

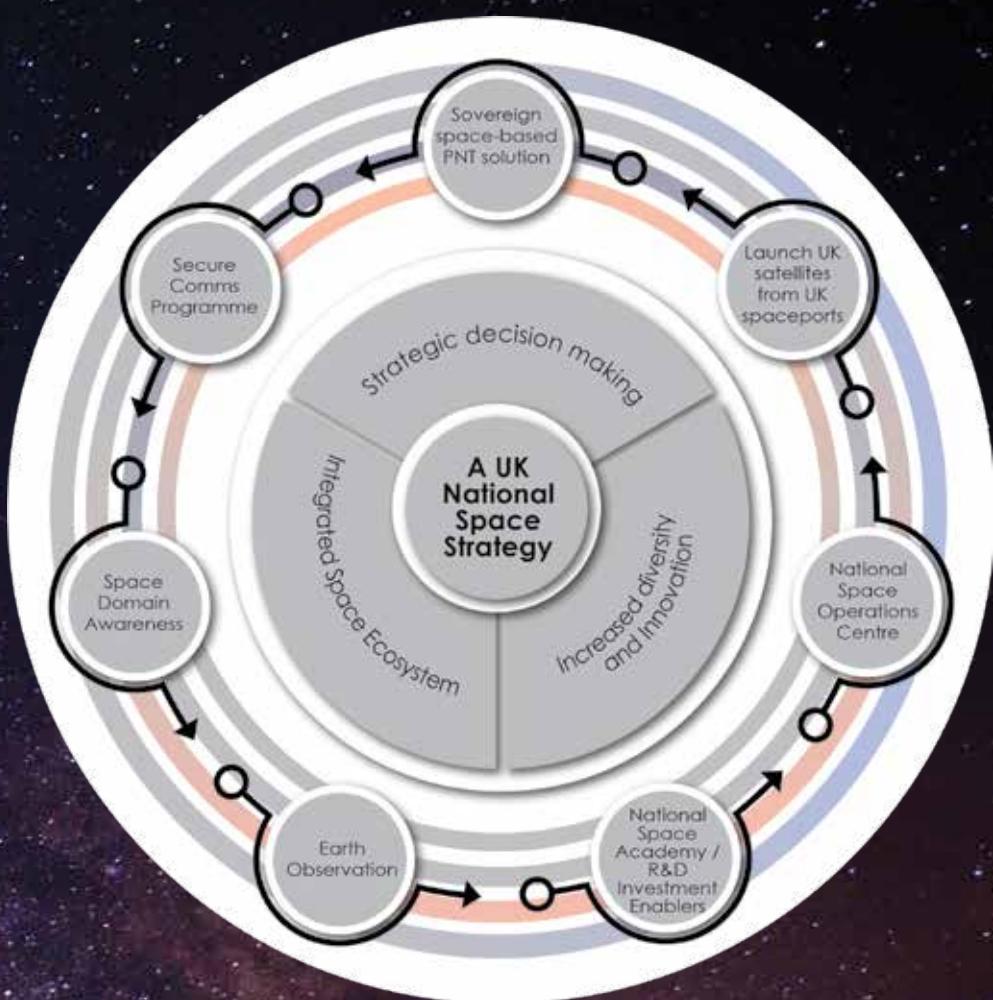


ATHENA

A NEW APPROACH
TO SPACE

A NEW APPROACH TO SPACE

Key focus areas 2020 - 2030



Foreword

The UK space sector is at a critical point in its evolution and there have been major strides and developments in recent months, not least the first meeting of the newly formed National Space Council, the procurement of a 45% share in the OneWeb LEO constellation and the launch of the Spaceflight Regulations.

Industry has been pleased to see the strong interest taken in the sector by the Prime Minister and his Government, but is also eagerly awaiting the much anticipated release of a UK National Space Strategy. As Abraham Lincoln once said, "The best way to predict the future is to shape it". In these uncertain times, we see Space as being a sector that will shape future growth, shape future economies and, indeed, shape society's future ways of life. Our four companies want to be part of the important discourse around a national ambition for Space and be part of its delivery. We have therefore formed team Athena, with the aim of providing a bold and visionary new approach to growth in the Space sector and the industrial strategy that underpins it.

Our four founding companies that together make up Athena are already a key part of delivering the UK's existing space programmes, with each of them offering a proven track record of supporting Governments in Space activity. Together we are already delivering critical space programmes for the UK, including military satellite communications on Skynet 5, space domain awareness at RAF Fylingdales, upgrading the command and control software in the UK Space Operations Centre and, most recently, developing the UK's First Launch capability. We therefore believe we have much to offer in the UK's national space strategy debate and have worked together to develop this paper with our thoughts and recommendations.

We commend this paper to you and look forward to playing a key role in establishing the UK as a leading member of the global community of major space powers



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EXECUTIVE SUMMARY



The UK's moment to propel its space economy is now!

A number of nations hold a special role in shaping global space policy and driving activity. In addition to the three global space superpowers – the US, Russia, and China – there are a handful of major global space powers that includes the EU, India, and Japan. These have unique attributes in common including the ability to launch, a robust space industrial base, academic and educational capability, and a meaningful military and intelligence role.

The United Kingdom has reached a pivotal moment in its space aspirations and it is critical that it should be a part of this group with an active voice in shaping future developments, leveraging its significant satellite industry, its strong military ties and cooperative space activity with the US and other Five Eyes nations, its participation in the International Space Station and the European Space Agency, and its emerging launch capability.

As nations around the world invest in their space economies, the bar is rising on what it takes to be part of the global space power group. Currently, the UK is trailing behind nations such as France, Germany,

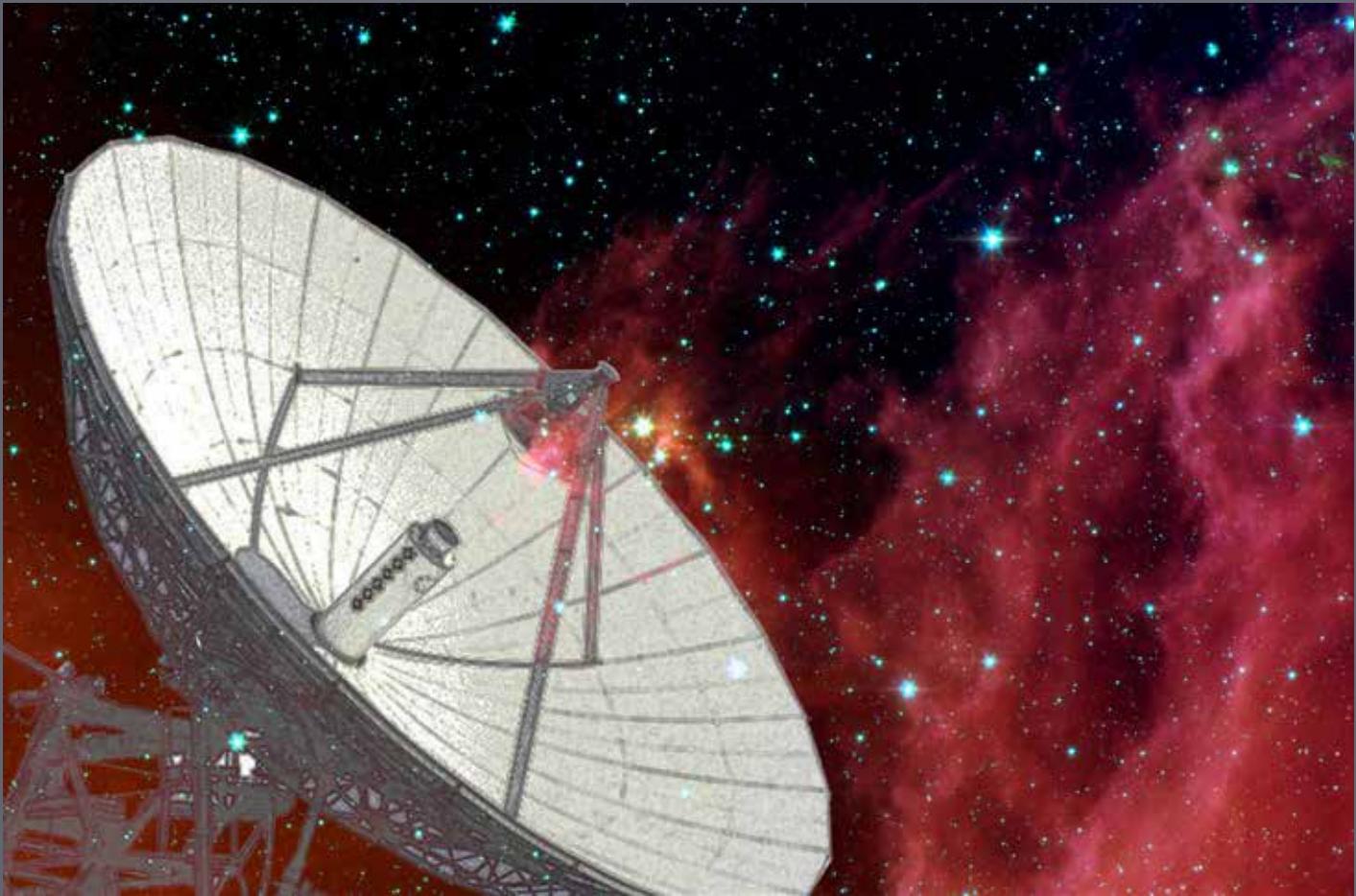
and Japan who are considered major space powers due to the depth and sophistication of their space capabilities, the uses to which they are put in pursuit of a clearly defined national strategy, and the resulting widely-recognised economic, technical, societal, and defence benefits. Now is the right time to galvanise our society across the civil-military divide and propel the UK towards an ambitious, achievable goal of becoming a respected major space-faring nation.

Space and its associated capabilities are strategically vital to civil, commercial, security and defence policy ends. As a nation, we are wholly reliant on it for everyday activities, from SATNAV for commuting through to precision timing for banking, global navigation services for shipping and earth observation services for weather forecasting.

Up until now, space has mostly been the preserve of nation states. However, with the advent of 'new space' – which has seen private companies and universities using new, and much more widely available, technologies and techniques, with significantly lower costs – the state and private

sector economic and technical opportunities in space have never been greater; but equally, neither have the security threats. The proliferation of new technologies and shortened innovation cycles, new sources of private capital, strains on legacy governance regimes, new alliances in space have changed space from the preserve of the few, to the realm of the many, meaning it is much more accessible and has become "democratised" in the process.

Meanwhile, a step change in space military tactics employed by major space powers has made it increasingly urgent that we protect our access to space; secure our freedom of manoeuvre in space; safeguard our orbital slots and electromagnetic frequencies; and prepare to defend and protect our assets and capabilities from hostile acts. In order to deliver this, all space activities and investments must ultimately relate back to clear rational and evidence-based decisions. This paper seeks to provide a compelling narrative to underpin a Government space-strategy and outlines a suggested approach to becoming a major space power by 2030.



INTRODUCTION

Although the UK has made substantial progress in recent years in devising and driving forward national space ambitions, there are still significant challenges, as well as opportunities, to ensuring successful outcomes in the UK space sector over the next decade. Some of these opportunities require strategic and targeted investment, creating the right tax incentives, as well as making best use of cross-Government, space-related, budgets. UK imperatives should include:

INTEGRATION: Centralising accountability, providing effective organisation across Government, ensuring the right people in the right places with the right skills, through an integrated approach across programmatic and user domain areas, while ensuring an efficient regulatory and licensing environment

SECURITY AND RESILIENCE: Ensuring systems are designed from the outset to operate in a contested space domain and can counter terrestrial threats

WORKFORCE: Recognising space is strategic to the nation's interests with a public awareness campaign and ensuring skills are prioritised and used to best effect

SUPPLY CHAIN: Fostering a more diverse UK-space sector and avoiding any trend towards excess consolidation or monolithic supply; creating more innovation through diversity.

SOFT POWER AND INTERNATIONAL INFLUENCE: Ensuring the UK is a world-leader in space technologies and applications and is taking advantage of increased international collaboration

Overcoming UK challenges requires a coherent, integrated national strategy that aligns well with UK ambitions and leverages industrial and allied capabilities. UK industry needs new models and approaches to support the growth of its world-class space capability and economy. For example, industry friendly policies, balanced with national security and safety considerations, cost little, but can benefit the economy, military, and civil space programmes.

A coordinated approach, along with robust investment in strategic programmes, will drive industrial growth through increased innovation and lead to thousands of new highly skilled jobs.

In order to turn our ambitions into reality, the UK requires a number of key programmes and underpinning enablers:

PROGRAMMES



PNT



NSpOC



Milsatcom



SDA



Space Launch



EO

KEY UNDERPINNING ENABLERS

- Efficient regulatory and licensing environment
- Space Academy/STEM/SQEP
- R&D and Innovation Landscape. Access to institutions and Academia needs to be done in a more strategic way, deepened ties between Government and academia
- Public understanding and engagement in space-related activities
 - provide a route into

advanced STEM skills more broadly (space is widely recognised as a key attractor for STEM subjects);

- develop public support for state activity and spending in space through understanding of societal reliance on space for resilience
- build awareness of tech capability in government as well as industry

- Diversity of supply chain. Having

a diverse supply base ensures resiliency and redundancy that leverages greater capabilities and reach without compromising on price

- New Space capabilities provide a qualitatively different approach and there is an opportunity to rebrand it to attract new STEM students and broad skillsets that supports resiliency in the workforce



A NEW APPROACH TO SPACE

The four founding members of Athena, comprised of Serco, Inmarsat, CGI UK and Lockheed Martin UK, envision a diverse and agile coalition of UK businesses that grow and adapt for purpose; Athena is not an exclusive club, but is a principles-based collaboration to better forge relationships across other businesses in the space sector. A fundamental precept of the Athena model is collaboration across the UK's rich community of space actors, including the Catapults, UK Space Agency, MOD, science parks and clusters, NPL, DSTL, National Space Academy, as well as industry partners and SMEs.

Athena is a flexible architecture, not a monolithic construct, and has strong alignment with international best practice in

its approach to programmes, offering substantial diversity in the supply chain for Government along with low risk Programme delivery.

Athena has military, civil, and commercial heritage and can help Government bring these together in an agile way to drive effective solution delivery. We are fundamentally commercial entities that are rapidly innovating and solving existing problems in real time in the real world. We offer subject matter expertise and insight into the space sector, related industries and academia from a commercial perspective. Athena also brings with it exceptional Five Eyes heritage, access to key global markets, and longstanding relationships and access at senior levels in foreign governments.

Athena has devised a set of principles for success to guide UK space activities, investments and strategic positioning, ensuring desired outcomes through collaboration. Leveraging this model will substantially boost the UK economy, driving increased momentum in the already flourishing UK start-up space ecosystem, and delivering thousands of highly skilled jobs. In addition to making regulatory and policy changes, the UK must invest in national security space and in fundamental technology development to enable future long-term applications and ensure sustained economic growth.

Athena's approach is founded on the following principles for successful UK space power outcomes:



PRINCIPLE 1: Strategic decision making

Informing policy decisions to enable government and industry to leverage new capabilities, innovation, and investment while building on today's valuable foundation to truly meet the nation's needs and goals in the future.



PRINCIPLE 2: Integrated space ecosystem

An integrated view of the space ecosystem that encompasses military, civil, and commercial space activities, the full space value chain from manufacturing and launch to downstream applications, and international dynamics of national space activities.



PRINCIPLE 3: Increased diversity and innovation

Realising practical benefits through diverse innovation pathways.

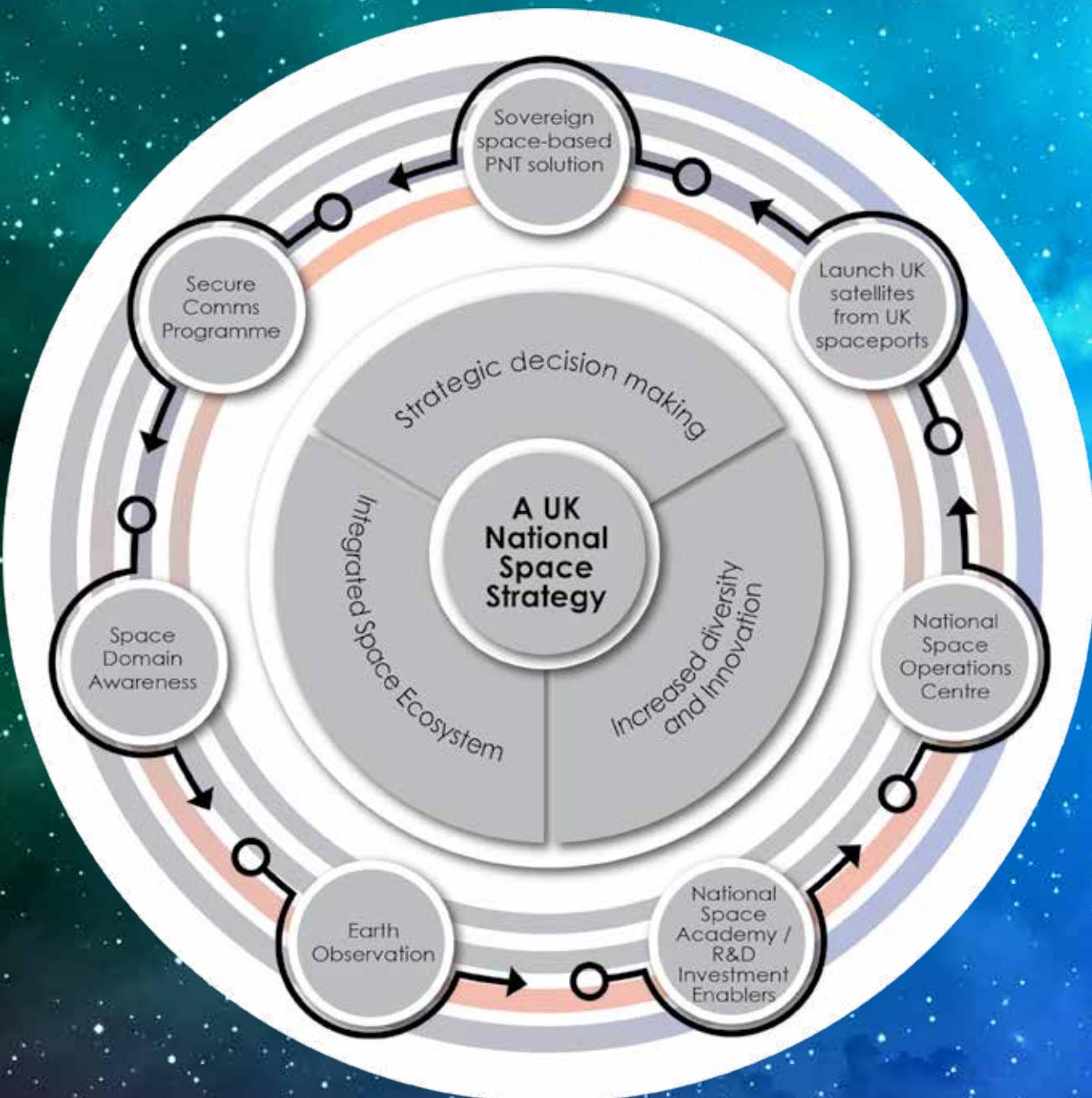
In sum, the UK can achieve greater diversity in its space industrial base by taking advantage of the operational leverage and reach that Athena can bring to a broad range of markets, supporting the UK SME community and driving innovation that has international appeal. A space sector that supports,

enables, and underpins a number of other key UK economic sectors – financial services, telecoms, transport, media and data sciences – and which can monitor and enable the UK's environmental commitments and ambitions. Team Athena plays across these diverse geographies through a principles-based

approach that promotes agility and adaptability.

Strategies need specific actions and plans to turn them into reality and outcomes and targets to aim for and be measured against. Athena has proposed seven key outcomes the UK should achieve by 2030.

NEXT STEPS TO 2030 – TURNING AMBITION INTO REALITY



A high-angle, aerial photograph of Earth as seen from space. The image captures the planet's curvature, with a dense layer of white and grey clouds covering the lower half. Above the clouds, the atmosphere is a deep blue, transitioning into a darker shade of blue at the top of the frame. The overall composition is a classic view of our home planet from an orbital perspective.

CHAPTER 1

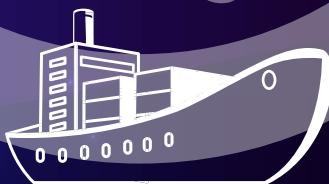
WHY IS SPACE IMPORTANT TO UK AMBITIONS AND ECONOMIC PROSPERITY?



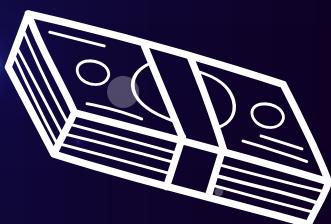
Space: a driver of post-Brexit growth and identity where UK leadership, in space, will power economic growth, diplomatic stature and security.

SPACE FUELS THE GLOBAL ECONOMY

Society and government extensively depend on space

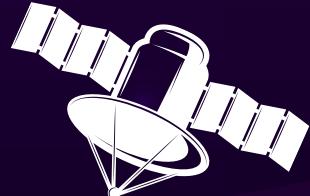


Up to
53,000
merchant ships reliant
on satellite-based safety
and communications
services



\$5.7 billion
total start-up space
investment raised in
2019

\$366 billion total
value of the global
space economy in 2019



6 billion
GNSS-enabled devices
worldwide



Most of the
40 UN
“essential climate
variables” are monitored
by space-based systems



All **17** UN SDGs benefit
meaningfully from space
and satellite capabilities



\$10 trillion
annual global
economic footprint of
satellite across multiple
economic sectors

THE UK IS INCREASINGLY RELIANT ON THE BENEFITS OF SPACE

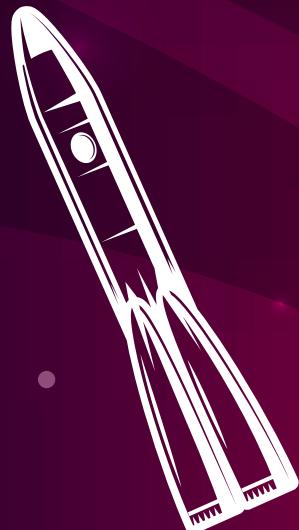
Space is one of the UK's

13

CNI sectors and is in the

top 10

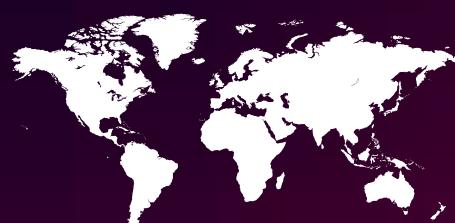
of risks faced by the UK, with critical reliance, across both civil and military space sectors, on GNSS, weather and other space data capabilities.



Space technologies underpin over

£300bn

per annum in UK economic activity



90%

of MOD capability is dependent on space in some way

£150m

in ODA-funded projects in over 40 countries

The sector supports over

40,000

jobs across the country

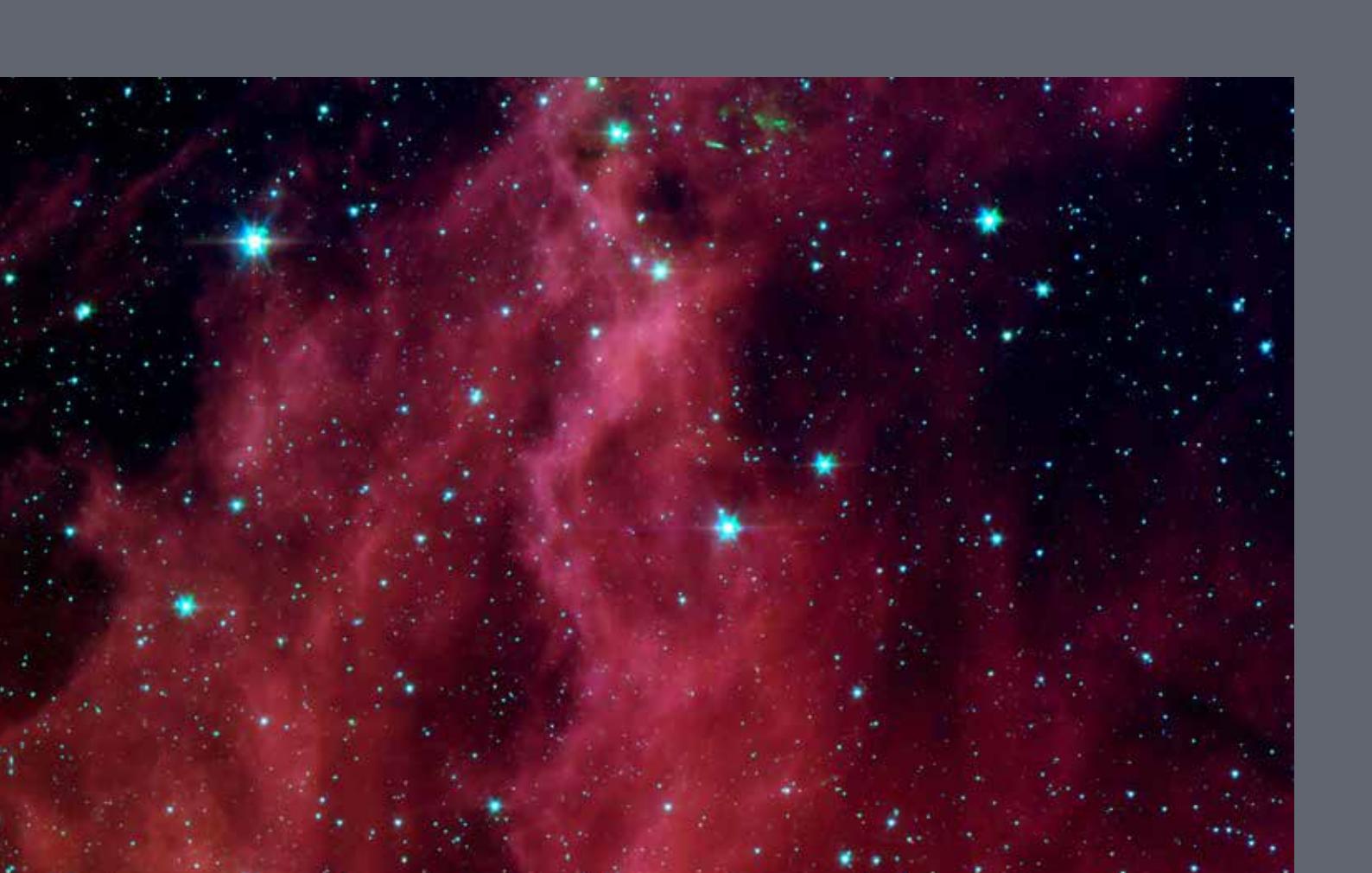


RELIANCE CONTINUES TO GROW AND SPACE SYSTEMS BECOME MORE PRODUCTIVE AND CAPABLE

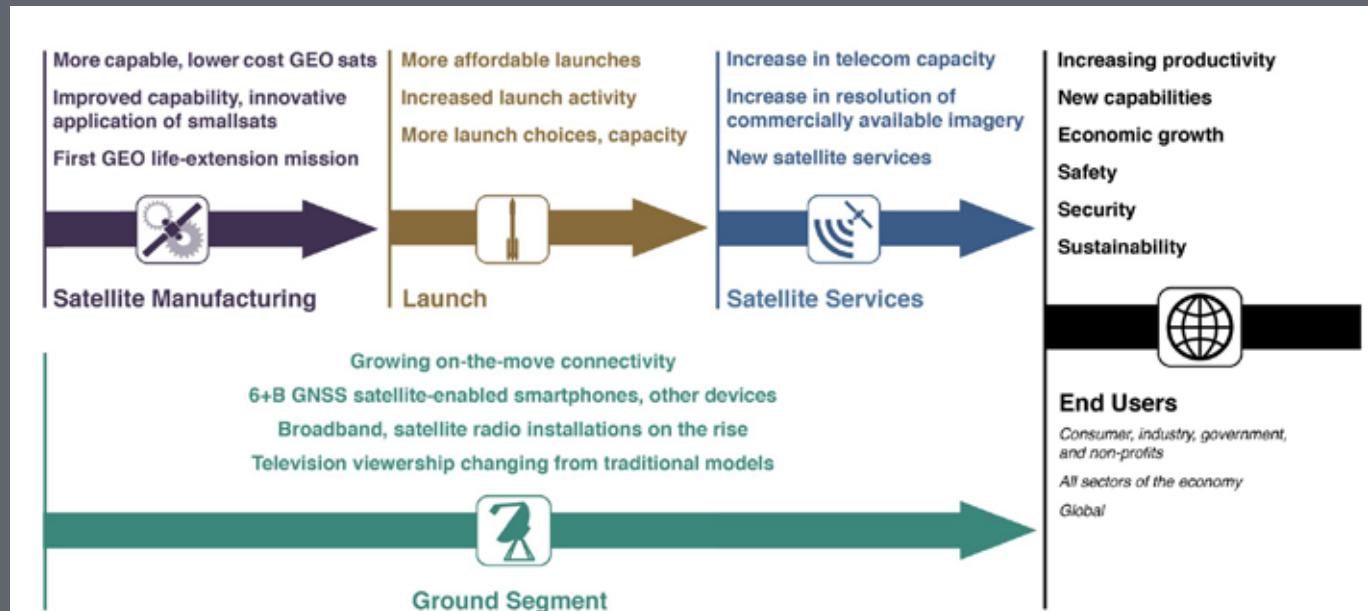
Every aspect of space activity incorporates and drives dramatic advances in technology. Satellites both take advantage of machine learning and AI, and are a major driver for further developments. Cybersecurity and data management, also essential components of the ecosystem, are evolving rapidly. Furthermore, an increasing range of launch options contributes to further benefits in the relationship between weight, capability and cost. Overall, these have led to exponential gains in recent years, but also to new and more significant threats and challenges.

As a consequence of the growing presence and importance of these technologies, space now directly impacts the lives of all UK citizens in some form. It underpins much of our way of life and, as the Blackett review stated, loss of the services it provides and supports would be devastating.

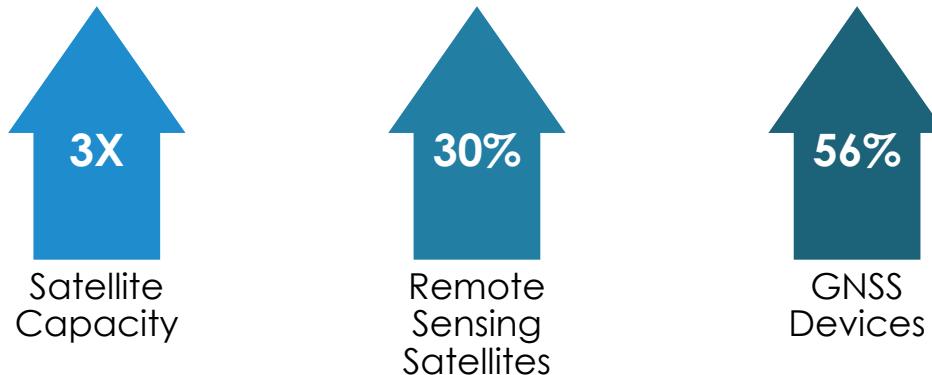
Satellite and launch systems are also increasingly efficient, with many types of new capability and significant reduction in cost throughout the supply chain (see charts).



INCREASING PRODUCTIVITY AND CAPABILITY OF SPACE SYSTEMS



Increased Capability



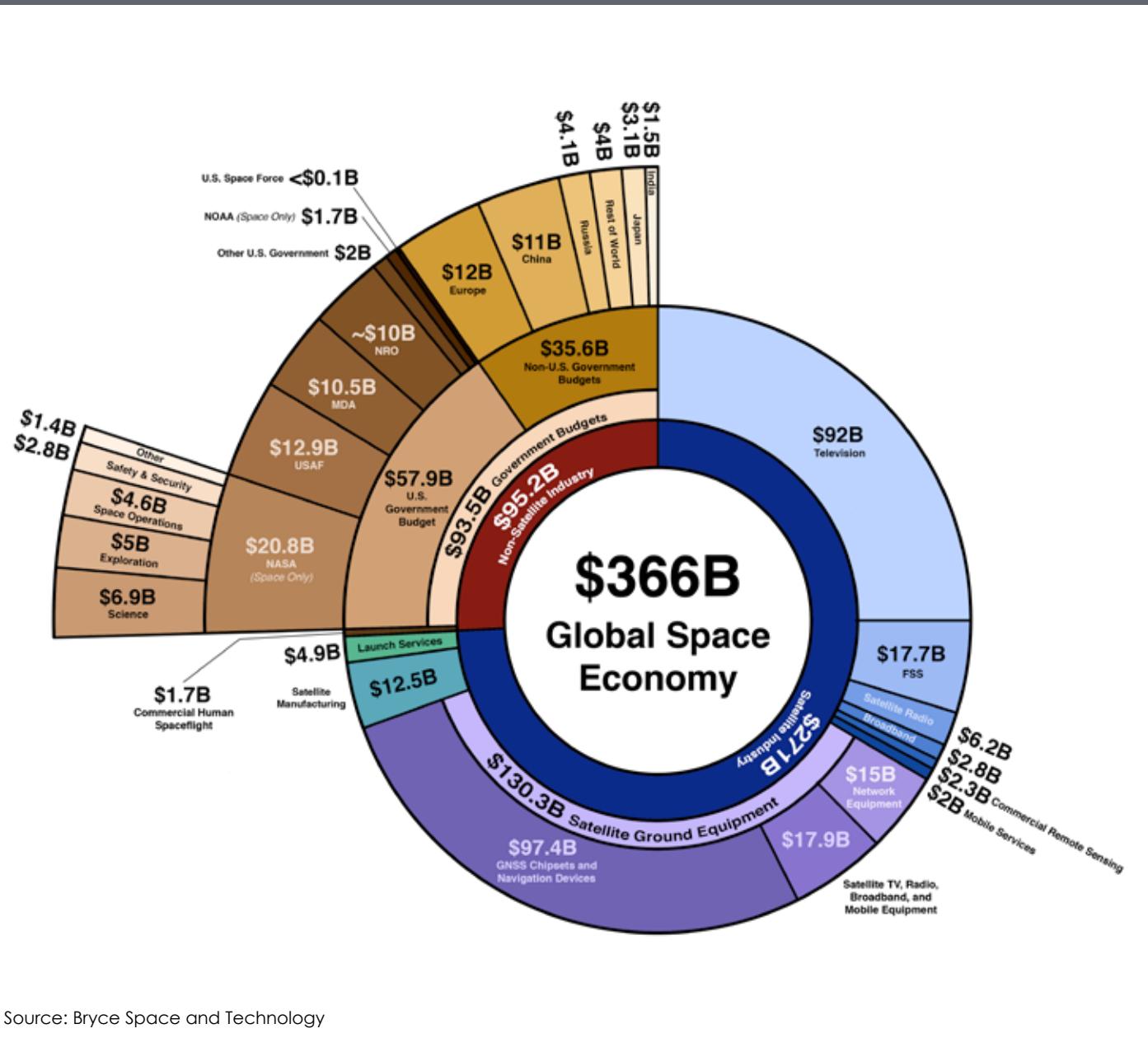
Dropping Costs



Source: Satellite Industry Association (SIA) and Bryce Space and Technology. Note: trends over the last ten years.

SPACE AND SATELLITE ACTIVITIES ARE ATTRACTING UNPRECEDENTED INVESTMENT

The size of the core global space economy was approximately \$366 billion in 2019 (see chart), consisting of government budgets and the revenues from satellite services, ground segment, launch, and manufacturing. The investment bank Morgan Stanley predicts the space economy will grow to \$600 billion by 2030.

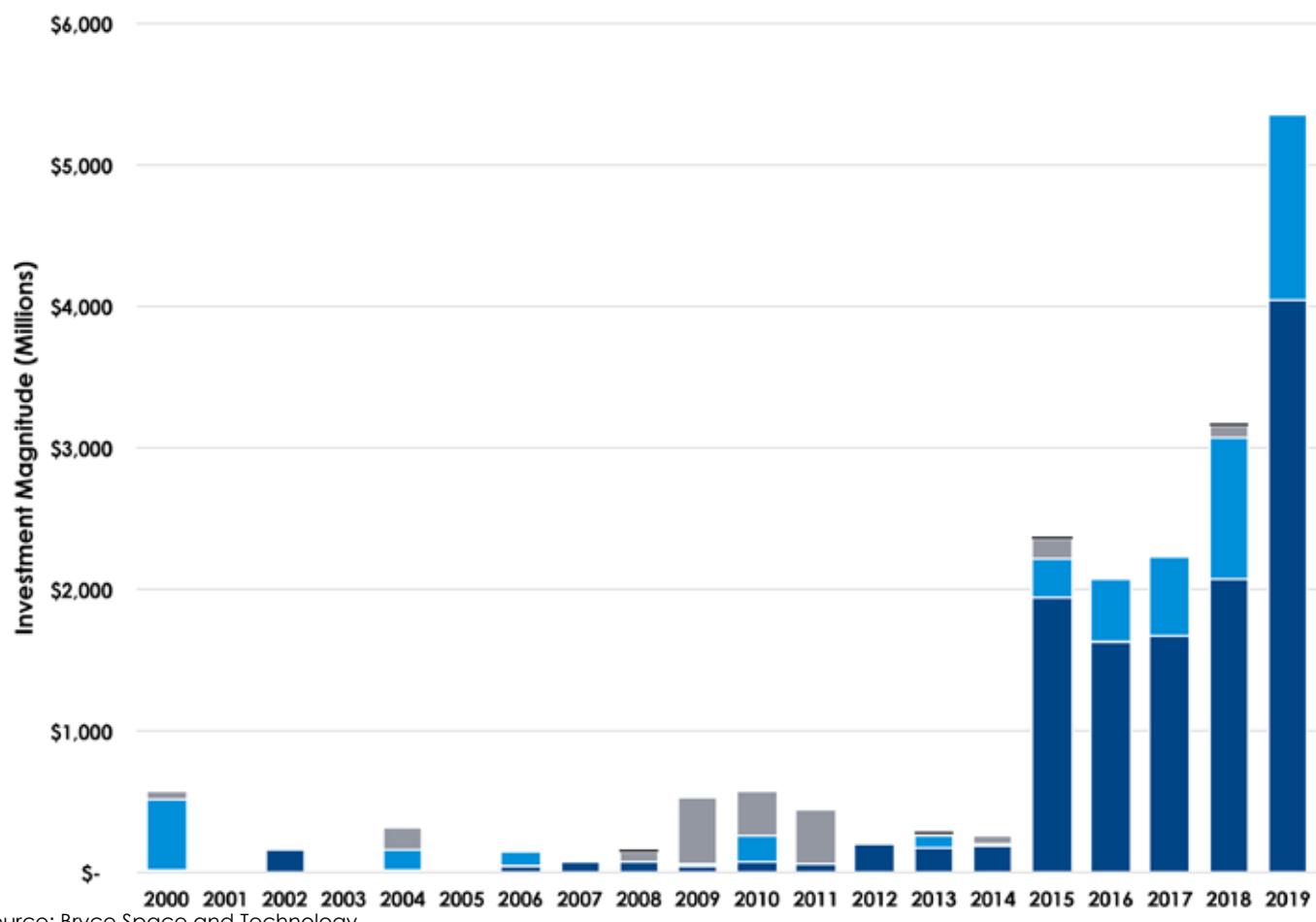


THE GLOBAL SPACE ECONOMY (2019)

The potential of space has been attracting new investors, spawning a new ecosystem of start-up firms. A significant increase in start-up space investment has occurred in the last five years. The chart below illustrates the substantial increase in investment over the last five years.

The UK start-up ecosystem is particularly buoyant, consistently in the top five globally in terms of amount of investment, number of investors, and number and diversity of start-ups. One of the world's earliest space focused investment firms, Seraphim Capital, is based in the UK and ranks among the top investors by number of space investments and number of space portfolio companies. This is a testament to the appeal of the UK for founders and investors and creates an opportunity for continued growth.

21ST CENTURY INVESTMENTS IN START-UP SPACE COMPANIES



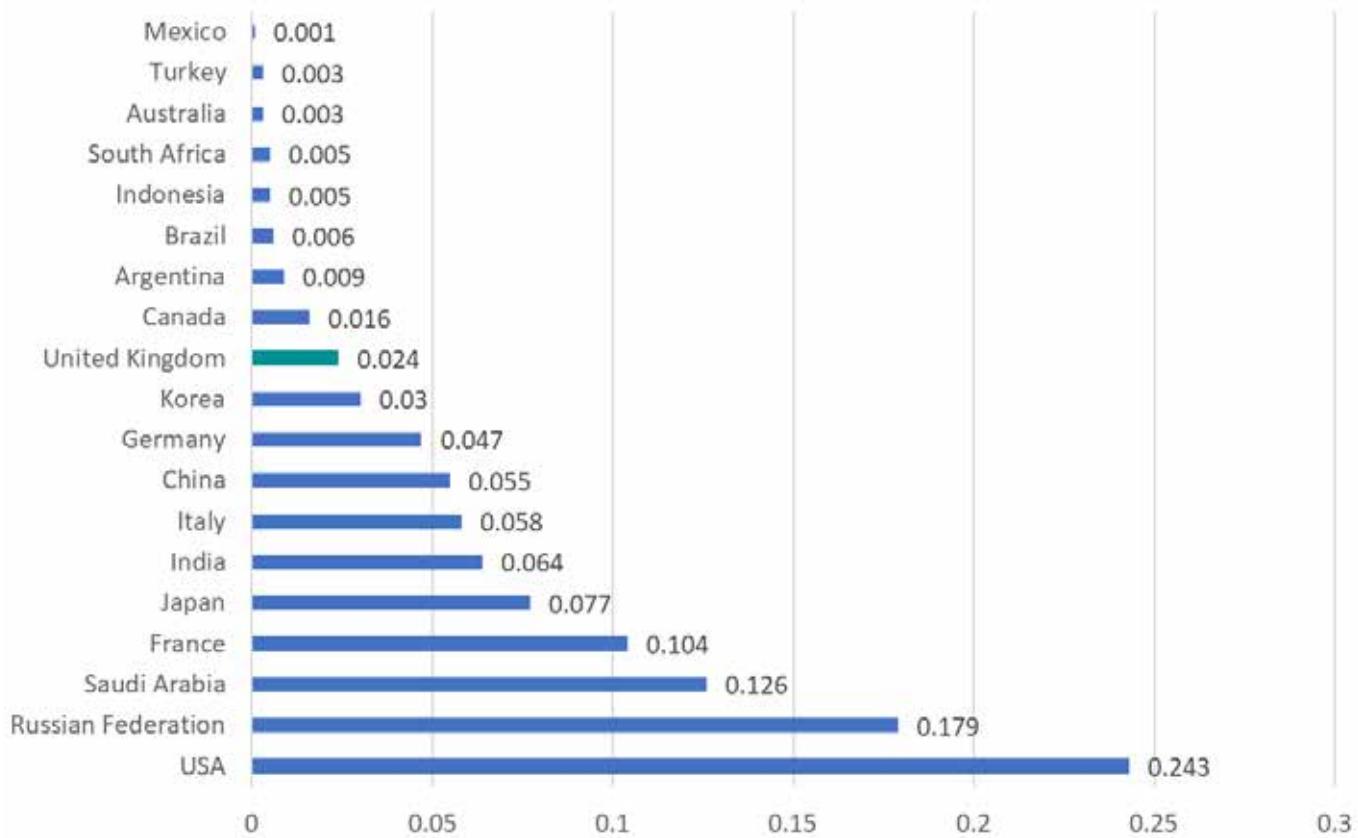
Source: Bryce Space and Technology

Space brings a global perspective to the UK's levelling up agenda

The UK currently has world-class space capabilities but faces intense competition from countries with strong domestic space programmes, which are often supported by government investment. Space is a strategic domain for all global, regional, and aspiring powers. Major space nations such as the US, India, China, Russia, France, and Japan are intensifying their focus on space, identifying it as critical to their national security and strategic autonomy and a driver for economic growth and prosperity.

Indeed, the UK space budget is amongst the lowest of major space powers as a share of GDP. The chart below compares national space budgets as a share of GDP, based on data from the Organisation for Economic Co-operation and Development (OECD).

2019 Share of GDP (%)



Source: Measuring the Economic Impact of the Space Sector, OECD (2020)

The European Commission continues to increase its investment in and governance of strategic European space programmes. These include the Galileo space-based PNT system, the Copernicus Earth observation programme, and space domain awareness initiatives. Given Brexit, the UK's opportunity for involvement in and benefit from these programmes is now significantly reduced. For example, Galileo is now dominated by France, with the secure elements of the system, which serve a unique purpose for critical defence platforms, supplied by French companies.

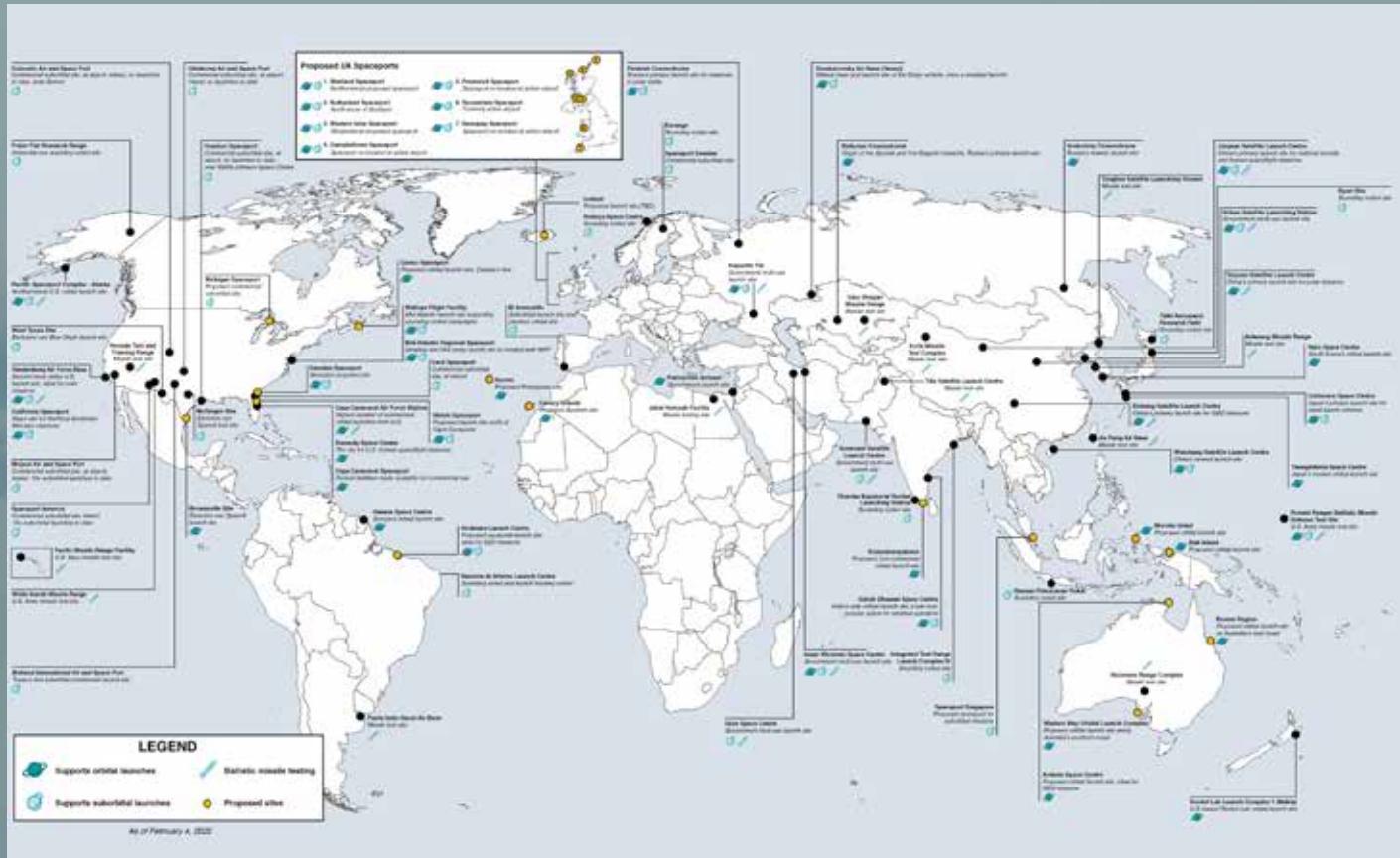
Having access to markets beyond Europe will be crucial to the UK's future prosperity, security, and global influence. It is therefore important to consider alternatives to existing ways of operating that have served the UK well but are unlikely to be fit for future purposes. This is particularly important in a future where alignment across military and industrial needs, and access to key growth markets, will prove vital.

In the post-Brexit context of a global Britain, space will play a key role in enabling new opportunities across strategic sectors of the economy, driving growth through inclusivity, and enabling increased cooperation and partnership with allied nations.

The increasingly competitive and growing global space landscape has driven investment in a number of areas, including launch. Below is a map illustrating the existing, under development, and proposed orbital and suborbital launch sites of the world.

Having a national space launch capability is seen by many nations as an economic enabler for small satellite manufacturing and their militaries are interested in having reactive launch capabilities.

GLOBAL SPACEPORT MAP



Source: Bryce Space and Technology.



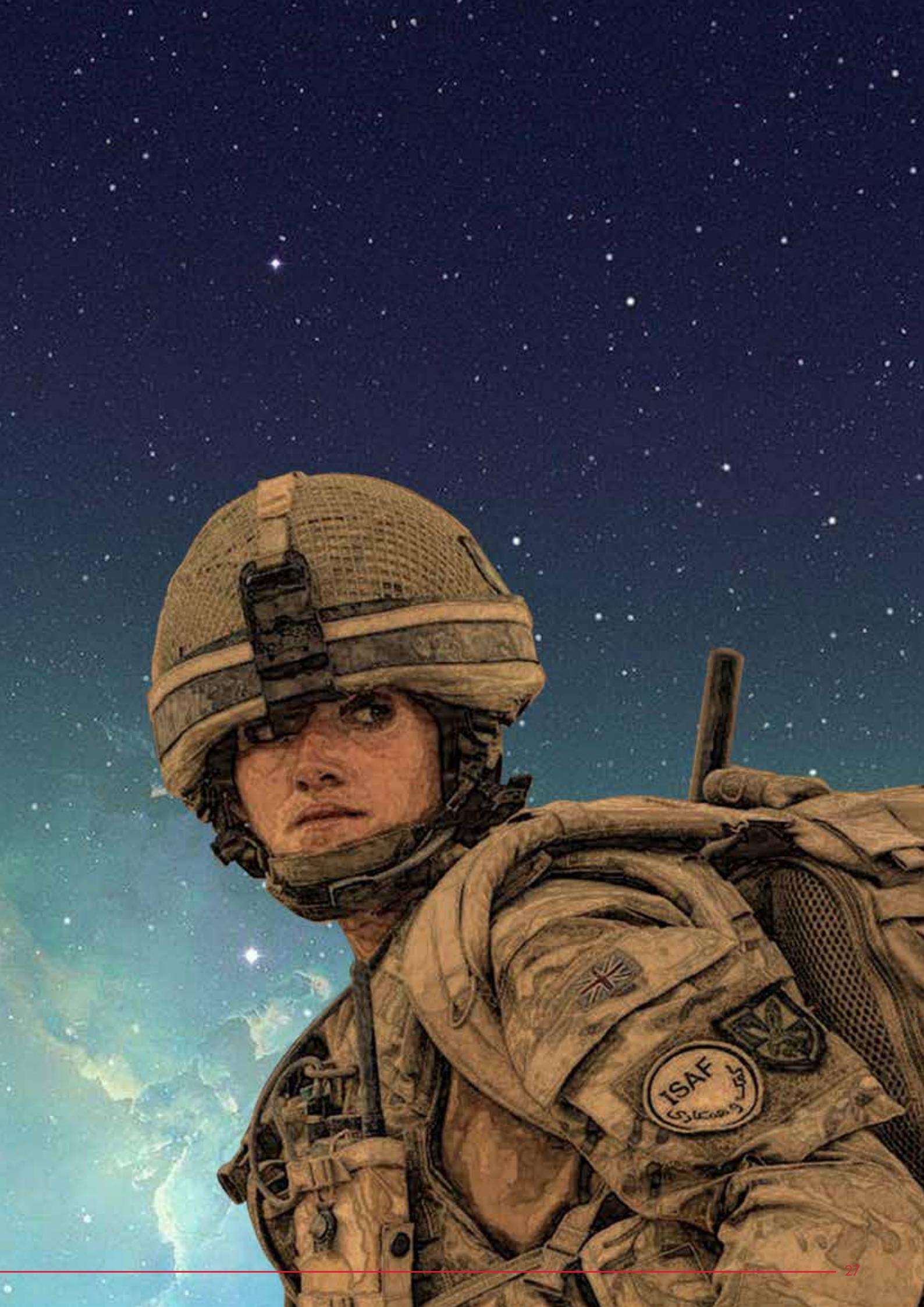


The number of launch sites around the world is growing rapidly as more and more nations seek to become new space nations



CHAPTER 2

SO WHAT? HOW DOES THE UK HARNESS ITS RESOURCES TO BEST EFFECT?



ATHENA'S VISION FOR 2030

THE UK NEEDS A NEW APPROACH TO SPACE

The UK should take advantage of the opportunities presented by a cross-domain, integrated approach using the full range of its industrial, military, economic and academic capabilities, thereby ensuring the UK becomes a major space power, driving economic growth while boosting the nation's diplomatic stature and security by deploying a new approach to space. Athena proposes a new, integrated approach that will power economic prosperity, strengthen capabilities and skillsets, and increase soft power and international influence. What challenges impact this mission?

Although the UK has made substantial progress in recent years in devising and driving forward national space ambitions, there are still significant challenges to ensuring successful space power outcomes over the next decade. Many of these challenges are driven by competing forces in government:

- **STRATEGIC, TARGETED INVESTMENT:** It is essential for the UK to make the best use of cross-department space-related budgets and avoid dilution of return on investment.
- **EMPOWERING ECONOMIES OF SCALE:** The UK needs to

capitalise on the synergies between defence and civil programmes in order to enable their true potential.

- **EXPANDING THE WORKFORCE:** Support the expansion of a diverse workforce that is adaptive to evolving sector needs by reducing the scarcity of suitably qualified and experienced personnel (SQEP) due to programmes of limited scale/scope.
- **ENSURING ACCOUNTABILITY:** Develop a lead authority for the successful implementation of a national space strategy with clear accountability for execution.
- **DEVELOPING CONFIDENCE:** Ensure a clearer roadmap and government commitment, which will help reduce current industry reticence to invest at a corporate level in support of national space initiatives.
- **INTERNATIONAL LEADERSHIP:** The UK should swiftly avoid lost opportunities and secure greater international market share, particularly as international competition in space markets moves forward.

Overcoming these challenges requires a coherent, integrated national strategy that aligns well with UK ambitions and

leverages industrial and allied capabilities. Agile and coordinated government action today can lead to profoundly valuable outcomes for the UK by 2030. While the US, Russia, and China have historically been global space superpowers, there are increasingly other globally recognised major space powers including India, Japan, and France and Germany (EU), that have multi-billion-dollar space budgets. As the UK seeks to take its place among those nations, its future should encompass taking full advantage of its current and anticipated capabilities (such as launch), and ensure its ability to offer unique capabilities to allies and partners. The UK can have a thriving and complete space ecosystem across commercial, military, and civil space programmes that takes advantage of the wider UK landscape. This ecosystem will focus on satellite applications; a business-friendly environment; the UK's workforce and educational system; our history of small-sat manufacturing; a focus on future technologies (such as cyber, quantum, and AI); our strategic and unique space relationship with the US; and our secure and well-advanced infrastructure.

The increasing importance of and reliance on space-based capabilities makes the UK correspondingly vulnerable to the loss of access to space



or space-based services. The rapid expansion in the number of state and non-state actors in the space domain create not just opportunities but new or increased threats and challenges. Space debris and malicious threats are increasing as specific nation states develop and test new kinetic, cyber and electronic capabilities to degrade or destroy the space-based systems of potential adversaries. At the same time, there is a need to be able to monitor and regulate behaviour in space. Therefore, the UK should protect its own space assets, grow its space domain awareness capability and build relationships in key areas by providing unique capabilities that augment allied strengths through increased burden sharing, and a sustained commitment to space.

In addition, the space sector has historically shown exceptional resilience and growth during economic downturns. During the financial crisis, for example, the UK space sector grew by more than 10 percent on average between 2008-2010 according to a UKSA report. Furthermore, the space sector has been similarly resilient during this COVID era with sustained private investment in start-up space companies and minimal disruption to the sector compared to other sectors of the economy. This resilience has strong appeal among investors and will be a critical component of a sustainable future economy in

which the UK builds back stronger, providing the ability to draw on the new knowledge and skills generated from investments in space.

The UK can be a part of the group of major space powers who are shaping developments across military, civil, and commercial space domains, and driving sustained economic prosperity. In order to get there, the UK needs a new approach to space that ensures economic prosperity, security, and international influence.

A NEW APPROACH TO SPACE

Athena proposes a principles-based, integrated approach that will power economic prosperity, strengthen capabilities and skillsets, and increase soft power and international influence. UK industry needs new models and approaches to support the growth of its world-class space capability and economy. For example, industry friendly policies, balanced with national security and safety considerations, cost little, but can benefit the economy, military, and civil space programmes. The UK consistently ranks in the top five in terms of amount of investment, number of investors, and number and diversity of start-ups. These alternative models can magnify the impact of significant capital investments by the private sector

and power the UK's recovery. The most efficient means of achieving such goals is by entering into government/commercial partnerships, thus leveraging the billions of dollars already invested by industry on technological innovation. A successful example of this is NASA's commercial crew spaceflight programme which, according to NASA, is poised to save the Agency approximately \$20-\$30 billion. Similar partnerships will allow the UK space programme to maximize access to state-of-the-art technology in the delivery of a world leading national space sector that supports, enables, and underpins a number of other key UK economic sectors:

- financial services
- telecoms
- transport
- telemedicine
- media
- data sciences, and
- the ability to monitor and enable the UK's environmental commitments and ambitions.

ATHENA'S FUTURE VISION INVOLVES EACH OF THE FOLLOWING OUTCOMES BEING REALISED BY 2030.

INTEGRATION.

The UK will have a single national entity that leads space strategy and the delivery of national programmes for a sector that is cross-government and integrated with industry and academia. The UK National Space Operations Centre (NSpOC) will house both military and civilian personnel across the majority of missions, according to classification and/or need. Research and development institutions will be aligned to an integrated strategy for UK prosperity. The UK will have clearly articulated programmes with published requirements, budgets and improved space acquisition and delivery capabilities, possibly with programmes led and delivered centrally on behalf of all of Government and reporting to an empowered National Space Council. This will have driven confidence in the UK sector and made the UK an indispensable/trusted partner and one of the most attractive space nations to invest in. Space applications and their associated data analytics (for Earth observation) will be in common use by government and industry and will have driven down the costs of operations, whilst increasing UK productivity and competitiveness in a number of market sectors.

SECURITY AND RESILIENCE.

All future space systems will have been designed from the outset to operate in a contested space domain, as well as countering terrestrial threats. They will, where appropriate, inherently be protected and defendable, demonstrating to our allies that we are an assured partner in space, offering a credible deterrent posture, whilst also having recognised the continuing need to be seen as a meaningful space player in both a US, 5-Eyes and NATO context, whilst looking to develop bi-lateral relations with the likes of Japan. A secure communications programme will be in place, integrating to a greater extent both space and land-based technologies from the best of military and civilian innovations in satellite communications. There will be collaborative space technology and research initiatives modelled upon exemplars, such as the Cyber UK/US S&T group which leads co-development of cyber capability.

WORKFORCE.

Space will be firmly established and recognised as strategic to the nation, with a public awareness campaign, a space STEM education road map, and potential career paths fully established. A national space academy will provide education and skills training for the whole of the UK, nurturing and developing STEM skills and a career pathway into space and, thereby, providing a much-needed boost to the UK's dwindling SQEP talent pool, as well as stimulating a broader STEM gateway, for both military and commercial space sectors. The Space Academy will be considered an international centre of excellence for space skills, utilised by our allies for their training needs and as a way to exert global influence. The UK workforce will be adaptable, with skills and talent moving between industry, academia and government, ensuring the right skills-transfer takes place, taking full advantage of the UK's world class space experts. Building a space cadre, capable of delivering the UK space ambition and strategy, will be key to our success. Providing the requisite structure behind education and career frameworks, in line with the National Space strategy, will attract investment and development, both within and to the UK. Harnessing the ongoing efforts from a number of key academic UK institutions will have been instrumental in achieving this (e.g., Leicester and Strathclyde).



If the UK takes a considered procurement approach to major programmes, then by 2030, the UK will have built a resilient UK-based sovereign space sector

SUPPLY CHAIN.

The UK will be launching UK-designed and -built small satellites from UK-based spaceports and is attracting inward investment through an integrated supply chain (including proving out technologies and gaining flight heritage through a UK funded in-orbit demonstration programme), while using technology transfer to rapidly grow its space sector in selected areas (e.g. PNT, AI, advanced sensors). The UK will have taken advantage of its OneWeb investment and will be leveraging its launch capability to launch some replenishment satellites. This will have generated a highly technical supply chain across the country but critically in key growth regions and cemented the UK's place as a global centre for the flourishing LEO economy. As a member of the exclusive club of launching states, the UK will be able to contribute to shaping global policy with access to the largest space markets in the world. This will help forge relationships with other commonwealth space players while nurturing the creation of domestic businesses and capabilities, including advanced analytics. The industrial base is well aligned with UK national ambitions and ensures increased focus towards US, Five Eyes, and other international allied nations. Greater diversity in the sector, with sufficient large space companies/alliances, offers opportunities for SMEs and academia to participate in the market and help drive innovation. As part of this supply chain, the UK is taking full advantage of its robust financial framework, regulatory lead, and targeted economic stimulus.

SOFT POWER AND INTERNATIONAL INFLUENCE.

The UK will be acknowledged as a world leader in space technologies and applications, able to take advantage of increased international collaboration, a leader in Space Domain Awareness, and key contributor to 5-Eyes and NATO, with best-in-class sensors, contributing to a global effort, to protect and assure space. The UK will have leveraged MOD's investment in additional BMD sensors for dual-use space domain awareness (SDA) applications, thereby enhancing not only international security by default, but also the UK's national prestige and international standing.

In a post-Brexit trading reality, the UK needs to build a strong indigenous alternative and resilient space supply chain, rather than the largely monopolistic situation that exists at present. Indeed, if the UK wants to meet its space ambitions, and deliver on key programmes, then it needs to consider its space industrial capacity, capability and skills in the round and support the growth, resilience, and diversity of its supplier base. To quote a senior government official, "If the UK ends up buying its PNT capability from the same company as its milsatcom and its Artemis programme, then it will have failed in thinking about security of supply". A choice of low risk today, should not inadvertently cause a risk of no choice tomorrow. If the UK takes a considered procurement approach to major programmes, then by 2030, the UK will have built a resilient UK-based sovereign space sector. This would provide the UK with freedom of action in decision making and resilience in delivery, secure high-tech skilled UK jobs and build a UK space skills pipeline to drive growth, and solidify UK position as a major space power.

CHAPTER 3

TURNING AMBITION INTO REALITY - NEXT STEPS TO 2030



Programme and Capabilities.

The UK spending on space will always inevitably be less than that of the three global space superpowers but should be sufficient to position it among major space powers whilst allowing it to maintain the specialised and niche space capabilities valued by our principal partners and which thus enhance national prestige and credibility as an ally or partner.

Over the next decade Athena anticipate the key capabilities needed to be:

Satellite Communications - Investment in the operation and evolution of Skynet to deliver a secure communications platform for the military and government utilising and integrating Space and land-based technologies

PNT - Develop a sovereign based PNT solution, interoperable with Five Eyes nations, that meets the needs of the UK CNI and public demand and contributing to UK prosperity

UK Launch - Launch UK-designed (and built) satellites from UK Spaceports as well as addressing the export market

Space Domain Awareness - Build on the UK's acknowledged world leading skills in SDA with additional assets providing data to assure and protect the Space Domain

National Space Operations Centre – Integrate the components of both the military and civil space sectors into a combined National Space Operations Centre to jointly operate key national

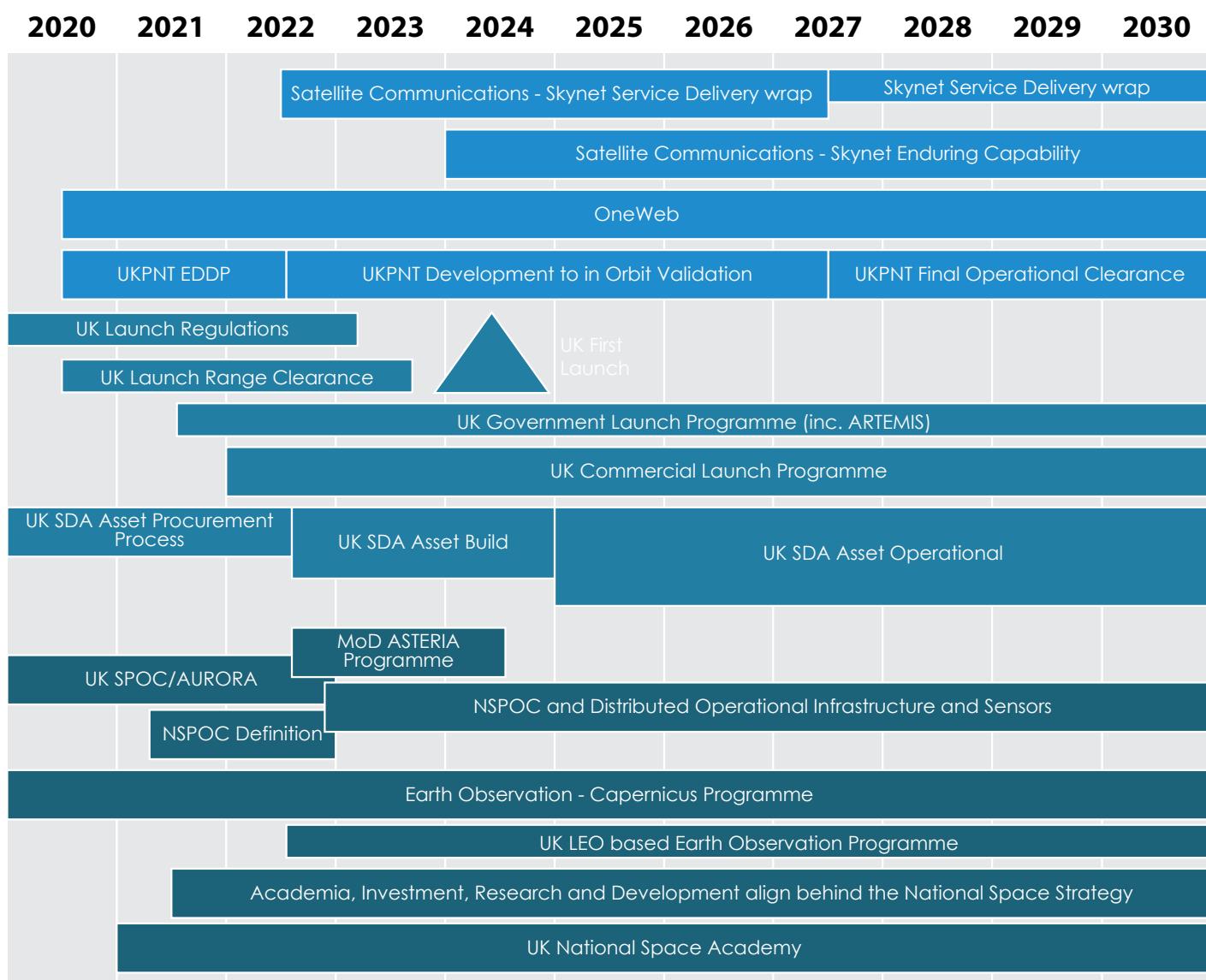
infrastructure and maximise the sharing of data

Earth Observation – Participate in the ESA Copernicus programme and supplement with UK specific scientific and ISR programmes launched from the UK

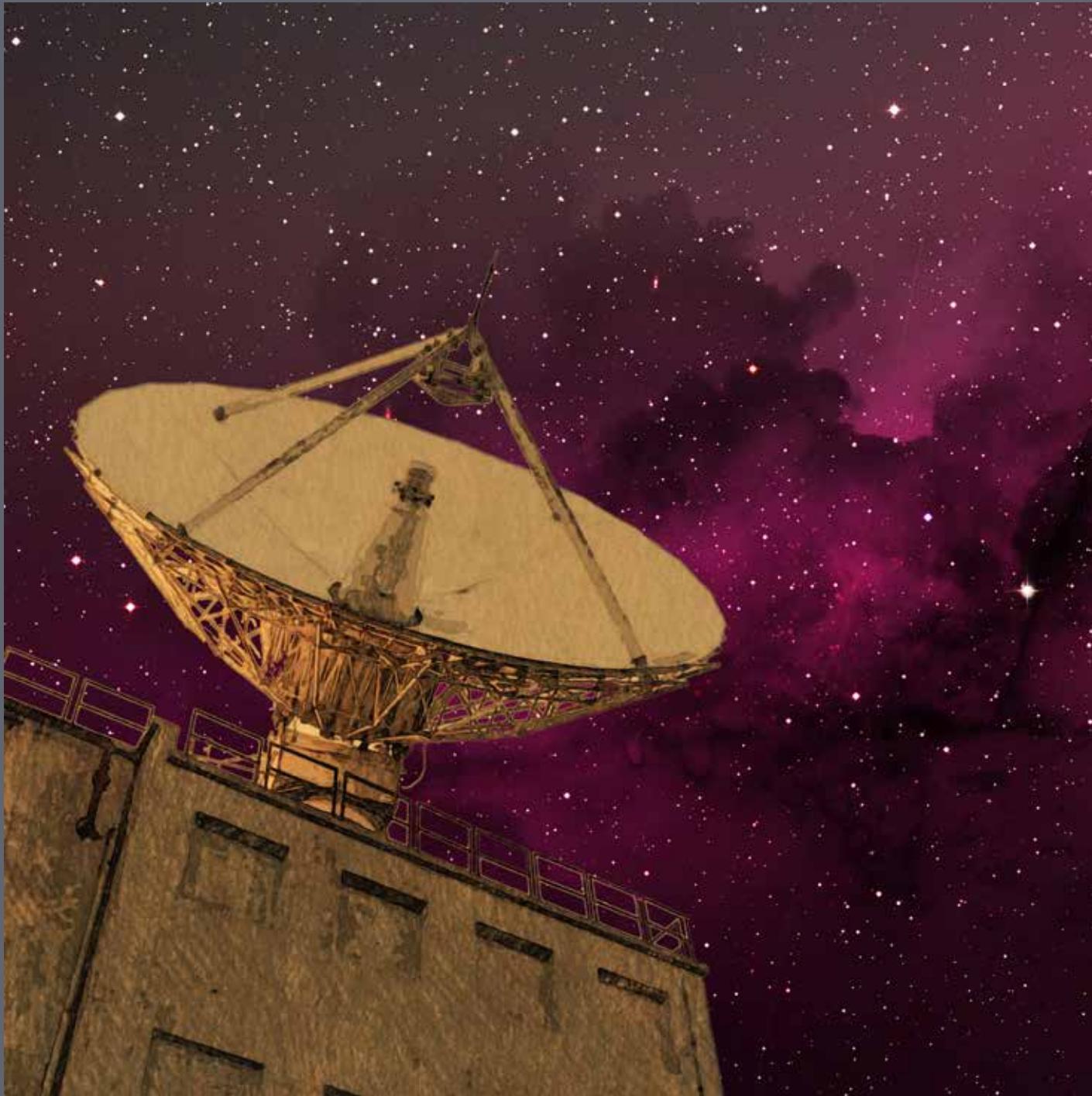
Underpinning Enablers

- Efficient regulatory and licensing environment
- Space Academy/STEM/SQEP
- R&D and Innovation Landscape. Access to institutions and Academia needs to be done in a more strategic way, deepened ties between Government and academia
- Public understanding and engagement in space-related activities
 - provide a route into advanced STEM skills more broadly;
 - develop public support for state activity and spending in space through understanding of societal reliance on space for resilience
 - build awareness of tech capability in government as well as industry
- Diversity of supply chain. Having a diverse supply base ensures resiliency and redundancy that leverages greater capabilities and reach without compromising on price
- New Space capabilities provide a qualitatively different approach and there is an opportunity to rebrand it to attract new STEM students and broad skillsets that supports resiliency in the workforce

An indicative programme is provided below to illustrate the timing of future and ongoing programmes in need of investment between 2020 and 2030.



Source: Athena



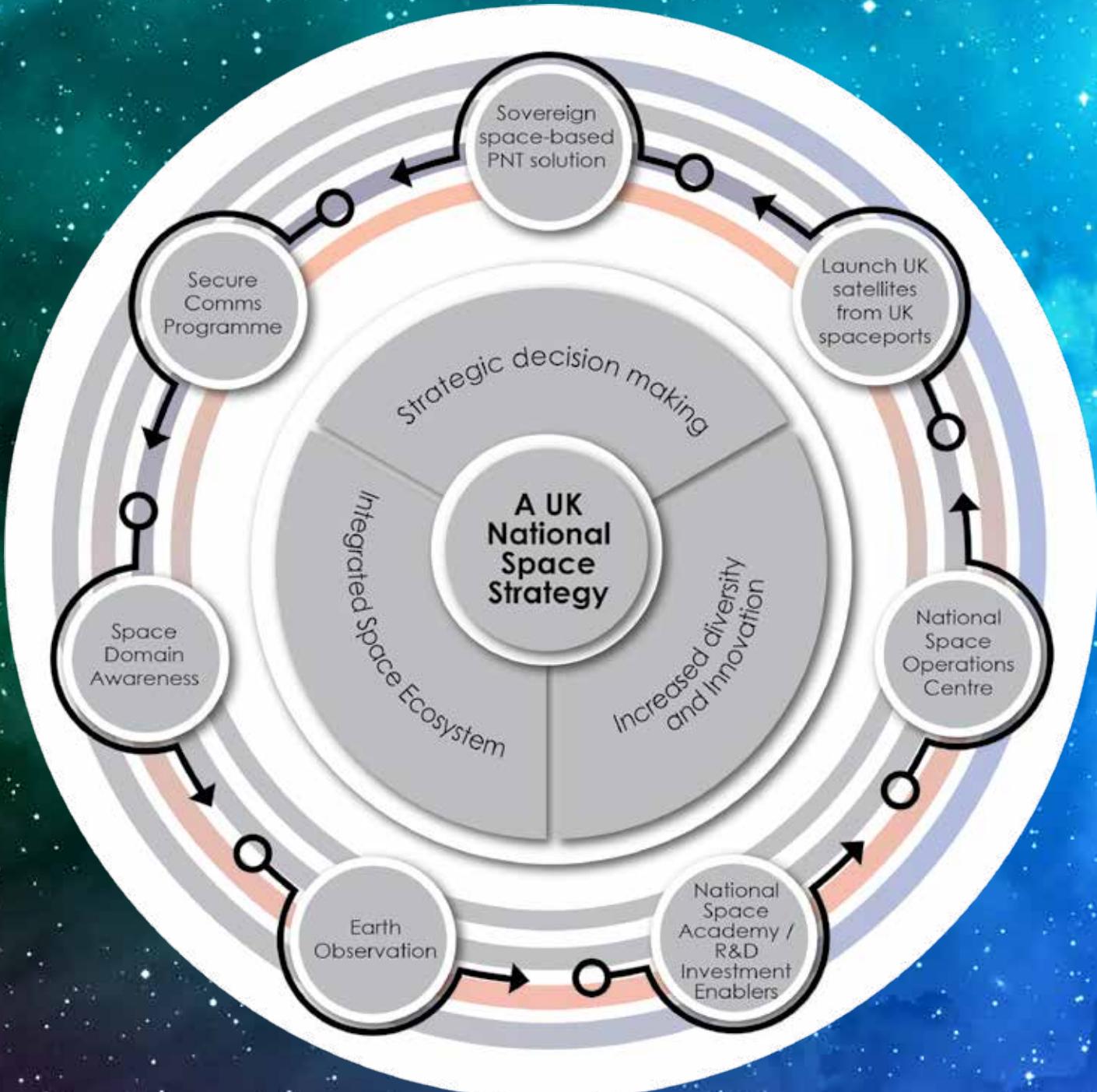
The UK can achieve greater diversity in its space industrial base by taking advantage of the operational leverage and reach that Athena can bring to a broad range of markets, supporting the UK SME community and driving innovation that has international appeal. A space sector that supports, enables, and underpins a number of other key UK economic sectors –financial services, telecoms, transport, media and data sciences – and which can monitor and enable the UK's environmental commitments and ambitions. Team Athena plays across these diverse geographies through a principles-based approach that also encompasses agility and adaptability.

Leveraging Athena's proposed model will substantially boost the UK economy, driving

increased momentum in the already burgeoning UK start-up space ecosystem, and delivering thousands of highly skilled jobs. In addition to making regulatory and policy changes, the UK must adequately invest in the national security of space and in fundamental technology development to enable future long-term applications and ensure sustained economic growth. Through many of the programmes that Athena is able to deliver, and the expertise we can provide, will give the UK the global credibility to follow through on these kinds of ambitions.

Taken together, this vision will ensure leadership in globally important industries that space enables, increase soft power and international influence, and deliver sustainable prosperity, security, and growth for the UK.

**Athena's
principles-based
vision will drive UK
success across
the entire space
ecosystem**



CHAPTER 4

WHY ATHENA?





Athena: Catalysing UK Space Success

The four founding members of Athena, comprised of Serco, Inmarsat, CGI UK and Lockheed Martin UK, envision a diverse and agile coalition of UK businesses that grows and adapts for purpose; Athena is a principles-based concept for linking UK companies and is not an exclusionary club. A fundamental precept of the Athena model is collaboration across the UK's rich community of space actors, including the Catapults, UK Space Agency, MOD, science parks and clusters, NPL, DSTL, National Space Academy, as well as industry partners and SMEs.

Athena harnesses the benefits of today's capabilities and tomorrow's innovation

The combined capabilities and technologies available to Athena will enhance the country's ability to deliver on the UK's 'Prosperity and Security in Space' strategy, which aims to increase the value of space to wider industrial activities to £500 billion, generate an extra £5 billion in UK exports, and attract £3 billion of additional inward investment.

Athena will work on several opportunities that leverage space-based technologies, their ground-based systems and end-to-end services as they arise, both in the UK and internationally in the export market. The UK has significant potential for strong growth in the space sector as it develops and facilitates important new technologies, such as driverless transport, enhanced navigation, secure communications for defence and for industry via the Internet of Things (IoT) and, more broadly, as part of 5G and other hybrid networks.

While continuing to operate as separate companies, Athena's founding members – already major employers in the UK – will develop shared capabilities

to meet future demand for space-enabled solutions for business and government customers. This will help boost the UK economy, in partnership with the UK government's growing focus on the space sector and its priorities around 'levelling up' economic benefits across the country.

Unleashing untapped potential in the UK space sector through future export business will deliver further growth and job creation at the four companies' sites across the country, as well as enhanced skills in the UK workforce.

Athena is a major investor in the UK and the global space economy

The combined capabilities and technologies available to Athena include a large UK and international workforce, facilities, manufacturing, computing, and the ability to conduct R&D at the most advanced levels in areas such as materials, engineering, robotics, and artificial intelligence. The founding members of Athena currently have approximately 40,000 employees in the UK and nearly a quarter of a million worldwide. They maintain dozens of facilities around the nation (including clean rooms and advanced manufacturing lines), operate state of the art testing facilities that support cross-domain requirements, and hire and train young people and participate in STEM outreach. Together, they have invested billions of pounds in new programmes, new business areas, training, and partnerships in the UK. In addition, the global presence of the Athena partners creates opportunities for access to international markets and a breadth of capability to facilitate rapid growth in the UK.

ATHENA'S IMPACT ACROSS THE UK



Political Factor	Serco	Lockheed	CGI	Inmarsat
Economic impact	<p>30,000 employees at over 80 sites across the UK</p> <p>48% of Serco UK&E's 3rd Party direct spend is with SMEs, almost double the Government target, with a value of £293m</p>	<p>1,800 employees across 20+ sites</p> <p>£1.6bn annual UK spend</p> <p>Support UK R&D of £50m</p> <p>Supporting 20k jobs across 1,000 businesses in UK supply chain</p>	<p>6,000 UK employees across 20+ sites</p>	<p>1,000 UK employees in London</p> <p>£180m annual UK spend</p>
Skills & innovation	<p>Apprenticeships to over 200 job types</p> <p>Member of the 5% club, developing workforce, STEM partnerships, and outreach</p>	<p>Member of the 5% club, developing workforce, STEM partnerships, and outreach</p>	<p>Support apprenticeship schemes, STEM outreach</p>	<p>1,000 young people engaged through STEM subject support, training, apprenticeships</p>
Global Britain	<p>UK est. 1929, strategic supplier, 70+ MoD contracts</p> <p>Serco supports more than 25 space missions on behalf of more than 10 Space or Government agencies around the globe</p>	<p>80-year heritage as strategic supplier to MoD, Responsible for 37 per cent of UK defence exports in 2018, Extensive 5 Eyes provision, 40 countries globally</p>	<p>UK est. in 1969, strategic supplier. Extensive 5 Eyes, MoD provision, 40 countries globally</p>	<p>UK est. 1979, 95% revenue exports, 5 Eyes provision</p>

Source: Athena

Achieving UK Space Power Success

Through Athena's Principles for Success, the UK can ensure agile, strategic decision making through an integrated approach that drives innovation and creates entirely new areas of competitive advantage.

Whilst Athena has four founding partners, it is not an exclusive club and calls upon a wide ecosystem of SMEs, academia and trading partners for ideas and initiatives to take forward the UK space economy.

Anyone can be part of this vision for contributing to the UK's success. The Athena ethos is linked by a shared belief in three key principles which we believe will drive success for the UK.

Principle 1: Strategic decision making

To achieve its strategic goals, the UK Government needs to ensure strategic decision making that is visionary (taking advantage of diverse capabilities and investments), integrated (across civil, military, and commercial domains), and considers the holistic supply chain and evolving international paradigms. Athena is the embodiment of strategic decision making on the Industry side, enabling highly effective strategy and programmatic execution.

The implementation of any strategy has to be consistent, agile, and collaborative. Athena is well aligned to do this with multiple companies coming together to drive rapid decision-making and partnered implementation. Athena's alliance of companies and SMEs with pre-agreed NDAs and

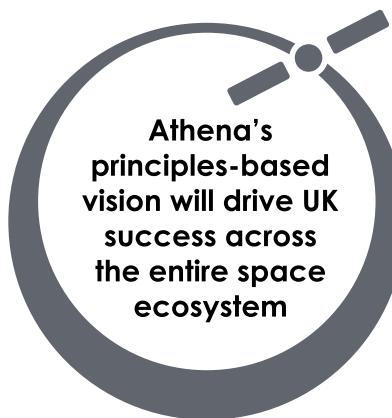
ways of working together offer greater flexibility in reacting to changes in operating environments, with each operating element taking advantage of its unique strengths and capabilities.

The UK government should evaluate policy decisions objectively, considering the full range of national goals for UK economic and security resilience. UK decisions about space activities must examine the nation's long-term strategies and near-term costs and impacts, evaluating evidence and not being limited to narrow programmatic or agency views. Acquisition should reflect desired capabilities without pre-supposing technical solutions.

The acquisition process must allow for new participants, alternative architectures, diverse business models, and technological advancement in order to deliver ambitious outcomes. To do so, it must tolerate a degree of productive risk and uncertainty, recognising that avoiding change may appear to be lower risk but in the current global environment is in fact the opposite.

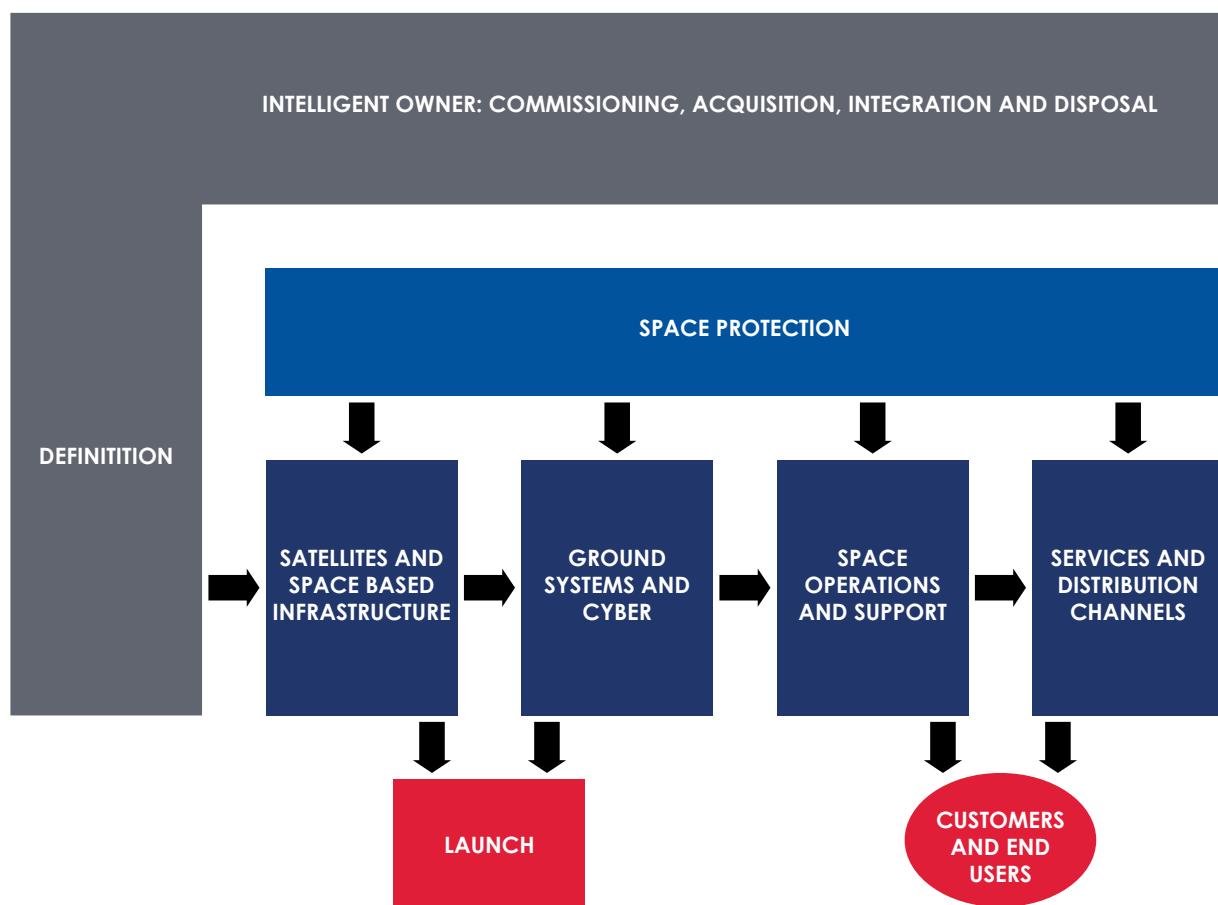
Principle 2: Integrated Space Ecosystem

The UK cannot afford civil and military government agencies to develop and implement independent space programmes. UK agencies must increase the power of their budgets by leveraging the benefits of an integrated space ecosystem. The UK will achieve better results at a lower cost through common training programmes across agencies, acquisition trades that consider all government and UK commercial space activities and their interrelationships, use of commercial capabilities to meet government requirements, and investment in industrial capacity with an eye to both government and commercial priorities.





THE SPACE VALUE CHAIN



Source: Athena



Principle 3: Increased diversity and Innovation

Strategic, integrated decision making is critical to foster an environment of space innovation. Space innovation, in turn, can yield increasingly greater benefit in today's context of active investment, technological breakthroughs, and new markets driven by global connectivity and vast computing power.

Emerging remote sensing firms are fusing hyperspectral, radar, lidar, and other advanced sensors with machine learning to create powerful tools for the finance, agriculture, and energy sectors. Mobile phones and industrial devices incorporate GNSS chipsets that enable comprehensive tracking, mapping, and logistics support. Massive constellations that seek to connect billions of users around the world have grown out of new small-sat capabilities combined with a spike in venture investment.

The industry anticipates software-defined satellites and platforms, agile and powerful user terminals enabled by phased array antennas, servicing and even manufacturing in space, and increasingly autonomous and intelligent robotic systems.

Continued and, most importantly, scalable innovation requires industrial capabilities and appropriate policy.

The vision of Athena involves collaboration for innovation across the whole space value chain with large and small companies from software to

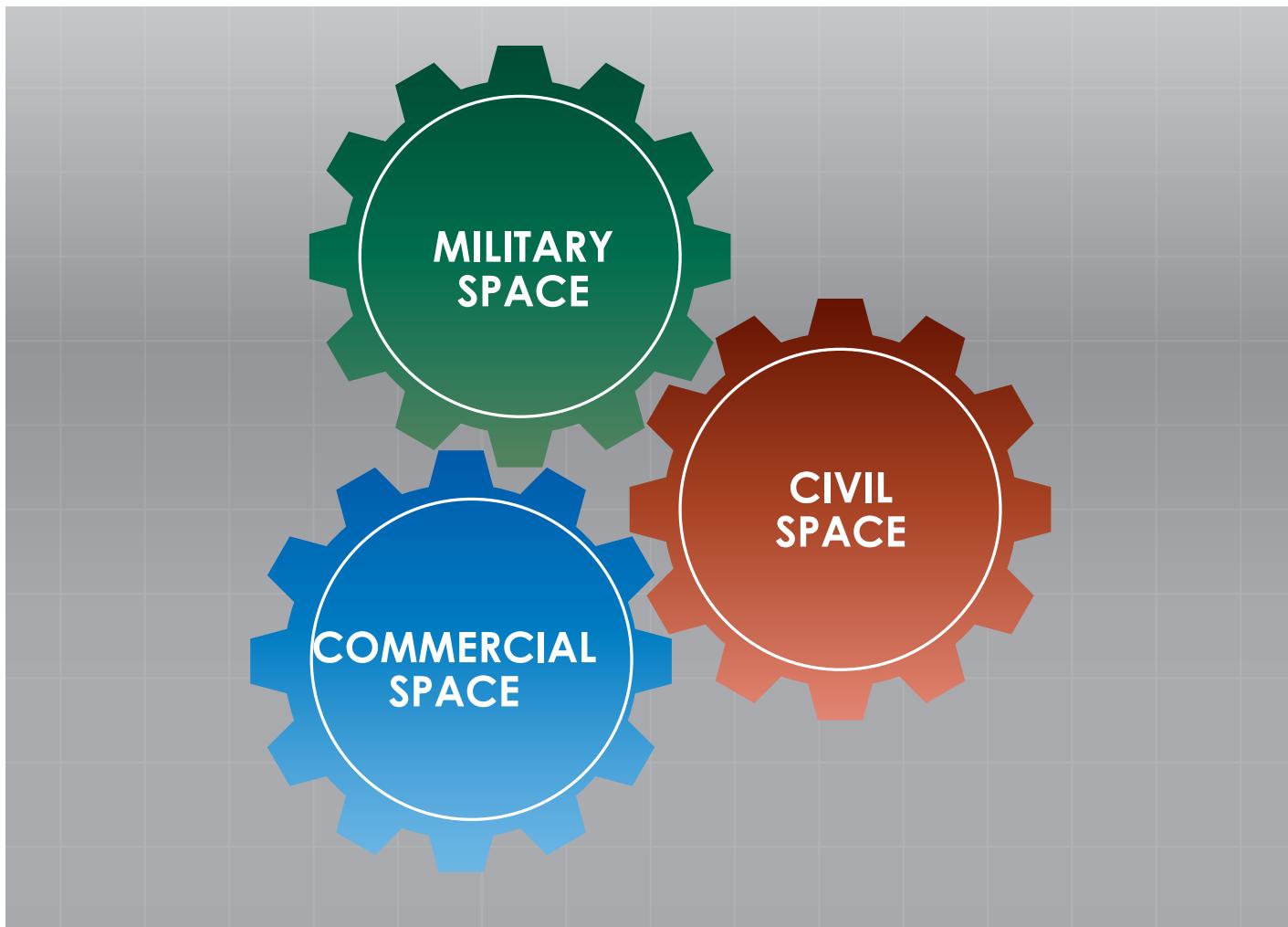
manufacturing, and from satellite operations to launch, to create growth in the UK and access to international markets.

The critical elements of a diverse innovation-friendly UK policy are:

- Capability-based acquisition, rather than predefined technical design that constrains innovation
- Regulations that allow companies to use new approaches by defining desired outcomes rather than specific mechanisms or tools
- Thoughtful use of the UK government's role as customer by, to cite a few examples, aligning government programmes (e.g. satellite and launch), and supporting investment by reducing uncertainty about anticipated government actions
- A modern industrial policy and procurement strategy that supports a diverse supply base with multiple redundancies ensuring the UK does not inadvertently create a monolithic environment which stifles innovation and reduces resilience.

Athena dynamically links the UK space supply chain to forge new capabilities, new systems, and new successes. Athena can take advantage of demonstrable operational leverage arising from innovation throughout its value chain, including innovation through changing international coalitions, and innovation throughout its domestic and international space supply chain.

THE INTEGRATED NATURE OF THE SPACE INDUSTRY





In evaluating space expenditures, it is important to recognise how space underpins all sectors of the economy and future technologies (e.g. autonomous vehicles, IoT, 5G, automation) and to understand the resulting widespread benefits of improved resilience of space-based systems, services, and infrastructure. Space activities occur remotely, generally with some degree of autonomy in harsh environments, with economic and operational penalties for large systems. The use of advanced technologies in space drives progress in key technology areas, such as AI, robotics, cyber security. This will benefit other sectors including advanced manufacturing, energy, e-mobility, and social care.

Integration is critical internationally as well as for national programmes. The emergence of China as a superpower means the UK needs to consider Asia more centrally in its foreign and security policy, and the implications for its space policy. The UK should develop closer relations in the space domain and potentially form joint space programmes with Australia, New Zealand, Japan, and India. (The Athena companies already have an international presence and space activity in all Five Eyes nations.)

The UK's traditional close allies and partner nations, in particular the USA, are calling for more balanced "burden-sharing" in the space domain. The US Defence Space Strategy (June 2020) identifies a specific line of effort to cooperate with allies, partners, industry, and other US government departments and agencies. In defence, the UK has traditionally relied on the USA for critical Intelligence, Reconnaissance, and Surveillance (ISR), resilient PNT, and other capabilities. In the security and CNI areas, the UK is critically dependent on GPS. However, the UK has some niche space capabilities and assets

(including geographical territories well suited for placement of space surveillance assets) of interest to allies which allow it to leverage a premier role within NATO. The creation of a co-ordinated, cross government national space programme, offers the opportunity to elevate the UK's role, which will strengthen key alliances and trade partnerships with key allies. This is particularly important given the UK's increasingly significant presence in space. LEO operators such as OneWeb, SpaceX's Starlink, and Amazon's Kuiper all anticipate deploying large numbers of satellites in the future and substantially amplifying the current total of over 3,000 operational satellites in orbit. OneWeb alone, having recently received an investment from the UK government and becoming a partly government asset, previously announced that its initial system will consist of 648 satellites, thereby adding substantially to the global total and further necessitating increased focus on SDA and the need for a sustainable orbital environment.

There are a number of elements of the space value chain necessary to deliver an ambitious national space programme. These elements include commissioning and acquisition (specifically the need for an "intelligent owner"), definition and design, space infrastructure provision, launch, space operations and support, ground systems integration, Cyber, service delivery, and global distribution. Space protection is an increasingly important overarching element that applies to many parts of the value chain. Athena's complementary industrial capability covers all elements of the value chain and provides access to a comprehensive onward supply chain in the UK and from 5-Eyes nations as necessary, as well as the ability to assist UK based suppliers with access to global markets.



ABOUT TEAM ATHENA

Athena is the UK's new national team in the space sector, formed by Serco, Inmarsat, CGI UK and Lockheed Martin UK. The Athena members are central players in the mainstay of the UK's space capability today, with leading roles in the majority of all current UK civil and military space programmes. The four companies are world leaders in the delivery of technology and services across defence, space, communications and information technology to governments, businesses and other organisations globally.

The four companies have decided to partner to create Athena due to our highly complementary capabilities that combined can address specific market opportunities both in the UK and the global space sector. Our ambition is to drive growth for the UK space economy through national capability development that also enables new export opportunities for the UK space sector value chain, and to leverage our international footprint and privileged position within key partner space nations around the world for the benefit of the UK.



ABOUT BRYCE SPACE AND TECHNOLOGY

Bryce Space and Technology is an analytic and engineering firm serving government and commercial clients. Bryce provides unique, integrated expertise on the space economy.

Bryce's expertise includes market analytics, technology readiness, cyber security, policy and economics, and strategy. Many authoritative data sets characterizing the space industry and sub-segments were originated by our analysts. We understand the interplay of national security, civil, and commercial space programmes, capabilities, and markets. Find out more at: brycetech.com

Bryce provided data (cited), design, and other support to Athena for this document. Except for cited data, all views expressed herein are those of Athena and its members (CGI, Inmarsat, Lockheed Martin, Serco), not Bryce Space and Technology.



A NEW
APPROACH
TO SPACE