforce required to translate research and engineering excellence into larger market outcomes.

[1] Welsh Government, 2023. Wales strengthens cooperation with German state of Baden-Württemberg through signing of a joint declaration. [Online] Available at: https://www.gov.wales/wales-strengthens-cooperation-german-state-baden-wurttemberg-through-signing-joint-declaration [Accessed 26th March 2026].

[2] UK Government, 2025. Treaty between the United Kingdom of Great Britain and Northern Ireland and the Federal Republic of Germany on friendship and bilateral cooperation. [Online] Available at: https://www.gov.uk/government/news/treaty-between-the-united-kingdom-of-great-britain-and-northern-ireland-and-the-federal-republic-of-germany-on-friendship-and-bilateral-cooperation [Accessed 26th March 2026].

Taken together, these findings suggest strong scope for cross-border engagement built on complementarity rather than duplication. For the UK and Germany, there are clear opportunities around advanced manufacturing, scientific payloads, secure connectivity, resilient data infrastructure, Earth Observation (EO) services, sustainability, and space safety and security. For Wales and Baden-Württemberg, there is particular promise in manufacturing, testing and evaluation, engineering, mission planning, sustainable space, launch-enabling services, return-from-orbit related activity, and the development of practical cluster-to-cluster relationships. These are areas in which targeted trade, inward investment, and collaborative programmes could generate mutual benefit.

The report, therefore, concludes that the strongest opportunities do not lie in either side trying to replicate the other. Rather, they lie in using ecosystem differences strategically: matching Welsh and UK agility, service strength, and commercial orientation with German and Baden-Württemberg industrial depth, engineering excellence, and research capability. If pursued through structured partnership mechanisms, this could support stronger bilateral trade, more targeted investment attraction, and more durable collaboration between institutions, firms, and clusters.

Introduction

This report has been prepared to support a more structured understanding of the space ecosystems of the United Kingdom and Germany, with particular focus on Wales and Baden-Württemberg. Its purpose is to identify areas where comparative strengths, strategic priorities, and ecosystem gaps create opportunities for collaboration, foreign direct investment, and export between both nations, and between the two focal regions. In doing so, it is intended not simply as a descriptive mapping exercise, but as a practical tool to inform engagement, relationship-building, and future economic activity.

The report sits within a wider project developed through Welsh Government Agile Cymru funding. That project was designed to strengthen links between Wales and Germany in the space sector, building on the Shared Statement of Cooperation between the Welsh Government and the German state of Baden-Württemberg. Led by Space Wales in collaboration with the Satellite Applications Catapult (the Catapult), the project used Space Tech Expo Europe 2025 in Bremen as a focal point for engagement, while also supporting the launch of a Wales-branded Space Capabilities Catalogue (SCC) to promote Welsh capability internationally. Following that activity, the project commissioned German ecosystem mapping, prioritising Baden-Württemberg, and this final insights report to identify complementarities, partnership potential, cluster-twinning opportunities, and recommendations for sustained collaboration, trade, and inward investment.

In that sense, the project has had two closely connected purposes. First, it has sought to increase the visibility of Welsh capability and strengthen relationships with relevant German stakeholders, especially in Baden-Württemberg. Second, it has sought to create an evidence base that can guide future action: helping both sides understand where capability strengths align, where gaps on one side could be addressed by strengths on the other, and where there is a strong case for joint activity rather than simple buyer-supplier engagement. The intended result is a clearer foundation for long-term international networking, cluster development, and greater competitiveness for the Welsh space sector within a wider UK – Germany context and beyond.

The comparative structure of the report reflects that objective. It first examines the UK and German ecosystems at national level, considering their strategic histories, present priorities, and capability gaps. It then turns to Wales and Baden-Württemberg as regional ecosystems within those wider national settings. This allows the report to assess opportunity on two levels simultaneously: nation-to-nation and region-to-region. That distinction matters, because some opportunities are best understood through national strategy, scale, and policy; others are more likely to emerge through cluster relationships, regional supply chains, and sub-national specialisation.

Accordingly, the report should be read as an opportunity-identification document. It is intended to help policymakers, cluster organisations, economic development bodies, and industry stakeholders consider where bilateral engagement is most likely to generate practical value. That includes opportunities for UK firms to address German needs; opportunities for German firms to address UK needs; areas where collaboration could strengthen both ecosystems; and, more specifically, opportunities for Wales and Baden-Württemberg to build a more sustained and strategically useful partnership.

Caveats and Limitations

As with all studies, it is important to recognise and acknowledge limitations and highlight appropriate caveats.

The scale and complexity of the space ecosystem presents significant challenges to developing a complete and comprehensive mapping of all supply chain stakeholders, their capabilities, and their activities. It is important to recognise that this analysis, while insightful, may not capture every aspect of the space capability landscape. Mapping has been limited by the availability of data, particularly with respect to private sector infrastructure where providers may not always publicise the full extent of their capabilities for commercial or proprietary reasons. This report may therefore, in certain areas, be limited in its ability to evaluate and analyse all activities and capabilities available to support the realisation of capability goals.

These limitations underscore the importance of interpreting the findings with caution, particularly where generalisations or extrapolations are made. Future research would benefit from additional primary data collection and expanded stakeholder engagement to address these gaps.

For further insights into the organisations and stakeholders working across the UK, Wales, Germany, and Baden-Württemberg space ecosystems, please visit the Catapult's *Space Capabilities Catalogue (SCC)*.

United Kingdom

The United Kingdom Space Sector, Strategies, & Priorities

The UK's Space Story

The story of the UK's journey into space begins in the early 1950s, during the Cold War, when a global race for technological advancement led many nations to look towards space. Spurred by the Soviet Union's Sputnik and America's early space ventures, the UK began developing its own capabilities.

The UK's journey into space began modestly with the Skylark sounding rocket in 1957 and the completion of the Jodrell Bank observatory, which tracked the launch of Sputnik 1 and the descent of the Eagle moon lander. In 1962, the UK launched its first satellite, becoming the third nation to do so. Buoyed by these successes, the UK developed its own launch vehicle, the Black Arrow, in 1971, which successfully placed the Prospero satellite into orbit, launching from Woomera, Australia, and making the UK the sixth nation to launch a satellite with its own rocket.

During the 1980s and 1990s, the UK emerged as a key player in the European space sector, becoming an active and essential member of the European Space Agency (ESA), which it helped establish a decade earlier. British scientists and engineers played leading roles in many of ESA's major missions, from Earth Observation (EO) to planetary science. Concurrently, British industry began to make its mark, revolutionising the use of small, low-cost satellites, proving that they could deliver high-value services at a fraction of the cost of traditional large satellites, thus creating new commercial opportunities and broadening access to space.

At the dawn of the new millennium, the UK strengthened its focus on space by recognising the strategic importance of satellite navigation. It became a key participant in the European Galileo project, an initiative to develop an independent satellite navigation system to rival the American GPS[3]. British companies were heavily involved in building Galileo's satellites and ground infrastructure, highlighting the UK's expanding expertise and growing reputation in satellite technology.

In 2010, the UK reached a milestone with the establishment of the UK Space Agency (UKSA), marking a new era of ambition in space. The government prioritised space as essential for economic growth, national security, and scientific leadership. In 2012, the UK launched its Space Innovation and Growth Strategy (IGS) with an ambitious goal: to capture 10% of the global space market by 2030. This strategy included plans to invest in space infrastructure, promote private-sector innovation, and create a more favourable regulatory environment to attract investment and support new businesses.

The following years saw further expansion as the UK laid plans for its own commercial spaceports. In 2015, the UKSA launched the UK Spaceport Programme with the aim of developing the country's first commercial spaceport, capable of launching satellites. The idea of launching satellites from UK soil, once abandoned with the end of the Black Arrow programme, was back on the agenda.

The UK's space heritage forms the basis of its continuing success and position as a global leader in the sector.
Today, the UK's space sector has evolved from a modest scientific endeavour to a dynamic commercial and strategic industry. The UK is redefining its global role, having recognised space as a key driver for international partnerships, security, economic growth, and sustainability. Since 2000, the sector has more than tripled in size and established itself as a global leader in deriving value from space activities. From satellite manufacturing to data services, the industry contributes some £18.9 billion to the UK economy, with exports accounting for £5.8 billion of that total (UKSA, 2024a)[4].

[3] The UK left the Galileo program when it left the European Union (EU).

[4] UKSA, 2024a. The Size and Health of the UK Space Industry 2023, London, UK: UK Space Agency

Strategies & Priorities

In September 2021, the UK government introduced the National Space Strategy (NSS) (DSIT, 2021)[5] , its first integrated civil-defence plan for space, jointly developed by the Department for Science, Innovation and Technology (DSIT) and the Ministry of Defence (MOD). The strategy presents a 10-year vision and policy framework to guide government support for the space economy, emphasising economic growth, national security, and international collaboration in space activities.

The NSS outlined five (5) goals, these were:

Goals

- ***Goal 1:*** Grow and level up our space economy
- ***Goal 2:*** Promote the values of Global Britain
- ***Goal 3:*** Lead pioneering scientific discovery and inspire the nation
- ***Goal 4:*** Protect and defend our national interests in and through space
- ***Goal 5:*** Use space to deliver for UK citizens and the world

To achieve these goals, the UK set out to grow existing strengths, establish global leadership in some of the largest and fastest growing markets in the space sector, and to lay the foundations to put the UK space sector in a position to fully capitalise on emerging space technologies and markets:

Grow existing strengths in:

- Manufacture of spacecraft and complex payloads
- Communications and high-end navigation terminals
- Mobility broadband services
- Professional supporting services

Develop our leadership in high-growth areas of:

- EO applications and services
- Navigation applications and services
- Space Domain Awareness
- Satellite broadband

Lay the foundations for leadership in emerging sectors such as:

- In-orbit servicing
- Active debris removal
- In-space manufacturing
- Space travel and habitation
- Space-based energy
- In-situ space resource utilisation

The desire to work in partnership to deliver opportunities that impact globally and drive economic benefits, has never been stronger.

[5] DSIT, 2021. National Space Strategy, London, UK: Department for Science, Innovation and Technology.

United Kingdom Space Sector Gap Analysis

Using ecosystem data presented in the Satellite Applications Catapult's Space Capabilities Catalogue as of February 2026, this section identifies where the UK has existing strengths in the priority areas set out in the UK's National Space Strategy. The following segment shall seek to outline, in brief, where the UK already excels and where it needs to develop to meet the objectives set out in the National Space Strategy. Each segment will outline a strategic priority, existing strengths, and areas for development.

Growing Existing Strengths

Manufacture of Spacecraft & Complex Payloads

Expertise

Whilst largely dominated by the likes of Airbus Defence and Space, the UK is a leader in the manufacture of spacecraft and complex payloads with almost ubiquitous coverage of an end-to-end supply chain covering manufacturing through to launch. This is supported by a robust ecosystem of organisations, such as Surrey Satellite Technology Ltd (SSTL), Alba Orbital, AAC-Clyde Space, Spire, and In-Space Mission, that deliver advanced satellite platforms ranging from small CubeSats to large geostationary satellites, with capabilities tailored for EO, telecommunications, and scientific exploration. Expertise in modular designs and payload integration allows the UK to offer high-performance, versatile solutions. Strong collaboration between academia, government, and industry further drives innovation in satellite technology.

Opportunity Area

While the UK has built a strong reputation for manufacturing complex small satellites, there are several key developmental opportunity areas that could help the country achieve its strategic space goals:

- **Advanced Manufacturing:** The UK has strong capability in designing and building complex small satellites, but it is better configured for high-value, low-volume production than for repeatable mass manufacture. The constraint is not a lack of technical competence, but a combination of limited production-scale facilities, fragmented demand, high qualification and assurance requirements, and insufficient long-term order certainty to justify major capital investment in automated manufacturing lines. Without clearer market signals and more scalable production infrastructure, the UK risks remaining strong in bespoke spacecraft manufacture while being less competitive in higher-volume markets. Expanding sovereign manufacturing capacity, alongside investment in automation, additive manufacturing, and modular spacecraft design, would help the UK scale production, improve efficiency, and reduce unit costs.

- **Materials Science & Lightweight Structures:** The UK could strengthen this area through targeted co-development partnerships with countries that already lead in advanced materials, radiation hardening, and high-performance manufacturing. In practice, this would mean joint R&D programmes, shared test and qualification activity, university-industry partnerships, and collaborative mission development in which UK firms contribute spacecraft design, payload integration, downstream applications expertise, or access to complementary markets. The mutual value is that partner countries gain access to UK system integration capability, mission-led innovation, commercial applications expertise, and routes into UK and European programmes, while the UK gains earlier access to advanced materials research and supply chains.

- **High-Performance Scientific Payloads:** The UK already undertakes a significant amount of international collaboration on scientific payloads. The key question is therefore not whether to partner, but how to prioritise partnerships that deliver strategic value. Collaborations should be selected where they align with wider UK objectives, for example by building capability in priority technologies, securing mission heritage, opening access to important programmes or markets, or strengthening the UK's position within longer-term industrial and research relationships. Bilateral mechanisms and partnership frameworks can be useful, but they are most effective when tied to clear delivery pathways, such as co-developed instruments, defined flight opportunities, market access, or follow-on commercial and institutional activity. In that sense, the opportunity is to use collaboration more selectively as a tool of capability-building and strategic positioning, rather than treating all international partnership as equally valuable.

Communications & High-End Navigation Terminals

Expertise

Recognised for its leadership in Communications and High-End Navigation Terminal technologies, the UK excels in developing advanced satellite communication systems for both commercial and secure military applications. This contributes to ensuring global connectivity and is underpinned by organisations like Inmarsat, Intelsat, and Spirent Communications. High-end navigation terminals produced in the UK support precision operations across sectors, including aviation, maritime, and autonomous systems. UK-based innovation increasingly combines communications, navigation, and AI-enabled processing with modern technologies such as 5G, while prioritising resilience against interference and spoofing. This strengthens reliability, situational awareness, and performance for critical infrastructure and emerging autonomous platforms.

Opportunity Area

The UK has established itself in the field of Communications and High-End Navigation Terminals, but there are opportunities to further develop this segment and help the UK achieve its strategic space goals:

- **Strengthen R&D Efforts:** Investing in domestic research and development for satellite communications and navigation technologies is crucial. Establishing dedicated innovation hubs or national research centres focused on satellite communications, HAPS, non-terrestrial networks (NTNs), 5G / 6G infrastructure, and next-generation navigation technologies would help the UK develop more integrated multi-layer communications and positioning architectures, foster innovation, and maintain leadership in this field.

- **Develop Sovereign Systems:** Developing national communication satellite constellations can ensure autonomy and create commercial opportunities. This approach would not only ensure autonomy in communications, but also offer opportunities for commercialisation, such as providing bandwidth for global services, disaster recovery, and support for national security initiatives, leveraging the growing demand for dual-use technologies (those that serve both military and commercial sectors). Developing dual-use satellite technologies would enable the UK to ensure its systems meet both civilian and national security needs, creating a sustainable competitive advantage.

- **Advanced Communication Systems:** Collaborating with leading space nations on next-generation communication technologies, such as high-throughput satellites (HTS), optical communication systems, and quantum-secure communications, can help the UK stay competitive in the global market. Joint projects can enhance the UK's satellite communication infrastructure, strengthen secure and resilient connectivity, and support the roll-out of 5G and future networks. This also creates space for emerging UK capability in quantum communications, including QKD-related activity, to be positioned as part of the next wave of strategic communications technology rather than as a separate niche.

Mobility Broadband Services

Expertise

The UK demonstrates strong capabilities in mobility broadband services, particularly through Eutelsat OneWeb and its wider supply chain, which provide low-latency connectivity across land, sea, and air. This capability is strongest where secure, resilient, and enterprise- or government-grade connectivity is required, and where satellite services are integrated with wider terrestrial networks and mobility platforms. However, compared with providers such as Starlink, the UK-backed position is less scaled in constellation size, mass-market reach, and direct-to-device capability. The strategic implication is that the UK's advantage lies less in competing head-on in commoditised global broadband at extreme scale, and more in higher-value segments that depend on assured service, mobility integration, security, and multi-orbit resilience.

Opportunity Area

The UK can enhance its capabilities in mobility broadband services by focusing on several strategic areas:

- **Investment in Low Earth Orbit (LEO) Satellites:** Developing LEO satellite capability, or securing trusted access to it, could strengthen the UK's connectivity architecture by adding resilience, lower-latency coverage, and diversification alongside terrestrial networks and existing GEO systems. This is particularly relevant where continuity, mobility, and assured service matter, including remote operations, government use, and defence-related communications. Collaboration between government, industry, and international partners could therefore support a more robust ecosystem for satellite-enabled broadband and, over time, inform protected communications architectures, including those relevant to military and national-security payloads and bands such as X-band.

- **Research into Wireless Technologies & 5G Integration:** Research into advanced wireless technologies, such as millimetre-wave communications, ultra-dense network deployments, and dynamic spectrum management, is important to optimise bandwidth and enhance mobile broadband services. By focusing on low-latency and resilient communication systems, the UK can support applications across smart rural connectivity, remote healthcare, health and social care delivery, and wider community resilience, as well as autonomous systems and other advanced use cases. Encouraging collaboration between telecommunications, space, and research sectors will support joint R&D projects, enabling the integration of satellite and 5G networks. This would improve connectivity in remote areas, widen digital inclusion, and strengthen the role of wireless infrastructure in supporting healthier, better connected communities.

- **Regulatory Framework Development:** Establishing clear licensing processes, spectrum management policies, and international coordination mechanisms will help ensure smooth and efficient operations for satellite providers. These frameworks should also address data privacy, security, competition, and resilience, while recognising that civil, commercial, dual-use, and defence-related services may require different assurance levels, operating conditions, and protection measures. By creating a supportive but differentiated regulatory environment, the UK can encourage innovation and new market entry, promote fair competition, and strengthen its position as a hub for satellite-enabled broadband and secure communications, while remaining aligned with international standards and best practice.

Professional Supporting Services

Expertise

The UK has established itself as a global leader in professional supporting services for the space sector, offering expertise in space law, finance, insurance, and policy. The UK represented 34% of global insurance capacity in 2022 (Elson, 2022)[6], with institutions such as Lloyd's of London providing specialised space insurance solutions, covering satellite launches and in-orbit operations. Similarly, the UK has several space law specialists, such as Alden Legal, Fieldfisher, and Foot Anstey. This foundation is further bolstered by consultancy firms that assist with risk management, intellectual property, and market entry, ensuring the UK's leadership, and providing capacity to support global space ventures.

Opportunity Area

The UK has significant opportunities to enhance its professional supporting services within the space sector by:

- **Developing Training Programmes:** Creating specialised training programmes for areas such as satellite operations, space mission planning, space law, data analytics, and space-specific cybersecurity is essential to build a skilled workforce capable of supporting the growing space sector. Partnering with universities, research institutions, and industry leaders can help create accredited training pathways that equip individuals with the technical expertise and practical experience required.

- **Expanding Space Legal & Regulatory Expertise:** Expanding the UK's space legal and regulatory expertise is crucial to managing the growing complexities of space activities. As the space sector evolves, there is an increasing need for robust legal frameworks to address challenges such as space debris management, space traffic management, and space resource utilisation. The UK can strengthen its position by investing in specialised legal expertise within government bodies like the UKSA and the Civil Aviation Authority, ensuring compliance with international treaties and supporting the commercialisation of space ventures. By collaborating with international space agencies and regulatory bodies, the UK can shape the future of space governance and contribute to developing global standards.

  Establishing clear licensing processes, spectrum management policies, and international coordination mechanisms will help ensure smooth and efficient operations for satellite providers. These frameworks should also address data privacy, security, competition, and resilience, while recognising that civil, commercial, dual-use, and defence-related services may require different assurance levels, operating conditions, and protection measures. By creating a supportive but differentiated regulatory environment, the UK can encourage innovation and new market entry, promote fair competition, and strengthen its position as a hub for satellite-enabled broadband and secure communications, while remaining aligned with international standards and best practice.

- **Enhancing Space Cybersecurity Support:** As space infrastructure becomes more integral to global systems, enhancing space cybersecurity support is critical to safeguarding satellites, communications, and data from emerging cyber threats. Developing specialised cybersecurity teams within government agencies such as the National Cyber Security Centre (NCSC), focused on space-specific risks and tailored security protocols, risk assessments, and incident response strategies, would strengthen protection across satellites, communications, and data systems. Collaborating with satellite operators and space agencies, the UK can advance technologies such as encryption, intrusion detection, secure communications methods, and, over time, quantum-resilient approaches including post-quantum cryptography and quantum-secure communications. This would help ensure that UK space systems remain resilient not only to current cyber threats, but also to future cryptographic and security challenges.

[6] Elson, P., 2022. SPACE MARKET UPDATE Q4 2022. [Online] Available at: https://specialty.ajg.com/plane-talking/space-market-update?overlay=2022-Q4-Space [Accessed 04th November 2024].

Develop Our Leadership

Earth Observation (EO) Applications & Services

Expertise

The UK has continuously strengthened its use of geospatial and EO capabilities, and is a renowned leader in EO applications and services, leveraging its strong data analytics and GIS expertise. Organisations such Geospatial Insight, Alcis, Earth-i, Rezatec, and the National Centre for Earth Observation (NCEO) develop innovative EO technologies for monitoring climate change, disaster response, agriculture, and urban planning. The UK excels in processing and analysing EO data, increasingly using AI and Machine Learning to generate actionable insights. Additionally, partnerships with ESA and commercial ventures ensure continuous innovation and global competitiveness in EO services.

Opportunity Area

Perhaps one of the more mature capability areas in the UK. The UK has expertise in EO data and data processing through organisations which provide EO data, such as the Met Office, ARGANS, Open Cosmos, and Surrey Satellite Technology Ltd (SSTL), as well as those which have expertise in processing geospatial data to provide digestible and actional insights, including 1Spatial, CGI, Cyient, Earthwave, and Pixalytics. Furthermore, the UK is present in European and international activities around data integrity, standards, and trustability.

- **Application & Services Adoption:** One sizable opportunity area is around the adoption of EO Applications and Services as commonplace. Encouraging the adoption of EO technologies across sectors is important to unlock their full potential and drive innovation. To achieve wider uptake, it is necessary to demonstrate the practical benefits of EO, such as improved decision-making, cost savings, enhanced sustainability, and better targeting of interventions in both densely populated and hard-to-reach areas. By promoting awareness, facilitating access, and offering support, EO technologies can enable businesses and governments, both domestic and overseas, to harness space-based data for a wide range of applications, from environmental monitoring and disaster response to smart urban management, rural land use, infrastructure monitoring, and agricultural resilience.

Navigation Applications & Services

Expertise

Positioning, Navigation and Timing (PNT) satellite signals from space are becoming increasingly vital to daily life, supporting essential services, infrastructure, security, defence, and the digital economy. the UK is rapidly advancing in navigation applications and services, with a focus on resilient and high-precision systems for a range of critical sectors, evidenced by a potential estimated economic loss to the UK of £7.6bn due to a GNSS outage of 7-days (DSIT, 2023)[7]. The UK Space-Based Positioning, Navigation, and Timing (PNT) Programme was established in 2020 to identify alternatives to Global Navigation Satellite Systems (GNSS), reducing dependency on external providers (UKSA, 2021)[8]. The UK has maintained its leadership in PNT within ESA and globally by fostering innovation and developing new technologies, products, and services. It has also adapted its commercial focus and shaped government programmes to align with national priorities.

Opportunity Area

Another of the UKs more mature capability areas, increasing domestic capabilities and a clearer focus on fostering partnerships to address sector-specific requirements, through high profile interventions such as UKSA's Connectivity in Low Earth Orbit Programme, the UK is approaching a point where it can balance domestic provision with strategic international sourcing.

- **Application & Services Adoption:** Perhaps the most pertinent opportunity area is the wider adoption of navigation applications and services across both civil and military use cases. Encouraging uptake is crucial to realising their full value across sectors such as transport, logistics, agriculture, autonomous systems, critical infrastructure, and defence-related operations. To accelerate adoption, the UK should demonstrate the practical benefits of these technologies in terms of efficiency, safety, resilience, and continuity, while also integrating AI to strengthen data fusion, automation, and decision support. The UK can facilitate this by showcasing dual-use case studies, providing clear value propositions, and developing platforms, standards, and support models that make navigation solutions easier to access, integrate, and scale for businesses and public users alike.

  Additionally, fostering collaboration between public and private sectors, along with providing specialised training and support, would ensure that users have the skills and resources needed to integrate these solutions effectively. By enhancing awareness and providing the tools necessary for seamless adoption, the UK can accelerate the uptake of navigation technologies, driving innovation and improving efficiency across industries such as transport, logistics, agriculture, and autonomous vehicles.

[7] DSIT, 2023. The economic impact on the UK of a disruption to GNSS - Executive summary, London, UK: Department for Science, Innovation & Technology.

[8] UKSA, 2021. Guidance: Space Based PNT Programme, London, UK: UK Space Agency.

Space Domain Awareness

Expertise

The UK demonstrates significant strengths in Space Domain Awareness (SDA), leveraging advanced tracking, monitoring, and data analysis capabilities to enhance orbital safety and security. Through the UK Space Operations Centre (UKSpOC), investments in technologies like the Deep Space Advanced Radar Capability (DARC), and partnerships with private companies, foster collaboration across academia, industry, and government. Collaborations with international initiatives, such as the *Combined Space Operations Initiative*, position the UK as a key stakeholder in global efforts to develop frameworks for space traffic management and mitigate risks in increasingly congested orbits. The UK's innovation, infrastructure, and regulatory maturity position it as a potential global leader in responsible space governance and operations.

Opportunity Area

The UK has significant opportunities to enhance its Space Domain Awareness (SDA) capabilities:

- **Development of Space Traffic Management Systems (STM):** Creating systems for monitoring and managing space traffic is essential to ensure safe operations and prevent collisions. By investing in cutting-edge technologies, such as AI-powered analytics and advanced sensors, the UK can enhance its ability to manage space traffic efficiently. Collaboration with international space agencies and private sector innovators will also be essential in creating global standards and shared frameworks for space traffic management. Developing robust STM systems will not only enhance the safety and sustainability of space operations, but also position the UK as a key player in the growing space economy.

- **Space Debris Detection & Mitigation:** Developing technologies for space debris detection and removal is crucial to maintaining the sustainability of orbital operations. The UK could lead in developing innovative debris mitigation technologies, such as deployable nets, robotic arms, or laser-based systems to safely remove debris from critical orbits. By collaborating with global space agencies and private companies, the UK can contribute to the creation of shared solutions and frameworks for debris removal, enhancing the safety and longevity of satellite constellations. In doing so, the UK can reinforce its role as a responsible spacefaring nation, while driving advancements in space sustainability technologies.

- **Monitoring & Protecting Critical Space Infrastructure:** The UK could enhance its capabilities by investing in advanced surveillance systems to monitor satellite constellations, ground stations, and other space assets for potential threats, including cyber-attacks, signal interference, and physical damage. The UK should further develop robust security protocols and integrated monitoring networks to strengthen infrastructure resilience. By prioritising the protection of critical space assets, the UK can ensure the reliability of essential services while positioning itself as a leader in space security and resilience.

Satellite Broadband

Expertise

The UK is a global leader in satellite broadband, driven by initiatives like OneWeb, which deploys Low Earth Orbit (LEO) constellations to provide high-speed, low-latency internet access worldwide. These services bridge connectivity gaps, delivering broadband to underserved and remote regions, supporting economic development and social inclusion. The UK's emphasis on integrating satellite broadband with terrestrial 5G and 6G networks enhances global mobility and resilience. This leadership extends to military applications, disaster recovery, and enabling cutting-edge technologies such as autonomous systems and IoT connectivity. UK Government investments in satellite enabled connectivity demonstrates a commitment to national security, economic opportunities, space industry leadership, and international collaboration (DCMS, 2022; UKSA, 2024b)[9] [10].

Opportunity Area

The UK has a significant opportunity to leverage satellite broadband to address pressing domestic connectivity challenges:

- **Bridging the Digital Divide:** By leveraging satellite technology, the UK can overcome the limitations of terrestrial infrastructure, delivering reliable connectivity to rural communities across the UK and beyond. This improved access would enable greater participation in remote education, telehealth services, and digital commerce, fostering economic growth and social inclusion. Investing in satellite broadband solutions not only addresses immediate connectivity challenges, but also ensures that all regions of the UK can benefit from advancements in the digital economy, reducing disparities and unlocking new opportunities for innovation and development.

- **Supporting Future Technologies & 5G Integration:** Satellite broadband offers a strong opportunity to support future technologies and should integrate seamlessly with 5G networks, enabling more robust and ubiquitous connectivity. By complementing terrestrial 5G infrastructure, satellites can extend coverage to remote and rural areas, strengthen network reliability, and provide fail-safe connectivity in emergencies. Collaborating with telecom providers and investing in advanced satellite technology would help position the UK at the forefront of next-generation communications, while also creating a useful domestic testbed for capabilities that could later be exported internationally. In that sense, UK deployment can act not only as an infrastructure solution at home, but also as a practical sandpit in which technologies, service models, and integration approaches are demonstrated, refined, and then taken to overseas markets.

- **Satellite Broadband Adoption:** Encouraging the adoption of satellite broadband is essential to unlocking its full potential and driving the associated societal and economic benefits. Public awareness campaigns and targeted subsidies can help make satellite broadband more accessible to underserved communities, ensuring equitable digital inclusion. Collaborations with local authorities, businesses, and educational institutions can showcase the transformative potential of satellite broadband in areas such as remote learning, telemedicine, and small business growth. Additionally, fostering partnerships with industry stakeholders to lower costs and improve service reliability can boost consumer and organisational confidence in adopting the technology. By integrating satellite broadband into broader digital infrastructure strategies, the UK can accelerate its adoption, ensuring widespread connectivity and supporting the growth of a more inclusive and innovative digital economy.

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[9] DCMS, 2022. UK to accelerate research on 5G and 6G technology as part of £110 million telecoms R and D package. [Online] Available at: https://www.gov.uk/government/news/uk-to-accelerate-research-on-5g-and-6g-technology-as-part-of-110-million-telecoms-r-and-d-package [Accessed 04th December 2024].

[10] UKSA, 2024b. Satellite communications to improve connectivity in remote areas. [Online] Available at: https://www.gov.uk/government/news/satellite-communications-to-improve-connectivity-in-remote-areas [Accessed 04th December 2024].

The Foundations for Leadership

In-Orbit Servicing

Expertise

The UK has an ambitious vision to position itself as a global leader in the in-orbit economy. Within In-Orbit Servicing, the UK seeks to focus on technologies that extend the operational life of satellites and maintain orbital assets. The sector has attracted inward investment from global companies, like Astroscale, Orbit Fab, and D-Orbit, who are pioneering solutions for satellite refuelling, repair, and repositioning, thereby reducing costs and resource waste. The UK Space Agency (UKSA) has also actively supported In-Orbit Servicing through grants and collaborations with the likes of ESA, driving advancements in robotic systems and autonomous servicing missions. This expertise supports commercial satellite operators, whilst enhancing sustainability through the mitigation of debris risks associated with increasingly congested orbital environments.

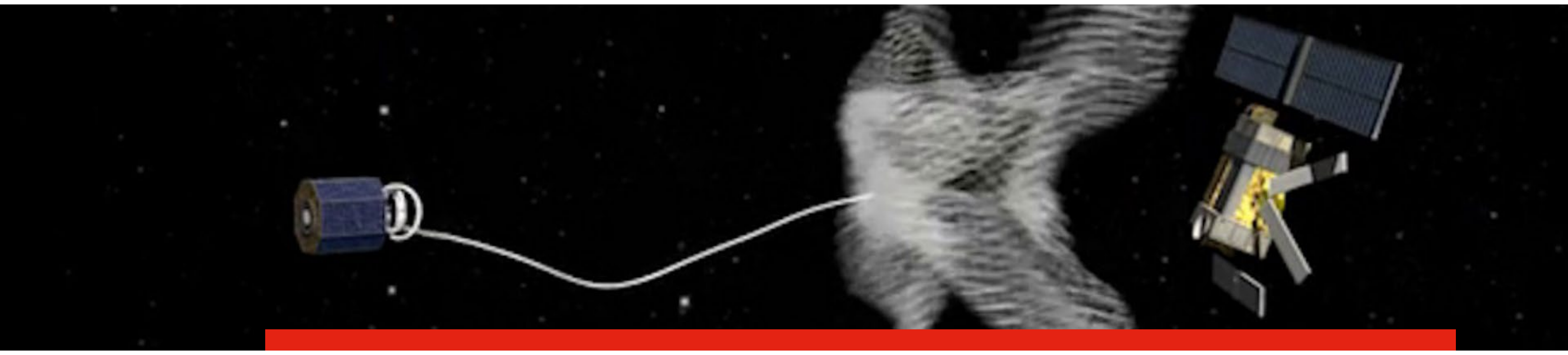
Opportunity Area

In-Orbit Servicing could represent a significant growth area for the UK, building on its existing strengths in satellite manufacturing and robotics:

- **Life Extension Services:** Developing technologies for in-orbit refuelling, repairs, and upgrades is essential to reduce the need for costly replacement launches and maximising the value of existing satellite assets. Autonomous servicing spacecraft equipped with advanced robotics and AI could enable these missions, supporting operators in sectors like telecommunications, EO, and defence. Investing in life extension capabilities would not only bolster the UK's position as a leader in satellite servicing, but also contribute to global efforts to create a more sustainable and efficient space environment.

- **De-Orbiting & Debris Removal:** Creating technologies for capturing and de-orbiting space debris is crucial to maintaining a secure space environment. The UK could lead in this area by developing innovative technologies, such as robotic arms, nets, or tether systems, to capture and de-orbit defunct satellites and large debris. By investing in these technologies and fostering collaboration between academia, industry, and government, the UK can position itself as a global leader in space sustainability.

- **Modular & Reconfigurable Satellites:** Modular and reconfigurable satellites offer a transformative approach to satellite design, allowing in-orbit upgrades, repairs, or reconfigurations to adapt to evolving mission requirements. By investing in modular architectures, the UK can reduce the need for costly replacement launches and enhance the flexibility and longevity of satellite operations. These systems enable the integration of new payloads or technologies, ensuring that launched and active satellites remain relevant in a rapidly changing technological landscape.



Active Debris Removal (ADR)

Expertise

The UK is developing innovative technologies to tackle the growing issue of space debris. These include capture mechanisms, such as magnetic docking systems, for safely de-orbiting defunct satellites and debris fragments. Supported by the UKSA and international partnerships, the UK contributes to global sustainability efforts by reducing collision risks in orbit.

The UK led the **RemoveDEBRIS** mission, the first-ever European ADR demonstration, and UK-based ClearSpace and Astroscale are conducting **CLEAR** and **COSMIC**, the world's first commercial ADR mission[11]. With an increasing focus on commercialisation, regulation, and innovation, the UK is positioning itself to lead in this critical area for the long-term sustainability of space operations.

Opportunity Area

The UK is well-positioned to lead in Active Debris Removal by leveraging its strengths in robotics and satellite engineering:

- **Debris Capture Technologies:** The development of debris capture technologies is essential for addressing the growing challenge of orbital congestion and ensuring the sustainability of space activities. The UK could design and manufacture advanced systems to safely and efficiently capture and remove defunct satellites and large debris. These technologies can prevent collisions that endanger active satellites and critical infrastructure, safeguarding key orbital pathways. The UK could establish itself as a leader in space debris removal, enhancing both its technological reputation and its contributions to global space sustainability.
- **Multi-Function Spacecraft for Servicing & ADR:** Developing multi-function spacecraft capable of both satellite servicing and ADR offers an opportunity to optimise space operations. These versatile spacecrafts could perform tasks such as refuelling, repairing, or upgrading operational satellites while also removing defunct satellites or debris from orbit. By combining these capabilities, mission costs can be reduced, and ADR can be made more commercially viable and scalable. Investing in multi-function spacecraft would strengthen the UK's competitiveness in the global space economy.
- **Policy & Regulatory Frameworks:** Defining robust policy and regulatory frameworks for ADR is essential for fostering innovation and ensuring the long-term sustainability of space activities. The UK could lead in defining clear guidelines on liability, ownership, and operational standards for ADR missions, providing certainty for industry stakeholders. Active participation in international discussions can help shape global agreements on debris removal responsibilities. A strong regulatory framework would position the UK as a leader in sustainable space governance, creating a competitive advantage for its industries while driving global collaboration on orbital debris management.

[11] The two companies received £2.25m and £1.7m in funding from UKSA, and aim to remove two defunct British satellites from orbit by 2026.

In-Space Manufacturing

Expertise

The UK is actively developing In-Space manufacturing capabilities, with notable example such as Space Forge providing early national strengths in microgravity-enabled advanced materials manufacturing and return technology. This is particularly relevant in high-value materials where the space environment may produce performance advantages that are difficult to achieve on Earth. Supported by the UKSA and ESA, efforts include advanced additive manufacturing techniques for creating components directly in orbit. These innovations aim to reduce reliance on Earth-based launches and enable the production of next-generation materials, such as optical fibres and pharmaceuticals, positioning the UK as a key player in the growing space economy.

Despite these advancements, the UK lacks established infrastructure for in-space manufacturing. the wider ecosystem remains comparatively early-stage: orbital production platforms, cargo transfer systems, docking infrastructure, and repeatable in-space logistics are still thin relative to the more mature capabilities emerging elsewhere. The strategic question is therefore not whether the UK has any capability, but whether it can scale a differentiated niche before larger players establish broader industrial advantage. This places the UK behind competitors like the United States, where companies such as SpaceX and Northrop Grumman are actively testing and deploying advanced space logistics solutions.

In practice, the UK's most defensible position may lie less in competing across all forms of generic in-space manufacturing, and more in specialising in areas where it can combine space-based production with existing domestic strengths, especially compound semiconductors and other advanced substrates linked to power electronics, telecommunications, quantum, and defence applications.

Opportunity Area

In-space manufacturing offers significant opportunities for the UK to expand its capabilities:

- **Advanced Additive Manufacturing in Microgravity:** By leveraging its existing expertise in additive manufacturing and materials science, the UK could develop, for example, 3D printing technologies designed to operate in the unique environment of space. These systems would enable on-demand production of critical tools and components, reducing the dependency on costly Earth-based launches. Testing these systems aboard platforms such as the ISS or UK-led missions could showcase the UK's leadership in innovative space solutions.

- **Development of In-Orbit Manufacturing Platforms:** Establishing In-Orbit Manufacturing platforms would enable the UK to gain a foothold in the growing In-Space manufacturing market. The UK could leverage its expertise in robotics and precision engineering to create infrastructure for manufacturing and assembly in space. These platforms could produce high-value materials or facilitate the construction of large-scale structures, benefiting multiple industries while demonstrating the UK's commitment to fostering sustainable and innovative space activities.

- **Modular Manufacturing for Long-Term Space Missions:** The ability to assemble large structures in orbit represents a game-changing opportunity for the UK to lead in long-term space exploration. Modular manufacturing systems could enable the construction of expansive structures such as solar power arrays, orbital telescopes, or habitats for human exploration. With its strengths in robotics and precision engineering, the UK is well-positioned to develop these platforms, opening the door to ambitious projects that could drive international collaboration and solidify the UK's role in the space economy.

Space Travel & Habitation

Expertise

The UK is beginning to establish itself in the emerging field of space travel and habitation, leveraging its expertise in advanced engineering, robotics, and sustainable technologies. The UK's involvement in international projects, such as lunar habitat design and Mars exploration, showcases its potential to contribute to off-world activities. Collaborations with commercial spaceflight providers could further the UK's position to develop infrastructure and technologies necessary for long-term human presence in space. These efforts align with global ambitions to establish sustainable space habitats, from orbiting platforms to extraterrestrial colonies.

Opportunity Area

The UK is a relative newcomer only in the sense that it does not possess a large, sovereign human spaceflight programme of its own. In practice, UK capability already contributes to international human spaceflight through ESA and Airbus participation in the European Service Module for NASA's Artemis missions, as well as through newer initiatives such as the UK Space Agency's agreement with Axiom Space on a potential UK astronaut mission. The strategic question is therefore not whether the UK is involved, but how it chooses to build on that involvement, selectively and credibly, in areas where it can add value through industrial contribution, technology development, science, and mission participation. Potential opportunity areas include:

- **Lunar Habitats:** International collaborations on lunar habitats offer the UK a chance to grow its role in human space exploration through enabling systems that support sustained surface presence. For example, the UK has emerging relevance in lunar surface power, where Rolls-Royce's work on modular nuclear power systems could support future Moon-base energy needs, and in adjacent fuel and materials research, where Bangor University's work on advanced nuclear fuels has relevance to both deep-space propulsion and longer-term off-world infrastructure. By contributing in these enabling areas as well as structural components and life support systems, alongside wider industrial and research strengths, the UK can strengthen its role and reputation = within international programmes while building a more distinctive position in the next phase of lunar exploration.
- **Spacecraft for Human Spaceflight:** Collaboration on human-rated spacecraft presents an opportunity for the UK to enhance its capabilities in space travel. By partnering with established players, the UK can contribute specialised components and technologies for crewed missions. These partnerships would accelerate the UK's involvement in human spaceflight, boost its industrial base, and establish its reputation as a contributor to space transportation systems.
- **Space Exploration Sustainability Standards:** The UK has an opportunity to lead the development of sustainability standards for space travel and habitation. By collaborating with international bodies, the UK can establish guidelines that ensure future exploration missions minimise environmental impacts both on Earth and in space. This leadership would enhance the UK's global influence in space governance while promoting responsible practices in space exploration.

Space-Based Energy

Expertise

Whilst a relatively nascent segment of the Space Sector, the UK is positioning itself as a key innovator in space-based energy, exploring technologies to harness solar power in orbit and beam it back to Earth. Organisations across various segments, including space manufacturing, spaceflight, ISAM, and SDA, will be crucial for building large space-based energy structures. Activities, such as the UK Space Energy Initiative, aim to create the environment to develop the supply chain for future success.

Products, services, and projects shall need to leverage advancements in lightweight materials, wireless power transmission, and modular satellite construction to make large-scale solar energy harvesting in space viable. With its strong engineering base and government backing, the UK is well-placed to contribute to this transformative energy solution, which could play a critical role in addressing global energy needs while supporting the transition to net-zero emissions.

Opportunity Area

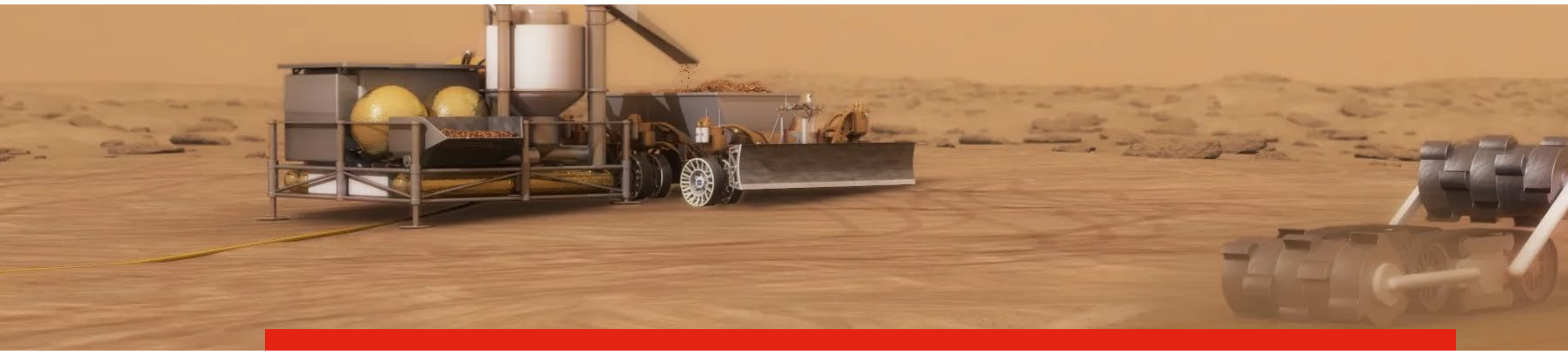
Space-based energy presents a transformative opportunity for the UK both domestically and in international collaboration:

- **Development of Space Solar Power (SSP) Systems:** Creating technologies for harnessing solar power in space, where sunlight is constant and unobstructed, can contribute to addressing global energy demands. Collaborative research with universities and advanced engineering firms would enable the UK to develop technologies that capture solar power in space and transmit it back to Earth. This renewable energy solution could reduce reliance on terrestrial energy sources and drive the UK's transition to a low-carbon economy.

- **Research in Wireless Power Transmission:** Advancing wireless power transmission technologies is a key area where the UK can make significant strides in space-based energy. By developing efficient methods for transmitting energy from space to Earth via microwave or laser technologies, the UK can lead in the next generation of energy infrastructure. This would contribute to meeting the world's growing energy needs, while creating export opportunities for UK technology in the global energy market.

- **Space-Based Energy Storage Solutions:** The UK can capitalise on its expertise in energy storage technologies to develop space-efficient, high-capacity batteries that can store energy generated by in-orbit solar power systems. By ensuring a reliable energy supply, even when ground sunlight is not available, the UK could significantly enhance the viability of space-based energy, making it a sustainable and consistent power source for Earth.

- **Global Space-Based Energy Standards and Policies:** The UK can play a key role in shaping the future of space-based energy by contributing to the development of international policies and standards. By collaborating with international organisations such as UNOOSA and space agencies around the world, the UK can help establish guidelines that ensure space-based solar power systems are safe, sustainable, and equitable. This would enhance the UK's standing as a global leader in space energy policy and contribute to the responsible and regulated growth of this emerging sector.



In-Situ Space Resource Utilisation

Expertise

The UK has developed expertise regarding In-Situ Space Resource Utilisation (ISRU), an emerging field that focuses on extracting and using resources found on the Moon, Mars, and other celestial bodies to support human exploration and reduce dependency on Earth-based supply chains. Research institutions and industry partners are advancing technologies for extracting water, oxygen, and metals from lunar regolith and asteroids. For example, collaborations with ESA and international missions are enabling the development of robotic systems and processes for mining, refining, and storing resources in space. These efforts not only support long-term habitation and exploration goals, but also align with the global push toward sustainable and cost-effective space operations. By investing in ISRU, the UK aims to position itself as a leader in this transformative area, critical for future deep-space missions and the establishment of off-world economies.

Opportunity Area

- **Development of Lunar & Asteroid Mining Technologies:** Developing technologies for lunar and asteroid mining can reduce reliance on Earth-based resources. By creating mining robots and autonomous systems designed for off-world resource extraction, the UK can support space missions that require fuel, water, or raw materials for construction. Collaborations between the UK space sector and mining companies would foster innovation in this area, making the UK a key player in the emerging space resource economy.

- **Manufacturing & Refining of Space Resources:** The UK could lead in the development of technologies that transform lunar regolith into construction materials or extract oxygen and hydrogen for rocket fuel. Such advancements would reduce the cost of space missions by eliminating the need to transport materials from Earth, creating sustainable infrastructure for long-term exploration and habitation of the Moon and beyond.

- **Energy Generation from Space Resources:** The UK could spearhead research into technologies that use lunar or asteroid resources to create sustainable energy sources, such as solar panels or nuclear reactors. This would reduce reliance on Earth-based energy supplies and enable longer, self-sustaining missions in deep space or on the Moon. By developing these energy systems, the UK can ensure that future missions have a reliable energy source, enabling the exploration and colonisation of other celestial bodies.

- **Shared Infrastructure for Resource Utilisation:** Collaborating internationally to create shared infrastructure for resource utilisation can significantly accelerate the development of sustainable space exploration. The UK can partner with international space agencies and private companies to create shared lunar bases or resource processing facilities. This shared approach would maximise resources, enhance collaboration, and ensure that the benefits of space resource utilisation are available to a broad range of space-faring nations.

Summary

The United Kingdom has one of the most mature and diversified space ecosystems in Europe, underpinned by longstanding heritage in satellite development, strong participation in European and international programmes, and a well-established commercial market spanning manufacturing, satellite applications, connectivity, data services, finance, insurance, law, and national security. This historic base has enabled the UK to evolve from an early scientific and engineering contributor into a globally relevant space economy with significant strengths across both upstream and downstream activities.

The National Space Strategy provides a clear framework for this next phase of development. It identifies three broad priorities: to grow existing strengths, to build leadership in fast-growing market segments, and to lay the foundations for future advantage in emerging areas of the space economy. Across these priorities, the UK already demonstrates clear capability in spacecraft and payload manufacturing, satellite communications, mobility broadband, professional supporting services, EO applications, navigation services, Space Domain Awareness, and satellite-enabled connectivity. These are supported by a broad ecosystem of prime contractors, SMEs, research institutions, government programmes, and specialist service providers.

At the same time, the analysis suggests that the UK's challenge is not one of absence, but of scaling, coordination, and adoption. In established areas, the key opportunity is often to deepen sovereign capability, strengthen research and development, improve regulatory and legal frameworks, and accelerate market uptake of existing strengths. In emerging segments, collaboration will be critical, but it should be selective and capability-led rather than generic. For example:

- For in-orbit servicing and active debris removal, the UK is best placed to work through the likes of ESA and other trusted European partnerships on demonstration missions, servicing capability, debris-removal technologies, and the standards and assurance frameworks that make these markets viable.
- For in-space manufacturing, the priority should be collaboration between regulators, advanced materials and life sciences actors, and early movers, so that developments are linked to relevant use cases.
- In space habitation and exploration-adjacent areas, the UK should prioritise partnerships where it contributes enabling technologies and industrial capability into wider programmes, for example through ESA exploration activity, the European Service Module supply chain, commercially sponsored astronaut missions, and lunar surface power or habitat-support systems.

Across all of these areas, the most valuable forms of collaboration are shared demonstration missions, co-funded R&D, regulatory sandboxes, qualification and standards work, and routes into anchor-customer programmes. The issue is therefore not collaboration in the abstract, but collaboration that builds flight heritage, strengthens priority capabilities, and creates a repeatable long-term commercial position.

Key Gap Themes:

- Limited scale in sovereign manufacturing and infrastructure in some priority areas
- Need to increase adoption of existing UK capabilities across wider markets
- Gaps in enabling regulation, standards, and policy frameworks for emerging activities
- Need for sustained investment in R&D, innovation, and commercialisation
- Skills and workforce development required to support future growth
- Dependence on international collaboration in areas where domestic capability is still emerging
- Need to convert strong individual capabilities into coordinated ecosystem-level leadership

Overall, the UK is well positioned to remain a leading space nation. Its strongest near-term advantage lies in accelerating the adoption and commercial uptake of capabilities it already possesses, while its longer-term success will depend on how quickly it can convert technical excellence, policy ambition, and international collaboration into scalable commercial and strategic leadership. This will require not only continued innovation, but also clear government signalling, targeted investment, and an enabling policy and regulatory environment to help prime new growth areas and give industry the confidence to invest at pace.

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The Welsh Space Sector, Strategy, & Priorities

The Welsh Space Story

The story of Wales' space sector is a recent one, shaped less by a single national space programme and more by the gradual mobilisation of long-standing Welsh assets in defence test and evaluation, space science, and an aerospace-strong nation.

Wales' enabling foundations can be traced back to the Second World War, when a military testing range was established in Cardigan Bay, controlled from a site near Aberporth (MOD Aberporth). This created enduring range, tracking, and airspace infrastructure that would later become relevant to near-space activity and wider spaceflight-adjacent operations (QinetiQ, 2026)[12]. Complementing this, Llanbedr Airfield was opened in 1941 and became part of Wales' long-running test, flying and range-related lineage in North Wales (ABCT, 2025)[13]. Wales also established an early, visible milestone in space science with the opening of the *Spaceguard Centre* near Knighton in 2001, which operates as the UK's national near-Earth objects information capability and a working observatory.

Its subsequent journey towards space-enabled growth and a modern, coordinated Welsh space story started with early sector mapping work in 2006 carried out with support from the Aerospace Wales Forum alongside the then British National Space Centre. A more decisive phase began in 2014, when Welsh Government commenced sustained engagement with the UK Space Agency (UKSA), creating a stronger policy and funding interface between Wales and the UK space ecosystem. This was followed by the publication of the first Wales Space Strategy in 2015 and the Welsh Government's "Spaceport Snowdonia Wales" brochure in early 2017, signalling intent to anchor Welsh growth around both upstream capability and downstream applications (Meechan, 2015)[14].

[12] QinetiQ, 2026. About MOD Aberporth. [Online] Available at: https://www.qinetiq.com/en/aberporth/about [Accessed 20th January 2026].

[13] ABCT, 2025. Llanbedr. [Online] Available at: https://www.abct.org.uk/airfields/llanbedr/ [Accessed 20th January 2026].

[14] Meechan, B., 2015. Mission: Wales aims for £2bn a year from space industry. [Online] Available at: https://www.bbc.co.uk/news/uk-wales-33507590 [Accessed 20th January 2026].

By 2019, Wales' ambitions were increasingly visible on the UK stage. The UK Space Conference, hosted at the newly opened International Convention Centre in Newport, became a platform for announcements tied to sector investment in Wales. Among these was a £500k award to Snowdonia Aerospace Centre from UKSA's Horizontal Spaceport Development Fund to develop a Spaceport Snowdonia Development Plan.

As strategic intent translated into delivery, Wales began strengthening the networks needed to turn capability into a coherent ecosystem. Over the five years leading into 2021, Welsh Government and the Aerospace Wales Forum worked to grow the national space sector network and raise its profile:

- Wales a Sustainable Space Nation was published in February 2022 (Welsh Government, 2022)[15];
- Space Wales established to drive the sector forward and to support engagement with space disruptors and entrepreneurial start-ups whose culture and business models differed from mainstream aerospace (Space Wales, 2026)[16];
- The Wales Academic Space Partnership (WASP) was established to strengthen university to industry cooperation, while Aerospace Wales formed a dedicated Space Group.

Alongside convening, Wales' space story has become increasingly defined by practical activity and enabling infrastructure. Snowdonia Aerospace Centre continued to expand its client base for future flight and space-related operations, boosted by £820,000 in funding from the UK Space Agency under the Space Clusters Infrastructure Fund (SCIF) to support the development of a new Space Technology Centre at the former Llanbedr Airfield (UKSA, 2023)[17], while near-space operations commenced through flights such as B2Space's stratospheric balloon and the Astigan HAPS, leveraging the established MoD / QinetiQ tracking range in Cardigan Bay.

Wales' trajectory is also tied to upstream manufacturing ambition and a growing commercial base. Space Forge's work on a returnable in-space manufacturing platform intendeds to enable materials manufacturing that is not feasible on Earth. In parallel, Wales also has downstream strengths, particularly in Earth observation (EO) and data-enabled services. Capability includes Environment Systems' Satellite Data Services (launched in 2017) and Aberystwyth University's Living Wales project, a world-first concept intended to capture landscape dynamics using EO data integrated with ground measurements and models, with longer-term potential to evolve beyond research into a national observatory concept.

This evolution is framed against a clear economic rationale. Wales has a strong position in aerospace (c.10% of the UK aerospace workforce) compared with a much smaller share of the UK space workforce (c.3%). Within that context, there is an ambition to achieve a space economy worth £2bn per year by 2030.

[15] Welsh Government, 2022. Wales: a Sustainable Space Nation. [Online] Available at: https://www.gov.wales/wales-sustainable-space-nation-html [Accessed 12th March 2026].

[16] Space Wales, 2026. About Us. [Online] Available at: https://spacewales.co.uk/about-us/ [Accessed 20th January 2026].

[17] UK Space Agency, 2023. £47 million investment to supercharge space infrastructure across the UK [Online]. Available at: https://www.gov.uk/government/news/47-million-investment-to-supercharge-space-infrastructure-across-the-uk [Accessed 23rd February 2026]

Wales' space story is presented as one of structured growth. The UKSA cluster development programme enabled the establishment of a Space Wales brand, Leadership Council, and network intended to develop and maintain a thriving space sector in Wales. At the same time, Wales has articulated a distinctive long-term identity: an ambition to become the world's first "sustainable space nation" by 2040, "leading the way to a greener space", with sustainable upstream practices and demand-led downstream innovation positioned as core drivers of future competitiveness.

Figure 1. Overview of Space Wales strategy development

Strategies & Priorities

Wales: a Sustainable Space Nation

The Wales: a Sustainable Space Nation strategy sets out a pathway for growing the Welsh space cluster by building on existing aerospace strengths and developing a coordinated ecosystem spanning upstream capability and downstream applications. It frames the Space Wales cluster and Leadership Group as mechanisms to maintain momentum, review progress against an action plan, and adapt priorities as circumstances change.

A distinctive feature of the strategy is its explicit positioning of sustainability as both a differentiator and a delivery principle: it links space activity to Wales' long-term well-being and sustainability drivers, while also recognising that space missions can have negative ecological impacts and that Wales should help drive cleaner approaches across manufacturing, launch, and operations.

Within that framing, the strategy articulates its priorities through a set of opportunity areas that span the full value chain and are intended to be advanced through practical actions, working groups, and key programmes. In summary, the priorities can be expressed as:

1. **Spaceflight, training, and experience:** The strategy positions spaceflight-adjacent activity, centred on the development of Llanbedr airfield / Spaceport Snowdonia, as a cornerstone priority, with actions covering site development planning, flood defence work, regulatory steps (including licensing), and the practical requirements to operate in restricted airspace (including engagement with MOD / QinetiQ regarding access and costs). It also links this to community engagement and an end-to-end demonstrator programme to evidence operational capability.

2. **In-space manufacturing and recovery of space vehicles:** The strategy identifies in-space manufacturing and recovery as a priority growth area and frames it as part of Wales' emerging upstream proposition, sitting alongside launch and test capability and linked to the wider aim of building sovereign and commercially attractive capabilities suited to Wales' geography and industrial base.

3. **Test and evaluation ecosystem:** A central enabling priority is the strengthening and marketing of Wales' test and evaluation capability as the UK launch market grows, including addressing gaps and bottlenecks, improving the collective visibility and accessibility of facilities, and tackling the regulatory challenges that can slow testing, qualification, and flight-adjacent activity. The strategy explicitly connects this to the need to develop and market Welsh test facilities and to resolve practical barriers such as charging regimes, access arrangements, and the wider approvals environment needed to support operational use.

4. Advanced manufacturing capability and emerging clusters: The strategy treats advanced manufacturing as a strategic upstream lever, building relationships with primes and OEMs, strengthening supply-chain readiness, and using coordinated sector engagement (events, supplier days, cluster-to-cluster collaboration) to convert Wales' wider industrial strengths into space-relevant opportunity and inward investment.

5. **Earth Observation (EO) and data-enabled services:** On the downstream side, the strategy highlights Wales' EO ecosystem, referencing university sensor capability, commercial analytics and applications, and institutional adoption (including public bodies using EO data). It proposes formalising this through an Earth Observation Group and explicitly links this to the potential establishment of a National Wales Space Observatory concept.

6. **Research and teaching facilities:** The strategy recognises skills, research capacity, and university–industry linkages as a priority, including the role of the Wales Academic Space Partnership (WASP) and actions to strengthen connectivity between academic capability audits and the wider Space Wales network.

Across these priorities, the strategy also sets out several cross-cutting "how" mechanisms, most notably: (i) leadership in sustainability via a proposed Sustainable Space Accelerator; (ii) alternative launch and recovery strategies; (iii) an attraction strategy to bring in "magnet businesses"; and (iv) governance / funding arrangements intended to keep investment decisions close to commercial exploitation while maintaining alignment with UK Government and UKSA.

2024 Space Wales Governance Workshop

In 2024, the cluster's strategic direction was reviewed to better reflect the Welsh space sector's value proposition and distinctive capabilities, and to define the approach needed to realise Wales's ambition to become the world's first sustainable space nation by 2040. The Leadership Council led the review and identified three key themes: alignment with UKSA objectives and wider national strategies; skills demand; and supply chain development. The cluster model and its support offer were also examined to ensure the cluster and partner organisations respond effectively to local stakeholder needs.

As part of this process, the Catapult was invited to deliver a Governance and Strategy Workshop in July 2024 to review the structure of the existing strategy, identify priority areas and required updates, and shape an approach that is clearer to communicate and easier to implement (including roles / responsibilities, commercialisation, and community-facing messaging).

Rather than replacing the Sustainable Space Nation priorities, the workshop refines how Wales articulates them. It proposes a more visual, value-chain representation that is accessible to non-experts and can be reused across the strategy (including to frame sustainability), underpinned by economic growth, cluster activities, and support mechanisms. The refined framing includes:

- **Design & Manufacture:** advanced space materials; optics and photonics; space software & AI; research and development.
- **Mission Planning & Launch:** energy and propulsion systems; nuclear testing; launch systems and support; ground and space-based operations.
- **In-space Operations & Services:** microgravity R&D and manufacturing; space-based solar power; in-space communications and data centres.
- **Downstream Applications:** resilient communications and connectivity; cross-sector collaboration; space data for public sector; monitoring, security, and cyber.

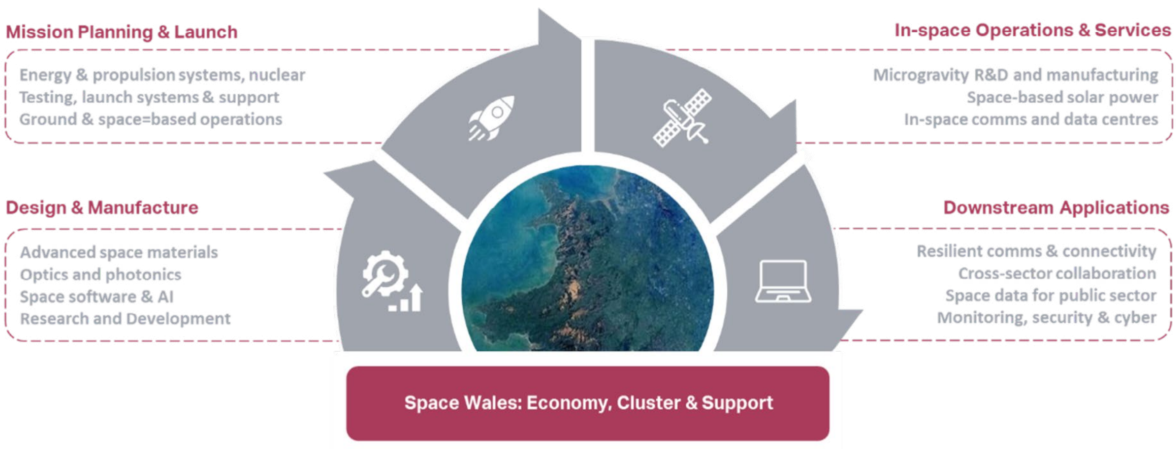

Figure 2. Space Wales supply chain visualisation

This refinement usefully bridges the original priority areas into a structure that is (i) more intuitive to external audiences, and (ii) readily mapped to both upstream capability development and downstream outcome themes.

Space Wales set out in its Strategy the ambition to establish a Sustainable Space Accelerator as a mechanism to stimulate collaboration, grow capability and embed space-enabled solutions into priority sectors across Wales. With support from the UK Space Agency, this ambition has been operationalised through the Space Wales Catalyst Fund (Space Wales, 2025)[18], an intervention designed to turn strategic intent into funded collaborative projects. Rather than focusing solely on early-stage R&D, the Catalyst Fund has leveraged the Welsh space community to address clearly defined priorities, encouraging partnerships between space companies, non-space sectors and public bodies, and accelerating the development of market-ready, sustainability-aligned solutions.

The Fund demonstrates how the Sustainable Space Accelerator concept can move from strategy to delivery: mobilising the cluster, directing resource towards areas of national relevance, and strengthening Wales' position as a sustainable space nation. The Catalyst Fund has created a practical pathway for translating community capability into funded projects that support environmental resilience, economic growth and cross-sector innovation.

Resilient Wales

Building on the Strategy Review, Space Wales has sought to position space as an enabling sector within Wales, one that supports growth and resilience across priority industries rather than operating in isolation. This framing aligns the Space Wales agenda with Welsh policy and legislative drivers, including the Well-being of Future Generations (Wales) Act and the Welsh Government's International Strategy 2020 – 2025, which identifies Germany as a priority market for Wales and emphasises values that resonate strongly with space-enabled capability, including the ambition for a "Resilient Wales" (Welsh Government, 2020, p. 36)[19].

Against this backdrop, Space Wales commissioned the Satellite Applications Catapult in 2025 to examine how satellite connectivity and EO can support national resilience outcomes within the Welsh ecosystem. That work identified three interlinked challenge areas where space-enabled technologies can make a material contribution to Welsh priorities:

- **Climate & Environment:** improving monitoring, early warning and decision-support for flood risk, wildfire exposure, land degradation, biodiversity loss, and coal tip stability under increasing climate pressure.
- **Rural Connectivity & Inclusion:** reducing digital not-spots that constrain access to healthcare and telecare, education, productivity tools, logistics, and emergency communications in hard-to-reach areas.
- **Infrastructure & Energy Resilience:** strengthening situational awareness and continuity for ageing and dispersed assets, coastal infrastructure at risk, renewable expansion, and grid monitoring across exposed geographies.

These three themes provide a challenge-led umbrella for the Welsh space proposition and are reflected throughout the gap analysis that follows.

[18] Space Wales, 2025. Space Wales Announces Successful Projects to be Funded by Wales Space Cluster Catalyst Fund. [Online] Available at: https://spacewales.co.uk/space-wales-announces-successful-projects-to-be-funded-by-wales-space-cluster-catalyst-fund/ [Accessed 23rd February 2026].

[19] Welsh Government, 2020. International Strategy, Cardiff, Wales: Welsh Government

Wales Space Sector Gap Analysis

Using ecosystem data presented in the Satellite Applications Catapult's Space Capabilities Catalogue as of February 2026, this section identifies where Wales has existing strengths in the priority areas set out in their space strategy. The following segment shall seek to outline, in brief, where Wales already excels and where it needs to develop to meet the objectives set out in in its Strategy. Each segment will outline a strategic priority, existing strengths, and areas for development.

Upstream

Design & Manufacture

Expertise

Wales shows a credible upstream base in design and manufacture, anchored by organisations providing Space Engineering, Space Hardware, Space Materials, and associated enabling services. The Welsh supply chain includes established aerospace and high-value engineering manufacturers (e.g., Magellan Aerospace, Electroimpact, Cottam & Brookes Engineering, GJM Engineering), advanced materials and manufacturing capability (e.g., Ensinger Precision Engineering, BlociCarbon, Formagrind), and electronics / components supply (e.g., Charcroft Electronics, Teledyne Labtech). Wales also a strong semiconductors and advanced materials ecosystem relevant to space hardware and sensing supply chains (e.g., IQE, the Compound Semiconductor Applications Catapult, CSconnected, and the Centre for Integrative Semiconductor Materials (CISM)). Together, these strengthen Wales' relevance to space hardware, sensing, photonics, and next-generation electronics supply chains, alongside a wider set of "spin-in" and enabling engineering firms that can be mobilised into space-relevant manufacture.

Opportunity Area

Wales' opportunity is to increase the space-readiness and market accessibility of its upstream capability, so that "manufacturing strength" reliably converts into space contracts and inward investment:

- **Space-grade manufacturing readiness (quality, traceability, and assurance** Wales has strong engineering and manufacturing capability, but the gap is often the assurance layer that primes and integrators expect: rigorous quality systems, configuration control, verification planning, and documented processes that reduce perceived risk. This aligns with UK-wide evidence of persistent skills gaps, including in critical and emerging areas that support delivery confidence. Closing this gap increases Wales' eligibility for higher-value work packages, shortens supplier onboarding cycles, and improves conversion from capability to contracted programmes.
- **Packaging "manufacture, test, and integration" into an investable cluster offer:** Rather than presenting capability as isolated suppliers, Wales can create bundled, prime-facing propositions (supplier development, test access, and demonstrators) that explicitly show how Welsh firms can deliver end-to-end sub-systems, not only components. Done well, this makes Wales easier to "buy from", supports inward investment decisions, and creates a clearer pathway from SME capability to prime-tier supply chain roles.

Test & Evaluation

Expertise

Wales has an identifiable (though relatively small) testing and engineering cohort, aligned to the strategy priority to strengthen and market a Welsh test and evaluation ecosystem. In addition, Wales' test and range heritage (including the MoD / QinetiQ range infrastructure and the evolution of the Snowdonia Space Centre / Llanbedr site) provides a credible enabling foundation for spaceflight-adjacent and space-hardware qualification activity, particularly where testing, assurance, and operational readiness are central to buyer confidence.

Opportunity Area

The opportunity is to make Welsh test and evaluation more visible, more accessible, and more directly connected to pathways from prototype to operational deployment, including Assembly, Integration, and Test (AIT) as a stepping-stone towards longer-term launch ambitions:

- **Visible, accessible qualification testing pathways (and clearer facility propositions):** The UK facilities evidence base highlights the centrality of environmental testing (e.g., thermal-vacuum, vibration, shock, EMC) to qualifying space hardware. Wales can use its existing testing capability as a foundation, but the opportunity is to make facilities and services easier to find, procure, and use, reducing friction for SMEs and external customers. This directly accelerates time-to-qualification for Welsh hardware, attracts external test demand, and strengthens Wales' credibility as a launch- and manufacturing-centre. It also matters in a wider competitive context: other UK and Ireland locations, such as Resonate Testing in Newry, are already positioning themselves around accessible commercial test services for the space sector, including integrated vibration, shock, and thermal-vacuum testing. For Wales, the implication is not simply to have facilities, but to present a clear, market-facing proposition on access, turnaround, assurance, and how Welsh testing complements rather than duplicates nearby capability.
- **AIT as a strategic bridge (from testing to flight-adjacent readiness):** Whilst facilities, such as Snowdonia, pivots towards Assembly, Integration, and Test, Wales has an opportunity to position itself as a place where payloads and sub-systems are assembled, integrated, tested, and prepared for missions, even before routine launch operations are in-scope. This builds commercial traction now and creates a credible pathway towards sustainable launch in the longer term.

Mission Planning, Launch, & Return from Orbit

Expertise

Wales has an identifiable set of mission-planning and launch-adjacent signals centred on Spaceport Snowdonia / Llanbedr and a small group of organisations across enabling functions (mission design and operations signals, payload integration, assembly & integration, and launch-adjacent infrastructure). Representative examples from the Welsh supply chain include Snowdonia Aerospace (spaceport / site capability and enabling infrastructure), B2Space (mission design and mission operations, including balloon-launch elements), Space Forge (launch systems / re-entry systems), and manufacturing / integration contributors such as Magellan Aerospace and Electroimpact (assembly & integration and payload integration signals in launch-adjacent contexts).

In addition, Wales' ambitions around Llanbedr / Spaceport Snowdonia and associated testing infrastructure point to a broader "systems" mindset: building operational capability, test facilities, and demonstrators that can underpin wider resilience objectives, not solely spaceflight. The progress narrative around facility development at Llanbedr (including test centre development and capability-building activity) is important not only because of future space ambitions, but because the site is already being developed through a practical, commercially led model and used for wider aerospace and autonomous-systems activity. This supports the plausibility of Wales developing enabling infrastructure that can serve multiple resilience-linked agendas.

Wales' current trajectory reflects a phased approach: sustainable launch remains a long-term ambition, while the near-term emphasis is increasingly on AIT capability, mission enablement, and return from orbit as a growth focus.

Opportunity Area

The opportunity is to build the enabling functions that make Wales operationally credible and commercially repeatable across mission planning, AIT, regulatory delivery, and return, recognising that launch is a long-term outcome rather than the immediate priority:

- **Spaceport operations "wrap" (campaign delivery capability):** Beyond site infrastructure, Wales needs more capacity in the practical service layer that supports missions and campaigns: mission planning support, customer onboarding, safety/assurance documentation, scheduling and coordination, ground support equipment access, payload processing, and AIT-to-campaign readiness processes. These services reduce cost and friction for customers now, create near-term commercial value, and build the operational maturity required for sustainable launch in the longer term.
- **Regulatory and assurance delivery capacity (licensing readiness and return regulation):** UK rules require a CAA-issued spaceport licence to operate a spaceport, and UK guidance indicates it can take at least nine months for an application to be assessed. Wales can therefore treat licensing / assurance capability as an investable "gap": safety case development, compliance management, and mission assurance expertise that reduces regulatory friction and increases investor confidence. Strengthening this capability shortens time-to-licence, increases the probability of successful applications and campaign approvals, and provides customers with confidence that operations will be robust and repeatable.

- **Market resilience: mitigating launch availability and scheduling bottlenecks:** Industry reporting has highlighted UK launch availability constraints and knock-on effects for operators (e.g., limited access to launch slots at particular sites). Wales can strengthen its proposition by building partnerships and capacity that improve scheduling resilience; this requires clear campaign pathways, diversified mission profiles (e.g., balloon / HAPS and horizontal launch where relevant), and robust test-to-flight integration. In the near term, that resilience may depend as much on access to trusted external launch and return pathways as on domestic infrastructure alone. For Wales, rather than focusing primarily on launch slot availability, the strategic opportunity is therefore to reduce regulatory and operational friction, build credible AIT-to-mission support, and position itself so that, over time, more of the mission-enabling and return-related value chain can be anchored locally as the wider UK market matures.
- **Return from orbit as a near-term focus area (a credible step towards sustainable launch):** If Wales positions return as a strategic focus, it can capture value in recovery logistics, inspection and verification, refurbishment pathways, and mission assurance for returnable systems, aligned to sustainability objectives. In practice, a credible "return offer" differentiates Wales, creates demand for AIT and testing services, and establishes flight heritage and operational credibility that supports the longer-term sustainable launch ambition.

Image credit: NASA/Johnson Space Center

Downstream

Climate & Environment

Expertise

Wales has a credible foundation in climate- and environment-oriented space activity, particularly where EO and geospatial analytics support public value outcomes. The Welsh Government's Wales: a sustainable space nation strategy explicitly positions sustainability as both a differentiator and a delivery principle, linking space-enabled capability to Wales' wider well-being and sustainability objectives.

Organisations such as Environment Systems, Geo Smart Decisions, and Ultranyx suggest a cluster that is highly capable, but relatively concentrated, with a small number of firms spanning multiple layers of the EO value chain (data, analytics, and application). This positions sustainability as both a differentiator and a delivery principle for the Welsh space sector, which strengthens the credibility of using climate and environmental resilience as the organising logic for downstream space-enabled services. Taken together, the ecosystem is best characterised as a small number of capable actors with multi-disciplinary breadth, rather than a large, deep bench of specialist EO product firms.

Opportunity Area

Wales' main gaps are not in recognising EO's relevance, but in building the delivery and commercialisation layers that turn EO into repeatable, investable services that public bodies and regulated sectors can adopt at scale:

- **Broaden the bench of application-led EO product companies:** The supply-chain evidence points to a strong nucleus, but limited breadth. The opportunity is to attract and grow more firms that provide sector-specific EO products (e.g., flood / coastal risk, land-use change, biodiversity / peatland monitoring, infrastructure risk, and climate adaptation planning, etc.), rather than relying on a small number of multi-role actors to cover the full spectrum.
- **Build "procurement-ready" EO services and operating models for public sector adoption:** UK-wide evidence consistently highlights that public sector procurement of EO data / services can be difficult because the market changes quickly, offerings vary, and buyers struggle to assess value-for-money and specify requirements. This is a known barrier to scaling EO beyond pilots. A Welsh "observatory" concept will need robust service definitions, assurance, data governance, and outcome metrics that make procurement straightforward and repeatable.
- **Strengthen the bridge from data to decision-support and operational action:** There is a gap between "EO outputs exist" and "operators act on them". Wales can address this by growing integrators who combine EO with local datasets, modelling, and operational workflows (alerting, prioritisation, response planning), and by developing reference architectures that public bodies can adopt without bespoke rework each time.

Rural Connectivity & Inclusion

Expertise

Rural connectivity is a persistent and well-evidenced policy challenge in Wales, and the broader UK context reinforces why hybrid connectivity solutions (including satellite-enabled options) remain relevant even as fibre and 4G coverage improves. Ofcom's reporting shows that fixed broadband not-spots are reducing, but still exist, and that there remains a "long tail" of premises without decent fixed-line broadband, particularly in rural areas (Ofcom, 2025)[20].

Welsh Government activity continues to focus on extending access to fast and reliable broadband and maintaining intervention mechanisms (e.g., grant schemes and successor programmes to earlier roll-outs). In parallel, UK-level programmes to tackle rural mobile coverage gaps (including new mast deployments in Wales) illustrate both progress and the continuing need for solutions that work in hard-to-reach geographies, reinforcing why satellite and hybrid connectivity remain relevant as an inclusion tool.

Organisations such as Excelerate Technology, MLS Solutions, and Dragon WiFi suggests Wales has meaningful capability fragments across connectivity provision, enabling technology, and adjacent platforms, but the number of organisations remains relatively modest.

Opportunity Area

Wales' main gaps are not in recognising EO's relevance, but in building the delivery and commercialisation layers that turn EO into repeatable, investable services that public bodies and regulated sectors can adopt at scale:

- **Develop and / or attract hybrid connectivity integrators and managed service providers:** The opportunity is to grow providers who can design, deploy, and operate end-to-end solutions that blend satcom, terrestrial networks, and IoT, covering installation, service management, uptime assurance, and user support. This is typically the missing layer between "connectivity capability exists" and "rural services reliably run on it".
- **Create adoption pathways that are procurement-friendly for local authorities and anchor institutions:** Even where technology works, roll-out can stall without standard packages, framework-friendly contracting, and clear outcome measures (coverage, resilience, cost per user / site). Wales can position itself by developing repeatable deployment models for rural hubs (community facilities, healthcare access points, emergency connectivity, remote logistics nodes).
- **Embed security-by-design as a standard feature of rural inclusion services:** As rural connectivity becomes a pathway for delivering public services and handling sensitive data, cyber resilience becomes a prerequisite rather than an optional add-on. UK national direction is towards tightening cyber resilience expectations for essential services and their suppliers, which increases the value of having credible security integration capacity within Welsh delivery teams.

[20] Ofcom, 2025. Connected Nations Wales Report 2025, London, UK: Ofcom.

Infrastructure & Energy Resilience

Expertise

Wales has strong strategic rationale for positioning space-enabled capability in support of infrastructure resilience, given the importance of distributed rural networks, coastal exposure, and the need for continuity of communications and monitoring during disruptive events. Space-enabled monitoring (EO), data infrastructure, and communications resilience are increasingly mainstream parts of national resilience toolkits, and Wales' sustainable space framing creates a natural umbrella for applying these tools to asset integrity, environmental hazards, and continuity planning.

Opportunity Area

The principal gap is to convert resilience intent into integrated, operational services that infrastructure owners can buy, adopt, and rely upon. This implies three concrete opportunity areas:

- **End-to-end resilience products (not point solutions):** Wales can build propositions that fuse EO monitoring, communications continuity, and analytics into services for transport corridors, coastal infrastructure, and utilities, moving from data services to decision support and action. This requires more integrators, stronger user-driven requirements capture, and sustained customer relationships with asset owners and public bodies. This is how Wales converts "space-enabled capability" into recurring revenue and measurable resilience outcomes: buyers pay for reduced downtime, faster response, and lower lifecycle cost, not for datasets.
- **Assurance, testing, and operational readiness as a differentiator:** Resilience markets are risk-sensitive. To compete, Wales needs visible assurance pathways, test, verification, validation, and operational readiness, that give buyers confidence in performance during outages or extreme events. Llanbedr-linked infrastructure and test ecosystem development is strategically relevant here, but must be packaged as an accessible, market-facing capability with clear routes from prototype to operational deployment. This lowers buyer risk and shortens procurement cycles, because operators can evidence performance under stressed conditions and demonstrate compliance with internal assurance and safety requirements.
- **Security-by-design at scale:** Critical infrastructure resilience increasingly intersects with cyber and information assurance. Where space-enabled data feeds infrastructure monitoring and response workflows, the absence of a mature, well-networked security layer becomes a material adoption barrier. Even if the technical EO / communications capability exists, procurement and operational stakeholders will expect credible assurance and cyber integration as standard. Security-by-design is a gate condition for adoption: without it, services will stall at pilot stage because asset owners cannot accept the operational and regulatory risk of insecure data pipelines or unmanaged supply chains.

Summary

Overall, the Welsh ecosystem presents a strong strategic narrative and a credible base of capability, but the gap analysis indicates that Wales' challenge is now less about "what to prioritise" and more about how to convert capability into repeatable delivery and investable propositions.

Across upstream and downstream segments, the most consistent constraint is the missing middle between having technically capable organisations and achieving sustained outcomes: space-grade assurance and verification maturity, accessible qualification and test pathways, and packaged offers that prime contractors, public bodies, and infrastructure operators can buy with confidence.

- A first consistent gap is assurance, trust, and operational readiness. Whether the objective is manufacturing for higher-value work packages, operating a spaceport, or deploying resilience services into critical infrastructure and public sector workflows, buyers' willingness to adopt is driven by confidence in performance, safety, and compliance. This translates into a need for clearer verification and validation routes, stronger quality / traceability disciplines, and demonstrators that evidence performance under realistic operating conditions. Without this, activity tends to remain at the "pilot" stage, procurement cycles become protracted, and the ecosystem struggles to build the track record required to attract anchor customers and inward investment.
- A second consistent gap is service integration and commercial packaging. Wales has multiple capability fragments, but outcomes depend on integrators who can convert technology into end-to-end services: turning EO into decision support, satcom into managed connectivity, and monitoring into operational resilience products that asset owners can procure as a managed service. This is where many ecosystems stall: the value is not wholly in the dataset or component, but the ability to operate a service reliably, define clear service levels, and evidence value-for-money against outcomes. Strengthening integrator capacity and producing procurement-ready service definitions is therefore central to scaling the three challenge-led themes.
- A third consistent gap is ecosystem breadth and scale in priority niches. Several areas appear concentrated into a small number of multi-role organisations, which constrains growth and creates fragility. Wales' strategy ambitions, particularly around sustainable space leadership, EO-driven public value, and launch-adjacent activity, will be easier to deliver if Wales deliberately broadens the bench in thin, but strategically important capability types: specialist qualification / testing services, cyber and information assurance, space software and AI, and application-led EO product firms. This is also where "magnet business" attraction strategies are most defensible: targeting specific archetypes that fill recognised gaps rather than generic inward investment.

A practical route to closing these gaps is to focus on delivery mechanisms as much as capability building. First, Wales can accelerate downstream adoption by working more closely with programmes such as Unlocking Space for Government, using challenge-led public sector demand to define requirements, standardise service specifications, and move EO and connectivity from pilots into procurement-ready, outcome-based services. Second, establishing a Sustainable Space Accelerator would provide a coherent vehicle to raise "space readiness" across suppliers, coordinate test access and demonstrator pathways, and attract "magnet" businesses into thin, but strategically important areas (e.g., space software & AI, cyber / security-by-design, and specialist qualification services). In parallel, Wales should treat regulatory enablement as a strategic workstream, working with the CAA to streamline approval pathways and to develop a clear route for return from orbit into Wales, thereby reducing friction for near-term delivery while building the governance and assurance maturity required for sustainable launch over time.

Taken together, these interventions would help Wales translate its sustainable space positioning into a durable competitive advantage: credible, assured, and market-facing offers that support launch-adjacent growth while directly delivering climate, inclusion, and infrastructure resilience outcomes.

Germany

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Germany

The German Space Sector, Strategy, & Priorities

The German Space Story

Germany's early contribution to spaceflight is rooted in a long European lineage of rocketry and experimentation in the early twentieth century. Foundational concepts of staged rockets had circulated for centuries, but the field began to crystallise in the interwar period as rocketry moved from speculation towards engineering.

In the 1920s, spaceflight entered the technical mainstream through influential theoretical work (notably Hermann Oberth's 1923 treatment of rockets for interplanetary travel) and a growing community of practitioners. This momentum consolidated with the formation of the Verein für Raumschiffahrt (VfR: Society for Space Travel), one of the best-known early rocketry organisations, in 1927, and by 1931 Johannes Winkler had achieved an early liquid-propellant launch in Europe, modest in altitude, but an important marker of capability shifting from theory to practical systems.

Through the 1930s, that experimental culture scaled into larger engineering programmes and dedicated facilities, culminating in development of the A4 rocket. In October 1942 the A4 reached roughly 100 kilometres, demonstrating a major technical threshold in propulsion, guidance, and systems integration, and later evolved into the V2.

Germany's modern space story begins not with a single national moonshot, but with a deliberate post-war pivot from rocketry as a weapon to space as a scientific and industrial capability, largely pursued through European cooperation. In the 1960s, West Germany began building the institutional and technical foundations needed to participate in international missions, including mission operations capabilities that would later become nationally significant. The German Space Operations Centre (GSOC) has operated spaceflight missions since 1969, anchoring a long-term competence in controlling satellites and human spaceflight operations from Oberpfaffenhofen (DLR, n.d.)[21].

[21] DLR, n.d. The Space Operations and Astronaut Training institution. [Online] Available at: https://www.dlr.de/en/rb/about-us/space-operations-and-astronaut-training [Accessed 20th January 2026].

A first visible milestone in national satellite capability came in 1969 with AZUR, Germany's first satellite, which helped establish early competence in spacecraft development and space science (DLR, n.d.)[22]. From there, Germany increasingly channelled ambition through European frameworks, becoming a major contributor to, and shaper of, the European space project through ESA and related institutions.

In the late 1970s and 1980s, Germany's role became more pronounced via human spaceflight and laboratory missions. A defining example is Spacelab, a reusable orbital laboratory designed by ESA and flown in NASA's Space Shuttle payload bay from 1983 onwards, often cited as a model of transatlantic cooperation and a practical pathway for European (including German) microgravity research. This period helped consolidate Germany's blend of industrial production, mission operations and scientific payload development as a sustained comparative advantage.

Following reunification, Germany's space economy matured into a broad-based system spanning upstream manufacturing, research infrastructure, and downstream data and applications. Over time, German industry and research institutions became embedded across ESA missions (Earth Observation (EO), telecommunications, exploration, and science) and EU flagship programmes such as Galileo and Copernicus, reinforcing Germany's profile as a dependable systems and operations partner as well as a technology developer.

Germany's long-standing industrial geography also shaped its space trajectory. Bremen, in particular, emerged as a focal point for European human spaceflight hardware: ESA's Columbus laboratory, Europe's principal ISS module, completed final integration in Bremen before delivery, reflecting the city's role in European space manufacturing supply chains (ESA, 2006)[23].

In the 2020s, Germany has sought to translate this institutional strength into competitiveness under "NewSpace" conditions: faster cycles, more commercial capital, and a greater emphasis on resilient infrastructure, secure connectivity, and scalable downstream services. This is accompanied by a sharper security framing across Europe, with Germany positioning space as both critical infrastructure and a strategic domain, while continuing to treat European cooperation as the default route to scale.

It is against this backdrop that Germany's recent strategic framework has been formalised. The 2023 Space Strategy was published in response to the growing relevance of space, a changed geopolitical environment, intensifying economic and systems competition between major blocs, accelerating climate pressures, and the rising centrality of safe and sustainable space activity as overall space use grows. It also reflects a market transition: the strategy notes the shift from institutionally dominated programmes to a more dynamic, competitive space economy, and sets out the need for a new framework linking public programmes with market competition (BMWK, 2023)[24]. The 2025 Space Safety and Security Strategy builds on this foundation and is anchored in a deteriorating European security environment. It highlights the increasing prevalence of counterspace threats (including destructive ASAT testing and wider interference with satellite services), and positions space security as a whole-of-government task within an integrated security approach, building on the National Security Strategy and the Space Strategy (BReg, 2025)[25].

Taken together, these trajectories and strategies reflect a consistent through-line in Germany's space story: a sustained commitment to European partnership and technically demanding roles (manufacturing, mission operations, and high-value research), now paired with a more explicit focus on resilience, sovereignty, and security of space-enabled services. As space becomes more contested and more economically consequential, Germany's current posture can be read as an attempt to protect the reliability of the systems it depends on, while ensuring its industrial and research base remains competitive in the next phase of global space development.

[22] DLR, n.d. Time¬line of im¬por¬tant events. [Online] Available at: https://www.dlr.de/en/dlr/about-us/history-of-dlr/timeline-of-important-events [Accessed 20th January 2026].

[23] ESA, 2006. N° 15–2006: European Columbus laboratory for the International Space Station ready for delivery. [Online] Available at: https://www.esa.int/Newsroom/Press_Releases/European_Columbus_laboratory_for_the_International_Space_Station_ready_for_delivery [Accessed 20th January 2026].

[24] BMWK, 2023. The German Federal Government's Space Strategy, Berlin, Germany: Federal Ministry for Economic Affairs and Climate Action.

[25] BReg, 2025. Space Safety and Security Strategy, Berlin, Germany: Federal Government of Germany.

Strategies & Priorities

Germany's space strategy for the period leading up to and including 2030 is defined by two key documents: the comprehensive Federal Government Space Strategy (September 2023) and the more recent, defence-focused Space Safety and Security Strategy (November 2025).

The German Federal Government's Space Strategy

The 2023 Space Strategy defines nine areas of activity as the basis for Germany's space policy goals to 2030, with implementation led across multiple federal ministries and supported by "key projects" intended to begin within the current legislative period. The nine areas are:

1. **European and international cooperation:** Germany positions ESA / EUMETSAT / EU cooperation as the "basic pillar" for successful space policy, with aims including: safeguarding ESA's independent role and strengthening its capacity; maintaining EUMETSAT's role; clarifying role distribution between ESA / EUMETSAT / EU; and encouraging procurement that strengthens European competition, innovation, and (where possible) sustainable space use, while keeping tenders accessible to SMEs and start-ups.
2. **Space as a growth market; high-tech and NewSpace:** The strategy explicitly frames NewSpace as a market shift requiring "attractive basic conditions" and an innovation ecosystem spanning corporates, SMEs, start-ups and research, oriented towards a resource-conserving, low-emissions value chain. It sets aims to help German firms position competitively in small satellites and microlaunchers, improve financing pathways (including private capital), and expand use of "anchor customer" approaches (including in ESA / EU tenders).
3. **Climate change, resource protection, and environmental protection:** The strategy emphasises the role of space services and cooperation in climate and environmental protection, including enabling reliable access to satellite data and tools (notably through cloud-based approaches) and integrated products combining multiple data sources (satellites / overflight / terrestrial measurements) to support climate and environmental research and monitoring.
4. **Digitalisation, data, and downstream activities:** Germany links competitiveness to reliable, secure availability of data services and the infrastructures to access them, supporting further development of international systems and national platforms such as CODE-DE. The strategy also stresses consolidating "government downstream requirements", expanding Copernicus uptake across public administration, supporting IRIS² framework conditions (including SME / start-up inclusion via competitive tendering), and strengthening competence clusters (including the German Galileo Control Centre).
5. **Security, strategic options, and global stability:** The Space Strategy places space security primarily in EU / NATO and partner-country frameworks, stressing that civil and military capabilities depend on resilient space infrastructure and services. It calls for guidelines for protection and defence in space and for greater national resilience, and notes Germany's commitment to international rule-making and risk reduction (including rejecting destructive ASAT missile tests and committing to refrain from them).

6. **Sustainable, safe use of space:** Germany sets out sustainability and safety as a high priority, linking it to protection of space as a common resource, prevention of environmental damage in space and adverse impacts on Earth, and strengthening international frameworks for space governance. A specific "key project" focus includes building national capabilities for space situational awareness through 2030, including sensors and the German Space Situational Awareness Centre (GSSAC), and continued leadership in EU SST.

7. **Space research:** The Space Strategy treats space research as a core national capability spanning both in-space and ground-based research, with a stated intent to sustain Germany's leading role in European science missions and to translate research excellence into innovation and wider societal benefit. It emphasises Germany's strong engagement in the ESA Science Programme (including instrument development through science–industry collaboration), continued use of the ISS (and preparation for the post-ISS era), and the role of smaller satellite approaches in enabling scientific missions and participation pathways.

8. **International space exploration:** Germany's exploration aims are explicitly stated as: international cooperation, cutting-edge technologies, scientific research, and human inspiration. It highlights ambitions around robotic landers and lunar logistics (EL3 / "Argonaut"), Germany's responsibility for the European Service Module contribution, support for German ESA reserve astronauts, and a focus on selected enabling technologies (e.g., robotics and AI), alongside support for international regulation of activities on celestial bodies and space resources.

9. **Space activities in the context of recruiting and attracting talent:** The Space Strategy frames space as a lever for strengthening the talent pipeline, arguing that space programmes should be used more actively to attract and retain skilled individuals, raise public visibility of space benefits, and stimulate interest in STEM and adjacent disciplines. It highlights the need for targeted education and training support (including upskilling and lifelong learning as NewSpace draws in more diverse professional backgrounds), and points to instruments such as student programmes / competitions and the profile effect of astronaut selection as mechanisms to inspire and broaden participation.

Taken together, the strategies outline an integrated approach covering civil, commercial, and defence aspects to ensure Germany's long-term ability to operate in space, covering areas such as:

- **Security and defence:** Germany is shifting towards a more robust military stance, categorizing space as a critical infrastructure sector. The strategy emphasizes building deterrence, strengthening resilience against threats like cyberattacks and jamming, and developing national and European space security architectures in cooperation with NATO and EU partners.
- **European Autonomy:** A central goal is to reduce dependence on non-European actors for vital services, including independent access to space through national and European launch capabilities. This includes supporting the development of competitive launchers by German start-ups like Isar Aerospace and Rocket Factory Augsburg (RFA).
- **Climate and Earth Observation:** The strategy places a major emphasis on using satellites for climate and environmental monitoring, with significant investment in programs like Copernicus and EUMETSAT.
- **Technological Innovation and "NewSpace":** Germany aims to foster a dynamic commercial space sector ("NewSpace") by encouraging private investment, supporting start-ups, and investing in key technologies such as artificial intelligence (AI), quantum technologies, and advanced data utilization. A Space Innovation Hub has been launched to facilitate this.
- **International Cooperation and Regulation:** Germany is committed to the peaceful use of space and strengthening international space law. It actively participates in international bodies and is developing national legal frameworks, including a potential future German space law, to provide a clear regulatory environment for the industry.

German Space Sector Gap Analysis

Using ecosystem data presented in the Satellite Applications Catapult's Space Capabilities Catalogue as of March 2026, this section identifies where Germany has existing strengths in the priority areas set out above. The following segment shall seek to outline, in brief, where Germany already excels and where it needs to develop to meet the objectives set out in in its Strategies. Each segment will outline a strategic priority, existing strengths, and areas for development.

NewSpace Growth & Commercial Scaling

Expertise

Germany's ecosystem shows strong depth in upstream engineering and build capability, dominated by activities such as manufacturing, payload and subsystem assembly, integration and test, and specialist engineering services. This "industrial backbone" is visible in the concentration of established primes and Tier-1 capability (e.g., Airbus Defence & Space, OHB, TESAT Spacecom, HENSOLDT) alongside a large tail of specialist engineering, electronics, materials, software, and test providers in the supply chain

It is also reflected in a growing cohort of commercially oriented NewSpace actors spanning smallsat platforms and integration (Berlin Space Technologies, Exolaunch), optical / communications hardware (Mynaric), and emerging service propositions (e.g., constellr in thermal EO). This suggests a mature technical base with high capacity to design, manufacture, qualify, and supply complex systems. Germany's strategic intent to foster NewSpace and make space a growth market is therefore built on substantial engineering foundations (BMWK, 2023).

Opportunity Area

The central challenge is to convert a technically strong, engineering-heavy ecosystem into a scalable commercial space economy with repeatable products, operators, and demand pull-through. This implies three practical opportunity areas:

- **Scaling operation capability (beyond build):** Germany has world-class technology developers, but has a thinner layer of organisations whose core competence is operating space-enabled services at scale, mission operations, service operations, reliability engineering, and long-term customer delivery. Where operator capability is visible, it is often concentrated in a small number of large players or institutional operators. The strategic gap is, therefore, less about developing technology and more about building the operational wrap that turns a capability into a service customers renew: service assurance, incident management, lifecycle support, and customer success functions that make performance dependable in production, not just in demonstration. Without that layer, the ecosystem risks remaining "project-shaped" (engineering delivery, pilots, one-off deployments) rather than "service-shaped" (recurring revenue, long-term contracts, predictable cashflow).
- **Anchor customer and procurement-to-scale pathways:** The Space Strategy explicitly points to "anchor customer" mechanisms and improved financing pathways to help SMEs and start-ups scale. Germany has a large supply base capable of building systems and analytics, but scaling will depend on demand design: contracting models that allow government and institutional buyers to purchase services repeatedly, not commission bespoke projects each time. The practical gap is the absence (or inconsistency) of repeatable procurement routes that create predictable revenue and reference customers. If public demand is fragmented across agencies and Länder, suppliers struggle to productise and investors struggle to underwrite scale. Conversely, if Germany can consolidate requirements, standardise procurement frameworks, and commit to multi-year service contracts in priority domains (e.g., EO environmental services, secure communications, SSA), the ecosystem will be able to shift from grant / project dependence to commercial scale.
- **Systems integration and productisation:** Germany's ecosystem contains many specialist firms and component providers, but scaling requires stronger integrator capacity that can package those building blocks into "buyable" offerings, complete with security assurance, performance guarantees, and clear liability. That means more entities (or more integrator functions within existing primes and mid-caps) that can combine spacecraft / payload supply chains with data pipelines, ground segment, and cyber assurance into end-to-end propositions. This is especially critical because Germany's strategic ambitions are increasingly system-level (resilient architectures, secure connectivity, safety / security, sustainability). These ambitions cannot be delivered by component excellence alone: they require integrators who can assemble multi-party capability into coherent solutions with defined service levels, certification / assurance pathways, and operational governance that makes adoption straightforward for risk-sensitive customers.

Access to Space & Launcher Competitiveness

Expertise

Germany has visible launcher-related capability concentrated in a comparatively small set of specialist organisations, supported by a much broader enabling base in propulsion, structures, avionics, materials, and test. On the launcher side, the ecosystem includes new-generation providers such as Isar Aerospace and Rocket Factory Augsburg (RFA), and propulsion-focused entrants such as HyImpulse (suborbital / hybrid), alongside established European launcher and subsystem capability anchored through large industrial groups (e.g., ArianeGroup and German industry participants across the Ariane value chain).

In parallel, Germany's propulsion and qualification infrastructure base (e.g., DLR Lampoldshausen and associated industrial partners) provides credible underpinning for engine development and system testing. Strategically, Germany is explicit about strengthening European autonomy and competitiveness, including launch capabilities and the broader conditions for NewSpace growth.

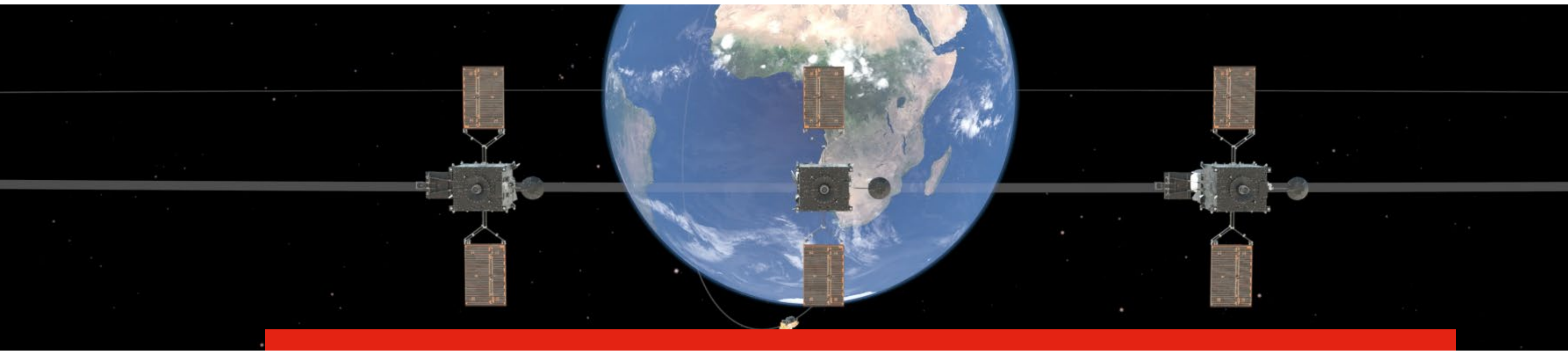
Opportunity Area

The principal gap is to translate launcher activity into reliable cadence and full-stack readiness, rather than isolated demonstrations. This implies three concrete opportunity areas:

- **Depth of the launch supply chain and qualification capacity:** Launch capability exists, but it thins as you move from enabling engineering into full system qualification, verification and validated operations. Strategic autonomy depends on robust qualification pipelines (test, range, safety cases, flight termination, regulated operations) that can support repeatability, not just capability in principle. This is where Germany's wider industrial strength must be "connected" to launcher delivery: ensuring that specialist suppliers can meet launch-specific requirements (traceability, acceptance testing, configuration control, and safety assurance) at the speed and cost points NewSpace demands.

- **Cadence, operational resilience, and learning loops:** Public evidence shows German microlaunchers are still in early flight / qualification phases, and reliability and cadence remain the gating conditions for "responsive" access to space. For example, Isar Aerospace successfully completed a second Spectrum flight in March 2026 following its first test flight in March 2025. RFA has delivered stages to SaxaVord ready for a test flight in 2026. The gap is, therefore, operational maturity: test-to-flight learning loops, manufacturing throughput, ground processing, launch site readiness, and a stable cadence. "Autonomy" in practice is earned through repeatability and reliability, not the existence of a vehicle design.

- **European autonomy versus practical dependency:** Near-term pathways will depend on non-German launch geography and partner regulation. Isar's Spectrum launches are conducted from Andøya (Norway), while RFA's initial launch campaign is tied to SaxaVord (UK), with the UK regulator having already granted a vertical launch licence for RFA's planned operations. HyImpulse has also signed an agreement with SaxaVord for a future SR75 flight from European territory. The strategic opportunity is to manage this pragmatically: partner for near-term access while accelerating the industrial, regulatory, and operational foundations required for medium-term autonomy. That means treating external spaceports not as a strategic failure, but as a bridging mechanism, provided Germany is simultaneously building the European supply-chain depth, qualification capacity, and operational maturity that will ultimately underpin sovereign and resilient access.



Climate, Environment, & Earth Observation (EO)

Expertise

Germany has substantial EO and geospatial depth across both institutional and commercial actors, spanning data acquisition, processing, analytics, and sector-specific applications. This is visible in a mix of operational and capability-building organisations: EUMETSAT provides a major operational anchor for meteorological EO in Europe; Airbus Defence & Space and HENSOLDT represent industrial-scale upstream competence relevant to EO payloads, systems, and security-adjacent sensing; and a strong set of specialist downstream providers convert EO into usable products and services. This breadth aligns closely with the Space Strategy's emphasis on climate / resource / environmental protection and the development of integrated products combining multiple data sources and delivery mechanisms.

Opportunity Area

The principal gap is to turn strong EO capability into operational, adopted services that public authorities and critical sectors buy and rely upon:

- **From analytics to operational decision services:** Germany has many capable analytics and mapping providers, but the strategic ambition requires services that connect EO to operational workflows, early warning, prioritisation, inspection regimes, regulatory compliance, and response planning. This means moving from "data outputs" to decision support and action: products that embed alerts, audit trails, and integration into customer workflows. The scaling gap is packaging outputs into end-to-end operational services with clear outcomes (reduced risk, faster response, lower lifecycle costs) and dependable service levels.
- **Institutional uptake and demand aggregation (making adoption repeatable):** Germany's CODE-DE platform provides cloud access and processing resources for EO data and is explicitly aimed at public authorities and their contractors. The gap is consistent adoption at scale: standardised procurement patterns, cross-ministry and cross-Länder demand coordination, and a shared set of operational requirements so providers can build repeatable products rather than one-off pilots. Without coordinated requirements, EO services remain fragmented, and value remains trapped in demonstrations. With coordinated requirements, suppliers can reuse architectures, assurance artefacts, and delivery playbooks, shortening procurement cycles and improving reliability.
- **Integration with terrestrial and airborne data (interoperability and trust):** The Space Strategy calls for integrated products combining satellite data with other measurement systems. This places a practical premium on interoperability and data-fusion readiness: common standards, trusted pipelines, and validated methods that allow satellites, aerial surveys, in-situ sensors, and models to be combined operationally, including in regulated or risk-sensitive environments (e.g., flood risk, environmental compliance, infrastructure monitoring). The opportunity is to formalise architectures and workflows (data fusion, handling, auditability), so that multi-source products can be deployed consistently across agencies and sectors rather than rebuilt case by case.

Digitalisation, Data Infrastructure, & Secure Connectivity

Expertise

Germany has strong digital and downstream building blocks across space software, data infrastructure, and communications capability, underpinned by an established institutional backbone for data access and service delivery. The national CODE-DE platform provides cloud-enabled access to EO data and is explicitly aimed at public authorities and their contractors, reflecting a deliberate effort to make satellite data usable "where the user is" (in cloud workflows). Germany's wider downstream competence is reinforced by organisations that combine industrial-scale systems delivery with high-assurance operations, including established communications and space-ICT actors such as TESAT Spacecom and mission / ground segment service providers such as DLR GfR, as well as a broad set of software and analytics firms that convert EO and satcom into applications. Germany's strategic intent to strengthen secure data availability, platform access, and downstream development therefore rests on a credible base of technical capability and institutional infrastructure.

Opportunity Area

The principal gap is to move from "building blocks" to secure, operator-grade service delivery for government and critical users. This implies three concrete opportunity areas:

- **Operator and integrator depth for secure connectivity:** Secure connectivity ambitions (including European multi-orbit secure communications initiatives) require integrators who can design and operate end-to-end architectures with certification, service-level commitments, and lifecycle support. Germany has strong component and subsystem capability and a mature operations footprint in specific programmes (for example, high-automation control centre operations in Oberpfaffenhofen and wider mission operations delivery via DLR-linked entities), but the adoption barrier is often the lack of "single accountable delivery" for secure services across space, ground, and user integration. The gap is not connectivity technology per se; it is the service wrap: assured integration into government networks, accredited security controls, continuous monitoring, and operational governance that allows critical users to treat space-enabled connectivity as dependable infrastructure rather than a pilot capability.

- **Assured cloud and sovereign data pathways:** CODE-DE demonstrates Germany's emphasis on cloud-enabled EO access and processing for public-sector users. The gap is to extend this model into a broader, cross-domain "single point of access" that supports sensitive users without bespoke engineering each time: trusted identity and access management, auditability, security accreditation, and consistent operating procedures that make data services procurement-ready. This becomes more important as secure connectivity and resilience objectives rise: customers will not only ask "can you provide the data?" but "can you prove the chain of custody, integrity, and compliance end-to-end?" Where those assurances are missing, services tend to stall at prototype stage because the operational and regulatory risk is too high.

- **Downstream demand coordination and reuse:** The Space Strategy references consolidating "government downstream requirements" to strengthen adoption and market formation. The key gap is that requirements and procurement remain fragmented across agencies and Länder, driving duplication of pilots and one-off solutions. Coordinated requirements enable reusable products: suppliers can build standardised service packages, shorten procurement cycles, and reduce delivery risk because the same architectures and assurance artefacts can be reused. This is also where the economics of secure services become viable: shared baselines and pooled demand create the recurring revenue that supports operator-grade reliability and continuous improvement.

Space Safety, Security, & Resilience

Expertise

Germany has a meaningful security-adjacent footprint and established institutional capability for space situational awareness through the German Space Situational Awareness Centre (GSSAC) in Uedem, operated jointly by the German Air Force and the German Space Agency at DLR since 2011. Strategically, the 2025 Space Safety and Security Strategy explicitly frames space as critical infrastructure and sets action areas focused on resilience and deterrence, anchored in close cooperation with NATO allies and European / international partners.

On the supply side, Germany's ecosystem includes defence and security actors able to contribute to space-domain awareness, protected sensing, and high-assurance communications and systems integration. Illustrative examples include HENSOLDT (space situational awareness sensors and solutions), which positions itself explicitly across space and cyber and describes SSA capabilities for tracking and characterising objects in orbit. Germany also has prime-level industrial capability that supports secure architectures and mission assurance (e.g., Airbus Defence & Space and OHB) alongside specialist cyber and information assurance capability (e.g., secunet) and long-standing test / verification bodies (e.g., IABG) that underpin assurance and qualification.

Opportunity Area

The principal gap is to translate security intent into integrated operational readiness across sensing, decision, and response, beyond technology components:

- **Security-by-design as a gate condition for adoption:** The security strategy stresses the risk landscape: interference, cyber threats, and the vulnerability of space-enabled services that underpin modern society. Even where technical capability exists, services will stall without credible assurance that critical users can accept as standard: supply chain security, secure-by-design architectures, vulnerability management, and audited operational security models. The practical adoption barrier is usually not whether an EO or comms service "works", but whether it can be trusted, accredited, and sustained under hostile conditions. This pushes Germany towards a default requirement for "assurance artefacts" (accreditation, audit trails, continuous monitoring, incident response readiness) built into services from day one, rather than added after pilots.
- **Civil–military integration pathways (governance, concepts, exercising):** The 2025 strategy is explicitly whole-of-government and positions the Bundeswehr as the backbone of national space safety and security architecture. The gap is often governance and integration rather than technology: shared operating concepts, clear division of roles across ministries, and rapid contracting mechanisms that allow government to pull in commercial capability at speed. Operational readiness also requires structured exercising and testing regimes, validating that sensing, analysis, decision-making and response are actually joined up, not merely co-located on paper. Germany's establishment of a dedicated military space command (introduced in 2021 at Uedem) underscores the shift in posture; the delivery challenge is turning that posture into integrated national routines across civil and military actors.
- **Resilience engineering and reconstitution planning (continuity under disruption):** Deterrence and resilience require redundancy, alternative pathways, and recovery / reconstitution options so that services can be maintained during disruption, not merely restored after failure. This is where technical capability must be packaged into "resilience products": diverse data sources; protected links; alternative ground segment options; and pre-arranged contractual and operational mechanisms to surge capacity. The 2025 strategy's focus on maintaining the ability to act in space across peace, crisis, and defence implies that resilience engineering must be treated as a design objective, a procurement condition, and a run-time operational discipline, not a contingency afterthought.

Summary

Germany is a major European space power whose modern role has been defined less by standalone national programmes and more by sustained leadership within European cooperation, particularly through technically demanding contributions in manufacturing, mission operations, and high-value research.

From early rocketry foundations through to post-war institutional capability (notably long-running mission operations and strong industrial geography in regions such as Bremen), Germany has built a mature space economy spanning upstream manufacturing, research infrastructure, and downstream services. In the 2020s, this legacy is being reframed for "NewSpace" conditions, shorter development cycles, increased commercial capital, and a sharper focus on resilience, sovereignty, and the protection of space-enabled services as critical infrastructure.

Germany's strategic direction to 2030 is set by two documents: the Federal Government Space Strategy (2023) and the Space Safety and Security Strategy (2025). Together, they describe an integrated civil–commercial–defence posture focused on European and international cooperation (as a foundational pillar), competitiveness and market growth (including microlaunchers and small satellites), climate and environmental monitoring (with strong emphasis on EO and data access), secure digital / data infrastructure (including platforms such as CODE-DE and alignment with European secure connectivity), and a stronger security stance that treats space as critical infrastructure and prioritises resilience, deterrence, and responsible behaviour in space. The Space Strategy also reinforces Germany's commitment to science leadership (ESA science, ISS and post-ISS planning) and uses space as a lever for talent attraction and skills development.

Against this strategic ambition, the ecosystem evidence suggests Germany's core strength lies in a deep engineering and manufacturing base, reinforced by a growing cohort of commercially oriented NewSpace actors. The key delivery gaps are therefore less about the absence of technology, and more about scaling and operationalisation:

- **Security & Defence:** The main gap is not technology, but operational readiness. Germany needs security-by-design as standard (accreditation, assurance artefacts, supply-chain security), clearer civil–military ways of working (shared operating concepts, exercising, rapid contracting), and resilience engineering that keeps services running during disruption rather than restoring them afterwards.
- **European Autonomy:** The constraint is turning "autonomy" into something that works in practice. Germany has credible launcher entrants and enabling capability, but it still needs reliable cadence and full-stack readiness; and, in the near term, it will often have to rely on partner spaceports and regulation while domestic and European capability matures.
- **Climate & Earth Observation:** The capability is strong, but adoption is the sticking point. The gap is moving from analytics and pilots to operational decision services that slot into real workflows, backed by coordinated requirements and repeatable procurement, and supported by interoperable data-fusion pipelines that combine satellite, airborne, and in-situ sources.
- **Technological Innovation & "NewSpace":** Germany is excellent at building, but scaling depends on operating. The gap is a thinner layer of operator-grade service delivery and integrator capacity to package multi-party capability into "buyable" offerings, alongside the demand-side mechanisms, anchor customers, predictable contracts, and productisation pathways, that unlock private investment.

Overall, Germany is well positioned to deliver on its ambitions, the underlying capability base is strong: it has globally competitive engineering and manufacturing, proven institutional delivery, and growing NewSpace momentum, but needs focus on the "last mile" of scale. Operator-grade service delivery, clearer demand pull-through, and security and resilience embedded by default should be the focus. Germany can convert its technical strength into sustained commercial growth and strategic autonomy. In doing so, it will be able not only to protect the space-enabled services it depends on, but to shape the European market for secure, sustainable, and operationally reliable space infrastructure in the decade ahead.

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Baden-Württemberg's Space Sector, Strategy, & Priorities

The Baden-Württemberg Space Story

Baden-Württemberg's space story is best understood not as that of a standalone national programme, but as that of a highly capable regional ecosystem embedded within German and European space activity. Its role has been shaped by a combination of advanced manufacturing, applied engineering, strong research institutions, and long-standing participation in major European programmes. In this sense, Baden-Württemberg has developed as an important space region in Germany: less visible politically than the federal level, but highly significant in the underlying industrial and research capabilities that make space systems possible.

The region's foundations lie in its broader industrial profile. Baden-Württemberg is one of Europe's strongest centres for precision engineering, automotive technologies, machinery, electronics, and high-value manufacturing. Over time, these strengths translated naturally into aerospace and space, where reliability, systems integration, specialist components, and applied research are critical. A regional study describes Baden-Württemberg's strength as an integrated value chain running "from the screw to the research satellite", which is a useful shorthand for the region's character: it combines deep supplier capability with nationally significant prime and research assets (DGLR, 2020, p. 21)[26].

[26] DGLR, 2020. RAUMFAHRT IN BADEN-WÜRTTEMBERG, Bonn, Germany: German Society for Aeronautics and Astronautics.

A defining feature of Baden-Württemberg's development has been the concentration of complementary space capabilities in several regional hubs. Around Friedrichshafen and the Bodensee area, the region hosts major satellite manufacturing and space hardware capability. Backnang developed into a leading centre for satellite communications. Stuttgart became a focal point for university-led space systems research, mission design, satellite operations, navigation, and enabling technologies. Lampoldshausen emerged as one of Europe's most important propulsion and test locations, with DLR's Institute of Space Propulsion tracing its history there back to 1959 and serving as a major European research and test centre for liquid rocket propulsion. Ulm adds further depth through quantum technologies, AI security, and communications-related research relevant to future space systems and secure digital infrastructure (DLR, 2026a; DLR, 2026b; DLR, 2026c; DLR, 2026d)[27],[28],[29],[30].

The University of Stuttgart has been especially important in giving the region a distinctive space identity. Stuttgart hosts the largest aerospace faculty in Europe, while the university's Institute of Space Systems has built a strong profile in small satellites, satellite technology, mission operations, and experimental in-orbit systems (BaWü, 2023)[31]. Its infrastructure includes its own ground station and satellite control capabilities, allowing Baden-Württemberg not only to design and build space systems, but also to operate them (UoS, 2026)[32]. This gives the region an end-to-end competence that goes beyond component supply and into system demonstration, mission execution, and skills development.

Research depth is another central part of the story. Baden-Württemberg's space ecosystem is supported not only by industrial firms and the University of Stuttgart, but also by DLR sites in Stuttgart, Lampoldshausen and Ulm, alongside Fraunhofer institutes and wider scientific infrastructure. DLR Stuttgart works on lightweight structures, re-entry technologies, and laser-based systems for space debris monitoring and removal. Lampoldshausen remains a core European asset for propulsion testing and launcher-related R&D. In Ulm, DLR's quantum technologies work is explicitly geared towards precision instruments for space applications. Taken together, these assets mean the region is active across propulsion, structures, satellite systems, communications, safety, security, and advanced instrumentation.

Baden-Württemberg's role is also notable for the way civil, commercial, and research capabilities overlap. The region contributes to traditional space strengths such as satellites, telecommunications, Earth Observation (EO), instrumentation, and propulsion, but it is also positioning for newer areas associated with commercialisation and "NewSpace". The state's aerospace strategy, launched in 2023, frames this explicitly: Baden-Württemberg aims not just to preserve existing strengths, but to expand them, open new fields, and increase the visibility of regional actors in federal, EU, and ESA programmes.

This gives Baden-Württemberg a space story with two linked chapters. The first is one of industrial and scientific depth: a region that became indispensable to German and European space through engineering excellence, propulsion, satellite manufacturing, communications, and research. The second is one of adaptation: how that legacy base is being reframed for a more commercial, competitive, and technology-convergent era in which space increasingly intersects with AI, quantum, climate services, secure connectivity, autonomy, and resilient critical infrastructure. Rather than trying to replicate a full national space architecture, Baden-Württemberg's strength lies in being a dense, innovation-driven regional node within a larger German and European system, with unusual breadth from research and testing through to subsystem supply, mission capability, and advanced applications.

[27] DLR, 2026a. The Institute of Space Propulsion. [Online] Available at: https://www.dlr.de/en/ra [Accessed 23rd March 2026].

[28] DLR, 2026b. DLR site Lampoldshausen. [Online] Available at: https://www.dlr.de/en/dlr/locations-and-offices/lampoldshausen [Accessed 23rd March 2026].

[29] DLR, 2026c. The Institute of Quantum Technologies. [Online] Available at: https://www.dlr.de/en/qt [Accessed 23rd March 2026].

[30] DLR, 2026d. The Institute for AI Safety and Security. [Online] Available at: https://www.dlr.de/en/ki [Accessed 23rd March 2026].

[31] BaWü, 2023. THE Aerospace LÄND, Stuttgart, Germany: Ministry of Economic Affairs, Labour and Tourism.

[32] UoS, 2026. Institute for Space Systems: Infrastructure. [Online] Available at: https://www.irs.uni-stuttgart.de/en/research/satellitetechnology-and-instruments/smallsatelliteprogram/flying-laptop/infrastructure/ [Accessed 23rd March 2026].

Strategies & Priorities

Baden-Württemberg's space strategy is set out within the state's 2023 aerospace strategy, which presents space not as an isolated sector, but as a strategically important high-technology field linked to industrial competitiveness, research excellence, climate and environmental goals, and future digital services. Within that wider framework, the space components of the strategy are centred on strengthening Baden-Württemberg's established capabilities while expanding its position in NewSpace, where commercialisation, agile development, data-enabled services, and cross-sector innovation are becoming more important (BaWü, 2023, pp. 9 - 10). The strategy is therefore both defensive and developmental: it aims to preserve the region's existing strengths, while repositioning Baden-Württemberg for a more competitive, sustainability-driven, and commercially dynamic space economy.

At the highest level, the strategy states that Baden-Württemberg wants to remain among the most successful aerospace regions and to respond to the major challenges facing the sector through a future concept built on **digitalisation, sustainability**, and **cooperation** (BaWü, 2023, pp. 3 - 4). In the space context, these pillars have a clear meaning. **Digital** space is about accelerating digital uptake across the sector, especially among SMEs, and using increasing volumes of data, particularly satellite data, to generate new services and business models. **Sustainable** space is focused on developing environmentally responsible space technologies and establishing a recognisable quality positioning for sustainable aerospace made in Baden-Württemberg as a hallmark of quality (BaWü, 2023, p. 16). **Cooperative** space is concerned with strengthening political representation, increasing the visibility and networking of the sector, and deepening collaboration between space and other industries. These three pillars operate as the organising logic for the region's space objectives.

Within the strategies dedicated space action fields, it identifies several priority objectives:

1. It seeks to **strengthen existing core competencies in conventional space while broadening capabilities in NewSpace.** This includes maintaining strengths in established industrial and research activities, but also adapting the ecosystem to faster development cycles, more agile technology programmes, and new commercial market opportunities. The strategy is explicit that digitalisation and sustainability should not remain isolated projects, but should be spread more widely across the sector.

2. The strategy places strong emphasis on **commercialisation and the use of space-derived data**. It argues that Baden-Württemberg should use satellite data to support the development of new digital services and business models, and to drive innovation beyond the space sector itself, including in areas such as autonomous driving, cybersecurity, and climate protection. This is an important point in strategic terms: the region is not only interested in upstream technologies, but also in downstream economic value creation from space-enabled data and services. In that sense, the strategy treats space as both an industrial capability and an enabling digital infrastructure for wider economic transformation.

3. **Sustainability** is positioned as a defining regional ambition in space. The strategy argues that Baden-Württemberg should take on a leading role in environmental and climate protection through space-based services and should make sustainable space a regional hallmark. This includes support for greener propulsion approaches, the reusability of engines, climate-friendly drive technologies, and a stronger focus on protecting space systems and avoiding space debris as orbital activity increases. The state is therefore not framing sustainability only in terrestrial terms; it also applies the idea to the conduct of space activity itself, including the long-term viability of the space environment.

4. The strategy gives notable weight to **research excellence, skills, and technology transfer**. It stresses the importance of maintaining and improving scientific capability, including the education and training of future space engineers, and explicitly identifies workforce security as a regional priority. This reflects Baden-Württemberg's wider model: the space economy is expected to be underpinned by strong universities, applied research institutions, and industry-research collaboration, rather than relying solely on prime contractors or standalone public programmes. The strategy, therefore, treats research capability, human capital, and translational innovation as essential enablers of long-term competitiveness.

5. The strategy seeks to **increase the visibility, political representation, and connectedness of the regional space sector**. It calls for stronger external visibility for Baden-Württemberg as a space location, greater networking within the sector, and more collaboration with other industries. This is partly about profile and influence, but it is also about economic structure: the region wants space to connect more effectively with adjacent strengths in digital technologies, manufacturing, mobility, energy, and environmental applications. This means Baden-Württemberg sees cross-sector spillovers as central to its NewSpace positioning.

These strategic themes are then translated into a number of specific space measures:

1. One of the most important is the continuation of the Integrated Research Platform for Affordable Satellites (IRAS), which is presented as a vehicle for agile technology development and structured collaboration between industry, the University of Stuttgart, and applied research organisations (BaWü, 2023, p. 16). The intention is to continue and expand this cooperative model, with particular importance attached to adapting process technologies and achieving very low cost targets, especially in ways that are accessible to SMEs. This makes IRAS a core instrument for improving agility, cost-efficiency, and cross-sector technology transfer in the regional space ecosystem.

2. A second major strand is the strategy's programme for sustainable space. This includes support for R&D on a launch vehicle using sustainable propulsion, support for the creation of a Green Space Baden-Württemberg centre to bundle environmentally oriented space activities, and stronger university research on Sustainable Space 2050 (BaWü, 2023, p. 17). The latter includes work on technical solutions for new orbital regions, exploration missions, minimising ecological impacts, protecting space systems, and reducing space debris. Taken together, these measures show that sustainability is not treated as a rhetorical theme; it is operationalised through propulsion, institutional capacity-building, and long-term research agendas.

3. The strategy also prioritises start-up support as part of its space agenda (BaWü, 2023, pp. 17 - 18). It states that the growth in satellite constellations and data volumes is creating new opportunities for services in climate and environmental protection, autonomous systems, and cybersecurity, and it links this to state-level support under Start-up BW and the ESA Business Incubation Centre in Baden-Württemberg. The emphasis here is on enabling new firms to build digital, data-driven products and services, rather than only supporting traditional hardware activity. This reinforces the broader strategic shift toward NewSpace and the commercial exploitation of satellite-derived capabilities.

4. Finally, the strategy underlines the need to strengthen cooperation with other sectors, including through a proposed "BW Space meets" event series intended to connect space more closely with other industry associations in the state and stimulate new innovative products (BaWü, 2023, p. 18). This reflects a recurring feature of Baden-Württemberg's approach: space is not treated only as a niche vertical, but as a source of technologies, data, and methods that can generate value across the wider economy.

Overall, the space aspects of Baden-Württemberg's strategy can be read as a regional competitiveness agenda built around five linked objectives: to modernise the space sector through digitalisation; to make sustainability a distinctive regional strength; to convert satellite data and NewSpace activity into new commercial value; to sustain research, skills, and agile innovation capacity; and to raise the visibility and connectedness of Baden-Württemberg as a space location. The result is a strategy that does not seek to replicate national space policy in full, but instead positions Baden-Württemberg as a high-value regional node within Germany and Europe, with particular emphasis on NewSpace, sustainability, and cross-sector innovation.

Baden-Württemberg's Space Sector Gap Analysis

Using ecosystem data presented in the Satellite Applications Catapult's Space Capabilities Catalogue as of March 2026, this section identifies where Baden-Württemberg has existing strengths in the priority areas set out in their space strategy. The following segment shall seek to outline, in brief, where Baden-Württemberg already excels and where it needs to develop to meet the objectives set out in in its Strategy. Each segment will outline a strategic priority, existing strengths, and areas for development.

Start-Up Growth, Commercialisation, & NewSpace Scaling

Expertise

The region does show signs of an entrepreneurial and commercial support layer. acitoflux is a useful example of venture and investment capability explicitly active in NewSpace and deep tech. **HyImpulse** and **Atmos Space Cargo** represent the type of younger, more frontier-oriented firms associated with NewSpace. **Xylene,** and some of the region's software- and analytics-led actors, indicate that there are also newer downstream-oriented business models present. This demonstrates that Baden-Württemberg's ecosystem is not composed only of universities, research institutes, and established engineering firms.

Opportunity Area

The principal gap is not the absence of start-up activity, but the relative thinness of the scale-up layer needed to turn promising firms into durable commercial anchors:

- **Scale-up capacity rather than start-up presence alone:** A region can generate innovative companies without consistently helping them become medium-sized or globally competitive firms. The likely gap in Baden-Württemberg is the architecture around growth: market access, customer traction, growth capital, procurement pathways, and the commercial support needed to move beyond technical proof points.
- **Commercial productisation of technical excellence:** Many of the region's organisations appear highly capable technically. The challenge is to ensure that this technical strength is turned into products and services that can be sold repeatedly, not only into bespoke engineering contracts or research-driven work. This is especially important if the strategy is to deliver in digital services, sustainability, and affordable mission architectures.
- **Visibility and bankability:** The strategy is right to emphasise visibility and networking. For younger firms, one of the practical constraints is not invention, but recognition by investors, customers, and public buyers. Baden-Württemberg's opportunity is to make more of its NewSpace firms legible as commercially credible, investable, and partnership-ready businesses.

Digitalisation & Satellite-data-Enabled Business Models

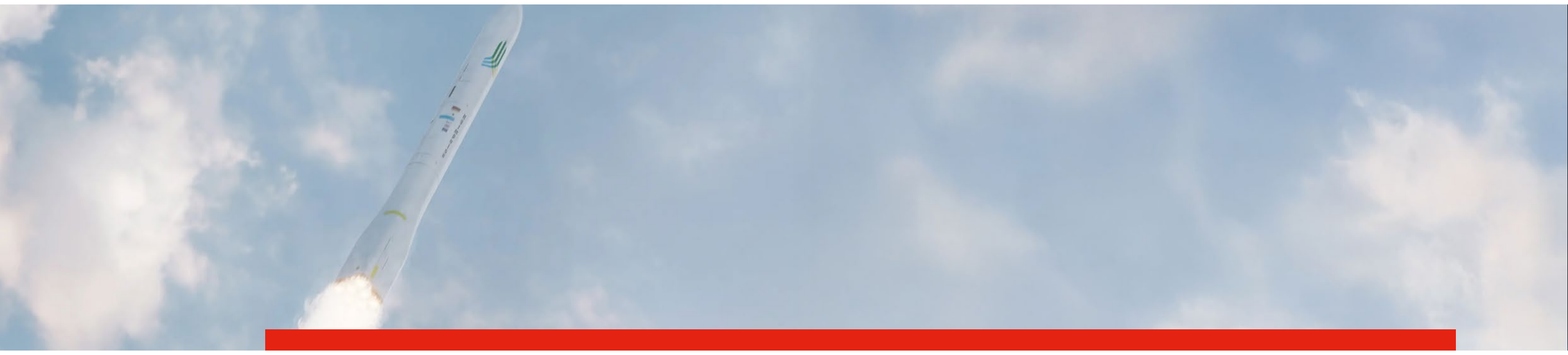
Expertise

Baden-Württemberg has a credible digital foothold, but it remains narrower than its upstream base and thinner than the strategy's ambitions imply. The regional ecosystem includes organisations able to support software, modelling, geospatial analysis, mission data handling, and digital applications. Illustrative examples include Altair Engineering, Spyrosoft, Xylene, NavPos Systems, and GTD System & Software Engineering, Taken together, these organisations show that Baden-Württemberg already has a strong base from which more advanced satellite-data exploitation and downstream product development could grow.

Opportunity Area

The principal gap is not the absence of digital competence, but the need to convert a technically credible set of capabilities into a broader, more commercially mature downstream layer that can deliver the strategy's ambitions around satellite-data-enabled business models and digitally enabled growth:

- **Application-layer scaling:** Baden-Württemberg has organisations that can process, model, analyse, and visualise data, but the ecosystem still appears stronger in enabling tools than in a thick cohort of companies turning space-derived data into commercial services. The strategic challenge is, therefore, to grow firms and propositions that sit closer to the customer and the market, especially in areas such as climate intelligence, industrial monitoring, mobility, and secure geospatial services.
- **From technical workflow to market-facing service:** A region can be strong in engineering software, mission tools, and analytics without necessarily capturing substantial downstream value. The gap here is productisation. Baden-Württemberg appears capable of supporting technical workflows around data and missions, but less visibly populated by firms packaging these capabilities into scalable services that can be adopted routinely by non-space customers.
- **Demand-side absorption across the wider economy:** The strategy's digital ambition depends not only on supply, but on uptake across Baden-Württemberg's, Germany's, and the wider industrial base. The opportunity is to strengthen the connection between space data and the region's non-space strengths, so that digitalisation becomes a route to new market demand rather than a capability that remains largely internal to the space and engineering community.



Sustainable Space, Environmental Services, & Responsible Operations

Expertise

Baden-Württemberg has meaningful building blocks for a sustainability-led space proposition. HyImpulse provides a clear example through its work on hybrid, paraffin-based propulsion and launch systems, aligning directly with the strategy's emphasis on greener propulsion approaches. Atmos Space Cargo adds capability around return-from-orbit systems, re-entry, and in-space research and manufacturing, which is highly relevant to questions of mission efficiency, reuse, and new sustainable mission architectures. Fraunhofer EMI brings research and engineering capability relevant to spacecraft testing, survivability, and system-level performance, while Fraunhofer IPA contributes manufacturing, coatings, testing, and industrial process capability that could support more efficient production and materials development. Organisations such as AZUR SPACE Solar Power, ASP Equipment, and Von Hoerner & Sulger further reinforce the regional base in photovoltaics, propulsion components, power systems, and payload-related engineering. Baden-Württemberg does have real capability that could underpin a sustainable space agenda.

Opportunity Area

The principal gap is that these capabilities do not yet appear to add up to a fully developed, system-level sustainable space proposition. The region has strong pieces, but less evidence of a broad cluster that combines green technologies, responsible operations, and downstream environmental value creation into a recognisable whole:

- **From technical inputs to a coherent sustainable space offer:** Baden-Württemberg has relevant strengths in propulsion, power, manufacturing, return systems, and research, but these appear somewhat dispersed. The opportunity is to connect them into a clearer regional proposition around sustainable space, rather than allowing sustainability to remain a useful narrative attached to isolated technical capabilities.

- **Operational responsibility beyond green hardware:** Sustainable space increasingly includes debris awareness, end-of-life planning, orbital responsibility, survivability, and protection of the space environment. Baden-Württemberg has some relevant technical foundations, but less visible depth in dedicated service-layer activity around debris, orbital safety, or responsible operational support. The gap is therefore one of operationalisation, not just technology.

- **Environmental services as a commercial growth area:** The strategy links sustainability to broader environmental and climate applications. While the region has some digital and geospatial actors that could contribute here, there is less evidence of a broad cohort of firms already monetising space-enabled environmental services at scale. The opportunity is to translate technical capability into stronger downstream environmental products and services.

Affordable Satellites, IRAS, & End-to-End System Integration

Expertise

Baden-Württemberg is particularly strong in the enabling capabilities that sit behind an affordable-satellite agenda. The region includes firms with credible hardware, subsystem, software, testing, and manufacturing expertise. TESAT is a major example, with capabilities spanning communications systems, payload design, photonics, RF electronics, optical relay systems, testing, and software. Von Hoerner & Sulger contributes payload design, propulsion components, deployment mechanisms, optical sensors, and testing services. ASP Equipment and AZUR SPACE Solar Power reinforce the base in power systems, photovoltaics, and engineering, while DIOPTIC, AXTAL, COMTRONIC, and Spherea add further depth in optical materials, photonics, radio electronics, control electronics, payloads, onboard processing, and testing. Astos Solutions contributes satellite platform design, mission design, and simulation software, and the University of Stuttgart Institute for Space Systems adds research, R&D, and skills development that underpin longer-term system capability. This is a serious upstream and technical foundation.

Opportunity Area

The principal gap is not component capability. It is the need to turn strong subsystem and engineering depth into more repeatable, integrated, end-to-end mission capability, consistent with the strategy's emphasis on affordable satellites and collaborative development:

- **System integration density, rather than component excellence alone:** Baden-Württemberg appears well supplied with organisations that can contribute parts, software, engineering, and testing. The thinner layer is end-to-end integration: actors that routinely assemble these capabilities into complete, affordable, repeatable satellite products and missions. That distinction matters because strategies built around affordability and agility depend on the ability to integrate, qualify, and deliver consistently, not only on technical excellence at subsystem level.

- **Operational follow-through across the asset lifecycle:** Affordable satellites also require mission planning, ground support, mission control, and operational continuity. Baden-Württemberg has some relevant assets here, but the operational layer still appears thinner than the underlying engineering base. The opportunity is to strengthen the full mission chain, from design through to operation and service delivery.

- **Industrialisation for speed and cost:** The strategy's Integrated Research Platform for Affordable Satellites (IRAS) project emphasis implies a need for faster cycles, cost-down production, and methods that can support SME participation. Baden-Württemberg has excellent manufacturing and engineering capability, but the opportunity is to align this more directly with modular architectures, quicker qualification routes, and more routinised delivery models that make affordability a sustained ecosystem characteristic rather than an occasional project outcome.

Skills, Research Translation, & Commercial Workforce Depth

Expertise

Baden-Württemberg is strong in research and technical capability development. The University of Stuttgart Institute for Space Systems is an obvious anchor, with research, R&D, and skills-and-training roles. Aalen University contributes applied research and workforce development. Fraunhofer EMI and Fraunhofer IPA add further depth in research, commercial R&D, testing, engineering, manufacturing, and industrial process capability. This gives the region a substantial knowledge base and a credible platform for longer-term talent development.

Opportunity Area

The principal gap is less at the research layer and more in the translation of technical excellence into a broader commercial and operational workforce suited to the strategy's ambitions:

- **A broader role mix for a changing sector:** Baden-Württemberg has engineers, researchers, and technical specialists. But a region pushing toward digital services, sustainable space, affordable missions, and New Space scaling also needs more people in product, operations, business development, regulation, programme delivery, and customer-facing roles. The opportunity is to broaden the workforce profile around the existing technical base.
- **Translation structures, not only education structures:** Strong institutes matter, but they do not automatically produce strong commercial outcomes. The strategic need is to improve the pathways between research capability, venture formation, industrial adoption, and scaled delivery, so that research excellence translates more consistently into market capture.
- **Retention and circulation of scale-up talent:** Regions with strong research systems can still struggle to build and retain enough commercially experienced growth talent. Baden-Württemberg's opportunity is to ensure that its ecosystem can support the people needed not just to invent and test, but to scale, sell, operate, and grow.

Summary

Baden-Württemberg is distinguished by deep industrial competence, strong applied research, and a concentrated set of regional hubs spanning satellite manufacturing, satellite communications, propulsion, mission design, and space systems research. Its role within the wider German and European space economy is as a high-value regional node: one that contributes critical enabling technologies, specialist engineering, research infrastructure, and mission capability into broader national and European systems. This gives the region a strong legacy base in conventional space activity, underpinned by strengths in advanced manufacturing, precision engineering, propulsion, telecommunications, and scientific research.

The Baden-Württemberg aerospace strategy seeks to build on that legacy by repositioning the region for a more digital, sustainable, and commercially dynamic space economy. The ecosystem evidence suggests that Baden-Württemberg already has much of the technical foundation needed to support this strategy. It appears particularly strong in upstream engineering, specialist subsystem capability, testing, manufacturing, propulsion-related activity, and research-led innovation. It also shows credible emerging strength in areas such as launch, return from orbit, mission design, and frontier NewSpace activity. However, the main challenge is not whether the region has capability in general, but whether it can convert that capability into a more complete and commercially mature ecosystem aligned with its strategic ambitions. The clearest gap areas are:

- **Digitalisation and satellite-data commercialisation:** Baden-Württemberg has a credible digital base, but it is still thinner than its upstream strength. The main gap is in scaling downstream, customer-facing products and services that turn satellite data into repeatable commercial value.
- **Sustainable space as a joined-up proposition:** the region has strong technical ingredients in propulsion, return systems, manufacturing, and research, but these do not yet appear to form a broad, system-level sustainable space cluster spanning green technologies, responsible operations, and space-enabled environmental services.
- **Affordable satellites and end-to-end integration:** Baden-Württemberg is strong in subsystem and engineering capability, but appears thinner in the layer of actors able to integrate, operate, and repeatedly deliver complete, affordable mission architectures.
- **Start-up growth and NewSpace scaling:** entrepreneurial activity is present, but the scale-up layer remains relatively narrow. The key challenge is helping promising firms move from technical credibility to durable commercial growth through stronger market access, customer traction, and growth support.
- **Skills and research translation:** the research base is a clear asset, but the region will need a broader commercially oriented workforce, including product, operations, regulatory, and business-development capability, if it is to deliver on its downstream and NewSpace ambitions.

Overall, Baden-Württemberg appears well positioned to remain one of Germany's leading space regions. Its strongest near-term advantage lies in the depth and quality of its engineering, research, and industrial base. Its longer-term success, however, will depend on how effectively it can translate those strengths into broader commercial capture: scaling NewSpace firms, growing downstream digital and environmental services, building more repeatable integrated mission capability, and turning cross-sector cooperation into sustained market demand. In that sense, Baden-Württemberg's opportunity is not to replicate national space policy at regional level, but to become an increasingly complete, visible, and strategically differentiated regional engine within Germany's and Europe's evolving space economy.

Conclusions

This report finds that the UK, Germany, Wales, and Baden-Württemberg each have credible and strategically significant space ecosystems, but that they differ in structure, maturity profile, and routes to growth. Those differences create a strong basis for practical complementarity.

At national level, the UK appears strongest where commercial service models, agile satellite manufacture, downstream applications, connectivity, navigation-enabled services, and specialist supporting services are concerned. Its main challenge is to deepen sovereign capability in selected areas, accelerate adoption, and scale new growth areas more effectively. Germany, by contrast, stands out for industrial depth, research capability, major engineering assets, and strong alignment with European institutional frameworks. Its key challenge is to turn that strength into faster commercial scaling, stronger NewSpace growth, broader downstream capture, and more integrated competitiveness in launch, data infrastructure, and security-related domains.

At regional level, Wales and Baden-Württemberg are also complementary rather than directly overlapping ecosystems. Wales offers agility, visible ambition, emerging launch-enabling and return-related thinking, developing downstream and applications capability, and the potential to act quickly in niche growth areas if supported by the right partnerships and market signals. Baden-Württemberg brings deeper industrial density, stronger subsystem and engineering capability, major research assets, and a more mature manufacturing and testing base. Wales' challenge is ecosystem depth and scale; Baden-Württemberg's challenge is commercial broadening, start-up scaling, downstream market capture, and fuller end-to-end system integration.

The central conclusion is therefore that the greatest value lies not in treating these ecosystems as competitors, but in treating them as complementary partners. A strategic approach to collaboration could help each side address gaps more quickly than attempting to build all capabilities domestically, while also creating new export routes, investment relationships, and joint propositions.

Opportunities for the UK to address Germany's gaps

The UK is well placed to support Germany in several areas where Germany's ecosystem appears comparatively thinner or where market translation remains a challenge. In particular, UK strengths in downstream service development, Earth Observation (EO) applications, navigation-enabled services, professional support services, and commercially oriented market models could help Germany accelerate the uptake and commercialisation of space-enabled services. This is especially relevant to German priorities around digitalisation, data infrastructure, secure connectivity, and broader downstream value capture.

The UK could also help Germany's NewSpace and commercial scaling agenda through partnerships with firms experienced in agile mission models, private customer development, international market access, and service-led commercialisation. Similarly, the UK's experience in areas such as space law, insurance, regulatory support, cybersecurity support, and commercial advisory services could complement German efforts to create more attractive operating conditions for SMEs, start-ups, and growth-stage firms.

Opportunities for Germany to address UK gaps

Germany is well placed to help the UK where the UK's needs are more industrial, infrastructural, or research-intensive. This includes advanced manufacturing, materials science, engineering depth, scientific payload development, and aspects of sovereign industrial capacity where Germany's ecosystem is particularly strong. German institutions and firms could, therefore, be valuable partners for UK ambitions in high-performance payloads, manufacturing scale-up, launcher-related industrial development, and elements of resilience and long-term research translation.

Germany's strong industrial base and federal research infrastructure may also help the UK address gaps in capability depth around sustainable space, resilient digital infrastructure, and selected security and sovereignty issues. For the UK, partnership with German actors may therefore offer not only export or procurement opportunities, but a route to strengthening capability in areas that are capital-intensive or difficult to build at pace through the domestic market alone.

Opportunities for the UK and Germany to collaborate

The strongest national-level opportunities are likely to be collaborative rather than one-directional. Shared opportunities are particularly evident in advanced manufacturing, scientific payloads, EO services, secure and resilient connectivity, space safety and security, sustainability, and the creation of more integrated data and service architectures. Both countries also have reasons to collaborate in areas where European resilience, sovereign capability, and trusted partnership matter, including secure infrastructure, dual-use applications, and standards-setting.

A productive UK – Germany approach would, therefore, combine industrial cooperation, joint innovation, and market-facing activity. That may include joint R&D, reciprocal business development, co-developed missions or payloads, coordinated activity through European programmes, and structured cluster or institutional partnerships that can move beyond one-off engagements into repeatable pipelines.

Opportunities for Wales to address Baden-Württemberg's gaps

Wales can contribute to Baden-Württemberg in areas where the German region needs broader commercial capture, ecosystem agility, and stronger market-facing application. Welsh strengths and ambitions in emerging launch-enabling activity, mission planning, return-from-orbit thinking, agile ecosystem development, and application-led collaboration may be particularly relevant where Baden-Württemberg seeks to convert technical assets into more complete and commercially visible propositions.

Wales may also be able to support Baden-Württemberg's downstream and service-oriented development through partnerships in applications, operational flexibility, and targeted niche capability building. Although Wales does not match Baden-Württemberg in industrial depth, it can offer a more agile testbed environment for cluster cooperation, pilot activity, and the development of smaller-scale collaborative initiatives that help move promising ideas towards market-facing outcomes.

Opportunities for Baden-Württemberg to address Wales' gaps

Baden-Württemberg is particularly well placed to address Welsh gaps in industrial depth, specialist engineering, subsystem capability, testing, propulsion-related research, and commercially translatable research excellence. For Wales, a relationship with Baden-Württemberg could provide access to stronger supply-chain depth, more mature research-industry interfaces, and partners able to support the growth of advanced manufacturing, system integration, and technical workforce capability.

This is especially relevant in fields such as manufacturing, test and evaluation, engineering, sustainable space technologies, and elements of end-to-end mission capability. Baden-Württemberg's deeper ecosystem may also help Wales strengthen the surrounding services and enabling conditions needed to move from niche capability toward a more complete and internationally competitive regional proposition.

Opportunities for Wales and Baden-Württemberg to collaborate

The Wales – Baden-Württemberg opportunity is arguably the most distinctive finding in the report. The project proposal itself anticipated collaboration opportunities in areas such as manufacturing, testing, data, and engineering, and the comparative analysis supports that direction. More specifically, the two regions appear well matched for cooperation around manufacturing and subsystem development, test and evaluation, engineering partnerships, mission planning, sustainable space, launch-enabling services, return-from-orbit related activity, and cluster-to-cluster knowledge exchange.

This relationship is likely to work best where it is made practical. That means moving beyond broad declarations towards identifiable firms, institutions, and cluster mechanisms; using ecosystem mapping as a basis for targeted introductions; and focusing on activities that can generate visible results, such as trade missions, reciprocal delegations, pilot projects, demonstrators, collaborative bids, and targeted inward investment discussions. In that sense, the most valuable outcome of this report is not only the identification of complementarity, but the creation of a clearer platform for acting on it.

Closing Conclusion

Overall, the report finds that there is a credible and practical basis for deeper UK – Germany and Wales – Baden-Württemberg engagement in space. The evidence suggests that the opportunity lies less in generic partnership language and more in deliberately matching one side's strengths to the other side's needs. For the UK and Germany, this means linking commercial agility and downstream service strength with industrial scale, engineering depth, and research capability. For Wales and Baden-Württemberg, it means linking a growing, agile regional cluster with a technically deep and industrially mature one. If pursued through structured collaboration, targeted export activity, and focused investment engagement, these complementarities could support stronger economic outcomes on both sides.

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